

GNU Unifont
16.0.03

Generated by Doxygen 1.9.3

1 GNU Unifont	1
1.1 GNU Unifont C Utilities	1
1.2 LICENSE	1
1.3 Introduction	1
1.4 The C Programs	2
1.5 Perl Scripts	9
2 Data Structure Index	13
2.1 Data Structures	13
3 File Index	15
3.1 File List	15
4 Data Structure Documentation	17
4.1 Buffer Struct Reference	17
4.1.1 Detailed Description	17
4.1.2 Field Documentation	17
4.1.2.1 begin	17
4.1.2.2 capacity	18
4.1.2.3 end	18
4.1.2.4 next	18
4.2 Font Struct Reference	18
4.2.1 Detailed Description	19
4.2.2 Field Documentation	19
4.2.2.1 glyphCount	19
4.2.2.2 glyphs	19
4.2.2.3 maxWidth	19
4.2.2.4 tables	20
4.3 Glyph Struct Reference	20
4.3.1 Detailed Description	20
4.3.2 Field Documentation	20
4.3.2.1 bitmap	21
4.3.2.2 byteCount	21
4.3.2.3 codePoint	21
4.3.2.4 combining	21
4.3.2.5 lsb	21
4.3.2.6 pos	22
4.4 NamePair Struct Reference	22
4.4.1 Detailed Description	22
4.4.2 Field Documentation	22
4.4.2.1 id	22

4.4.2.2 str	23
4.5 Options Struct Reference	23
4.5.1 Detailed Description	23
4.5.2 Field Documentation	23
4.5.2.1 bitmap	23
4.5.2.2 blankOutline	24
4.5.2.3 cff	24
4.5.2.4 gpos	24
4.5.2.5 gsub	24
4.5.2.6 hex	24
4.5.2.7 nameStrings	24
4.5.2.8 out	25
4.5.2.9 pos	25
4.5.2.10 truetype	25
4.6 PARAMS Struct Reference	25
4.6.1 Detailed Description	25
4.6.2 Field Documentation	26
4.6.2.1 cho_end	26
4.6.2.2 cho_start	26
4.6.2.3 infp	26
4.6.2.4 jong_end	26
4.6.2.5 jong_start	26
4.6.2.6 jung_end	27
4.6.2.7 jung_start	27
4.6.2.8 outfp	27
4.6.2.9 starting_codept	27
4.7 Table Struct Reference	27
4.7.1 Detailed Description	28
4.7.2 Field Documentation	28
4.7.2.1 content	28
4.7.2.2 tag	28
4.8 TableRecord Struct Reference	28
4.8.1 Detailed Description	29
4.8.2 Field Documentation	29
4.8.2.1 checksum	29
4.8.2.2 length	29
4.8.2.3 offset	29
4.8.2.4 tag	29
5 File Documentation	31

5.1 src/hangul.h File Reference	31
5.1.1 Detailed Description	35
5.1.2 Macro Definition Documentation	35
5.1.2.1 CHO_ANCIENT_HEX	35
5.1.2.2 CHO_EXT_A_HEX	35
5.1.2.3 CHO_EXT_A_UNICODE_END	35
5.1.2.4 CHO_EXT_A_UNICODE_START	36
5.1.2.5 CHO_HEX	36
5.1.2.6 CHO_LAST_HEX	36
5.1.2.7 CHO_UNICODE_END	36
5.1.2.8 CHO_UNICODE_START	36
5.1.2.9 CHO_VARIATIONS	37
5.1.2.10 EXTENDED_HANGUL	37
5.1.2.11 JAMO_END	37
5.1.2.12 JAMO_EXT_A_END	37
5.1.2.13 JAMO_EXT_A_HEX	37
5.1.2.14 JAMO_EXT_B_END	38
5.1.2.15 JAMO_EXT_B_HEX	38
5.1.2.16 JAMO_HEX	38
5.1.2.17 JONG_ANCIENT_HEX	38
5.1.2.18 JONG_EXT_B_HEX	38
5.1.2.19 JONG_EXT_B_UNICODE_END	39
5.1.2.20 JONG_EXT_B_UNICODE_START	39
5.1.2.21 JONG_HEX	39
5.1.2.22 JONG_LAST_HEX	39
5.1.2.23 JONG_UNICODE_END	39
5.1.2.24 JONG_UNICODE_START	40
5.1.2.25 JONG_VARIATIONS	40
5.1.2.26 JUNG_ANCIENT_HEX	40
5.1.2.27 JUNG_EXT_B_HEX	40
5.1.2.28 JUNG_EXT_B_UNICODE_END	40
5.1.2.29 JUNG_EXT_B_UNICODE_START	41
5.1.2.30 JUNG_HEX	41
5.1.2.31 JUNG_LAST_HEX	41
5.1.2.32 JUNG_UNICODE_END	41
5.1.2.33 JUNG_UNICODE_START	41
5.1.2.34 JUNG_VARIATIONS	42
5.1.2.35 MAX_GLYPHS	42
5.1.2.36 MAXLINE	42
5.1.2.37 NCHO_ANCIENT	42

5.1.2.38 NCHO_EXT_A	42
5.1.2.39 NCHO_EXT_A_RSRVD	43
5.1.2.40 NCHO_MODERN	43
5.1.2.41 NJONG_ANCIENT	43
5.1.2.42 NJONG_EXTB	43
5.1.2.43 NJONG_EXTB_RSRVD	43
5.1.2.44 NJONG_MODERN	44
5.1.2.45 NJUNG_ANCIENT	44
5.1.2.46 NJUNG_EXTB	44
5.1.2.47 NJUNG_EXTB_RSRVD	44
5.1.2.48 NJUNG_MODERN	44
5.1.2.49 PUA_END	45
5.1.2.50 PUA_START	45
5.1.2.51 TOTAL_CHO	45
5.1.2.52 TOTAL_JONG	45
5.1.2.53 TOTAL_JUNG	45
5.1.3 Function Documentation	45
5.1.3.1 cho_variation()	46
5.1.3.2 combine_glyphs()	48
5.1.3.3 combined_jamo()	49
5.1.3.4 glyph_overlap()	53
5.1.3.5 hangul_compose()	54
5.1.3.6 hangul_decompose()	55
5.1.3.7 hangul_hex_indices()	57
5.1.3.8 hangul_read_base16()	59
5.1.3.9 hangul_read_base8()	61
5.1.3.10 hangul_syllable()	62
5.1.3.11 hangul_variations()	64
5.1.3.12 is_wide_vowel()	66
5.1.3.13 jong_variation()	68
5.1.3.14 jung_variation()	69
5.1.3.15 one_jamo()	70
5.1.3.16 print_glyph_hex()	71
5.1.3.17 print_glyph_txt()	73
5.2 hangul.h	74
5.3 src/hex2otf.c File Reference	76
5.3.1 Detailed Description	81
5.3.2 Macro Definition Documentation	81
5.3.2.1 addByte	81
5.3.2.2 ASCENDER	81

5.3.2.3 B0	81
5.3.2.4 B1	82
5.3.2.5 BX	82
5.3.2.6 defineStore	82
5.3.2.7 DESCENDER	82
5.3.2.8 FU	82
5.3.2.9 FUPEM	82
5.3.2.10 GLYPH_HEIGHT	83
5.3.2.11 GLYPH_MAX_BYTE_COUNT	83
5.3.2.12 GLYPH_MAX_WIDTH	83
5.3.2.13 MAX_GLYPHS	83
5.3.2.14 MAX_NAME_IDS	83
5.3.2.15 PRI_CP	83
5.3.2.16 PW	83
5.3.2.17 static_assert	83
5.3.2.18 U16MAX	84
5.3.2.19 U32MAX	84
5.3.2.20 VERSION	84
5.3.3 Typedef Documentation	84
5.3.3.1 Buffer	84
5.3.3.2 byte	84
5.3.3.3 Glyph	84
5.3.3.4 NameStrings	84
5.3.3.5 Options	85
5.3.3.6 pixels_t	85
5.3.3.7 Table	85
5.3.4 Enumeration Type Documentation	85
5.3.4.1 ContourOp	85
5.3.4.2 FillSide	86
5.3.4.3 LocaFormat	86
5.3.5 Function Documentation	87
5.3.5.1 addTable()	87
5.3.5.2 buildOutline()	89
5.3.5.3 byCodePoint()	91
5.3.5.4 byTableTag()	92
5.3.5.5 cacheBuffer()	92
5.3.5.6 cacheBytes()	93
5.3.5.7 cacheCFFOperand()	95
5.3.5.8 cacheStringAsUTF16BE()	96
5.3.5.9 cacheU16()	97

5.3.5.10	cacheU32()	99
5.3.5.11	cacheU8()	101
5.3.5.12	cacheZeros()	101
5.3.5.13	cleanBuffers()	103
5.3.5.14	defineStore()	103
5.3.5.15	ensureBuffer()	103
5.3.5.16	fail()	105
5.3.5.17	fillBitmap()	106
5.3.5.18	fillBlankOutline()	109
5.3.5.19	fillCFF()	110
5.3.5.20	fillCmapTable()	114
5.3.5.21	fillGposTable()	116
5.3.5.22	fillGsubTable()	117
5.3.5.23	fillHeadTable()	119
5.3.5.24	fillHheaTable()	120
5.3.5.25	fillHmtxTable()	122
5.3.5.26	fillMaxpTable()	123
5.3.5.27	fillNameTable()	125
5.3.5.28	fillOS2Table()	127
5.3.5.29	fillPostTable()	129
5.3.5.30	fillTrueType()	130
5.3.5.31	freeBuffer()	133
5.3.5.32	initBuffers()	133
5.3.5.33	main()	134
5.3.5.34	matchToken()	136
5.3.5.35	newBuffer()	137
5.3.5.36	organizeTables()	140
5.3.5.37	parseOptions()	142
5.3.5.38	positionGlyphs()	144
5.3.5.39	prepareOffsets()	146
5.3.5.40	prepareStringIndex()	147
5.3.5.41	printHelp()	148
5.3.5.42	printVersion()	149
5.3.5.43	readCodePoint()	149
5.3.5.44	readGlyphs()	150
5.3.5.45	sortGlyphs()	152
5.3.5.46	writeBytes()	153
5.3.5.47	writeFont()	154
5.3.5.48	writeU16()	157
5.3.5.49	writeU32()	158

5.3.6 Variable Documentation	159
5.3.6.1 allBuffers	159
5.3.6.2 bufferCount	159
5.3.6.3 nextBufferIndex	159
5.4 hex2otf.c	159
5.5 src/hex2otf.h File Reference	192
5.5.1 Detailed Description	193
5.5.2 Macro Definition Documentation	193
5.5.2.1 DEFAULT_ID0	193
5.5.2.2 DEFAULT_ID1	194
5.5.2.3 DEFAULT_ID11	194
5.5.2.4 DEFAULT_ID13	194
5.5.2.5 DEFAULT_ID14	194
5.5.2.6 DEFAULT_ID2	194
5.5.2.7 DEFAULT_ID5	194
5.5.2.8 NAMEPAIR	194
5.5.2.9 UNIFONT_VERSION	194
5.5.3 Variable Documentation	195
5.5.3.1 defaultNames	195
5.6 hex2otf.h	195
5.7 src/johab2syllables.c File Reference	196
5.7.1 Detailed Description	197
5.7.2 Function Documentation	197
5.7.2.1 main()	197
5.7.2.2 print_help()	199
5.8 johab2syllables.c	200
5.9 src/unibdf2hex.c File Reference	202
5.9.1 Detailed Description	203
5.9.2 Macro Definition Documentation	203
5.9.2.1 MAXBUF	203
5.9.2.2 UNISTART	203
5.9.2.3 UNISTOP	203
5.9.3 Function Documentation	203
5.9.3.1 main()	204
5.10 unibdf2hex.c	205
5.11 src/unibmp2hex.c File Reference	206
5.11.1 Detailed Description	207
5.11.2 Macro Definition Documentation	207
5.11.2.1 MAXBUF	208
5.11.3 Function Documentation	208

5.11.3.1 main()	208
5.11.4 Variable Documentation	215
5.11.4.1 bits_per_pixel	215
5.11.4.2	216
5.11.4.3 color_table	216
5.11.4.4 compression	216
5.11.4.5 file_size	216
5.11.4.6 filetype	216
5.11.4.7 flip	216
5.11.4.8 forcewide	216
5.11.4.9 height	216
5.11.4.10 hexdigit	217
5.11.4.11 image_offset	217
5.11.4.12 image_size	217
5.11.4.13 important_colors	217
5.11.4.14 info_size	217
5.11.4.15 ncolors	217
5.11.4.16 nplanes	217
5.11.4.17 planeset	217
5.11.4.18 unidigit	217
5.11.4.19 uniplane	218
5.11.4.20 width	218
5.11.4.21 x_ppm	218
5.11.4.22 y_ppm	218
5.12 unibmp2hex.c	218
5.13 src/unibmpbump.c File Reference	227
5.13.1 Detailed Description	228
5.13.2 Macro Definition Documentation	228
5.13.2.1 MAX_COMPRESSION_METHOD	229
5.13.2.2 VERSION	229
5.13.3 Function Documentation	229
5.13.3.1 get_bytes()	229
5.13.3.2 main()	230
5.13.3.3 regrid()	235
5.14 unibmpbump.c	237
5.15 src/unicoverage.c File Reference	244
5.15.1 Detailed Description	245
5.15.2 Macro Definition Documentation	245
5.15.2.1 MAXBUF	245
5.15.3 Function Documentation	245

5.15.3.1	main()	245
5.15.3.2	nextrange()	248
5.15.3.3	print_subtotal()	250
5.16	unicoverage.c	251
5.17	src/unidup.c File Reference	254
5.17.1	Detailed Description	255
5.17.2	Macro Definition Documentation	255
5.17.2.1	MAXBUF	255
5.17.3	Function Documentation	256
5.17.3.1	main()	256
5.18	unidup.c	257
5.19	src/unifont-support.c File Reference	258
5.19.1	Detailed Description	258
5.19.2	Function Documentation	258
5.19.2.1	glyph2bits()	259
5.19.2.2	glyph2string()	260
5.19.2.3	hexpose()	261
5.19.2.4	parse_hex()	263
5.19.2.5	xglyph2string()	264
5.20	unifont-support.c	266
5.21	src/unifont1per.c File Reference	270
5.21.1	Detailed Description	270
5.21.2	Macro Definition Documentation	270
5.21.2.1	MAXFILENAME	271
5.21.2.2	MAXSTRING	271
5.21.3	Function Documentation	271
5.21.3.1	main()	271
5.22	unifont1per.c	272
5.23	src/unifontpic.c File Reference	275
5.23.1	Detailed Description	275
5.23.2	Macro Definition Documentation	276
5.23.2.1	HDR_LEN	276
5.23.3	Function Documentation	276
5.23.3.1	genlongbmp()	276
5.23.3.2	genwidebmp()	281
5.23.3.3	gethex()	286
5.23.3.4	main()	288
5.23.3.5	output2()	290
5.23.3.6	output4()	291
5.24	unifontpic.c	292

5.25 src/unifontpic.h File Reference	303
5.25.1 Detailed Description	304
5.25.2 Macro Definition Documentation	304
5.25.2.1 HEADER_STRING	304
5.25.2.2 MAXSTRING	304
5.25.3 Variable Documentation	304
5.25.3.1 ascii_bits	304
5.25.3.2 ascii_hex	304
5.25.3.3 hexdigit	305
5.26 unifontpic.h	305
5.27 src/unigen-hangul.c File Reference	308
5.27.1 Detailed Description	308
5.27.2 Function Documentation	309
5.27.2.1 get_hex_range()	309
5.27.2.2 main()	310
5.27.2.3 parse_args()	311
5.28 unigen-hangul.c	314
5.29 src/unigencircles.c File Reference	319
5.29.1 Detailed Description	320
5.29.2 Macro Definition Documentation	320
5.29.2.1 MAXSTRING	320
5.29.3 Function Documentation	320
5.29.3.1 add_double_circle()	320
5.29.3.2 add_single_circle()	322
5.29.3.3 main()	323
5.30 unigencircles.c	325
5.31 src/unigenwidth.c File Reference	329
5.31.1 Detailed Description	329
5.31.2 Macro Definition Documentation	330
5.31.2.1 MAXSTRING	330
5.31.2.2 PIKTO_END	330
5.31.2.3 PIKTO_SIZE	330
5.31.2.4 PIKTO_START	330
5.31.3 Function Documentation	330
5.31.3.1 main()	330
5.32 unigenwidth.c	335
5.33 src/unihangul-support.c File Reference	339
5.33.1 Detailed Description	341
5.33.2 Function Documentation	341
5.33.2.1 cho_variation()	341

5.33.2.2	combine_glyphs()	343
5.33.2.3	combined_jamo()	344
5.33.2.4	glyph_overlap()	349
5.33.2.5	hangul_compose()	349
5.33.2.6	hangul_decompose()	350
5.33.2.7	hangul_hex_indices()	352
5.33.2.8	hangul_read_base16()	354
5.33.2.9	hangul_read_base8()	356
5.33.2.10	hangul_syllable()	357
5.33.2.11	hangul_variations()	359
5.33.2.12	is_wide_vowel()	361
5.33.2.13	jong_variation()	363
5.33.2.14	jung_variation()	364
5.33.2.15	one_jamo()	365
5.33.2.16	print_glyph_hex()	366
5.33.2.17	print_glyph_txt()	368
5.34	unihangul-support.c	369
5.35	src/unihex2bmp.c File Reference	380
5.35.1	Detailed Description	381
5.35.2	Macro Definition Documentation	382
5.35.2.1	MAXBUF	382
5.35.3	Function Documentation	382
5.35.3.1	hex2bit()	382
5.35.3.2	init()	383
5.35.3.3	main()	386
5.35.4	Variable Documentation	390
5.35.4.1	flip	390
5.35.4.2	hex	390
5.35.4.3	hexbits	390
5.35.4.4	unipage	391
5.36	unihex2bmp.c	391
5.37	src/unihexgen.c File Reference	397
5.37.1	Detailed Description	398
5.37.2	Function Documentation	399
5.37.2.1	hexprint4()	399
5.37.2.2	hexprint6()	400
5.37.2.3	main()	401
5.37.3	Variable Documentation	403
5.37.3.1	hexdigit	403
5.38	unihexgen.c	403

5.39 unihexpose.c	407
5.40 src/unijohab2html.c File Reference	408
5.40.1 Detailed Description	409
5.40.2 Macro Definition Documentation	410
5.40.2.1 BLACK	410
5.40.2.2 BLUE	410
5.40.2.3 GREEN	410
5.40.2.4 MAXFILENAME	410
5.40.2.5 RED	410
5.40.2.6 START_JUNG	411
5.40.2.7 WHITE	411
5.40.3 Function Documentation	411
5.40.3.1 main()	411
5.40.3.2 parse_args()	418
5.41 unijohab2html.c	419
5.42 src/unipagecount.c File Reference	427
5.42.1 Detailed Description	428
5.42.2 Macro Definition Documentation	429
5.42.2.1 MAXBUF	429
5.42.3 Function Documentation	429
5.42.3.1 main()	429
5.42.3.2 mkftable()	431
5.43 unipagecount.c	433
Index	437

Chapter 1

GNU Unifont

1.1 GNU Unifont C Utilities

This documentation covers C utility programs for creating GNU Unifont glyphs and fonts.

1.2 LICENSE

This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program. If not, see <http://www.gnu.org/licenses/>.

1.3 Introduction

Unifont is the creation of Roman Czyborra, who created Perl utilities for generating a dual-width Bitmap Distribution Format (BDF) font 16 pixels tall, `unifont.bdf`, from an input file named `unifont.hex`. The `unifont.hex` file contained two fields separated by a colon: a Unicode code point as four hexadecimal digits, and a hexadecimal string of 32 or 64 characters representing the glyph bitmap pattern. Roman also wrote other Perl scripts for manipulating `unifont.hex` files.

Jungshik Shin wrote a Perl script, `johab2ucs2`, to convert Hangul syllable glyph elements into Hangul Johab-encoded fonts. These glyph elements are compatible with Jaekyung "Jake" Song's Hanterm terminal emulator. Paul Hardy modified `johab2ucs2` and drew Hangul Syllables Unicode elements for compatibility with this Johab encoding and with Hanterm. These new glyphs were created to avoid licensing issues with the Hangul Syllables glyphs that were in the original `unifont.hex` file.

Over time, Unifont was extended to allow correct positioning of combining marks in a TrueType font, coverage beyond Unicode Plane 0, and the addition of Under-ConScript Unicode Registry (UCSUR) glyphs. There is also partial support for experimental quadruple-width glyphs.

Paul Hardy wrote the first pair of C programs, [unihex2bmp.c](#) and [unibmp2hex.c](#), to facilitate editing the bitmaps at their real aspect ratio. These programs allow conversion between the Unifont .hex format and a Windows Bitmap or Wireless Bitmap file for editing with a graphics editor. This was followed by make files, other C programs, Perl scripts, and shell scripts.

Luis Alejandro González Miranda wrote scripts for converting unifont.hex into a TrueType font using FontForge.

Andrew Miller wrote additional Perl programs for directly rendering unifont.hex files, for converting unifont.hex to and from Portable Network Graphics (PNG) files for editing based upon Paul Hardy's BMP conversion programs, and also wrote other Perl scripts.

David Corbett wrote a Perl script to rotate glyphs in a unifont.hex file and an awk script to substitute new glyphs for old glyphs of the same Unicode code point in a unifont.hex file.

何志翔 (He Zhixiang) wrote a program to convert Unifont files into OpenType fonts, [hex2otf.c](#).

Minseo Lee created new Hangul glyphs for the original Unifont Johab 10/3 or 4/4 encoding. This was followed immediately after by Ho-Seok Ee, who created Hangul glyphs for a new, simpler Johab 6/3/1 encoding that are now in Unifont.

1.4 The C Programs

This documentation only covers C programs and their header files. These programs are typically longer than the Unifont package's Perl scripts, which being much smaller are easier to understand. The C programs are, in alphabetical order:

Pro-gram	De-scrip-tion
hex2otf.c	Convert a GNU Unifont .hex file to an OpenType font
johab2syll.c	Generate Hangul Syllables range with simple
	posi-tion-ing

Pro-gram	De-scrip-tion
unibdf2hex	Convert a BDF file into a uni-font.hex file
unibmp2t1	Turn a .bmp or .wbmp glyph matrix into a GNU Uni-font hex glyph set of 256 characters
unibmp2png	Adjust a Microsoft bitmap (.bmp) file that was created by uni-hex2png but converted to .bmp

Pro-gram	De-scrip-tion
unicoverage	Show the coverage of Uni-code plane scripts for a GNU Uni-font hex glyph file
unidup.c	Check for dupli-cate code points in sorted uni-font.hex file
unifont1p.c	Read a Uni-font .hex file from stan-dard input and pro-duce one glyph per .bmp bitmap file as out-put

Pro-gram	De-scrip-tion
unifontpic	See the "Big Picture": the entire Uni-font in one BMP bitmap
unigen-ha	Generate modern and ancient Hangul syllables with shifting of final consonants combined with diphthongs having two long vertical strokes on the right
unigencir	Superimpose dashed combining circles on combining glyphs

Pro-gram	De-scrip-tion
unigenwidths	IEEE 1003.1-2008 setup to calculate wchar_t string widths
unihex2bmap	Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing
unihexgen	Generate a series of glyphs containing hexadecimal code points

Pro-gram	De-scrip-tion
unihexpose	Transpose Uni- font .hex glyph bitmaps to sim- plify send- ing to graph- ics dis- play con- troller chips that read bitmaps as a se- ries of columns 8 rows (one byte) high

Pro-gram	De-scrip-tion
unijohab2enc.c	Read a hangul-base.hex file and produce an HTML page as output showing juxtaposition and overlapping of all letter combinations in modern and ancient Hangul syllables
unipagecount.c	Count the number of glyphs defined in each page of 256 code points

1.5 Perl Scripts

The very first program written for Unifont conversion was Roman Czyborra's hexdraw Perl script. That one script would convert a unifont.hex file into a text file with 16 lines per glyph (one for each glyph row) followed by a blank line after each glyph. That allowed editing unifont.hex glyphs with a text-based editor.

Combined with Roman's hex2bdf Perl script to convert a unifont.hex file into a BDF font, these two scripts formed a complete package for editing Unifont and generating the resulting BDF fonts.

There was no combining mark support initially, and the original unifont.hex file included combining circles with combining mark glyphs.

The list below gives a brief description of these and the other Perl scripts that are in the Unifont package src subdirectory.

Perl Script	Description
bdfimplot	Convert a BDF font into GNU Unifont .hex format
hex2bdf	Convert a GNU Unifont .hex file into a BDF font
hex2sfd	Convert a GNU Unifont .hex file into a Font-Forge .sfd format

Perl Script	De- scrip- tion
hexbraille	Algorithmically generate the Uni- code Braille range (U+28xx)
hexdraw	Convert a GNU Uni- font .hex file to and from an ASCII text file
hexkinya	Create the Pri- vate Use Area Kinya sylla- bles
hexmerge	Merge two or more GNU Uni- font .hex font files into one

Perl Script	Description
johab2ucs2	Convert a Johab BDF font into GNU Unifont Hangul Syllables
unifont-viewer	View a .hex font file with a graphical user interface
unifontchop	Extract Hangul syllables that have no final consonant
unifontksx	Extract Hangul syllables that comprise KS X 1001:1992

Perl Script	De- scrip- tion
unihex2png	Convert GNU Unifont .hex file to Portable Network Graphics converter
unihexfill	Generate range of Unifont 4- or 6-digit hexadecimal glyph
unihexrotate	Rotate Unifont hex glyphs in quarter turn increments
unipng2hex	Convert Portable Network Graphics to GNU Unifont .hex file converter

Chapter 2

Data Structure Index

2.1 Data Structures

Here are the data structures with brief descriptions:

Buffer	Generic data structure for a linked list of buffer elements	17
Font	Data structure to hold information for one font	18
Glyph	Data structure to hold data for one bitmap glyph	20
NamePair	Data structure for a font ID number and name character string	22
Options	Data structure to hold options for OpenType font output	23
PARAMS	25
Table	Data structure for an OpenType table	27
TableRecord	Data structure for data associated with one OpenType table	28

Chapter 3

File Index

3.1 File List

Here is a list of all documented files with brief descriptions:

src/ hangul.h	Define constants and function prototypes for using Hangul glyphs	31
src/ hex2otf.c	Hex2otf - Convert GNU Unifont .hex file to OpenType font	76
src/ hex2otf.h	Hex2otf.h - Header file for hex2otf.c	192
src/ johab2syllables.c	Create the Unicode Hangul Syllables block from component letters	196
src/ unibdf2hex.c	Unibdf2hex - Convert a BDF file into a unifont.hex file	202
src/ unibmp2hex.c	Unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters	206
src/ unibmpbump.c	Unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp	227
src/ unicoverage.c	Unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file	244
src/ unidup.c	Unidup - Check for duplicate code points in sorted unifont.hex file	254
src/ unifont-support.c	: Support functions for Unifont .hex files	258
src/ unifont1per.c	Unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output	270
src/ unifontpic.c	Unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap	275
src/ unifontpic.h	Unifontpic.h - Header file for unifontpic.c	303
src/ unigen-hangul.c	Generate arbitrary hangul syllables	308

src/ unigencircles.c	
Unigencircles - Superimpose dashed combining circles on combining glyphs	319
src/ unigenwidth.c	
Unigenwidth - IEEE 1003.1-2008 setup to calculate wchar_t string widths	329
src/ unihangul-support.c	
Functions for converting Hangul letters into syllables	339
src/ unihex2bmp.c	
Unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing	380
src/ unihexgen.c	
Unihexgen - Generate a series of glyphs containing hexadecimal code points	397
src/ unihexpose.c	407
src/ unijohab2html.c	
Display overlapped Hangul letter combinations in a grid	408
src/ unipagecount.c	
Unipagecount - Count the number of glyphs defined in each page of 256 code points . . .	427

Chapter 4

Data Structure Documentation

4.1 Buffer Struct Reference

Generic data structure for a linked list of buffer elements.

Data Fields

- `size_t capacity`
- `byte * begin`
- `byte * next`
- `byte * end`

4.1.1 Detailed Description

Generic data structure for a linked list of buffer elements.

A buffer can act as a vector (when filled with 'store*' functions), or a temporary output area (when filled with 'cache*' functions). The 'store*' functions use native endian. The 'cache*' functions use big endian or other formats in OpenType. Beware of memory alignment.

Definition at line 133 of file [hex2otf.c](#).

4.1.2 Field Documentation

4.1.2.1 begin

`byte*` Buffer::begin

Definition at line 136 of file [hex2otf.c](#).

4.1.2.2 capacity

size_t Buffer::capacity

Definition at line 135 of file [hex2otf.c](#).

4.1.2.3 end

byte * Buffer::end

Definition at line 136 of file [hex2otf.c](#).

4.1.2.4 next

byte * Buffer::next

Definition at line 136 of file [hex2otf.c](#).

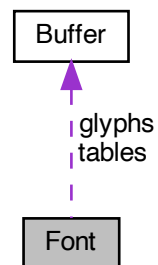
The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

4.2 Font Struct Reference

Data structure to hold information for one font.

Collaboration diagram for Font:



Data Fields

- [Buffer * tables](#)
- [Buffer * glyphs](#)
- [uint_fast32_t glyphCount](#)
- [pixels_t maxWidth](#)

4.2.1 Detailed Description

Data structure to hold information for one font.

Definition at line [628](#) of file [hex2otf.c](#).

4.2.2 Field Documentation

4.2.2.1 glyphCount

[uint_fast32_t](#) Font::glyphCount

Definition at line [632](#) of file [hex2otf.c](#).

4.2.2.2 glyphs

[Buffer*](#) Font::glyphs

Definition at line [631](#) of file [hex2otf.c](#).

4.2.2.3 maxWidth

[pixels_t](#) Font::maxWidth

Definition at line [633](#) of file [hex2otf.c](#).

4.2.2.4 tables

[Buffer*](#) Font::tables

Definition at line [630](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

4.3 Glyph Struct Reference

Data structure to hold data for one bitmap glyph.

Data Fields

- `uint_least32_t` [codePoint](#)
undefined for glyph 0
- `byte` [bitmap](#) [[GLYPH_MAX_BYTE_COUNT](#)]
hexadecimal bitmap character array
- `uint_least8_t` [byteCount](#)
length of bitmap data
- `bool` [combining](#)
whether this is a combining glyph
- `pixels_t` [pos](#)
- `pixels_t` [lsb](#)
left side bearing (x position of leftmost contour point)

4.3.1 Detailed Description

Data structure to hold data for one bitmap glyph.

This data structure holds data to represent one Unifont bitmap glyph: Unicode code point, number of bytes in its bitmap array, whether or not it is a combining character, and an offset from the glyph origin to the start of the bitmap.

Definition at line [614](#) of file [hex2otf.c](#).

4.3.2 Field Documentation

4.3.2.1 bitmap

`byte` Glyph::bitmap[GLYPH_MAX_BYTE_COUNT]

hexadecimal bitmap character array

Definition at line 617 of file [hex2otf.c](#).

4.3.2.2 byteCount

`uint_least8_t` Glyph::byteCount

length of bitmap data

Definition at line 618 of file [hex2otf.c](#).

4.3.2.3 codePoint

`uint_least32_t` Glyph::codePoint

undefined for glyph 0

Definition at line 616 of file [hex2otf.c](#).

4.3.2.4 combining

`bool` Glyph::combining

whether this is a combining glyph

Definition at line 619 of file [hex2otf.c](#).

4.3.2.5 lsb

`pixels_t` Glyph::lsb

left side bearing (x position of leftmost contour point)

Definition at line 622 of file [hex2otf.c](#).

4.3.2.6 pos

[pixels_t](#) Glyph::pos

number of pixels the glyph should be moved to the right (negative number means moving to the left)

Definition at line [620](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

4.4 NamePair Struct Reference

Data structure for a font ID number and name character string.

```
#include <hex2otf.h>
```

Data Fields

- int [id](#)
- const char * [str](#)

4.4.1 Detailed Description

Data structure for a font ID number and name character string.

Definition at line [77](#) of file [hex2otf.h](#).

4.4.2 Field Documentation

4.4.2.1 id

int NamePair::id

Definition at line [79](#) of file [hex2otf.h](#).

4.4.2.2 str

const char* NamePair::str

Definition at line 80 of file [hex2otf.h](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.h](#)

4.5 Options Struct Reference

Data structure to hold options for OpenType font output.

Data Fields

- bool [truetype](#)
- bool [blankOutline](#)
- bool [bitmap](#)
- bool [gpos](#)
- bool [gsub](#)
- int [cff](#)
- const char * [hex](#)
- const char * [pos](#)
- const char * [out](#)
- [NameStrings](#) [nameStrings](#)

4.5.1 Detailed Description

Data structure to hold options for OpenType font output.

This data structure holds the status of options that can be specified as command line arguments for creating the output OpenType font file.

Definition at line 2453 of file [hex2otf.c](#).

4.5.2 Field Documentation

4.5.2.1 bitmap

bool Options::bitmap

Definition at line 2455 of file [hex2otf.c](#).

4.5.2.2 blankOutline

bool Options::blankOutline

Definition at line [2455](#) of file [hex2otf.c](#).

4.5.2.3 cff

int Options::cff

Definition at line [2456](#) of file [hex2otf.c](#).

4.5.2.4 gpos

bool Options::gpos

Definition at line [2455](#) of file [hex2otf.c](#).

4.5.2.5 gsub

bool Options::gsub

Definition at line [2455](#) of file [hex2otf.c](#).

4.5.2.6 hex

const char* Options::hex

Definition at line [2457](#) of file [hex2otf.c](#).

4.5.2.7 nameStrings

[NameStrings](#) Options::nameStrings

Definition at line [2458](#) of file [hex2otf.c](#).

4.5.2.8 out

const char * Options::out

Definition at line [2457](#) of file [hex2otf.c](#).

4.5.2.9 pos

const char * Options::pos

Definition at line [2457](#) of file [hex2otf.c](#).

4.5.2.10 truetype

bool Options::truetype

Definition at line [2455](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

4.6 PARAMS Struct Reference

Data Fields

- unsigned [starting_codept](#)
- unsigned [cho_start](#)
- unsigned [cho_end](#)
- unsigned [jung_start](#)
- unsigned [jung_end](#)
- unsigned [jong_start](#)
- unsigned [jong_end](#)
- FILE * [infp](#)
- FILE * [outfp](#)

4.6.1 Detailed Description

Definition at line [55](#) of file [unigen-hangul.c](#).

4.6.2 Field Documentation

4.6.2.1 cho_end

unsigned PARAMS::cho_end

Definition at line [57](#) of file [unigen-hangul.c](#).

4.6.2.2 cho_start

unsigned PARAMS::cho_start

Definition at line [57](#) of file [unigen-hangul.c](#).

4.6.2.3 infp

FILE* PARAMS::infp

Definition at line [60](#) of file [unigen-hangul.c](#).

4.6.2.4 jong_end

unsigned PARAMS::jong_end

Definition at line [59](#) of file [unigen-hangul.c](#).

4.6.2.5 jong_start

unsigned PARAMS::jong_start

Definition at line [59](#) of file [unigen-hangul.c](#).

4.6.2.6 jung_end

unsigned PARAMS::jung_end

Definition at line 58 of file [unigen-hangul.c](#).

4.6.2.7 jung_start

unsigned PARAMS::jung_start

Definition at line 58 of file [unigen-hangul.c](#).

4.6.2.8 outfp

FILE* PARAMS::outfp

Definition at line 61 of file [unigen-hangul.c](#).

4.6.2.9 starting_codept

unsigned PARAMS::starting_codept

Definition at line 56 of file [unigen-hangul.c](#).

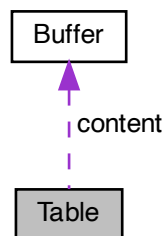
The documentation for this struct was generated from the following file:

- [src/unigen-hangul.c](#)

4.7 Table Struct Reference

Data structure for an OpenType table.

Collaboration diagram for Table:



Data Fields

- `uint_fast32_t tag`
- `Buffer * content`

4.7.1 Detailed Description

Data structure for an OpenType table.

This data structure contains a table tag and a pointer to the start of the buffer that holds data for this OpenType table.

For information on the OpenType tables and their structure, see <https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables>.

Definition at line 645 of file `hex2otf.c`.

4.7.2 Field Documentation

4.7.2.1 content

`Buffer* Table::content`

Definition at line 648 of file `hex2otf.c`.

4.7.2.2 tag

`uint_fast32_t Table::tag`

Definition at line 647 of file `hex2otf.c`.

The documentation for this struct was generated from the following file:

- `src/hex2otf.c`

4.8 TableRecord Struct Reference

Data structure for data associated with one OpenType table.

Data Fields

- `uint_least32_t` [tag](#)
- `uint_least32_t` [offset](#)
- `uint_least32_t` [length](#)
- `uint_least32_t` [checksum](#)

4.8.1 Detailed Description

Data structure for data associated with one OpenType table.

This data structure contains an OpenType table's tag, start within an OpenType font file, length in bytes, and checksum at the end of the table.

Definition at line [747](#) of file [hex2otf.c](#).

4.8.2 Field Documentation

4.8.2.1 checksum

`uint_least32_t` TableRecord::checksum

Definition at line [749](#) of file [hex2otf.c](#).

4.8.2.2 length

`uint_least32_t` TableRecord::length

Definition at line [749](#) of file [hex2otf.c](#).

4.8.2.3 offset

`uint_least32_t` TableRecord::offset

Definition at line [749](#) of file [hex2otf.c](#).

4.8.2.4 tag

`uint_least32_t` TableRecord::tag

Definition at line [749](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

Chapter 5

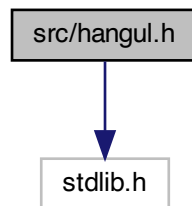
File Documentation

5.1 src/hangul.h File Reference

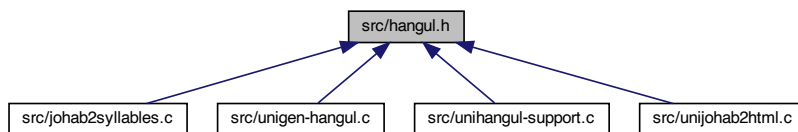
Define constants and function prototypes for using Hangul glyphs.

```
#include <stdlib.h>
```

Include dependency graph for hangul.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define `MAXLINE` 256
Length of maximum file input line.
- #define `EXTENDED_HANGUL` /* Use rare Hangul code points beyond U+1100 */
- #define `PUA_START` 0xE000
- #define `PUA_END` 0xE8FF
- #define `MAX_GLYPHS` (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
- #define `CHO_UNICODE_START` 0x1100
Modern Hangul choseong start.
- #define `CHO_UNICODE_END` 0x115E
Hangul Jamo choseong end.
- #define `CHO_EXT_A_UNICODE_START` 0xA960
Hangul Extended-A choseong start.
- #define `CHO_EXT_A_UNICODE_END` 0xA97C
Hangul Extended-A choseong end.
- #define `JUNG_UNICODE_START` 0x1161
Modern Hangul jungseong start.
- #define `JUNG_UNICODE_END` 0x11A7
Modern Hangul jungseong end.
- #define `JUNG_EXT_B_UNICODE_START` 0xD7B0
Hangul Extended-B jungseong start.
- #define `JUNG_EXT_B_UNICODE_END` 0xD7C6
Hangul Extended-B jungseong end.
- #define `JONG_UNICODE_START` 0x11A8
Modern Hangul jongseong start.
- #define `JONG_UNICODE_END` 0x11FF
Modern Hangul jongseong end.
- #define `JONG_EXT_B_UNICODE_START` 0xD7CB
Hangul Extended-B jongseong start.
- #define `JONG_EXT_B_UNICODE_END` 0xD7FB
Hangul Extended-B jongseong end.
- #define `NCHO_MODERN` 19
19 modern Hangul Jamo choseong
- #define `NCHO_ANCIENT` 76
ancient Hangul Jamo choseong
- #define `NCHO_EXT_A` 29
Hangul Extended-A choseong.
- #define `NCHO_EXT_A_RSRVD` 3
Reserved at end of Extended-A choseong.
- #define `NJUNG_MODERN` 21
21 modern Hangul Jamo jungseong
- #define `NJUNG_ANCIENT` 50
ancient Hangul Jamo jungseong
- #define `NJUNG_EXT_B` 23
Hangul Extended-B jungseong.
- #define `NJUNG_EXT_B_RSRVD` 4

- Reserved at end of Extended-B junseong.
- #define **NJONG_MODERN** 27
28 modern Hangul Jamo jongseong
- #define **NJONG_ANCIENT** 61
ancient Hangul Jamo jongseong
- #define **NJONG_EXTB** 49
Hangul Extended-B jongseong.
- #define **NJONG_EXTB_RSRVD** 4
Reserved at end of Extended-B jonseong.
- #define **CHO_VARIATIONS** 6
6 choseong variations
- #define **JUNG_VARIATIONS** 3
3 jungseong variations
- #define **JONG_VARIATIONS** 1
1 jongseong variation
- #define **CHO_HEX** 0x0001
Location of first choseong (location 0x0000 is a blank glyph)
- #define **CHO_ANCIENT_HEX** (**CHO_HEX** + **CHO_VARIATIONS** * **NCHO_MODERN**)
Location of first ancient choseong.
- #define **CHO_EXT_A_HEX** (**CHO_ANCIENT_HEX** + **CHO_VARIATIONS** * **NCHO_ANCIENT**)
U+A960 Extended-A choseong.
- #define **CHO_LAST_HEX** (**CHO_EXT_A_HEX** + **CHO_VARIATIONS** * (**NCHO_EXT_A** + **NCHO_EXT_A_RSRVD**) - 1)
U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end.
- #define **JUNG_HEX** (**CHO_LAST_HEX** + 1)
Location of first jungseong (will be 0x2FB)
- #define **JUNG_ANCIENT_HEX** (**JUNG_HEX** + **JUNG_VARIATIONS** * **NJUNG_MODERN**)
Location of first ancient jungseong.
- #define **JUNG_EXTB_HEX** (**JUNG_ANCIENT_HEX** + **JUNG_VARIATIONS** * **NJUNG_ANCIENT**)
U+D7B0 Extended-B jungseong.
- #define **JUNG_LAST_HEX** (**JUNG_EXTB_HEX** + **JUNG_VARIATIONS** * (**NJUNG_EXTB** + **NJUNG_EXTB_RSRVD**) - 1)
U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end.
- #define **JONG_HEX** (**JUNG_LAST_HEX** + 1)
Location of first jongseong (will be 0x421)
- #define **JONG_ANCIENT_HEX** (**JONG_HEX** + **JONG_VARIATIONS** * **NJONG_MODERN**)
Location of first ancient jongseong.
- #define **JONG_EXTB_HEX** (**JONG_ANCIENT_HEX** + **JONG_VARIATIONS** * **NJONG_ANCIENT**)
U+D7CB Extended-B jongseong.
- #define **JONG_LAST_HEX** (**JONG_EXTB_HEX** + **JONG_VARIATIONS** * (**NJONG_EXTB** + **NJONG_EXTB_RSRVD**) - 1)
U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end.
- #define **JAMO_HEX** 0x0500
Start of U+1100..U+11FF glyphs.
- #define **JAMO_END** 0x05FF
End of U+1100..U+11FF glyphs.
- #define **JAMO_EXT_A_HEX** 0x0600

- Start of U+A960..U+A97F glyphs.
- #define [JAMO_EXT_A_END](#) 0x061F
- End of U+A960..U+A97F glyphs.
- #define [JAMO_EXT_B_HEX](#) 0x0620
- Start of U+D7B0..U+D7FF glyphs.
- #define [JAMO_EXT_B_END](#) 0x066F
- End of U+D7B0..U+D7FF glyphs.
- #define [TOTAL_CHO](#) ([NCHO_MODERN](#) + [NCHO_ANCIENT](#) + [NCHO_EXT_A](#))
- #define [TOTAL_JUNG](#) ([NJUNG_MODERN](#) + [NJUNG_ANCIENT](#) + [NJUNG_EXT_B](#))
- #define [TOTAL_JONG](#) ([NJONG_MODERN](#) + [NJONG_ANCIENT](#) + [NJONG_EXT_B](#))

Functions

- unsigned [hangul_read_base8](#) (FILE *infp, unsigned char base[][32])
Read hangul-base.hex file into a unsigned char array.
- unsigned [hangul_read_base16](#) (FILE *infp, unsigned base[][16])
Read hangul-base.hex file into a unsigned array.
- void [hangul_decompose](#) (unsigned codept, int *initial, int *medial, int *final)
Decompose a Hangul Syllables code point into three letters.
- unsigned [hangul_compose](#) (int initial, int medial, int final)
Compose a Hangul syllable into a code point, or 0 if none exists.
- void [hangul_hex_indices](#) (int choseong, int jungseong, int jongseong, int *cho_index, int *jung_index, int *jong_index)
Determine index values to the bitmaps for a syllable's components.
- void [hangul_variations](#) (int choseong, int jungseong, int jongseong, int *cho_var, int *jung_var, int *jong_var)
Determine the variations of each letter in a Hangul syllable.
- int [is_wide_vowel](#) (int vowel)
Whether vowel has rightmost vertical stroke to the right.
- int [cho_variation](#) (int choseong, int jungseong, int jongseong)
Return the Johab 6/3/1 choseong variation for a syllable.
- int [jung_variation](#) (int choseong, int jungseong, int jongseong)
Return the Johab 6/3/1 jungseong variation.
- int [jong_variation](#) (int choseong, int jungseong, int jongseong)
Return the Johab 6/3/1 jongseong variation.
- void [hangul_syllable](#) (int choseong, int jungseong, int jongseong, unsigned char hangul_base[][32], unsigned char *syllable)
Given letters in a Hangul syllable, return a glyph.
- int [glyph_overlap](#) (unsigned *glyph1, unsigned *glyph2)
See if two glyphs overlap.
- void [combine_glyphs](#) (unsigned *glyph1, unsigned *glyph2, unsigned *combined_glyph)
Combine two glyphs into one glyph.
- void [one_jamo](#) (unsigned glyph_table[[MAX_GLYPHS](#)][16], unsigned jamo, unsigned *jamo_glyph)
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void [combined_jamo](#) (unsigned glyph_table[[MAX_GLYPHS](#)][16], unsigned cho, unsigned jung, unsigned jong, unsigned *combined_glyph)
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void [print_glyph_txt](#) (FILE *fp, unsigned codept, unsigned *this_glyph)
Print one glyph in Unifont hexdraw plain text style.
- void [print_glyph_hex](#) (FILE *fp, unsigned codept, unsigned *this_glyph)
Print one glyph in Unifont hexdraw hexadecimal string style.

5.1.1 Detailed Description

Define constants and function prototypes for using Hangul glyphs.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [hangul.h](#).

5.1.2 Macro Definition Documentation

5.1.2.1 CHO_ANCIENT_HEX

```
#define CHO_ANCIENT_HEX (CHO_HEX + CHO_VARIATIONS * NCHO_MODERN)
```

Location of first ancient choseong.

Definition at line 99 of file [hangul.h](#).

5.1.2.2 CHO_EXT_A_HEX

```
#define CHO_EXT_A_HEX (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)
```

U+A960 Extended-A choseong.

Definition at line 102 of file [hangul.h](#).

5.1.2.3 CHO_EXT_A_UNICODE_END

```
#define CHO_EXT_A_UNICODE_END 0xA97C
```

Hangul Extended-A choseong end.

Definition at line 53 of file [hangul.h](#).

5.1.2.4 CHO_EXT_A_UNICODE_START

```
#define CHO_EXT_A_UNICODE_START 0xA960
```

Hangul Extended-A choseong start.

Definition at line 52 of file [hangul.h](#).

5.1.2.5 CHO_HEX

```
#define CHO_HEX 0x0001
```

Location of first choseong (location 0x0000 is a blank glyph)

Definition at line 96 of file [hangul.h](#).

5.1.2.6 CHO_LAST_HEX

```
#define CHO_LAST_HEX (CHO_EXT_A_HEX + CHO_VARIATIONS * (NCHO_EXT_A + NCHO_EXT_A_RSRVD) - 1)
```

U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end.

Definition at line 105 of file [hangul.h](#).

5.1.2.7 CHO_UNICODE_END

```
#define CHO_UNICODE_END 0x115E
```

Hangul Jamo choseong end.

Definition at line 51 of file [hangul.h](#).

5.1.2.8 CHO_UNICODE_START

```
#define CHO_UNICODE_START 0x1100
```

Modern Hangul choseong start.

Definition at line 50 of file [hangul.h](#).

5.1.2.9 CHO_VARIATIONS

```
#define CHO_VARIATIONS 6
```

6 choseong variations

Definition at line 88 of file [hangul.h](#).

5.1.2.10 EXTENDED_HANGUL

```
#define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */
```

Definition at line 35 of file [hangul.h](#).

5.1.2.11 JAMO_END

```
#define JAMO_END 0x05FF
```

End of U+1100..U+11FF glyphs.

Definition at line 133 of file [hangul.h](#).

5.1.2.12 JAMO_EXTEND_END

```
#define JAMO_EXTEND_END 0x061F
```

End of U+A960..U+A97F glyphs.

Definition at line 137 of file [hangul.h](#).

5.1.2.13 JAMO_EXTEND_HEX

```
#define JAMO_EXTEND_HEX 0x0600
```

Start of U+A960..U+A97F glyphs.

Definition at line 136 of file [hangul.h](#).

5.1.2.14 JAMO_EXTB_END

```
#define JAMO_EXTB_END 0x066F
```

End of U+D7B0..U+D7FF glyphs.

Definition at line [141](#) of file [hangul.h](#).

5.1.2.15 JAMO_EXTB_HEX

```
#define JAMO_EXTB_HEX 0x0620
```

Start of U+D7B0..U+D7FF glyphs.

Definition at line [140](#) of file [hangul.h](#).

5.1.2.16 JAMO_HEX

```
#define JAMO_HEX 0x0500
```

Start of U+1100..U+11FF glyphs.

Definition at line [132](#) of file [hangul.h](#).

5.1.2.17 JONG_ANCIENT_HEX

```
#define JONG_ANCIENT_HEX (JONG_HEX + JONG_VARIATIONS * NJONG_MODERN)
```

Location of first ancient jongseong.

Definition at line [123](#) of file [hangul.h](#).

5.1.2.18 JONG_EXTB_HEX

```
#define JONG_EXTB_HEX (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)
```

U+D7CB Extended-B jongseong.

Definition at line [126](#) of file [hangul.h](#).

5.1.2.19 JONG_EXTB_UNICODE_END

```
#define JONG_EXTB_UNICODE_END 0xD7FB
```

Hangul Extended-B jongseong end.

Definition at line 63 of file [hangul.h](#).

5.1.2.20 JONG_EXTB_UNICODE_START

```
#define JONG_EXTB_UNICODE_START 0xD7CB
```

Hangul Extended-B jongseong start.

Definition at line 62 of file [hangul.h](#).

5.1.2.21 JONG_HEX

```
#define JONG_HEX (JONG_LAST_HEX + 1)
```

Location of first jongseong (will be 0x421)

Definition at line 120 of file [hangul.h](#).

5.1.2.22 JONG_LAST_HEX

```
#define JONG_LAST_HEX (JONG_EXTB_HEX + JONG_VARIATIONS * (NJONG_EXTB + NJONG_EXTB_RSRVD)  
- 1)
```

U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end.

Definition at line 129 of file [hangul.h](#).

5.1.2.23 JONG_UNICODE_END

```
#define JONG_UNICODE_END 0x11FF
```

Modern Hangul jongseong end.

Definition at line 61 of file [hangul.h](#).

5.1.2.24 JONG_UNICODE_START

```
#define JONG_UNICODE_START 0x11A8
```

Modern Hangul jongseong start.

Definition at line [60](#) of file [hangul.h](#).

5.1.2.25 JONG_VARIATIONS

```
#define JONG_VARIATIONS 1
```

1 jongseong variation

Definition at line [90](#) of file [hangul.h](#).

5.1.2.26 JUNG_ANCIENT_HEX

```
#define JUNG_ANCIENT_HEX (JUNG_HEX + JUNG_VARIATIONS * NJUNG_MODERN)
```

Location of first ancient jungseong.

Definition at line [111](#) of file [hangul.h](#).

5.1.2.27 JUNG_EXTB_HEX

```
#define JUNG_EXTB_HEX (JUNG_ANCIENT_HEX + JUNG_VARIATIONS * NJUNG_ANCIENT)
```

U+D7B0 Extended-B jungseong.

Definition at line [114](#) of file [hangul.h](#).

5.1.2.28 JUNG_EXTB_UNICODE_END

```
#define JUNG_EXTB_UNICODE_END 0xD7C6
```

Hangul Extended-B jungseong end.

Definition at line [58](#) of file [hangul.h](#).

5.1.2.29 JUNG_EXTB_UNICODE_START

```
#define JUNG_EXTB_UNICODE_START 0xD7B0
```

Hangul Extended-B jungseong start.

Definition at line 57 of file [hangul.h](#).

5.1.2.30 JUNG_HEX

```
#define JUNG_HEX (CHO_LAST_HEX + 1)
```

Location of first jungseong (will be 0x2FB)

Definition at line 108 of file [hangul.h](#).

5.1.2.31 JUNG_LAST_HEX

```
#define JUNG_LAST_HEX (JUNG_EXTB_HEX + JUNG_VARIATIONS * (NJUNG_EXTB + NJUNG_EXTB_RSRVD)  
- 1)
```

U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end.

Definition at line 117 of file [hangul.h](#).

5.1.2.32 JUNG_UNICODE_END

```
#define JUNG_UNICODE_END 0x11A7
```

Modern Hangul jungseong end.

Definition at line 56 of file [hangul.h](#).

5.1.2.33 JUNG_UNICODE_START

```
#define JUNG_UNICODE_START 0x1161
```

Modern Hangul jungseong start.

Definition at line 55 of file [hangul.h](#).

5.1.2.34 JUNG_VARIATIONS

```
#define JUNG_VARIATIONS 3
```

3 jungseong variations

Definition at line 89 of file [hangul.h](#).

5.1.2.35 MAX_GLYPHS

```
#define MAX_GLYPHS (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
```

Definition at line 40 of file [hangul.h](#).

5.1.2.36 MAXLINE

```
#define MAXLINE 256
```

Length of maximum file input line.

Definition at line 33 of file [hangul.h](#).

5.1.2.37 NCHO_ANCIENT

```
#define NCHO_ANCIENT 76
```

ancient Hangul Jamo choseong

Definition at line 70 of file [hangul.h](#).

5.1.2.38 NCHO_EXT_A

```
#define NCHO_EXT_A 29
```

Hangul Extended-A choseong.

Definition at line 71 of file [hangul.h](#).

5.1.2.39 NCHO_EXT_A_RSRVD

```
#define NCHO_EXT_A_RSRVD 3
```

Reserved at end of Extended-A choseong.

Definition at line 72 of file [hangul.h](#).

5.1.2.40 NCHO_MODERN

```
#define NCHO_MODERN 19
```

19 modern Hangul Jamo choseong

Definition at line 69 of file [hangul.h](#).

5.1.2.41 NJONG_ANTIEN

```
#define NJONG_ANTIEN 61
```

ancient Hangul Jamo jongseong

Definition at line 80 of file [hangul.h](#).

5.1.2.42 NJONG_EXTB

```
#define NJONG_EXTB 49
```

Hangul Extended-B jongseong.

Definition at line 81 of file [hangul.h](#).

5.1.2.43 NJONG_EXTB_RSRVD

```
#define NJONG_EXTB_RSRVD 4
```

Reserved at end of Extended-B jonseong.

Definition at line 82 of file [hangul.h](#).

5.1.2.44 NJONG_MODERN

```
#define NJONG_MODERN 27
```

28 modern Hangul Jamo jongseong

Definition at line [79](#) of file [hangul.h](#).

5.1.2.45 NJUNG_ANCIENT

```
#define NJUNG_ANCIENT 50
```

ancient Hangul Jamo jungseong

Definition at line [75](#) of file [hangul.h](#).

5.1.2.46 NJUNG_EXTB

```
#define NJUNG_EXTB 23
```

Hangul Extended-B jungseong.

Definition at line [76](#) of file [hangul.h](#).

5.1.2.47 NJUNG_EXTB_RSRVD

```
#define NJUNG_EXTB_RSRVD 4
```

Reserved at end of Extended-B junseong.

Definition at line [77](#) of file [hangul.h](#).

5.1.2.48 NJUNG_MODERN

```
#define NJUNG_MODERN 21
```

21 modern Hangul Jamo jungseong

Definition at line [74](#) of file [hangul.h](#).

5.1.2.49 PUA_END

```
#define PUA_END 0xE8FF
```

Definition at line 39 of file [hangul.h](#).

5.1.2.50 PUA_START

```
#define PUA_START 0xE000
```

Definition at line 38 of file [hangul.h](#).

5.1.2.51 TOTAL_CHO

```
#define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXT_A )
```

Definition at line 150 of file [hangul.h](#).

5.1.2.52 TOTAL_JONG

```
#define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)
```

Definition at line 152 of file [hangul.h](#).

5.1.2.53 TOTAL_JUNG

```
#define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)
```

Definition at line 151 of file [hangul.h](#).

5.1.3 Function Documentation

5.1.3.1 cho_variation()

```
int cho_variation (
    int choseong,
    int jungseong,
    int jongseong )
```

Return the Johab 6/3/1 choseong variation for a syllable.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the initial consonant (choseong).

Each choseong has 6 variations:

Variation Occurrence

0 Choseong with a vertical vowel such as "A". 1 Choseong with a horizontal vowel such as "O". 2 Choseong with a vertical and horizontal vowel such as "WA". 3 Same as variation 0, but with jongseong (final consonant). 4 Same as variation 1, but with jongseong (final consonant). Also a horizontal vowel pointing down, such as U and YU. 5 Same as variation 2, but with jongseong (final consonant). Also a horizontal vowel pointing down with vertical element, such as WEO, WE, and WI.

In addition, if the vowel is horizontal and a downward-pointing stroke as in the modern letters U, WEO, WE, WI, and YU, and in archaic letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added to the initial variation of 0 to 2, resulting in a choseong variation of 3 to 5, respectively.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

The choseong variation, 0 to 5.

Definition at line 350 of file [unihangul-support.c](#).

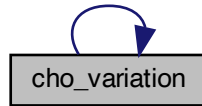
```
00350 {
00351     int cho_variation; /* Return value */
00352
00353     /*
00354      * The Choseong cho_var is determined by the
00355      * 21 modern + 50 ancient Jungseong, and whether
```

```

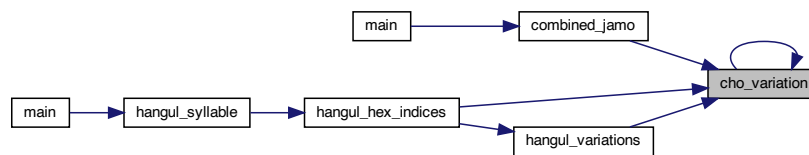
00356 or not the syllable contains a final consonant
00357 (Jongseong).
00358 */
00359 static int choseong_var [TOTAL_JUNG + 1] = {
00360     /*
00361     Modern Jungseong in positions 0..20.
00362     */
00363     /* Location Variations Unicode Range Vowel # Vowel Names */
00364     /* ----- */
00365     /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00366     /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00367     /* 0x30D */ 0, 0, 0, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00368     /* 0x313 */ 1, // U+1169 -->[ 8] O
00369     /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00370     /* 0x31F */ 1, 4, // U+116D..U+116E-->[12..13] YO, U
00371     /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16] WEO, WE, WI
00372     /* 0x32E */ 4, 1, // U+1172..U+1173-->[17..18] YU, EU
00373     /* 0x334 */ 2, // U+1174 -->[19] YI
00374     /* 0x337 */ 0, // U+1175 -->[20] I
00375     /*
00376     Ancient Jungseong in positions 21..70.
00377     */
00378     /* Location Variations Unicode Range Vowel # Vowel Names */
00379     /* ----- */
00380     /* 0x33A */ 2, 5, 2, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00381     /* 0x343 */ 2, 2, 5, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00382     /* 0x34C */ 2, 2, 5, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00383     /* 0x355 */ 2, 5, 5, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00384     /* 0x35E */ 4, 4, 2, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00385     /* 0x367 */ 2, 2, 5, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00386     /* 0x370 */ 2, 5, 5, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00387     /* 0x379 */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00388     /* 0x382 */ 5, 5, 5, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00389     /* 0x38B */ 5, 5, 2, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00390     /* 0x394 */ 5, 2, 2, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00391     /* 0x39D */ 2, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00392     /* 0x3A6 */ 2, 5, 2, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00393     /* 0x3AF */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEAE, ARAEA, ARAEA-EO,
00394     /* 0x3B8 */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEAE,
00395     /* 0x3C1 */ 2, 5, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00396     /* 0x3CA */ 2, 2, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE,
00397     #ifdef EXTENDED_HANGUL
00398     /* 0x3D0 */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00399     /* 0x3D9 */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00400     /* 0x3E2 */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00401     /* 0x3EB */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00402     /* 0x3F4 */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00403     /* 0x3FD */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00404     /* 0x406 */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00405     /* 0x40F */ 2, 2, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406     /* 0x415 */ -1 // Mark end of list of vowels.
00407     #else
00408     /* 0x310 */ -1 // Mark end of list of vowels.
00409     #endif
00410 };
00411
00412
00413 if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415 }
00416 else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419         cho_variation += 3;
00420 }
00421
00422
00423 return cho_variation;
00424 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.2 combine_glyphs()

```

void combine_glyphs (
    unsigned * glyph1,
    unsigned * glyph2,
    unsigned * combined_glyph )
  
```

Combine two glyphs into one glyph.

Parameters

in	glyph1	The first glyph to overlap.
in	glyph2	The second glyph to overlap.

Parameters

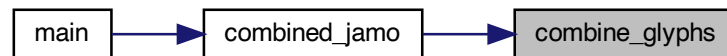
out	combined_glyph	The re-turned combination glyph.
-----	----------------	----------------------------------

Definition at line 637 of file [unihangul-support.c](#).

```

00638     {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642         combined_glyph[i] = glyph1[i] | glyph2[i];
00643
00644     return;
00645 }
```

Here is the caller graph for this function:



5.1.3.3 combined_jamo()

```

void combined_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned cho,
    unsigned jung,
    unsigned jong,
    unsigned * combined_glyph )
```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

This function converts input Hangul choseong, jungseong, and jongseong Unicode code triplets into a Hangul syllable. Any of those with an out of range code point are assigned a blank glyph for combining. This function performs the following steps:

- 1) Determine the sequence number of choseong, jungseong, and jongseong, from 0 to the total number of choseong, jungseong, or jongseong, respectively, minus one. The sequence for each is as follows:
 - a) Choseong: Unicode code points of U+1100..U+115E and then U+A960..U+A97C.
 - b) Jungseong: Unicode code points of U+1161..U+11A7 and then U+D7B0..U+D7C6.
 - c) Jongseong: Unicode code points of U+11A8..U+11FF and then U+D7CB..U+D7FB.

- 2) From the choseong, jungseong, and jongseong sequence number, determine the variation of choseong and jungseong (there is only one jongseong variation, although it is shifted right by one column for some vowels with a pair of long vertical strokes on the right side).
- 3) Convert the variation numbers for the three syllable components to index locations in the glyph array.
- 4) Combine the glyph array glyphs into a syllable.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	cho	The choseong Unicode code point, 0 or 0x1100..0x115F.
in	jung	The jungseong Unicode code point, 0 or 0x1160..0x11A7.
in	jong	The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
out	combined_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 787 of file [unihangul-support.c](#).

```

00789         {
00790
00791     int i; /* Loop variable. */
00792     int cho_num, jung_num, jong_num;
00793     int cho_group, jung_group, jong_group;
00794     int cho_index, jung_index, jong_index;
00795
00796     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798     int cho_variation (int choseong, int jungseong, int jongseong);
00799
00800     void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00801                         unsigned *combined_glyph);
00802
00803
00804     /* Choose a blank glyph for each syllable by default. */
00805     cho_index = jung_index = jong_index = 0x000;
00806
00807     /*
00808     Convert Unicode code points to jamo sequence number
00809     of each letter, or -1 if letter is not in valid range.
00810     */
00811     if (cho >= 0x1100 && cho <= 0x115E)
00812         cho_num = cho - CHO_UNICODE_START;
00813     else if (cho >= CHO_EXTB_UNICODE_START &&
00814             cho < (CHO_EXTB_UNICODE_START + NCHO_EXTB))
00815         cho_num = cho - CHO_EXTB_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816     else
00817         cho_num = -1;
00818
00819     if (jung >= 0x1161 && jung <= 0x11A7)
00820         jung_num = jung - JUNG_UNICODE_START;
00821     else if (jung >= JUNG_EXTB_UNICODE_START &&
00822             jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823         jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824     else
00825         jung_num = -1;
00826
00827     if (jong >= 0x11A8 && jong <= 0x11FF)
00828         jong_num = jong - JONG_UNICODE_START;
00829     else if (jong >= JONG_EXTB_UNICODE_START &&
00830             jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831         jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832     else
00833         jong_num = -1;
00834
00835     /*
00836     Choose initial consonant (choseong) variation based upon
00837     the vowel (jungseong) if both are specified.
00838     */
00839     if (cho_num < 0) {
00840         cho_index = cho_group = 0; /* Use blank glyph for choseong. */
00841     }
00842     else {
00843         if (jung_num < 0 && jong_num < 0) { /* Choseong is by itself. */
00844             cho_group = 0;
00845             if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846                 cho_index = cho_num + JAMO_HEX;
00847             else /* Choseong is in Hangul Jamo Extended-A range. */
00848                 cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                     + JAMO_EXTB_HEX;
00850         }
00851         else {
00852             if (jung_num >= 0) { /* Valid jungseong with choseong. */
00853                 cho_group = cho_variation (cho_num, jung_num, jong_num);
00854             }
00855             else { /* Invalid vowel; see if final consonant is valid. */
00856                 /*
00857                 If initial consonant and final consonant are specified,
00858                 set cho_group to 4, which is the group that would apply
00859                 to a horizontal-only vowel such as Hangul "O", so the
00860                 consonant appears full-width.
00861                 */
00862                 cho_group = 0;
00863                 if (jong_num >= 0) {
00864                     cho_group = 4;
00865                 }
00866             }
00867             cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868                 cho_group;
00869         } /* Choseong combined with jungseong and/or jongseong. */

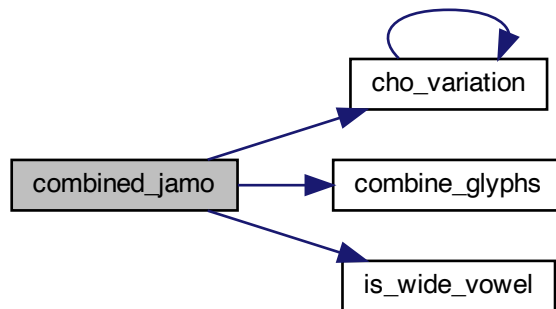
```

```

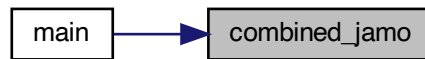
00870 } /* Valid choseong. */
00871
00872 /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876 jung_index = jung_group = 0; /* Use blank glyph for jungseong. */
00877
00878 if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) { /* Jungseong is by itself. */
00880         jung_group = 0;
00881         jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884         if (jong_num >= 0) { /* If there is a final consonant. */
00885             if (jong_num == 3) /* Nieun; choose variation 3. */
00886                 jung_group = 2;
00887             else
00888                 jung_group = 1;
00889         } /* Valid jongseong. */
00890         /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891         else if (cho_num >= 0)
00892             jung_group = 0;
00893     }
00894     jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895 }
00896
00897 /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901 if (jong_num < 0) {
00902     jong_index = jong_group = 0; /* Use blank glyph for jongseong. */
00903 }
00904 else { /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) { /* Jungseong is by itself. */
00906         jong_group = 0;
00907         jong_index = jung_num + 0x4A8;
00908     }
00909     else { /* There is only one jongseong variation if combined. */
00910         jong_group = 0;
00911         jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912             jong_group;
00913     }
00914 }
00915
00916 /*
00917 Now that we know the index locations for choseong, jungseong, and
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920 combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921     combined_glyph);
00922
00923 if (jong_index > 0) {
00924     /*
00925     If the vowel has a vertical stroke that is one column
00926     away from the right border, shift this jongseung right
00927     by one column to line up with the rightmost vertical
00928     stroke in the vowel.
00929     */
00930     if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932             tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935             combined_glyph);
00936     }
00937     else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939             combined_glyph);
00940     }
00941 }
00942
00943 return;
00944 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.4 glyph_overlap()

```
int glyph_overlap (
    unsigned * glyph1,
    unsigned * glyph2 )
```

See if two glyphs overlap.

Parameters

in	glyph1	The first glyph, as a 16-row bitmap.
----	--------	--------------------------------------

Parameters

in	glyph2	The second glyph, as a 16-row bitmap.
----	--------	---------------------------------------

Returns

0 if no overlaps between glyphs, 1 otherwise.

Definition at line 613 of file [unihangul-support.c](#).

```

00613     {
00614     int overlaps; /* Return value; 0 if no overlaps, -1 if overlaps. */
00615     int i;
00616
00617     /* Check for overlaps between the two glyphs. */
00618
00619     i = 0;
00620     do {
00621         overlaps = (glyph1[i] & glyph2[i]) != 0;
00622         i++;
00623     } while (i < 16 && overlaps == 0);
00624
00625     return overlaps;
00626 }
```

5.1.3.5 hangul_compose()

```

unsigned hangul_compose (
    int initial,
    int medial,
    int final )
```

Compose a Hangul syllable into a code point, or 0 if none exists.

This function takes three letters that can form a modern Hangul syllable and returns the corresponding Unicode Hangul Syllables code point in the range 0xAC00 to 0xD7A3.

If a three-letter combination includes one or more archaic letters, it will not map into the Hangul Syllables range. In that case, the returned code point will be 0 to indicate that no valid Hangul Syllables code point exists.

Parameters

in	initial	The first letter (choseong), 0 to 18.
in	medial	The second letter (jungseong), 0 to 20.

Parameters

in	final	The third letter (jongseong), 0 to 26 or -1 if none.
----	-------	--

Returns

The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.

Definition at line 201 of file [unihangul-support.c](#).

```

00201     {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial >= 0 && medial <= 20 &&
00207         final >= 0 && final <= 26) {
00208
00209         codept = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }
```

5.1.3.6 hangul_decompose()

```

void hangul_decompose (
    unsigned codept,
    int * initial,
    int * medial,
    int * final )
```

Decompose a Hangul Syllables code point into three letters.

Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:

- Choseong 0-19
- Jungseong 0-20
- Jongseong 0-27 or -1 if no jongseong

All letter values are set to -1 if the letters do not form a syllable in the Hangul Syllables range. This function only handles modern Hangul, because that is all that is in the Hangul Syllables range.

Parameters

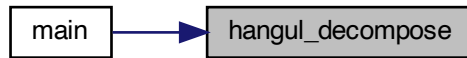
in	codept	The Uni-code code point to de-code, from 0xAC00 to 0xD7A3.
out	initial	The 1st letter (choseong) in the syllable.
out	initial	The 2nd letter (jungseong) in the syllable.
out	initial	The 3rd letter (jongseong) in the syllable.

Definition at line 167 of file [unihangul-support.c](#).

```

00167 {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept -= 0xAC00;
00174         *initial = codept / (28 * 21);
00175         *medial = (codept / 28) % 21;
00176         *final = codept % 28 - 1;
00177     }
00178
00179     return;
00180 }
```

Here is the caller graph for this function:



5.1.3.7 hangul_hex_indices()

```

void hangul_hex_indices (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_index,
    int * jung_index,
    int * jong_index )
  
```

Determine index values to the bitmaps for a syllable's components.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

These variations are then converted into index locations within the glyph array that was read in from the hangul-base.hex file. Those index locations can then be used to form a composite syllable.

There is no restriction to only use the modern Hangul letters.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.

Parameters

in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_index	Index location to the 1st letter variation from the hangul-base.hex file.
out	jung_index	Index location to the 2nd letter variation from the hangul-base.hex file.
out	jong_index	Index location to the 3rd letter variation from the hangul-base.hex file.

Definition at line 249 of file [unihangul-support.c](#).

```

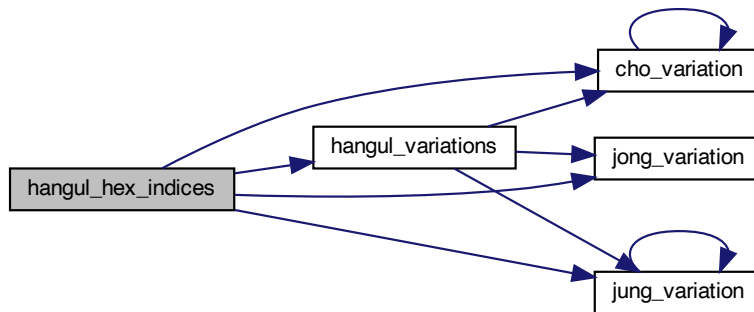
00250     {
00251
00252     int cho_variation, jung_variation, jong_variation; /* Letter variations */
00253
00254     void hangul_variations (int choseong, int jungseong, int jongseong,
```

```

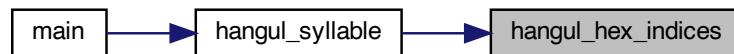
00255         int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257
00258     hangul_variations (choseong, jungseong, jongseong,
00259                       &cho_variation, &jung_variation, &jong_variation);
00260
00261     *cho_index = CHO_HEX + choseong * CHO_VARIATIONS + cho_variation;
00262     *jung_index = JUNG_HEX + jungseong * JUNG_VARIATIONS + jung_variation;;
00263     *jong_index = jongseong < 0 ? 0x0000 :
00264                     JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266     return;
00267 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.8 hangul_read_base16()

```

unsigned hangul_read_base16 (
    FILE * infp,
    unsigned base[][16] )

```

Read hangul-base.hex file into a unsigned array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).

- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 16 16-bit values per letter.

Returns

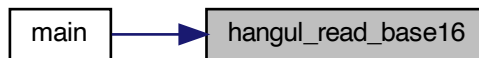
The maximum code point value read in the file.

Definition at line 116 of file [unihangul-support.c](#).

```

00116                                     {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int     i, j;
00120     char    instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126         sscanf (instring, "%X", &codept);
00127         codept -= PUA_START;
00128         /* If code point is within range, add it */
00129         if (codept < MAX_GLYPHS) {
00130             /* Find the start of the glyph bitmap. */
00131             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132             if (instring[i] == ':') {
00133                 i++; /* Skip over ':' to get to start of bitmap. */
00134                 for (j = 0; j < 16; j++) {
00135                     sscanf (&instring[i], "%4X", &base[codept][j]);
00136                     i += 4;
00137                 }
00138                 if (codept > max_codept) max_codept = codept;
00139             }
00140         }
00141     }
00142
00143     return max_codept;
00144 }
```

Here is the caller graph for this function:



5.1.3.9 hangul_read_base8()

```

unsigned hangul_read_base8 (
    FILE * infp,
    unsigned char base[][32] )
  
```

Read hangul-base.hex file into a unsigned char array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 32 8-bit values per letter.

Returns

The maximum code point value read in the file.

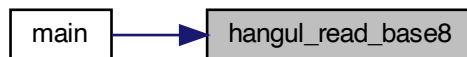
Definition at line 63 of file [unihangul-support.c](#).

```

00063                                     {
00064     unsigned codept;
00065     unsigned max_codept;
00066     int     i, j;
00067     char    instring[MAXLINE];
00068
00069
00070     max_codept = 0;
00071
00072     while (fgets (instring, MAXLINE, infp) != NULL) {
00073         sscanf (instring, "%X", &codept);
00074         codept -= PUA_START;
00075         /* If code point is within range, add it */
00076         if (codept < MAX_GLYPHS) {
00077             /* Find the start of the glyph bitmap. */
00078             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079             if (instring[i] == ':') {
00080                 i++; /* Skip over ':' to get to start of bitmap. */
00081                 for (j = 0; j < 32; j++) {
00082                     sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083                     i += 2;
00084                 }
00085                 if (codept > max_codept) max_codept = codept;
00086             }
00087         }
00088     }
00089     return max_codept;
00091 }

```

Here is the caller graph for this function:



5.1.3.10 hangul_syllable()

```

void hangul_syllable (
    int choseong,
    int jungseong,
    int jongseong,
    unsigned char hangul_base[][32],
    unsigned char * syllable )

```

Given letters in a Hangul syllable, return a glyph.

This function returns a glyph bitmap comprising up to three Hangul letters that form a syllable. It reads the three component letters (choseong, jungseong, and jongseong), then calls a function that determines the appropriate variation of each letter, returning the letter bitmap locations in the glyph array. Then these letter bitmaps are combined with a logical OR operation to produce a final bitmap, which forms a 16 row by 16 column bitmap glyph.

Parameters

in	choseong	The 1st letter in the composite glyph.
in	jungseong	The 2nd letter in the composite glyph.
in	jongseong	The 3rd letter in the composite glyph.
in	hangul_base	The glyphs read from the "hangul_base.hex" file.

Returns

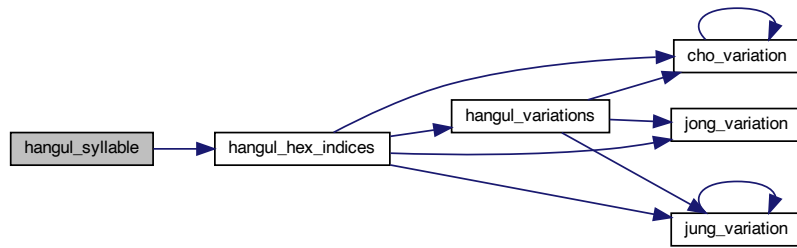
syllable The composite syllable, as a 16 by 16 pixel bitmap.

Definition at line 583 of file [unihangul-support.c](#).

```

00584                                     {
00585
00586     int    i; /* loop variable */
00587     int    cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                         &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595         glyph_byte = hangul_base [cho_hex][i];
00596         glyph_byte |= hangul_base [jung_hex][i];
00597         if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598         syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.11 hangul_variations()

```

void hangul_variations (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_var,
    int * jung_var,
    int * jong_var )
  
```

Determine the variations of each letter in a Hangul syllable.

Given the three letters that will form a syllable, return the variation of each letter used to form the composite glyph.

This function can determine variations for both modern and archaic Hangul letters; it is not limited to only the letters combinations that comprise the Unicode Hangul Syllables range.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_var	Variation of the 1st letter from the hangul-base.hex file.
out	jung_var	Variation of the 2nd letter from the hangul-base.hex file.
out	jong_var	Variation of the 3rd letter from the hangul-base.hex file.

Definition at line 298 of file [unihangul-support.c](#).

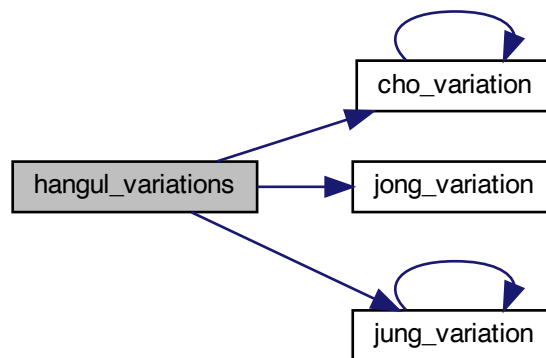
```
00299     {
00300
00301     int cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);
```

```

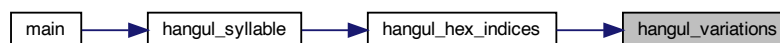
00303 int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305 /*
00306 Find the variation for each letter component.
00307 */
00308 *cho_var = cho_variation (choseong, jungseong, jongseong);
00309 *jung_var = jung_variation (choseong, jungseong, jongseong);
00310 *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313 return;
00314 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.12 is__wide__vowel()

```

int is__wide__vowel (
    int vowel )

```

Whether vowel has rightmost vertical stroke to the right.

Parameters

in	vowel	Vowel num- ber, from 0 to TOTAL_JUNG - 1.
----	-------	---

Returns

1 if this vowel's vertical stroke is wide on the right side; else 0.

Definition at line 434 of file [unihangul-support.c](#).

```

00434     {
00435     int retval; /* Return value. */
00436
00437     static int wide_vowel [TOTAL_JUNG + 1] = {
00438     /*
00439     Modern Jungseong in positions 0..20.
00440     */
00441     /* Location Variations Unicode Range Vowel # Vowel Names */
00442     /* ----- */
00443     /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00444     /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00445     /* 0x30D */ 0, 1, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00446     /* 0x313 */ 0, // U+1169 -->[ 8] O
00447     /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00448     /* 0x31F */ 0, 0, // U+116D..U+116E-->[12..13] YO, U
00449     /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16] WEO, WE, WI
00450     /* 0x32E */ 0, 0, // U+1172..U+1173-->[17..18] YU, EU
00451     /* 0x334 */ 0, // U+1174 -->[19] YI
00452     /* 0x337 */ 0, // U+1175 -->[20] I
00453     /*
00454     Ancient Jungseong in positions 21..70.
00455     */
00456     /* Location Variations Unicode Range Vowel # Vowel Names */
00457     /* ----- */
00458     /* 0x33A */ 0, 0, 0, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00459     /* 0x343 */ 0, 0, 0, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00460     /* 0x34C */ 0, 0, 0, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00461     /* 0x355 */ 0, 1, 1, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00462     /* 0x35E */ 0, 0, 0, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00463     /* 0x367 */ 1, 0, 0, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00464     /* 0x370 */ 0, 0, 1, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00465     /* 0x379 */ 0, 1, 0, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00466     /* 0x382 */ 0, 0, 1, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00467     /* 0x38B */ 0, 1, 0, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00468     /* 0x394 */ 0, 0, 0, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00469     /* 0x39D */ 0, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00470     /* 0x3A6 */ 0, 0, 0, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00471     /* 0x3AF */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAE, ARAEA, ARAEA-EO,
00472     /* 0x3B8 */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAE,
00473     /* 0x3C1 */ 0, 0, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00474     /* 0x3CA */ 0, 1, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE
00475     #ifdef EXTENDED_HANGUL
00476     /* 0x3D0 */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00477     /* 0x3D9 */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00478     /* 0x3E2 */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00479     /* 0x3EB */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00480     /* 0x3F4 */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00481     /* 0x3FD */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00482     /* 0x406 */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00483     /* 0x40F */ 0, 1, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484     /* 0x415 */ 0, -1 // Mark end of list of vowels.
00485     #else
00486     /* 0x310 */ 0, -1 // Mark end of list of vowels.
00487     #endif
00488     };
00489
00490
00491     if (vowel >= 0 && vowel < TOTAL_JUNG) {

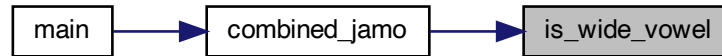
```

```

00492     retval = wide_vowel [vowel];
00493 }
00494 else {
00495     retval = 0;
00496 }
00497
00498
00499 return retval;
00500 }

```

Here is the caller graph for this function:



5.1.3.13 jong_variation()

```

int jong_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]

```

Return the Johab 6/3/1 jongseong variation.

There is only one jongseong variation, so this function always returns 0. It is a placeholder function for possible future adaptation to other johab encodings.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

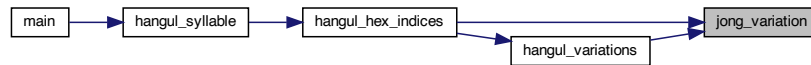
Returns

The jongseong variation, always 0.

Definition at line 558 of file [unihangul-support.c](#).

```
00558     {
00559
00560     return 0; /* There is only one Jongseong variation. */
00561 }
```

Here is the caller graph for this function:



5.1.3.14 jung_variation()

```
int jung_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]
```

Return the Johab 6/3/1 jungseong variation.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the vowel (jungseong).

Each jungseong has 3 variations:

Variation Occurrence

0 Jungseong with only chungseong (no jungseong). 1 Jungseong with chungseong and jungseong (except nieun). 2 Jungseong with chungseong and jungseong nieun.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

The jungseong variation, 0 to 2.

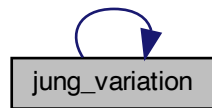
Definition at line 524 of file [unihangul-support.c](#).

```

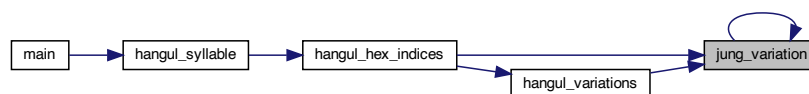
00524     {
00525     int jung_variation; /* Return value */
00526
00527     if (jungseong < 0) {
00528         jung_variation = -1;
00529     }
00530     else {
00531         jung_variation = 0;
00532         if (jongseong >= 0) {
00533             if (jongseong == 3)
00534                 jung_variation = 2; /* Vowel for final Nieun. */
00535             else
00536                 jung_variation = 1;
00537         }
00538     }
00539
00540
00541     return jung_variation;
00542 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.15 one_jamo()

```

void one_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned jamo,
    unsigned * jamo_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	jamo	The Unicode code point, 0 or 0x1100..0x115F.
out	jamo_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 717 of file [unihangul-support.c](#).

```

00718     {
00719
00720     int i; /* Loop variable */
00721     int glyph_index; /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {
00726         glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729         glyph_index = jamo - 0xA960 + JAMO_EXT_A_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732         glyph_index = jamo - 0x1100 + JAMO_EXT_B_HEX;
00733     }
00734     else {
00735         glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739         jamo_glyph[i] = glyph_table[glyph_index][i];
00740     }
00741
00742     return;
00743 }

```

5.1.3.16 print_glyph_hex()

```

void print_glyph_hex (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )

```

Print one glyph in Unifont hexdraw hexadecimal string style.

Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 692 of file [unihangul-support.c](#).

```

00692                                     {
00693
00694     int i;
00695
00696     fprintf (fp, "%04X:", codept);
00697
00698     /* for each this_glyph row */
00699     for (i = 0; i < 16; i++) {
00700         fprintf (fp, "%04X", this_glyph[i]);
00701     }
00702     fputc ('\n', fp);
00703
00704     return;
00705 }
00706

```

Here is the caller graph for this function:



5.1.3.17 print_glyph_txt()

```
void print_glyph_txt (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw plain text style.

Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 656 of file [unihangul-support.c](#).

```
00656                                     {
00657     int i;
00658     unsigned mask;
00659
00660     fprintf (fp, "%04X:", codept);
00661
00662     /* for each this_glyph row */
00663     for (i = 0; i < 16; i++) {
00664         mask = 0x8000;
00665         fputc ('\t', fp);
00666         while (mask != 0x0000) {
00667             if (mask & this_glyph[i]) {
00668                 fputc ('#', fp);
00669             }
00670             else {
00671                 fputc ('.', fp);
00672             }
00673             mask »= 1; /* shift to next bit in this_glyph row */
00674         }
00675         fputc ('\n', fp);
00676     }
00677     fputc ('\n', fp);
00678
00679     return;
00680 }
00681 }
```

5.2 hangul.h

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file hangul.h
00003
00004 @brief Define constants and function prototypes for using Hangul glyphs.
00005
00006 @author Paul Hardy
00007
00008 @copyright Copyright © 2023 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program. If not, see <http://www.gnu.org/licenses/>.
00025 */
00026
00027 #ifndef _HANGUL_H_
00028 #define _HANGUL_H_
00029
00030 #include <stdlib.h>
00031
00032
00033 #define MAXLINE 256 ///< Length of maximum file input line.
00034
00035 #define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */
00036
00037 /* Definitions to move Hangul .hex file contents into the Private Use Area. */
00038 #define PUA_START 0xE000
00039 #define PUA_END 0xE8FF
00040 #define MAX_GLYPHS (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
00041
00042 /*
00043 Unicode ranges for Hangul choseong, jungseong, and jongseong.
00044
00045 U+1100..U+11FF is the main range of modern and ancient Hangul jamo.
00046 U+A960..U+A97C is the range for extended Hangul choseong.
00047 U+D7B0..U+D7C6 is the range for extended Hangul jungseong.
00048 U+D7CB..U+D7FB is the range for extended Hangul jongseong.
00049 */
00050 #define CHO_UNICODE_START 0x1100 ///< Modern Hangul choseong start
00051 #define CHO_UNICODE_END 0x115E ///< Hangul Jamo choseong end
00052 #define CHO_EXT_A_UNICODE_START 0xA960 ///< Hangul Extended-A choseong start
00053 #define CHO_EXT_A_UNICODE_END 0xA97C ///< Hangul Extended-A choseong end
00054
00055 #define JUNG_UNICODE_START 0x1161 ///< Modern Hangul jungseong start
00056 #define JUNG_UNICODE_END 0x11A7 ///< Modern Hangul jungseong end
00057 #define JUNG_EXT_B_UNICODE_START 0xD7B0 ///< Hangul Extended-B jungseong start
00058 #define JUNG_EXT_B_UNICODE_END 0xD7C6 ///< Hangul Extended-B jungseong end
00059
00060 #define JONG_UNICODE_START 0x11A8 ///< Modern Hangul jongseong start
00061 #define JONG_UNICODE_END 0x11FF ///< Modern Hangul jongseong end
00062 #define JONG_EXT_B_UNICODE_START 0xD7CB ///< Hangul Extended-B jongseong start
00063 #define JONG_EXT_B_UNICODE_END 0xD7FB ///< Hangul Extended-B jongseong end
00064
00065 /*
00066 Number of modern and ancient letters in hangul-base.hex file.
00067 */
00068 #define NCHO_MODERN 19 ///< 19 modern Hangul Jamo choseong
00069 #define NCHO_ANCIENT 76 ///< ancient Hangul Jamo choseong
00070 #define NCHO_EXT_A 29 ///< Hangul Extended-A choseong
00071 #define NCHO_EXT_A_RSVD 3 ///< Reserved at end of Extended-A choseong
00072
00073 #define NJUNG_MODERN 21 ///< 21 modern Hangul Jamo jungseong
00074 #define NJUNG_ANCIENT 50 ///< ancient Hangul Jamo jungseong
00075 #define NJUNG_EXT_B 23 ///< Hangul Extended-B jungseong
00076 #define NJUNG_EXT_B_RSVD 4 ///< Reserved at end of Extended-B junseong

```

```

00078
00079 #define NJONG_MODERN    27 ///< 28 modern Hangul Jamo jongseong
00080 #define NJONG_ANCIENT   61 ///< ancient Hangul Jamo jongseong
00081 #define NJONG_EXTB      49 ///< Hangul Extended-B jongseong
00082 #define NJONG_EXTB_RSRVD 4 ///< Reserved at end of Extended-B jongseong
00083
00084
00085 /*
00086 Number of variations of each component in a Johab 6/3/1 arrangement.
00087 */
00088 #define CHO_VARIATIONS  6 ///< 6 choseong variations
00089 #define JUNG_VARIATIONS 3 ///< 3 jungseong variations
00090 #define JONG_VARIATIONS 1 ///< 1 jongseong variation
00091
00092 /*
00093 Starting positions in the hangul-base.hex file for each component.
00094 */
00095 ///< Location of first choseong (location 0x0000 is a blank glyph)
00096 #define CHO_HEX          0x0001
00097
00098 ///< Location of first ancient choseong
00099 #define CHO_ANCIENT_HEX (CHO_HEX          + CHO_VARIATIONS * NCHO_MODERN)
00100
00101 ///< U+A960 Extended-A choseong
00102 #define CHO_EXTB_HEX    (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)
00103
00104 ///< U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end
00105 #define CHO_LAST_HEX    (CHO_EXTB_HEX    + CHO_VARIATIONS * (NCHO_EXTB + NCHO_EXTB_RSRVD) - 1)
00106
00107 ///< Location of first jungseong (will be 0x2FB)
00108 #define JUNG_HEX        (CHO_LAST_HEX + 1)
00109
00110 ///< Location of first ancient jungseong
00111 #define JUNG_ANCIENT_HEX (JUNG_HEX        + JUNG_VARIATIONS * NJUNG_MODERN)
00112
00113 ///< U+D7B0 Extended-B jungseong
00114 #define JUNG_EXTB_HEX    (JUNG_ANCIENT_HEX + JUNG_VARIATIONS * NJUNG_ANCIENT)
00115
00116 ///< U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end
00117 #define JUNG_LAST_HEX    (JUNG_EXTB_HEX    + JUNG_VARIATIONS * (NJUNG_EXTB + NJUNG_EXTB_RSRVD) - 1)
00118
00119 ///< Location of first jongseong (will be 0x421)
00120 #define JONG_HEX        (JUNG_LAST_HEX + 1)
00121
00122 ///< Location of first ancient jongseong
00123 #define JONG_ANCIENT_HEX (JONG_HEX        + JONG_VARIATIONS * NJONG_MODERN)
00124
00125 ///< U+D7CB Extended-B jongseong
00126 #define JONG_EXTB_HEX    (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)
00127
00128 ///< U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end
00129 #define JONG_LAST_HEX    (JONG_EXTB_HEX    + JONG_VARIATIONS * (NJONG_EXTB + NJONG_EXTB_RSRVD) - 1)
00130
00131 /* Common modern and ancient Hangul Jamo range */
00132 #define JAMO_HEX          0x0500 ///< Start of U+1100..U+11FF glyphs
00133 #define JAMO_END          0x05FF ///< End   of U+1100..U+11FF glyphs
00134
00135 /* Hangul Jamo Extended-A range */
00136 #define JAMO_EXTB_HEX     0x0600 ///< Start of U+A960..U+A97F glyphs
00137 #define JAMO_EXTB_END     0x061F ///< End   of U+A960..U+A97F glyphs
00138
00139 /* Hangul Jamo Extended-B range */
00140 #define JAMO_EXTB_HEX     0x0620 ///< Start of U+D7B0..U+D7FF glyphs
00141 #define JAMO_EXTB_END     0x066F ///< End   of U+D7B0..U+D7FF glyphs
00142
00143 /*
00144 These values allow enumeration of all modern and ancient letters.
00145
00146 If RARE_HANGUL is defined, include Hangul code points above U+11FF.
00147 */
00148 #ifdef EXTENDED_HANGUL
00149
00150 #define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXTB )
00151 #define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)
00152 #define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)
00153
00154 #else
00155
00156 #define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT )

```

```

00157 #define TOTAL_JUNG    (NJUNG_MODERN + NJUNG_ANCIENT)
00158 #define TOTAL_JONG    (NJONG_MODERN + NJONG_ANCIENT)
00159
00160 #endif
00161
00162 /*
00163 Function Prototypes.
00164 */
00165
00166 unsigned hangul_read_base8 (FILE *infp, unsigned char base[][32]);
00167 unsigned hangul_read_base16 (FILE *infp, unsigned base[][16]);
00168
00169 void hangul_decompose (unsigned codept,
00170                      int *initial, int *medial, int *final);
00171 unsigned hangul_compose (int initial, int medial, int final);
00172
00173 void hangul_hex_indices (int choseong, int jungseong, int jongseong,
00174                         int *cho_index, int *jung_index, int *jong_index);
00175 void hangul_variations (int choseong, int jungseong, int jongseong,
00176                       int *cho_var, int *jung_var, int *jong_var);
00177 int is_wide_vowel (int vowel);
00178 int cho_variation (int choseong, int jungseong, int jongseong);
00179 int jung_variation (int choseong, int jungseong, int jongseong);
00180 int jong_variation (int choseong, int jungseong, int jongseong);
00181
00182 void hangul_syllable (int choseong, int jungseong, int jongseong,
00183                    unsigned char hangul_base[][32], unsigned char *syllable);
00184 int glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00185 void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00186                   unsigned *combined_glyph);
00187 void one_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00188             unsigned jamo, unsigned *jamo_glyph);
00189 void combined_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00190                  unsigned cho, unsigned jung, unsigned jong,
00191                  unsigned *combined_glyph);
00192 void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00193 void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00194
00195
00196
00197 #endif

```

5.3 src/hex2otf.c File Reference

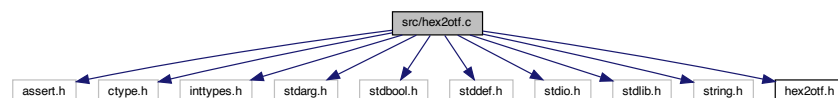
hex2otf - Convert GNU Unifont .hex file to OpenType font

```

#include <assert.h>
#include <ctype.h>
#include <inttypes.h>
#include <stdarg.h>
#include <stdbool.h>
#include <stddef.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hex2otf.h"

```

Include dependency graph for hex2otf.c:



Data Structures

- struct [Buffer](#)
Generic data structure for a linked list of buffer elements.
- struct [Glyph](#)
Data structure to hold data for one bitmap glyph.
- struct [Font](#)
Data structure to hold information for one font.
- struct [Table](#)
Data structure for an OpenType table.
- struct [TableRecord](#)
Data structure for data associated with one OpenType table.
- struct [Options](#)
Data structure to hold options for OpenType font output.

Macros

- `#define VERSION "1.0.1"`
Program version, for "--version" option.
- `#define U16MAX 0xffff`
Maximum UTF-16 code point value.
- `#define U32MAX 0xffffffff`
Maximum UTF-32 code point value.
- `#define PRI_CP "U+%.4"PRIxF32`
Format string to print Unicode code point.
- `#define static_assert(a, b) (assert(a))`
If "a" is true, return string "b".
- `#define BX(shift, x) ((uintmax_t)(!!(x)) << (shift))`
Truncate & shift word.
- `#define B0(shift) BX((shift), 0)`
Clear a given bit in a word.
- `#define B1(shift) BX((shift), 1)`
Set a given bit in a word.
- `#define GLYPH_MAX_WIDTH 16`
Maximum glyph width, in pixels.
- `#define GLYPH_HEIGHT 16`
Maximum glyph height, in pixels.
- `#define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)`
Number of bytes to represent one bitmap glyph as a binary array.
- `#define DESCENDER 2`
Count of pixels below baseline.
- `#define ASCENDER (GLYPH_HEIGHT - DESCENDER)`
Count of pixels above baseline.
- `#define FUPEM 64`
[Font](#) units per em.
- `#define MAX_GLYPHS 65536`
An OpenType font has at most 65536 glyphs.
- `#define MAX_NAME_IDS 256`

- Name IDs 0-255 are used for standard names.
- `#define FU(x) ((x) * FUPEM / GLYPH_HEIGHT)`
Convert pixels to font units.
- `#define PW(x) ((x) / (GLYPH_HEIGHT / 8))`
Convert glyph byte count to pixel width.
- `#define defineStore(name, type)`
Temporary define to look up an element in an array of given type.
- `#define addByte(shift)`
- `#define getRowBit(rows, x, y) ((rows)[(y)] & x0 >> (x))`
- `#define flipRowBit(rows, x, y) ((rows)[(y)] ^= x0 >> (x))`
- `#define stringCount (sizeof strings / sizeof *strings)`
- `#define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))`

Typedefs

- `typedef unsigned char byte`
Definition of "byte" type as an unsigned char.
- `typedef int_least8_t pixels_t`
This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).
- `typedef struct Buffer Buffer`
Generic data structure for a linked list of buffer elements.
- `typedef const char * NameStrings[MAX_NAME_IDS]`
Array of OpenType names indexed directly by Name IDs.
- `typedef struct Glyph Glyph`
Data structure to hold data for one bitmap glyph.
- `typedef struct Font Font`
Data structure to hold information for one font.
- `typedef struct Table Table`
Data structure for an OpenType table.
- `typedef struct Options Options`
Data structure to hold options for OpenType font output.

Enumerations

- `enum LocaFormat { LOCA_OFFSET16 = 0 , LOCA_OFFSET32 = 1 }`
Index to Location ("loca") offset information.
- `enum ContourOp { OP_CLOSE , OP_POINT }`
Specify the current contour drawing operation.
- `enum FillSide { FILL_LEFT , FILL_RIGHT }`
Fill to the left side (CFF) or right side (TrueType) of a contour.

Functions

- `void fail (const char *reason,...)`
Print an error message on stderr, then exit.
- `void initBuffers (size_t count)`
Initialize an array of buffer pointers to all zeroes.
- `void cleanBuffers ()`
Free all allocated buffer pointers.

- `Buffer * newBuffer (size_t initialCapacity)`
Create a new buffer.
- `void ensureBuffer (Buffer *buf, size_t needed)`
Ensure that the buffer has at least the specified minimum size.
- `void freeBuffer (Buffer *buf)`
Free the memory previously allocated for a buffer.
- `defineStore (storeU8, uint_least8_t)`
- `void cacheU8 (Buffer *buf, uint_fast8_t value)`
Append one unsigned byte to the end of a byte array.
- `void cacheU16 (Buffer *buf, uint_fast16_t value)`
Append two unsigned bytes to the end of a byte array.
- `void cacheU32 (Buffer *buf, uint_fast32_t value)`
Append four unsigned bytes to the end of a byte array.
- `void cacheCFFOperand (Buffer *buf, int_fast32_t value)`
Cache charstring number encoding in a CFF buffer.
- `void cacheZeros (Buffer *buf, size_t count)`
Append 1 to 4 bytes of zeroes to a buffer, for padding.
- `void cacheBytes (Buffer *restrict buf, const void *restrict src, size_t count)`
Append a string of bytes to a buffer.
- `void cacheBuffer (Buffer *restrict bufDest, const Buffer *restrict bufSrc)`
Append bytes of a table to a byte buffer.
- `void writeBytes (const byte bytes[], size_t count, FILE *file)`
Write an array of bytes to an output file.
- `void writeU16 (uint_fast16_t value, FILE *file)`
Write an unsigned 16-bit value to an output file.
- `void writeU32 (uint_fast32_t value, FILE *file)`
Write an unsigned 32-bit value to an output file.
- `void addTable (Font *font, const char tag[static 4], Buffer *content)`
Add a TrueType or OpenType table to the font.
- `void organizeTables (Font *font, bool isCFF)`
Sort tables according to OpenType recommendations.
- `int byTableTag (const void *a, const void *b)`
Compare tables by 4-byte unsigned table tag value.
- `void writeFont (Font *font, bool isCFF, const char *fileName)`
Write OpenType font to output file.
- `bool readCodePoint (uint_fast32_t *codePoint, const char *fileName, FILE *file)`
Read up to 6 hexadecimal digits and a colon from file.
- `void readGlyphs (Font *font, const char *fileName)`
Read glyph definitions from a Unifont .hex format file.
- `int byCodePoint (const void *a, const void *b)`
Compare two Unicode code points to determine which is greater.
- `void positionGlyphs (Font *font, const char *fileName, pixels_t *xMin)`
Position a glyph within a 16-by-16 pixel bounding box.
- `void sortGlyphs (Font *font)`
Sort the glyphs in a font by Unicode code point.
- `void buildOutline (Buffer *result, const byte bitmap[], const size_t byteCount, const enum FillSide fillSide)`

- Build a glyph outline.
- void [prepareOffsets](#) (size_t *sizes)
 - Prepare 32-bit glyph offsets in a font table.
- Buffer * [prepareStringIndex](#) (const NameStrings names)
 - Prepare a font name string index.
- void [fillCFF](#) (Font *font, int version, const NameStrings names)
 - Add a CFF table to a font.
- void [fillTrueType](#) (Font *font, enum LocaFormat *format, uint_fast16_t *maxPoints, uint_fast16_t *maxContours)
 - Add a TrueType table to a font.
- void [fillBlankOutline](#) (Font *font)
 - Create a dummy blank outline in a font table.
- void [fillBitmap](#) (Font *font)
 - Fill OpenType bitmap data and location tables.
- void [fillHeadTable](#) (Font *font, enum LocaFormat locaFormat, pixels_t xMin)
 - Fill a "head" font table.
- void [fillHheaTable](#) (Font *font, pixels_t xMin)
 - Fill a "hhea" font table.
- void [fillMaxpTable](#) (Font *font, bool isCFF, uint_fast16_t maxPoints, uint_fast16_t maxContours)
 - Fill a "maxp" font table.
- void [fillOS2Table](#) (Font *font)
 - Fill an "OS/2" font table.
- void [fillHmtxTable](#) (Font *font)
 - Fill an "hmtx" font table.
- void [fillCmapTable](#) (Font *font)
 - Fill a "cmap" font table.
- void [fillPostTable](#) (Font *font)
 - Fill a "post" font table.
- void [fillGposTable](#) (Font *font)
 - Fill a "GPOS" font table.
- void [fillGsubTable](#) (Font *font)
 - Fill a "GSUB" font table.
- void [cacheStringAsUTF16BE](#) (Buffer *buf, const char *str)
 - Cache a string as a big-ending UTF-16 surrogate pair.
- void [fillNameTable](#) (Font *font, NameStrings nameStrings)
 - Fill a "name" font table.
- void [printVersion](#) ()
 - Print program version string on stdout.
- void [printHelp](#) ()
 - Print help message to stdout and then exit.
- const char * [matchToken](#) (const char *operand, const char *key, char delimiter)
 - Match a command line option with its key for enabling.
- Options [parseOptions](#) (char *const argv[const])
 - Parse command line options.
- int [main](#) (int argc, char *argv[])
 - The main function.

Variables

- [Buffer * allBuffers](#)
Initial allocation of empty array of buffer pointers.
- `size_t` [bufferCount](#)
Number of buffers in a [Buffer *](#) array.
- `size_t` [nextBufferIndex](#)
Index number to tail element of [Buffer *](#) array.

5.3.1 Detailed Description

hex2otf - Convert GNU Unifont .hex file to OpenType font

This program reads a Unifont .hex format file and a file containing combining mark offset information, and produces an OpenType font file.

Copyright

Copyright © 2022 何志翔 (He Zhixiang)

Author

何志翔 (He Zhixiang)

Definition in file [hex2otf.c](#).

5.3.2 Macro Definition Documentation

5.3.2.1 addByte

```
#define addByte(  
                shift )
```

Value:

```
if (p == end) \
    break; \
record->checksum += (uint_fast32_t)*p++ « (shift);
```

5.3.2.2 ASCENDER

```
#define ASCENDER (GLYPH\_HEIGHT - DESCENDER)
```

Count of pixels above baseline.

Definition at line 79 of file [hex2otf.c](#).

5.3.2.3 B0

```
#define B0(  
        shift ) BX((shift), 0)
```

Clear a given bit in a word.

Definition at line 66 of file [hex2otf.c](#).

5.3.2.4 B1

```
#define B1(
    shift ) BX((shift), 1)
```

Set a given bit in a word.

Definition at line 67 of file [hex2otf.c](#).

5.3.2.5 BX

```
#define BX(
    shift,
    x ) ((uintmax_t)(!(x)) << (shift))
```

Truncate & shift word.

Definition at line 65 of file [hex2otf.c](#).

5.3.2.6 defineStore

```
#define defineStore(
    name,
    type )
```

Value:

```
void name (Buffer *buf, type value) \
{ \
    type *slot = getBufferSlot (buf, sizeof value); \
    *slot = value; \
}
```

Temporary define to look up an element in an array of given type.

This definition is used to create lookup functions to return a given element in unsigned arrays of size 8, 16, and 32 bytes, and in an array of pixels.

Definition at line 350 of file [hex2otf.c](#).

5.3.2.7 DESCENDER

```
#define DESCENDER 2
```

Count of pixels below baseline.

Definition at line 76 of file [hex2otf.c](#).

5.3.2.8 FU

```
#define FU(
    x ) ((x) * FUPEM / GLYPH_HEIGHT)
```

Convert pixels to font units.

Definition at line 91 of file [hex2otf.c](#).

5.3.2.9 FUPEM

```
#define FUPEM 64
```

Font units per em.

Definition at line 82 of file [hex2otf.c](#).

5.3.2.10 GLYPH_HEIGHT

```
#define GLYPH_HEIGHT 16
```

Maximum glyph height, in pixels.
Definition at line 70 of file [hex2otf.c](#).

5.3.2.11 GLYPH_MAX_BYTE_COUNT

```
#define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)
```

Number of bytes to represent one bitmap glyph as a binary array.
Definition at line 73 of file [hex2otf.c](#).

5.3.2.12 GLYPH_MAX_WIDTH

```
#define GLYPH_MAX_WIDTH 16
```

Maximum glyph width, in pixels.
Definition at line 69 of file [hex2otf.c](#).

5.3.2.13 MAX_GLYPHS

```
#define MAX_GLYPHS 65536
```

An OpenType font has at most 65536 glyphs.
Definition at line 85 of file [hex2otf.c](#).

5.3.2.14 MAX_NAME_IDS

```
#define MAX_NAME_IDS 256
```

Name IDs 0-255 are used for standard names.
Definition at line 88 of file [hex2otf.c](#).

5.3.2.15 PRI_CP

```
#define PRI_CP "U+%.4"PRIFAST32
```

Format string to print Unicode code point.
Definition at line 58 of file [hex2otf.c](#).

5.3.2.16 PW

```
#define PW(  
    x ) ((x) / (GLYPH_HEIGHT / 8))
```

Convert glyph byte count to pixel width.
Definition at line 94 of file [hex2otf.c](#).

5.3.2.17 static_assert

```
#define static_assert(  
    a,  
    b ) (assert(a))
```

If "a" is true, return string "b".
Definition at line 61 of file [hex2otf.c](#).

5.3.2.18 U16MAX

`#define U16MAX 0xffff`

Maximum UTF-16 code point value.

Definition at line 55 of file [hex2otf.c](#).

5.3.2.19 U32MAX

`#define U32MAX 0xffffffff`

Maximum UTF-32 code point value.

Definition at line 56 of file [hex2otf.c](#).

5.3.2.20 VERSION

`#define VERSION "1.0.1"`

Program version, for "--version" option.

Definition at line 51 of file [hex2otf.c](#).

5.3.3 Typedef Documentation

5.3.3.1 Buffer

`typedef struct Buffer Buffer`

Generic data structure for a linked list of buffer elements.

A buffer can act as a vector (when filled with 'store*' functions), or a temporary output area (when filled with 'cache*' functions). The 'store*' functions use native endian. The 'cache*' functions use big endian or other formats in OpenType. Beware of memory alignment.

5.3.3.2 byte

`typedef unsigned char byte`

Definition of "byte" type as an unsigned char.

Definition at line 97 of file [hex2otf.c](#).

5.3.3.3 Glyph

`typedef struct Glyph Glyph`

Data structure to hold data for one bitmap glyph.

This data structure holds data to represent one Unifont bitmap glyph: Unicode code point, number of bytes in its bitmap array, whether or not it is a combining character, and an offset from the glyph origin to the start of the bitmap.

5.3.3.4 NameStrings

`typedef const char* NameStrings[MAX_NAME_IDS]`

Array of OpenType names indexed directly by Name IDs.

Definition at line 604 of file [hex2otf.c](#).

5.3.3.5 Options

typedef struct [Options](#) [Options](#)

Data structure to hold options for OpenType font output.

This data structure holds the status of options that can be specified as command line arguments for creating the output OpenType font file.

5.3.3.6 pixels_t

typedef int_least8_t [pixels_t](#)

This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).

Definition at line 100 of file [hex2otf.c](#).

5.3.3.7 Table

typedef struct [Table](#) [Table](#)

Data structure for an OpenType table.

This data structure contains a table tag and a pointer to the start of the buffer that holds data for this OpenType table.

For information on the OpenType tables and their structure, see <https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables>.

5.3.4 Enumeration Type Documentation

5.3.4.1 ContourOp

enum [ContourOp](#)

Specify the current contour drawing operation.

Enumerator

OP_CLOSE	Close the current contour path that was being drawn.
OP_POINT	Add one more (x,y) point to the contour being drawn.

Definition at line 1136 of file [hex2otf.c](#).

```
01136 {
01137     OP_CLOSE,    ///< Close the current contour path that was being drawn.
01138     OP_POINT     ///< Add one more (x,y) point to the contour being drawn.
01139 };
```

5.3.4.2 FillSide

enum [FillSide](#)

Fill to the left side (CFF) or right side (TrueType) of a contour.

Enumerator

FILL_LEFT	Draw out-line counter-clockwise (CFF, PostScript).
FILL_RIGHT	Draw out-line clockwise (TrueType).

Definition at line 1144 of file [hex2otf.c](#).

```
01144 {
01145     FILL_LEFT,    ///< Draw outline counter-clockwise (CFF, PostScript).
01146     FILL_RIGHT    ///< Draw outline clockwise (TrueType).
01147 };
```

5.3.4.3 LocaFormat

enum [LocaFormat](#)

Index to Location ("loca") offset information.

This enumerated type encodes the type of offset to locations in a table. It denotes Offset16 (16-bit) and Offset32 (32-bit) offset types.

Enumerator

LOCA_OFFSET16	Offset to location is a 16-bit Offset16 value.
---------------	--

Enumerator

LOCA_OFFSET32	Offset to location is a 32-bit Offset32 value.
---------------	--

Definition at line 658 of file [hex2otf.c](#).

```
00658     {
00659         LOCA_OFFSET16 = 0,    ///< Offset to location is a 16-bit Offset16 value
00660         LOCA_OFFSET32 = 1,    ///< Offset to location is a 32-bit Offset32 value
00661     };
```

5.3.5 Function Documentation

5.3.5.1 addTable()

```
void addTable (
    Font * font,
    const char tag[static 4],
    Buffer * content )
```

Add a TrueType or OpenType table to the font.

This function adds a TrueType or OpenType table to a font. The 4-byte table tag is passed as an unsigned 32-bit integer in big-endian format.

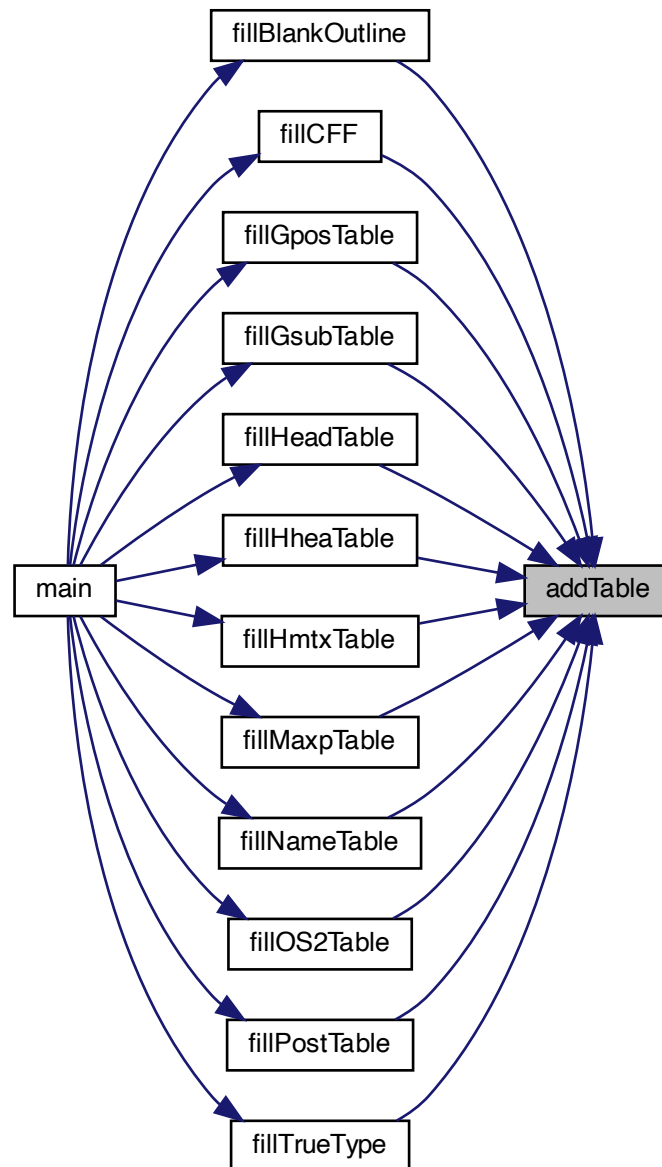
Parameters

in,out	font	The font to which a font table will be added.
in	tag	The 4-byte table name.
in	content	The table bytes to add, of type Buffer *.

Definition at line 694 of file [hex2otf.c](#).

```
00695 {  
00696     Table *table = getBufferSlot (font->tables, sizeof (Table));  
00697     table->tag = tagAsU32 (tag);  
00698     table->content = content;  
00699 }
```

Here is the caller graph for this function:



5.3.5.2 buildOutline()

```
void buildOutline (
    Buffer * result,
    const byte bitmap[],
    const size_t byteCount,
    const enum FillSide fillSide )
```

Build a glyph outline.

This function builds a glyph outline from a Unifont glyph bitmap.

Parameters

out	result	The result- ing glyph out- line.
in	bitmap	A bitmap array.
in	byteCount	the num- ber of bytes in the input bitmap array.
in	fillSide	Enumerated indi- cator to fill left or right side.

Get the value of a given bit that is in a given row.

Invert the value of a given bit that is in a given row.

Definition at line 1160 of file [hex2otf.c](#).

```
01162 {
01163     enum Direction {RIGHT, LEFT, DOWN, UP}; // order is significant
01164
01165     // respective coordinate deltas
01166     const pixels_t dx[] = {1, -1, 0, 0}, dy[] = {0, 0, -1, 1};
01167
01168     assert (byteCount % GLYPH_HEIGHT == 0);
01169     const uint_fast8_t bytesPerRow = byteCount / GLYPH_HEIGHT;
01170     const pixels_t glyphWidth = bytesPerRow * 8;
01171     assert (glyphWidth <= GLYPH_MAX_WIDTH);
01172
01173     #if GLYPH_MAX_WIDTH < 32
01174         typedef uint_fast32_t row_t;
01175     #elif GLYPH_MAX_WIDTH < 64
01176         typedef uint_fast64_t row_t;
01177     #else
01178         #error GLYPH_MAX_WIDTH is too large.
01179     #endif
01180
01181     row_t pixels[GLYPH_HEIGHT + 2] = {0};
01182     for (pixels_t row = GLYPH_HEIGHT; row > 0; row--)
```

```

01183     for (pixels_t b = 0; b < bytesPerRow; b++)
01184         pixels[row] = pixels[row] « 8 | *bitmap++;
01185     typedef row_t graph_t[GLYPH_HEIGHT + 1];
01186     graph_t vectors[4];
01187     const row_t *lower = pixels, *upper = pixels + 1;
01188     for (pixels_t row = 0; row <= GLYPH_HEIGHT; row++)
01189     {
01190         const row_t m = (fillSide == FILL_RIGHT) - 1;
01191         vectors[RIGHT][row] = (m ^ (*lower « 1)) & (~m ^ (*upper « 1));
01192         vectors[LEFT][row] = (m ^ (*upper )) & (~m ^ (*lower ));
01193         vectors[DOWN][row] = (m ^ (*lower )) & (~m ^ (*lower « 1));
01194         vectors[UP][row] = (m ^ (*upper « 1)) & (~m ^ (*upper ));
01195         lower++;
01196         upper++;
01197     }
01198     graph_t selection = {0};
01199     const row_t x0 = (row_t)1 « glyphWidth;
01200
01201     /// Get the value of a given bit that is in a given row.
01202     #define getRowBit(rows, x, y) ((rows)[(y)] & x0 » (x))
01203
01204     /// Invert the value of a given bit that is in a given row.
01205     #define flipRowBit(rows, x, y) ((rows)[(y)] ^ x0 » (x))
01206
01207     for (pixels_t y = GLYPH_HEIGHT; y >= 0; y--)
01208     {
01209         for (pixels_t x = 0; x <= glyphWidth; x++)
01210         {
01211             assert(!getRowBit (vectors[LEFT], x, y));
01212             assert(!getRowBit (vectors[UP], x, y));
01213             enum Direction initial;
01214
01215             if (getRowBit (vectors[RIGHT], x, y))
01216                 initial = RIGHT;
01217             else if (getRowBit (vectors[DOWN], x, y))
01218                 initial = DOWN;
01219             else
01220                 continue;
01221
01222             static_assert (((GLYPH_MAX_WIDTH + 1) * (GLYPH_HEIGHT + 1) * 2 <=
01223                 U16MAX, "potential overflow");
01224
01225             uint_fast16_t lastPointCount = 0;
01226             for (bool converged = false;;)
01227             {
01228                 uint_fast16_t pointCount = 0;
01229                 enum Direction heading = initial;
01230                 for (pixels_t tx = x, ty = y;;)
01231                 {
01232                     if (converged)
01233                     {
01234                         storePixels (result, OP_POINT);
01235                         storePixels (result, tx);
01236                         storePixels (result, ty);
01237                     }
01238                     do
01239                     {
01240                         if (converged)
01241                             flipRowBit (vectors[heading], tx, ty);
01242                         tx += dx[heading];
01243                         ty += dy[heading];
01244                     } while (getRowBit (vectors[heading], tx, ty));
01245                     if (tx == x && ty == y)
01246                         break;
01247                     static_assert ((UP ^ DOWN) == 1 && (LEFT ^ RIGHT) == 1,
01248                         "wrong enums");
01249                     heading = (heading & 2) ^ 2;
01250                     heading |= !getRowBit (selection, tx, ty);
01251                     heading ^= !getRowBit (vectors[heading], tx, ty);
01252                     assert (getRowBit (vectors[heading], tx, ty));
01253                     flipRowBit (selection, tx, ty);
01254                     pointCount++;
01255                 }
01256                 if (converged)
01257                     break;
01258                 converged = pointCount == lastPointCount;
01259                 lastPointCount = pointCount;
01260             }
01261
01262             storePixels (result, OP_CLOSE);
01263         }

```

```

01264     }
01265 #undef getRowBit
01266 #undef flipRowBit
01267 }

```

5.3.5.3 byCodePoint()

```

int byCodePoint (
    const void * a,
    const void * b )

```

Compare two Unicode code points to determine which is greater.

This function compares the Unicode code points contained within two [Glyph](#) data structures. The function returns 1 if the first code point is greater, and -1 if the second is greater.

Parameters

in	a	A Glyph data structure containing the first code point.
in	b	A Glyph data structure containing the second code point.

Returns

1 if the code point a is greater, -1 if less, 0 if equal.

Definition at line 1040 of file [hex2otf.c](#).

```

01041 {
01042     const Glyph *const ga = a, *const gb = b;
01043     int gt = ga->codePoint > gb->codePoint;
01044     int lt = ga->codePoint < gb->codePoint;
01045     return gt - lt;
01046 }

```

5.3.5.4 byTableTag()

```
int byTableTag (
    const void * a,
    const void * b )
```

Compare tables by 4-byte unsigned table tag value.

This function takes two pointers to a [TableRecord](#) data structure and extracts the four-byte tag structure element for each. The two 32-bit numbers are then compared. If the first tag is greater than the first, then $gt = 1$ and $lt = 0$, and so $1 - 0 = 1$ is returned. If the first is less than the second, then $gt = 0$ and $lt = 1$, and so $0 - 1 = -1$ is returned.

Parameters

in	a	Pointer to the first TableRecord structure.
in	b	Pointer to the second TableRecord structure.

Returns

1 if the tag in "a" is greater, -1 if less, 0 if equal.

Definition at line [767](#) of file [hex2otf.c](#).

```
00768 {
00769     const struct TableRecord *const ra = a, *const rb = b;
00770     int gt = ra->tag > rb->tag;
00771     int lt = ra->tag < rb->tag;
00772     return gt - lt;
00773 }
```

5.3.5.5 cacheBuffer()

```
void cacheBuffer (
    Buffer *restrict bufDest,
    const Buffer *restrict bufSrc )
```

Append bytes of a table to a byte buffer.

Parameters

in,out	bufDest	The buffer to which the new bytes are appended.
in	bufSrc	The bytes to append to the buffer array.

Definition at line 523 of file [hex2otf.c](#).

```

00524 {
00525     size_t length = countBufferedBytes (bufSrc);
00526     ensureBuffer (bufDest, length);
00527     memcpy (bufDest->next, bufSrc->begin, length);
00528     bufDest->next += length;
00529 }
```

5.3.5.6 cacheBytes()

```

void cacheBytes (
    Buffer *restrict buf,
    const void *restrict src,
    size_t count )
```

Append a string of bytes to a buffer.

This function appends an array of 1 to 4 bytes to the end of a buffer.

Parameters

in,out	buf	The buffer to which the bytes are appended.
--------	-----	---

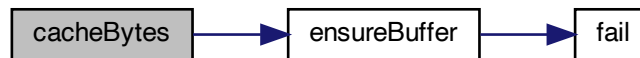
Parameters

in	src	The array of bytes to append to the buffer.
in	count	The number of bytes containing zeroes to append.

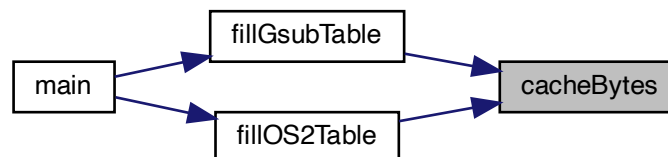
Definition at line 509 of file [hex2otf.c](#).

```
00510 {  
00511     ensureBuffer (buf, count);  
00512     memcpy (buf->next, src, count);  
00513     buf->next += count;  
00514 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.7 cacheCFFOperand()

```
void cacheCFFOperand (
    Buffer * buf,
    int_fast32_t value )
```

Cache charstring number encoding in a CFF buffer.

This function caches two's complement 8-, 16-, and 32-bit words as per Adobe's Type 2 Charstring encoding for operands. These operands are used in Compact [Font](#) Format data structures.

Byte values can have offsets, for which this function compensates, optionally followed by additional bytes:

Byte Range	Offset	Bytes	Adjusted Range
0 to 11	0	1	0 to 11 (operators)
12	0	2	Next byte is 8-bit op code
13 to 18	0	1	13 to 18 (operators)
19 to 20	0	2+	hintmask and cntrmask operators
21 to 27	0	1	21 to 27 (operators)
28	0	3	16-bit 2's complement number
29 to 31	0	1	29 to 31 (operators)
32 to 246	-139	1	-107 to +107
247 to 250	+108	2	+108 to +1131
251 to 254	-108	2	-108 to -1131
255	0	5	16-bit integer and 16-bit fraction

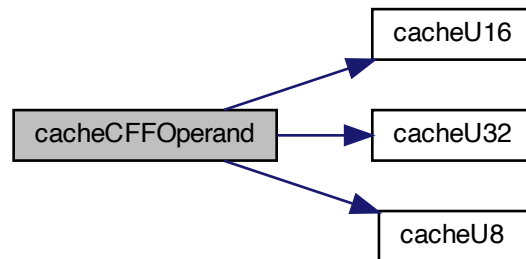
Parameters

in,out	buf	The buffer to which the operand value is appended.
in	value	The operand value.

Definition at line 460 of file [hex2otf.c](#).

```
00461 {
00462     if (-107 <= value && value <= 107)
00463         cacheU8 (buf, value + 139);
00464     else if (108 <= value && value <= 1131)
00465     {
00466         cacheU8 (buf, (value - 108) / 256 + 247);
00467         cacheU8 (buf, (value - 108) % 256);
00468     }
00469     else if (-32768 <= value && value <= 32767)
00470     {
00471         cacheU8 (buf, 28);
00472         cacheU16 (buf, value);
00473     }
00474     else if (-2147483647 <= value && value <= 2147483647)
00475     {
00476         cacheU8 (buf, 29);
00477         cacheU32 (buf, value);
00478     }
00479     else
00480         assert (false); // other encodings are not used and omitted
00481     static_assert (GLYPH_MAX_WIDTH <= 107, "More encodings are needed.");
00482 }
```

Here is the call graph for this function:



5.3.5.8 cacheStringAsUTF16BE()

```
void cacheStringAsUTF16BE (
    Buffer * buf,
    const char * str )
```

Cache a string as a big-ending UTF-16 surrogate pair.

This function encodes a UTF-8 string as a big-endian UTF-16 surrogate pair.

Parameters

in,out	buf	Pointer to a Buffer struct to update.
in	str	The character array to encode.

Definition at line 2316 of file [hex2otf.c](#).

```

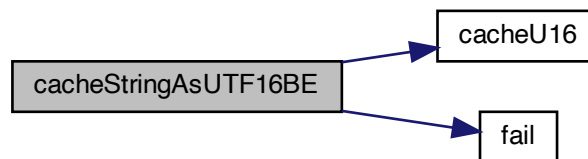
02317 {
02318     for (const char *p = str; *p; p++)
02319     {
02320         byte c = *p;
02321         if (c < 0x80)
02322         {
02323             cacheU16 (buf, c);
02324             continue;
02325         }
02326         int length = 1;
02327         byte mask = 0x40;
02328         for (; c & mask; mask >>= 1)
02329             length++;
02330         if (length == 1 || length > 4)
02331             fail ("Ill-formed UTF-8 sequence.");
  
```

```

02332     uint_fast32_t codePoint = c & (mask - 1);
02333     for (int i = 1; i < length; i++)
02334     {
02335         c = *++p;
02336         if ((c & 0xc0) != 0x80) // NUL checked here
02337             fail ("Ill-formed UTF-8 sequence.");
02338         codePoint = (codePoint « 6) | (c & 0x3f);
02339     }
02340     const int lowerBits = length==2 ? 7 : length==3 ? 11 : 16;
02341     if (codePoint » lowerBits == 0)
02342         fail ("Ill-formed UTF-8 sequence."); // sequence should be shorter
02343     if (codePoint >= 0xd800 && codePoint <= 0xdfff)
02344         fail ("Ill-formed UTF-8 sequence.");
02345     if (codePoint > 0x10ffff)
02346         fail ("Ill-formed UTF-8 sequence.");
02347     if (codePoint > 0xffff)
02348     {
02349         cacheU16 (buf, 0xd800 | (codePoint - 0x10000) » 10);
02350         cacheU16 (buf, 0xdc00 | (codePoint & 0x3ff));
02351     }
02352     else
02353         cacheU16 (buf, codePoint);
02354 }
02355 }

```

Here is the call graph for this function:



5.3.5.9 cacheU16()

```

void cacheU16 (
    Buffer * buf,
    uint_fast16_t value )

```

Append two unsigned bytes to the end of a byte array.

This function adds two bytes to the end of a byte array. The buffer is updated to account for the newly-added bytes.

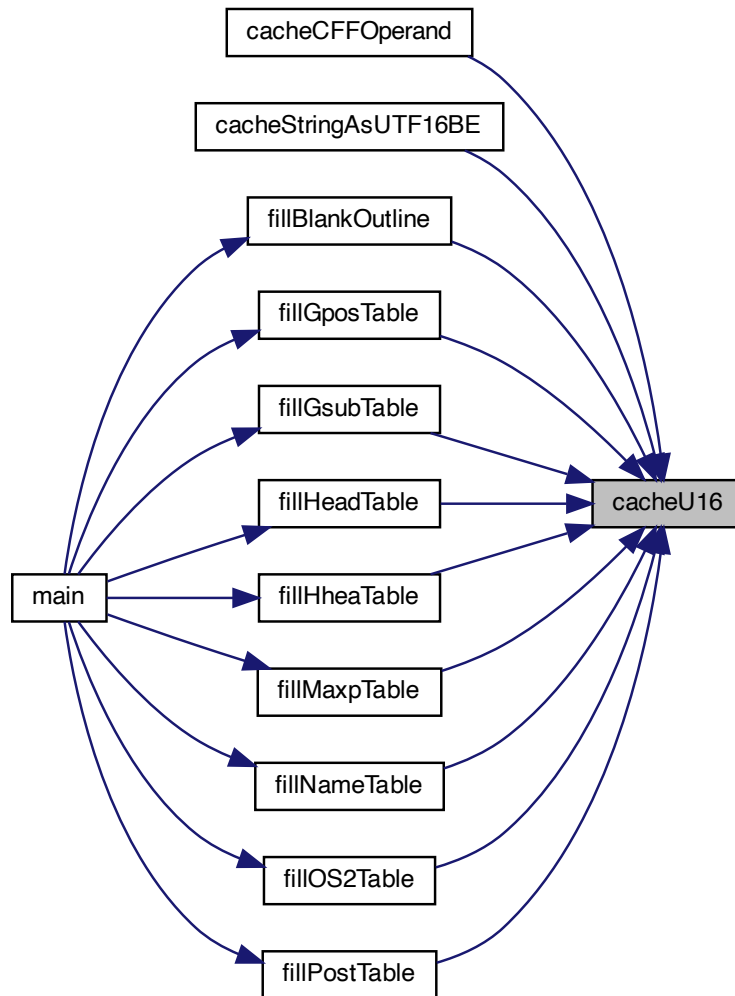
Parameters

in,out	buf	The array of bytes to which to append two new bytes.
in	value	The 16-bit unsigned value to append to the buf array.

Definition at line [412](#) of file [hex2otf.c](#).

```
00413 {  
00414     cacheU (buf, value, 2);  
00415 }
```

Here is the caller graph for this function:



5.3.5.10 cacheU32()

```
void cacheU32 (
    Buffer * buf,
    uint_fast32_t value )
```

Append four unsigned bytes to the end of a byte array.

This function adds four bytes to the end of a byte array. The buffer is updated to account for the newly-added bytes.

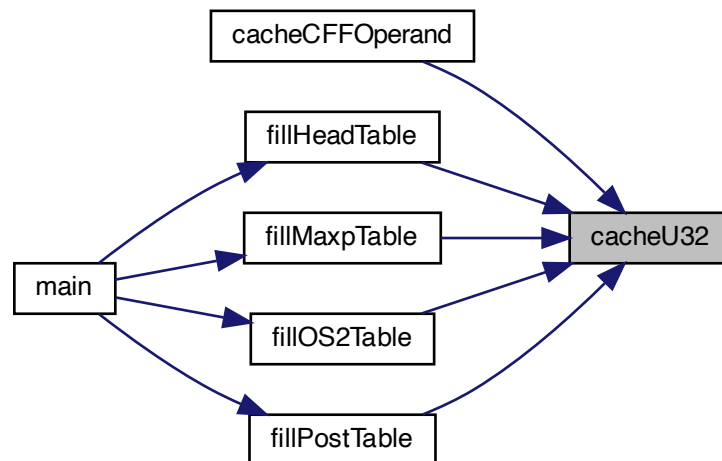
Parameters

in,out	buf	The array of bytes to which to append four new bytes.
in	value	The 32-bit unsigned value to append to the buf array.

Definition at line 427 of file [hex2otf.c](#).

```
00428 {
00429     cacheU (buf, value, 4);
00430 }
```

Here is the caller graph for this function:



5.3.5.11 cacheU8()

```
void cacheU8 (
    Buffer * buf,
    uint_fast8_t value )
```

Append one unsigned byte to the end of a byte array.

This function adds one byte to the end of a byte array. The buffer is updated to account for the newly-added byte.

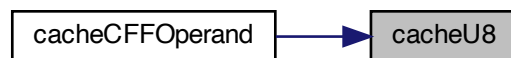
Parameters

in,out	buf	The array of bytes to which to append a new byte.
in	value	The 8-bit unsigned value to append to the buf array.

Definition at line 397 of file [hex2otf.c](#).

```
00398 {
00399     storeU8 (buf, value & 0xff);
00400 }
```

Here is the caller graph for this function:



5.3.5.12 cacheZeros()

```
void cacheZeros (
    Buffer * buf,
    size_t count )
```

Append 1 to 4 bytes of zeroes to a buffer, for padding.

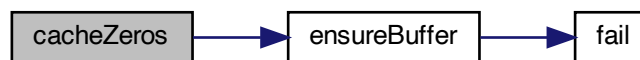
Parameters

in,out	buf	The buffer to which the operand value is appended.
in	count	The number of bytes containing zeroes to append.

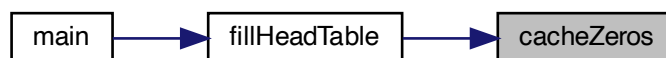
Definition at line 491 of file [hex2otf.c](#).

```
00492 {
00493     ensureBuffer (buf, count);
00494     memset (buf->next, 0, count);
00495     buf->next += count;
00496 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.13 cleanBuffers()

```
void cleanBuffers ( )
```

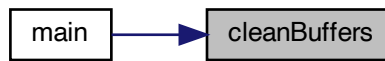
Free all allocated buffer pointers.

This function frees all buffer pointers previously allocated in the initBuffers function.

Definition at line 170 of file [hex2otf.c](#).

```
00171 {
00172     for (size_t i = 0; i < bufferCount; i++)
00173         if (allBuffers[i].capacity)
00174             free (allBuffers[i].begin);
00175     free (allBuffers);
00176     bufferCount = 0;
00177 }
```

Here is the caller graph for this function:



5.3.5.14 defineStore()

```
defineStore (
```

```
    storeU8 ,
```

```
    uint_least8_t )
```

Definition at line 356 of file [hex2otf.c](#).

```
00375 {
00376     assert (1 <= bytes && bytes <= 4);
00377     ensureBuffer (buf, bytes);
00378     switch (bytes)
00379     {
00380     case 4: *buf->next++ = value » 24 & 0xff; // fall through
00381     case 3: *buf->next++ = value » 16 & 0xff; // fall through
00382     case 2: *buf->next++ = value » 8  & 0xff; // fall through
00383     case 1: *buf->next++ = value    & 0xff;
00384     }
00385 }
```

5.3.5.15 ensureBuffer()

```
void ensureBuffer (
```

```
    Buffer * buf,
```

```
    size_t needed )
```

Ensure that the buffer has at least the specified minimum size.

This function takes a buffer array of type [Buffer](#) and the necessary minimum number of elements as inputs, and attempts to increase the size of the buffer if it must be larger.

If the buffer is too small and cannot be resized, the program will terminate with an error message and an exit status of `EXIT_FAILURE`.

Parameters

in,out	buf	The buffer to check.
in	needed	The required minimum number of elements in the buffer.

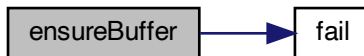
Definition at line 239 of file [hex2otf.c](#).

```

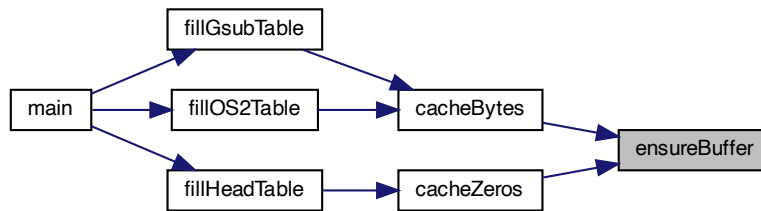
00240 {
00241     if (buf->end - buf->next >= needed)
00242         return;
00243     ptrdiff_t occupied = buf->next - buf->begin;
00244     size_t required = occupied + needed;
00245     if (required < needed) // overflow
00246         fail ("Cannot allocate %zu + %zu bytes of memory.", occupied, needed);
00247     if (required > SIZE_MAX / 2)
00248         buf->capacity = required;
00249     else while (buf->capacity < required)
00250         buf->capacity *= 2;
00251     void *extended = realloc (buf->begin, buf->capacity);
00252     if (!extended)
00253         fail ("Failed to allocate %zu bytes of memory.", buf->capacity);
00254     buf->begin = extended;
00255     buf->next = buf->begin + occupied;
00256     buf->end = buf->begin + buf->capacity;
00257 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.16 fail()

```
void fail (
    const char * reason,
    ... )
```

Print an error message on stderr, then exit.

This function prints the provided error string and optional following arguments to stderr, and then exits with a status of `EXIT_FAILURE`.

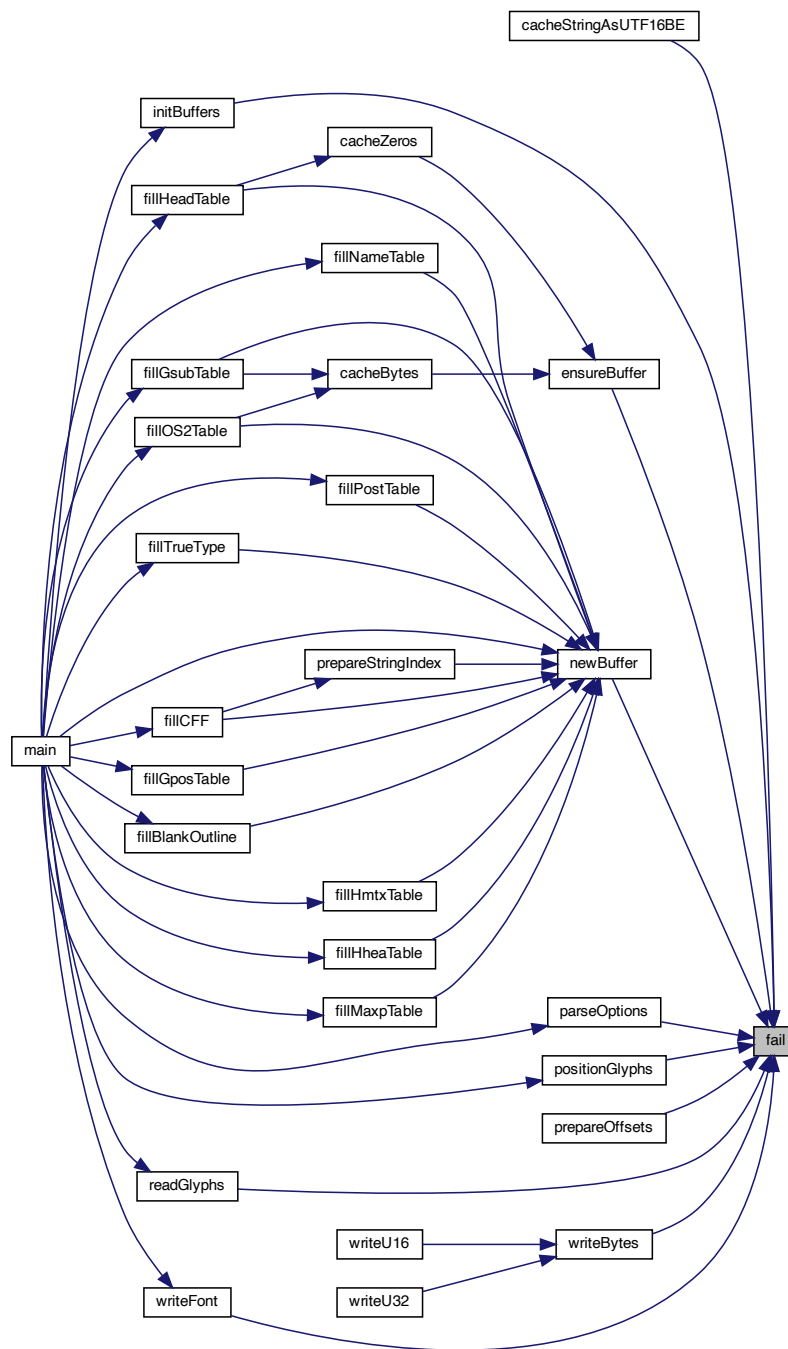
Parameters

in	reason	The output string to describe the error.
in	...	Optional following arguments to output.

Definition at line 113 of file `hex2otf.c`.

```
00114 {
00115     fputs ("ERROR: ", stderr);
00116     va_list args;
00117     va_start (args, reason);
00118     vfprintf (stderr, reason, args);
00119     va_end (args);
00120     putc ('\n', stderr);
00121     exit (EXIT_FAILURE);
00122 }
```

Here is the caller graph for this function:



5.3.5.17 fillBitmap()

```
void fillBitmap (
```

[Font](#) * font)

Fill OpenType bitmap data and location tables.

This function fills an Embedded Bitmap Data (EBDT) [Table](#) and an Embedded Bitmap Location (EBLC) [Table](#) with glyph bitmap information. These tables enable embedding bitmaps in OpenType fonts. No Embedded Bitmap Scaling (EBSC) table is used for the bitmap glyphs, only EBDT and EBLC.

Parameters

in,out	font	Pointer to a Font struct in which to add bitmaps.
--------	------	---

Definition at line 1728 of file [hex2otf.c](#).

```

1729 {
1730     const Glyph *const glyphs = getBufferHead (font->glyphs);
1731     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
1732     size_t bitmapsSize = 0;
1733     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
1734         bitmapsSize += glyph->byteCount;
1735     Buffer *ebdt = newBuffer (4 + bitmapsSize);
1736     addTable (font, "EBDT", ebdt);
1737     cacheU16 (ebdt, 2); // majorVersion
1738     cacheU16 (ebdt, 0); // minorVersion
1739     uint_fast8_t byteCount = 0; // unequal to any glyph
1740     pixels_t pos = 0;
1741     bool combining = false;
1742     Buffer *rangeHeads = newBuffer (32);
1743     Buffer *offsets = newBuffer (64);
1744     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
1745     {
1746         if (glyph->byteCount != byteCount || glyph->pos != pos ||
1747             glyph->combining != combining)
1748         {
1749             storeU16 (rangeHeads, glyph - glyphs);
1750             storeU32 (offsets, countBufferedBytes (ebdt));
1751             byteCount = glyph->byteCount;
1752             pos = glyph->pos;
1753             combining = glyph->combining;
1754         }
1755         cacheBytes (ebdt, glyph->bitmap, byteCount);
1756     }
1757     const uint_least16_t *ranges = getBufferHead (rangeHeads);
1758     const uint_least16_t *rangesEnd = getBufferTail (rangeHeads);
1759     uint_fast32_t rangeCount = rangesEnd - ranges;
1760     storeU16 (rangeHeads, font->glyphCount);
1761     Buffer *eblc = newBuffer (4096);
1762     addTable (font, "EBLC", eblc);
1763     cacheU16 (eblc, 2); // majorVersion
1764     cacheU16 (eblc, 0); // minorVersion
1765     cacheU32 (eblc, 1); // numSizes
1766     { // bitmapSizes[0]
1767         cacheU32 (eblc, 56); // indexSubTableArrayOffset
1768         cacheU32 (eblc, (8 + 20) * rangeCount); // indexTablesSize
1769         cacheU32 (eblc, rangeCount); // numberOfIndexSubTables
1770         cacheU32 (eblc, 0); // colorRef
1771         { // hori
1772             cacheU8 (eblc, ASCENDER); // ascender
1773             cacheU8 (eblc, -DESCENDER); // descender
1774             cacheU8 (eblc, font->maxWidth); // widthMax
1775             cacheU8 (eblc, 1); // caretSlopeNumerator
1776             cacheU8 (eblc, 0); // caretSlopeDenominator
1777             cacheU8 (eblc, 0); // caretOffset
1778             cacheU8 (eblc, 0); // minOriginSB
1779             cacheU8 (eblc, 0); // minAdvanceSB
1780             cacheU8 (eblc, ASCENDER); // maxBeforeBL
1781             cacheU8 (eblc, -DESCENDER); // minAfterBL
1782             cacheU8 (eblc, 0); // pad1

```

```

01783     cacheU8 (eblc, 0); // pad2
01784 }
01785 { // vert
01786     cacheU8 (eblc, ASCENDER); // ascender
01787     cacheU8 (eblc, -DESCENDER); // descender
01788     cacheU8 (eblc, font->maxWidth); // widthMax
01789     cacheU8 (eblc, 1); // caretSlopeNumerator
01790     cacheU8 (eblc, 0); // caretSlopeDenominator
01791     cacheU8 (eblc, 0); // caretOffset
01792     cacheU8 (eblc, 0); // minOriginSB
01793     cacheU8 (eblc, 0); // minAdvanceSB
01794     cacheU8 (eblc, ASCENDER); // maxBeforeBL
01795     cacheU8 (eblc, -DESCENDER); // minAfterBL
01796     cacheU8 (eblc, 0); // pad1
01797     cacheU8 (eblc, 0); // pad2
01798 }
01799 cacheU16 (eblc, 0); // startGlyphIndex
01800 cacheU16 (eblc, font->glyphCount - 1); // endGlyphIndex
01801 cacheU8 (eblc, 16); // ppemX
01802 cacheU8 (eblc, 16); // ppemY
01803 cacheU8 (eblc, 1); // bitDepth
01804 cacheU8 (eblc, 1); // flags = Horizontal
01805 }
01806 { // IndexSubTableArray
01807     uint_fast32_t offset = rangeCount * 8;
01808     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01809     {
01810         cacheU16 (eblc, *p); // firstGlyphIndex
01811         cacheU16 (eblc, p[1] - 1); // lastGlyphIndex
01812         cacheU32 (eblc, offset); // additionalOffsetToIndexSubtable
01813         offset += 20;
01814     }
01815 }
01816 { // IndexSubTables
01817     const uint_least32_t *offset = getBufferHead (offsets);
01818     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01819     {
01820         const Glyph *glyph = &glyphs[*p];
01821         cacheU16 (eblc, 2); // indexFormat
01822         cacheU16 (eblc, 5); // imageFormat
01823         cacheU32 (eblc, *offset++); // imageDataOffset
01824         cacheU32 (eblc, glyph->byteCount); // imageSize
01825         { // bigMetrics
01826             cacheU8 (eblc, GLYPH_HEIGHT); // height
01827             const uint_fast8_t width = PW (glyph->byteCount);
01828             cacheU8 (eblc, width); // width
01829             cacheU8 (eblc, glyph->pos); // horiBearingX
01830             cacheU8 (eblc, ASCENDER); // horiBearingY
01831             cacheU8 (eblc, glyph->combining ? 0 : width); // horiAdvance
01832             cacheU8 (eblc, 0); // vertBearingX
01833             cacheU8 (eblc, 0); // vertBearingY
01834             cacheU8 (eblc, GLYPH_HEIGHT); // vertAdvance
01835         }
01836     }
01837 }
01838 freeBuffer (rangeHeads);
01839 freeBuffer (offsets);
01840 }

```

Here is the caller graph for this function:



5.3.5.18 fillBlankOutline()

```
void fillBlankOutline (
    Font * font )
```

Create a dummy blank outline in a font table.

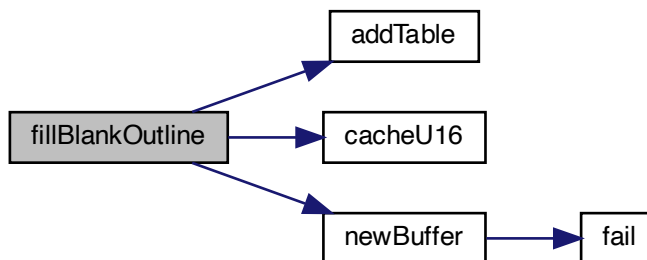
Parameters

in,out	font	Pointer to a Font struct to in- sert a blank out- line.
--------	------	---

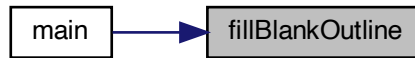
Definition at line 1697 of file [hex2otf.c](#).

```
01698 {
01699     Buffer *glyf = newBuffer (12);
01700     addTable (font, "glyf", glyf);
01701     // Empty table is not allowed, but an empty outline for glyph 0 suffices.
01702     cacheU16 (glyf, 0); // numberOfContours
01703     cacheU16 (glyf, FU (0)); // xMin
01704     cacheU16 (glyf, FU (0)); // yMin
01705     cacheU16 (glyf, FU (0)); // xMax
01706     cacheU16 (glyf, FU (0)); // yMax
01707     cacheU16 (glyf, 0); // instructionLength
01708     Buffer *loca = newBuffer (2 * (font->glyphCount + 1));
01709     addTable (font, "loca", loca);
01710     cacheU16 (loca, 0); // offsets[0]
01711     assert (countBufferedBytes (glyf) % 2 == 0);
01712     for (uint_fast32_t i = 1; i <= font->glyphCount; i++)
01713         cacheU16 (loca, countBufferedBytes (glyf) / 2); // offsets[i]
01714 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.19 fillCFF()

```
void fillCFF (
    Font * font,
    int version,
    const NameStrings names )
```

Add a CFF table to a font.

Parameters

in,out	font	Pointer to a Font struct to contain the CFF table.
in	version	Version of CFF table, with value 1 or 2.
in	names	List of NameStrings .

Use fixed width integer for variables to simplify offset calculation.

Definition at line [1329](#) of file [hex2otf.c](#).

```

01330 {
01331     // HACK: For convenience, CFF data structures are hard coded.
01332     assert (0 < version && version <= 2);
01333     Buffer *cff = newBuffer (65536);
01334     addTable (font, version == 1 ? "CFF " : "CFF2", cff);
01335
01336     /// Use fixed width integer for variables to simplify offset calculation.
01337     #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))
01338
01339     // In Unifont, 16px glyphs are more common. This is used by CFF1 only.
01340     const pixels_t defaultWidth = 16, nominalWidth = 8;
01341     if (version == 1)
```

```

01342 {
01343     Buffer *strings = prepareStringIndex (names);
01344     size_t stringsSize = countBufferedBytes (strings);
01345     const char *cffName = names[6];
01346     assert (cffName);
01347     size_t nameLength = strlen (cffName);
01348     size_t namesSize = nameLength + 5;
01349     // These sizes must be updated together with the data below.
01350     size_t offsets[] = {4, namesSize, 45, stringsSize, 2, 5, 8, 32, 4, 0};
01351     prepareOffsets (offsets);
01352     { // Header
01353         cacheU8 (cff, 1); // major
01354         cacheU8 (cff, 0); // minor
01355         cacheU8 (cff, 4); // hdrSize
01356         cacheU8 (cff, 1); // offSize
01357     }
01358     assert (countBufferedBytes (cff) == offsets[0]);
01359     { // Name INDEX (should not be used by OpenType readers)
01360         cacheU16 (cff, 1); // count
01361         cacheU8 (cff, 1); // offSize
01362         cacheU8 (cff, 1); // offset[0]
01363         if (nameLength + 1 > 255) // must be too long; spec limit is 63
01364             fail ("PostScript name is too long.");
01365         cacheU8 (cff, nameLength + 1); // offset[1]
01366         cacheBytes (cff, cffName, nameLength);
01367     }
01368     assert (countBufferedBytes (cff) == offsets[1]);
01369     { // Top DICT INDEX
01370         cacheU16 (cff, 1); // count
01371         cacheU8 (cff, 1); // offSize
01372         cacheU8 (cff, 1); // offset[0]
01373         cacheU8 (cff, 41); // offset[1]
01374         cacheCFFOperand (cff, 391); // "Adobe"
01375         cacheCFFOperand (cff, 392); // "Identity"
01376         cacheCFFOperand (cff, 0);
01377         cacheBytes (cff, (byte[]){12, 30}, 2); // ROS
01378         cacheCFF32 (cff, font->glyphCount);
01379         cacheBytes (cff, (byte[]){12, 34}, 2); // CIDCount
01380         cacheCFF32 (cff, offsets[6]);
01381         cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01382         cacheCFF32 (cff, offsets[5]);
01383         cacheBytes (cff, (byte[]){12, 37}, 2); // FDSelect
01384         cacheCFF32 (cff, offsets[4]);
01385         cacheU8 (cff, 15); // charSet
01386         cacheCFF32 (cff, offsets[8]);
01387         cacheU8 (cff, 17); // CharStrings
01388     }
01389     assert (countBufferedBytes (cff) == offsets[2]);
01390     { // String INDEX
01391         cacheBuffer (cff, strings);
01392         freeBuffer (strings);
01393     }
01394     assert (countBufferedBytes (cff) == offsets[3]);
01395     cacheU16 (cff, 0); // Global Subr INDEX
01396     assert (countBufferedBytes (cff) == offsets[4]);
01397     { // Charsets
01398         cacheU8 (cff, 2); // format
01399         { // Range2[0]
01400             cacheU16 (cff, 1); // first
01401             cacheU16 (cff, font->glyphCount - 2); // nLeft
01402         }
01403     }
01404     assert (countBufferedBytes (cff) == offsets[5]);
01405     { // FDSelect
01406         cacheU8 (cff, 3); // format
01407         cacheU16 (cff, 1); // nRanges
01408         cacheU16 (cff, 0); // first
01409         cacheU8 (cff, 0); // fd
01410         cacheU16 (cff, font->glyphCount); // sentinel
01411     }
01412     assert (countBufferedBytes (cff) == offsets[6]);
01413     { // FDArray
01414         cacheU16 (cff, 1); // count
01415         cacheU8 (cff, 1); // offSize
01416         cacheU8 (cff, 1); // offset[0]
01417         cacheU8 (cff, 28); // offset[1]
01418         cacheCFFOperand (cff, 393);
01419         cacheBytes (cff, (byte[]){12, 38}, 2); // FontName
01420         // Windows requires FontMatrix in Font DICT.
01421         const byte unit[] = {0x1e, 0x15, 0x62, 0x5c, 0x6f}; // 1/64 (0.015625)
01422         cacheBytes (cff, unit, sizeof unit);

```

```

01423     cacheCFFOperand (cff, 0);
01424     cacheCFFOperand (cff, 0);
01425     cacheBytes (cff, unit, sizeof unit);
01426     cacheCFFOperand (cff, 0);
01427     cacheCFFOperand (cff, 0);
01428     cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01429     cacheCFFOperand (cff, offsets[8] - offsets[7]); // size
01430     cacheCFF32 (cff, offsets[7]); // offset
01431     cacheU8 (cff, 18); // Private
01432 }
01433 assert (countBufferedBytes (cff) == offsets[7]);
01434 { // Private
01435     cacheCFFOperand (cff, FU (defaultWidth));
01436     cacheU8 (cff, 20); // defaultWidthX
01437     cacheCFFOperand (cff, FU (nominalWidth));
01438     cacheU8 (cff, 21); // nominalWidthX
01439 }
01440 assert (countBufferedBytes (cff) == offsets[8]);
01441 }
01442 else
01443 {
01444     assert (version == 2);
01445     // These sizes must be updated together with the data below.
01446     size_t offsets[] = {5, 21, 4, 10, 0};
01447     prepareOffsets (offsets);
01448     { // Header
01449         cacheU8 (cff, 2); // majorVersion
01450         cacheU8 (cff, 0); // minorVersion
01451         cacheU8 (cff, 5); // headerSize
01452         cacheU16 (cff, offsets[1] - offsets[0]); // topDictLength
01453     }
01454     assert (countBufferedBytes (cff) == offsets[0]);
01455     { // Top DICT
01456         const byte unit[] = {0x1e, 0x15, 0x62, 0x5c, 0x6f}; // 1/64 (0.015625)
01457         cacheBytes (cff, unit, sizeof unit);
01458         cacheCFFOperand (cff, 0);
01459         cacheCFFOperand (cff, 0);
01460         cacheBytes (cff, unit, sizeof unit);
01461         cacheCFFOperand (cff, 0);
01462         cacheCFFOperand (cff, 0);
01463         cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01464         cacheCFFOperand (cff, offsets[2]);
01465         cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01466         cacheCFFOperand (cff, offsets[3]);
01467         cacheU8 (cff, 17); // CharStrings
01468     }
01469     assert (countBufferedBytes (cff) == offsets[1]);
01470     cacheU32 (cff, 0); // Global Subr INDEX
01471     assert (countBufferedBytes (cff) == offsets[2]);
01472     { // Font DICT INDEX
01473         cacheU32 (cff, 1); // count
01474         cacheU8 (cff, 1); // offSize
01475         cacheU8 (cff, 1); // offset[0]
01476         cacheU8 (cff, 4); // offset[1]
01477         cacheCFFOperand (cff, 0);
01478         cacheCFFOperand (cff, 0);
01479         cacheU8 (cff, 18); // Private
01480     }
01481     assert (countBufferedBytes (cff) == offsets[3]);
01482 }
01483 { // CharStrings INDEX
01484     Buffer *offsets = newBuffer (4096);
01485     Buffer *charstrings = newBuffer (4096);
01486     Buffer *outline = newBuffer (1024);
01487     const Glyph *glyph = getBufferHead (font->glyphs);
01488     const Glyph *const endGlyph = glyph + font->glyphCount;
01489     for (; glyph < endGlyph; glyph++)
01490     {
01491         // CFF offsets start at 1
01492         storeU32 (offsets, countBufferedBytes (charstrings) + 1);
01493
01494         pixels_t rx = -glyph->pos;
01495         pixels_t ry = DESCENDER;
01496         resetBuffer (outline);
01497         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_LEFT);
01498         enum CFFOp {rmoveto=21, hmoveto=22, vmoveto=4, hlineto=6,
01499             vlineto=7, endchar=14};
01500         enum CFFOp pendingOp = 0;
01501         const int STACK_LIMIT = version == 1 ? 48 : 513;
01502         int stackSize = 0;
01503         bool isDrawing = false;

```

```

01504     pixels_t width = glyph->combining ? 0 : PW (glyph->byteCount);
01505     if (version == 1 && width != defaultWidth)
01506     {
01507         cacheCFFOperand (charstrings, FU (width - nominalWidth));
01508         stackSize++;
01509     }
01510     for (const pixels_t *p = getBufferHead (outline),
01511          *const end = getBufferTail (outline); p < end;)
01512     {
01513         int s = 0;
01514         const enum ContourOp op = *p++;
01515         if (op == OP_POINT)
01516         {
01517             const pixels_t x = *p++, y = *p++;
01518             if (x != rx)
01519             {
01520                 cacheCFFOperand (charstrings, FU (x - rx));
01521                 rx = x;
01522                 stackSize++;
01523                 s |= 1;
01524             }
01525             if (y != ry)
01526             {
01527                 cacheCFFOperand (charstrings, FU (y - ry));
01528                 ry = y;
01529                 stackSize++;
01530                 s |= 2;
01531             }
01532             assert (!(isDrawing && s == 3));
01533         }
01534         if (s)
01535         {
01536             if (!isDrawing)
01537             {
01538                 const enum CFFOp moves[] = {0, hmoveto, vmoveto,
01539                                             rmoveto};
01540                 cacheU8 (charstrings, moves[s]);
01541                 stackSize = 0;
01542             }
01543             else if (!pendingOp)
01544                 pendingOp = (enum CFFOp[]){0, hlineto, vlineto}[s];
01545         }
01546         else if (!isDrawing)
01547         {
01548             // only when the first point happens to be (0, 0)
01549             cacheCFFOperand (charstrings, FU (0));
01550             cacheU8 (charstrings, hmoveto);
01551             stackSize = 0;
01552         }
01553         if (op == OP_CLOSE || stackSize >= STACK_LIMIT)
01554         {
01555             assert (stackSize <= STACK_LIMIT);
01556             cacheU8 (charstrings, pendingOp);
01557             pendingOp = 0;
01558             stackSize = 0;
01559         }
01560         isDrawing = op != OP_CLOSE;
01561     }
01562     if (version == 1)
01563         cacheU8 (charstrings, endchar);
01564 }
01565 size_t lastOffset = countBufferedBytes (charstrings) + 1;
01566 #if SIZE_MAX > U32MAX
01567     if (lastOffset > U32MAX)
01568         fail ("CFF data exceeded size limit.");
01569 #endif
01570 storeU32 (offsets, lastOffset);
01571 int offsetSize = 1 + (lastOffset > 0xff)
01572                 + (lastOffset > 0xffff)
01573                 + (lastOffset > 0xffffffff);
01574 // count (must match 'numGlyphs' in 'maxp' table)
01575 cacheU (cff, font->glyphCount, version * 2);
01576 cacheU8 (cff, offsetSize); // offSize
01577 const uint_least32_t *p = getBufferHead (offsets);
01578 const uint_least32_t *const end = getBufferTail (offsets);
01579 for (; p < end; p++)
01580     cacheU (cff, *p, offsetSize); // offsets
01581 cacheBuffer (cff, charstrings); // data
01582 freeBuffer (offsets);
01583 freeBuffer (charstrings);
01584 freeBuffer (outline);

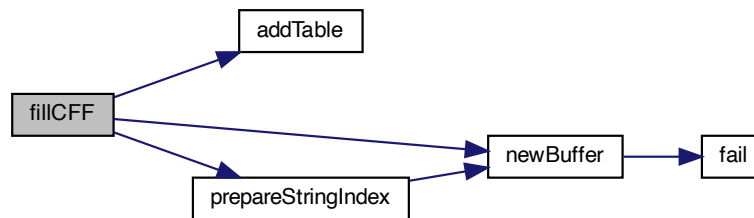
```

```

01585     }
01586 #undef cacheCFF32
01587 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.20 fillCmapTable()

```

void fillCmapTable (
    Font * font )

```

Fill a "cmap" font table.

The "cmap" table contains character to glyph index mapping information.

Parameters

in,out	font	The Font struct to which to add the table.
--------	------	--

Definition at line [2109](#) of file [hex2otf.c](#).

```

02110 {
02111     Glyph *const glyphs = getBufferHead (font->glyphs);
02112     Buffer *rangeHeads = newBuffer (16);
02113     uint_fast32_t rangeCount = 0;

```

```

02114     uint_fast32_t bmpRangeCount = 1; // 1 for the last 0xffff-0xffff range
02115     glyphs[0].codePoint = glyphs[1].codePoint; // to start a range at glyph 1
02116     for (uint_fast16_t i = 1; i < font->glyphCount; i++)
02117     {
02118         if (glyphs[i].codePoint != glyphs[i - 1].codePoint + 1)
02119         {
02120             storeU16 (rangeHeads, i);
02121             rangeCount++;
02122             bmpRangeCount += glyphs[i].codePoint < 0xffff;
02123         }
02124     }
02125     Buffer *cmap = newBuffer (256);
02126     addTable (font, "cmap", cmap);
02127     // Format 4 table is always generated for compatibility.
02128     bool hasFormat12 = glyphs[font->glyphCount - 1].codePoint > 0xffff;
02129     cacheU16 (cmap, 0); // version
02130     cacheU16 (cmap, 1 + hasFormat12); // numTables
02131     { // encodingRecords[0]
02132         cacheU16 (cmap, 3); // platformID
02133         cacheU16 (cmap, 1); // encodingID
02134         cacheU32 (cmap, 12 + 8 * hasFormat12); // subtableOffset
02135     }
02136     if (hasFormat12) // encodingRecords[1]
02137     {
02138         cacheU16 (cmap, 3); // platformID
02139         cacheU16 (cmap, 10); // encodingID
02140         cacheU32 (cmap, 36 + 8 * bmpRangeCount); // subtableOffset
02141     }
02142     const uint_least16_t *ranges = getBufferHead (rangeHeads);
02143     const uint_least16_t *const rangesEnd = getBufferTail (rangeHeads);
02144     storeU16 (rangeHeads, font->glyphCount);
02145     { // format 4 table
02146         cacheU16 (cmap, 4); // format
02147         cacheU16 (cmap, 16 + 8 * bmpRangeCount); // length
02148         cacheU16 (cmap, 0); // language
02149         if (bmpRangeCount * 2 > U16MAX)
02150             fail ("Too many ranges in 'cmap' table.");
02151         cacheU16 (cmap, bmpRangeCount * 2); // segCountX2
02152         uint_fast16_t searchRange = 1, entrySelector = -1;
02153         while (searchRange <= bmpRangeCount)
02154         {
02155             searchRange <= 1;
02156             entrySelector++;
02157         }
02158         cacheU16 (cmap, searchRange); // searchRange
02159         cacheU16 (cmap, entrySelector); // entrySelector
02160         cacheU16 (cmap, bmpRangeCount * 2 - searchRange); // rangeShift
02161         { // endCode[]
02162             const uint_least16_t *p = ranges;
02163             for (p++; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02164                 cacheU16 (cmap, glyphs[*p - 1].codePoint);
02165             uint_fast32_t cp = glyphs[*p - 1].codePoint;
02166             if (cp > 0xffff)
02167                 cp = 0xffff;
02168             cacheU16 (cmap, cp);
02169             cacheU16 (cmap, 0xffff);
02170         }
02171         cacheU16 (cmap, 0); // reservedPad
02172         { // startCode[]
02173             for (uint_fast32_t i = 0; i < bmpRangeCount - 1; i++)
02174                 cacheU16 (cmap, glyphs[ranges[i]].codePoint);
02175             cacheU16 (cmap, 0xffff);
02176         }
02177         { // idDelta[]
02178             const uint_least16_t *p = ranges;
02179             for (; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02180                 cacheU16 (cmap, *p - glyphs[*p].codePoint);
02181             uint_fast16_t delta = 1;
02182             if (p < rangesEnd && *p == 0xffff)
02183                 delta = *p - glyphs[*p].codePoint;
02184             cacheU16 (cmap, delta);
02185         }
02186         { // idRangeOffsets[]
02187             for (uint_least16_t i = 0; i < bmpRangeCount; i++)
02188                 cacheU16 (cmap, 0);
02189         }
02190     }
02191     if (hasFormat12) // format 12 table
02192     {
02193         cacheU16 (cmap, 12); // format
02194         cacheU16 (cmap, 0); // reserved

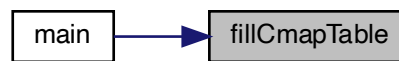
```

```

02195     cacheU32 (cmap, 16 + 12 * rangeCount); // length
02196     cacheU32 (cmap, 0); // language
02197     cacheU32 (cmap, rangeCount); // numGroups
02198
02199     // groups[]
02200     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
02201     {
02202         cacheU32 (cmap, glyphs[*p].codePoint); // startCharCode
02203         cacheU32 (cmap, glyphs[p[1] - 1].codePoint); // endCharCode
02204         cacheU32 (cmap, *p); // startGlyphID
02205     }
02206 }
02207 freeBuffer (rangeHeads);
02208 }

```

Here is the caller graph for this function:



5.3.5.21 fillGposTable()

```
void fillGposTable (
```

```
    Font * font )
```

Fill a "GPOS" font table.

The "GPOS" table contains information for glyph positioning.

Parameters

in,out	font	The Font struct to which to add the table.
--------	------	--

Definition at line [2241](#) of file [hex2otf.c](#).

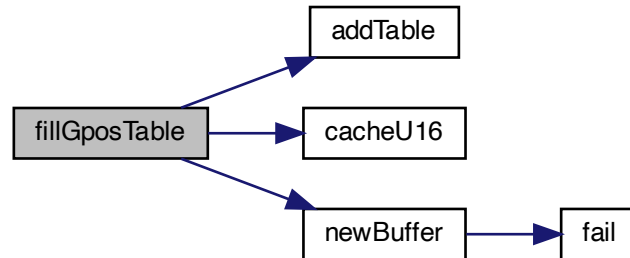
```

02242 {
02243     Buffer *gpos = newBuffer (16);
02244     addTable (font, "GPOS", gpos);
02245     cacheU16 (gpos, 1); // majorVersion
02246     cacheU16 (gpos, 0); // minorVersion
02247     cacheU16 (gpos, 10); // scriptListOffset
02248     cacheU16 (gpos, 12); // featureListOffset
02249     cacheU16 (gpos, 14); // lookupListOffset
02250     { // ScriptList table
02251         cacheU16 (gpos, 0); // scriptCount
02252     }
02253     { // Feature List table
02254         cacheU16 (gpos, 0); // featureCount
02255     }
02256     { // Lookup List Table
02257         cacheU16 (gpos, 0); // lookupCount
02258     }

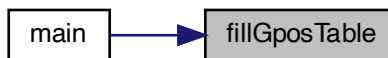
```

02259 }

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.22 fillGsubTable()

```
void fillGsubTable (
    Font * font )
```

Fill a "GSUB" font table.

The "GSUB" table contains information for glyph substitution.

Parameters

in,out	font	The Font struct to which to add the table.
--------	------	--

Definition at line [2269](#) of file [hex2otf.c](#).

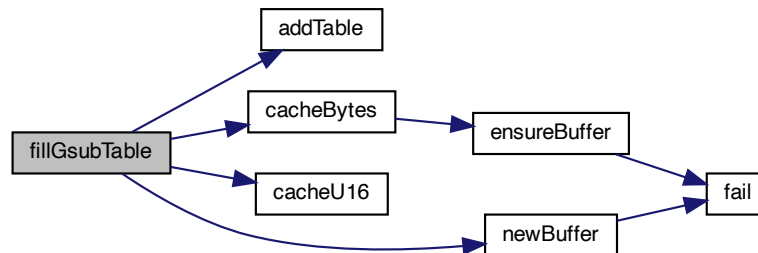
```
02270 {
02271     Buffer *gsub = newBuffer (38);
```

```

02272 addTable (font, "GSUB", gsub);
02273 cacheU16 (gsub, 1); // majorVersion
02274 cacheU16 (gsub, 0); // minorVersion
02275 cacheU16 (gsub, 10); // scriptListOffset
02276 cacheU16 (gsub, 34); // featureListOffset
02277 cacheU16 (gsub, 36); // lookupListOffset
02278 { // ScriptList table
02279     cacheU16 (gsub, 2); // scriptCount
02280     { // scriptRecords[0]
02281         cacheBytes (gsub, "DFLT", 4); // scriptTag
02282         cacheU16 (gsub, 14); // scriptOffset
02283     }
02284     { // scriptRecords[1]
02285         cacheBytes (gsub, "thai", 4); // scriptTag
02286         cacheU16 (gsub, 14); // scriptOffset
02287     }
02288     { // Script table
02289         cacheU16 (gsub, 4); // defaultLangSysOffset
02290         cacheU16 (gsub, 0); // langSysCount
02291         { // Default Language System table
02292             cacheU16 (gsub, 0); // lookupOrderOffset
02293             cacheU16 (gsub, 0); // requiredFeatureIndex
02294             cacheU16 (gsub, 0); // featureIndexCount
02295         }
02296     }
02297 }
02298 { // Feature List table
02299     cacheU16 (gsub, 0); // featureCount
02300 }
02301 { // Lookup List Table
02302     cacheU16 (gsub, 0); // lookupCount
02303 }
02304 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.23 fillHeadTable()

```
void fillHeadTable (
    Font * font,
    enum LocaFormat locaFormat,
    pixels_t xMin )
```

Fill a "head" font table.

The "head" table contains font header information common to the whole font.

Parameters

in,out	font	The Font struct to which to add the table.
in	locaFormat	The "loca" offset index location table.
in	xMin	The minimum x-coordinate for a glyph.

Definition at line 1853 of file [hex2otf.c](#).

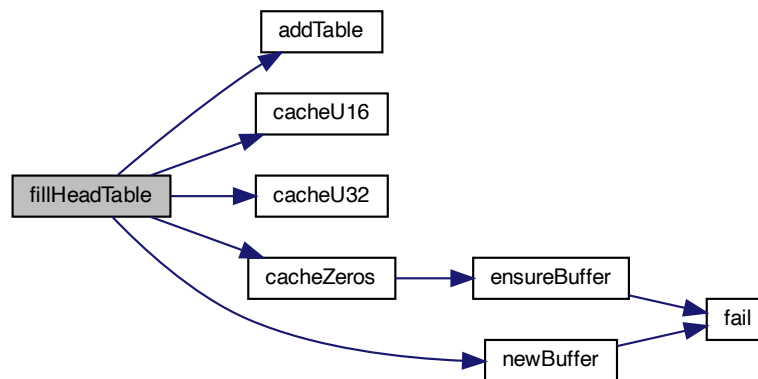
```
01854 {
01855     Buffer *head = newBuffer (56);
01856     addTable (font, "head", head);
01857     cacheU16 (head, 1); // majorVersion
01858     cacheU16 (head, 0); // minorVersion
01859     cacheZeros (head, 4); // fontRevision (unused)
01860     // The 'checksumAdjustment' field is a checksum of the entire file.
01861     // It is later calculated and written directly in the 'writeFont' function.
01862     cacheU32 (head, 0); // checksumAdjustment (placeholder)
01863     cacheU32 (head, 0x5f0f3cf5); // magicNumber
01864     const uint_fast16_t flags =
01865         + B1 (0) // baseline at y=0
01866         + B1 (1) // LSB at x=0 (doubtful; probably should be LSB=xMin)
01867         + B0 (2) // instructions may depend on point size
01868         + B0 (3) // force internal ppem to integers
01869         + B0 (4) // instructions may alter advance width
01870         + B0 (5) // not used in OpenType
01871         + B0 (6) // not used in OpenType
01872         + B0 (7) // not used in OpenType
01873         + B0 (8) // not used in OpenType
01874         + B0 (9) // not used in OpenType
01875         + B0 (10) // not used in OpenType
01876         + B0 (11) // font transformed
01877         + B0 (12) // font converted
01878         + B0 (13) // font optimized for ClearType
01879         + B0 (14) // last resort font
01880         + B0 (15) // reserved
01881     ;
01882     cacheU16 (head, flags); // flags
```

```

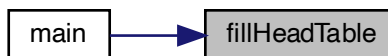
01883  cacheU16 (head, FUPEM); // unitsPerEm
01884  cacheZeros (head, 8); // created (unused)
01885  cacheZeros (head, 8); // modified (unused)
01886  cacheU16 (head, FU (xMin)); // xMin
01887  cacheU16 (head, FU (-DESCENDER)); // yMin
01888  cacheU16 (head, FU (font->maxWidth)); // xMax
01889  cacheU16 (head, FU (ASCENDER)); // yMax
01890  // macStyle (must agree with 'fsSelection' in 'OS/2' table)
01891  const uint_fast16_t macStyle =
01892      + B0 (0) // bold
01893      + B0 (1) // italic
01894      + B0 (2) // underline
01895      + B0 (3) // outline
01896      + B0 (4) // shadow
01897      + B0 (5) // condensed
01898      + B0 (6) // extended
01899      // 7-15 reserved
01900  ;
01901  cacheU16 (head, macStyle);
01902  cacheU16 (head, GLYPH_HEIGHT); // lowestRecPPEM
01903  cacheU16 (head, 2); // fontDirectionHint
01904  cacheU16 (head, locaFormat); // indexToLocFormat
01905  cacheU16 (head, 0); // glyphDataFormat
01906 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.24 fillHheaTable()

```
void fillHheaTable (
```

```
Font * font,
pixels_t xMin )
```

Fill a "hhea" font table.

The "hhea" table contains horizontal header information, for example left and right side bearings.

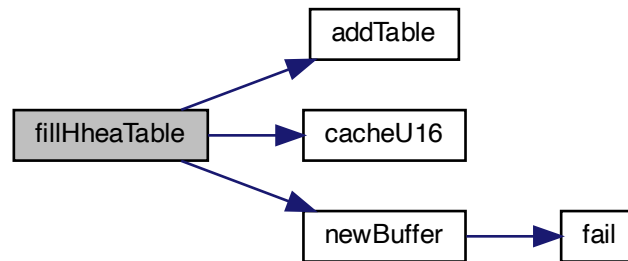
Parameters

in,out	font	The Font struct to which to add the table.
in	xMin	The minimum x-coordinate for a glyph.

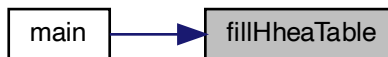
Definition at line 1918 of file [hex2otf.c](#).

```
01919 {
01920     Buffer *hhea = newBuffer (36);
01921     addTable (font, "hhea", hhea);
01922     cacheU16 (hhea, 1); // majorVersion
01923     cacheU16 (hhea, 0); // minorVersion
01924     cacheU16 (hhea, FU (ASCENDER)); // ascender
01925     cacheU16 (hhea, FU (-DESCENDER)); // descender
01926     cacheU16 (hhea, FU (0)); // lineGap
01927     cacheU16 (hhea, FU (font->maxWidth)); // advanceWidthMax
01928     cacheU16 (hhea, FU (xMin)); // minLeftSideBearing
01929     cacheU16 (hhea, FU (0)); // minRightSideBearing (unused)
01930     cacheU16 (hhea, FU (font->maxWidth)); // xMaxExtent
01931     cacheU16 (hhea, 1); // caretSlopeRise
01932     cacheU16 (hhea, 0); // caretSlopeRun
01933     cacheU16 (hhea, 0); // caretOffset
01934     cacheU16 (hhea, 0); // reserved
01935     cacheU16 (hhea, 0); // reserved
01936     cacheU16 (hhea, 0); // reserved
01937     cacheU16 (hhea, 0); // reserved
01938     cacheU16 (hhea, 0); // metricDataFormat
01939     cacheU16 (hhea, font->glyphCount); // numberOfMetrics
01940 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.25 fillHmtxTable()

void fillHmtxTable (
 Font * font)

Fill an "hmtx" font table.

The "hmtx" table contains horizontal metrics information.

Parameters

in,out	font	The Font struct to which to add the table.
--------	------	--

Definition at line [2087](#) of file [hex2otf.c](#).

```

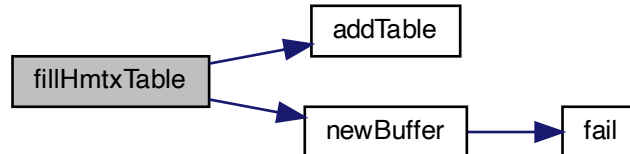
02088 {
02089     Buffer *hmtx = newBuffer (4 * font->glyphCount);
02090     addTable (font, "hmtx", hmtx);
02091     const Glyph *const glyphs = getBufferHead (font->glyphs);
  
```

```

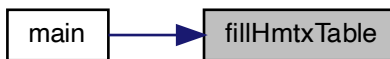
02092  const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
02093  for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
02094  {
02095      int_fast16_t aw = glyph->combining ? 0 : PW (glyph->byteCount);
02096      cacheU16 (hmtx, FU (aw)); // advanceWidth
02097      cacheU16 (hmtx, FU (glyph->lsb)); // lsb
02098  }
02099  }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.26 fillMaxpTable()

```

void fillMaxpTable (
    Font * font,
    bool isCFF,
    uint_fast16_t maxPoints,
    uint_fast16_t maxContours )

```

Fill a "maxp" font table.

The "maxp" table contains maximum profile information, such as the memory required to contain the font.

Parameters

in,out	font	The <code>Font</code> struct to which to add the table.
--------	------	---

Parameters

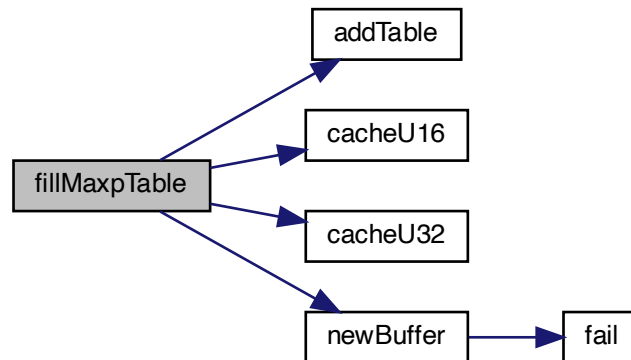
in	isCFF	true if a CFF font is included, false otherwise.
in	maxPoints	Maximum points in a non-composite glyph.
in	maxContours	Maximum contours in a non-composite glyph.

Definition at line 1954 of file [hex2otf.c](#).

```

01956 {
01957     Buffer *maxp = newBuffer (32);
01958     addTable (font, "maxp", maxp);
01959     cacheU32 (maxp, isCFF ? 0x00005000 : 0x00010000); // version
01960     cacheU16 (maxp, font->glyphCount); // numGlyphs
01961     if (isCFF)
01962         return;
01963     cacheU16 (maxp, maxPoints); // maxPoints
01964     cacheU16 (maxp, maxContours); // maxContours
01965     cacheU16 (maxp, 0); // maxCompositePoints
01966     cacheU16 (maxp, 0); // maxCompositeContours
01967     cacheU16 (maxp, 0); // maxZones
01968     cacheU16 (maxp, 0); // maxTwilightPoints
01969     cacheU16 (maxp, 0); // maxStorage
01970     cacheU16 (maxp, 0); // maxFunctionDefs
01971     cacheU16 (maxp, 0); // maxInstructionDefs
01972     cacheU16 (maxp, 0); // maxStackElements
01973     cacheU16 (maxp, 0); // maxSizeOfInstructions
01974     cacheU16 (maxp, 0); // maxComponentElements
01975     cacheU16 (maxp, 0); // maxComponentDepth
01976 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.27 fillNameTable()

```
void fillNameTable (
    Font * font,
    NameStrings nameStrings )
```

Fill a "name" font table.

The "name" table contains name information, for example for Name IDs.

Parameters

in,out	font	The <code>Font</code> struct to which to add the table.
--------	------	---

Parameters

in	names	List of NameStrings.
----	-------	----------------------

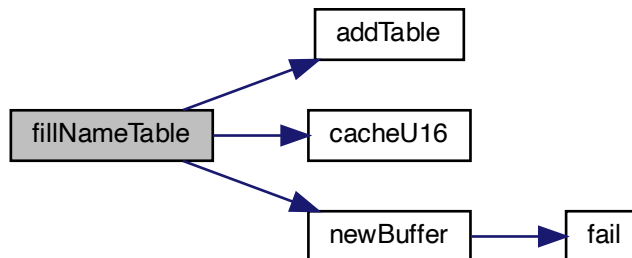
Definition at line 2366 of file [hex2otf.c](#).

```

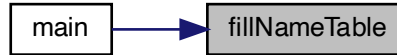
02367 {
02368     Buffer *name = newBuffer (2048);
02369     addTable (font, "name", name);
02370     size_t nameStringCount = 0;
02371     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02372         nameStringCount += !nameStrings[i];
02373     cacheU16 (name, 0); // version
02374     cacheU16 (name, nameStringCount); // count
02375     cacheU16 (name, 2 * 3 + 12 * nameStringCount); // storageOffset
02376     Buffer *stringData = newBuffer (1024);
02377     // nameRecord[]
02378     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02379     {
02380         if (!nameStrings[i])
02381             continue;
02382         size_t offset = countBufferedBytes (stringData);
02383         cacheStringAsUTF16BE (stringData, nameStrings[i]);
02384         size_t length = countBufferedBytes (stringData) - offset;
02385         if (offset > U16MAX || length > U16MAX)
02386             fail ("Name strings are too long.");
02387         // Platform ID 0 (Unicode) is not well supported.
02388         // ID 3 (Windows) seems to be the best for compatibility.
02389         cacheU16 (name, 3); // platformID = Windows
02390         cacheU16 (name, 1); // encodingID = Unicode BMP
02391         cacheU16 (name, 0x0409); // languageID = en-US
02392         cacheU16 (name, i); // nameID
02393         cacheU16 (name, length); // length
02394         cacheU16 (name, offset); // stringOffset
02395     }
02396     cacheBuffer (name, stringData);
02397     freeBuffer (stringData);
02398 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.28 fillOS2Table()

void fillOS2Table (
 Font * font)

Fill an "OS/2" font table.

The "OS/2" table contains OS/2 and Windows font metrics information.

Parameters

in,out	font	The Font struct to which to add the table.
--------	------	---

Definition at line 1986 of file [hex2otf.c](#).

```

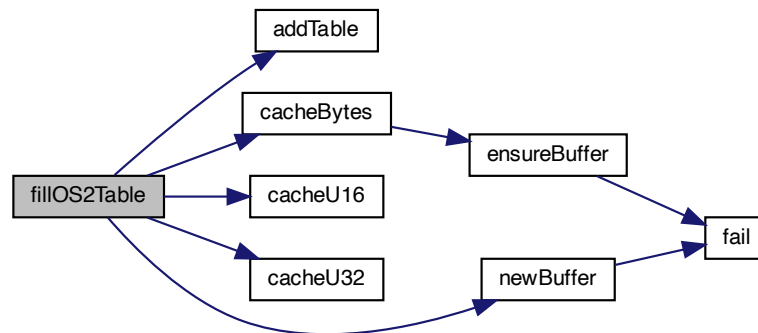
1987 {
1988     Buffer *os2 = newBuffer (100);
1989     addTable (font, "OS/2", os2);
1990     cacheU16 (os2, 5); // version
1991     // HACK: Average glyph width is not actually calculated.
1992     cacheU16 (os2, FU (font->maxWidth)); // xAvgCharWidth
1993     cacheU16 (os2, 400); // usWeightClass = Normal
1994     cacheU16 (os2, 5); // usWidthClass = Medium
1995     const uint_fast16_t typeFlags =
1996         + B0 (0) // reserved
1997         // usage permissions, one of:
1998         // Default: Installable embedding
1999         + B0 (1) // Restricted License embedding
2000         + B0 (2) // Preview & Print embedding
2001         + B0 (3) // Editable embedding
2002         // 4-7 reserved
2003         + B0 (8) // no subsetting
2004         + B0 (9) // bitmap embedding only
2005         // 10-15 reserved
2006     ;
2007     cacheU16 (os2, typeFlags); // fsType
2008     cacheU16 (os2, FU (5)); // ySubscriptXSize
2009     cacheU16 (os2, FU (7)); // ySubscriptYSize
2010     cacheU16 (os2, FU (0)); // ySubscriptXOffset
2011     cacheU16 (os2, FU (1)); // ySubscriptYOffset
2012     cacheU16 (os2, FU (5)); // ySuperscriptXSize
2013     cacheU16 (os2, FU (7)); // ySuperscriptYSize
2014     cacheU16 (os2, FU (0)); // ySuperscriptXOffset
2015     cacheU16 (os2, FU (4)); // ySuperscriptYOffset
2016     cacheU16 (os2, FU (1)); // yStrikeoutSize
2017     cacheU16 (os2, FU (5)); // yStrikeoutPosition
2018     cacheU16 (os2, 0x080a); // sFamilyClass = Sans Serif, Matrix
  
```

```

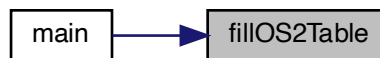
02019  const byte panose[] =
02020  {
02021      2, // Family Kind = Latin Text
02022      11, // Serif Style = Normal Sans
02023      4, // Weight = Thin
02024      // Windows would render all glyphs to the same width,
02025      // if 'Proportion' is set to 'Monospaced' (as Unifont should be).
02026      // 'Condensed' is the best alternative according to metrics.
02027      6, // Proportion = Condensed
02028      2, // Contrast = None
02029      2, // Stroke = No Variation
02030      2, // Arm Style = Straight Arms
02031      8, // Letterform = Normal/Square
02032      2, // Midline = Standard/Trimmed
02033      4, // X-height = Constant/Large
02034  };
02035  cacheBytes (os2, panose, sizeof panose); // panose
02036  // HACK: All defined Unicode ranges are marked functional for convenience.
02037  cacheU32 (os2, 0xffffffff); // ulUnicodeRange1
02038  cacheU32 (os2, 0xffffffff); // ulUnicodeRange2
02039  cacheU32 (os2, 0xffffffff); // ulUnicodeRange3
02040  cacheU32 (os2, 0x0effffff); // ulUnicodeRange4
02041  cacheBytes (os2, "GNU ", 4); // achVendID
02042  // fsSelection (must agree with 'macStyle' in 'head' table)
02043  const uint_fast16_t selection =
02044      + B0 (0) // italic
02045      + B0 (1) // underscored
02046      + B0 (2) // negative
02047      + B0 (3) // outlined
02048      + B0 (4) // strikeout
02049      + B0 (5) // bold
02050      + B1 (6) // regular
02051      + B1 (7) // use sTypo* metrics in this table
02052      + B1 (8) // font name conforms to WWS model
02053      + B0 (9) // oblique
02054      // 10-15 reserved
02055  ;
02056  cacheU16 (os2, selection);
02057  const Glyph *glyphs = getBufferHead (font->glyphs);
02058  uint_fast32_t first = glyphs[1].codePoint;
02059  uint_fast32_t last = glyphs[font->glyphCount - 1].codePoint;
02060  cacheU16 (os2, first < U16MAX ? first : U16MAX); // usFirstCharIndex
02061  cacheU16 (os2, last < U16MAX ? last : U16MAX); // usLastCharIndex
02062  cacheU16 (os2, FU (ASCENDER)); // sTypoAscender
02063  cacheU16 (os2, FU (-DESCENDER)); // sTypoDescender
02064  cacheU16 (os2, FU (0)); // sTypoLineGap
02065  cacheU16 (os2, FU (ASCENDER)); // usWinAscent
02066  cacheU16 (os2, FU (DESCENDER)); // usWinDescent
02067  // HACK: All reasonable code pages are marked functional for convenience.
02068  cacheU32 (os2, 0x603f01ff); // ulCodePageRange1
02069  cacheU32 (os2, 0xffff0000); // ulCodePageRange2
02070  cacheU16 (os2, FU (8)); // sxHeight
02071  cacheU16 (os2, FU (10)); // sCapHeight
02072  cacheU16 (os2, 0); // usDefaultChar
02073  cacheU16 (os2, 0x20); // usBreakChar
02074  cacheU16 (os2, 0); // usMaxContext
02075  cacheU16 (os2, 0); // usLowerOpticalPointSize
02076  cacheU16 (os2, 0xffff); // usUpperOpticalPointSize
02077  }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.29 fillPostTable()

```
void fillPostTable (
    Font * font )
```

Fill a "post" font table.

The "post" table contains information for PostScript printers.

Parameters

in,out	font	The Font struct to which to add the table.
--------	------	--

Definition at line [2218](#) of file [hex2otf.c](#).

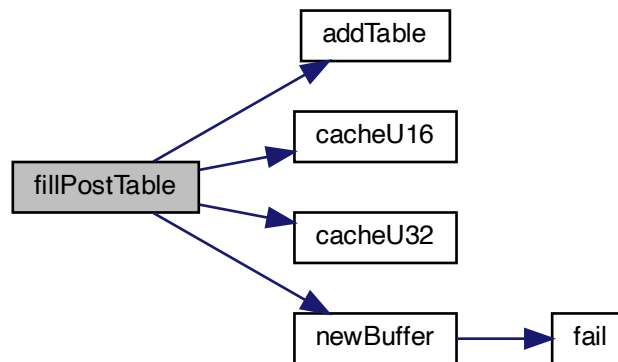
```
02219 {
02220     Buffer *post = newBuffer (32);
```

```

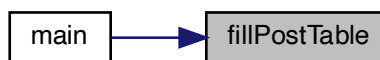
02221  addTable (font, "post", post);
02222  cacheU32 (post, 0x00030000); // version = 3.0
02223  cacheU32 (post, 0); // italicAngle
02224  cacheU16 (post, 0); // underlinePosition
02225  cacheU16 (post, 1); // underlineThickness
02226  cacheU32 (post, 1); // isFixedPitch
02227  cacheU32 (post, 0); // minMemType42
02228  cacheU32 (post, 0); // maxMemType42
02229  cacheU32 (post, 0); // minMemType1
02230  cacheU32 (post, 0); // maxMemType1
02231 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.30 fillTrueType()

```

void fillTrueType (
    Font * font,
    enum LocaFormat * format,
    uint_fast16_t * maxPoints,
    uint_fast16_t * maxContours )

```

Add a TrueType table to a font.

Parameters

in,out	font	Pointer to a Font struct to contain the True-Type table.
in	format	The True-Type "loca" table format, Off-set16 or Off-set32.
in	names	List of NameStrings.

Definition at line 1597 of file [hex2otf.c](#).

```

01599 {
01600     Buffer *glyph = newBuffer (65536);
01601     addTable (font, "glyph", glyph);
01602     Buffer *loca = newBuffer (4 * (font->glyphCount + 1));
01603     addTable (font, "loca", loca);
01604     *format = LOCA_OFFSET32;
01605     Buffer *endPoints = newBuffer (256);
01606     Buffer *flags = newBuffer (256);
01607     Buffer *xs = newBuffer (256);
01608     Buffer *ys = newBuffer (256);
01609     Buffer *outline = newBuffer (1024);
01610     Glyph *const glyphs = getBufferHead (font->glyphs);
01611     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01612     for (Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01613     {
01614         cacheU32 (loca, countBufferedBytes (glyph));
01615         pixels_t rx = -glyph->pos;
01616         pixels_t ry = DESCENDER;
01617         pixels_t xMin = GLYPH_MAX_WIDTH, xMax = 0;
01618         pixels_t yMin = ASCENDER, yMax = -DESCENDER;
01619         resetBuffer (endPoints);
01620         resetBuffer (flags);
01621         resetBuffer (xs);
01622         resetBuffer (ys);
01623         resetBuffer (outline);
01624         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_RIGHT);
01625         uint_fast32_t pointCount = 0, contourCount = 0;
01626         for (const pixels_t *p = getBufferHead (outline),
01627              *const end = getBufferTail (outline); p < end;)
01628         {
01629             const enum ContourOp op = *p++;
01630             if (op == OP_CLOSE)
01631             {
01632                 contourCount++;
01633                 assert (contourCount <= U16MAX);
01634                 cacheU16 (endPoints, pointCount - 1);
01635                 continue;
01636             }
01637             assert (op == OP_POINT);

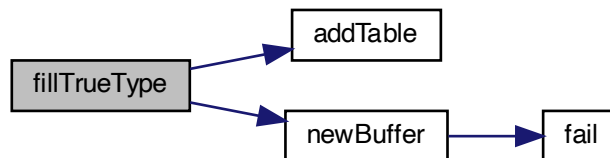
```

```

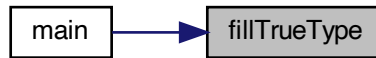
01638     pointCount++;
01639     assert (pointCount <= U16MAX);
01640     const pixels_t x = *p++, y = *p++;
01641     uint_fast8_t pointFlags =
01642         + B1 (0) // point is on curve
01643         + BX (1, x != rx) // x coordinate is 1 byte instead of 2
01644         + BX (2, y != ry) // y coordinate is 1 byte instead of 2
01645         + B0 (3) // repeat
01646         + BX (4, x >= rx) // when x is 1 byte: x is positive;
01647           // when x is 2 bytes: x unchanged and omitted
01648         + BX (5, y >= ry) // when y is 1 byte: y is positive;
01649           // when y is 2 bytes: y unchanged and omitted
01650         + B1 (6) // contours may overlap
01651         + B0 (7) // reserved
01652     ;
01653     cacheU8 (flags, pointFlags);
01654     if (x != rx)
01655         cacheU8 (xs, FU (x > rx ? x - rx : rx - x));
01656     if (y != ry)
01657         cacheU8 (ys, FU (y > ry ? y - ry : ry - y));
01658     if (x < xMin) xMin = x;
01659     if (y < yMin) yMin = y;
01660     if (x > xMax) xMax = x;
01661     if (y > yMax) yMax = y;
01662     rx = x;
01663     ry = y;
01664 }
01665 if (contourCount == 0)
01666     continue; // blank glyph is indicated by the 'loca' table
01667 glyph->lsb = glyph->pos + xMin;
01668 cacheU16 (glyf, contourCount); // numberOfContours
01669 cacheU16 (glyf, FU (glyph->pos + xMin)); // xMin
01670 cacheU16 (glyf, FU (yMin)); // yMin
01671 cacheU16 (glyf, FU (glyph->pos + xMax)); // xMax
01672 cacheU16 (glyf, FU (yMax)); // yMax
01673 cacheBuffer (glyf, endPoints); // endPtsOfContours[]
01674 cacheU16 (glyf, 0); // instructionLength
01675 cacheBuffer (glyf, flags); // flags[]
01676 cacheBuffer (glyf, xs); // xCoordinates[]
01677 cacheBuffer (glyf, ys); // yCoordinates[]
01678 if (pointCount > *maxPoints)
01679     *maxPoints = pointCount;
01680 if (contourCount > *maxContours)
01681     *maxContours = contourCount;
01682 }
01683 cacheU32 (loca, countBufferedBytes (glyf));
01684 freeBuffer (endPoints);
01685 freeBuffer (flags);
01686 freeBuffer (xs);
01687 freeBuffer (ys);
01688 freeBuffer (outline);
01689 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.31 freeBuffer()

```
void freeBuffer (  
    Buffer * buf )
```

Free the memory previously allocated for a buffer.

This function frees the memory allocated to an array of type `Buffer *`.

Parameters

in	buf	The pointer to an array of type <code>Buffer</code> *.

Definition at line 337 of file `hex2otf.c`.

```
00338 {  
00339     free (buf->begin);  
00340     buf->capacity = 0;  
00341 }
```

5.3.5.32 initBuffers()

```
void initBuffers (  
    size_t count )
```

Initialize an array of buffer pointers to all zeroes.

This function initializes the "allBuffers" array of buffer pointers to all zeroes.

Parameters

in	count	The number of buffer array pointers to allocate.
----	-------	--

Definition at line 152 of file [hex2otf.c](#).

```

00153 {
00154     assert (count > 0);
00155     assert (bufferCount == 0); // uninitialized
00156     allBuffers = calloc (count, sizeof *allBuffers);
00157     if (!allBuffers)
00158         fail ("Failed to initialize buffers.");
00159     bufferCount = count;
00160     nextBufferIndex = 0;
00161 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.33 main()

```

int main (
    int argc,
    char * argv[] )

```

The main function.

Parameters

in	argc	The number of command-line arguments.
in	argv	The array of command-line arguments.

Returns

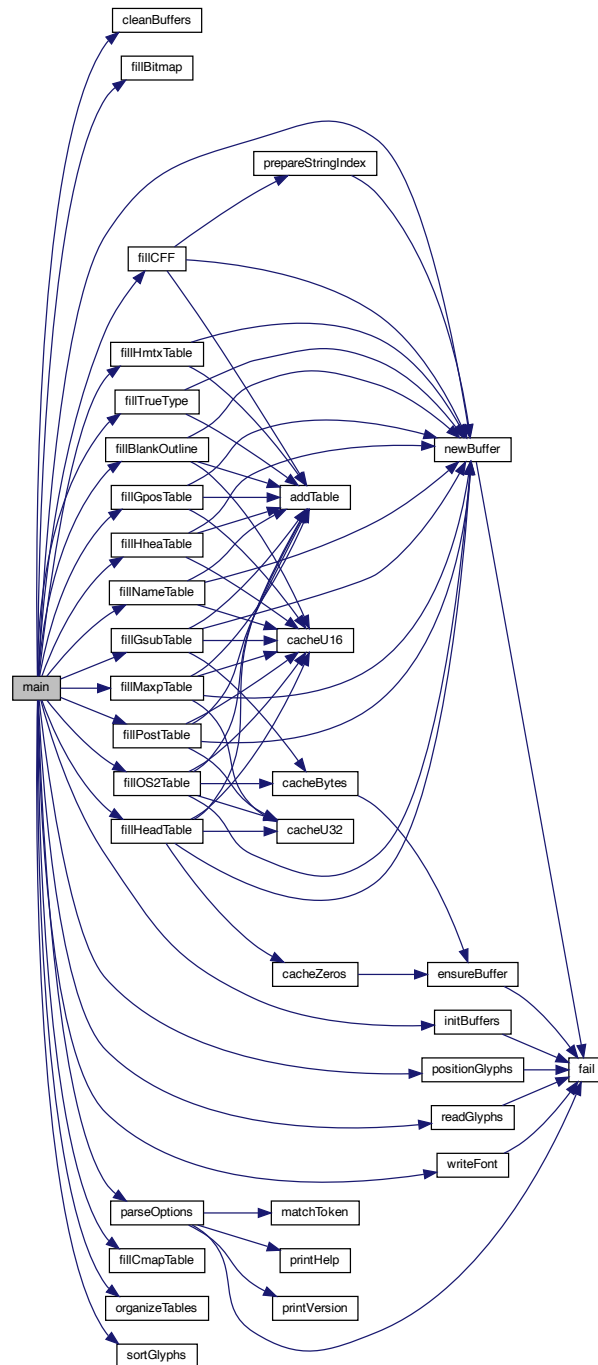
EXIT_FAILURE upon fatal error, EXIT_SUCCESS otherwise.

Definition at line 2603 of file [hex2otf.c](#).

```

02604 {
02605     initBuffers (16);
02606     atexit (cleanBuffers);
02607     Options opt = parseOptions (argv);
02608     Font font;
02609     font.tables = newBuffer (sizeof (Table) * 16);
02610     font.glyphs = newBuffer (sizeof (Glyph) * MAX_GLYPHS);
02611     readGlyphs (&font, opt.hex);
02612     sortGlyphs (&font);
02613     enum LocaFormat loca = LOCA_OFFSET16;
02614     uint_fast16_t maxPoints = 0, maxContours = 0;
02615     pixels_t xMin = 0;
02616     if (opt.pos)
02617         positionGlyphs (&font, opt.pos, &xMin);
02618     if (opt.gpos)
02619         fillGposTable (&font);
02620     if (opt.gsub)
02621         fillGsubTable (&font);
02622     if (opt.cff)
02623         fillCFF (&font, opt.cff, opt.nameStrings);
02624     if (opt.truetype)
02625         fillTrueType (&font, &loca, &maxPoints, &maxContours);
02626     if (opt.blankOutline)
02627         fillBlankOutline (&font);
02628     if (opt.bitmap)
02629         fillBitmap (&font);
02630     fillHeadTable (&font, loca, xMin);
02631     fillHheaTable (&font, xMin);
02632     fillMaxpTable (&font, opt.cff, maxPoints, maxContours);
02633     fillOS2Table (&font);
02634     fillNameTable (&font, opt.nameStrings);
02635     fillHmtxTable (&font);
02636     fillCmapTable (&font);
02637     fillPostTable (&font);
02638     organizeTables (&font, opt.cff);
02639     writeFont (&font, opt.cff, opt.out);
02640     return EXIT_SUCCESS;
02641 }
```

Here is the call graph for this function:



5.3.5.34 matchToken()

```
const char * matchToken (
```

```

    const char * operand,
    const char * key,
    char delimiter )

```

Match a command line option with its key for enabling.

Parameters

in	operand	A pointer to the specified operand.
in	key	Pointer to the option structure.
in	delimiter	The delimiter to end searching.

Returns

Pointer to the first character of the desired option.

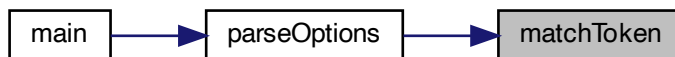
Definition at line 2470 of file [hex2otf.c](#).

```

02471 {
02472     while (*key)
02473         if (*operand++ != *key++)
02474             return NULL;
02475     if (!*operand || *operand++ == delimiter)
02476         return operand;
02477     return NULL;
02478 }

```

Here is the caller graph for this function:



5.3.5.35 newBuffer()

```

Buffer * newBuffer (
    size_t initialCapacity )

```

Create a new buffer.

This function creates a new buffer array of type [Buffer](#), with an initial size of `initialCapacity` elements.

Parameters

in	initialCapacity	The initial number of elements in the buffer.
----	-----------------	---

Definition at line 188 of file [hex2otf.c](#).

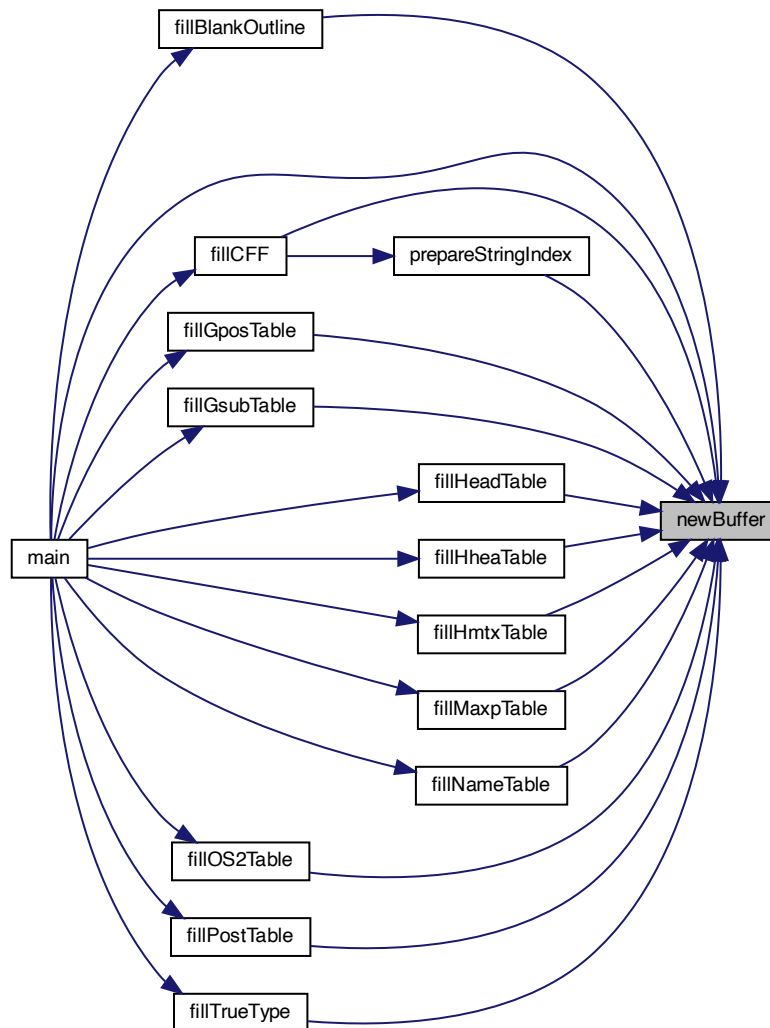
```

00189 {
00190     assert (initialCapacity > 0);
00191     Buffer *buf = NULL;
00192     size_t sentinel = nextBufferIndex;
00193     do
00194     {
00195         if (nextBufferIndex == bufferCount)
00196             nextBufferIndex = 0;
00197         if (allBuffers[nextBufferIndex].capacity == 0)
00198         {
00199             buf = &allBuffers[nextBufferIndex++];
00200             break;
00201         }
00202     } while (++nextBufferIndex != sentinel);
00203     if (!buf) // no existing buffer available
00204     {
00205         size_t newSize = sizeof (Buffer) * bufferCount * 2;
00206         void *extended = realloc (allBuffers, newSize);
00207         if (!extended)
00208             fail ("Failed to create new buffers.");
00209         allBuffers = extended;
00210         memset (allBuffers + bufferCount, 0, sizeof (Buffer) * bufferCount);
00211         buf = &allBuffers[bufferCount];
00212         nextBufferIndex = bufferCount + 1;
00213         bufferCount *= 2;
00214     }
00215     buf->begin = malloc (initialCapacity);
00216     if (!buf->begin)
00217         fail ("Failed to allocate %zu bytes of memory.", initialCapacity);
00218     buf->capacity = initialCapacity;
00219     buf->next = buf->begin;
00220     buf->end = buf->begin + initialCapacity;
00221     return buf;
00222 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.36 organizeTables()

```
void organizeTables (
    Font * font,
    bool isCFF )
```

Sort tables according to OpenType recommendations.

The various tables in a font are sorted in an order recommended for TrueType font files.

Parameters

in,out	font	The font in which to sort tables.
in	isCFF	True iff Compact Font Format (CFF) is being used.

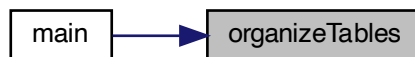
Definition at line 711 of file [hex2otf.c](#).

```

00712 {
00713     const char *const cffOrder[] = {"head", "hhea", "maxp", "OS/2", "name",
00714         "cmap", "post", "CFF ", NULL};
00715     const char *const truetypeOrder[] = {"head", "hhea", "maxp", "OS/2",
00716         "hmtx", "LTSH", "VDMX", "hdmx", "cmap", "fpgm", "prep", "cvt ", "loca",
00717         "glyf", "kern", "name", "post", "gasp", "PCLT", "DSIG", NULL};
00718     const char *const *const order = isCFF ? cffOrder : truetypeOrder;
00719     Table *unordered = getBufferHead (font->tables);
00720     const Table *const tablesEnd = getBufferTail (font->tables);
00721     for (const char *const *p = order; *p; p++)
00722     {
00723         uint_fast32_t tag = tagAsU32 (*p);
00724         for (Table *t = unordered; t < tablesEnd; t++)
00725         {
00726             if (t->tag != tag)
00727                 continue;
00728             if (t != unordered)
00729             {
00730                 Table temp = *unordered;
00731                 *unordered = *t;
00732                 *t = temp;
00733             }
00734             unordered++;
00735             break;
00736         }
00737     }
00738 }

```

Here is the caller graph for this function:



5.3.5.37 parseOptions()

Options parseOptions (
char *const argv[const])

Parse command line options.

Option	Data Type	Description
-----	-----	-----
truetype	bool	Generate TrueType outlines
blankOutline	bool	Generate blank outlines
bitmap	bool	Generate embedded bitmap
gpos	bool	Generate a dummy GPOS table
gsub	bool	Generate a dummy GSUB table
cff	int	Generate CFF 1 or CFF 2 outlines
hex	const char *	Name of Unifont .hex file
pos	const char *	Name of Unifont combining data file
out	const char *	Name of output font file
nameStrings	NameStrings	Array of TrueType font Name IDs

Parameters

in	argv	Pointer to ar- ray of com- mand line op- tions.
----	------	--

Returns

Data structure to hold requested command line options.

Definition at line 2500 of file [hex2otf.c](#).

```

02501 {
02502     Options opt = {0}; // all options default to 0, false and NULL
02503     const char *format = NULL;
02504     struct StringArg
02505     {
02506         const char *const key;
02507         const char **const value;
02508     } strArgs[] =
02509     {
02510         {"hex", &opt.hex},
02511         {"pos", &opt.pos},
02512         {"out", &opt.out},
02513         {"format", &format},
02514         {NULL, NULL} // sentinel
02515     };
02516     for (char *const *argp = argv + 1; *argp; argp++)
02517     {
02518         const char *const arg = *argp;
02519         struct StringArg *p;
02520         const char *value = NULL;
02521         if (strcmp (arg, "--help") == 0)
02522             printHelp ();
02523         if (strcmp (arg, "--version") == 0)
02524             printVersion ();
02525         for (p = strArgs; p->key; p++)
02526             if ((value = matchToken (arg, p->key, '=')))
02527                 break;
02528         if (p->key)
02529         {
02530             if (!*value)
02531                 fail ("Empty argument: '%s'", p->key);
02532             if (*p->value)
02533                 fail ("Duplicate argument: '%s'", p->key);

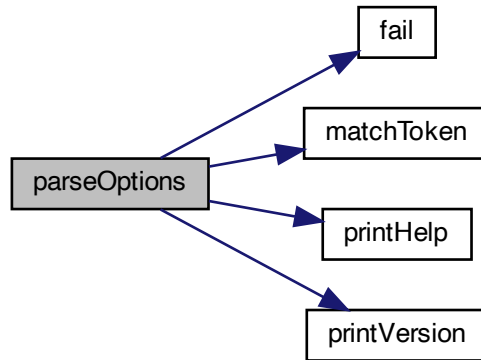
```

```

02534     *p->value = value;
02535 }
02536 else // shall be a name string
02537 {
02538     char *endptr;
02539     unsigned long id = strtoul (arg, &endptr, 10);
02540     if (endptr == arg || id >= MAX_NAME_IDS || *endptr != '=')
02541         fail ("Invalid argument: '%s'", arg);
02542     endptr++; // skip '='
02543     if (opt.nameStrings[id])
02544         fail ("Duplicate name ID: %lu.", id);
02545     opt.nameStrings[id] = endptr;
02546 }
02547 }
02548 if (!opt.hex)
02549     fail ("Hex file is not specified.");
02550 if (opt.pos && opt.pos[0] == '\0')
02551     opt.pos = NULL; // Position file is optional. Empty path means none.
02552 if (!opt.out)
02553     fail ("Output file is not specified.");
02554 if (!format)
02555     fail ("Format is not specified.");
02556 for (const NamePair *p = defaultNames; p->str; p++)
02557     if (!opt.nameStrings[p->id])
02558         opt.nameStrings[p->id] = p->str;
02559 bool cff = false, cff2 = false;
02560 struct Symbol
02561 {
02562     const char *const key;
02563     bool *const found;
02564 } symbols[] =
02565 {
02566     {"cff", &cff},
02567     {"cff2", &cff2},
02568     {"truetype", &opt.truetype},
02569     {"blank", &opt.blankOutline},
02570     {"bitmap", &opt.bitmap},
02571     {"gpos", &opt.gpos},
02572     {"gsub", &opt.gsub},
02573     {NULL, NULL} // sentinel
02574 };
02575 while (*format)
02576 {
02577     const struct Symbol *p;
02578     const char *next = NULL;
02579     for (p = symbols; p->key; p++)
02580         if ((next = matchToken (format, p->key, ',')))
02581             break;
02582     if (!p->key)
02583         fail ("Invalid format.");
02584     *p->found = true;
02585     format = next;
02586 }
02587 if (cff + cff2 + opt.truetype + opt.blankOutline > 1)
02588     fail ("At most one outline format can be accepted.");
02589 if (!(cff || cff2 || opt.truetype || opt.bitmap))
02590     fail ("Invalid format.");
02591 opt.cff = cff + cff2 * 2;
02592 return opt;
02593 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.38 positionGlyphs()

```
void positionGlyphs (
    Font * font,
    const char * fileName,
    pixels_t * xMin )
```

Position a glyph within a 16-by-16 pixel bounding box.

Position a glyph within the 16-by-16 pixel drawing area and note whether or not the glyph is a combining character.

N.B.: Glyphs must be sorted by code point before calling this function.

Parameters

in,out	font	Font data structure pointer to store glyphs.
in	fileName	Name of glyph file to read.
in	xMin	Minimum x-axis value (for left side bearing).

Definition at line 1061 of file [hex2otf.c](#).

```

01062 {
01063     *xMin = 0;
01064     FILE *file = fopen (fileName, "r");
01065     if (!file)
01066         fail ("Failed to open file '%s'", fileName);
01067     Glyph *glyphs = getBufferHead (font->glyphs);
01068     const Glyph *const endGlyph = glyphs + font->glyphCount;
01069     Glyph *nextGlyph = &glyphs[1]; // predict and avoid search
01070     for (;;)
01071     {
01072         uint_fast32_t codePoint;
01073         if (readCodePoint (&codePoint, fileName, file))
01074             break;
01075         Glyph *glyph = nextGlyph;
01076         if (glyph == endGlyph || glyph->codePoint != codePoint)
01077         {
01078             // Prediction failed. Search.
01079             const Glyph key = { .codePoint = codePoint };
01080             glyph = bsearch (&key, glyphs + 1, font->glyphCount - 1,
01081                             sizeof key, byCodePoint);
01082             if (!glyph)
01083                 fail ("Glyph 'PRI_CP' is positioned but not defined.",
01084                     codePoint);
01085         }
01086         nextGlyph = glyph + 1;
01087         char s[8];
01088         if (!fgets (s, sizeof s, file))
01089             fail ("%s: Read error.", fileName);
01090         char *end;
01091         const long value = strtol (s, &end, 10);
01092         if (*end != '\n' && *end != '\0')
01093             fail ("Position of glyph 'PRI_CP' is invalid.", codePoint);
01094         // Currently no glyph is moved to the right,
01095         // so positive position is considered out of range.
01096         // If this limit is to be lifted,
01097         // 'xMax' of bounding box in 'head' table shall also be updated.
01098         if (value < -GLYPH_MAX_WIDTH || value > 0)
01099             fail ("Position of glyph 'PRI_CP' is out of range.", codePoint);
01100         glyph->combining = true;
01101         glyph->pos = value;
01102         glyph->lsb = value; // updated during outline generation
01103         if (value < *xMin)
01104             *xMin = value;

```

```

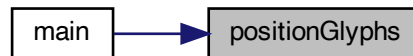
01105     }
01106     fclose (file);
01107 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.39 prepareOffsets()

```

void prepareOffsets (
    size_t * sizes )

```

Prepare 32-bit glyph offsets in a font table.

Parameters

in	sizes	Array of glyph sizes, for offset cal- cula- tions.
----	-------	--

Definition at line [1275](#) of file [hex2otf.c](#).

```

01276 {
01277     size_t *p = sizes;
01278     for (size_t *i = sizes + 1; *i; i++)
01279         *i += *p++;
01280     if (*p > 2147483647U) // offset not representable
01281         fail ("CFF table is too large.");
01282 }

```

Here is the call graph for this function:



5.3.5.40 prepareStringIndex()

`Buffer *` prepareStringIndex (
 const `NameStrings` names)

Prepare a font name string index.

Parameters

in	names	List of name strings.
----	-------	-----------------------------

Returns

Pointer to a `Buffer` struct containing the string names.

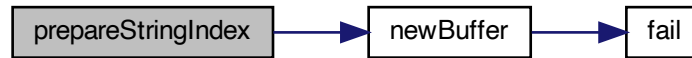
Get the number of elements in array `char *strings[]`.

Definition at line 1291 of file `hex2otf.c`.

```

1292 {
1293     Buffer *buf = newBuffer (256);
1294     assert (names[6]);
1295     const char *strings[] = {"Adobe", "Identity", names[6]};
1296     /// Get the number of elements in array char *strings[].
1297     #define stringCount (sizeof strings / sizeof *strings)
1298     static_assert (stringCount <= U16MAX, "too many strings");
1299     size_t offset = 1;
1300     size_t lengths[stringCount];
1301     for (size_t i = 0; i < stringCount; i++)
1302     {
1303         assert (strings[i]);
1304         lengths[i] = strlen (strings[i]);
1305         offset += lengths[i];
1306     }
1307     int offsetSize = 1 + (offset > 0xff)
1308                     + (offset > 0xffff)
1309                     + (offset > 0xffffffff);
1310     cacheU16 (buf, stringCount); // count
1311     cacheU8 (buf, offsetSize); // offsetSize
1312     cacheU (buf, offset = 1, offsetSize); // offset[0]
1313     for (size_t i = 0; i < stringCount; i++)
1314         cacheU (buf, offset += lengths[i], offsetSize); // offset[i + 1]
1315     for (size_t i = 0; i < stringCount; i++)
1316         cacheBytes (buf, strings[i], lengths[i]);
1317     #undef stringCount
1318     return buf;
1319 }
  
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.41 printHelp()

void printHelp ()

Print help message to stdout and then exit.

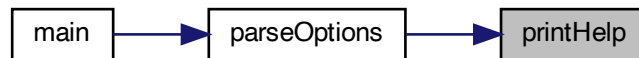
Print help message if invoked with the "--help" option, and then exit successfully.

Definition at line 2426 of file [hex2otf.c](#).

```

02426 {
02427     printf ("Synopsis: hex2otf <options>:\n\n");
02428     printf ("  hex=<filename>      Specify Unifont .hex input file.\n");
02429     printf ("  pos=<filename>      Specify combining file. (Optional)\n");
02430     printf ("  out=<filename>      Specify output font file.\n");
02431     printf ("  format=<f1>,<f2>,... Specify font format(s); values:\n");
02432     printf ("                    cff\n");
02433     printf ("                    cff2\n");
02434     printf ("                    truetype\n");
02435     printf ("                    blank\n");
02436     printf ("                    bitmap\n");
02437     printf ("                    gpos\n");
02438     printf ("                    gsub\n");
02439     printf ("\nExample:\n\n");
02440     printf ("  hex2otf hex=Myfont.hex out=Myfont.otf format=cff\n");
02441     printf ("For more information, consult the hex2otf(1) man page.\n\n");
02442
02443     exit (EXIT_SUCCESS);
02444 }
```

Here is the caller graph for this function:



5.3.5.42 printVersion()

```
void printVersion ( )
```

Print program version string on stdout.

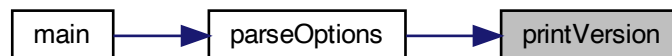
Print program version if invoked with the "--version" option, and then exit successfully.

Definition at line 2407 of file [hex2otf.c](#).

```

02407 {
02408     printf ("hex2otf (GNU Unifont) %s\n", VERSION);
02409     printf ("Copyright \u00A9 2022 \u4F55\u5FD7\u7FD4 (He Zhixiang)\n");
02410     printf ("License GPLv2+: GNU GPL version 2 or later\n");
02411     printf ("<https://gnu.org/licenses/gpl.html>\n");
02412     printf ("This is free software: you are free to change and\n");
02413     printf ("redistribute it.  There is NO WARRANTY, to the extent\n");
02414     printf ("permitted by law.\n");
02415
02416     exit (EXIT_SUCCESS);
02417 }
```

Here is the caller graph for this function:



5.3.5.43 readCodePoint()

```
bool readCodePoint (
    uint_fast32_t * codePoint,
    const char * fileName,
    FILE * file )
```

Read up to 6 hexadecimal digits and a colon from file.

This function reads up to 6 hexadecimal digits followed by a colon from a file.

If the end of the file is reached, the function returns true. The file name is provided to include in an error message if the end of file was reached unexpectedly.

Parameters

out	codePoint	The Uni-code code point.
in	fileName	The name of the input file.
in	file	Pointer to the input file stream.

Returns

true if at end of file, false otherwise.

Definition at line 919 of file [hex2otf.c](#).

```

00920 {
00921     *codePoint = 0;
00922     uint_fast8_t digitCount = 0;
00923     for (;;)
00924     {
00925         int c = getc (file);
00926         if (isxdigit (c) && ++digitCount <= 6)
00927         {
00928             *codePoint = (*codePoint « 4) | nibbleValue (c);
00929             continue;
00930         }
00931         if (c == ':' && digitCount > 0)
00932             return false;
00933         if (c == EOF)
00934         {
00935             if (digitCount == 0)
00936                 return true;
00937             if (feof (file))
00938                 fail ("%s: Unexpected end of file.", fileName);
00939             else
00940                 fail ("%s: Read error.", fileName);
00941         }
00942         fail ("%s: Unexpected character: %#.2x.", fileName, (unsigned)c);
00943     }
00944 }
```

5.3.5.44 readGlyphs()

```

void readGlyphs (
    Font * font,
    const char * fileName )
```

Read glyph definitions from a Unifont .hex format file.

This function reads in the glyph bitmaps contained in a Unifont .hex format file. These input files contain one glyph bitmap per line. Each line is of the form

<hexadecimal code point> ':' <hexadecimal bitmap sequence>

The code point field typically consists of 4 hexadecimal digits for a code point in Unicode Plane 0, and 6 hexadecimal digits for code points above Plane 0. The hexadecimal bitmap sequence is 32 hexadecimal digits long for a glyph that is 8 pixels wide by 16 pixels high, and 64 hexadecimal digits long for a glyph that is 16 pixels wide by 16 pixels high.

Parameters

in,out	font	The font data structure to update with new glyphs.
in	fileName	The name of the Uni-font .hex format input file.

Definition at line 966 of file [hex2otf.c](#).

```

00967 {
00968     FILE *file = fopen (fileName, "r");
00969     if (!file)
00970         fail ("Failed to open file '%s'.", fileName);
00971     uint_fast32_t glyphCount = 1; // for glyph 0
00972     uint_fast8_t maxByteCount = 0;
00973     { // Hard code the notdef glyph.
00974         const byte bitmap[] = "\0\0\0~fZZzvv~vv~\0\0"; // same as U+FFFD
00975         const size_t byteCount = sizeof bitmap - 1;
00976         assert (byteCount <= GLYPH_MAX_BYTE_COUNT);
00977         assert (byteCount % GLYPH_HEIGHT == 0);
00978         Glyph *notdef = getBufferSlot (font->glyphs, sizeof (Glyph));
00979         memcpy (notdef->bitmap, bitmap, byteCount);
00980         notdef->byteCount = maxByteCount = byteCount;
00981         notdef->combining = false;
00982         notdef->pos = 0;
00983         notdef->lsb = 0;
00984     }
00985     for (;;)
00986     {
00987         uint_fast32_t codePoint;
00988         if (readCodePoint (&codePoint, fileName, file))
00989             break;
00990         if (++glyphCount > MAX_GLYPHS)
00991             fail ("OpenType does not support more than %lu glyphs.",
00992                 MAX_GLYPHS);
00993         Glyph *glyph = getBufferSlot (font->glyphs, sizeof (Glyph));
00994         glyph->codePoint = codePoint;
00995         glyph->byteCount = 0;
00996         glyph->combining = false;
00997         glyph->pos = 0;
00998         glyph->lsb = 0;
00999         for (byte *p = glyph->bitmap;; p++)
01000         {
01001             int h, l;
01002             if (isxdigit (h = getc (file)) && isxdigit (l = getc (file)))
01003             {
01004                 if (++glyph->byteCount > GLYPH_MAX_BYTE_COUNT)
01005                     fail ("Hex stream of 'PRI_CP' is too long.", codePoint);
01006                 *p = nibbleValue (h) « 4 | nibbleValue (l);
01007             }
01008             else if (h == '\n' || (h == EOF && feof (file)))
01009                 break;
01010             else if (ferror (file))
01011                 fail ("%s: Read error.", fileName);

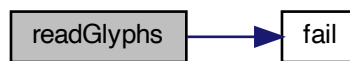
```

```

01012         else
01013             fail ("Hex stream of "PRI_CP" is invalid.", codePoint);
01014     }
01015     if (glyph->byteCount % GLYPH_HEIGHT != 0)
01016         fail ("Hex length of "PRI_CP" is indivisible by glyph height %d.",
01017             codePoint, GLYPH_HEIGHT);
01018     if (glyph->byteCount > maxByteCount)
01019         maxByteCount = glyph->byteCount;
01020 }
01021 if (glyphCount == 1)
01022     fail ("No glyph is specified.");
01023 font->glyphCount = glyphCount;
01024 font->maxWidth = PW (maxByteCount);
01025 fclose (file);
01026 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.45 sortGlyphs()

```

void sortGlyphs (
    Font * font )

```

Sort the glyphs in a font by Unicode code point.

This function reads in an array of glyphs and sorts them by Unicode code point. If a duplicate code point is encountered, that will result in a fatal error with an error message to stderr.

Parameters

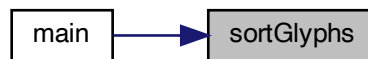
in,out	font	Pointer to a Font structure with glyphs to sort.
--------	------	--

Definition at line 1119 of file [hex2otf.c](#).

```

01120 {
01121     Glyph *glyphs = getBufferHead (font->glyphs);
01122     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01123     glyphs++; // glyph 0 does not need sorting
01124     qsort (glyphs, glyphsEnd - glyphs, sizeof *glyphs, byCodePoint);
01125     for (const Glyph *glyph = glyphs; glyph < glyphsEnd - 1; glyph++)
01126     {
01127         if (glyph[0].codePoint == glyph[1].codePoint)
01128             fail ("Duplicate code point: "PRI_CP", glyph[0].codePoint);
01129         assert (glyph[0].codePoint < glyph[1].codePoint);
01130     }
01131 }
```

Here is the caller graph for this function:



5.3.5.46 writeBytes()

```

void writeBytes (
    const byte bytes[],
    size\_t count,
    FILE * file )
```

Write an array of bytes to an output file.

Parameters

in	bytes	An array of unsigned bytes to write.
----	-------	--------------------------------------

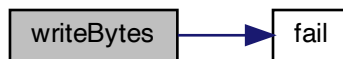
Parameters

in	file	The file pointer for writing, of type FILE*.
----	------	--

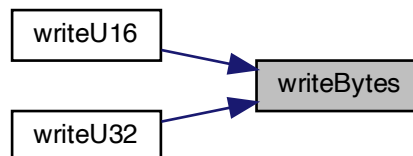
Definition at line 538 of file [hex2otf.c](#).

```
00539 {
00540     if (fwrite (bytes, count, 1, file) != 1 && count != 0)
00541         fail ("Failed to write %zu bytes to output file.", count);
00542 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.47 writeFont()

```
void writeFont (
    Font * font,
    bool isCFF,
    const char * fileName )
```

Write OpenType font to output file.

This function writes the constructed OpenType font to the output file named "filename".

Parameters

in	font	Pointer to the font, of type Font *.
in	isCFF	Boolean indicating whether the font has CFF data.
in	filename	The name of the font file to create.

Add a byte shifted by 24, 16, 8, or 0 bits.

Definition at line [786](#) of file [hex2otf.c](#).

```

00787 {
00788     FILE *file = fopen (fileName, "wb");
00789     if (!file)
00790         fail ("Failed to open file '%s'", fileName);
00791     const Table *const tables = getBufferHead (font->tables);
00792     const Table *const tablesEnd = getBufferTail (font->tables);
00793     size_t tableCount = tablesEnd - tables;
00794     assert (0 < tableCount && tableCount <= U16MAX);
00795     size_t offset = 12 + 16 * tableCount;
00796     uint_fast32_t totalChecksum = 0;
00797     Buffer *tableRecords =
00798         newBuffer (sizeof (struct TableRecord) * tableCount);
00799     for (size_t i = 0; i < tableCount; i++)
00800     {
00801         struct TableRecord *record =
00802             getBufferSlot (tableRecords, sizeof *record);
00803         record->tag = tables[i].tag;
00804         size_t length = countBufferedBytes (tables[i].content);
00805         #if SIZE_MAX > U32MAX
00806             if (offset > U32MAX)
00807                 fail ("Table offset exceeded 4 GiB.");
00808             if (length > U32MAX)
00809                 fail ("Table size exceeded 4 GiB.");
00810         #endif
00811         record->length = length;
00812         record->checksum = 0;
00813         const byte *p = getBufferHead (tables[i].content);
00814         const byte *const end = getBufferTail (tables[i].content);
00815
00816         /// Add a byte shifted by 24, 16, 8, or 0 bits.
00817         #define addByte(shift) \
00818         if (p == end) \
00819             break; \
00820         record->checksum += (uint_fast32_t)*p++ « (shift);
00821
00822         for (;;)
00823         {
00824             addByte (24)
00825             addByte (16)

```

```

00826         addByte (8)
00827         addByte (0)
00828     }
00829     #undef addByte
00830     cacheZeros (tables[i].content, (~length + 1U) & 3U);
00831     record->offset = offset;
00832     offset += countBufferedBytes (tables[i].content);
00833     totalChecksum += record->checksum;
00834 }
00835 struct TableRecord *records = getBufferHead (tableRecords);
00836 qsort (records, tableCount, sizeof *records, byTableTag);
00837 // Offset Table
00838 uint_fast32_t sfntVersion = isCFF ? 0x4f54544f : 0x00010000;
00839 writeU32 (sfntVersion, file); // sfntVersion
00840 totalChecksum += sfntVersion;
00841 uint_fast16_t entrySelector = 0;
00842 for (size_t k = tableCount; k != 1; k >= 1)
00843     entrySelector++;
00844 uint_fast16_t searchRange = 1 << (entrySelector + 4);
00845 uint_fast16_t rangeShift = (tableCount - (1 << entrySelector)) << 4;
00846 writeU16 (tableCount, file); // numTables
00847 writeU16 (searchRange, file); // searchRange
00848 writeU16 (entrySelector, file); // entrySelector
00849 writeU16 (rangeShift, file); // rangeShift
00850 totalChecksum += (uint_fast32_t)tableCount << 16;
00851 totalChecksum += searchRange;
00852 totalChecksum += (uint_fast32_t)entrySelector << 16;
00853 totalChecksum += rangeShift;
00854 // Table Records (always sorted by table tags)
00855 for (size_t i = 0; i < tableCount; i++)
00856 {
00857     // Table Record
00858     writeU32 (records[i].tag, file); // tableTag
00859     writeU32 (records[i].checksum, file); // checksum
00860     writeU32 (records[i].offset, file); // offset
00861     writeU32 (records[i].length, file); // length
00862     totalChecksum += records[i].tag;
00863     totalChecksum += records[i].checksum;
00864     totalChecksum += records[i].offset;
00865     totalChecksum += records[i].length;
00866 }
00867 freeBuffer (tableRecords);
00868 for (const Table *table = tables; table < tablesEnd; table++)
00869 {
00870     if (table->tag == 0x68656164) // 'head' table
00871     {
00872         byte *begin = getBufferHead (table->content);
00873         byte *end = getBufferTail (table->content);
00874         writeBytes (begin, 8, file);
00875         writeU32 (0xb1b0afbaU - totalChecksum, file); // checksumAdjustment
00876         writeBytes (begin + 12, end - (begin + 12), file);
00877         continue;
00878     }
00879     writeBuffer (table->content, file);
00880 }
00881 fclose (file);
00882 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.48 writeU16()

```
void writeU16 (  
    uint_fast16_t value,  
    FILE * file )
```

Write an unsigned 16-bit value to an output file.

This function writes a 16-bit unsigned value in big-endian order to an output file specified with a file pointer.

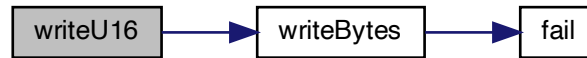
Parameters

in	value	The 16-bit value to write.
in	file	The file pointer for writing, of type FILE*.

Definition at line 554 of file [hex2otf.c](#).

```
00555 {  
00556     byte bytes[] =  
00557     {  
00558         (value » 8) & 0xff,  
00559         (value ) & 0xff,  
00560     };  
00561     writeBytes (bytes, sizeof bytes, file);  
00562 }
```

Here is the call graph for this function:



5.3.5.49 writeU32()

```
void writeU32 (  
    uint_fast32_t value,  
    FILE * file )
```

Write an unsigned 32-bit value to an output file.

This function writes a 32-bit unsigned value in big-endian order to an output file specified with a file pointer.

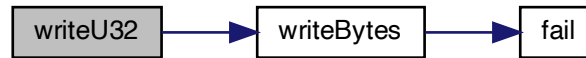
Parameters

in	value	The 32-bit value to write.
in	file	The file pointer for writing, of type FILE*.

Definition at line 574 of file [hex2otf.c](#).

```
00575 {  
00576     byte bytes[] =  
00577     {  
00578         (value » 24) & 0xff,  
00579         (value » 16) & 0xff,  
00580         (value » 8) & 0xff,  
00581         (value ) & 0xff,  
00582     };  
00583     writeBytes (bytes, sizeof bytes, file);  
00584 }
```

Here is the call graph for this function:



5.3.6 Variable Documentation

5.3.6.1 allBuffers

[Buffer](#)* allBuffers

Initial allocation of empty array of buffer pointers.

Definition at line [139](#) of file [hex2otf.c](#).

5.3.6.2 bufferCount

size_t bufferCount

Number of buffers in a [Buffer](#) * array.

Definition at line [140](#) of file [hex2otf.c](#).

5.3.6.3 nextBufferIndex

size_t nextBufferIndex

Index number to tail element of [Buffer](#) * array.

Definition at line [141](#) of file [hex2otf.c](#).

5.4 hex2otf.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file hex2otf.c
00003
00004  @brief hex2otf - Convert GNU Unifont .hex file to OpenType font
00005
00006  This program reads a Unifont .hex format file and a file containing
00007  combining mark offset information, and produces an OpenType font file.
00008
00009  @copyright Copyright © 2022 何志翔 (He Zhixiang)
00010
00011  @author 何志翔 (He Zhixiang)
00012  */
00013
00014  /*
00015  LICENSE:
00016
00017  This program is free software; you can redistribute it and/or
00018  modify it under the terms of the GNU General Public License
00019  as published by the Free Software Foundation; either version 2
00020  of the License, or (at your option) any later version.
00021
00022  This program is distributed in the hope that it will be useful,
00023  but WITHOUT ANY WARRANTY; without even the implied warranty of
  
```

```

00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program; if not, write to the Free Software
00029 Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA
00030 02110-1301, USA.
00031
00032 NOTE: It is a violation of the license terms of this software
00033 to delete or override license and copyright information contained
00034 in the hex2otf.h file if creating a font derived from Unifont glyphs.
00035 Fonts derived from Unifont can add names to the copyright notice
00036 for creators of new or modified glyphs.
00037 */
00038
00039 #include <assert.h>
00040 #include <ctype.h>
00041 #include <inttypes.h>
00042 #include <stdarg.h>
00043 #include <stdbool.h>
00044 #include <stddef.h>
00045 #include <stdio.h>
00046 #include <stdlib.h>
00047 #include <string.h>
00048
00049 #include "hex2otf.h"
00050
00051 #define VERSION "1.0.1" ///< Program version, for "--version" option.
00052
00053 // This program assumes the execution character set is compatible with ASCII.
00054
00055 #define U16MAX 0xffff ///< Maximum UTF-16 code point value.
00056 #define U32MAX 0xffffffff ///< Maximum UTF-32 code point value.
00057
00058 #define PRI_CP "U+%.*"PRI_FAST32 ///< Format string to print Unicode code point.
00059
00060 #ifndef static_assert
00061 #define static_assert(a, b) (assert(a)) ///< If "a" is true, return string "b".
00062 #endif
00063
00064 // Set or clear a particular bit.
00065 #define BX(shift, x) ((uintmax_t)(!!(x)) << (shift)) ///< Truncate & shift word.
00066 #define B0(shift) BX((shift), 0) ///< Clear a given bit in a word.
00067 #define B1(shift) BX((shift), 1) ///< Set a given bit in a word.
00068
00069 #define GLYPH_MAX_WIDTH 16 ///< Maximum glyph width, in pixels.
00070 #define GLYPH_HEIGHT 16 ///< Maximum glyph height, in pixels.
00071
00072 /// Number of bytes to represent one bitmap glyph as a binary array.
00073 #define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)
00074
00075 /// Count of pixels below baseline.
00076 #define DESCENDER 2
00077
00078 /// Count of pixels above baseline.
00079 #define ASCENDER (GLYPH_HEIGHT - DESCENDER)
00080
00081 /// Font units per em.
00082 #define FUPM 64
00083
00084 /// An OpenType font has at most 65536 glyphs.
00085 #define MAX_GLYPHS 65536
00086
00087 /// Name IDs 0-255 are used for standard names.
00088 #define MAX_NAME_IDS 256
00089
00090 /// Convert pixels to font units.
00091 #define FU(x) ((x) * FUPM / GLYPH_HEIGHT)
00092
00093 /// Convert glyph byte count to pixel width.
00094 #define PW(x) ((x) / (GLYPH_HEIGHT / 8))
00095
00096 /// Definition of "byte" type as an unsigned char.
00097 typedef unsigned char byte;
00098
00099 /// This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).
00100 typedef int_least8_t pixels_t;
00101
00102 /**
00103 @brief Print an error message on stderr, then exit.
00104

```

```

00105 This function prints the provided error string and optional
00106 following arguments to stderr, and then exits with a status
00107 of EXIT_FAILURE.
00108
00109 @param[in] reason The output string to describe the error.
00110 @param[in] ... Optional following arguments to output.
00111 */
00112 void
00113 fail (const char *reason, ...)
00114 {
00115     fputs ("ERROR: ", stderr);
00116     va_list args;
00117     va_start (args, reason);
00118     vfprintf (stderr, reason, args);
00119     va_end (args);
00120     putc ('\n', stderr);
00121     exit (EXIT_FAILURE);
00122 }
00123
00124 /**
00125 @brief Generic data structure for a linked list of buffer elements.
00126
00127 A buffer can act as a vector (when filled with 'store*' functions),
00128 or a temporary output area (when filled with 'cache*' functions).
00129 The 'store*' functions use native endian.
00130 The 'cache*' functions use big endian or other formats in OpenType.
00131 Beware of memory alignment.
00132 */
00133 typedef struct Buffer
00134 {
00135     size_t capacity; // = 0 iff this buffer is free
00136     byte *begin, *next, *end;
00137 } Buffer;
00138
00139 Buffer *allBuffers; ///< Initial allocation of empty array of buffer pointers.
00140 size_t bufferCount; ///< Number of buffers in a Buffer * array.
00141 size_t nextBufferIndex; ///< Index number to tail element of Buffer * array.
00142
00143 /**
00144 @brief Initialize an array of buffer pointers to all zeroes.
00145
00146 This function initializes the "allBuffers" array of buffer
00147 pointers to all zeroes.
00148
00149 @param[in] count The number of buffer array pointers to allocate.
00150 */
00151 void
00152 initBuffers (size_t count)
00153 {
00154     assert (count > 0);
00155     assert (bufferCount == 0); // uninitialized
00156     allBuffers = calloc (count, sizeof *allBuffers);
00157     if (!allBuffers)
00158         fail ("Failed to initialize buffers.");
00159     bufferCount = count;
00160     nextBufferIndex = 0;
00161 }
00162
00163 /**
00164 @brief Free all allocated buffer pointers.
00165
00166 This function frees all buffer pointers previously allocated
00167 in the initBuffers function.
00168 */
00169 void
00170 cleanBuffers ()
00171 {
00172     for (size_t i = 0; i < bufferCount; i++)
00173         if (allBuffers[i].capacity)
00174             free (allBuffers[i].begin);
00175     free (allBuffers);
00176     bufferCount = 0;
00177 }
00178
00179 /**
00180 @brief Create a new buffer.
00181
00182 This function creates a new buffer array of type Buffer,
00183 with an initial size of initialCapacity elements.
00184
00185 @param[in] initialCapacity The initial number of elements in the buffer.

```

```

00186 */
00187 Buffer *
00188 newBuffer (size_t initialCapacity)
00189 {
00190     assert (initialCapacity > 0);
00191     Buffer *buf = NULL;
00192     size_t sentinel = nextBufferIndex;
00193     do
00194     {
00195         if (nextBufferIndex == bufferCount)
00196             nextBufferIndex = 0;
00197         if (allBuffers[nextBufferIndex].capacity == 0)
00198         {
00199             buf = &allBuffers[nextBufferIndex++];
00200             break;
00201         }
00202     } while (++nextBufferIndex != sentinel);
00203     if (!buf) // no existing buffer available
00204     {
00205         size_t newSize = sizeof (Buffer) * bufferCount * 2;
00206         void *extended = realloc (allBuffers, newSize);
00207         if (!extended)
00208             fail ("Failed to create new buffers.");
00209         allBuffers = extended;
00210         memset (allBuffers + bufferCount, 0, sizeof (Buffer) * bufferCount);
00211         buf = &allBuffers[bufferCount];
00212         nextBufferIndex = bufferCount + 1;
00213         bufferCount *= 2;
00214     }
00215     buf->begin = malloc (initialCapacity);
00216     if (!buf->begin)
00217         fail ("Failed to allocate %zu bytes of memory.", initialCapacity);
00218     buf->capacity = initialCapacity;
00219     buf->next = buf->begin;
00220     buf->end = buf->begin + initialCapacity;
00221     return buf;
00222 }
00223
00224 /**
00225 @brief Ensure that the buffer has at least the specified minimum size.
00226
00227 This function takes a buffer array of type Buffer and the
00228 necessary minimum number of elements as inputs, and attempts
00229 to increase the size of the buffer if it must be larger.
00230
00231 If the buffer is too small and cannot be resized, the program
00232 will terminate with an error message and an exit status of
00233 EXIT_FAILURE.
00234
00235 @param[in,out] buf The buffer to check.
00236 @param[in] needed The required minimum number of elements in the buffer.
00237 */
00238 void
00239 ensureBuffer (Buffer *buf, size_t needed)
00240 {
00241     if (buf->end - buf->next >= needed)
00242         return;
00243     ptrdiff_t occupied = buf->next - buf->begin;
00244     size_t required = occupied + needed;
00245     if (required < needed) // overflow
00246         fail ("Cannot allocate %zu + %zu bytes of memory.", occupied, needed);
00247     if (required > SIZE_MAX / 2)
00248         buf->capacity = required;
00249     else while (buf->capacity < required)
00250         buf->capacity *= 2;
00251     void *extended = realloc (buf->begin, buf->capacity);
00252     if (!extended)
00253         fail ("Failed to allocate %zu bytes of memory.", buf->capacity);
00254     buf->begin = extended;
00255     buf->next = buf->begin + occupied;
00256     buf->end = buf->begin + buf->capacity;
00257 }
00258
00259 /**
00260 @brief Count the number of elements in a buffer.
00261
00262 @param[in] buf The buffer to be examined.
00263 @return The number of elements in the buffer.
00264 */
00265 static inline size_t
00266 countBufferedBytes (const Buffer *buf)

```

```

00267 {
00268     return buf->next - buf->begin;
00269 }
00270
00271 /**
00272 @brief Get the start of the buffer array.
00273
00274 @param[in] buf The buffer to be examined.
00275 @return A pointer of type Buffer * to the start of the buffer.
00276 */
00277 static inline void *
00278 getBufferHead (const Buffer *buf)
00279 {
00280     return buf->begin;
00281 }
00282
00283 /**
00284 @brief Get the end of the buffer array.
00285
00286 @param[in] buf The buffer to be examined.
00287 @return A pointer of type Buffer * to the end of the buffer.
00288 */
00289 static inline void *
00290 getBufferTail (const Buffer *buf)
00291 {
00292     return buf->next;
00293 }
00294
00295 /**
00296 @brief Add a slot to the end of a buffer.
00297
00298 This function ensures that the buffer can grow by one slot,
00299 and then returns a pointer to the new slot within the buffer.
00300
00301 @param[in] buf The pointer to an array of type Buffer *.
00302 @param[in] slotSize The new slot number.
00303 @return A pointer to the new slot within the buffer.
00304 */
00305 static inline void *
00306 getBufferSlot (Buffer *buf, size_t slotSize)
00307 {
00308     ensureBuffer (buf, slotSize);
00309     void *slot = buf->next;
00310     buf->next += slotSize;
00311     return slot;
00312 }
00313
00314 /**
00315 @brief Reset a buffer pointer to the buffer's beginning.
00316
00317 This function resets an array of type Buffer * to point
00318 its tail to the start of the array.
00319
00320 @param[in] buf The pointer to an array of type Buffer *.
00321 */
00322 static inline void
00323 resetBuffer (Buffer *buf)
00324 {
00325     buf->next = buf->begin;
00326 }
00327
00328 /**
00329 @brief Free the memory previously allocated for a buffer.
00330
00331 This function frees the memory allocated to an array
00332 of type Buffer *.
00333
00334 @param[in] buf The pointer to an array of type Buffer *.
00335 */
00336 void
00337 freeBuffer (Buffer *buf)
00338 {
00339     free (buf->begin);
00340     buf->capacity = 0;
00341 }
00342
00343 /**
00344 @brief Temporary define to look up an element in an array of given type.
00345
00346 This definition is used to create lookup functions to return
00347 a given element in unsigned arrays of size 8, 16, and 32 bytes,

```

```

00348 and in an array of pixels.
00349 */
00350 #define defineStore(name, type) \
00351 void name (Buffer *buf, type value) \
00352 { \
00353     type *slot = getBufferSlot (buf, sizeof value); \
00354     *slot = value; \
00355 }
00356 #defineStore (storeU8, uint_least8_t)
00357 #defineStore (storeU16, uint_least16_t)
00358 #defineStore (storeU32, uint_least32_t)
00359 #defineStore (storePixels, pixels_t)
00360 #undef defineStore
00361
00362 /**
00363 @brief Cache bytes in a big-endian format.
00364
00365 This function adds from 1, 2, 3, or 4 bytes to the end of
00366 a byte array in big-endian order. The buffer is updated
00367 to account for the newly-added bytes.
00368
00369 @param[in,out] buf The array of bytes to which to append new bytes.
00370 @param[in] value The bytes to add, passed as a 32-bit unsigned word.
00371 @param[in] bytes The number of bytes to append to the buffer.
00372 */
00373 void
00374 cacheU (Buffer *buf, uint_fast32_t value, int bytes)
00375 {
00376     assert (1 <= bytes && bytes <= 4);
00377     ensureBuffer (buf, bytes);
00378     switch (bytes)
00379     {
00380         case 4: *buf->next++ = value >> 24 & 0xff; // fall through
00381         case 3: *buf->next++ = value >> 16 & 0xff; // fall through
00382         case 2: *buf->next++ = value >> 8 & 0xff; // fall through
00383         case 1: *buf->next++ = value & 0xff;
00384     }
00385 }
00386
00387 /**
00388 @brief Append one unsigned byte to the end of a byte array.
00389
00390 This function adds one byte to the end of a byte array.
00391 The buffer is updated to account for the newly-added byte.
00392
00393 @param[in,out] buf The array of bytes to which to append a new byte.
00394 @param[in] value The 8-bit unsigned value to append to the buf array.
00395 */
00396 void
00397 cacheU8 (Buffer *buf, uint_fast8_t value)
00398 {
00399     storeU8 (buf, value & 0xff);
00400 }
00401
00402 /**
00403 @brief Append two unsigned bytes to the end of a byte array.
00404
00405 This function adds two bytes to the end of a byte array.
00406 The buffer is updated to account for the newly-added bytes.
00407
00408 @param[in,out] buf The array of bytes to which to append two new bytes.
00409 @param[in] value The 16-bit unsigned value to append to the buf array.
00410 */
00411 void
00412 cacheU16 (Buffer *buf, uint_fast16_t value)
00413 {
00414     cacheU (buf, value, 2);
00415 }
00416
00417 /**
00418 @brief Append four unsigned bytes to the end of a byte array.
00419
00420 This function adds four bytes to the end of a byte array.
00421 The buffer is updated to account for the newly-added bytes.
00422
00423 @param[in,out] buf The array of bytes to which to append four new bytes.
00424 @param[in] value The 32-bit unsigned value to append to the buf array.
00425 */
00426 void
00427 cacheU32 (Buffer *buf, uint_fast32_t value)
00428 {

```

```

00429     cacheU (buf, value, 4);
00430 }
00431
00432 /**
00433 @brief Cache charstring number encoding in a CFF buffer.
00434
00435 This function caches two's complement 8-, 16-, and 32-bit
00436 words as per Adobe's Type 2 Charstring encoding for operands.
00437 These operands are used in Compact Font Format data structures.
00438
00439 Byte values can have offsets, for which this function
00440 compensates, optionally followed by additional bytes:
00441
00442 Byte Range  Offset  Bytes  Adjusted Range
00443 -----
00444 0 to 11      0      1      0 to 11 (operators)
00445 12           0      2      Next byte is 8-bit op code
00446 13 to 18     0      1      13 to 18 (operators)
00447 19 to 20     0      2+     hintmask and cntrmask operators
00448 21 to 27     0      1      21 to 27 (operators)
00449 28           0      3      16-bit 2's complement number
00450 29 to 31     0      1      29 to 31 (operators)
00451 32 to 246   -139     1      -107 to +107
00452 247 to 250  +108     2      +108 to +1131
00453 251 to 254  -108     2      -108 to -1131
00454 255         0      5      16-bit integer and 16-bit fraction
00455
00456 @param[in,out] buf The buffer to which the operand value is appended.
00457 @param[in] value The operand value.
00458 */
00459 void
00460 cacheCFFOperand (Buffer *buf, int_fast32_t value)
00461 {
00462     if (-107 <= value && value <= 107)
00463         cacheU8 (buf, value + 139);
00464     else if (108 <= value && value <= 1131)
00465     {
00466         cacheU8 (buf, (value - 108) / 256 + 247);
00467         cacheU8 (buf, (value - 108) % 256);
00468     }
00469     else if (-32768 <= value && value <= 32767)
00470     {
00471         cacheU8 (buf, 28);
00472         cacheU16 (buf, value);
00473     }
00474     else if (-2147483647 <= value && value <= 2147483647)
00475     {
00476         cacheU8 (buf, 29);
00477         cacheU32 (buf, value);
00478     }
00479     else
00480         assert (false); // other encodings are not used and omitted
00481     static_assert (GLYPH_MAX_WIDTH <= 107, "More encodings are needed.");
00482 }
00483
00484 /**
00485 @brief Append 1 to 4 bytes of zeroes to a buffer, for padding.
00486
00487 @param[in,out] buf The buffer to which the operand value is appended.
00488 @param[in] count The number of bytes containing zeroes to append.
00489 */
00490 void
00491 cacheZeros (Buffer *buf, size_t count)
00492 {
00493     ensureBuffer (buf, count);
00494     memset (buf->next, 0, count);
00495     buf->next += count;
00496 }
00497
00498 /**
00499 @brief Append a string of bytes to a buffer.
00500
00501 This function appends an array of 1 to 4 bytes to the end of
00502 a buffer.
00503
00504 @param[in,out] buf The buffer to which the bytes are appended.
00505 @param[in] src The array of bytes to append to the buffer.
00506 @param[in] count The number of bytes containing zeroes to append.
00507 */
00508 void
00509 cacheBytes (Buffer *restrict buf, const void *restrict src, size_t count)

```

```

00510 {
00511     ensureBuffer (buf, count);
00512     memcpy (buf->next, src, count);
00513     buf->next += count;
00514 }
00515
00516 /**
00517  @brief Append bytes of a table to a byte buffer.
00518
00519  @param[in,out] bufDest The buffer to which the new bytes are appended.
00520  @param[in] bufSrc The bytes to append to the buffer array.
00521  */
00522 void
00523 cacheBuffer (Buffer *restrict bufDest, const Buffer *restrict bufSrc)
00524 {
00525     size_t length = countBufferedBytes (bufSrc);
00526     ensureBuffer (bufDest, length);
00527     memcpy (bufDest->next, bufSrc->begin, length);
00528     bufDest->next += length;
00529 }
00530
00531 /**
00532  @brief Write an array of bytes to an output file.
00533
00534  @param[in] bytes An array of unsigned bytes to write.
00535  @param[in] file The file pointer for writing, of type FILE *.
00536  */
00537 void
00538 writeBytes (const byte bytes[], size_t count, FILE *file)
00539 {
00540     if (fwrite (bytes, count, 1, file) != 1 && count != 0)
00541         fail ("Failed to write %zu bytes to output file.", count);
00542 }
00543
00544 /**
00545  @brief Write an unsigned 16-bit value to an output file.
00546
00547  This function writes a 16-bit unsigned value in big-endian order
00548  to an output file specified with a file pointer.
00549
00550  @param[in] value The 16-bit value to write.
00551  @param[in] file The file pointer for writing, of type FILE *.
00552  */
00553 void
00554 writeU16 (uint_fast16_t value, FILE *file)
00555 {
00556     byte bytes[] =
00557     {
00558         (value » 8) & 0xff,
00559         (value     ) & 0xff,
00560     };
00561     writeBytes (bytes, sizeof bytes, file);
00562 }
00563
00564 /**
00565  @brief Write an unsigned 32-bit value to an output file.
00566
00567  This function writes a 32-bit unsigned value in big-endian order
00568  to an output file specified with a file pointer.
00569
00570  @param[in] value The 32-bit value to write.
00571  @param[in] file The file pointer for writing, of type FILE *.
00572  */
00573 void
00574 writeU32 (uint_fast32_t value, FILE *file)
00575 {
00576     byte bytes[] =
00577     {
00578         (value » 24) & 0xff,
00579         (value » 16) & 0xff,
00580         (value » 8) & 0xff,
00581         (value     ) & 0xff,
00582     };
00583     writeBytes (bytes, sizeof bytes, file);
00584 }
00585
00586 /**
00587  @brief Write an entire buffer array of bytes to an output file.
00588
00589  This function determines the size of a buffer of bytes and
00590  writes that number of bytes to an output file specified with

```

```

00591 a file pointer. The number of bytes is determined from the
00592 length information stored as part of the Buffer * data structure.
00593
00594 @param[in] buf An array containing unsigned bytes to write.
00595 @param[in] file The file pointer for writing, of type FILE *.
00596 */
00597 static inline void
00598 writeBuffer (const Buffer *buf, FILE *file)
00599 {
00600     writeBytes (getBufferHead (buf), countBufferedBytes (buf), file);
00601 }
00602
00603 /// Array of OpenType names indexed directly by Name IDs.
00604 typedef const char *NameStrings[MAX_NAME_IDS];
00605
00606 /**
00607 @brief Data structure to hold data for one bitmap glyph.
00608
00609 This data structure holds data to represent one Unifont bitmap
00610 glyph: Unicode code point, number of bytes in its bitmap array,
00611 whether or not it is a combining character, and an offset from
00612 the glyph origin to the start of the bitmap.
00613 */
00614 typedef struct Glyph
00615 {
00616     uint_least32_t codePoint; ///< undefined for glyph 0
00617     byte bitmap[GLYPH_MAX_BYTE_COUNT]; ///< hexadecimal bitmap character array
00618     uint_least8_t byteCount; ///< length of bitmap data
00619     bool combining; ///< whether this is a combining glyph
00620     pixels_t pos; ///< number of pixels the glyph should be moved to the right
00621     ///< (negative number means moving to the left)
00622     pixels_t lsb; ///< left side bearing (x position of leftmost contour point)
00623 } Glyph;
00624
00625 /**
00626 @brief Data structure to hold information for one font.
00627 */
00628 typedef struct Font
00629 {
00630     Buffer *tables;
00631     Buffer *glyphs;
00632     uint_fast32_t glyphCount;
00633     pixels_t maxWidth;
00634 } Font;
00635
00636 /**
00637 @brief Data structure for an OpenType table.
00638
00639 This data structure contains a table tag and a pointer to the
00640 start of the buffer that holds data for this OpenType table.
00641
00642 For information on the OpenType tables and their structure, see
00643 https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables.
00644 */
00645 typedef struct Table
00646 {
00647     uint_fast32_t tag;
00648     Buffer *content;
00649 } Table;
00650
00651 /**
00652 @brief Index to Location ("loca") offset information.
00653
00654 This enumerated type encodes the type of offset to locations
00655 in a table. It denotes Offset16 (16-bit) and Offset32 (32-bit)
00656 offset types.
00657 */
00658 enum LocaFormat {
00659     LOCA_OFFSET16 = 0,    ///< Offset to location is a 16-bit Offset16 value
00660     LOCA_OFFSET32 = 1,    ///< Offset to location is a 32-bit Offset32 value
00661 };
00662
00663 /**
00664 @brief Convert a 4-byte array to the machine's native 32-bit endian order.
00665
00666 This function takes an array of 4 bytes in big-endian order and
00667 converts it to a 32-bit word in the endian order of the native machine.
00668
00669 @param[in] tag The array of 4 bytes in big-endian order.
00670 @return The 32-bit unsigned word in a machine's native endian order.
00671 */

```

```

00672 static inline uint_fast32_t tagAsU32 (const char tag[static 4])
00673 {
00674     uint_fast32_t r = 0;
00675     r |= (tag[0] & 0xff) << 24;
00676     r |= (tag[1] & 0xff) << 16;
00677     r |= (tag[2] & 0xff) << 8;
00678     r |= (tag[3] & 0xff);
00679     return r;
00680 }
00681 /**
00682 @brief Add a TrueType or OpenType table to the font.
00683 This function adds a TrueType or OpenType table to a font.
00684 The 4-byte table tag is passed as an unsigned 32-bit integer
00685 in big-endian format.
00686 @param[in,out] font The font to which a font table will be added.
00687 @param[in] tag The 4-byte table name.
00688 @param[in] content The table bytes to add, of type Buffer *.
00689 */
00690 void
00691 addTable (Font *font, const char tag[static 4], Buffer *content)
00692 {
00693     Table *table = getBufferSlot (font->tables, sizeof (Table));
00694     table->tag = tagAsU32 (tag);
00695     table->content = content;
00696 }
00697 /**
00698 @brief Sort tables according to OpenType recommendations.
00699 The various tables in a font are sorted in an order recommended
00700 for TrueType font files.
00701 @param[in,out] font The font in which to sort tables.
00702 @param[in] isCFF True iff Compact Font Format (CFF) is being used.
00703 */
00704 void
00705 organizeTables (Font *font, bool isCFF)
00706 {
00707     const char *const cffOrder[] = {"head","hhea","maxp","OS/2","name",
00708                                     "cmap","post","CFF ",NULL};
00709     const char *const truetypeOrder[] = {"head","hhea","maxp","OS/2",
00710                                           "hmtx","LTSH","VDMX","hdmx","cmap","fpgm","prep","cvt ","loca",
00711                                           "glyf","kern","name","post","gasp","PCLT","DSIG",NULL};
00712     const char *const *const order = isCFF ? cffOrder : truetypeOrder;
00713     Table *unordered = getBufferHead (font->tables);
00714     const Table *const tablesEnd = getBufferTail (font->tables);
00715     for (const char *const *p = order; *p; p++)
00716     {
00717         uint_fast32_t tag = tagAsU32 (*p);
00718         for (Table *t = unordered; t < tablesEnd; t++)
00719         {
00720             if (t->tag != tag)
00721                 continue;
00722             if (t != unordered)
00723             {
00724                 Table temp = *unordered;
00725                 *unordered = *t;
00726                 *t = temp;
00727             }
00728             unordered++;
00729             break;
00730         }
00731     }
00732 }
00733 /**
00734 @brief Data structure for data associated with one OpenType table.
00735 This data structure contains an OpenType table's tag, start within
00736 an OpenType font file, length in bytes, and checksum at the end of
00737 the table.
00738 */
00739 struct TableRecord
00740 {
00741     uint_least32_t tag, offset, length, checksum;
00742 };
00743 /**

```

```

00753 @brief Compare tables by 4-byte unsigned table tag value.
00754
00755 This function takes two pointers to a TableRecord data structure
00756 and extracts the four-byte tag structure element for each. The
00757 two 32-bit numbers are then compared. If the first tag is greater
00758 than the first, then gt = 1 and lt = 0, and so 1 - 0 = 1 is
00759 returned. If the first is less than the second, then gt = 0 and
00760 lt = 1, and so 0 - 1 = -1 is returned.
00761
00762 @param[in] a Pointer to the first TableRecord structure.
00763 @param[in] b Pointer to the second TableRecord structure.
00764 @return 1 if the tag in "a" is greater, -1 if less, 0 if equal.
00765 */
00766 int
00767 byTableTag (const void *a, const void *b)
00768 {
00769     const struct TableRecord *const ra = a, *const rb = b;
00770     int gt = ra->tag > rb->tag;
00771     int lt = ra->tag < rb->tag;
00772     return gt - lt;
00773 }
00774
00775 /**
00776 @brief Write OpenType font to output file.
00777
00778 This function writes the constructed OpenType font to the
00779 output file named "filename".
00780
00781 @param[in] font Pointer to the font, of type Font *.
00782 @param[in] isCFF Boolean indicating whether the font has CFF data.
00783 @param[in] filename The name of the font file to create.
00784 */
00785 void
00786 writeFont (Font *font, bool isCFF, const char *fileName)
00787 {
00788     FILE *file = fopen (fileName, "wb");
00789     if (!file)
00790         fail ("Failed to open file '%s'.", fileName);
00791     const Table *const tables = getBufferHead (font->tables);
00792     const Table *const tablesEnd = getBufferTail (font->tables);
00793     size_t tableCount = tablesEnd - tables;
00794     assert (0 < tableCount && tableCount <= U16MAX);
00795     size_t offset = 12 + 16 * tableCount;
00796     uint_fast32_t totalChecksum = 0;
00797     Buffer *tableRecords =
00798         newBuffer (sizeof (struct TableRecord) * tableCount);
00799     for (size_t i = 0; i < tableCount; i++)
00800     {
00801         struct TableRecord *record =
00802             getBufferSlot (tableRecords, sizeof *record);
00803         record->tag = tables[i].tag;
00804         size_t length = countBufferedBytes (tables[i].content);
00805         #if SIZE_MAX > U32MAX
00806             if (offset > U32MAX)
00807                 fail ("Table offset exceeded 4 GiB.");
00808             if (length > U32MAX)
00809                 fail ("Table size exceeded 4 GiB.");
00810         #endif
00811         record->length = length;
00812         record->checksum = 0;
00813         const byte *p = getBufferHead (tables[i].content);
00814         const byte *const end = getBufferTail (tables[i].content);
00815
00816         /// Add a byte shifted by 24, 16, 8, or 0 bits.
00817         #define addByte(shift) \
00818         if (p == end) \
00819         break; \
00820         record->checksum += (uint_fast32_t)*p++ « (shift);
00821
00822         for (;;)
00823         {
00824             addByte (24)
00825             addByte (16)
00826             addByte (8)
00827             addByte (0)
00828         }
00829         #undef addByte
00830         cacheZeros (tables[i].content, (~length + 1U) & 3U);
00831         record->offset = offset;
00832         offset += countBufferedBytes (tables[i].content);
00833         totalChecksum += record->checksum;

```

```

00834     }
00835     struct TableRecord *records = getBufferHead (tableRecords);
00836     qsort (records, tableCount, sizeof *records, byTableTag);
00837     // Offset Table
00838     uint_fast32_t sfntVersion = isCFF ? 0x4f54544f : 0x00010000;
00839     writeU32 (sfntVersion, file); // sfntVersion
00840     totalChecksum += sfntVersion;
00841     uint_fast16_t entrySelector = 0;
00842     for (size_t k = tableCount; k != 1; k >>= 1)
00843         entrySelector++;
00844     uint_fast16_t searchRange = 1 << (entrySelector + 4);
00845     uint_fast16_t rangeShift = (tableCount - (1 << entrySelector)) << 4;
00846     writeU16 (tableCount, file); // numTables
00847     writeU16 (searchRange, file); // searchRange
00848     writeU16 (entrySelector, file); // entrySelector
00849     writeU16 (rangeShift, file); // rangeShift
00850     totalChecksum += (uint_fast32_t)tableCount << 16;
00851     totalChecksum += searchRange;
00852     totalChecksum += (uint_fast32_t)entrySelector << 16;
00853     totalChecksum += rangeShift;
00854     // Table Records (always sorted by table tags)
00855     for (size_t i = 0; i < tableCount; i++)
00856     {
00857         // Table Record
00858         writeU32 (records[i].tag, file); // tableTag
00859         writeU32 (records[i].checksum, file); // checksum
00860         writeU32 (records[i].offset, file); // offset
00861         writeU32 (records[i].length, file); // length
00862         totalChecksum += records[i].tag;
00863         totalChecksum += records[i].checksum;
00864         totalChecksum += records[i].offset;
00865         totalChecksum += records[i].length;
00866     }
00867     freeBuffer (tableRecords);
00868     for (const Table *table = tables; table < tablesEnd; table++)
00869     {
00870         if (table->tag == 0x68656164) // 'head' table
00871         {
00872             byte *begin = getBufferHead (table->content);
00873             byte *end = getBufferTail (table->content);
00874             writeBytes (begin, 8, file);
00875             writeU32 (0xb1b0afb4U - totalChecksum, file); // checksumAdjustment
00876             writeBytes (begin + 12, end - (begin + 12), file);
00877             continue;
00878         }
00879         writeBuffer (table->content, file);
00880     }
00881     fclose (file);
00882 }
00883
00884 /**
00885 @brief Convert a hexadecimal digit character to a 4-bit number.
00886
00887 This function takes a character that contains one hexadecimal digit
00888 and returns the 4-bit value (as an unsigned 8-bit value) corresponding
00889 to the hexadecimal digit.
00890
00891 @param[in] nibble The character containing one hexadecimal digit.
00892 @return The hexadecimal digit value, 0 through 15, inclusive.
00893 */
00894 static inline byte
00895 nibbleValue (char nibble)
00896 {
00897     if (isdigit (nibble))
00898         return nibble - '0';
00899     nibble = toupper (nibble);
00900     return nibble - 'A' + 10;
00901 }
00902
00903 /**
00904 @brief Read up to 6 hexadecimal digits and a colon from file.
00905
00906 This function reads up to 6 hexadecimal digits followed by
00907 a colon from a file.
00908
00909 If the end of the file is reached, the function returns true.
00910 The file name is provided to include in an error message if
00911 the end of file was reached unexpectedly.
00912
00913 @param[out] codePoint The Unicode code point.
00914 @param[in] fileName The name of the input file.

```

```

00915 @param[in] file Pointer to the input file stream.
00916 @return true if at end of file, false otherwise.
00917 */
00918 bool
00919 readCodePoint (uint_fast32_t *codePoint, const char *fileName, FILE *file)
00920 {
00921     *codePoint = 0;
00922     uint_fast8_t digitCount = 0;
00923     for (;;)
00924     {
00925         int c =getc (file);
00926         if (isxdigit (c) && ++digitCount <= 6)
00927         {
00928             *codePoint = (*codePoint « 4) | nibbleValue (c);
00929             continue;
00930         }
00931         if (c == ':' && digitCount > 0)
00932             return false;
00933         if (c == EOF)
00934         {
00935             if (digitCount == 0)
00936                 return true;
00937             if (feof (file))
00938                 fail ("%s: Unexpected end of file.", fileName);
00939             else
00940                 fail ("%s: Read error.", fileName);
00941         }
00942         fail ("%s: Unexpected character: %#.2x.", fileName, (unsigned)c);
00943     }
00944 }
00945 /**
00946 @brief Read glyph definitions from a Unifont .hex format file.
00947
00948 This function reads in the glyph bitmaps contained in a Unifont
00949 .hex format file. These input files contain one glyph bitmap
00950 per line. Each line is of the form
00951 <hexadecimal code point> ':' <hexadecimal bitmap sequence>
00952
00953 The code point field typically consists of 4 hexadecimal digits
00954 for a code point in Unicode Plane 0, and 6 hexadecimal digits for
00955 code points above Plane 0. The hexadecimal bitmap sequence is
00956 32 hexadecimal digits long for a glyph that is 8 pixels wide by
00957 16 pixels high, and 64 hexadecimal digits long for a glyph that
00958 is 16 pixels wide by 16 pixels high.
00959
00960 @param[in,out] font The font data structure to update with new glyphs.
00961 @param[in] fileName The name of the Unifont .hex format input file.
00962 */
00963 void
00964 readGlyphs (Font *font, const char *fileName)
00965 {
00966     FILE *file = fopen (fileName, "r");
00967     if (!file)
00968         fail ("Failed to open file '%s'.", fileName);
00969     uint_fast32_t glyphCount = 1; // for glyph 0
00970     uint_fast8_t maxByteCount = 0;
00971     { // Hard code the .notdef glyph.
00972         const byte bitmap[] = "\0\0\0~fZZzvv~vv~\0\0"; // same as U+FFFD
00973         const size_t byteCount = sizeof bitmap - 1;
00974         assert (byteCount <= GLYPH_MAX_BYTE_COUNT);
00975         assert (byteCount % GLYPH_HEIGHT == 0);
00976         Glyph *notdef = getBufferSlot (font->glyphs, sizeof (Glyph));
00977         memcpy (notdef->bitmap, bitmap, byteCount);
00978         notdef->byteCount = maxByteCount = byteCount;
00979         notdef->combining = false;
00980         notdef->pos = 0;
00981         notdef->lsb = 0;
00982     }
00983     for (;;)
00984     {
00985         uint_fast32_t codePoint;
00986         if (readCodePoint (&codePoint, fileName, file))
00987             break;
00988         if (++glyphCount > MAX_GLYPHS)
00989             fail ("OpenType does not support more than %lu glyphs.",
00990                 MAX_GLYPHS);
00991         Glyph *glyph = getBufferSlot (font->glyphs, sizeof (Glyph));
00992         glyph->codePoint = codePoint;
00993         glyph->byteCount = 0;

```

```

00996     glyph->combining = false;
00997     glyph->pos = 0;
00998     glyph->lsb = 0;
00999     for (byte *p = glyph->bitmap;; p++)
01000     {
01001         int h, l;
01002         if (isxdigit (h = getc (file)) && isxdigit (l = getc (file)))
01003         {
01004             if (++glyph->byteCount > GLYPH_MAX_BYTE_COUNT)
01005                 fail ("Hex stream of \"PRI_CP\" is too long.", codePoint);
01006             *p = nibbleValue (h) « 4 | nibbleValue (l);
01007         }
01008         else if (h == '\n' || (h == EOF && feof (file)))
01009             break;
01010         else if (ferror (file))
01011             fail ("%s: Read error.", fileName);
01012         else
01013             fail ("Hex stream of \"PRI_CP\" is invalid.", codePoint);
01014     }
01015     if (glyph->byteCount % GLYPH_HEIGHT != 0)
01016         fail ("Hex length of \"PRI_CP\" is indivisible by glyph height %d.",
01017             codePoint, GLYPH_HEIGHT);
01018     if (glyph->byteCount > maxByteCount)
01019         maxByteCount = glyph->byteCount;
01020 }
01021 if (glyphCount == 1)
01022     fail ("No glyph is specified.");
01023 font->glyphCount = glyphCount;
01024 font->maxWidth = PW (maxByteCount);
01025 fclose (file);
01026 }
01027
01028 /**
01029 @brief Compare two Unicode code points to determine which is greater.
01030
01031 This function compares the Unicode code points contained within
01032 two Glyph data structures. The function returns 1 if the first
01033 code point is greater, and -1 if the second is greater.
01034
01035 @param[in] a A Glyph data structure containing the first code point.
01036 @param[in] b A Glyph data structure containing the second code point.
01037 @return 1 if the code point a is greater, -1 if less, 0 if equal.
01038 */
01039 int
01040 byCodePoint (const void *a, const void *b)
01041 {
01042     const Glyph *const ga = a, *const gb = b;
01043     int gt = ga->codePoint > gb->codePoint;
01044     int lt = ga->codePoint < gb->codePoint;
01045     return gt - lt;
01046 }
01047
01048 /**
01049 @brief Position a glyph within a 16-by-16 pixel bounding box.
01050
01051 Position a glyph within the 16-by-16 pixel drawing area and
01052 note whether or not the glyph is a combining character.
01053
01054 N.B.: Glyphs must be sorted by code point before calling this function.
01055
01056 @param[in,out] font Font data structure pointer to store glyphs.
01057 @param[in] fileName Name of glyph file to read.
01058 @param[in] xMin Minimum x-axis value (for left side bearing).
01059 */
01060 void
01061 positionGlyphs (Font *font, const char *fileName, pixels_t *xMin)
01062 {
01063     *xMin = 0;
01064     FILE *file = fopen (fileName, "r");
01065     if (!file)
01066         fail ("Failed to open file '%s'", fileName);
01067     Glyph *glyphs = getBufferHead (font->glyphs);
01068     const Glyph *const endGlyph = glyphs + font->glyphCount;
01069     Glyph *nextGlyph = &glyphs[1]; // predict and avoid search
01070     for (;;)
01071     {
01072         uint_fast32_t codePoint;
01073         if (readCodePoint (&codePoint, fileName, file))
01074             break;
01075         Glyph *glyph = nextGlyph;
01076         if (glyph == endGlyph || glyph->codePoint != codePoint)

```

```

01077     {
01078         // Prediction failed. Search.
01079         const Glyph key = { .codePoint = codePoint };
01080         glyph = bsearch (&key, glyphs + 1, font->glyphCount - 1,
01081             sizeof key, byCodePoint);
01082         if (!glyph)
01083             fail ("Glyph \"PRI_CP\" is positioned but not defined.",
01084                 codePoint);
01085     }
01086     nextGlyph = glyph + 1;
01087     char s[8];
01088     if (!fgets (s, sizeof s, file))
01089         fail ("%s: Read error.", fileName);
01090     char *end;
01091     const long value = strtol (s, &end, 10);
01092     if (*end != '\n' && *end != '\0')
01093         fail ("Position of glyph \"PRI_CP\" is invalid.", codePoint);
01094     // Currently no glyph is moved to the right,
01095     // so positive position is considered out of range.
01096     // If this limit is to be lifted,
01097     // 'xMax' of bounding box in 'head' table shall also be updated.
01098     if (value < -GLYPH_MAX_WIDTH || value > 0)
01099         fail ("Position of glyph \"PRI_CP\" is out of range.", codePoint);
01100     glyph->combining = true;
01101     glyph->pos = value;
01102     glyph->lsb = value; // updated during outline generation
01103     if (value < *xMin)
01104         *xMin = value;
01105 }
01106 fclose (file);
01107 }
01108
01109 /**
01110 @brief Sort the glyphs in a font by Unicode code point.
01111
01112 This function reads in an array of glyphs and sorts them
01113 by Unicode code point. If a duplicate code point is encountered,
01114 that will result in a fatal error with an error message to stderr.
01115
01116 @param[in,out] font Pointer to a Font structure with glyphs to sort.
01117 */
01118 void
01119 sortGlyphs (Font *font)
01120 {
01121     Glyph *glyphs = getBufferHead (font->glyphs);
01122     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01123     glyphs++; // glyph 0 does not need sorting
01124     qsort (glyphs, glyphsEnd - glyphs, sizeof *glyphs, byCodePoint);
01125     for (const Glyph *glyph = glyphs; glyph < glyphsEnd - 1; glyph++)
01126     {
01127         if (glyph[0].codePoint == glyph[1].codePoint)
01128             fail ("Duplicate code point: \"PRI_CP\"", glyph[0].codePoint);
01129         assert (glyph[0].codePoint < glyph[1].codePoint);
01130     }
01131 }
01132
01133 /**
01134 @brief Specify the current contour drawing operation.
01135 */
01136 enum ContourOp {
01137     OP_CLOSE, ///< Close the current contour path that was being drawn.
01138     OP_POINT  ///< Add one more (x,y) point to the contour being drawn.
01139 };
01140
01141 /**
01142 @brief Fill to the left side (CFF) or right side (TrueType) of a contour.
01143 */
01144 enum FillSide {
01145     FILL_LEFT, ///< Draw outline counter-clockwise (CFF, PostScript).
01146     FILL_RIGHT ///< Draw outline clockwise (TrueType).
01147 };
01148
01149 /**
01150 @brief Build a glyph outline.
01151
01152 This function builds a glyph outline from a Unifont glyph bitmap.
01153
01154 @param[out] result The resulting glyph outline.
01155 @param[in] bitmap A bitmap array.
01156 @param[in] byteCount the number of bytes in the input bitmap array.
01157 @param[in] fillSide Enumerated indicator to fill left or right side.

```

```

01158 */
01159 void
01160 buildOutline (Buffer *result, const byte bitmap[], const size_t byteCount,
01161             const enum FillSide fillSide)
01162 {
01163     enum Direction {RIGHT, LEFT, DOWN, UP}; // order is significant
01164
01165     // respective coordinate deltas
01166     const pixels_t dx[] = {1, -1, 0, 0}, dy[] = {0, 0, -1, 1};
01167
01168     assert (byteCount % GLYPH_HEIGHT == 0);
01169     const uint_fast8_t bytesPerRow = byteCount / GLYPH_HEIGHT;
01170     const pixels_t glyphWidth = bytesPerRow * 8;
01171     assert (glyphWidth <= GLYPH_MAX_WIDTH);
01172
01173     #if GLYPH_MAX_WIDTH < 32
01174         typedef uint_fast32_t row_t;
01175     #elif GLYPH_MAX_WIDTH < 64
01176         typedef uint_fast64_t row_t;
01177     #else
01178         #error GLYPH_MAX_WIDTH is too large.
01179     #endif
01180
01181     row_t pixels[GLYPH_HEIGHT + 2] = {0};
01182     for (pixels_t row = GLYPH_HEIGHT; row > 0; row--)
01183         for (pixels_t b = 0; b < bytesPerRow; b++)
01184             pixels[row] = pixels[row] « 8 | *bitmap++;
01185     typedef row_t graph_t[GLYPH_HEIGHT + 1];
01186     graph_t vectors[4];
01187     const row_t *lower = pixels, *upper = pixels + 1;
01188     for (pixels_t row = 0; row <= GLYPH_HEIGHT; row++)
01189     {
01190         const row_t m = (fillSide == FILL_RIGHT) - 1;
01191         vectors[RIGHT][row] = (m ^ (*lower « 1)) & (~m ^ (*upper « 1));
01192         vectors[LEFT][row] = (m ^ (*upper )) & (~m ^ (*lower ));
01193         vectors[DOWN][row] = (m ^ (*lower )) & (~m ^ (*lower « 1));
01194         vectors[UP][row] = (m ^ (*upper « 1)) & (~m ^ (*upper ));
01195         lower++;
01196         upper++;
01197     }
01198     graph_t selection = {0};
01199     const row_t x0 = (row_t)1 « glyphWidth;
01200
01201     /// Get the value of a given bit that is in a given row.
01202     #define getRowBit(rows, x, y) ((rows)[(y)] & x0 » (x))
01203
01204     /// Invert the value of a given bit that is in a given row.
01205     #define flipRowBit(rows, x, y) ((rows)[(y)] ^ x0 » (x))
01206
01207     for (pixels_t y = GLYPH_HEIGHT; y >= 0; y--)
01208     {
01209         for (pixels_t x = 0; x <= glyphWidth; x++)
01210         {
01211             assert (!getRowBit (vectors[LEFT], x, y));
01212             assert (!getRowBit (vectors[UP], x, y));
01213             enum Direction initial;
01214
01215             if (getRowBit (vectors[RIGHT], x, y))
01216                 initial = RIGHT;
01217             else if (getRowBit (vectors[DOWN], x, y))
01218                 initial = DOWN;
01219             else
01220                 continue;
01221
01222             static_assert (((GLYPH_MAX_WIDTH + 1) * (GLYPH_HEIGHT + 1) * 2 <=
01223                             U16MAX, "potential overflow");
01224
01225             uint_fast16_t lastPointCount = 0;
01226             for (bool converged = false;;)
01227             {
01228                 uint_fast16_t pointCount = 0;
01229                 enum Direction heading = initial;
01230                 for (pixels_t tx = x, ty = y;;)
01231                 {
01232                     if (converged)
01233                     {
01234                         storePixels (result, OP_POINT);
01235                         storePixels (result, tx);
01236                         storePixels (result, ty);
01237                     }
01238                     do

```

```

01239         {
01240             if (converged)
01241                 flipRowBit (vectors[heading], tx, ty);
01242             tx += dx[heading];
01243             ty += dy[heading];
01244         } while (getRowBit (vectors[heading], tx, ty));
01245         if (tx == x && ty == y)
01246             break;
01247         static_assert ((UP ^ DOWN) == 1 && (LEFT ^ RIGHT) == 1,
01248             "wrong enums");
01249         heading = (heading & 2) ^ 2;
01250         heading |= !getRowBit (selection, tx, ty);
01251         heading ^= !getRowBit (vectors[heading], tx, ty);
01252         assert (getRowBit (vectors[heading], tx, ty));
01253         flipRowBit (selection, tx, ty);
01254         pointCount++;
01255     }
01256     if (converged)
01257         break;
01258     converged = pointCount == lastPointCount;
01259     lastPointCount = pointCount;
01260 }
01261
01262 storePixels (result, OP_CLOSE);
01263 }
01264 }
01265 #undef getRowBit
01266 #undef flipRowBit
01267 }
01268
01269 /**
01270 @brief Prepare 32-bit glyph offsets in a font table.
01271
01272 @param[in] sizes Array of glyph sizes, for offset calculations.
01273 */
01274 void
01275 prepareOffsets (size_t *sizes)
01276 {
01277     size_t *p = sizes;
01278     for (size_t *i = sizes + 1; *i; i++)
01279         *i += *p++;
01280     if (*p > 2147483647U) // offset not representable
01281         fail ("CFF table is too large.");
01282 }
01283
01284 /**
01285 @brief Prepare a font name string index.
01286
01287 @param[in] names List of name strings.
01288 @return Pointer to a Buffer struct containing the string names.
01289 */
01290 Buffer *
01291 prepareStringIndex (const NameStrings names)
01292 {
01293     Buffer *buf = newBuffer (256);
01294     assert (names[6]);
01295     const char *strings[] = {"Adobe", "Identity", names[6]};
01296     // Get the number of elements in array char *strings[].
01297     #define stringCount (sizeof strings / sizeof *strings)
01298     static_assert (stringCount <= U16MAX, "too many strings");
01299     size_t offset = 1;
01300     size_t lengths[stringCount];
01301     for (size_t i = 0; i < stringCount; i++)
01302     {
01303         assert (strings[i]);
01304         lengths[i] = strlen (strings[i]);
01305         offset += lengths[i];
01306     }
01307     int offsetSize = 1 + (offset > 0xff)
01308         + (offset > 0xffff)
01309         + (offset > 0xffffffff);
01310     cacheU16 (buf, stringCount); // count
01311     cacheU8 (buf, offsetSize); // offSize
01312     cacheU (buf, offset = 1, offsetSize); // offset[0]
01313     for (size_t i = 0; i < stringCount; i++)
01314         cacheU (buf, offset += lengths[i], offsetSize); // offset[i + 1]
01315     for (size_t i = 0; i < stringCount; i++)
01316         cacheBytes (buf, strings[i], lengths[i]);
01317 #undef stringCount
01318     return buf;
01319 }

```

```

01320
01321 /**
01322 @brief Add a CFF table to a font.
01323
01324 @param[in,out] font Pointer to a Font struct to contain the CFF table.
01325 @param[in] version Version of CFF table, with value 1 or 2.
01326 @param[in] names List of NameStrings.
01327 */
01328 void
01329 fillCFF (Font *font, int version, const NameStrings names)
01330 {
01331     // HACK: For convenience, CFF data structures are hard coded.
01332     assert (0 < version && version <= 2);
01333     Buffer *cff = newBuffer (65536);
01334     addTable (font, version == 1 ? "CFF " : "CFF2", cff);
01335
01336     /// Use fixed width integer for variables to simplify offset calculation.
01337     #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))
01338
01339     // In Unifont, 16px glyphs are more common. This is used by CFF1 only.
01340     const pixels_t defaultWidth = 16, nominalWidth = 8;
01341     if (version == 1)
01342     {
01343         Buffer *strings = prepareStringIndex (names);
01344         size_t stringsSize = countBufferedBytes (strings);
01345         const char *cffName = names[6];
01346         assert (cffName);
01347         size_t nameLength = strlen (cffName);
01348         size_t namesSize = nameLength + 5;
01349         // These sizes must be updated together with the data below.
01350         size_t offsets[] = {4, namesSize, 45, stringsSize, 2, 5, 8, 32, 4, 0};
01351         prepareOffsets (offsets);
01352         { // Header
01353             cacheU8 (cff, 1); // major
01354             cacheU8 (cff, 0); // minor
01355             cacheU8 (cff, 4); // hdrSize
01356             cacheU8 (cff, 1); // offSize
01357         }
01358         assert (countBufferedBytes (cff) == offsets[0]);
01359         { // Name INDEX (should not be used by OpenType readers)
01360             cacheU16 (cff, 1); // count
01361             cacheU8 (cff, 1); // offSize
01362             cacheU8 (cff, 1); // offset[0]
01363             if (nameLength + 1 > 255) // must be too long; spec limit is 63
01364                 fail ("PostScript name is too long.");
01365             cacheU8 (cff, nameLength + 1); // offset[1]
01366             cacheBytes (cff, cffName, nameLength);
01367         }
01368         assert (countBufferedBytes (cff) == offsets[1]);
01369         { // Top DICT INDEX
01370             cacheU16 (cff, 1); // count
01371             cacheU8 (cff, 1); // offSize
01372             cacheU8 (cff, 1); // offset[0]
01373             cacheU8 (cff, 41); // offset[1]
01374             cacheCFFOperand (cff, 391); // "Adobe"
01375             cacheCFFOperand (cff, 392); // "Identity"
01376             cacheCFFOperand (cff, 0);
01377             cacheBytes (cff, (byte[]){12, 30}, 2); // ROS
01378             cacheCFF32 (cff, font->glyphCount);
01379             cacheBytes (cff, (byte[]){12, 34}, 2); // CIDCount
01380             cacheCFF32 (cff, offsets[6]);
01381             cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01382             cacheCFF32 (cff, offsets[5]);
01383             cacheBytes (cff, (byte[]){12, 37}, 2); // FDSelect
01384             cacheCFF32 (cff, offsets[4]);
01385             cacheU8 (cff, 15); // charset
01386             cacheCFF32 (cff, offsets[8]);
01387             cacheU8 (cff, 17); // CharStrings
01388         }
01389         assert (countBufferedBytes (cff) == offsets[2]);
01390         { // String INDEX
01391             cacheBuffer (cff, strings);
01392             freeBuffer (strings);
01393         }
01394         assert (countBufferedBytes (cff) == offsets[3]);
01395         cacheU16 (cff, 0); // Global Subr INDEX
01396         assert (countBufferedBytes (cff) == offsets[4]);
01397         { // Charsets
01398             cacheU8 (cff, 2); // format
01399             { // Range2[0]
01400                 cacheU16 (cff, 1); // first

```

```

14401         cacheU16 (cff, font->glyphCount - 2); // nLeft
14402     }
14403 }
14404 assert (countBufferedBytes (cff) == offsets[5]);
14405 { // FDSelect
14406     cacheU8 (cff, 3); // format
14407     cacheU16 (cff, 1); // nRanges
14408     cacheU16 (cff, 0); // first
14409     cacheU8 (cff, 0); // fd
14410     cacheU16 (cff, font->glyphCount); // sentinel
14411 }
14412 assert (countBufferedBytes (cff) == offsets[6]);
14413 { // FDDArray
14414     cacheU16 (cff, 1); // count
14415     cacheU8 (cff, 1); // offSize
14416     cacheU8 (cff, 1); // offset[0]
14417     cacheU8 (cff, 28); // offset[1]
14418     cacheCFFOperand (cff, 393);
14419     cacheBytes (cff, (byte[]){12, 38}, 2); // FontName
14420     // Windows requires FontMatrix in Font DICT.
14421     const byte unit[] = {0x1e, 0x15, 0x62, 0x5c, 0x6f}; // 1/64 (0.015625)
14422     cacheBytes (cff, unit, sizeof unit);
14423     cacheCFFOperand (cff, 0);
14424     cacheCFFOperand (cff, 0);
14425     cacheBytes (cff, unit, sizeof unit);
14426     cacheCFFOperand (cff, 0);
14427     cacheCFFOperand (cff, 0);
14428     cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
14429     cacheCFFOperand (cff, offsets[8] - offsets[7]); // size
14430     cacheCFF32 (cff, offsets[7]); // offset
14431     cacheU8 (cff, 18); // Private
14432 }
14433 assert (countBufferedBytes (cff) == offsets[7]);
14434 { // Private
14435     cacheCFFOperand (cff, FU (defaultWidth));
14436     cacheU8 (cff, 20); // defaultWidthX
14437     cacheCFFOperand (cff, FU (nominalWidth));
14438     cacheU8 (cff, 21); // nominalWidthX
14439 }
14440 assert (countBufferedBytes (cff) == offsets[8]);
14441 }
14442 else
14443 {
14444     assert (version == 2);
14445     // These sizes must be updated together with the data below.
14446     size_t offsets[] = {5, 21, 4, 10, 0};
14447     prepareOffsets (offsets);
14448     { // Header
14449         cacheU8 (cff, 2); // majorVersion
14450         cacheU8 (cff, 0); // minorVersion
14451         cacheU8 (cff, 5); // headerSize
14452         cacheU16 (cff, offsets[1] - offsets[0]); // topDictLength
14453     }
14454     assert (countBufferedBytes (cff) == offsets[0]);
14455     { // Top DICT
14456         const byte unit[] = {0x1e, 0x15, 0x62, 0x5c, 0x6f}; // 1/64 (0.015625)
14457         cacheBytes (cff, unit, sizeof unit);
14458         cacheCFFOperand (cff, 0);
14459         cacheCFFOperand (cff, 0);
14460         cacheBytes (cff, unit, sizeof unit);
14461         cacheCFFOperand (cff, 0);
14462         cacheCFFOperand (cff, 0);
14463         cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
14464         cacheCFFOperand (cff, offsets[2]);
14465         cacheBytes (cff, (byte[]){12, 36}, 2); // FDDArray
14466         cacheCFFOperand (cff, offsets[3]);
14467         cacheU8 (cff, 17); // CharStrings
14468     }
14469     assert (countBufferedBytes (cff) == offsets[1]);
14470     cacheU32 (cff, 0); // Global Subr INDEX
14471     assert (countBufferedBytes (cff) == offsets[2]);
14472     { // Font DICT INDEX
14473         cacheU32 (cff, 1); // count
14474         cacheU8 (cff, 1); // offSize
14475         cacheU8 (cff, 1); // offset[0]
14476         cacheU8 (cff, 4); // offset[1]
14477         cacheCFFOperand (cff, 0);
14478         cacheCFFOperand (cff, 0);
14479         cacheU8 (cff, 18); // Private
14480     }
14481     assert (countBufferedBytes (cff) == offsets[3]);

```

```

01482 }
01483 { // CharStrings INDEX
01484     Buffer *offsets = newBuffer (4096);
01485     Buffer *charstrings = newBuffer (4096);
01486     Buffer *outline = newBuffer (1024);
01487     const Glyph *glyph = getBufferHead (font->glyphs);
01488     const Glyph *const endGlyph = glyph + font->glyphCount;
01489     for (; glyph < endGlyph; glyph++)
01490     {
01491         // CFF offsets start at 1
01492         storeU32 (offsets, countBufferedBytes (charstrings) + 1);
01493
01494         pixels_t rx = -glyph->pos;
01495         pixels_t ry = DESCENDER;
01496         resetBuffer (outline);
01497         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_LEFT);
01498         enum CFFOp {rmoveto=21, hmoveto=22, vmoveto=4, hlineto=6,
01499             vlineto=7, endchar=14};
01500         enum CFFOp pendingOp = 0;
01501         const int STACK_LIMIT = version == 1 ? 48 : 513;
01502         int stackSize = 0;
01503         bool isDrawing = false;
01504         pixels_t width = glyph->combining ? 0 : PW (glyph->byteCount);
01505         if (version == 1 && width != defaultWidth)
01506         {
01507             cacheCFFOperand (charstrings, FU (width - nominalWidth));
01508             stackSize++;
01509         }
01510         for (const pixels_t *p = getBufferHead (outline),
01511             *const end = getBufferTail (outline); p < end;)
01512         {
01513             int s = 0;
01514             const enum ContourOp op = *p++;
01515             if (op == OP_POINT)
01516             {
01517                 const pixels_t x = *p++, y = *p++;
01518                 if (x != rx)
01519                 {
01520                     cacheCFFOperand (charstrings, FU (x - rx));
01521                     rx = x;
01522                     stackSize++;
01523                     s |= 1;
01524                 }
01525                 if (y != ry)
01526                 {
01527                     cacheCFFOperand (charstrings, FU (y - ry));
01528                     ry = y;
01529                     stackSize++;
01530                     s |= 2;
01531                 }
01532                 assert (!(isDrawing && s == 3));
01533             }
01534             if (s)
01535             {
01536                 if (!isDrawing)
01537                 {
01538                     const enum CFFOp moves[] = {0, hmoveto, vmoveto,
01539                         rmoveto};
01540                     cacheU8 (charstrings, moves[s]);
01541                     stackSize = 0;
01542                 }
01543                 else if (!pendingOp)
01544                     pendingOp = (enum CFFOp[]){0, hlineto, vlineto}[s];
01545             }
01546             else if (!isDrawing)
01547             {
01548                 // only when the first point happens to be (0, 0)
01549                 cacheCFFOperand (charstrings, FU (0));
01550                 cacheU8 (charstrings, hmoveto);
01551                 stackSize = 0;
01552             }
01553             if (op == OP_CLOSE || stackSize >= STACK_LIMIT)
01554             {
01555                 assert (stackSize <= STACK_LIMIT);
01556                 cacheU8 (charstrings, pendingOp);
01557                 pendingOp = 0;
01558                 stackSize = 0;
01559             }
01560             isDrawing = op != OP_CLOSE;
01561         }
01562         if (version == 1)

```

```

01563         cacheU8 (charstrings, endchar);
01564     }
01565     size_t lastOffset = countBufferedBytes (charstrings) + 1;
01566 #if SIZE_MAX > U32MAX
01567     if (lastOffset > U32MAX)
01568         fail ("CFF data exceeded size limit.");
01569 #endif
01570     storeU32 (offsets, lastOffset);
01571     int offsetSize = 1 + (lastOffset > 0xff)
01572         + (lastOffset > 0xffff)
01573         + (lastOffset > 0xffffffff);
01574     // count (must match 'numGlyphs' in 'maxp' table)
01575     cacheU (cff, font->glyphCount, version * 2);
01576     cacheU8 (cff, offsetSize); // offsetSize
01577     const uint_least32_t *p = getBufferHead (offsets);
01578     const uint_least32_t *const end = getBufferTail (offsets);
01579     for (; p < end; p++)
01580         cacheU (cff, *p, offsetSize); // offsets
01581     cacheBuffer (cff, charstrings); // data
01582     freeBuffer (offsets);
01583     freeBuffer (charstrings);
01584     freeBuffer (outline);
01585 }
01586 #undef cacheCFF32
01587 }
01588
01589 /**
01590 @brief Add a TrueType table to a font.
01591
01592 @param[in,out] font Pointer to a Font struct to contain the TrueType table.
01593 @param[in] format The TrueType "loca" table format, Offset16 or Offset32.
01594 @param[in] names List of NameStrings.
01595 */
01596 void
01597 fillTrueType (Font *font, enum LocaFormat *format,
01598     uint_fast16_t *maxPoints, uint_fast16_t *maxContours)
01599 {
01600     Buffer *glyf = newBuffer (65536);
01601     addTable (font, "glyf", glyf);
01602     Buffer *loca = newBuffer (4 * (font->glyphCount + 1));
01603     addTable (font, "loca", loca);
01604     *format = LOCA_OFFSET32;
01605     Buffer *endPoints = newBuffer (256);
01606     Buffer *flags = newBuffer (256);
01607     Buffer *xs = newBuffer (256);
01608     Buffer *ys = newBuffer (256);
01609     Buffer *outline = newBuffer (1024);
01610     Glyph *const glyphs = getBufferHead (font->glyphs);
01611     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01612     for (Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01613     {
01614         cacheU32 (loca, countBufferedBytes (glyf));
01615         pixels_t rx = -glyph->pos;
01616         pixels_t ry = DESCENDER;
01617         pixels_t xMin = GLYPH_MAX_WIDTH, xMax = 0;
01618         pixels_t yMin = ASCENDER, yMax = -DESCENDER;
01619         resetBuffer (endPoints);
01620         resetBuffer (flags);
01621         resetBuffer (xs);
01622         resetBuffer (ys);
01623         resetBuffer (outline);
01624         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_RIGHT);
01625         uint_fast32_t pointCount = 0, contourCount = 0;
01626         for (const pixels_t *p = getBufferHead (outline),
01627             *const end = getBufferTail (outline); p < end;)
01628         {
01629             const enum ContourOp op = *p++;
01630             if (op == OP_CLOSE)
01631             {
01632                 contourCount++;
01633                 assert (contourCount <= U16MAX);
01634                 cacheU16 (endPoints, pointCount - 1);
01635                 continue;
01636             }
01637             assert (op == OP_POINT);
01638             pointCount++;
01639             assert (pointCount <= U16MAX);
01640             const pixels_t x = *p++, y = *p++;
01641             uint_fast8_t pointFlags =
01642                 + B1 (0) // point is on curve
01643                 + BX (1, x != rx) // x coordinate is 1 byte instead of 2

```

```

01644     + BX (2, y != ry) // y coordinate is 1 byte instead of 2
01645     + B0 (3) // repeat
01646     + BX (4, x >= rx) // when x is 1 byte: x is positive;
01647                     // when x is 2 bytes: x unchanged and omitted
01648     + BX (5, y >= ry) // when y is 1 byte: y is positive;
01649                     // when y is 2 bytes: y unchanged and omitted
01650     + B1 (6) // contours may overlap
01651     + B0 (7) // reserved
01652 ;
01653 cacheU8 (flags, pointFlags);
01654 if (x != rx)
01655     cacheU8 (xs, FU (x > rx ? x - rx : rx - x));
01656 if (y != ry)
01657     cacheU8 (ys, FU (y > ry ? y - ry : ry - y));
01658 if (x < xMin) xMin = x;
01659 if (y < yMin) yMin = y;
01660 if (x > xMax) xMax = x;
01661 if (y > yMax) yMax = y;
01662 rx = x;
01663 ry = y;
01664 }
01665 if (contourCount == 0)
01666     continue; // blank glyph is indicated by the 'loca' table
01667 glyph->lsb = glyph->pos + xMin;
01668 cacheU16 (glyph, contourCount); // numberOfContours
01669 cacheU16 (glyph, FU (glyph->pos + xMin)); // xMin
01670 cacheU16 (glyph, FU (yMin)); // yMin
01671 cacheU16 (glyph, FU (glyph->pos + xMax)); // xMax
01672 cacheU16 (glyph, FU (yMax)); // yMax
01673 cacheBuffer (glyph, endPoints); // endPtsOfContours[]
01674 cacheU16 (glyph, 0); // instructionLength
01675 cacheBuffer (glyph, flags); // flags[]
01676 cacheBuffer (glyph, xs); // xCoordinates[]
01677 cacheBuffer (glyph, ys); // yCoordinates[]
01678 if (pointCount > *maxPoints)
01679     *maxPoints = pointCount;
01680 if (contourCount > *maxContours)
01681     *maxContours = contourCount;
01682 }
01683 cacheU32 (loca, countBufferedBytes (glyph));
01684 freeBuffer (endPoints);
01685 freeBuffer (flags);
01686 freeBuffer (xs);
01687 freeBuffer (ys);
01688 freeBuffer (outline);
01689 }
01690 /**
01691 @brief Create a dummy blank outline in a font table.
01692
01693 @param[in,out] font Pointer to a Font struct to insert a blank outline.
01694 */
01695 void
01696 fillBlankOutline (Font *font)
01697 {
01698     Buffer *glyph = newBuffer (12);
01699     addTable (font, "glyph", glyph);
01700     // Empty table is not allowed, but an empty outline for glyph 0 suffices.
01701     cacheU16 (glyph, 0); // numberOfContours
01702     cacheU16 (glyph, FU (0)); // xMin
01703     cacheU16 (glyph, FU (0)); // yMin
01704     cacheU16 (glyph, FU (0)); // xMax
01705     cacheU16 (glyph, FU (0)); // yMax
01706     cacheU16 (glyph, 0); // instructionLength
01707     Buffer *loca = newBuffer (2 * (font->glyphCount + 1));
01708     addTable (font, "loca", loca);
01709     cacheU16 (loca, 0); // offsets[0]
01710     assert (countBufferedBytes (glyph) % 2 == 0);
01711     for (uint_fast32_t i = 1; i <= font->glyphCount; i++)
01712         cacheU16 (loca, countBufferedBytes (glyph) / 2); // offsets[i]
01713 }
01714 /**
01715 @brief Fill OpenType bitmap data and location tables.
01716
01717 This function fills an Embedded Bitmap Data (EBDT) Table
01718 and an Embedded Bitmap Location (EBLC) Table with glyph
01719 bitmap information. These tables enable embedding bitmaps
01720 in OpenType fonts. No Embedded Bitmap Scaling (EBSC) table
01721 is used for the bitmap glyphs, only EBDT and EBLC.
01722
01723
01724

```

```

01725 @param[in,out] font Pointer to a Font struct in which to add bitmaps.
01726 */
01727 void
01728 fillBitmap (Font *font)
01729 {
01730     const Glyph *const glyphs = getBufferHead (font->glyphs);
01731     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01732     size_t bitmapsSize = 0;
01733     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01734         bitmapsSize += glyph->byteCount;
01735     Buffer *ebdt = newBuffer (4 + bitmapsSize);
01736     addTable (font, "EBDT", ebdt);
01737     cacheU16 (ebdt, 2); // majorVersion
01738     cacheU16 (ebdt, 0); // minorVersion
01739     uint_fast8_t byteCount = 0; // unequal to any glyph
01740     pixels_t pos = 0;
01741     bool combining = false;
01742     Buffer *rangeHeads = newBuffer (32);
01743     Buffer *offsets = newBuffer (64);
01744     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01745     {
01746         if (glyph->byteCount != byteCount || glyph->pos != pos ||
01747             glyph->combining != combining)
01748         {
01749             storeU16 (rangeHeads, glyph - glyphs);
01750             storeU32 (offsets, countBufferedBytes (ebdt));
01751             byteCount = glyph->byteCount;
01752             pos = glyph->pos;
01753             combining = glyph->combining;
01754         }
01755         cacheBytes (ebdt, glyph->bitmap, byteCount);
01756     }
01757     const uint_least16_t *ranges = getBufferHead (rangeHeads);
01758     const uint_least16_t *rangesEnd = getBufferTail (rangeHeads);
01759     uint_fast32_t rangeCount = rangesEnd - ranges;
01760     storeU16 (rangeHeads, font->glyphCount);
01761     Buffer *eblc = newBuffer (4096);
01762     addTable (font, "EBLC", eblc);
01763     cacheU16 (eblc, 2); // majorVersion
01764     cacheU16 (eblc, 0); // minorVersion
01765     cacheU32 (eblc, 1); // numSizes
01766     { // bitmapSizes[0]
01767         cacheU32 (eblc, 56); // indexSubTableArrayOffset
01768         cacheU32 (eblc, (8 + 20) * rangeCount); // indexTablesSize
01769         cacheU32 (eblc, rangeCount); // numberOfIndexSubTables
01770         cacheU32 (eblc, 0); // colorRef
01771         { // hori
01772             cacheU8 (eblc, ASCENDER); // ascender
01773             cacheU8 (eblc, -DESCENDER); // descender
01774             cacheU8 (eblc, font->maxWidth); // widthMax
01775             cacheU8 (eblc, 1); // caretSlopeNumerator
01776             cacheU8 (eblc, 0); // caretSlopeDenominator
01777             cacheU8 (eblc, 0); // caretOffset
01778             cacheU8 (eblc, 0); // minOriginSB
01779             cacheU8 (eblc, 0); // minAdvanceSB
01780             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01781             cacheU8 (eblc, -DESCENDER); // minAfterBL
01782             cacheU8 (eblc, 0); // pad1
01783             cacheU8 (eblc, 0); // pad2
01784         }
01785         { // vert
01786             cacheU8 (eblc, ASCENDER); // ascender
01787             cacheU8 (eblc, -DESCENDER); // descender
01788             cacheU8 (eblc, font->maxWidth); // widthMax
01789             cacheU8 (eblc, 1); // caretSlopeNumerator
01790             cacheU8 (eblc, 0); // caretSlopeDenominator
01791             cacheU8 (eblc, 0); // caretOffset
01792             cacheU8 (eblc, 0); // minOriginSB
01793             cacheU8 (eblc, 0); // minAdvanceSB
01794             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01795             cacheU8 (eblc, -DESCENDER); // minAfterBL
01796             cacheU8 (eblc, 0); // pad1
01797             cacheU8 (eblc, 0); // pad2
01798         }
01799         cacheU16 (eblc, 0); // startGlyphIndex
01800         cacheU16 (eblc, font->glyphCount - 1); // endGlyphIndex
01801         cacheU8 (eblc, 16); // ppemX
01802         cacheU8 (eblc, 16); // ppemY
01803         cacheU8 (eblc, 1); // bitDepth
01804         cacheU8 (eblc, 1); // flags = Horizontal
01805     }

```

```

01806 { // IndexSubTableArray
01807     uint_fast32_t offset = rangeCount * 8;
01808     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01809     {
01810         cacheU16 (eblc, *p); // firstGlyphIndex
01811         cacheU16 (eblc, p[1] - 1); // lastGlyphIndex
01812         cacheU32 (eblc, offset); // additionalOffsetToIndexSubtable
01813         offset += 20;
01814     }
01815 }
01816 { // IndexSubTables
01817     const uint_least32_t *offset = getBufferHead (offsets);
01818     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01819     {
01820         const Glyph *glyph = &glyphs[*p];
01821         cacheU16 (eblc, 2); // indexFormat
01822         cacheU16 (eblc, 5); // imageFormat
01823         cacheU32 (eblc, *offset++); // imageDataOffset
01824         cacheU32 (eblc, glyph->byteCount); // imageSize
01825         { // bigMetrics
01826             cacheU8 (eblc, GLYPH_HEIGHT); // height
01827             const uint_fast8_t width = PW (glyph->byteCount);
01828             cacheU8 (eblc, width); // width
01829             cacheU8 (eblc, glyph->pos); // horiBearingX
01830             cacheU8 (eblc, ASCENDER); // horiBearingY
01831             cacheU8 (eblc, glyph->combining ? 0 : width); // horiAdvance
01832             cacheU8 (eblc, 0); // vertBearingX
01833             cacheU8 (eblc, 0); // vertBearingY
01834             cacheU8 (eblc, GLYPH_HEIGHT); // vertAdvance
01835         }
01836     }
01837 }
01838 freeBuffer (rangeHeads);
01839 freeBuffer (offsets);
01840 }
01841 /**
01842 @brief Fill a "head" font table.
01843
01844 The "head" table contains font header information common to the
01845 whole font.
01846
01847 @param[in,out] font The Font struct to which to add the table.
01848 @param[in] locaFormat The "loca" offset index location table.
01849 @param[in] xMin The minimum x-coordinate for a glyph.
01850 */
01851 void
01852 fillHeadTable (Font *font, enum LocaFormat locaFormat, pixels_t xMin)
01853 {
01854     Buffer *head = newBuffer (56);
01855     addTable (font, "head", head);
01856     cacheU16 (head, 1); // majorVersion
01857     cacheU16 (head, 0); // minorVersion
01858     cacheZeros (head, 4); // fontRevision (unused)
01859     // The 'checksumAdjustment' field is a checksum of the entire file.
01860     // It is later calculated and written directly in the 'writeFont' function.
01861     cacheU32 (head, 0); // checksumAdjustment (placeholder)
01862     cacheU32 (head, 0x5f0f3cf5); // magicNumber
01863     const uint_fast16_t flags =
01864         + B1 (0) // baseline at y=0
01865         + B1 (1) // LSB at x=0 (doubtful; probably should be LSB=xMin)
01866         + B0 (2) // instructions may depend on point size
01867         + B0 (3) // force internal ppem to integers
01868         + B0 (4) // instructions may alter advance width
01869         + B0 (5) // not used in OpenType
01870         + B0 (6) // not used in OpenType
01871         + B0 (7) // not used in OpenType
01872         + B0 (8) // not used in OpenType
01873         + B0 (9) // not used in OpenType
01874         + B0 (10) // not used in OpenType
01875         + B0 (11) // font transformed
01876         + B0 (12) // font converted
01877         + B0 (13) // font optimized for ClearType
01878         + B0 (14) // last resort font
01879         + B0 (15) // reserved
01880     ;
01881     cacheU16 (head, flags); // flags
01882     cacheU16 (head, FUPEM); // unitsPerEm
01883     cacheZeros (head, 8); // created (unused)
01884     cacheZeros (head, 8); // modified (unused)
01885     cacheU16 (head, FU (xMin)); // xMin

```

```

01887 cacheU16 (head, FU (-DESCENDER)); // yMin
01888 cacheU16 (head, FU (font->maxWidth)); // xMax
01889 cacheU16 (head, FU (ASCENDER)); // yMax
01890 // macStyle (must agree with 'fsSelection' in 'OS/2' table)
01891 const uint_fast16_t macStyle =
01892     + B0 (0) // bold
01893     + B0 (1) // italic
01894     + B0 (2) // underline
01895     + B0 (3) // outline
01896     + B0 (4) // shadow
01897     + B0 (5) // condensed
01898     + B0 (6) // extended
01899     // 7-15 reserved
01900 ;
01901 cacheU16 (head, macStyle);
01902 cacheU16 (head, GLYPH_HEIGHT); // lowestRecPPEM
01903 cacheU16 (head, 2); // fontDirectionHint
01904 cacheU16 (head, locaFormat); // indexToLocFormat
01905 cacheU16 (head, 0); // glyphDataFormat
01906 }
01907
01908 /**
01909 @brief Fill a "hhea" font table.
01910
01911 The "hhea" table contains horizontal header information,
01912 for example left and right side bearings.
01913
01914 @param[in,out] font The Font struct to which to add the table.
01915 @param[in] xMin The minimum x-coordinate for a glyph.
01916 */
01917 void
01918 fillHheaTable (Font *font, pixels_t xMin)
01919 {
01920     Buffer *hhea = newBuffer (36);
01921     addTable (font, "hhea", hhea);
01922     cacheU16 (hhea, 1); // majorVersion
01923     cacheU16 (hhea, 0); // minorVersion
01924     cacheU16 (hhea, FU (ASCENDER)); // ascender
01925     cacheU16 (hhea, FU (-DESCENDER)); // descender
01926     cacheU16 (hhea, FU (0)); // lineGap
01927     cacheU16 (hhea, FU (font->maxWidth)); // advanceWidthMax
01928     cacheU16 (hhea, FU (xMin)); // minLeftSideBearing
01929     cacheU16 (hhea, FU (0)); // minRightSideBearing (unused)
01930     cacheU16 (hhea, FU (font->maxWidth)); // xMaxExtent
01931     cacheU16 (hhea, 1); // caretSlopeRise
01932     cacheU16 (hhea, 0); // caretSlopeRun
01933     cacheU16 (hhea, 0); // caretOffset
01934     cacheU16 (hhea, 0); // reserved
01935     cacheU16 (hhea, 0); // reserved
01936     cacheU16 (hhea, 0); // reserved
01937     cacheU16 (hhea, 0); // reserved
01938     cacheU16 (hhea, 0); // metricDataFormat
01939     cacheU16 (hhea, font->glyphCount); // numberOfMetrics
01940 }
01941
01942 /**
01943 @brief Fill a "maxp" font table.
01944
01945 The "maxp" table contains maximum profile information,
01946 such as the memory required to contain the font.
01947
01948 @param[in,out] font The Font struct to which to add the table.
01949 @param[in] isCFF true if a CFF font is included, false otherwise.
01950 @param[in] maxPoints Maximum points in a non-composite glyph.
01951 @param[in] maxContours Maximum contours in a non-composite glyph.
01952 */
01953 void
01954 fillMaxpTable (Font *font, bool isCFF, uint_fast16_t maxPoints,
01955               uint_fast16_t maxContours)
01956 {
01957     Buffer *maxp = newBuffer (32);
01958     addTable (font, "maxp", maxp);
01959     cacheU32 (maxp, isCFF ? 0x00005000 : 0x00010000); // version
01960     cacheU16 (maxp, font->glyphCount); // numGlyphs
01961     if (isCFF)
01962         return;
01963     cacheU16 (maxp, maxPoints); // maxPoints
01964     cacheU16 (maxp, maxContours); // maxContours
01965     cacheU16 (maxp, 0); // maxCompositePoints
01966     cacheU16 (maxp, 0); // maxCompositeContours
01967     cacheU16 (maxp, 0); // maxZones

```

```

01968     cacheU16 (maxp, 0); // maxTwilightPoints
01969     cacheU16 (maxp, 0); // maxStorage
01970     cacheU16 (maxp, 0); // maxFunctionDefs
01971     cacheU16 (maxp, 0); // maxInstructionDefs
01972     cacheU16 (maxp, 0); // maxStackElements
01973     cacheU16 (maxp, 0); // maxSizeOfInstructions
01974     cacheU16 (maxp, 0); // maxComponentElements
01975     cacheU16 (maxp, 0); // maxComponentDepth
01976 }
01977 /**
01978 @brief Fill an "OS/2" font table.
01980 The "OS/2" table contains OS/2 and Windows font metrics information.
01982 @param[in,out] font The Font struct to which to add the table.
01984 */
01985 void
01986 fillOS2Table (Font *font)
01987 {
01988     Buffer *os2 = newBuffer (100);
01989     addTable (font, "OS/2", os2);
01990     cacheU16 (os2, 5); // version
01991     // HACK: Average glyph width is not actually calculated.
01992     cacheU16 (os2, FU (font->maxWidth)); // xAvgCharWidth
01993     cacheU16 (os2, 400); // usWeightClass = Normal
01994     cacheU16 (os2, 5); // usWidthClass = Medium
01995     const uint_fast16_t typeFlags =
01996         + B0 (0) // reserved
01997         // usage permissions, one of:
01998         // Default: Installable embedding
01999         + B0 (1) // Restricted License embedding
02000         + B0 (2) // Preview & Print embedding
02001         + B0 (3) // Editable embedding
02002         // 4-7 reserved
02003         + B0 (8) // no subsetting
02004         + B0 (9) // bitmap embedding only
02005         // 10-15 reserved
02006     ;
02007     cacheU16 (os2, typeFlags); // fsType
02008     cacheU16 (os2, FU (5)); // ySubscriptXSize
02009     cacheU16 (os2, FU (7)); // ySubscriptYSize
02010     cacheU16 (os2, FU (0)); // ySubscriptXOffset
02011     cacheU16 (os2, FU (1)); // ySubscriptYOffset
02012     cacheU16 (os2, FU (5)); // ySuperscriptXSize
02013     cacheU16 (os2, FU (7)); // ySuperscriptYSize
02014     cacheU16 (os2, FU (0)); // ySuperscriptXOffset
02015     cacheU16 (os2, FU (4)); // ySuperscriptYOffset
02016     cacheU16 (os2, FU (1)); // yStrikeoutSize
02017     cacheU16 (os2, FU (5)); // yStrikeoutPosition
02018     cacheU16 (os2, 0x080a); // sFamilyClass = Sans Serif, Matrix
02019     const byte panose[] =
02020     {
02021         2, // Family Kind = Latin Text
02022         11, // Serif Style = Normal Sans
02023         4, // Weight = Thin
02024         // Windows would render all glyphs to the same width,
02025         // if 'Proportion' is set to 'Monospaced' (as Unifont should be).
02026         // 'Condensed' is the best alternative according to metrics.
02027         6, // Proportion = Condensed
02028         2, // Contrast = None
02029         2, // Stroke = No Variation
02030         2, // Arm Style = Straight Arms
02031         8, // Letterform = Normal/Square
02032         2, // Midline = Standard/Trimmed
02033         4, // X-height = Constant/Large
02034     };
02035     cacheBytes (os2, panose, sizeof panose); // panose
02036     // HACK: All defined Unicode ranges are marked functional for convenience.
02037     cacheU32 (os2, 0xffffffff); // ulUnicodeRange1
02038     cacheU32 (os2, 0xffffffff); // ulUnicodeRange2
02039     cacheU32 (os2, 0xffffffff); // ulUnicodeRange3
02040     cacheU32 (os2, 0x0effffff); // ulUnicodeRange4
02041     cacheBytes (os2, "GNU ", 4); // achVendID
02042     // fsSelection (must agree with 'macStyle' in 'head' table)
02043     const uint_fast16_t selection =
02044         + B0 (0) // italic
02045         + B0 (1) // underscored
02046         + B0 (2) // negative
02047         + B0 (3) // outlined
02048         + B0 (4) // strikeout

```

```

02049     + B0 (5) // bold
02050     + B1 (6) // regular
02051     + B1 (7) // use sTypo* metrics in this table
02052     + B1 (8) // font name conforms to WWS model
02053     + B0 (9) // oblique
02054     // 10-15 reserved
02055 ;
02056 cacheU16 (os2, selection);
02057 const Glyph *glyphs = getBufferHead (font->glyphs);
02058 uint_fast32_t first = glyphs[1].codePoint;
02059 uint_fast32_t last = glyphs[font->glyphCount - 1].codePoint;
02060 cacheU16 (os2, first < U16MAX ? first : U16MAX); // usFirstCharIndex
02061 cacheU16 (os2, last < U16MAX ? last : U16MAX); // usLastCharIndex
02062 cacheU16 (os2, FU (ASCENDER)); // sTypoAscender
02063 cacheU16 (os2, FU (-DESCENDER)); // sTypoDescender
02064 cacheU16 (os2, FU (0)); // sTypoLineGap
02065 cacheU16 (os2, FU (ASCENDER)); // usWinAscent
02066 cacheU16 (os2, FU (DESCENDER)); // usWinDescent
02067 // HACK: All reasonable code pages are marked functional for convenience.
02068 cacheU32 (os2, 0x603f01ff); // ulCodePageRange1
02069 cacheU32 (os2, 0xffff0000); // ulCodePageRange2
02070 cacheU16 (os2, FU (8)); // sxHeight
02071 cacheU16 (os2, FU (10)); // sCapHeight
02072 cacheU16 (os2, 0); // usDefaultChar
02073 cacheU16 (os2, 0x20); // usBreakChar
02074 cacheU16 (os2, 0); // usMaxContext
02075 cacheU16 (os2, 0); // usLowerOpticalPointSize
02076 cacheU16 (os2, 0xffff); // usUpperOpticalPointSize
02077 }
02078
02079 /**
02080 @brief Fill an "hmtx" font table.
02081
02082 The "hmtx" table contains horizontal metrics information.
02083
02084 @param[in,out] font The Font struct to which to add the table.
02085 */
02086 void
02087 fillHmtxTable (Font *font)
02088 {
02089     Buffer *hmtx = newBuffer (4 * font->glyphCount);
02090     addTable (font, "hmtx", hmtx);
02091     const Glyph *const glyphs = getBufferHead (font->glyphs);
02092     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
02093     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
02094     {
02095         int_fast16_t aw = glyph->combining ? 0 : PW (glyph->byteCount);
02096         cacheU16 (hmtx, FU (aw)); // advanceWidth
02097         cacheU16 (hmtx, FU (glyph->lsb)); // lsb
02098     }
02099 }
02100
02101 /**
02102 @brief Fill a "cmap" font table.
02103
02104 The "cmap" table contains character to glyph index mapping information.
02105
02106 @param[in,out] font The Font struct to which to add the table.
02107 */
02108 void
02109 fillCmapTable (Font *font)
02110 {
02111     Glyph *const glyphs = getBufferHead (font->glyphs);
02112     Buffer *rangeHeads = newBuffer (16);
02113     uint_fast32_t rangeCount = 0;
02114     uint_fast32_t bmpRangeCount = 1; // 1 for the last 0xffff-0xffff range
02115     glyphs[0].codePoint = glyphs[1].codePoint; // to start a range at glyph 1
02116     for (uint_fast16_t i = 1; i < font->glyphCount; i++)
02117     {
02118         if (glyphs[i].codePoint != glyphs[i - 1].codePoint + 1)
02119         {
02120             storeU16 (rangeHeads, i);
02121             rangeCount++;
02122             bmpRangeCount += glyphs[i].codePoint < 0xffff;
02123         }
02124     }
02125     Buffer *cmap = newBuffer (256);
02126     addTable (font, "cmap", cmap);
02127     // Format 4 table is always generated for compatibility.
02128     bool hasFormat12 = glyphs[font->glyphCount - 1].codePoint > 0xffff;
02129     cacheU16 (cmap, 0); // version

```

```

02130 cacheU16 (cmap, 1 + hasFormat12); // numTables
02131 { // encodingRecords[0]
02132     cacheU16 (cmap, 3); // platformID
02133     cacheU16 (cmap, 1); // encodingID
02134     cacheU32 (cmap, 12 + 8 * hasFormat12); // subtableOffset
02135 }
02136 if (hasFormat12) // encodingRecords[1]
02137 {
02138     cacheU16 (cmap, 3); // platformID
02139     cacheU16 (cmap, 10); // encodingID
02140     cacheU32 (cmap, 36 + 8 * bmpRangeCount); // subtableOffset
02141 }
02142 const uint_least16_t *ranges = getBufferHead (rangeHeads);
02143 const uint_least16_t *const rangesEnd = getBufferTail (rangeHeads);
02144 storeU16 (rangeHeads, font->glyphCount);
02145 { // format 4 table
02146     cacheU16 (cmap, 4); // format
02147     cacheU16 (cmap, 16 + 8 * bmpRangeCount); // length
02148     cacheU16 (cmap, 0); // language
02149     if (bmpRangeCount * 2 > U16MAX)
02150         fail ("Too many ranges in 'cmap' table.");
02151     cacheU16 (cmap, bmpRangeCount * 2); // segCountX2
02152     uint_fast16_t searchRange = 1, entrySelector = -1;
02153     while (searchRange <= bmpRangeCount)
02154     {
02155         searchRange <<= 1;
02156         entrySelector++;
02157     }
02158     cacheU16 (cmap, searchRange); // searchRange
02159     cacheU16 (cmap, entrySelector); // entrySelector
02160     cacheU16 (cmap, bmpRangeCount * 2 - searchRange); // rangeShift
02161     { // endCode[]
02162         const uint_least16_t *p = ranges;
02163         for (p++; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02164             cacheU16 (cmap, glyphs[*p - 1].codePoint);
02165         uint_fast32_t cp = glyphs[*p - 1].codePoint;
02166         if (cp > 0xfffe)
02167             cp = 0xffff;
02168         cacheU16 (cmap, cp);
02169         cacheU16 (cmap, 0xffff);
02170     }
02171     cacheU16 (cmap, 0); // reservedPad
02172     { // startCode[]
02173         for (uint_fast32_t i = 0; i < bmpRangeCount - 1; i++)
02174             cacheU16 (cmap, glyphs[ranges[i]].codePoint);
02175         cacheU16 (cmap, 0xffff);
02176     }
02177     { // idDelta[]
02178         const uint_least16_t *p = ranges;
02179         for (; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02180             cacheU16 (cmap, *p - glyphs[*p].codePoint);
02181         uint_fast16_t delta = 1;
02182         if (p < rangesEnd && *p == 0xffff)
02183             delta = *p - glyphs[*p].codePoint;
02184         cacheU16 (cmap, delta);
02185     }
02186     { // idRangeOffsets[]
02187         for (uint_least16_t i = 0; i < bmpRangeCount; i++)
02188             cacheU16 (cmap, 0);
02189     }
02190 }
02191 if (hasFormat12) // format 12 table
02192 {
02193     cacheU16 (cmap, 12); // format
02194     cacheU16 (cmap, 0); // reserved
02195     cacheU32 (cmap, 16 + 12 * rangeCount); // length
02196     cacheU32 (cmap, 0); // language
02197     cacheU32 (cmap, rangeCount); // numGroups
02198
02199     // groups[]
02200     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
02201     {
02202         cacheU32 (cmap, glyphs[*p].codePoint); // startCharCode
02203         cacheU32 (cmap, glyphs[p[1] - 1].codePoint); // endCharCode
02204         cacheU32 (cmap, *p); // startGlyphID
02205     }
02206 }
02207 freeBuffer (rangeHeads);
02208 }
02209
02210 /**

```

```

02211 @brief Fill a "post" font table.
02212
02213 The "post" table contains information for PostScript printers.
02214
02215 @param[in,out] font The Font struct to which to add the table.
02216 */
02217 void
02218 fillPostTable (Font *font)
02219 {
02220     Buffer *post = newBuffer (32);
02221     addTable (font, "post", post);
02222     cacheU32 (post, 0x00030000); // version = 3.0
02223     cacheU32 (post, 0); // italicAngle
02224     cacheU16 (post, 0); // underlinePosition
02225     cacheU16 (post, 1); // underlineThickness
02226     cacheU32 (post, 1); // isFixedPitch
02227     cacheU32 (post, 0); // minMemType42
02228     cacheU32 (post, 0); // maxMemType42
02229     cacheU32 (post, 0); // minMemType1
02230     cacheU32 (post, 0); // maxMemType1
02231 }
02232 /**
02234 @brief Fill a "GPOS" font table.
02235
02236 The "GPOS" table contains information for glyph positioning.
02237
02238 @param[in,out] font The Font struct to which to add the table.
02239 */
02240 void
02241 fillGposTable (Font *font)
02242 {
02243     Buffer *gpos = newBuffer (16);
02244     addTable (font, "GPOS", gpos);
02245     cacheU16 (gpos, 1); // majorVersion
02246     cacheU16 (gpos, 0); // minorVersion
02247     cacheU16 (gpos, 10); // scriptListOffset
02248     cacheU16 (gpos, 12); // featureListOffset
02249     cacheU16 (gpos, 14); // lookupListOffset
02250     { // ScriptList table
02251         cacheU16 (gpos, 0); // scriptCount
02252     }
02253     { // Feature List table
02254         cacheU16 (gpos, 0); // featureCount
02255     }
02256     { // Lookup List Table
02257         cacheU16 (gpos, 0); // lookupCount
02258     }
02259 }
02260 /**
02262 @brief Fill a "GSUB" font table.
02263
02264 The "GSUB" table contains information for glyph substitution.
02265
02266 @param[in,out] font The Font struct to which to add the table.
02267 */
02268 void
02269 fillGsubTable (Font *font)
02270 {
02271     Buffer *gsub = newBuffer (38);
02272     addTable (font, "GSUB", gsub);
02273     cacheU16 (gsub, 1); // majorVersion
02274     cacheU16 (gsub, 0); // minorVersion
02275     cacheU16 (gsub, 10); // scriptListOffset
02276     cacheU16 (gsub, 34); // featureListOffset
02277     cacheU16 (gsub, 36); // lookupListOffset
02278     { // ScriptList table
02279         cacheU16 (gsub, 2); // scriptCount
02280         { // scriptRecords[0]
02281             cacheBytes (gsub, "DFLT", 4); // scriptTag
02282             cacheU16 (gsub, 14); // scriptOffset
02283         }
02284         { // scriptRecords[1]
02285             cacheBytes (gsub, "thai", 4); // scriptTag
02286             cacheU16 (gsub, 14); // scriptOffset
02287         }
02288     }
02289     { // Script table
02290         cacheU16 (gsub, 4); // defaultLangSysOffset
02291         cacheU16 (gsub, 0); // langSysCount
02292     }
02293     { // Default Language System table

```

```

02292         cacheU16 (gsub, 0); // lookupOrderOffset
02293         cacheU16 (gsub, 0); // requiredFeatureIndex
02294         cacheU16 (gsub, 0); // featureIndexCount
02295     }
02296 }
02297 }
02298 { // Feature List table
02299     cacheU16 (gsub, 0); // featureCount
02300 }
02301 { // Lookup List Table
02302     cacheU16 (gsub, 0); // lookupCount
02303 }
02304 }
02305
02306 /**
02307 @brief Cache a string as a big-ending UTF-16 surrogate pair.
02308
02309 This function encodes a UTF-8 string as a big-endian UTF-16
02310 surrogate pair.
02311
02312 @param[in,out] buf Pointer to a Buffer struct to update.
02313 @param[in] str The character array to encode.
02314 */
02315 void
02316 cacheStringAsUTF16BE (Buffer *buf, const char *str)
02317 {
02318     for (const char *p = str; *p; p++)
02319     {
02320         byte c = *p;
02321         if (c < 0x80)
02322         {
02323             cacheU16 (buf, c);
02324             continue;
02325         }
02326         int length = 1;
02327         byte mask = 0x40;
02328         for (; c & mask; mask >>= 1)
02329             length++;
02330         if (length == 1 || length > 4)
02331             fail ("Ill-formed UTF-8 sequence.");
02332         uint_fast32_t codePoint = c & (mask - 1);
02333         for (int i = 1; i < length; i++)
02334         {
02335             c = *p++;
02336             if ((c & 0xc0) != 0x80) // NUL checked here
02337                 fail ("Ill-formed UTF-8 sequence.");
02338             codePoint = (codePoint << 6) | (c & 0x3f);
02339         }
02340         const int lowerBits = length==2 ? 7 : length==3 ? 11 : 16;
02341         if (codePoint >> lowerBits == 0)
02342             fail ("Ill-formed UTF-8 sequence."); // sequence should be shorter
02343         if (codePoint >= 0xd800 && codePoint <= 0xdfff)
02344             fail ("Ill-formed UTF-8 sequence.");
02345         if (codePoint > 0x10ffff)
02346             fail ("Ill-formed UTF-8 sequence.");
02347         if (codePoint > 0xffff)
02348         {
02349             cacheU16 (buf, 0xd800 | (codePoint - 0x10000) >> 10);
02350             cacheU16 (buf, 0xdc00 | (codePoint & 0x3ff));
02351         }
02352         else
02353             cacheU16 (buf, codePoint);
02354     }
02355 }
02356
02357 /**
02358 @brief Fill a "name" font table.
02359
02360 The "name" table contains name information, for example for Name IDs.
02361
02362 @param[in,out] font The Font struct to which to add the table.
02363 @param[in] names List of NameStrings.
02364 */
02365 void
02366 fillNameTable (Font *font, NameStrings nameStrings)
02367 {
02368     Buffer *name = newBuffer (2048);
02369     addTable (font, "name", name);
02370     size_t nameStringCount = 0;
02371     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02372         nameStringCount += !nameStrings[i];

```

```

02373 cacheU16 (name, 0); // version
02374 cacheU16 (name, nameStringCount); // count
02375 cacheU16 (name, 2 * 3 + 12 * nameStringCount); // storageOffset
02376 Buffer *stringData = newBuffer (1024);
02377 // nameRecord[]
02378 for (size_t i = 0; i < MAX_NAME_IDS; i++)
02379 {
02380     if (!nameStrings[i])
02381         continue;
02382     size_t offset = countBufferedBytes (stringData);
02383     cacheStringAsUTF16BE (stringData, nameStrings[i]);
02384     size_t length = countBufferedBytes (stringData) - offset;
02385     if (offset > U16MAX || length > U16MAX)
02386         fail ("Name strings are too long.");
02387     // Platform ID 0 (Unicode) is not well supported.
02388     // ID 3 (Windows) seems to be the best for compatibility.
02389     cacheU16 (name, 3); // platformID = Windows
02390     cacheU16 (name, 1); // encodingID = Unicode BMP
02391     cacheU16 (name, 0x0409); // languageID = en-US
02392     cacheU16 (name, i); // nameID
02393     cacheU16 (name, length); // length
02394     cacheU16 (name, offset); // stringOffset
02395 }
02396 cacheBuffer (name, stringData);
02397 freeBuffer (stringData);
02398 }
02399
02400 /**
02401 @brief Print program version string on stdout.
02402
02403 Print program version if invoked with the "--version" option,
02404 and then exit successfully.
02405 */
02406 void
02407 printVersion () {
02408     printf ("hex2otf (GNU Unifont) %s\n", VERSION);
02409     printf ("Copyright \u00A9 2022 \u4F55\u5FD7\u7FD4 (He Zhixiang)\n");
02410     printf ("License GPLv2+: GNU GPL version 2 or later\n");
02411     printf ("<https://gnu.org/licenses/gpl.html>\n");
02412     printf ("This is free software: you are free to change and\n");
02413     printf ("redistribute it. There is NO WARRANTY, to the extent\n");
02414     printf ("permitted by law.\n");
02415     exit (EXIT_SUCCESS);
02416 }
02417
02418 /**
02419 @brief Print help message to stdout and then exit.
02420
02421 Print help message if invoked with the "--help" option,
02422 and then exit successfully.
02423 */
02424 void
02425 printHelp () {
02426     printf ("Synopsis: hex2otf <options>:\n\n");
02427     printf ("  hex=<filename>      Specify Unifont .hex input file.\n");
02428     printf ("  pos=<filename>      Specify combining file. (Optional)\n");
02429     printf ("  out=<filename>      Specify output font file.\n");
02430     printf ("  format=<f1>,<f2>,... Specify font format(s); values:\n");
02431     printf ("                      cff\n");
02432     printf ("                      cff2\n");
02433     printf ("                      truetype\n");
02434     printf ("                      blank\n");
02435     printf ("                      bitmap\n");
02436     printf ("                      gpos\n");
02437     printf ("                      gsub\n");
02438     printf ("\nExample:\n\n");
02439     printf ("  hex2otf hex=Myfont.hex out=Myfont.otf format=cff\n");
02440     printf ("For more information, consult the hex2otf(1) man page.\n\n");
02441     exit (EXIT_SUCCESS);
02442 }
02443
02444 /**
02445 @brief Data structure to hold options for OpenType font output.
02446
02447 This data structure holds the status of options that can be
02448 specified as command line arguments for creating the output
02449 OpenType font file.
02450 */
02451 typedef struct Options

```

```

02454 {
02455     bool truetype, blankOutline, bitmap, gpos, gsub;
02456     int cff; // 0 = no CFF outline; 1 = use 'CFF' table; 2 = use 'CFF2' table
02457     const char *hex, *pos, *out; // file names
02458     NameStrings nameStrings; // indexed directly by Name IDs
02459 } Options;
02460
02461 /**
02462 @brief Match a command line option with its key for enabling.
02463
02464 @param[in] operand A pointer to the specified operand.
02465 @param[in] key Pointer to the option structure.
02466 @param[in] delimiter The delimiter to end searching.
02467 @return Pointer to the first character of the desired option.
02468 */
02469 const char *
02470 matchToken (const char *operand, const char *key, char delimiter)
02471 {
02472     while (*key)
02473         if (*operand++ != *key++)
02474             return NULL;
02475     if (!*operand || *operand++ == delimiter)
02476         return operand;
02477     return NULL;
02478 }
02479
02480 /**
02481 @brief Parse command line options.
02482
02483 Option      Data Type      Description
02484 -----
02485 truetype     bool           Generate TrueType outlines
02486 blankOutline bool           Generate blank outlines
02487 bitmap       bool           Generate embedded bitmap
02488 gpos         bool           Generate a dummy GPOS table
02489 gsub         bool           Generate a dummy GSUB table
02490 cff          int            Generate CFF 1 or CFF 2 outlines
02491 hex          const char *   Name of Unifont .hex file
02492 pos          const char *   Name of Unifont combining data file
02493 out          const char *   Name of output font file
02494 nameStrings  NameStrings    Array of TrueType font Name IDs
02495
02496 @param[in] argv Pointer to array of command line options.
02497 @return Data structure to hold requested command line options.
02498 */
02499 Options
02500 parseOptions (char *const argv[const])
02501 {
02502     Options opt = {0}; // all options default to 0, false and NULL
02503     const char *format = NULL;
02504     struct StringArg
02505     {
02506         const char *const key;
02507         const char **const value;
02508     } strArgs[] =
02509     {
02510         {"hex", &opt.hex},
02511         {"pos", &opt.pos},
02512         {"out", &opt.out},
02513         {"format", &format},
02514         {NULL, NULL} // sentinel
02515     };
02516     for (char *const *argp = argv + 1; *argp; argp++)
02517     {
02518         const char *const arg = *argp;
02519         struct StringArg *p;
02520         const char *value = NULL;
02521         if (strcmp (arg, "--help") == 0)
02522             printHelp ();
02523         if (strcmp (arg, "--version") == 0)
02524             printVersion ();
02525         for (p = strArgs; p->key; p++)
02526             if ((value = matchToken (arg, p->key, '=')))
02527                 break;
02528         if (p->key)
02529         {
02530             if (!*value)
02531                 fail ("Empty argument: '%s'", p->key);
02532             if (*p->value)
02533                 fail ("Duplicate argument: '%s'", p->key);
02534             *p->value = value;

```

```

02535     }
02536     else // shall be a name string
02537     {
02538         char *endptr;
02539         unsigned long id = strtoul (arg, &endptr, 10);
02540         if (endptr == arg || id >= MAX_NAME_IDS || *endptr != '=')
02541             fail ("Invalid argument: '%s'", arg);
02542         endptr++; // skip '='
02543         if (opt.nameStrings[id])
02544             fail ("Duplicate name ID: %lu.", id);
02545         opt.nameStrings[id] = endptr;
02546     }
02547 }
02548 if (!opt.hex)
02549     fail ("Hex file is not specified.");
02550 if (opt.pos && opt.pos[0] == '\0')
02551     opt.pos = NULL; // Position file is optional. Empty path means none.
02552 if (!opt.out)
02553     fail ("Output file is not specified.");
02554 if (!format)
02555     fail ("Format is not specified.");
02556 for (const NamePair *p = defaultNames; p->str; p++)
02557     if (!opt.nameStrings[p->id])
02558         opt.nameStrings[p->id] = p->str;
02559 bool cff = false, cff2 = false;
02560 struct Symbol
02561 {
02562     const char *const key;
02563     bool *const found;
02564 } symbols[] =
02565 {
02566     {"cff", &cff},
02567     {"cff2", &cff2},
02568     {"truetype", &opt.truetype},
02569     {"blank", &opt.blankOutline},
02570     {"bitmap", &opt.bitmap},
02571     {"gpos", &opt.gpos},
02572     {"gsub", &opt.gsub},
02573     {NULL, NULL} // sentinel
02574 };
02575 while (*format)
02576 {
02577     const struct Symbol *p;
02578     const char *next = NULL;
02579     for (p = symbols; p->key; p++)
02580         if ((next = matchToken (format, p->key, ',')))
02581             break;
02582     if (!p->key)
02583         fail ("Invalid format.");
02584     *p->found = true;
02585     format = next;
02586 }
02587 if (cff + cff2 + opt.truetype + opt.blankOutline > 1)
02588     fail ("At most one outline format can be accepted.");
02589 if (!(cff || cff2 || opt.truetype || opt.bitmap))
02590     fail ("Invalid format.");
02591 opt.cff = cff + cff2 * 2;
02592 return opt;
02593 }
02594
02595 /**
02596 @brief The main function.
02597
02598 @param[in] argc The number of command-line arguments.
02599 @param[in] argv The array of command-line arguments.
02600 @return EXIT_FAILURE upon fatal error, EXIT_SUCCESS otherwise.
02601 */
02602 int
02603 main (int argc, char *argv[])
02604 {
02605     initBuffers (16);
02606     atexit (cleanBuffers);
02607     Options opt = parseOptions (argv);
02608     Font font;
02609     font.tables = newBuffer (sizeof (Table) * 16);
02610     font.glyphs = newBuffer (sizeof (Glyph) * MAX_GLYPHS);
02611     readGlyphs (&font, opt.hex);
02612     sortGlyphs (&font);
02613     enum LocaFormat loca = LOCA_OFFSET16;
02614     uint_fast16_t maxPoints = 0, maxContours = 0;
02615     pixels_t xMin = 0;

```

```

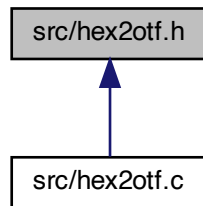
02616     if (opt.pos)
02617         positionGlyphs (&font, opt.pos, &xMin);
02618     if (opt.gpos)
02619         fillGposTable (&font);
02620     if (opt.gsub)
02621         fillGsubTable (&font);
02622     if (opt.cff)
02623         fillCFF (&font, opt.cff, opt.nameStrings);
02624     if (opt.truetype)
02625         fillTrueType (&font, &loca, &maxPoints, &maxContours);
02626     if (opt.blankOutline)
02627         fillBlankOutline (&font);
02628     if (opt.bitmap)
02629         fillBitmap (&font);
02630     fillHeadTable (&font, loca, xMin);
02631     fillHheaTable (&font, xMin);
02632     fillMaxpTable (&font, opt.cff, maxPoints, maxContours);
02633     fillOS2Table (&font);
02634     fillNameTable (&font, opt.nameStrings);
02635     fillHmtxTable (&font);
02636     fillCmapTable (&font);
02637     fillPostTable (&font);
02638     organizeTables (&font, opt.cff);
02639     writeFont (&font, opt.cff, opt.out);
02640     return EXIT_SUCCESS;
02641 }

```

5.5 src/hex2otf.h File Reference

[hex2otf.h](#) - Header file for [hex2otf.c](#)

This graph shows which files directly or indirectly include this file:



Data Structures

- struct [NamePair](#)
Data structure for a font ID number and name character string.

Macros

- `#define UNIFONT_VERSION "16.0.03"`
Current Unifont version.
- `#define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \Nils Moskopp, Rebecca Bettencourt, et al."`
- `#define DEFAULT_ID1 "Unifont"`
Default NameID 1 string ([Font](#) Family)
- `#define DEFAULT_ID2 "Regular"`

- Default NameID 2 string ([Font Subfamily](#))
- `#define DEFAULT_ID5 "Version "UNIFONT_VERSION`
Default NameID 5 string (Version of the Name [Table](#))
- `#define DEFAULT_ID11 "https://unifoundry.com/unifont/"`
Default NameID 11 string ([Font Vendor URL](#))
- `#define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \and GNU GPL version 2 or later with the GNU Font Embedding Exception."`
Default NameID 13 string (License Description)
- `#define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \https://scripts.sil.org/OFL"`
Default NameID 14 string (License Information URLs)
- `#define NAMEPAIR(n) {(n), DEFAULT_ID##n}`
Macro to initialize name identifier codes to default values defined above.

Typedefs

- typedef struct [NamePair](#) NamePair
Data structure for a font ID number and name character string.

Variables

- const [NamePair](#) defaultNames []
Allocate array of NameID codes with default values.

5.5.1 Detailed Description

[hex2otf.h](#) - Header file for [hex2otf.c](#)

Copyright

Copyright © 2022 [何志翔](#) (He Zhixiang)

Author

[何志翔](#) (He Zhixiang)

Definition in file [hex2otf.h](#).

5.5.2 Macro Definition Documentation

5.5.2.1 [DEFAULT_ID0](#)

`#define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \Nils Moskopp, Rebecca Bettencourt, et al."`
Define default strings for some TrueType font NameID strings.

NameID Description

-----	-----
0	Copyright Notice
1	Font Family
2	Font Subfamily
5	Version of the Name Table
11	URL of the Font Vendor
13	License Description
14	License Information URL

Default NameID 0 string (Copyright Notice)

Definition at line [53](#) of file [hex2otf.h](#).

5.5.2.2 DEFAULT_ID1

```
#define DEFAULT_ID1 "Unifont"
Default NameID 1 string (Font Family)
Definition at line 57 of file hex2otf.h.
```

5.5.2.3 DEFAULT_ID11

```
#define DEFAULT_ID11 "https://unifoundry.com/unifont/"
Default NameID 11 string (Font Vendor URL)
Definition at line 64 of file hex2otf.h.
```

5.5.2.4 DEFAULT_ID13

```
#define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \
and GNU GPL version 2 or later with the GNU Font Embedding Exception."
Default NameID 13 string (License Description)
Definition at line 67 of file hex2otf.h.
```

5.5.2.5 DEFAULT_ID14

```
#define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \
https://scripts.sil.org/OFL"
Default NameID 14 string (License Information URLs)
Definition at line 71 of file hex2otf.h.
```

5.5.2.6 DEFAULT_ID2

```
#define DEFAULT_ID2 "Regular"
Default NameID 2 string (Font Subfamily)
Definition at line 58 of file hex2otf.h.
```

5.5.2.7 DEFAULT_ID5

```
#define DEFAULT_ID5 "Version " UNIFONT_VERSION
Default NameID 5 string (Version of the Name Table)
Definition at line 61 of file hex2otf.h.
```

5.5.2.8 NAMEPAIR

```
#define NAMEPAIR(
    n ) {(n), DEFAULT_ID##n}
Macro to initialize name identifier codes to default values defined above.
Definition at line 84 of file hex2otf.h.
```

5.5.2.9 UNIFONT_VERSION

```
#define UNIFONT_VERSION "16.0.03"
Current Unifont version.
Definition at line 36 of file hex2otf.h.
```

5.5.3 Variable Documentation

5.5.3.1 defaultNames

const [NamePair](#) defaultNames[]

Initial value:

```
=
{
    NAMEPAIR (0),
    NAMEPAIR (1),
    NAMEPAIR (2),
    NAMEPAIR (5),
    NAMEPAIR (11),
    NAMEPAIR (13),
    NAMEPAIR (14),
    {0, NULL}
}
```

Allocate array of NameID codes with default values.

This array contains the default values for several TrueType NameID strings, as defined above in this file. Strings are assigned using the NAMEPAIR macro defined above.

Definition at line 93 of file [hex2otf.h](#).

5.6 hex2otf.h

[Go to the documentation of this file.](#)

```
00001 /**
00002  @file hex2otf.h
00003
00004  @brief hex2otf.h - Header file for hex2otf.c
00005
00006  @copyright Copyright © 2022 何志翔 (He Zhixiang)
00007
00008  @author 何志翔 (He Zhixiang)
00009 */
00010
00011 /*
00012  LICENSE:
00013
00014  This program is free software; you can redistribute it and/or
00015  modify it under the terms of the GNU General Public License
00016  as published by the Free Software Foundation; either version 2
00017  of the License, or (at your option) any later version.
00018
00019  This program is distributed in the hope that it will be useful,
00020  but WITHOUT ANY WARRANTY; without even the implied warranty of
00021  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00022  GNU General Public License for more details.
00023
00024  You should have received a copy of the GNU General Public License
00025  along with this program; if not, write to the Free Software
00026  Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA
00027  02110-1301, USA.
00028
00029  NOTE: It is a violation of the license terms of this software
00030  to delete license and copyright information below if creating
00031  a font derived from Unifont glyphs.
00032 */
00033 #ifndef __HEX2OTF_H__
00034 #define __HEX2OTF_H__
00035
00036 #define UNIFONT_VERSION "16.0.03" ///< Current Unifont version.
00037
00038 /**
00039  Define default strings for some TrueType font NameID strings.
00040
00041  NameID   Description
00042  -----
00043  0       Copyright Notice
00044  1       Font Family
00045  2       Font Subfamily
00046  5       Version of the Name Table
00047  11      URL of the Font Vendor
```

```

00048 13    License Description
00049 14    License Information URL
00050
00051 Default NameID 0 string (Copyright Notice)
00052 */
00053 #define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \
00054 Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \
00055 Nils Moskopp, Rebecca Bettencourt, et al."
00056
00057 #define DEFAULT_ID1 "Unifont"    ///< Default NameID 1 string (Font Family)
00058 #define DEFAULT_ID2 "Regular"    ///< Default NameID 2 string (Font Subfamily)
00059
00060 ///< Default NameID 5 string (Version of the Name Table)
00061 #define DEFAULT_ID5 "Version "UNIFONT_VERSION
00062
00063 ///< Default NameID 11 string (Font Vendor URL)
00064 #define DEFAULT_ID11 "https://unifoundry.com/unifont/"
00065
00066 ///< Default NameID 13 string (License Description)
00067 #define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \
00068 and GNU GPL version 2 or later with the GNU Font Embedding Exception."
00069
00070 ///< Default NameID 14 string (License Information URLs)
00071 #define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \
00072 https://scripts.sil.org/OFL"
00073
00074 /**
00075 @brief Data structure for a font ID number and name character string.
00076 */
00077 typedef struct NamePair
00078 {
00079     int id;
00080     const char *str;
00081 } NamePair;
00082
00083 ///< Macro to initialize name identifier codes to default values defined above.
00084 #define NAMEPAIR(n) {(n), DEFAULT_ID##n}
00085
00086 /**
00087 @brief Allocate array of NameID codes with default values.
00088
00089 This array contains the default values for several TrueType NameID
00090 strings, as defined above in this file. Strings are assigned using
00091 the NAMEPAIR macro defined above.
00092 */
00093 const NamePair defaultNames[] =
00094 {
00095     NAMEPAIR (0), // Copyright notice; required (used in CFF)
00096     NAMEPAIR (1), // Font family; required (used in CFF)
00097     NAMEPAIR (2), // Font subfamily
00098     NAMEPAIR (5), // Version of the name table
00099     NAMEPAIR (11), // URL of font vendor
00100     NAMEPAIR (13), // License description
00101     NAMEPAIR (14), // License information URL
00102     {0, NULL} // Sentinel
00103 };
00104
00105 #undef NAMEPAIR
00106
00107 #endif

```

5.7 src/johab2syllables.c File Reference

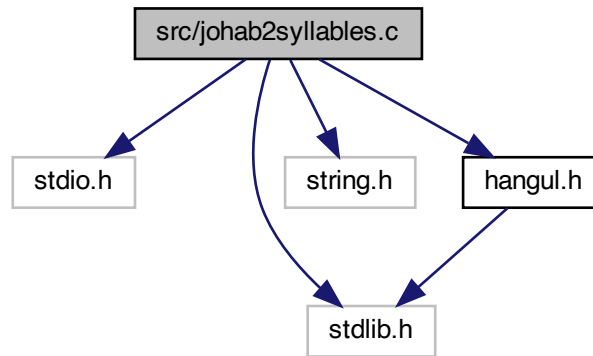
Create the Unicode Hangul Syllables block from component letters.

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hangul.h"

```

Include dependency graph for johab2syllables.c:



Functions

- `int main (int argc, char *argv[])`
The main function.
- `void print_help ()`
Print a help message.

5.7.1 Detailed Description

Create the Unicode Hangul Syllables block from component letters.

This program reads in a "hangul-base.hex" file containing Hangul letters in Johab 6/3/1 format and outputs a Unifont .hex format file covering the Unicode Hangul Syllables range of U+AC00..U+D7A3.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [johab2syllables.c](#).

5.7.2 Function Documentation

5.7.2.1 main()

```
int main (  
    int argc,  
    char * argv[] )
```

The main function.

Definition at line 42 of file [johab2syllables.c](#).

```

00042     {
00043     int    i;          /* Loop variables */
00044     int    arg_count; /* index into *argv[] */
00045     unsigned codept;
00046     unsigned max_codept;
00047     unsigned char hangul_base[MAX_GLYPHS][32];
00048     int    initial, medial, final; /* Base glyphs for a syllable. */
00049     unsigned char syllable[32]; /* Syllable glyph built for output. */
00050
00051     FILE *infp = stdin; /* Input Hangul Johab 6/3/1 file */
00052     FILE *outfp = stdout; /* Output Hangul Syllables file */
00053
00054     /* Print a help message */
00055     void print_help ();
00056
00057     /* Read the file containing Hangul base glyphs. */
00058     unsigned hangul_read_base8 (FILE *infp, unsigned char hangul_base[][32]);
00059
00060     /* Given a Hangul Syllables code point, determine component glyphs. */
00061     void hangul_decompose (unsigned codept, int *, int *, int *);
00062
00063     /* Given letters in a Hangul syllable, return a glyph. */
00064     void hangul_syllable (int choseong, int jungseong, int jongseong,
00065                          unsigned char hangul_base[][32],
00066                          unsigned char *syllable);
00067
00068
00069     /*
00070     If there are command line arguments, parse them.
00071     */
00072     arg_count = 1;
00073
00074     while (arg_count < argc) {
00075         /* If input file is specified, open it for read access. */
00076         if (strcmp (argv [arg_count], "-i", 2) == 0) {
00077             arg_count++;
00078             if (arg_count < argc) {
00079                 infp = fopen (argv [arg_count], "r");
00080                 if (infp == NULL) {
00081                     fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00082                             argv [arg_count]);
00083                     exit (EXIT_FAILURE);
00084                 }
00085             }
00086         }
00087         /* If output file is specified, open it for write access. */
00088         else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00089             arg_count++;
00090             if (arg_count < argc) {
00091                 outfp = fopen (argv [arg_count], "w");
00092                 if (outfp == NULL) {
00093                     fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00094                             argv [arg_count]);
00095                     exit (EXIT_FAILURE);
00096                 }
00097             }
00098         }
00099         /* If help is requested, print help message and exit. */
00100         else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00101                  strcmp (argv [arg_count], "--help", 6) == 0) {
00102             print_help ();
00103             exit (EXIT_SUCCESS);
00104         }
00105
00106         arg_count++;
00107     }
00108
00109     /*
00110     Initialize entire glyph array to zeroes in case the input
00111     file skips over some code points.
00112     */
00113     for (codept = 0; codept < MAX_GLYPHS; codept++) {
00114         for (i = 0; i < 32; i++) hangul_base[codept][i] = 0;
00115     }
00116
00117     /*
00118     Read the entire "hangul-base.hex" file into an array
00119     organized as hangul_base [code_point][glyph_byte].
00120     The Hangul glyphs are 16 columns wide, which is
00121     two bytes, by 16 rows, for a total of 2 * 16 = 32 bytes.

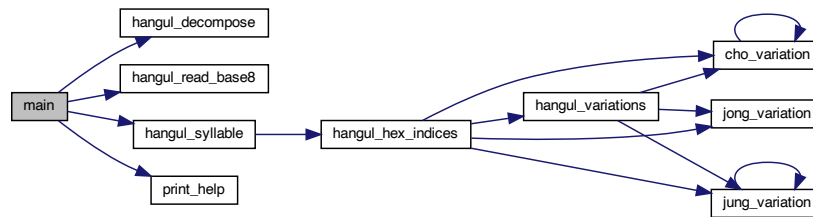
```

```

00123 */
00124 max_codept = hangul_read_base8 (infp, hangul_base);
00125 if (max_codept > 0x8FFF) {
00126     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00127 }
00128
00129 /*
00130 For each glyph in the Unicode Hangul Syllables block,
00131 form a composite glyph of choseong + jungseong +
00132 optional jongseong and output it in Unifont .hex format.
00133 */
00134 for (codept = 0xAC00; codept < 0xAC00 + 19 * 21 * 28; codept++) {
00135     hangul_decompose (codept, &initial, &medial, &final);
00136
00137     hangul_syllable (initial, medial, final, hangul_base, syllable);
00138
00139     fprintf (outfp, "%04X:", codept);
00140
00141     for (i = 0; i < 32; i++) {
00142         fprintf (outfp, "%02X", syllable[i]);
00143     }
00144     fputc ('\n', outfp);
00145 }
00146
00147 exit (EXIT_SUCCESS);
00148 }

```

Here is the call graph for this function:



5.7.2.2 print_help()

void print_help ()

Print a help message.

Definition at line 155 of file [johab2syllables.c](#).

```

00155 {
00156
00157     printf ("\ngen-hangul [options]\n\n");
00158     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00159     printf ("    in Johab 6/3/1 format.  The output is the Unicode Hangul Syllables\n");
00160     printf ("    range, U+AC00..U+D7A3.\n\n");
00161     printf ("    This program demonstrates forming Hangul syllables without shifting\n");
00162     printf ("    the final consonant (jongseong) when combined with a vowel having\n");
00163     printf ("    a long double vertical stroke.  For a program that demonstrtes\n");
00164     printf ("    shifting jongseong in those cases, see unigen-hangul, which is what\n");
00165     printf ("    creates the Unifont Hangul Syllables block.\n\n");
00166
00167     printf ("    This program may be invoked with the following command line options:\n\n");
00168
00169     printf ("    Option   Parameters   Function\n");
00170     printf ("    ----   -\n");
00171     printf ("    -h, --help           Print this message and exit.\n\n");
00172     printf ("    -i      input_file   Unifont hangul-base.hex formatted input file.\n\n");
00173     printf ("    -o      output_file  Unifont .hex format output file.\n\n");
00174     printf ("    Example:\n\n");
00175     printf ("    johab2syllables -i hangul-base.hex -o hangul-syllables.hex\n\n");
00176
00177     return;
00178 }

```

Here is the caller graph for this function:



5.8 johab2syllables.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file johab2syllables.c
00003
00004  @brief Create the Unicode Hangul Syllables block from component letters.
00005
00006  This program reads in a "hangul-base.hex" file containing Hangul
00007  letters in Johab 6/3/1 format and outputs a Unifont .hex format
00008  file covering the Unicode Hangul Syllables range of U+AC00..U+D7A3.
00009
00010  @author Paul Hardy
00011
00012  @copyright Copyright © 2023 Paul Hardy
00013  */
00014  /*
00015  LICENSE:
00016
00017  This program is free software: you can redistribute it and/or modify
00018  it under the terms of the GNU General Public License as published by
00019  the Free Software Foundation, either version 2 of the License, or
00020  (at your option) any later version.
00021
00022  This program is distributed in the hope that it will be useful,
00023  but WITHOUT ANY WARRANTY; without even the implied warranty of
00024  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00025  GNU General Public License for more details.
00026
00027  You should have received a copy of the GNU General Public License
00028  along with this program. If not, see <http://www.gnu.org/licenses/>.
00029  */
00030
00031  #include <stdio.h>
00032  #include <stdlib.h>
00033  #include <string.h>
00034
00035  #include "hangul.h"
00036
00037  /**
00038  @brief The main function.
00039  */
00040  /*
00041  int
00042  main (int argc, char *argv[]) {
00043      int i; /* Loop variables */
00044      int arg_count; /* index into *argv[] */
00045      unsigned codept;
00046      unsigned max_codept;
00047      unsigned char hangul_base[MAX_GLYPHS][32];
00048      int initial, medial, final; /* Base glyphs for a syllable. */
00049      unsigned char syllable[32]; /* Syllable glyph built for output. */
00050
00051      FILE *infp = stdin; /* Input Hangul Johab 6/3/1 file */
00052      FILE *outfp = stdout; /* Output Hangul Syllables file */
00053
00054      /* Print a help message */
00055      void print_help ();
00056
00057      /* Read the file containing Hangul base glyphs. */
00058      unsigned hangul_read_base8 (FILE *infp, unsigned char hangul_base[][32]);
  
```

```

00059
00060 /* Given a Hangul Syllables code point, determine component glyphs. */
00061 void hangul_decompose (unsigned codept, int *, int *, int *);
00062
00063 /* Given letters in a Hangul syllable, return a glyph. */
00064 void hangul_syllable (int choseong, int jungseong, int jongseong,
00065                     unsigned char hangul_base[][32],
00066                     unsigned char *syllable);
00067
00068
00069 /*
00070 If there are command line arguments, parse them.
00071 */
00072 arg_count = 1;
00073
00074 while (arg_count < argc) {
00075     /* If input file is specified, open it for read access. */
00076     if (strcmp (argv [arg_count], "-i", 2) == 0) {
00077         arg_count++;
00078         if (arg_count < argc) {
00079             infp = fopen (argv [arg_count], "r");
00080             if (infp == NULL) {
00081                 fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00082                         argv [arg_count]);
00083                 exit (EXIT_FAILURE);
00084             }
00085         }
00086     }
00087     /* If output file is specified, open it for write access. */
00088     else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00089         arg_count++;
00090         if (arg_count < argc) {
00091             outfp = fopen (argv [arg_count], "w");
00092             if (outfp == NULL) {
00093                 fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00094                         argv [arg_count]);
00095                 exit (EXIT_FAILURE);
00096             }
00097         }
00098     }
00099     /* If help is requested, print help message and exit. */
00100     else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00101             strcmp (argv [arg_count], "--help", 6) == 0) {
00102         print_help ();
00103         exit (EXIT_SUCCESS);
00104     }
00105     arg_count++;
00106 }
00107
00108
00109 /*
00110 Initialize entire glyph array to zeroes in case the input
00111 file skips over some code points.
00112 */
00113 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00114     for (i = 0; i < 32; i++) hangul_base[codept][i] = 0;
00115 }
00116
00117 /*
00118 Read the entire "hangul-base.hex" file into an array
00119 organized as hangul_base [code_point][glyph_byte].
00120 The Hangul glyphs are 16 columns wide, which is
00121 two bytes, by 16 rows, for a total of 2 * 16 = 32 bytes.
00122 */
00123 max_codept = hangul_read_base8 (infp, hangul_base);
00124 if (max_codept > 0x8FFF) {
00125     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00126 }
00127
00128 /*
00129 For each glyph in the Unicode Hangul Syllables block,
00130 form a composite glyph of choseong + jungseong +
00131 optional jongseong and output it in Unifont .hex format.
00132 */
00133 for (codept = 0xAC00; codept < 0xAC00 + 19 * 21 * 28; codept++) {
00134     hangul_decompose (codept, &initial, &medial, &final);
00135     hangul_syllable (initial, medial, final, hangul_base, syllable);
00136     fprintf (outfp, "%04X:", codept);

```

```

00140
00141     for (i = 0; i < 32; i++) {
00142         fprintf (outfp, "%02X", syllable[i]);
00143     }
00144     fputc ('\n', outfp);
00145 }
00146
00147 exit (EXIT_SUCCESS);
00148 }
00149
00150
00151 /**
00152 @brief Print a help message.
00153 */
00154 void
00155 print_help () {
00156     printf ("\ngen-hangul [options]\n\n");
00157     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00158     printf ("    in Johab 6/3/1 format.  The output is the Unicode Hangul Syllables\n");
00159     printf ("    range, U+AC00..U+D7A3.\n\n");
00160     printf ("    This program demonstrates forming Hangul syllables without shifting\n");
00161     printf ("    the final consonant (jongseong) when combined with a vowel having\n");
00162     printf ("    a long double vertical stroke.  For a program that demonstrtes\n");
00163     printf ("    shifting jongseong in those cases, see unigen-hangul, which is what\n");
00164     printf ("    creates the Unifont Hangul Syllables block.\n\n");
00165     printf ("    This program may be invoked with the following command line options:\n\n");
00166
00167     printf ("    Option   Parameters   Function\n");
00168     printf ("    -----   -\n");
00169     printf ("    -h, --help           Print this message and exit.\n\n");
00170     printf ("    -i      input_file   Unifont hangul-base.hex formatted input file.\n\n");
00171     printf ("    -o      output_file  Unifont .hex format output file.\n\n");
00172     printf ("    Example:\n\n");
00173     printf ("    johab2syllables -i hangul-base.hex -o hangul-syllables.hex\n\n");
00174
00175     return;
00176 }
00177
00178 }
00179

```

5.9 src/unibdf2hex.c File Reference

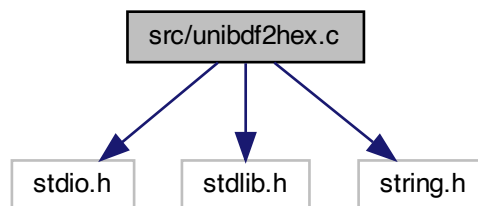
unibdf2hex - Convert a BDF file into a unifont.hex file

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unibdf2hex.c:



Macros

- #define UNISTART 0x3400

- First Unicode code point to examine.
- `#define UNISTOP 0x4DBF`
Last Unicode code point to examine.
- `#define MAXBUF 256`
Maximum allowable input file line length - 1.

Functions

- `int main ()`
The main function.

5.9.1 Detailed Description

unibdf2hex - Convert a BDF file into a unifont.hex file

Author

Paul Hardy, January 2008

Copyright

Copyright (C) 2008, 2013 Paul Hardy

Note: currently this has hard-coded code points for glyphs extracted from Wen Quan Yi to create the Unifont source file "wqy.hex".

Definition in file [unibdf2hex.c](#).

5.9.2 Macro Definition Documentation

5.9.2.1 MAXBUF

`#define MAXBUF 256`

Maximum allowable input file line length - 1.

Definition at line [37](#) of file [unibdf2hex.c](#).

5.9.2.2 UNISTART

`#define UNISTART 0x3400`

First Unicode code point to examine.

Definition at line [34](#) of file [unibdf2hex.c](#).

5.9.2.3 UNISTOP

`#define UNISTOP 0x4DBF`

Last Unicode code point to examine.

Definition at line [35](#) of file [unibdf2hex.c](#).

5.9.3 Function Documentation

5.9.3.1 main()

int main ()

The main function.

Returns

Exit status is always 0 (successful termination).

Definition at line 46 of file [unibdf2hex.c](#).

```

00047 {
00048     int i;
00049     int digitsout; /* how many hex digits we output in a bitmap */
00050     int thispoint;
00051     char inbuf[MAXBUF];
00052     int bbxx, bbxy, bbxxoff, bbxyoff;
00053
00054     int descent=4; /* font descent wrt baseline */
00055     int startrow; /* row to start glyph */
00056     unsigned rowout;
00057
00058     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL) {
00059         if (strcmp (inbuf, "ENCODING ", 9) == 0) {
00060             sscanf (&inbuf[9], "%d", &thispoint); /* get code point */
00061             /*
00062             If we want this code point, get the BBX (bounding box) and
00063             BITMAP information.
00064             */
00065             if ((thispoint >= 0x2E80 && thispoint <= 0x2EFF) || /* CJK Radicals Supplement
00066                 (thispoint >= 0x2F00 && thispoint <= 0x2FDF) || /* Kangxi Radicals
00067                 (thispoint >= 0x2FF0 && thispoint <= 0x2FFF) || /* Ideographic Description Characters
00068                 (thispoint >= 0x3001 && thispoint <= 0x303F) || /* CJK Symbols and Punctuation (U+3000 is a space)
00069                 (thispoint >= 0x3100 && thispoint <= 0x312F) || /* Bopomofo
00070                 (thispoint >= 0x31A0 && thispoint <= 0x31BF) || /* Bopomofo extend
00071                 (thispoint >= 0x31C0 && thispoint <= 0x31EF) || /* CJK Strokes
00072                 (thispoint >= 0x3400 && thispoint <= 0x4DBF) || /* CJK Unified Ideographs Extension A
00073                 (thispoint >= 0x4E00 && thispoint <= 0x9FCF) || /* CJK Unified Ideographs
00074                 (thispoint >= 0xF900 && thispoint <= 0FAFF)) /* CJK Compatibility Ideographs
00075             {
00076                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00077                     strcmp (inbuf, "BBX ", 4) != 0); /* find bounding box */
00078
00079                 sscanf (&inbuf[4], "%d %d %d %d", &bbxx, &bbxy, &bbxxoff, &bbxyoff);
00080                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00081                     strcmp (inbuf, "BITMAP", 6) != 0); /* find bitmap start */
00082                 fprintf (stdout, "%04X:", thispoint);
00083                 digitsout = 0;
00084                 /* Print initial blank rows */
00085                 startrow = descent + bbxyoff + bbxy;
00086
00087                 /* Force everything to 16 pixels wide */
00088                 for (i = 16; i > startrow; i--) {
00089                     fprintf (stdout, "0000");
00090                     digitsout += 4;
00091                 }
00092                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00093                     strcmp (inbuf, "END", 3) != 0) { /* copy bitmap until END */
00094                     sscanf (inbuf, "%X", &rowout);
00095                     /* Now force glyph to a 16x16 grid even if they'd fit in 8x16 */
00096                     if (bbxx <= 8) rowout <= 8; /* shift left for 16x16 glyph */
00097                     rowout >= bbxxoff;
00098                     fprintf (stdout, "%04X", rowout);
00099                     digitsout += 4;
00100                 }
00101
00102                 /* Pad for 16x16 glyph */
00103                 while (digitsout < 64) {
00104                     fprintf (stdout, "0000");
00105                     digitsout += 4;
00106                 }
00107                 fprintf (stdout, "\n");
00108             }
00109         }
00110     }
00111     exit (0);
00112 }
```

5.10 unibdf2hex.c

Go to the [documentation of this file](#).

```

00001 /**
00002 @file unibdf2hex.c
00003
00004 @brief unibdf2hex - Convert a BDF file into a unifont.hex file
00005
00006 @author Paul Hardy, January 2008
00007
00008 @copyright Copyright (C) 2008, 2013 Paul Hardy
00009
00010 Note: currently this has hard-coded code points for glyphs extracted
00011 from Wen Quan Yi to create the Unifont source file "wqy.hex".
00012 */
00013 /*
00014 LICENSE:
00015
00016 This program is free software: you can redistribute it and/or modify
00017 it under the terms of the GNU General Public License as published by
00018 the Free Software Foundation, either version 2 of the License, or
00019 (at your option) any later version.
00020
00021 This program is distributed in the hope that it will be useful,
00022 but WITHOUT ANY WARRANTY; without even the implied warranty of
00023 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00024 GNU General Public License for more details.
00025
00026 You should have received a copy of the GNU General Public License
00027 along with this program. If not, see <http://www.gnu.org/licenses/>.
00028 */
00029
00030 #include <stdio.h>
00031 #include <stdlib.h>
00032 #include <string.h>
00033
00034 #define UNISTART 0x3400 ///< First Unicode code point to examine
00035 #define UNISTOP 0x4DBF ///< Last Unicode code point to examine
00036
00037 #define MAXBUF 256 ///< Maximum allowable input file line length - 1
00038
00039
00040 /**
00041 @brief The main function.
00042
00043 @return Exit status is always 0 (successful termination).
00044 */
00045 int
00046 main()
00047 {
00048     int i;
00049     int digitsout; /* how many hex digits we output in a bitmap */
00050     int thispoint;
00051     char inbuf[MAXBUF];
00052     int bbxx, bbxy, bbxcoff, bbycoff;
00053
00054     int descent=4; /* font descent wrt baseline */
00055     int startrow; /* row to start glyph */
00056     unsigned rowout;
00057
00058     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL) {
00059         if (strcmp (inbuf, "ENCODING ", 9) == 0) {
00060             sscanf (&inbuf[9], "%d", &thispoint); /* get code point */
00061             /*
00062 If we want this code point, get the BBX (bounding box) and
00063 BITMAP information.
00064 */
00065             if ((thispoint >= 0x2E80 && thispoint <= 0x2EFF) || /* CJK Radicals Supplement
00066 (thispoint >= 0x2F00 && thispoint <= 0x2FDF) || /* Kangxi Radicals
00067 (thispoint >= 0x2FF0 && thispoint <= 0x2FFF) || /* Ideographic Description Characters
00068 (thispoint >= 0x3001 && thispoint <= 0x303F) || /* CJK Symbols and Punctuation (U+3000 is a space)
00069 (thispoint >= 0x3100 && thispoint <= 0x312F) || /* Bopomofo
00070 (thispoint >= 0x31A0 && thispoint <= 0x31BF) || /* Bopomofo extend
00071 (thispoint >= 0x31C0 && thispoint <= 0x31EF) || /* CJK Strokes
00072 (thispoint >= 0x3400 && thispoint <= 0x4DBF) || /* CJK Unified Ideographs Extension A
00073 (thispoint >= 0x4E00 && thispoint <= 0x9FCF) || /* CJK Unified Ideographs
00074 (thispoint >= 0xF900 && thispoint <= 0xFAFF)) /* CJK Compatibility Ideographs
00075 {
00076             while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00077                 strcmp (inbuf, "BBX ", 4) != 0); /* find bounding box */

```

```

00078
00079     sscanf (&inbuf[4], "%d %d %d %d", &bbxx, &bbxy, &bbxxoff, &bbxyoff);
00080     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00081             strcmp (inbuf, "BITMAP", 6) != 0); /* find bitmap start */
00082     fprintf (stdout, "%04X:", thispoint);
00083     digitsout = 0;
00084     /* Print initial blank rows */
00085     startrow = descent + bbxyoff + bbxy;
00086
00087     /* Force everything to 16 pixels wide */
00088     for (i = 16; i > startrow; i--) {
00089         fprintf (stdout, "0000");
00090         digitsout += 4;
00091     }
00092     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00093             strcmp (inbuf, "END", 3) != 0) { /* copy bitmap until END */
00094         sscanf (inbuf, "%X", &rowout);
00095         /* Now force glyph to a 16x16 grid even if they'd fit in 8x16 */
00096         if (bbxx <= 8) rowout <<= 8; /* shift left for 16x16 glyph */
00097         rowout >= bbxxoff;
00098         fprintf (stdout, "%04X", rowout);
00099         digitsout += 4;
00100     }
00101
00102     /* Pad for 16x16 glyph */
00103     while (digitsout < 64) {
00104         fprintf (stdout, "0000");
00105         digitsout += 4;
00106     }
00107     fprintf (stdout, "\n");
00108 }
00109 }
00110 }
00111 exit (0);
00112 }

```

5.11 src/unibmp2hex.c File Reference

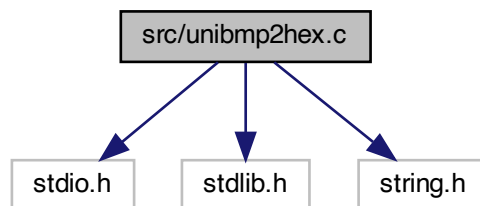
unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unibmp2hex.c:



Macros

- `#define MAXBUF 256`
Maximum input file line length - 1.

Functions

- int `main` (int argc, char *argv[])
The main function.

Variables

- unsigned `hexdigit` [16][4]
32 bit representation of 16x8 0..F bitmap
- unsigned `uniplane` =0
Unicode plane number, 0..0xff ff ff.
- unsigned `planeset` =0
=1: use plane specified with -p parameter
- unsigned `flip` =0
=1 if we're transposing glyph matrix
- unsigned `forcewide` =0
=1 to set each glyph to 16 pixels wide
- unsigned `unidigit` [6][4]
- struct {
 char `filetype` [2]
 int `file_size`
 int `image_offset`
 int `info_size`
 int `width`
 int `height`
 int `nplanes`
 int `bits_per_pixel`
 int `compression`
 int `image_size`
 int `x_ppm`
 int `y_ppm`
 int `ncolors`
 int `important_colors`
} `bmp_header`
- unsigned char `color_table` [256][4]

5.11.1 Detailed Description

unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

Copyright (C) 2007, 2008, 2013, 2017, 2019, 2022 Paul Hardy

Synopsis: unibmp2hex [-iin_file.bmp] [-oout_file.hex] [-phex_page_num] [-w]
Definition in file [unibmp2hex.c](#).

5.11.2 Macro Definition Documentation

5.11.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input file line length - 1.

Definition at line 116 of file [unibmp2hex.c](#).

5.11.3 Function Documentation

5.11.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 161 of file [unibmp2hex.c](#).

```
00162 {
00163
00164     int i, j, k; /* loop variables */
00165     unsigned char inchar; /* temporary input character */
00166     char header[MAXBUF]; /* input buffer for bitmap file header */
00167     int wbmp=0; /* =0 for Windows Bitmap (.bmp); 1 for Wireless Bitmap (.wbmp) */
00168     int fatal; /* =1 if a fatal error occurred */
00169     int match; /* =1 if we're still matching a pattern, 0 if no match */
00170     int empty1, empty2; /* =1 if bytes tested are all zeroes */
00171     unsigned char thischar1[16], thischar2[16]; /* bytes of hex char */
00172     unsigned char thischar0[16], thischar3[16]; /* bytes for quadruple-width */
00173     int thisrow; /* index to point into thischar1[] and thischar2[] */
00174     int tmpsum; /* temporary sum to see if a character is blank */
00175     unsigned this_pixel; /* color of one pixel, if > 1 bit per pixel */
00176     unsigned next_pixels; /* pending group of 8 pixels being read */
00177     unsigned color_mask = 0x00; /* to invert monochrome bitmap, set to 0xFF */
00178
00179     unsigned char bitmap[17*32][18*32/8]; /* final bitmap */
00180     /* For wide array:
00181     0 = don't force glyph to double-width;
00182     1 = force glyph to double-width;
00183     4 = force glyph to quadruple-width.
```

```

00184 */
00185 char wide[0x200000]={0x200000 * 0};
00186
00187 char *infile="", *outfile=""; /* names of input and output files */
00188 FILE *infp, *outfp; /* file pointers of input and output files */
00189
00190 if (argc > 1) {
00191     for (i = 1; i < argc; i++) {
00192         if (argv[i][0] == '-') { /* this is an option argument */
00193             switch (argv[i][1]) {
00194                 case 'i': /* name of input file */
00195                     infile = &argv[i][2];
00196                     break;
00197                 case 'o': /* name of output file */
00198                     outfile = &argv[i][2];
00199                     break;
00200                 case 'p': /* specify a Unicode plane */
00201                     sscanf (&argv[i][2], "%x", &uniplane); /* Get Unicode plane */
00202                     planeset = 1; /* Use specified range, not what's in bitmap */
00203                     break;
00204                 case 'w': /* force wide (16 pixels) for each glyph */
00205                     forcewide = 1;
00206                     break;
00207                 default: /* if unrecognized option, print list and exit */
00208                     fprintf (stderr, "\nSyntax:\n\n");
00209                     fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00210                     fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00211                     fprintf (stderr, " -w specifies .wbmp output instead of ");
00212                     fprintf (stderr, "default Windows .bmp output.\n\n");
00213                     fprintf (stderr, " -p is followed by 1 to 6 ");
00214                     fprintf (stderr, "Unicode plane hex digits ");
00215                     fprintf (stderr, "(default is Page 0).\n\n");
00216                     fprintf (stderr, "\nExample:\n\n");
00217                     fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n",
00218                             argv[0]);
00219                     exit (1);
00220             }
00221         }
00222     }
00223 }
00224 /*
00225 Make sure we can open any I/O files that were specified before
00226 doing anything else.
00227 */
00228 if (strlen (infile) > 0) {
00229     if ((infp = fopen (infile, "r")) == NULL) {
00230         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00231         exit (1);
00232     }
00233 }
00234 else {
00235     infp = stdin;
00236 }
00237 if (strlen (outfile) > 0) {
00238     if ((outfp = fopen (outfile, "w")) == NULL) {
00239         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00240         exit (1);
00241     }
00242 }
00243 else {
00244     outfp = stdout;
00245 }
00246 /*
00247 Initialize selected code points for double width (16x16).
00248 Double-width is forced in cases where a glyph (usually a combining
00249 glyph) only occupies the left-hand side of a 16x16 grid, but must
00250 be rendered as double-width to appear properly with other glyphs
00251 in a given script. If additions were made to a script after
00252 Unicode 5.0, the Unicode version is given in parentheses after
00253 the script name.
00254 */
00255 for (i = 0x0700; i <= 0x074F; i++) wide[i] = 1; /* Syriac */
00256 for (i = 0x0800; i <= 0x083F; i++) wide[i] = 1; /* Samaritan (5.2) */
00257 for (i = 0x0900; i <= 0x0DFF; i++) wide[i] = 1; /* Indic */
00258 for (i = 0x1000; i <= 0x109F; i++) wide[i] = 1; /* Myanmar */
00259 for (i = 0x1100; i <= 0x11FF; i++) wide[i] = 1; /* Hangul Jamo */
00260 for (i = 0x1400; i <= 0x167F; i++) wide[i] = 1; /* Canadian Aboriginal */
00261 for (i = 0x1700; i <= 0x171F; i++) wide[i] = 1; /* Tagalog */
00262 for (i = 0x1720; i <= 0x173F; i++) wide[i] = 1; /* Hanunoo */
00263 for (i = 0x1740; i <= 0x175F; i++) wide[i] = 1; /* Buhid */
00264 for (i = 0x1760; i <= 0x177F; i++) wide[i] = 1; /* Tagbanwa */

```

```

00265 for (i = 0x1780; i <= 0x17FF; i++) wide[i] = 1; /* Khmer */
00266 for (i = 0x18B0; i <= 0x18FF; i++) wide[i] = 1; /* Ext. Can. Aboriginal */
00267 for (i = 0x1800; i <= 0x18AF; i++) wide[i] = 1; /* Mongolian */
00268 for (i = 0x1900; i <= 0x194F; i++) wide[i] = 1; /* Limbu */
00269 // for (i = 0x1980; i <= 0x19DF; i++) wide[i] = 1; /* New Tai Lue */
00270 for (i = 0x1A00; i <= 0x1A1F; i++) wide[i] = 1; /* Buginese */
00271 for (i = 0x1A20; i <= 0x1AAF; i++) wide[i] = 1; /* Tai Tham (5.2) */
00272 for (i = 0x1B00; i <= 0x1B7F; i++) wide[i] = 1; /* Balinese */
00273 for (i = 0x1B80; i <= 0x1BBF; i++) wide[i] = 1; /* Sundanese (5.1) */
00274 for (i = 0x1BC0; i <= 0x1BFF; i++) wide[i] = 1; /* Batak (6.0) */
00275 for (i = 0x1C00; i <= 0x1C4F; i++) wide[i] = 1; /* Lepcha (5.1) */
00276 for (i = 0x1CC0; i <= 0x1CCF; i++) wide[i] = 1; /* Sundanese Supplement */
00277 for (i = 0x1CD0; i <= 0x1CFF; i++) wide[i] = 1; /* Vedic Extensions (5.2) */
00278 wide[0x2329] = wide[0x232A] = 1; /* Left- & Right-pointing Angle Brackets */
00279 for (i = 0x2E80; i <= 0xA4CF; i++) wide[i] = 1; /* CJK */
00280 // for (i = 0x9FD8; i <= 0x9FE9; i++) wide[i] = 4; /* CJK quadruple-width */
00281 for (i = 0xA900; i <= 0xA92F; i++) wide[i] = 1; /* Kayah Li (5.1) */
00282 for (i = 0xA930; i <= 0xA95F; i++) wide[i] = 1; /* Rejang (5.1) */
00283 for (i = 0xA960; i <= 0xA97F; i++) wide[i] = 1; /* Hangul Jamo Extended-A */
00284 for (i = 0xA980; i <= 0xA9DF; i++) wide[i] = 1; /* Javanese (5.2) */
00285 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham (5.1) */
00286 for (i = 0xA9E0; i <= 0xA9FF; i++) wide[i] = 1; /* Myanmar Extended-B */
00287 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham */
00288 for (i = 0xAA60; i <= 0xAA7F; i++) wide[i] = 1; /* Myanmar Extended-A */
00289 for (i = 0xAAE0; i <= 0xA AFF; i++) wide[i] = 1; /* Meetei Mayek Ext (6.0) */
00290 for (i = 0xABC0; i <= 0xABFF; i++) wide[i] = 1; /* Meetei Mayek (5.2) */
00291 for (i = 0xAC00; i <= 0xD7AF; i++) wide[i] = 1; /* Hangul Syllables */
00292 for (i = 0xD7B0; i <= 0xD7FF; i++) wide[i] = 1; /* Hangul Jamo Extended-B */
00293 for (i = 0xF900; i <= 0xFAFF; i++) wide[i] = 1; /* CJK Compatibility */
00294 for (i = 0xFE10; i <= 0xFE1F; i++) wide[i] = 1; /* Vertical Forms */
00295 for (i = 0xFE30; i <= 0xFE60; i++) wide[i] = 1; /* CJK Compatibility Forms */
00296 for (i = 0xFFE0; i <= 0xFFE6; i++) wide[i] = 1; /* CJK Compatibility Forms */
00297
00298 wide[0x303F] = 0; /* CJK half-space fill */
00299
00300 /* Supplemental Multilingual Plane (Plane 01) */
00301 for (i = 0x0105C0; i <= 0x0105FF; i++) wide[i] = 1; /* Todhri */
00302 for (i = 0x010A00; i <= 0x010A5F; i++) wide[i] = 1; /* Kharoshthi */
00303 for (i = 0x011000; i <= 0x01107F; i++) wide[i] = 1; /* Brahmi */
00304 for (i = 0x011080; i <= 0x0110CF; i++) wide[i] = 1; /* Kaithi */
00305 for (i = 0x011100; i <= 0x01114F; i++) wide[i] = 1; /* Chakma */
00306 for (i = 0x011180; i <= 0x0111DF; i++) wide[i] = 1; /* Sharada */
00307 for (i = 0x011200; i <= 0x01124F; i++) wide[i] = 1; /* Khojki */
00308 for (i = 0x0112B0; i <= 0x0112FF; i++) wide[i] = 1; /* Khudawadi */
00309 for (i = 0x011300; i <= 0x01137F; i++) wide[i] = 1; /* Grantha */
00310 for (i = 0x011380; i <= 0x0113FF; i++) wide[i] = 1; /* Tulu-Tigalari */
00311 for (i = 0x011400; i <= 0x01147F; i++) wide[i] = 1; /* Newa */
00312 for (i = 0x011480; i <= 0x0114DF; i++) wide[i] = 1; /* Tirhuta */
00313 for (i = 0x011580; i <= 0x0115FF; i++) wide[i] = 1; /* Siddham */
00314 for (i = 0x011600; i <= 0x01165F; i++) wide[i] = 1; /* Modi */
00315 for (i = 0x011660; i <= 0x01167F; i++) wide[i] = 1; /* Mongolian Suppl. */
00316 for (i = 0x011680; i <= 0x0116CF; i++) wide[i] = 1; /* Takri */
00317 for (i = 0x0116D0; i <= 0x0116FF; i++) wide[i] = 1; /* Myanmar Extended-C */
00318 for (i = 0x011700; i <= 0x01173F; i++) wide[i] = 1; /* Ahom */
00319 for (i = 0x011800; i <= 0x01184F; i++) wide[i] = 1; /* Dogra */
00320 for (i = 0x011900; i <= 0x01195F; i++) wide[i] = 1; /* Dives Akuru */
00321 for (i = 0x0119A0; i <= 0x0119FF; i++) wide[i] = 1; /* Nandinagari */
00322 for (i = 0x011A00; i <= 0x011A4F; i++) wide[i] = 1; /* Zanabazar Square */
00323 for (i = 0x011A50; i <= 0x011AAF; i++) wide[i] = 1; /* Soyombo */
00324 for (i = 0x011B00; i <= 0x011B5F; i++) wide[i] = 1; /* Devanagari Extended-A */
00325 for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi */
00326 for (i = 0x011C00; i <= 0x011C6F; i++) wide[i] = 1; /* Bhaiksuki */
00327 for (i = 0x011C70; i <= 0x011CBF; i++) wide[i] = 1; /* Marchen */
00328 for (i = 0x011D00; i <= 0x011D5F; i++) wide[i] = 1; /* Masaram Gondi */
00329 for (i = 0x011EE0; i <= 0x011EFF; i++) wide[i] = 1; /* Makasar */
00330 for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi */
00331 for (i = 0x012F90; i <= 0x012FFF; i++) wide[i] = 1; /* Cypro-Minoan */
00332 /* Make Bassa Vah all single width or all double width */
00333 for (i = 0x016100; i <= 0x01613F; i++) wide[i] = 1; /* Gurung Khema */
00334 for (i = 0x016AD0; i <= 0x016AFF; i++) wide[i] = 1; /* Bassa Vah */
00335 for (i = 0x016B00; i <= 0x016B8F; i++) wide[i] = 1; /* Pahawh Hmong */
00336 for (i = 0x016D40; i <= 0x016D7F; i++) wide[i] = 1; /* Kirat Rai */
00337 for (i = 0x016F00; i <= 0x016F9F; i++) wide[i] = 1; /* Miao */
00338 for (i = 0x016FE0; i <= 0x016FFF; i++) wide[i] = 1; /* Ideograph Sym/Punct */
00339 for (i = 0x017000; i <= 0x0187FF; i++) wide[i] = 1; /* Tangut */
00340 for (i = 0x018800; i <= 0x018AFF; i++) wide[i] = 1; /* Tangut Components */
00341 for (i = 0x018B00; i <= 0x018CFF; i++) wide[i] = 1; /* Khitan Small Script */
00342 for (i = 0x01AFF0; i <= 0x01AFFF; i++) wide[i] = 1; /* Kana Extended-B */
00343 for (i = 0x01B000; i <= 0x01B0FF; i++) wide[i] = 1; /* Kana Supplement */
00344 for (i = 0x01B100; i <= 0x01B12F; i++) wide[i] = 1; /* Kana Extended-A */
00345 for (i = 0x01B170; i <= 0x01B2FF; i++) wide[i] = 1; /* Nushu */

```

```

00346 for (i = 0x01CF00; i <= 0x01CFCF; i++) wide[i] = 1; /* Znamenny Musical */
00347 for (i = 0x01D800; i <= 0x01DAAF; i++) wide[i] = 1; /* Sutton SignWriting */
00348 for (i = 0x01E2C0; i <= 0x01E2FF; i++) wide[i] = 1; /* Wancho */
00349 for (i = 0x01E500; i <= 0x01E5FF; i++) wide[i] = 1; /* Ol Onal */
00350 for (i = 0x01E800; i <= 0x01E8DF; i++) wide[i] = 1; /* Mende Kikakui */
00351 for (i = 0x01F200; i <= 0x01F2FF; i++) wide[i] = 1; /* Encl Ideograp Suppl*/
00352 wide[0x01F5E7] = 1; /* Three Rays Right */
00353
00354 /*
00355 Determine whether or not the file is a Microsoft Windows Bitmap file.
00356 If it starts with 'B', 'M', assume it's a Windows Bitmap file.
00357 Otherwise, assume it's a Wireless Bitmap file.
00358
00359 WARNING: There isn't much in the way of error checking here --
00360 if you give it a file that wasn't first created by hex2bmp.c,
00361 all bets are off.
00362 */
00363 fatal = 0; /* assume everything is okay with reading input file */
00364 if ((header[0] = fgetc (infp)) != EOF) {
00365     if ((header[1] = fgetc (infp)) != EOF) {
00366         if (header[0] == 'B' && header[1] == 'M') {
00367             wbmp = 0; /* Not a Wireless Bitmap -- it's a Windows Bitmap */
00368         }
00369         else {
00370             wbmp = 1; /* Assume it's a Wireless Bitmap */
00371         }
00372     }
00373     else
00374         fatal = 1;
00375 }
00376 else
00377     fatal = 1;
00378
00379 if (fatal) {
00380     fprintf (stderr, "Fatal error; end of input file.\n\n");
00381     exit (1);
00382 }
00383 /*
00384 If this is a Wireless Bitmap (.wbmp) format file,
00385 skip the header and point to the start of the bitmap itself.
00386 */
00387 if (wbmp) {
00388     for (i=2; i<6; i++)
00389         header[i] = fgetc (infp);
00390     /*
00391 Now read the bitmap.
00392 */
00393     for (i=0; i < 32*17; i++) {
00394         for (j=0; j < 32*18/8; j++) {
00395             inchar = fgetc (infp);
00396             bitmap[i][j] = ~inchar; /* invert bits for proper color */
00397         }
00398     }
00399 }
00400 /*
00401 Otherwise, treat this as a Windows Bitmap file, because we checked
00402 that it began with "BM". Save the header contents for future use.
00403 Expect a 14 byte standard BITMAPFILEHEADER format header followed
00404 by a 40 byte standard BITMAPINFOHEADER Device Independent Bitmap
00405 header, with data stored in little-endian format.
00406 */
00407 else {
00408     for (i = 2; i < 54; i++)
00409         header[i] = fgetc (infp);
00410
00411     bmp_header.filetype[0] = 'B';
00412     bmp_header.filetype[1] = 'M';
00413
00414     bmp_header.file_size =
00415         (header[2] & 0xFF) | ((header[3] & 0xFF) << 8) |
00416         ((header[4] & 0xFF) << 16) | ((header[5] & 0xFF) << 24);
00417
00418     /* header bytes 6..9 are reserved */
00419
00420     bmp_header.image_offset =
00421         (header[10] & 0xFF) | ((header[11] & 0xFF) << 8) |
00422         ((header[12] & 0xFF) << 16) | ((header[13] & 0xFF) << 24);
00423
00424     bmp_header.info_size =
00425         (header[14] & 0xFF) | ((header[15] & 0xFF) << 8) |
00426         ((header[16] & 0xFF) << 16) | ((header[17] & 0xFF) << 24);

```

```

00427
00428     bmp_header.width =
00429         (header[18] & 0xFF) | ((header[19] & 0xFF) « 8) |
00430         ((header[20] & 0xFF) « 16) | ((header[21] & 0xFF) « 24);
00431
00432     bmp_header.height =
00433         (header[22] & 0xFF) | ((header[23] & 0xFF) « 8) |
00434         ((header[24] & 0xFF) « 16) | ((header[25] & 0xFF) « 24);
00435
00436     bmp_header.nplanes =
00437         (header[26] & 0xFF) | ((header[27] & 0xFF) « 8);
00438
00439     bmp_header.bits_per_pixel =
00440         (header[28] & 0xFF) | ((header[29] & 0xFF) « 8);
00441
00442     bmp_header.compression =
00443         (header[30] & 0xFF) | ((header[31] & 0xFF) « 8) |
00444         ((header[32] & 0xFF) « 16) | ((header[33] & 0xFF) « 24);
00445
00446     bmp_header.image_size =
00447         (header[34] & 0xFF) | ((header[35] & 0xFF) « 8) |
00448         ((header[36] & 0xFF) « 16) | ((header[37] & 0xFF) « 24);
00449
00450     bmp_header.x_ppm =
00451         (header[38] & 0xFF) | ((header[39] & 0xFF) « 8) |
00452         ((header[40] & 0xFF) « 16) | ((header[41] & 0xFF) « 24);
00453
00454     bmp_header.y_ppm =
00455         (header[42] & 0xFF) | ((header[43] & 0xFF) « 8) |
00456         ((header[44] & 0xFF) « 16) | ((header[45] & 0xFF) « 24);
00457
00458     bmp_header.ncolors =
00459         (header[46] & 0xFF) | ((header[47] & 0xFF) « 8) |
00460         ((header[48] & 0xFF) « 16) | ((header[49] & 0xFF) « 24);
00461
00462     bmp_header.important_colors =
00463         (header[50] & 0xFF) | ((header[51] & 0xFF) « 8) |
00464         ((header[52] & 0xFF) « 16) | ((header[53] & 0xFF) « 24);
00465
00466     if (bmp_header.ncolors == 0)
00467         bmp_header.ncolors = 1 « bmp_header.bits_per_pixel;
00468
00469     /* If a Color Table exists, read it */
00470     if (bmp_header.ncolors > 0 && bmp_header.bits_per_pixel <= 8) {
00471         for (i = 0; i < bmp_header.ncolors; i++) {
00472             color_table[i][0] = fgetc (infp); /* Red */
00473             color_table[i][1] = fgetc (infp); /* Green */
00474             color_table[i][2] = fgetc (infp); /* Blue */
00475             color_table[i][3] = fgetc (infp); /* Alpha */
00476         }
00477     }
00478     Determine from the first color table entry whether we
00479     are inverting the resulting bitmap image.
00480     */
00481     if ( (color_table[0][0] + color_table[0][1] + color_table[0][2])
00482         < (3 * 128) ) {
00483         color_mask = 0xFF;
00484     }
00485 }
00486
00487 #ifdef DEBUG
00488
00489     /*
00490     Print header info for possibly adding support for
00491     additional file formats in the future, to determine
00492     how the bitmap is encoded.
00493     */
00494     fprintf (stderr, "Filetype: '%c%c'\n",
00495             bmp_header.filetype[0], bmp_header.filetype[1]);
00496     fprintf (stderr, "File Size: %d\n", bmp_header.file_size);
00497     fprintf (stderr, "Image Offset: %d\n", bmp_header.image_offset);
00498     fprintf (stderr, "Info Header Size: %d\n", bmp_header.info_size);
00499     fprintf (stderr, "Image Width: %d\n", bmp_header.width);
00500     fprintf (stderr, "Image Height: %d\n", bmp_header.height);
00501     fprintf (stderr, "Number of Planes: %d\n", bmp_header.nplanes);
00502     fprintf (stderr, "Bits per Pixel: %d\n", bmp_header.bits_per_pixel);
00503     fprintf (stderr, "Compression Method: %d\n", bmp_header.compression);
00504     fprintf (stderr, "Image Size: %d\n", bmp_header.image_size);
00505     fprintf (stderr, "X Pixels per Meter: %d\n", bmp_header.x_ppm);
00506     fprintf (stderr, "Y Pixels per Meter: %d\n", bmp_header.y_ppm);
00507     fprintf (stderr, "Number of Colors: %d\n", bmp_header.ncolors);

```

```

00508     fprintf (stderr, "Important Colors: %d\n", bmp_header.important_colors);
00509
00510 #endif
00511
00512 /*
00513 Now read the bitmap.
00514 */
00515 for (i = 32*17-1; i >= 0; i--) {
00516     for (j=0; j < 32*18/8; j++) {
00517         next_pixels = 0x00; /* initialize next group of 8 pixels */
00518         /* Read a monochrome image -- the original case */
00519         if (bmp_header.bits_per_pixel == 1) {
00520             next_pixels = fgetc (infp);
00521         }
00522         /* Read a 32 bit per pixel RGB image; convert to monochrome */
00523         else if ( bmp_header.bits_per_pixel == 24 ||
00524                  bmp_header.bits_per_pixel == 32) {
00525             next_pixels = 0;
00526             for (k = 0; k < 8; k++) { /* get next 8 pixels */
00527                 this_pixel = (fgetc (infp) & 0xFF) +
00528                             (fgetc (infp) & 0xFF) +
00529                             (fgetc (infp) & 0xFF);
00530
00531                 if (bmp_header.bits_per_pixel == 32) {
00532                     (void) fgetc (infp); /* ignore alpha value */
00533                 }
00534
00535                 /* convert RGB color space to monochrome */
00536                 if (this_pixel >= (128 * 3))
00537                     this_pixel = 0;
00538                 else
00539                     this_pixel = 1;
00540
00541                 /* shift next pixel color into place for 8 pixels total */
00542                 next_pixels = (next_pixels « 1) | this_pixel;
00543             }
00544         }
00545         if (bmp_header.height < 0) { /* Bitmap drawn top to bottom */
00546             bitmap [(32*17-1) - i] [j] = next_pixels;
00547         }
00548         else { /* Bitmap drawn bottom to top */
00549             bitmap [i] [j] = next_pixels;
00550         }
00551     }
00552 }
00553
00554 /*
00555 If any bits are set in color_mask, apply it to
00556 entire bitmap to invert black <--> white.
00557 */
00558 if (color_mask != 0x00) {
00559     for (i = 32*17-1; i >= 0; i--) {
00560         for (j=0; j < 32*18/8; j++) {
00561             bitmap [i] [j] ^= color_mask;
00562         }
00563     }
00564 }
00565
00566 }
00567
00568 /*
00569 We've read the entire file. Now close the input file pointer.
00570 */
00571 fclose (infp);
00572 /*
00573 We now have the header portion in the header[] array,
00574 and have the bitmap portion from top-to-bottom in the bitmap[] array.
00575 */
00576 /*
00577 If no Unicode range (U+nnnnnn00 through U+nnnnnnFF) was specified
00578 with a -p parameter, determine the range from the digits in the
00579 bitmap itself.
00580
00581 Store bitmaps for the hex digit patterns that this file uses.
00582 */
00583 if (!planeset) { /* If Unicode range not specified with -p parameter */
00584     for (i = 0x0; i <= 0xF; i++) { /* hex digit pattern we're storing */
00585         for (j = 0; j < 4; j++) {
00586             hexdigit[i] [j] =
00587                 ((unsigned) bitmap[32 * (i+1) + 4 * j + 8] [6] « 24 ) |
00588                 ((unsigned) bitmap[32 * (i+1) + 4 * j + 8 + 1] [6] « 16 ) |

```

```

00589         ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 2][6] « 8 ) |
00590         ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 3][6]      );
00591     }
00592 }
00593 /*
00594 Read the Unicode plane digits into arrays for comparison, to
00595 determine the upper four hex digits of the glyph addresses.
00596 */
00597 for (i = 0; i < 4; i++) {
00598     for (j = 0; j < 4; j++) {
00599         unidigit[i][j] =
00600             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 1][i + 3] « 24 ) |
00601             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 2][i + 3] « 16 ) |
00602             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 3][i + 3] « 8 ) |
00603             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 4][i + 3]      );
00604     }
00605 }
00606
00607 tmpsum = 0;
00608 for (i = 4; i < 6; i++) {
00609     for (j = 0; j < 4; j++) {
00610         unidigit[i][j] =
00611             ((unsigned)bitmap[32 * 1 + 4 * j + 8      ][i] « 24 ) |
00612             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 1][i] « 16 ) |
00613             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 2][i] « 8 ) |
00614             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 3][i]      );
00615         tmpsum |= unidigit[i][j];
00616     }
00617 }
00618 if (tmpsum == 0) { /* the glyph matrix is transposed */
00619     flip = 1; /* note transposed order for processing glyphs in matrix */
00620 }
00621 Get 5th and 6th hex digits by shifting first column header left by
00622 1.5 columns, thereby shifting the hex digit right after the leading
00623 "U+nnnn" page number.
00624 */
00625 for (i = 0x08; i < 0x18; i++) {
00626     bitmap[i][7] = (bitmap[i][8] « 4) | ((bitmap[i][9] » 4) & 0xf);
00627     bitmap[i][8] = (bitmap[i][9] « 4) | ((bitmap[i][10] » 4) & 0xf);
00628 }
00629 for (i = 4; i < 6; i++) {
00630     for (j = 0; j < 4; j++) {
00631         unidigit[i][j] =
00632             ((unsigned)bitmap[4 * j + 8 + 1][i + 3] « 24 ) |
00633             ((unsigned)bitmap[4 * j + 8 + 2][i + 3] « 16 ) |
00634             ((unsigned)bitmap[4 * j + 8 + 3][i + 3] « 8 ) |
00635             ((unsigned)bitmap[4 * j + 8 + 4][i + 3]      );
00636     }
00637 }
00638 }
00639
00640 /*
00641 Now determine the Unicode plane by comparing unidigit[0..5] to
00642 the hexdigit[0x0..0xF] array.
00643 */
00644 uniplane = 0;
00645 for (i=0; i<6; i++) { /* go through one bitmap digit at a time */
00646     match = 0; /* haven't found pattern yet */
00647     for (j = 0x0; !match && j <= 0xF; j++) {
00648         if (unidigit[i][0] == hexdigit[j][0] &&
00649             unidigit[i][1] == hexdigit[j][1] &&
00650             unidigit[i][2] == hexdigit[j][2] &&
00651             unidigit[i][3] == hexdigit[j][3]) { /* we found the digit */
00652             uniplane |= j;
00653             match = 1;
00654         }
00655     }
00656     uniplane «= 4;
00657 }
00658 uniplane »= 4;
00659 }
00660 /*
00661 Now read each glyph and print it as hex.
00662 */
00663 for (i = 0x0; i <= 0xf; i++) {
00664     for (j = 0x0; j <= 0xf; j++) {
00665         for (k = 0; k < 16; k++) {
00666             if (flip) { /* transpose glyph matrix */
00667                 thischar0[k] = bitmap[32*(j+1) + k + 7][4 * (i+2)   ];
00668                 thischar1[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 1];
00669                 thischar2[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 2];

```

```

00670         thischar3[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 3];
00671     }
00672     else {
00673         thischar0[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) ];
00674         thischar1[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 1];
00675         thischar2[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 2];
00676         thischar3[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 3];
00677     }
00678 }
00679 /*
00680 If the second half of the 16*16 character is all zeroes, this
00681 character is only 8 bits wide, so print a half-width character.
00682 */
00683     empty1 = empty2 = 1;
00684     for (k=0; (empty1 || empty2) && k < 16; k++) {
00685         if (thischar1[k] != 0) empty1 = 0;
00686         if (thischar2[k] != 0) empty2 = 0;
00687     }
00688 /*
00689 Only print this glyph if it isn't blank.
00690 */
00691     if (!empty1 || !empty2) {
00692 /*
00693 If the second half is empty, this is a half-width character.
00694 Only print the first half.
00695 */
00696 /*
00697 Original GNU Unifont format is four hexadecimal digit character
00698 code followed by a colon followed by a hex string.  Add support
00699 for codes beyond the Basic Multilingual Plane.
00700
00701 Unicode ranges from U+0000 to U+10FFFF, so print either a
00702 4-digit or a 6-digit code point.  Note that this software
00703 should support up to an 8-digit code point, extending beyond
00704 the normal Unicode range, but this has not been fully tested.
00705 */
00706         if (uniplane > 0xff)
00707             fprintf (outfp, "%04X%X%X:", uniplane, i, j); // 6 digit code pt.
00708         else
00709             fprintf (outfp, "%02X%X%X:", uniplane, i, j); // 4 digit code pt.
00710         for (thisrow=0; thisrow<16; thisrow++) {
00711 /*
00712 If second half is empty and we're not forcing this
00713 code point to double width, print as single width.
00714 */
00715             if (!forcewide &&
00716                 empty2 && !wide[(uniplane « 8) | (i « 4) | j]) {
00717                 fprintf (outfp,
00718                     "%02X",
00719                     thischar1[thisrow]);
00720             }
00721             else if (wide[(uniplane « 8) | (i « 4) | j] == 4) {
00722 /* quadruple-width; force 32nd pixel to zero */
00723                 fprintf (outfp,
00724                     "%02X%02X%02X%02X",
00725                     thischar0[thisrow], thischar1[thisrow],
00726                     thischar2[thisrow], thischar3[thisrow] & 0xFE);
00727             }
00728             else { /* treat as double-width */
00729                 fprintf (outfp,
00730                     "%02X%02X",
00731                     thischar1[thisrow], thischar2[thisrow]);
00732             }
00733         }
00734         fprintf (outfp, "\n");
00735     }
00736 }
00737 }
00738 exit (0);
00739 }

```

5.11.4 Variable Documentation

5.11.4.1 bits_per_pixel

int bits_per_pixel

Definition at line [139](#) of file [unibmp2hex.c](#).

5.11.4.2

struct { ... } bmp_header

Bitmap Header parameters

5.11.4.3 color_table

unsigned char color_table[256][4]

Bitmap Color [Table](#) – maximum of 256 colors in a BMP file

Definition at line [149](#) of file [unibmp2hex.c](#).

5.11.4.4 compression

int compression

Definition at line [140](#) of file [unibmp2hex.c](#).

5.11.4.5 file_size

int file_size

Definition at line [133](#) of file [unibmp2hex.c](#).

5.11.4.6 filetype

char filetype[2]

Definition at line [132](#) of file [unibmp2hex.c](#).

5.11.4.7 flip

unsigned flip =0

=1 if we're transposing glyph matrix

Definition at line [123](#) of file [unibmp2hex.c](#).

5.11.4.8 forcewide

unsigned forcewide =0

=1 to set each glyph to 16 pixels wide

Definition at line [124](#) of file [unibmp2hex.c](#).

5.11.4.9 height

int height

Definition at line [137](#) of file [unibmp2hex.c](#).

5.11.4.10 hexdigit

unsigned hexdigit[16][4]

32 bit representation of 16x8 0..F bitmap

Definition at line 119 of file [unibmp2hex.c](#).

5.11.4.11 image_offset

int image_offset

Definition at line 134 of file [unibmp2hex.c](#).

5.11.4.12 image_size

int image_size

Definition at line 141 of file [unibmp2hex.c](#).

5.11.4.13 important_colors

int important_colors

Definition at line 145 of file [unibmp2hex.c](#).

5.11.4.14 info_size

int info_size

Definition at line 135 of file [unibmp2hex.c](#).

5.11.4.15 ncolors

int ncolors

Definition at line 144 of file [unibmp2hex.c](#).

5.11.4.16 nplanes

int nplanes

Definition at line 138 of file [unibmp2hex.c](#).

5.11.4.17 planeset

unsigned planeset =0

=1: use plane specified with -p parameter

Definition at line 122 of file [unibmp2hex.c](#).

5.11.4.18 unidigit

unsigned unidigit[6][4]

The six Unicode plane digits, from left-most (0) to right-most (5)

Definition at line 127 of file [unibmp2hex.c](#).

5.11.4.19 uniplane

unsigned uniplane =0

Unicode plane number, 0..0xff ff.

Definition at line 121 of file [unibmp2hex.c](#).

5.11.4.20 width

int width

Definition at line 136 of file [unibmp2hex.c](#).

5.11.4.21 x_ppm

int x_ppm

Definition at line 142 of file [unibmp2hex.c](#).

5.11.4.22 y_ppm

int y_ppm

Definition at line 143 of file [unibmp2hex.c](#).

5.12 unibmp2hex.c

[Go to the documentation of this file.](#)

```
00001 /**
00002  @file unibmp2hex.c
00003
00004  @brief unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a
00005  GNU Unifont hex glyph set of 256 characters
00006
00007  @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009  @copyright Copyright (C) 2007, 2008, 2013, 2017, 2019, 2022 Paul Hardy
00010
00011  Synopsis: unibmp2hex [-iin_file.bmp] [-oout_file.hex] [-phex_page_num] [-w]
00012  */
00013 /*
00014
00015  LICENSE:
00016
00017  This program is free software: you can redistribute it and/or modify
00018  it under the terms of the GNU General Public License as published by
00019  the Free Software Foundation, either version 2 of the License, or
00020  (at your option) any later version.
00021
00022  This program is distributed in the hope that it will be useful,
00023  but WITHOUT ANY WARRANTY; without even the implied warranty of
00024  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00025  GNU General Public License for more details.
00026
00027  You should have received a copy of the GNU General Public License
00028  along with this program. If not, see <http://www.gnu.org/licenses/>.
00029  */
00030
00031 /*
00032  2 September 2024 [Paul Hardy] - Set these scripts to double width:
00033  - U+10D40..U+10D8F (Garay)
00034  - U+11380..U+113FF (Tulu-Tigalari)
00035  - U+116D0..U+116FF (Myanmar Extended-C)
00036  - U+11F00..U+11F5F (Kawi)
00037  - U+16100..U+1613F (Gurung Khema)
00038  - U+16D40..U+16D7F (Kirat Rai)
00039  - U+18B00..U+18CFF (Khitani Small Script)
00040  - U+1E5D0..U+1E5FF (Ol Onal)
00041
00042  6 September 2021 [Paul Hardy]:
```

```

00043 - Set U+12F90..U+12FFF (Cypro-Minoan) to be double width.
00044 - Set U+1CF00..U+1CFCF (Znamenny Musical Notation) to be double width.
00045 - Set U+1AFF0..U+1AFFF (Kana Extended-B) to be double width.
00046
00047 20 June 2017 [Paul Hardy]:
00048 - Modify to allow hard-coding of quadruple-width hex glyphs.
00049 The 32nd column (rightmost column) is cleared to zero, because
00050 that column contains the vertical cell border.
00051 - Set U+9FD8..U+9FE9 (complex CJK) to be quadruple-width.
00052 - Set U+011A00..U+011A4F (Masaram Gondi, non-digits) to be wide.
00053 - Set U+011A50..U+011AAF (Soyombo) to be wide.
00054
00055 8 July 2017 [Paul Hardy]:
00056 - All CJK glyphs in the range U+4E00..u+9FFF are double width
00057 again; commented out the line that sets U+9FD8..U+9FE9 to be
00058 quadruple width.
00059
00060 6 August 2017 [Paul Hardy]:
00061 - Remove hard-coding of U+01D200..U+01D24F Ancient Greek Musical
00062 Notation to double-width; allow range to be dual-width.
00063
00064 12 August 2017 [Paul Hardy]:
00065 - Remove Miao script from list of wide scripts, so it can contain
00066 single-width glyphs.
00067
00068 26 December 2017 Paul Hardy:
00069 - Removed Tibetan from list of wide scripts, so it can contain
00070 single-width glyphs.
00071 - Added a number of scripts to be explicitly double-width in case
00072 they are redrawn.
00073 - Added Miao script back as wide, because combining glyphs are
00074 added back to font/plane01/plane01-combining.txt.
00075
00076 05 June 2018 Paul Hardy:
00077 - Made U+2329 and U+232A wide.
00078 - Added to wide settings for CJK Compatibility Forms over entire range.
00079 - Made Kayah Li script double-width.
00080 - Made U+232A (Right-pointing Angle Bracket) double-width.
00081 - Made U+01F5E7 (Three Rays Right) double-width.
00082
00083 July 2018 Paul Hardy:
00084 - Changed 2017 to 2018 in previous change entry.
00085 - Added Dogra (U+011800..U+01184F) as double width.
00086 - Added Makasar (U+011EE0..U+011EFF) as double width.
00087
00088 23 February 2019 [Paul Hardy]:
00089 - Set U+119A0..U+119FF (Nandinagari) to be wide.
00090 - Set U+1E2C0..U+1E2FF (Wancho) to be wide.
00091
00092 25 May 2019 [Paul Hardy]:
00093 - Added support for the case when the original .bmp monochrome
00094 file has been converted to a 32 bit per pixel RGB file.
00095 - Added support for bitmap images stored from either top to bottom
00096 or bottom to top.
00097 - Add DEBUG compile flag to print header information, to ease
00098 adding support for additional bitmap formats in the future.
00099
00100 13 March 2022 [Paul Hardy]:
00101 - Added support for 24 bits per pixel RGB file.
00102
00103 12 June 2022 [Paul Hardy]:
00104 - Set U+11B00..U+11B5F (Devanagari Extended-A) to be wide.
00105 - Set U+11F00..U+11F5F (Kawi) to be wide.
00106
00107 19 April 2025 [Paul Hardy]:
00108 - Remove hard-coding of U+1D100..U+1D1FF (Musical Symbols)
00109 to double-width; allow range to be dual-width.
00110 */
00111
00112 #include <stdio.h>
00113 #include <stdlib.h>
00114 #include <string.h>
00115
00116 #define MAXBUF 256 ///< Maximum input file line length - 1
00117
00118
00119 unsigned hexdigit[16][4]; ///< 32 bit representation of 16x8 0..F bitmap
00120
00121 unsigned uniplane=0; ///< Unicode plane number, 0..0xff ff
00122 unsigned planeset=0; ///< =1: use plane specified with -p parameter
00123 unsigned flip=0; ///< =1 if we're transposing glyph matrix

```

```

00124 unsigned forcewide=0;    ///< =1 to set each glyph to 16 pixels wide
00125
00126 /** The six Unicode plane digits, from left-most (0) to right-most (5) */
00127 unsigned unidigit[6][4];
00128
00129
00130 /** Bitmap Header parameters */
00131 struct {
00132     char filetype[2];
00133     int file_size;
00134     int image_offset;
00135     int info_size;
00136     int width;
00137     int height;
00138     int nplanes;
00139     int bits_per_pixel;
00140     int compression;
00141     int image_size;
00142     int x_ppm;
00143     int y_ppm;
00144     int ncolors;
00145     int important_colors;
00146 } bmp_header;
00147
00148 /** Bitmap Color Table -- maximum of 256 colors in a BMP file */
00149 unsigned char color_table[256][4]; /* R, G, B, alpha for up to 256 colors */
00150
00151 // #define DEBUG
00152
00153 /**
00154  * @brief The main function.
00155  *
00156  * @param[in] argc The count of command line arguments.
00157  * @param[in] argv Pointer to array of command line arguments.
00158  * @return This program exits with status 0.
00159  */
00160 int
00161 main (int argc, char *argv[])
00162 {
00163
00164     int i, j, k; /* loop variables */
00165     unsigned char inchar; /* temporary input character */
00166     char header[MAXBUF]; /* input buffer for bitmap file header */
00167     int wbmp=0; /* =0 for Windows Bitmap (.bmp); 1 for Wireless Bitmap (.wbmp) */
00168     int fatal; /* =1 if a fatal error occurred */
00169     int match; /* =1 if we're still matching a pattern, 0 if no match */
00170     int empty1, empty2; /* =1 if bytes tested are all zeroes */
00171     unsigned char thischar1[16], thischar2[16]; /* bytes of hex char */
00172     unsigned char thischar0[16], thischar3[16]; /* bytes for quadruple-width */
00173     int thisrow; /* index to point into thischar1[] and thischar2[] */
00174     int tmpsum; /* temporary sum to see if a character is blank */
00175     unsigned this_pixel; /* color of one pixel, if > 1 bit per pixel */
00176     unsigned next_pixels; /* pending group of 8 pixels being read */
00177     unsigned color_mask = 0x00; /* to invert monochrome bitmap, set to 0xFF */
00178
00179     unsigned char bitmap[17*32][18*32/8]; /* final bitmap */
00180     /* For wide array:
00181     0 = don't force glyph to double-width;
00182     1 = force glyph to double-width;
00183     4 = force glyph to quadruple-width.
00184     */
00185     char wide[0x200000]={0x200000 * 0};
00186
00187     char *infile="", *outfile=""; /* names of input and output files */
00188     FILE *infp, *outfp; /* file pointers of input and output files */
00189
00190     if (argc > 1) {
00191         for (i = 1; i < argc; i++) {
00192             if (argv[i][0] == '-') { /* this is an option argument */
00193                 switch (argv[i][1]) {
00194                     case 'i': /* name of input file */
00195                         infile = &argv[i][2];
00196                         break;
00197                     case 'o': /* name of output file */
00198                         outfile = &argv[i][2];
00199                         break;
00200                     case 'p': /* specify a Unicode plane */
00201                         sscanf (&argv[i][2], "%x", &uniplane); /* Get Unicode plane */
00202                         planeset = 1; /* Use specified range, not what's in bitmap */
00203                         break;
00204                     case 'w': /* force wide (16 pixels) for each glyph */

```

```

00205         forcewide = 1;
00206     break;
00207     default: /* if unrecognized option, print list and exit */
00208         fprintf (stderr, "\nSyntax: \n\n");
00209         fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00210         fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00211         fprintf (stderr, " -w specifies .wbmp output instead of ");
00212         fprintf (stderr, "default Windows .bmp output.\n\n");
00213         fprintf (stderr, " -p is followed by 1 to 6 ");
00214         fprintf (stderr, "Unicode plane hex digits ");
00215         fprintf (stderr, "(default is Page 0).\n\n");
00216         fprintf (stderr, "\nExample: \n\n");
00217         fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n",
00218                 argv[0]);
00219         exit (1);
00220     }
00221 }
00222 }
00223 }
00224 /*
00225 Make sure we can open any I/O files that were specified before
00226 doing anything else.
00227 */
00228 if (strlen (infile) > 0) {
00229     if ((infp = fopen (infile, "r")) == NULL) {
00230         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00231         exit (1);
00232     }
00233 }
00234 else {
00235     infp = stdin;
00236 }
00237 if (strlen (outfile) > 0) {
00238     if ((outfp = fopen (outfile, "w")) == NULL) {
00239         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00240         exit (1);
00241     }
00242 }
00243 else {
00244     outfp = stdout;
00245 }
00246 /*
00247 Initialize selected code points for double width (16x16).
00248 Double-width is forced in cases where a glyph (usually a combining
00249 glyph) only occupies the left-hand side of a 16x16 grid, but must
00250 be rendered as double-width to appear properly with other glyphs
00251 in a given script. If additions were made to a script after
00252 Unicode 5.0, the Unicode version is given in parentheses after
00253 the script name.
00254 */
00255 for (i = 0x0700; i <= 0x074F; i++) wide[i] = 1; /* Syriac */
00256 for (i = 0x0800; i <= 0x083F; i++) wide[i] = 1; /* Samaritan (5.2) */
00257 for (i = 0x0900; i <= 0x0DFF; i++) wide[i] = 1; /* Indic */
00258 for (i = 0x1000; i <= 0x109F; i++) wide[i] = 1; /* Myanmar */
00259 for (i = 0x1100; i <= 0x11FF; i++) wide[i] = 1; /* Hangul Jamo */
00260 for (i = 0x1400; i <= 0x167F; i++) wide[i] = 1; /* Canadian Aboriginal */
00261 for (i = 0x1700; i <= 0x171F; i++) wide[i] = 1; /* Tagalog */
00262 for (i = 0x1720; i <= 0x173F; i++) wide[i] = 1; /* Hanunoo */
00263 for (i = 0x1740; i <= 0x175F; i++) wide[i] = 1; /* Buhid */
00264 for (i = 0x1760; i <= 0x177F; i++) wide[i] = 1; /* Tagbanwa */
00265 for (i = 0x1780; i <= 0x17FF; i++) wide[i] = 1; /* Khmer */
00266 for (i = 0x18B0; i <= 0x18FF; i++) wide[i] = 1; /* Ext. Can. Aboriginal */
00267 for (i = 0x1800; i <= 0x18AF; i++) wide[i] = 1; /* Mongolian */
00268 for (i = 0x1900; i <= 0x194F; i++) wide[i] = 1; /* Limbu */
00269 // for (i = 0x1980; i <= 0x19DF; i++) wide[i] = 1; /* New Tai Lue */
00270 for (i = 0x1A00; i <= 0x1A1F; i++) wide[i] = 1; /* Buginese */
00271 for (i = 0x1A20; i <= 0x1AAF; i++) wide[i] = 1; /* Tai Tham (5.2) */
00272 for (i = 0x1B00; i <= 0x1B7F; i++) wide[i] = 1; /* Balinese */
00273 for (i = 0x1B80; i <= 0x1BBF; i++) wide[i] = 1; /* Sundanese (5.1) */
00274 for (i = 0x1BC0; i <= 0x1BFF; i++) wide[i] = 1; /* Batak (6.0) */
00275 for (i = 0x1C00; i <= 0x1C4F; i++) wide[i] = 1; /* Lepcha (5.1) */
00276 for (i = 0x1CC0; i <= 0x1CCF; i++) wide[i] = 1; /* Sundanese Supplement */
00277 for (i = 0x1CD0; i <= 0x1CFF; i++) wide[i] = 1; /* Vedic Extensions (5.2) */
00278 wide[0x2329] = wide[0x232A] = 1; /* Left- & Right-pointing Angle Brackets */
00279 for (i = 0x2E80; i <= 0xA4CF; i++) wide[i] = 1; /* CJK */
00280 // for (i = 0x9FD8; i <= 0x9FE9; i++) wide[i] = 4; /* CJK quadruple-width */
00281 for (i = 0xA900; i <= 0xA92F; i++) wide[i] = 1; /* Kayah Li (5.1) */
00282 for (i = 0xA930; i <= 0xA95F; i++) wide[i] = 1; /* Rejang (5.1) */
00283 for (i = 0xA960; i <= 0xA97F; i++) wide[i] = 1; /* Hangul Jamo Extended-A */
00284 for (i = 0xA980; i <= 0xA9DF; i++) wide[i] = 1; /* Javanese (5.2) */
00285 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham (5.1) */

```

```

00286 for (i = 0xA9E0; i <= 0xA9FF; i++) wide[i] = 1; /* Myanmar Extended-B */
00287 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham */
00288 for (i = 0xAA60; i <= 0xAA7F; i++) wide[i] = 1; /* Myanmar Extended-A */
00289 for (i = 0xAAE0; i <= 0xA AFF; i++) wide[i] = 1; /* Meetei Mayek Ext (6.0) */
00290 for (i = 0xABC0; i <= 0xABFF; i++) wide[i] = 1; /* Meetei Mayek (5.2) */
00291 for (i = 0xAC00; i <= 0xD7AF; i++) wide[i] = 1; /* Hangul Syllables */
00292 for (i = 0xD7B0; i <= 0xD7FF; i++) wide[i] = 1; /* Hangul Jamo Extended-B */
00293 for (i = 0xF900; i <= 0FAFF; i++) wide[i] = 1; /* CJK Compatibility */
00294 for (i = 0xFE10; i <= 0xFE1F; i++) wide[i] = 1; /* Vertical Forms */
00295 for (i = 0xFE30; i <= 0xFE60; i++) wide[i] = 1; /* CJK Compatibility Forms */
00296 for (i = 0xFFE0; i <= 0xFFE6; i++) wide[i] = 1; /* CJK Compatibility Forms */
00297
00298 wide[0x303F] = 0; /* CJK half-space fill */
00299
00300 /* Supplemental Multilingual Plane (Plane 01) */
00301 for (i = 0x0105C0; i <= 0x0105FF; i++) wide[i] = 1; /* Todhri */
00302 for (i = 0x010A00; i <= 0x010A5F; i++) wide[i] = 1; /* Kharoshthi */
00303 for (i = 0x011000; i <= 0x01107F; i++) wide[i] = 1; /* Brahmi */
00304 for (i = 0x011080; i <= 0x0110CF; i++) wide[i] = 1; /* Kaithi */
00305 for (i = 0x011100; i <= 0x01114F; i++) wide[i] = 1; /* Chakma */
00306 for (i = 0x011180; i <= 0x0111DF; i++) wide[i] = 1; /* Sharada */
00307 for (i = 0x011200; i <= 0x01124F; i++) wide[i] = 1; /* Khojki */
00308 for (i = 0x0112B0; i <= 0x0112FF; i++) wide[i] = 1; /* Khudawadi */
00309 for (i = 0x011300; i <= 0x01137F; i++) wide[i] = 1; /* Grantha */
00310 for (i = 0x011380; i <= 0x0113FF; i++) wide[i] = 1; /* Tulu-Tigalari */
00311 for (i = 0x011400; i <= 0x01147F; i++) wide[i] = 1; /* Newa */
00312 for (i = 0x011480; i <= 0x0114DF; i++) wide[i] = 1; /* Tirhuta */
00313 for (i = 0x011580; i <= 0x0115FF; i++) wide[i] = 1; /* Siddham */
00314 for (i = 0x011600; i <= 0x01165F; i++) wide[i] = 1; /* Modi */
00315 for (i = 0x011660; i <= 0x01167F; i++) wide[i] = 1; /* Mongolian Suppl. */
00316 for (i = 0x011680; i <= 0x0116CF; i++) wide[i] = 1; /* Takri */
00317 for (i = 0x0116D0; i <= 0x0116FF; i++) wide[i] = 1; /* Myanmar Extended-C */
00318 for (i = 0x011700; i <= 0x01173F; i++) wide[i] = 1; /* Ahom */
00319 for (i = 0x011800; i <= 0x01184F; i++) wide[i] = 1; /* Dogra */
00320 for (i = 0x011900; i <= 0x01195F; i++) wide[i] = 1; /* Dives Akuru */
00321 for (i = 0x0119A0; i <= 0x0119FF; i++) wide[i] = 1; /* Nandinagari */
00322 for (i = 0x011A00; i <= 0x011A4F; i++) wide[i] = 1; /* Zanabazar Square */
00323 for (i = 0x011A50; i <= 0x011AAF; i++) wide[i] = 1; /* Soyombo */
00324 for (i = 0x011B00; i <= 0x011B5F; i++) wide[i] = 1; /* Devanagari Extended-A */
00325 for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi */
00326 for (i = 0x011C00; i <= 0x011C6F; i++) wide[i] = 1; /* Bhaiksuki */
00327 for (i = 0x011C70; i <= 0x011CBF; i++) wide[i] = 1; /* Marchen */
00328 for (i = 0x011D00; i <= 0x011D5F; i++) wide[i] = 1; /* Masaram Gondi */
00329 for (i = 0x011EE0; i <= 0x011EFF; i++) wide[i] = 1; /* Makasar */
00330 for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi */
00331 for (i = 0x012F90; i <= 0x012FFF; i++) wide[i] = 1; /* Cypro-Minoan */
00332 /* Make Bassa Vah all single width or all double width */
00333 for (i = 0x016100; i <= 0x01613F; i++) wide[i] = 1; /* Gurung Khema */
00334 for (i = 0x016AD0; i <= 0x016AFF; i++) wide[i] = 1; /* Bassa Vah */
00335 for (i = 0x016B00; i <= 0x016B8F; i++) wide[i] = 1; /* Pahawh Hmong */
00336 for (i = 0x016D40; i <= 0x016D7F; i++) wide[i] = 1; /* Kirat Rai */
00337 for (i = 0x016F00; i <= 0x016F9F; i++) wide[i] = 1; /* Miao */
00338 for (i = 0x016FE0; i <= 0x016FFF; i++) wide[i] = 1; /* Ideograph Sym/Punct */
00339 for (i = 0x017000; i <= 0x0187FF; i++) wide[i] = 1; /* Tangut */
00340 for (i = 0x018800; i <= 0x018AFF; i++) wide[i] = 1; /* Tangut Components */
00341 for (i = 0x018B00; i <= 0x018CFF; i++) wide[i] = 1; /* Khitan Small Script */
00342 for (i = 0x01AFF0; i <= 0x01AFFF; i++) wide[i] = 1; /* Kana Extended-B */
00343 for (i = 0x01B000; i <= 0x01B0FF; i++) wide[i] = 1; /* Kana Supplement */
00344 for (i = 0x01B100; i <= 0x01B12F; i++) wide[i] = 1; /* Kana Extended-A */
00345 for (i = 0x01B170; i <= 0x01B2FF; i++) wide[i] = 1; /* Nushu */
00346 for (i = 0x01CF00; i <= 0x01CFCF; i++) wide[i] = 1; /* Znamenny Musical */
00347 for (i = 0x01D800; i <= 0x01DAAF; i++) wide[i] = 1; /* Sutton SignWriting */
00348 for (i = 0x01E2C0; i <= 0x01E2FF; i++) wide[i] = 1; /* Wancho */
00349 for (i = 0x01E500; i <= 0x01E5FF; i++) wide[i] = 1; /* Ol Onal */
00350 for (i = 0x01E800; i <= 0x01E8DF; i++) wide[i] = 1; /* Mende Kikakui */
00351 for (i = 0x01F200; i <= 0x01F2FF; i++) wide[i] = 1; /* Encl Ideograp Suppl */
00352 wide[0x01F5E7] = 1; /* Three Rays Right */
00353
00354 /*
00355 Determine whether or not the file is a Microsoft Windows Bitmap file.
00356 If it starts with 'B', 'M', assume it's a Windows Bitmap file.
00357 Otherwise, assume it's a Wireless Bitmap file.
00358
00359 WARNING: There isn't much in the way of error checking here --
00360 if you give it a file that wasn't first created by hex2bmp.c,
00361 all bets are off.
00362 */
00363 fatal = 0; /* assume everything is okay with reading input file */
00364 if ((header[0] = fgetc (infp)) != EOF) {
00365     if ((header[1] = fgetc (infp)) != EOF) {
00366         if (header[0] == 'B' && header[1] == 'M') {

```

```

00367         wbmp = 0; /* Not a Wireless Bitmap -- it's a Windows Bitmap */
00368     }
00369     else {
00370         wbmp = 1; /* Assume it's a Wireless Bitmap */
00371     }
00372 }
00373 else
00374     fatal = 1;
00375 }
00376 else
00377     fatal = 1;
00378
00379 if (fatal) {
00380     fprintf(stderr, "Fatal error; end of input file.\n\n");
00381     exit (1);
00382 }
00383 /*
00384 If this is a Wireless Bitmap (.wbmp) format file,
00385 skip the header and point to the start of the bitmap itself.
00386 */
00387 if (wbmp) {
00388     for (i=2; i<6; i++)
00389         header[i] = fgetc (infp);
00390     /*
00391 Now read the bitmap.
00392 */
00393     for (i=0; i < 32*17; i++) {
00394         for (j=0; j < 32*18/8; j++) {
00395             inchar = fgetc (infp);
00396             bitmap[i][j] = ~inchar; /* invert bits for proper color */
00397         }
00398     }
00399 }
00400 /*
00401 Otherwise, treat this as a Windows Bitmap file, because we checked
00402 that it began with "BM". Save the header contents for future use.
00403 Expect a 14 byte standard BITMAPFILEHEADER format header followed
00404 by a 40 byte standard BITMAPINFOHEADER Device Independent Bitmap
00405 header, with data stored in little-endian format.
00406 */
00407 else {
00408     for (i = 2; i < 54; i++)
00409         header[i] = fgetc (infp);
00410
00411     bmp_header.filetype[0] = 'B';
00412     bmp_header.filetype[1] = 'M';
00413
00414     bmp_header.file_size =
00415         (header[2] & 0xFF) | ((header[3] & 0xFF) « 8) |
00416         ((header[4] & 0xFF) « 16) | ((header[5] & 0xFF) « 24);
00417
00418     /* header bytes 6..9 are reserved */
00419
00420     bmp_header.image_offset =
00421         (header[10] & 0xFF) | ((header[11] & 0xFF) « 8) |
00422         ((header[12] & 0xFF) « 16) | ((header[13] & 0xFF) « 24);
00423
00424     bmp_header.info_size =
00425         (header[14] & 0xFF) | ((header[15] & 0xFF) « 8) |
00426         ((header[16] & 0xFF) « 16) | ((header[17] & 0xFF) « 24);
00427
00428     bmp_header.width =
00429         (header[18] & 0xFF) | ((header[19] & 0xFF) « 8) |
00430         ((header[20] & 0xFF) « 16) | ((header[21] & 0xFF) « 24);
00431
00432     bmp_header.height =
00433         (header[22] & 0xFF) | ((header[23] & 0xFF) « 8) |
00434         ((header[24] & 0xFF) « 16) | ((header[25] & 0xFF) « 24);
00435
00436     bmp_header.nplanes =
00437         (header[26] & 0xFF) | ((header[27] & 0xFF) « 8);
00438
00439     bmp_header.bits_per_pixel =
00440         (header[28] & 0xFF) | ((header[29] & 0xFF) « 8);
00441
00442     bmp_header.compression =
00443         (header[30] & 0xFF) | ((header[31] & 0xFF) « 8) |
00444         ((header[32] & 0xFF) « 16) | ((header[33] & 0xFF) « 24);
00445
00446     bmp_header.image_size =
00447         (header[34] & 0xFF) | ((header[35] & 0xFF) « 8) |

```

```

00448     ((header[36] & 0xFF) « 16) | ((header[37] & 0xFF) « 24);
00449
00450     bmp_header.x_ppm =
00451         (header[38] & 0xFF) | ((header[39] & 0xFF) « 8) |
00452         ((header[40] & 0xFF) « 16) | ((header[41] & 0xFF) « 24);
00453
00454     bmp_header.y_ppm =
00455         (header[42] & 0xFF) | ((header[43] & 0xFF) « 8) |
00456         ((header[44] & 0xFF) « 16) | ((header[45] & 0xFF) « 24);
00457
00458     bmp_header.ncolors =
00459         (header[46] & 0xFF) | ((header[47] & 0xFF) « 8) |
00460         ((header[48] & 0xFF) « 16) | ((header[49] & 0xFF) « 24);
00461
00462     bmp_header.important_colors =
00463         (header[50] & 0xFF) | ((header[51] & 0xFF) « 8) |
00464         ((header[52] & 0xFF) « 16) | ((header[53] & 0xFF) « 24);
00465
00466     if (bmp_header.ncolors == 0)
00467         bmp_header.ncolors = 1 « bmp_header.bits_per_pixel;
00468
00469     /* If a Color Table exists, read it */
00470     if (bmp_header.ncolors > 0 && bmp_header.bits_per_pixel <= 8) {
00471         for (i = 0; i < bmp_header.ncolors; i++) {
00472             color_table[i][0] = fgetc (infp); /* Red */
00473             color_table[i][1] = fgetc (infp); /* Green */
00474             color_table[i][2] = fgetc (infp); /* Blue */
00475             color_table[i][3] = fgetc (infp); /* Alpha */
00476         }
00477     }
00478     Determine from the first color table entry whether we
00479     are inverting the resulting bitmap image.
00480     */
00481     if ( (color_table[0][0] + color_table[0][1] + color_table[0][2])
00482          < (3 * 128) ) {
00483         color_mask = 0xFF;
00484     }
00485 }
00486
00487 #ifdef DEBUG
00488
00489     /*
00490     Print header info for possibly adding support for
00491     additional file formats in the future, to determine
00492     how the bitmap is encoded.
00493     */
00494     fprintf (stderr, "Filetype: '%c%c'\n",
00495             bmp_header.filetype[0], bmp_header.filetype[1]);
00496     fprintf (stderr, "File Size: %d\n", bmp_header.file_size);
00497     fprintf (stderr, "Image Offset: %d\n", bmp_header.image_offset);
00498     fprintf (stderr, "Info Header Size: %d\n", bmp_header.info_size);
00499     fprintf (stderr, "Image Width: %d\n", bmp_header.width);
00500     fprintf (stderr, "Image Height: %d\n", bmp_header.height);
00501     fprintf (stderr, "Number of Planes: %d\n", bmp_header.nplanes);
00502     fprintf (stderr, "Bits per Pixel: %d\n", bmp_header.bits_per_pixel);
00503     fprintf (stderr, "Compression Method: %d\n", bmp_header.compression);
00504     fprintf (stderr, "Image Size: %d\n", bmp_header.image_size);
00505     fprintf (stderr, "X Pixels per Meter: %d\n", bmp_header.x_ppm);
00506     fprintf (stderr, "Y Pixels per Meter: %d\n", bmp_header.y_ppm);
00507     fprintf (stderr, "Number of Colors: %d\n", bmp_header.ncolors);
00508     fprintf (stderr, "Important Colors: %d\n", bmp_header.important_colors);
00509
00510 #endif
00511
00512     /*
00513     Now read the bitmap.
00514     */
00515     for (i = 32*17-1; i >= 0; i--) {
00516         for (j=0; j < 32*18/8; j++) {
00517             next_pixels = 0x00; /* initialize next group of 8 pixels */
00518             /* Read a monochrome image -- the original case */
00519             if (bmp_header.bits_per_pixel == 1) {
00520                 next_pixels = fgetc (infp);
00521             }
00522             /* Read a 32 bit per pixel RGB image; convert to monochrome */
00523             else if ( bmp_header.bits_per_pixel == 24 ||
00524                      bmp_header.bits_per_pixel == 32) {
00525                 next_pixels = 0;
00526                 for (k = 0; k < 8; k++) { /* get next 8 pixels */
00527                     this_pixel = (fgetc (infp) & 0xFF) +
00528                         (fgetc (infp) & 0xFF) +

```

```

00529         (fgetc (infp) & 0xFF);
00530
00531         if (bmp_header.bits_per_pixel == 32) {
00532             (void) fgetc (infp); /* ignore alpha value */
00533         }
00534
00535         /* convert RGB color space to monochrome */
00536         if (this_pixel >= (128 * 3))
00537             this_pixel = 0;
00538         else
00539             this_pixel = 1;
00540
00541         /* shift next pixel color into place for 8 pixels total */
00542         next_pixels = (next_pixels « 1) | this_pixel;
00543     }
00544 }
00545 if (bmp_header.height < 0) { /* Bitmap drawn top to bottom */
00546     bitmap [(32*17-1) - i][j] = next_pixels;
00547 }
00548 else { /* Bitmap drawn bottom to top */
00549     bitmap [i][j] = next_pixels;
00550 }
00551 }
00552 }
00553
00554 /*
00555 If any bits are set in color_mask, apply it to
00556 entire bitmap to invert black <--> white.
00557 */
00558 if (color_mask != 0x00) {
00559     for (i = 32*17-1; i >= 0; i--) {
00560         for (j=0; j < 32*18/8; j++) {
00561             bitmap [i][j] ^= color_mask;
00562         }
00563     }
00564 }
00565 }
00566 }
00567
00568 /*
00569 We've read the entire file. Now close the input file pointer.
00570 */
00571 fclose (infp);
00572 /*
00573 We now have the header portion in the header[] array,
00574 and have the bitmap portion from top-to-bottom in the bitmap[] array.
00575 */
00576 /*
00577 If no Unicode range (U+nnnnnn00 through U+nnnnnnFF) was specified
00578 with a -p parameter, determine the range from the digits in the
00579 bitmap itself.
00580
00581 Store bitmaps for the hex digit patterns that this file uses.
00582 */
00583 if (!planeset) { /* If Unicode range not specified with -p parameter */
00584     for (i = 0x0; i <= 0xFF; i++) { /* hex digit pattern we're storing */
00585         for (j = 0; j < 4; j++) {
00586             hexdigit[i][j] =
00587                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8][6] « 24) |
00588                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 1][6] « 16) |
00589                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 2][6] « 8) |
00590                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 3][6]);
00591         }
00592     }
00593 }
00594 /*
00595 Read the Unicode plane digits into arrays for comparison, to
00596 determine the upper four hex digits of the glyph addresses.
00597 */
00598 for (i = 0; i < 4; i++) {
00599     for (j = 0; j < 4; j++) {
00600         unidigit[i][j] =
00601             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 1][i + 3] « 24) |
00602             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 2][i + 3] « 16) |
00603             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 3][i + 3] « 8) |
00604             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 4][i + 3]);
00605     }
00606 }
00607 tmpsum = 0;
00608 for (i = 4; i < 6; i++) {
00609     for (j = 0; j < 4; j++) {

```

```

00610         unidigit[i][j] =
00611             ((unsigned)bitmap[32 * 1 + 4 * j + 8 ][i] « 24 ) |
00612             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 1][i] « 16 ) |
00613             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 2][i] « 8 ) |
00614             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 3][i] );
00615         tmpsum |= unidigit[i][j];
00616     }
00617 }
00618 if (tmpsum == 0) { /* the glyph matrix is transposed */
00619     flip = 1; /* note transposed order for processing glyphs in matrix */
00620     /*
00621     Get 5th and 6th hex digits by shifting first column header left by
00622     1.5 columns, thereby shifting the hex digit right after the leading
00623     "U+nnnn" page number.
00624     */
00625     for (i = 0x08; i < 0x18; i++) {
00626         bitmap[i][7] = (bitmap[i][8] « 4) | ((bitmap[i][ 9] » 4) & 0xf);
00627         bitmap[i][8] = (bitmap[i][9] « 4) | ((bitmap[i][10] » 4) & 0xf);
00628     }
00629     for (i = 4; i < 6; i++) {
00630         for (j = 0; j < 4; j++) {
00631             unidigit[i][j] =
00632                 ((unsigned)bitmap[4 * j + 8 + 1][i + 3] « 24 ) |
00633                 ((unsigned)bitmap[4 * j + 8 + 2][i + 3] « 16 ) |
00634                 ((unsigned)bitmap[4 * j + 8 + 3][i + 3] « 8 ) |
00635                 ((unsigned)bitmap[4 * j + 8 + 4][i + 3] );
00636         }
00637     }
00638 }
00639 /*
00640 Now determine the Unicode plane by comparing unidigit[0..5] to
00641 the hexdigit[0x0..0xF] array.
00642 */
00643 uniplane = 0;
00644 for (i=0; i<6; i++) { /* go through one bitmap digit at a time */
00645     match = 0; /* haven't found pattern yet */
00646     for (j = 0x0; !match && j <= 0xF; j++) {
00647         if (unidigit[i][0] == hexdigit[j][0] &&
00648             unidigit[i][1] == hexdigit[j][1] &&
00649             unidigit[i][2] == hexdigit[j][2] &&
00650             unidigit[i][3] == hexdigit[j][3]) { /* we found the digit */
00651             uniplane |= j;
00652             match = 1;
00653         }
00654     }
00655     uniplane «= 4;
00656 }
00657 uniplane »= 4;
00658 }
00659 /*
00660 Now read each glyph and print it as hex.
00661 */
00662 for (i = 0x0; i <= 0xf; i++) {
00663     for (j = 0x0; j <= 0xf; j++) {
00664         for (k = 0; k < 16; k++) {
00665             if (flip) { /* transpose glyph matrix */
00666                 thischar0[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) ];
00667                 thischar1[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 1];
00668                 thischar2[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 2];
00669                 thischar3[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 3];
00670             }
00671             else {
00672                 thischar0[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) ];
00673                 thischar1[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 1];
00674                 thischar2[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 2];
00675                 thischar3[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 3];
00676             }
00677         }
00678     }
00679     /*
00680     If the second half of the 16*16 character is all zeroes, this
00681     character is only 8 bits wide, so print a half-width character.
00682     */
00683     empty1 = empty2 = 1;
00684     for (k=0; (empty1 || empty2) && k < 16; k++) {
00685         if (thischar1[k] != 0) empty1 = 0;
00686         if (thischar2[k] != 0) empty2 = 0;
00687     }
00688     /*
00689     Only print this glyph if it isn't blank.
00690     */

```

```

00691         if (!empty1 || !empty2) {
00692             /*
00693              * If the second half is empty, this is a half-width character.
00694              * Only print the first half.
00695              */
00696             /*
00697              * Original GNU Unifont format is four hexadecimal digit character
00698              * code followed by a colon followed by a hex string.  Add support
00699              * for codes beyond the Basic Multilingual Plane.
00700              *
00701              * Unicode ranges from U+0000 to U+10FFFF, so print either a
00702              * 4-digit or a 6-digit code point.  Note that this software
00703              * should support up to an 8-digit code point, extending beyond
00704              * the normal Unicode range, but this has not been fully tested.
00705              */
00706             if (uniplane > 0xff)
00707                 fprintf (outfp, "%04X%X%X:", uniplane, i, j); // 6 digit code pt.
00708             else
00709                 fprintf (outfp, "%02X%X%X:", uniplane, i, j); // 4 digit code pt.
00710             for (thisrow=0; thisrow<16; thisrow++) {
00711                 /*
00712                  * If second half is empty and we're not forcing this
00713                  * code point to double width, print as single width.
00714                  */
00715                 if (!forcewide &&
00716                     empty2 && !wide[(uniplane « 8) | (i « 4) | j]) {
00717                     fprintf (outfp,
00718                             "%02X",
00719                             thischar1[thisrow]);
00720                 }
00721                 else if (wide[(uniplane « 8) | (i « 4) | j] == 4) {
00722                     /* quadruple-width; force 32nd pixel to zero */
00723                     fprintf (outfp,
00724                             "%02X%02X%02X%02X",
00725                             thischar0[thisrow], thischar1[thisrow],
00726                             thischar2[thisrow], thischar3[thisrow] & 0xFE);
00727                 }
00728                 else { /* treat as double-width */
00729                     fprintf (outfp,
00730                             "%02X%02X",
00731                             thischar1[thisrow], thischar2[thisrow]);
00732                 }
00733             }
00734             fprintf (outfp, "\n");
00735         }
00736     }
00737 }
00738 exit (0);
00739 }

```

5.13 src/unibmpbump.c File Reference

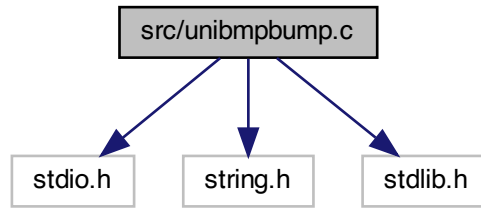
unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp

```

#include <stdio.h>
#include <string.h>
#include <stdlib.h>

```

Include dependency graph for unibmpbump.c:



Macros

- `#define` [VERSION](#) "1.0"
Version of this program.
- `#define` [MAX_COMPRESSION_METHOD](#) 13
Maximum supported compression method.

Functions

- `int` [main](#) (`int` argc, `char` *argv[])
The main function.
- `unsigned` [get_bytes](#) (`FILE` *infp, `int` nbytes)
Get from 1 to 4 bytes, inclusive, from input file.
- `void` [regrid](#) (`unsigned` *image_bytes)
After reading in the image, shift it.

5.13.1 Detailed Description

`unibmpbump` - Adjust a Microsoft bitmap (.bmp) file that was created by `unihex2png` but converted to .bmp

Author

Paul Hardy, `unifoundry` <at> `unifoundry.com`

Copyright

Copyright (C) 2019 Paul Hardy

This program shifts the glyphs in a bitmap file to adjust an original PNG file that was saved in BMP format. This is so the result matches the format of a `unihex2bmp` image. This conversion then lets `unibmp2hex` decode the result.

Synopsis: `unibmpbump [-iin_file.bmp] [-oout_file.bmp]`

Definition in file [unibmpbump.c](#).

5.13.2 Macro Definition Documentation

5.13.2.1 MAX_COMPRESSION_METHOD

#define MAX_COMPRESSION_METHOD 13
Maximum supported compression method.
Definition at line 40 of file [unibmpbump.c](#).

5.13.2.2 VERSION

#define VERSION "1.0"
Version of this program.
Definition at line 38 of file [unibmpbump.c](#).

5.13.3 Function Documentation

5.13.3.1 get_bytes()

unsigned get_bytes (
 FILE * infp,
 int nbytes)
Get from 1 to 4 bytes, inclusive, from input file.

Parameters

in	infp	Pointer to input file.
in	nbytes	Number of bytes to read, from 1 to 4, inclusive.

Returns

The unsigned 1 to 4 bytes in machine native endian format.

Definition at line 487 of file [unibmpbump.c](#).

```

00487                                     {
00488     int i;
00489     unsigned char inchar[4];
00490     unsigned inword;
00491
00492     for (i = 0; i < nbytes; i++) {
00493         if (fread (&inchar[i], 1, 1, infp) != 1) {
00494             inchar[i] = 0;
00495         }
00496     }
00497     for (i = nbytes; i < 4; i++) inchar[i] = 0;
00498
00499     inword = ((inchar[3] & 0xFF) « 24) | ((inchar[2] & 0xFF) « 16) |
00500             ((inchar[1] & 0xFF) « 8) | (inchar[0] & 0xFF);
00501
00502     return inword;

```

```
00503 }
```

5.13.3.2 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 50 of file [unibmpbump.c](#).

```
00050     {
00051
00052     /*
00053     Values preserved from file header (first 14 bytes).
00054     */
00055     char file_format[3]; /* "BM" for original Windows format */
00056     unsigned filesize; /* size of file in bytes */
00057     unsigned char rsvd_hdr[4]; /* 4 reserved bytes */
00058     unsigned image_start; /* byte offset of image in file */
00059
00060     /*
00061     Values preserved from Device Independent Bitmap (DIB) Header.
00062
00063     The DIB fields below are in the standard 40-byte header. Version
00064     4 and version 5 headers have more information, mainly for color
00065     information. That is skipped over, because a valid glyph image
00066     is just monochrome.
00067     */
00068     int dib_length; /* in bytes, for parsing by header version */
00069     int image_width = 0; /* Signed image width */
00070     int image_height = 0; /* Signed image height */
00071     int num_planes = 0; /* number of planes; must be 1 */
00072     int bits_per_pixel = 0; /* for palletized color maps (< 2^16 colors) */
00073     /*
00074     The following fields are not in the original spec, so initialize
00075     them to 0 so we can correctly parse an original file format.
00076     */
00077     int compression_method=0; /* 0 --> uncompressed RGB/monochrome */
00078     int image_size = 0; /* 0 is a valid size if no compression */
00079     int hres = 0; /* image horizontal resolution */
00080     int vres = 0; /* image vertical resolution */
```

```

00081  int num_colors = 0;      /* Number of colors for pallettized images */
00082  int important_colors = 0; /* Number of significant colors (0 or 2) */
00083
00084  int true_colors = 0;      /* interpret num_colors, which can equal 0 */
00085
00086  /*
00087  Color map. This should be a monochrome file, so only two
00088  colors are stored.
00089  */
00090  unsigned char color_map[2][4]; /* two of R, G, B, and possibly alpha */
00091
00092  /*
00093  The monochrome image bitmap, stored as a vector 544 rows by
00094  72*8 columns.
00095  */
00096  unsigned image_bytes[544*72];
00097
00098  /*
00099  Flags for conversion & I/O.
00100  */
00101  int verbose = 0; /* Whether to print file info on stderr */
00102  unsigned image_xor = 0x00; /* Invert (= 0xFF) if color 0 is not black */
00103
00104  /*
00105  Temporary variables.
00106  */
00107  int i, j, k; /* loop variables */
00108
00109  /* Compression type, for parsing file */
00110  char *compression_type[MAX_COMPRESSION_METHOD + 1] = {
00111      "BI_RGB", /* 0 */
00112      "BI_RLE8", /* 1 */
00113      "BI_RLE4", /* 2 */
00114      "BI_BITFIELDS", /* 3 */
00115      "BI_JPEG", /* 4 */
00116      "BI_PNG", /* 5 */
00117      "BI_ALPHABITFIELDS", /* 6 */
00118      ",", ",", ",", ",", /* 7 - 10 */
00119      "BI_CMYK", /* 11 */
00120      "BI_CMYKRLE8", /* 12 */
00121      "BI_CMYKRLE4", /* 13 */
00122  };
00123
00124  /* Standard unihex2bmp.c header for BMP image */
00125  unsigned standard_header[62] = {
00126      /* 0 */ 0x42, 0x4d, 0x3e, 0x99, 0x00, 0x00, 0x00, 0x00,
00127      /* 8 */ 0x00, 0x00, 0x3e, 0x00, 0x00, 0x00, 0x28, 0x00,
00128      /* 16 */ 0x00, 0x00, 0x40, 0x02, 0x00, 0x00, 0x20, 0x02,
00129      /* 24 */ 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00,
00130      /* 32 */ 0x00, 0x00, 0x00, 0x99, 0x00, 0x00, 0xc4, 0x0e,
00131      /* 40 */ 0x00, 0x00, 0xc4, 0x0e, 0x00, 0x00, 0x00, 0x00,
00132      /* 48 */ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
00133      /* 56 */ 0x00, 0x00, 0xff, 0xff, 0xff, 0x00
00134  };
00135
00136  unsigned get_bytes (FILE *, int);
00137  void regrid (unsigned *);
00138
00139  char *infile="", *outfile=""; /* names of input and output files */
00140  FILE *infp, *outfp; /* file pointers of input and output files */
00141
00142  /*
00143  Process command line arguments.
00144  */
00145  if (argc > 1) {
00146      for (i = 1; i < argc; i++) {
00147          if (argv[i][0] == '-') { /* this is an option argument */
00148              switch (argv[i][1]) {
00149                  case 'i': /* name of input file */
00150                      infile = &argv[i][2];
00151                      break;
00152                  case 'o': /* name of output file */
00153                      outfile = &argv[i][2];
00154                      break;
00155                  case 'v': /* verbose output */
00156                      verbose = 1;
00157                      break;
00158                  case 'V': /* print version & quit */
00159                      fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00160                      exit (EXIT_SUCCESS);
00161                      break;

```

```

00162         case '.': /* see if "--verbose" */
00163             if (strcmp (argv[i], "--verbose") == 0) {
00164                 verbose = 1;
00165             }
00166             else if (strcmp (argv[i], "--version") == 0) {
00167                 fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00168                 exit (EXIT_SUCCESS);
00169             }
00170             break;
00171         default: /* if unrecognized option, print list and exit */
00172             fprintf (stderr, "\nSyntax:\n\n");
00173             fprintf (stderr, "    unibmpbump ");
00174             fprintf (stderr, "-i<Input_File> -o<Output_File>\n\n");
00175             fprintf (stderr, "-v or --verbose gives verbose output");
00176             fprintf (stderr, "    on stderr\n\n");
00177             fprintf (stderr, "-V or --version prints version");
00178             fprintf (stderr, "    on stderr and exits\n\n");
00179             fprintf (stderr, "\nExample:\n\n");
00180             fprintf (stderr, "    unibmpbump -iuni0101.bmp");
00181             fprintf (stderr, "    -onew-uni0101.bmp\n\n");
00182             exit (EXIT_SUCCESS);
00183     }
00184 }
00185 }
00186 }
00187
00188 /*
00189 Make sure we can open any I/O files that were specified before
00190 doing anything else.
00191 */
00192 if (strlen (infile) > 0) {
00193     if ((infp = fopen (infile, "r")) == NULL) {
00194         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00195         exit (EXIT_FAILURE);
00196     }
00197 }
00198 else {
00199     infp = stdin;
00200 }
00201 if (strlen (outfile) > 0) {
00202     if ((outfp = fopen (outfile, "w")) == NULL) {
00203         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00204         exit (EXIT_FAILURE);
00205     }
00206 }
00207 else {
00208     outfp = stdout;
00209 }
00210
00211 /* Read bitmap file header */
00212 file_format[0] = get_bytes (infp, 1);
00213 file_format[1] = get_bytes (infp, 1);
00214 file_format[2] = '\0'; /* Terminate string with null */
00215
00216 /* Read file size */
00217 filesize = get_bytes (infp, 4);
00218
00219 /* Read Reserved bytes */
00220 rsvd_hdr[0] = get_bytes (infp, 1);
00221 rsvd_hdr[1] = get_bytes (infp, 1);
00222 rsvd_hdr[2] = get_bytes (infp, 1);
00223 rsvd_hdr[3] = get_bytes (infp, 1);
00224
00225 /* Read Image Offset Address within file */
00226 image_start = get_bytes (infp, 4);
00227
00228 /*
00229 See if this looks like a valid image file based on
00230 the file header first two bytes.
00231 */
00232 if (strncmp (file_format, "BM", 2) != 0) {
00233     fprintf (stderr, "\nInvalid file format: not file type \"BM\".\n\n");
00234     exit (EXIT_FAILURE);
00235 }
00236
00237 if (verbose) {
00238     fprintf (stderr, "\nFile Header:\n");
00239     fprintf (stderr, "    File Type:    \"%s\"\n", file_format);
00240     fprintf (stderr, "    File Size:    %d bytes\n", filesize);
00241     fprintf (stderr, "    Reserved:    ");

```

```

00243     for (i = 0; i < 4; i++) fprintf(stderr, " 0x%02X", rsvd_hdr[i]);
00244     fputc('\n', stderr);
00245     fprintf(stderr, "    Image Start: %d. = 0x%02X = 0%05o\n\n",
00246             image_start, image_start, image_start);
00247 } /* if (verbose) */
00248
00249 /*
00250 Device Independent Bitmap (DIB) Header: bitmap information header
00251 ("BM" format file DIB Header is 12 bytes long).
00252 */
00253 dib_length = get_bytes (infp, 4);
00254
00255 /*
00256 Parse one of three versions of Device Independent Bitmap (DIB) format:
00257
00258 Length Format
00259 -----
00260 12  BITMAPCOREHEADER
00261 40  BITMAPINFOHEADER
00262 108 BITMAPV4HEADER
00263 124 BITMAPV5HEADER
00264 */
00265 if (dib_length == 12) { /* BITMAPCOREHEADER format -- UNTESTED */
00266     image_width  = get_bytes (infp, 2);
00267     image_height = get_bytes (infp, 2);
00268     num_planes   = get_bytes (infp, 2);
00269     bits_per_pixel = get_bytes (infp, 2);
00270 }
00271 else if (dib_length >= 40) { /* BITMAPINFOHEADER format or later */
00272     image_width  = get_bytes (infp, 4);
00273     image_height = get_bytes (infp, 4);
00274     num_planes   = get_bytes (infp, 2);
00275     bits_per_pixel = get_bytes (infp, 2);
00276     compression_method = get_bytes (infp, 4); /* BI_BITFIELDS */
00277     image_size       = get_bytes (infp, 4);
00278     hres             = get_bytes (infp, 4);
00279     vres             = get_bytes (infp, 4);
00280     num_colors       = get_bytes (infp, 4);
00281     important_colors = get_bytes (infp, 4);
00282
00283     /* true_colors is true number of colors in image */
00284     if (num_colors == 0)
00285         true_colors = 1 « bits_per_pixel;
00286     else
00287         true_colors = num_colors;
00288
00289     /*
00290 If dib_length > 40, the format is BITMAPV4HEADER or
00291 BITMAPV5HEADER. As this program is only designed
00292 to handle a monochrome image, we can ignore the rest
00293 of the header but must read past the remaining bytes.
00294 */
00295     for (i = 40; i < dib_length; i++) (void) get_bytes (infp, 1);
00296 }
00297
00298 if (verbose) {
00299     fprintf(stderr, "Device Independent Bitmap (DIB) Header:\n");
00300     fprintf(stderr, "    DIB Length:  %9d bytes (version = ", dib_length);
00301
00302     if (dib_length == 12) fprintf(stderr, "\"BITMAPCOREHEADER\")\n");
00303     else if (dib_length == 40) fprintf(stderr, "\"BITMAPINFOHEADER\")\n");
00304     else if (dib_length == 108) fprintf(stderr, "\"BITMAPV4HEADER\")\n");
00305     else if (dib_length == 124) fprintf(stderr, "\"BITMAPV5HEADER\")\n");
00306     else fprintf(stderr, "unknown");
00307     fprintf(stderr, "    Bitmap Width:  %6d pixels\n", image_width);
00308     fprintf(stderr, "    Bitmap Height: %6d pixels\n", image_height);
00309     fprintf(stderr, "    Color Planes:  %6d\n", num_planes);
00310     fprintf(stderr, "    Bits per Pixel: %6d\n", bits_per_pixel);
00311     fprintf(stderr, "    Compression Method: %2d --> ", compression_method);
00312     if (compression_method <= MAX_COMPRESSION_METHOD) {
00313         fprintf(stderr, "%s", compression_type [compression_method]);
00314     }
00315     /*
00316 Supported compression method values:
00317 0 --> uncompressed RGB
00318 11 --> uncompressed CMYK
00319 */
00320     if (compression_method == 0 || compression_method == 11) {
00321         fprintf(stderr, " (no compression)");
00322     }
00323     else {

```

```

00324     fprintf(stderr, "Image uses compression; this is unsupported.\n\n");
00325     exit (EXIT_FAILURE);
00326 }
00327 fprintf (stderr, "\n");
00328 fprintf (stderr, "  Image Size:           %5d bytes\n", image_size);
00329 fprintf (stderr, "  Horizontal Resolution: %5d pixels/meter\n", hres);
00330 fprintf (stderr, "  Vertical Resolution:   %5d pixels/meter\n", vres);
00331 fprintf (stderr, "  Number of Colors:      %5d", num_colors);
00332 if (num_colors != true_colors) {
00333     fprintf (stderr, " --> %d", true_colors);
00334 }
00335 fputc ('\n', stderr);
00336 fprintf (stderr, "  Important Colors:       %5d", important_colors);
00337 if (important_colors == 0)
00338     fprintf (stderr, " (all colors are important)");
00339 fprintf (stderr, "\n\n");
00340 } /* if (verbose) */
00341
00342 /*
00343 Print Color Table information for images with pallettized colors.
00344 */
00345 if (bits_per_pixel <= 8) {
00346     for (i = 0; i < 2; i++) {
00347         color_map [i][0] = get_bytes (infp, 1);
00348         color_map [i][1] = get_bytes (infp, 1);
00349         color_map [i][2] = get_bytes (infp, 1);
00350         color_map [i][3] = get_bytes (infp, 1);
00351     }
00352     /* Skip remaining color table entries if more than 2 */
00353     while (i < true_colors) {
00354         (void) get_bytes (infp, 4);
00355         i++;
00356     }
00357
00358     if (color_map [0][0] >= 128) image_xor = 0xFF; /* Invert colors */
00359 }
00360
00361 if (verbose) {
00362     fprintf (stderr, "Color Palette [R, G, B, %s] Values:\n",
00363             (dib_length <= 40) ? "reserved" : "Alpha");
00364     for (i = 0; i < 2; i++) {
00365         fprintf (stderr, "%7d: [", i);
00366         fprintf (stderr, "%3d,", color_map [i][0] & 0xFF);
00367         fprintf (stderr, "%3d,", color_map [i][1] & 0xFF);
00368         fprintf (stderr, "%3d,", color_map [i][2] & 0xFF);
00369         fprintf (stderr, "%3d]\n", color_map [i][3] & 0xFF);
00370     }
00371     if (image_xor == 0xFF) fprintf (stderr, "Will Invert Colors.\n");
00372     fputc ('\n', stderr);
00373 } /* if (verbose) */
00374
00375
00376
00377 /*
00378 Check format before writing output file.
00379 */
00380 if (image_width != 560 && image_width != 576) {
00381     fprintf (stderr, "\nUnsupported image width: %d\n", image_width);
00382     fprintf (stderr, "Width should be 560 or 576 pixels.\n\n");
00383     exit (EXIT_FAILURE);
00384 }
00385
00386 if (image_height != 544) {
00387     fprintf (stderr, "\nUnsupported image height: %d\n", image_height);
00388     fprintf (stderr, "Height should be 544 pixels.\n\n");
00389     exit (EXIT_FAILURE);
00390 }
00391
00392 if (num_planes != 1) {
00393     fprintf (stderr, "\nUnsupported number of planes: %d\n", num_planes);
00394     fprintf (stderr, "Number of planes should be 1.\n\n");
00395     exit (EXIT_FAILURE);
00396 }
00397
00398 if (bits_per_pixel != 1) {
00399     fprintf (stderr, "\nUnsupported number of bits per pixel: %d\n",
00400             bits_per_pixel);
00401     fprintf (stderr, "Bits per pixel should be 1.\n\n");
00402     exit (EXIT_FAILURE);
00403 }
00404

```

```

00405 if (compression_method != 0 && compression_method != 11) {
00406     fprintf(stderr, "\nUnsupported compression method: %d\n",
00407             compression_method);
00408     fprintf(stderr, "Compression method should be 1 or 11.\n\n");
00409     exit (EXIT_FAILURE);
00410 }
00411
00412 if (true_colors != 2) {
00413     fprintf(stderr, "\nUnsupported number of colors: %d\n", true_colors);
00414     fprintf(stderr, "Number of colors should be 2.\n\n");
00415     exit (EXIT_FAILURE);
00416 }
00417
00418
00419 /*
00420 If we made it this far, things look okay, so write out
00421 the standard header for image conversion.
00422 */
00423 for (i = 0; i < 62; i++) fputc (standard_header[i], outfp);
00424
00425
00426 /*
00427 Image Data. Each row must be a multiple of 4 bytes, with
00428 padding at the end of each row if necessary.
00429 */
00430 k = 0; /* byte number within the binary image */
00431 for (i = 0; i < 544; i++) {
00432     /*
00433 If original image is 560 pixels wide (not 576), add
00434 2 white bytes at beginning of row.
00435 */
00436     if (image_width == 560) { /* Insert 2 white bytes */
00437         image_bytes[k++] = 0xFF;
00438         image_bytes[k++] = 0xFF;
00439     }
00440     for (j = 0; j < 70; j++) { /* Copy next 70 bytes */
00441         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00442     }
00443     /*
00444 If original image is 560 pixels wide (not 576), skip
00445 2 padding bytes at end of row in file because we inserted
00446 2 white bytes at the beginning of the row.
00447 */
00448     if (image_width == 560) {
00449         (void) get_bytes (infp, 2);
00450     }
00451     else { /* otherwise, next 2 bytes are part of the image so copy them */
00452         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00453         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00454     }
00455 }
00456
00457
00458 /*
00459 Change the image to match the unihex2bmp.c format if original wasn't
00460 */
00461 if (image_width == 560) {
00462     regrid (image_bytes);
00463 }
00464
00465 for (i = 0; i < 544 * 576 / 8; i++) {
00466     fputc (image_bytes[i], outfp);
00467 }
00468
00469
00470 /*
00471 Wrap up.
00472 */
00473 fclose (infp);
00474 fclose (outfp);
00475
00476 exit (EXIT_SUCCESS);
00477 }

```

5.13.3.3 regrid()

void regrid (

unsigned * image_bytes)

After reading in the image, shift it.

This function adjusts the input image from an original PNG file to match [unihex2bmp.c](#) format.

Parameters

in,out	image_bytes	The pixels in an image.
--------	-------------	-------------------------

Definition at line 514 of file [unibmpbump.c](#).

```

00514     {
00515     int i, j, k; /* loop variables */
00516     int offset;
00517     unsigned glyph_row; /* one grid row of 32 pixels */
00518     unsigned last_pixel; /* last pixel in a byte, to preserve */
00519
00520     /* To insert "00" after "U+" at top of image */
00521     char zero_pattern[16] = {
00522         0x00, 0x00, 0x00, 0x00, 0x18, 0x24, 0x42, 0x42,
00523         0x42, 0x42, 0x42, 0x42, 0x24, 0x18, 0x00, 0x00
00524     };
00525
00526     /* This is the horizontal grid pattern on glyph boundaries */
00527     unsigned hgrid[72] = {
00528         /* 0 */ 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xfe,
00529         /* 8 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00530         /* 16 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00531         /* 24 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00532         /* 32 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00533         /* 40 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00534         /* 48 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00535         /* 56 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00536         /* 64 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00
00537     };
00538
00539     /*
00540     First move "U+" left and insert "00" after it.
00541     */
00542     j = 15; /* rows are written bottom to top, so we'll decrement j */
00543     for (i = 543 - 8; i > 544 - 24; i--) {
00544         offset = 72 * i;
00545         image_bytes[offset + 0] = image_bytes[offset + 2];
00546         image_bytes[offset + 1] = image_bytes[offset + 3];
00547         image_bytes[offset + 2] = image_bytes[offset + 4];
00548         image_bytes[offset + 3] = image_bytes[offset + 4] =
00549             ~zero_pattern[15 - j--] & 0xFF;
00550     }
00551
00552     /*
00553     Now move glyph bitmaps to the right by 8 pixels.
00554     */
00555     for (i = 0; i < 16; i++) { /* for each glyph row */
00556         for (j = 0; j < 16; j++) { /* for each glyph column */
00557             /* set offset to lower left-hand byte of next glyph */
00558             offset = (32 * 72 * i) + (9 * 72) + (4 * j) + 8;
00559             for (k = 0; k < 16; k++) { /* for each glyph row */
00560                 glyph_row = (image_bytes[offset + 0] << 24) |
00561                     (image_bytes[offset + 1] << 16) |
00562                     (image_bytes[offset + 2] << 8) |
00563                     (image_bytes[offset + 3]);
00564                 last_pixel = glyph_row & 1; /* preserve border */
00565                 glyph_row >>= 4;
00566                 glyph_row &= 0xFFFFFEE;
00567                 /* Set left 4 pixels to white and preserve last pixel */
00568                 glyph_row |= 0xF0000000 | last_pixel;
00569                 image_bytes[offset + 3] = glyph_row & 0xFF;
00570                 glyph_row >>= 8;
00571                 image_bytes[offset + 2] = glyph_row & 0xFF;
00572                 glyph_row >>= 8;
00573                 image_bytes[offset + 1] = glyph_row & 0xFF;
00574                 glyph_row >>= 8;
00575                 image_bytes[offset + 0] = glyph_row & 0xFF;

```

```

00577         offset += 72; /* move up to next row in current glyph */
00578     }
00579 }
00580 }
00581
00582 /* Replace horizontal grid with unihex2bmp.c grid */
00583 for (i = 0; i <= 16; i++) {
00584     offset = 32 * 72 * i;
00585     for (j = 0; j < 72; j++) {
00586         image_bytes[offset + j] = hgrid[j];
00587     }
00588 }
00589
00590 return;
00591 }

```

5.14 unibmpbump.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unibmpbump.c
00003
00004  @brief unibmpbump - Adjust a Microsoft bitmap (.bmp) file that
00005  was created by unihex2png but converted to .bmp
00006
00007  @author Paul Hardy, unfoundry <at> unfoundry.com
00008
00009  @copyright Copyright (C) 2019 Paul Hardy
00010
00011  This program shifts the glyphs in a bitmap file to adjust an
00012  original PNG file that was saved in BMP format. This is so the
00013  result matches the format of a unihex2bmp image. This conversion
00014  then lets unibmp2hex decode the result.
00015
00016  Synopsis: unibmpbump [-iin_file.bmp] [-out_file.bmp]
00017  */
00018  /*
00019  LICENSE:
00020
00021  This program is free software: you can redistribute it and/or modify
00022  it under the terms of the GNU General Public License as published by
00023  the Free Software Foundation, either version 2 of the License, or
00024  (at your option) any later version.
00025
00026  This program is distributed in the hope that it will be useful,
00027  but WITHOUT ANY WARRANTY; without even the implied warranty of
00028  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00029  GNU General Public License for more details.
00030
00031  You should have received a copy of the GNU General Public License
00032  along with this program. If not, see <http://www.gnu.org/licenses/>.
00033  */
00034  #include <stdio.h>
00035  #include <string.h>
00036  #include <stdlib.h>
00037
00038  #define VERSION "1.0" ///< Version of this program
00039
00040  #define MAX_COMPRESSION_METHOD 13 ///< Maximum supported compression method
00041
00042
00043  /**
00044  @brief The main function.
00045
00046  @param[in] argc The count of command line arguments.
00047  @param[in] argv Pointer to array of command line arguments.
00048  @return This program exits with status EXIT_SUCCESS.
00049  */
00050  int main (int argc, char *argv[]) {
00051
00052  /*
00053  Values preserved from file header (first 14 bytes).
00054  */
00055  char file_format[3]; /* "BM" for original Windows format */
00056  unsigned filesize; /* size of file in bytes */
00057  unsigned char rsvd_hdr[4]; /* 4 reserved bytes */
00058  unsigned image_start; /* byte offset of image in file */
00059

```

```

00060  /*
00061  Values preserved from Device Independent Bitmap (DIB) Header.
00062
00063  The DIB fields below are in the standard 40-byte header.  Version
00064  4 and version 5 headers have more information, mainly for color
00065  information.  That is skipped over, because a valid glyph image
00066  is just monochrome.
00067  */
00068  int dib_length;          /* in bytes, for parsing by header version */
00069  int image_width = 0;     /* Signed image width */
00070  int image_height = 0;    /* Signed image height */
00071  int num_planes = 0;      /* number of planes; must be 1 */
00072  int bits_per_pixel = 0;  /* for palletized color maps (< 2^16 colors) */
00073  /*
00074  The following fields are not in the original spec, so initialize
00075  them to 0 so we can correctly parse an original file format.
00076  */
00077  int compression_method=0; /* 0 --> uncompressed RGB/monochrome */
00078  int image_size = 0;       /* 0 is a valid size if no compression */
00079  int hres = 0;             /* image horizontal resolution */
00080  int vres = 0;            /* image vertical resolution */
00081  int num_colors = 0;       /* Number of colors for palletized images */
00082  int important_colors = 0; /* Number of significant colors (0 or 2) */
00083
00084  int true_colors = 0;      /* interpret num_colors, which can equal 0 */
00085
00086  /*
00087  Color map.  This should be a monochrome file, so only two
00088  colors are stored.
00089  */
00090  unsigned char color_map[2][4]; /* two of R, G, B, and possibly alpha */
00091
00092  /*
00093  The monochrome image bitmap, stored as a vector 544 rows by
00094  72*8 columns.
00095  */
00096  unsigned image_bytes[544*72];
00097
00098  /*
00099  Flags for conversion & I/O.
00100  */
00101  int verbose = 0;          /* Whether to print file info on stderr */
00102  unsigned image_xor = 0x00; /* Invert (= 0xFF) if color 0 is not black */
00103
00104  /*
00105  Temporary variables.
00106  */
00107  int i, j, k;              /* loop variables */
00108
00109  /* Compression type, for parsing file */
00110  char *compression_type[MAX_COMPRESSION_METHOD + 1] = {
00111      "BI_RGB",             /* 0 */
00112      "BI_RLE8",            /* 1 */
00113      "BI_RLE4",            /* 2 */
00114      "BI_BITFIELDS",       /* 3 */
00115      "BI_JPEG",            /* 4 */
00116      "BI_PNG",             /* 5 */
00117      "BI_ALPHABITFIELDS", /* 6 */
00118      "", "", "", "",       /* 7 - 10 */
00119      "BI_CMYK",            /* 11 */
00120      "BI_CMYKRLE8",        /* 12 */
00121      "BI_CMYKRLE4",        /* 13 */
00122  };
00123
00124  /* Standard unihex2bmp.c header for BMP image */
00125  unsigned standard_header [62] = {
00126      /* 0 */ 0x42, 0x4d, 0x3e, 0x99, 0x00, 0x00, 0x00, 0x00,
00127      /* 8 */ 0x00, 0x00, 0x3e, 0x00, 0x00, 0x00, 0x28, 0x00,
00128      /* 16 */ 0x00, 0x00, 0x40, 0x02, 0x00, 0x00, 0x20, 0x02,
00129      /* 24 */ 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00,
00130      /* 32 */ 0x00, 0x00, 0x00, 0x99, 0x00, 0x00, 0xc4, 0x0e,
00131      /* 40 */ 0x00, 0x00, 0xc4, 0x0e, 0x00, 0x00, 0x00, 0x00,
00132      /* 48 */ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
00133      /* 56 */ 0x00, 0x00, 0xff, 0xff, 0xff, 0x00
00134  };
00135
00136  unsigned get_bytes (FILE *, int);
00137  void regrid (unsigned *);
00138
00139  char *infile="", *outfile=""; /* names of input and output files */
00140  FILE *infp, *outfp;           /* file pointers of input and output files */

```

```

00141
00142  /*
00143  Process command line arguments.
00144  */
00145  if (argc > 1) {
00146      for (i = 1; i < argc; i++) {
00147          if (argv[i][0] == '-') { /* this is an option argument */
00148              switch (argv[i][1]) {
00149                  case 'i': /* name of input file */
00150                      infile = &argv[i][2];
00151                      break;
00152                  case 'o': /* name of output file */
00153                      outfile = &argv[i][2];
00154                      break;
00155                  case 'v': /* verbose output */
00156                      verbose = 1;
00157                      break;
00158                  case 'V': /* print version & quit */
00159                      fprintf(stderr, "unibmpbump version %s\n\n", VERSION);
00160                      exit (EXIT_SUCCESS);
00161                      break;
00162                  case '-': /* see if "--verbose" */
00163                      if (strcmp (argv[i], "--verbose") == 0) {
00164                          verbose = 1;
00165                      }
00166                      else if (strcmp (argv[i], "--version") == 0) {
00167                          fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00168                          exit (EXIT_SUCCESS);
00169                      }
00170                      break;
00171                  default: /* if unrecognized option, print list and exit */
00172                      fprintf (stderr, "\nSyntax:\n\n");
00173                      fprintf (stderr, "  unibmpbump ");
00174                      fprintf (stderr, "-i<Input_File> -o<Output_File>\n\n");
00175                      fprintf (stderr, "-v or --verbose gives verbose output");
00176                      fprintf (stderr, "  on stderr\n\n");
00177                      fprintf (stderr, "-V or --version prints version");
00178                      fprintf (stderr, "  on stderr and exits\n\n");
00179                      fprintf (stderr, "\nExample:\n\n");
00180                      fprintf (stderr, "  unibmpbump -iuni0101.bmp");
00181                      fprintf (stderr, " -onew-uni0101.bmp\n\n");
00182                      exit (EXIT_SUCCESS);
00183              }
00184          }
00185      }
00186  }
00187
00188  /*
00189  Make sure we can open any I/O files that were specified before
00190  doing anything else.
00191  */
00192  if (strlen (infile) > 0) {
00193      if ((infp = fopen (infile, "r")) == NULL) {
00194          fprintf (stderr, "Error: can't open %s for input.\n", infile);
00195          exit (EXIT_FAILURE);
00196      }
00197  }
00198  else {
00199      infp = stdin;
00200  }
00201  if (strlen (outfile) > 0) {
00202      if ((outfp = fopen (outfile, "w")) == NULL) {
00203          fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00204          exit (EXIT_FAILURE);
00205      }
00206  }
00207  else {
00208      outfp = stdout;
00209  }
00210
00211  /* Read bitmap file header */
00212  file_format[0] = get_bytes (infp, 1);
00213  file_format[1] = get_bytes (infp, 1);
00214  file_format[2] = '\0'; /* Terminate string with null */
00215
00216  /* Read file size */
00217  filesize = get_bytes (infp, 4);
00218
00219  /* Read Reserved bytes */
00220  rsvd_hdr[0] = get_bytes (infp, 1);

```

```

00222  rsvd_hdr[1] = get_bytes (infp, 1);
00223  rsvd_hdr[2] = get_bytes (infp, 1);
00224  rsvd_hdr[3] = get_bytes (infp, 1);
00225
00226  /* Read Image Offset Address within file */
00227  image_start = get_bytes (infp, 4);
00228
00229  /*
00230  See if this looks like a valid image file based on
00231  the file header first two bytes.
00232  */
00233  if (strncmp (file_format, "BM", 2) != 0) {
00234      fprintf (stderr, "\nInvalid file format: not file type \"BM\".\n\n");
00235      exit (EXIT_FAILURE);
00236  }
00237
00238  if (verbose) {
00239      fprintf (stderr, "\nFile Header:\n");
00240      fprintf (stderr, "  File Type:  \"%s\"\n", file_format);
00241      fprintf (stderr, "  File Size:   %d bytes\n", filesize);
00242      fprintf (stderr, "  Reserved:   ");
00243      for (i = 0; i < 4; i++) fprintf (stderr, " 0x%02X", rsvd_hdr[i]);
00244      fputc ('\n', stderr);
00245      fprintf (stderr, "  Image Start: %d. = 0x%02X = 0%05o\n\n",
00246              image_start, image_start, image_start);
00247  } /* if (verbose) */
00248
00249  /*
00250  Device Independent Bitmap (DIB) Header: bitmap information header
00251  ("BM" format file DIB Header is 12 bytes long).
00252  */
00253  dib_length = get_bytes (infp, 4);
00254
00255  /*
00256  Parse one of three versions of Device Independent Bitmap (DIB) format:
00257
00258  Length Format
00259  -----
00260  12  BITMAPCOREHEADER
00261  40  BITMAPINFOHEADER
00262  108 BITMAPV4HEADER
00263  124 BITMAPV5HEADER
00264  */
00265  if (dib_length == 12) { /* BITMAPCOREHEADER format -- UNTESTED */
00266      image_width  = get_bytes (infp, 2);
00267      image_height = get_bytes (infp, 2);
00268      num_planes   = get_bytes (infp, 2);
00269      bits_per_pixel = get_bytes (infp, 2);
00270  }
00271  else if (dib_length >= 40) { /* BITMAPINFOHEADER format or later */
00272      image_width  = get_bytes (infp, 4);
00273      image_height = get_bytes (infp, 4);
00274      num_planes   = get_bytes (infp, 2);
00275      bits_per_pixel = get_bytes (infp, 2);
00276      compression_method = get_bytes (infp, 4); /* BI_BITFIELDS */
00277      image_size      = get_bytes (infp, 4);
00278      hres            = get_bytes (infp, 4);
00279      vres            = get_bytes (infp, 4);
00280      num_colors      = get_bytes (infp, 4);
00281      important_colors = get_bytes (infp, 4);
00282
00283      /* true_colors is true number of colors in image */
00284      if (num_colors == 0)
00285          true_colors = 1 « bits_per_pixel;
00286      else
00287          true_colors = num_colors;
00288
00289      /*
00290      If dib_length > 40, the format is BITMAPV4HEADER or
00291      BITMAPV5HEADER. As this program is only designed
00292      to handle a monochrome image, we can ignore the rest
00293      of the header but must read past the remaining bytes.
00294      */
00295      for (i = 40; i < dib_length; i++) (void) get_bytes (infp, 1);
00296  }
00297
00298  if (verbose) {
00299      fprintf (stderr, "Device Independent Bitmap (DIB) Header:\n");
00300      fprintf (stderr, "  DIB Length:  %9d bytes (version = ", dib_length);
00301
00302      if (dib_length == 12) fprintf (stderr, "\"BITMAPCOREHEADER\"");

```

```

00303     else if (dib_length == 40) fprintf (stderr, "\"BITMAPINFOHEADER\\\"\\n");
00304     else if (dib_length == 108) fprintf (stderr, "\"BITMAPV4HEADER\\\"\\n");
00305     else if (dib_length == 124) fprintf (stderr, "\"BITMAPV5HEADER\\\"\\n");
00306     else fprintf (stderr, "unknown");
00307     fprintf (stderr, "    Bitmap Width:    %6d pixels\\n", image_width);
00308     fprintf (stderr, "    Bitmap Height:   %6d pixels\\n", image_height);
00309     fprintf (stderr, "    Color Planes:   %6d\\n",    num_planes);
00310     fprintf (stderr, "    Bits per Pixel: %6d\\n",    bits_per_pixel);
00311     fprintf (stderr, "    Compression Method: %2d --> ", compression_method);
00312     if (compression_method <= MAX_COMPRESSION_METHOD) {
00313         fprintf (stderr, "%s", compression_type [compression_method]);
00314     }
00315     /*
00316     Supported compression method values:
00317     0 --> uncompressed RGB
00318     11 --> uncompressed CMYK
00319     */
00320     if (compression_method == 0 || compression_method == 11) {
00321         fprintf (stderr, " (no compression)");
00322     }
00323     else {
00324         fprintf (stderr, "Image uses compression; this is unsupported.\\n\\n");
00325         exit (EXIT_FAILURE);
00326     }
00327     fprintf (stderr, "\\n");
00328     fprintf (stderr, "    Image Size:          %5d bytes\\n", image_size);
00329     fprintf (stderr, "    Horizontal Resolution: %5d pixels/meter\\n", hres);
00330     fprintf (stderr, "    Vertical Resolution:  %5d pixels/meter\\n", vres);
00331     fprintf (stderr, "    Number of Colors:     %5d", num_colors);
00332     if (num_colors != true_colors) {
00333         fprintf (stderr, " --> %d", true_colors);
00334     }
00335     fputc ('\n', stderr);
00336     fprintf (stderr, "    Important Colors:      %5d", important_colors);
00337     if (important_colors == 0)
00338         fprintf (stderr, " (all colors are important)");
00339     fprintf (stderr, "\\n\\n");
00340 } /* if (verbose) */
00341
00342 /*
00343 Print Color Table information for images with pallettized colors.
00344 */
00345 if (bits_per_pixel <= 8) {
00346     for (i = 0; i < 2; i++) {
00347         color_map [i][0] = get_bytes (infp, 1);
00348         color_map [i][1] = get_bytes (infp, 1);
00349         color_map [i][2] = get_bytes (infp, 1);
00350         color_map [i][3] = get_bytes (infp, 1);
00351     }
00352     /* Skip remaining color table entries if more than 2 */
00353     while (i < true_colors) {
00354         (void) get_bytes (infp, 4);
00355         i++;
00356     }
00357
00358     if (color_map [0][0] >= 128) image_xor = 0xFF; /* Invert colors */
00359 }
00360
00361 if (verbose) {
00362     fprintf (stderr, "Color Palette [R, G, B, %s] Values:\\n",
00363             (dib_length <= 40) ? "reserved" : "Alpha");
00364     for (i = 0; i < 2; i++) {
00365         fprintf (stderr, "%7d: [", i);
00366         fprintf (stderr, "%3d,", color_map [i][0] & 0xFF);
00367         fprintf (stderr, "%3d,", color_map [i][1] & 0xFF);
00368         fprintf (stderr, "%3d,", color_map [i][2] & 0xFF);
00369         fprintf (stderr, "%3d\\n", color_map [i][3] & 0xFF);
00370     }
00371     if (image_xor == 0xFF) fprintf (stderr, "Will Invert Colors.\\n");
00372     fputc ('\n', stderr);
00373 } /* if (verbose) */
00374
00375 /*
00376
00377 Check format before writing output file.
00378 */
00379 if (image_width != 560 && image_width != 576) {
00380     fprintf (stderr, "\\nUnsupported image width: %d\\n", image_width);
00381     fprintf (stderr, "Width should be 560 or 576 pixels.\\n\\n");
00382     exit (EXIT_FAILURE);
00383 }

```

```

00384 }
00385
00386 if (image_height != 544) {
00387     fprintf(stderr, "\nUnsupported image height: %d\n", image_height);
00388     fprintf(stderr, "Height should be 544 pixels.\n\n");
00389     exit (EXIT_FAILURE);
00390 }
00391
00392 if (num_planes != 1) {
00393     fprintf(stderr, "\nUnsupported number of planes: %d\n", num_planes);
00394     fprintf(stderr, "Number of planes should be 1.\n\n");
00395     exit (EXIT_FAILURE);
00396 }
00397
00398 if (bits_per_pixel != 1) {
00399     fprintf(stderr, "\nUnsupported number of bits per pixel: %d\n",
00400             bits_per_pixel);
00401     fprintf(stderr, "Bits per pixel should be 1.\n\n");
00402     exit (EXIT_FAILURE);
00403 }
00404
00405 if (compression_method != 0 && compression_method != 11) {
00406     fprintf(stderr, "\nUnsupported compression method: %d\n",
00407             compression_method);
00408     fprintf(stderr, "Compression method should be 1 or 11.\n\n");
00409     exit (EXIT_FAILURE);
00410 }
00411
00412 if (true_colors != 2) {
00413     fprintf(stderr, "\nUnsupported number of colors: %d\n", true_colors);
00414     fprintf(stderr, "Number of colors should be 2.\n\n");
00415     exit (EXIT_FAILURE);
00416 }
00417
00418
00419 /*
00420 If we made it this far, things look okay, so write out
00421 the standard header for image conversion.
00422 */
00423 for (i = 0; i < 62; i++) fputc (standard_header[i], outfp);
00424
00425
00426 /*
00427 Image Data. Each row must be a multiple of 4 bytes, with
00428 padding at the end of each row if necessary.
00429 */
00430 k = 0; /* byte number within the binary image */
00431 for (i = 0; i < 544; i++) {
00432     /*
00433 If original image is 560 pixels wide (not 576), add
00434 2 white bytes at beginning of row.
00435 */
00436     if (image_width == 560) { /* Insert 2 white bytes */
00437         image_bytes[k++] = 0xFF;
00438         image_bytes[k++] = 0xFF;
00439     }
00440     for (j = 0; j < 70; j++) { /* Copy next 70 bytes */
00441         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00442     }
00443     /*
00444 If original image is 560 pixels wide (not 576), skip
00445 2 padding bytes at end of row in file because we inserted
00446 2 white bytes at the beginning of the row.
00447 */
00448     if (image_width == 560) {
00449         (void) get_bytes (infp, 2);
00450     }
00451     else { /* otherwise, next 2 bytes are part of the image so copy them */
00452         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00453         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00454     }
00455 }
00456
00457
00458 /*
00459 Change the image to match the unihex2bmp.c format if original wasn't
00460 */
00461 if (image_width == 560) {
00462     regrid (image_bytes);
00463 }
00464

```

```

00465     for (i = 0; i < 544 * 576 / 8; i++) {
00466         fputc (image_bytes[i], outfp);
00467     }
00468
00469
00470     /*
00471     Wrap up.
00472     */
00473     fclose (infp);
00474     fclose (outfp);
00475
00476     exit (EXIT_SUCCESS);
00477 }
00478
00479
00480 /**
00481 @brief Get from 1 to 4 bytes, inclusive, from input file.
00482
00483 @param[in] infp Pointer to input file.
00484 @param[in] nbytes Number of bytes to read, from 1 to 4, inclusive.
00485 @return The unsigned 1 to 4 bytes in machine native endian format.
00486 */
00487 unsigned get_bytes (FILE *infp, int nbytes) {
00488     int i;
00489     unsigned char inchar[4];
00490     unsigned inword;
00491
00492     for (i = 0; i < nbytes; i++) {
00493         if (fread (&inchar[i], 1, 1, infp) != 1) {
00494             inchar[i] = 0;
00495         }
00496     }
00497     for (i = nbytes; i < 4; i++) inchar[i] = 0;
00498
00499     inword = ((inchar[3] & 0xFF) << 24) | ((inchar[2] & 0xFF) << 16) |
00500             ((inchar[1] & 0xFF) << 8) | (inchar[0] & 0xFF);
00501
00502     return inword;
00503 }
00504
00505
00506 /**
00507 @brief After reading in the image, shift it.
00508
00509 This function adjusts the input image from an original PNG file
00510 to match unihex2bmp.c format.
00511
00512 @param[in,out] image_bytes The pixels in an image.
00513 */
00514 void regrid (unsigned *image_bytes) {
00515     int i, j, k; /* loop variables */
00516     int offset;
00517     unsigned glyph_row; /* one grid row of 32 pixels */
00518     unsigned last_pixel; /* last pixel in a byte, to preserve */
00519
00520     /* To insert "00" after "U+" at top of image */
00521     char zero_pattern[16] = {
00522         0x00, 0x00, 0x00, 0x00, 0x18, 0x24, 0x42, 0x42,
00523         0x42, 0x42, 0x42, 0x42, 0x24, 0x18, 0x00, 0x00
00524     };
00525
00526     /* This is the horizontal grid pattern on glyph boundaries */
00527     unsigned hgrid[72] = {
00528         /* 0 */ 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff,
00529         /* 8 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00530         /* 16 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00531         /* 24 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00532         /* 32 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00533         /* 40 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00534         /* 48 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00535         /* 56 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00536         /* 64 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00
00537     };
00538
00539
00540     /*
00541     First move "U+" left and insert "00" after it.
00542     */
00543     j = 15; /* rows are written bottom to top, so we'll decrement j */
00544     for (i = 543 - 8; i > 544 - 24; i--) {
00545         offset = 72 * i;

```

```

00546     image_bytes[offset + 0] = image_bytes[offset + 2];
00547     image_bytes[offset + 1] = image_bytes[offset + 3];
00548     image_bytes[offset + 2] = image_bytes[offset + 4];
00549     image_bytes[offset + 3] = image_bytes[offset + 4] =
00550     ~zero_pattern[15 - j--] & 0xFF;
00551 }
00552
00553 /*
00554 Now move glyph bitmaps to the right by 8 pixels.
00555 */
00556 for (i = 0; i < 16; i++) { /* for each glyph row */
00557     for (j = 0; j < 16; j++) { /* for each glyph column */
00558         /* set offset to lower left-hand byte of next glyph */
00559         offset = (32 * 72 * i) + (9 * 72) + (4 * j) + 8;
00560         for (k = 0; k < 16; k++) { /* for each glyph row */
00561             glyph_row = (image_bytes[offset + 0] « 24) |
00562                 (image_bytes[offset + 1] « 16) |
00563                 (image_bytes[offset + 2] « 8) |
00564                 (image_bytes[offset + 3]);
00565             last_pixel = glyph_row & 1; /* preserve border */
00566             glyph_row »= 4;
00567             glyph_row &= 0xFFFFFEE;
00568             /* Set left 4 pixels to white and preserve last pixel */
00569             glyph_row |= 0xF000000 | last_pixel;
00570             image_bytes[offset + 3] = glyph_row & 0xFF;
00571             glyph_row »= 8;
00572             image_bytes[offset + 2] = glyph_row & 0xFF;
00573             glyph_row »= 8;
00574             image_bytes[offset + 1] = glyph_row & 0xFF;
00575             glyph_row »= 8;
00576             image_bytes[offset + 0] = glyph_row & 0xFF;
00577             offset += 72; /* move up to next row in current glyph */
00578         }
00579     }
00580 }
00581
00582 /* Replace horizontal grid with unihex2bmp.c grid */
00583 for (i = 0; i <= 16; i++) {
00584     offset = 32 * 72 * i;
00585     for (j = 0; j < 72; j++) {
00586         image_bytes[offset + j] = hgrid[j];
00587     }
00588 }
00589
00590 return;
00591 }

```

5.15 src/unicoverage.c File Reference

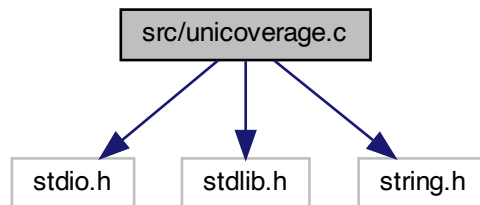
unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unicoverage.c:



Macros

- `#define MAXBUF 256`
Maximum input line length - 1.

Functions

- `int main (int argc, char *argv[])`
The main function.
- `int nextrange (FILE *coveragefp, int *cstart, int *cend, char *coverstring)`
Get next Unicode range.
- `void print_subtotal (FILE *outfp, int print_n, int nglyphs, int cstart, int cend, char *coverstring)`
Print the subtotal for one Unicode script range.

5.15.1 Detailed Description

unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file

Author

Paul Hardy, unifoundry <at> unifoundry.com, 6 January 2008

Copyright

Copyright (C) 2008, 2013 Paul Hardy

Synopsis: `unicoverage [-ifont_file.hex] [-ocoverage_file.txt]`

This program requires the file "coverage.dat" to be present in the directory from which it is run.

Definition in file [unicoverage.c](#).

5.15.2 Macro Definition Documentation

5.15.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input line length - 1.

Definition at line [60](#) of file [unicoverage.c](#).

5.15.3 Function Documentation

5.15.3.1 main()

```
int main (  
    int argc,  
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 71 of file `unicoverage.c`.

```

00072 {
00073
00074     int    print_n=0;        /* print # of glyphs, not percentage */
00075     unsigned i;              /* loop variable */
00076     unsigned slen;           /* string length of coverage file line */
00077     char    inbuf[256];      /* input buffer */
00078     unsigned thischar;       /* the current character */
00079
00080     char *infile="", *outfile=""; /* names of input and output files */
00081     FILE *infp, *outfp;        /* file pointers of input and output files */
00082     FILE *coveragefp;         /* file pointer to coverage.dat file */
00083     int cstart, cend;         /* current coverage start and end code points */
00084     char coverstring[MAXBUF]; /* description of current coverage range */
00085     int nglyphs;              /* number of glyphs in this section */
00086
00087     /* to get next range & name of Unicode glyphs */
00088     int nextrange(FILE *coveragefp, int *cstart, int *cend, char *coverstring);
00089
00090     void print_subtotal(FILE *outfp, int print_n, int nglyphs,
00091                        int cstart, int cend, char *coverstring);
00092
00093     if ((coveragefp = fopen("coverage.dat", "r")) == NULL) {
00094         fprintf(stderr, "\nError: data file \"coverage.dat\" not found.\n\n");
00095         exit(0);
00096     }
00097
00098     if (argc > 1) {
00099         for (i = 1; i < argc; i++) {
00100             if (argv[i][0] == '-') { /* this is an option argument */
00101                 switch (argv[i][1]) {
00102                     case 'i': /* name of input file */
00103                         infile = &argv[i][2];
00104                         break;
00105                     case 'n': /* print number of glyphs instead of percentage */
00106                         print_n = 1;
00107                     case 'o': /* name of output file */
00108                         outfile = &argv[i][2];
00109                         break;
00110                     default: /* if unrecognized option, print list and exit */
00111                         fprintf(stderr, "\nSyntax:\n\n");
00112                         fprintf(stderr, " %s -p<Unicode_Page> ", argv[0]);
00113                         fprintf(stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00114                         exit(1);
00115                 }
00116             }
00117         }

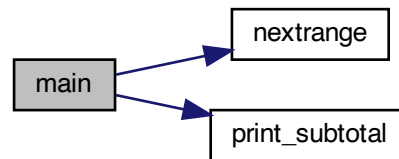
```

```

00118     }
00119     /*
00120     Make sure we can open any I/O files that were specified before
00121     doing anything else.
00122     */
00123     if (strlen (infile) > 0) {
00124         if ((infp = fopen (infile, "r")) == NULL) {
00125             fprintf (stderr, "Error: can't open %s for input.\n", infile);
00126             exit (1);
00127         }
00128     }
00129     else {
00130         infp = stdin;
00131     }
00132     if (strlen (outfile) > 0) {
00133         if ((outfp = fopen (outfile, "w")) == NULL) {
00134             fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00135             exit (1);
00136         }
00137     }
00138     else {
00139         outfp = stdout;
00140     }
00141
00142     /*
00143     Print header row.
00144     */
00145     if (print_n) {
00146         fprintf (outfp, "# Glyphs      Range      Script\n");
00147         fprintf (outfp, "-----      ----      ----- \n");
00148     }
00149     else {
00150         fprintf (outfp, "Covered      Range      Script\n");
00151         fprintf (outfp, "-----      ----      ----- \n\n");
00152     }
00153
00154     slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00155     nglyphs = 0;
00156
00157     /*
00158     Read in the glyphs in the file
00159     */
00160     while (slen != 0 && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00161         sscanf (inbuf, "%x", &thischar);
00162
00163         /* Read a character beyond end of current script. */
00164         while (cend < thischar && slen != 0) {
00165             print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00166
00167             /* start new range total */
00168             slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00169             nglyphs = 0;
00170         }
00171         nglyphs++;
00172     }
00173
00174     print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00175
00176     exit (0);
00177 }

```

Here is the call graph for this function:



5.15.3.2 nextrange()

```
int nextrange (
    FILE * coveragefp,
    int * cstart,
    int * cend,
    char * coverstring )
```

Get next Unicode range.

This function reads the next Unicode script range to count its glyph coverage.

Parameters

in	coveragefp	File pointer to Unicode script range data file.
in	cstart	Starting code point in current Unicode script range.

Parameters

in	cend	Ending code point in current Uni-code script range.
out	coverstring	String containing <cstart>-<cend> substring.

Returns

Length of the last string read, or 0 for end of file.

Definition at line 192 of file [unicoverage.c](#).

```

00195 {
00196     int i;
00197     static char inbuf[MAXBUF];
00198     int retval; /* the return value */
00199
00200     retval = 0;
00201
00202     do {
00203         if (fgets (inbuf, MAXBUF-1, coveragefp) != NULL) {
00204             retval = strlen (inbuf);
00205             if ((inbuf[0] >= '0' && inbuf[0] <= '9') ||
00206                 (inbuf[0] >= 'A' && inbuf[0] <= 'F') ||
00207                 (inbuf[0] >= 'a' && inbuf[0] <= 'f')) {
00208                 sscanf (inbuf, "%x-%x", cstart, cend);
00209                 i = 0;
00210                 while (inbuf[i] != ' ') i++; /* find first blank */
00211                 while (inbuf[i] == ' ') i++; /* find next non-blank */
00212                 strncpy (coverstring, &inbuf[i], MAXBUF);
00213             }
00214             else retval = 0;
00215         }
00216         else retval = 0;
00217     } while (retval == 0 && !feof (coveragefp));
00218
00219     return (retval);
00220 }

```

Here is the caller graph for this function:



5.15.3.3 print_subtotal()

```
void print_subtotal (
    FILE * outfp,
    int print_n,
    int nglyphs,
    int cstart,
    int cend,
    char * coverstring )
```

Print the subtotal for one Unicode script range.

Parameters

in	outfp	Pointer to out-put file.
in	print_n	1 = print number of glyphs, 0 = print percentage.
in	nglyphs	Number of glyphs in current range.
in	cstart	Starting code point for current range.
in	cend	Ending code point for current range.

Parameters

in	coverstring	Character string of " <code><cstart></code> "- <code><cend></code> ".
----	-------------	---

Definition at line 233 of file unicoverage.c.

```

00234 {
00235
00236     /* print old range total */
00237     if (print_n) { /* Print number of glyphs, not percentage */
00238         fprintf (outfp, " %6d ", nglyphs);
00239     }
00240     else {
00241         fprintf (outfp, " %5.1f%%", 100.0*nglyphs/(1+cend-cstart));
00242     }
00243
00244     if (cend < 0x10000)
00245         fprintf (outfp, " U+%04X..U+%04X  %s",
00246                 cstart, cend, coverstring);
00247     else
00248         fprintf (outfp, " U+%05X..U+%05X  %s",
00249                 cstart, cend, coverstring);
00250
00251     return;
00252 }

```

Here is the caller graph for this function:



5.16 unicoverage.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unicoverage.c
00003
00004  @brief unicoverage - Show the coverage of Unicode plane scripts
00005  for a GNU Unifont hex glyph file
00006
00007  @author Paul Hardy, unifoundry <at> unifoundry.com, 6 January 2008
00008
00009  @copyright Copyright (C) 2008, 2013 Paul Hardy
00010
00011  Synopsis: unicoverage [-ifont_file.hex] [-ocoverage_file.txt]
00012
00013  This program requires the file "coverage.dat" to be present
00014  in the directory from which it is run.
00015  */
00016  /*
00017  LICENSE:
00018
00019  This program is free software: you can redistribute it and/or modify
00020  it under the terms of the GNU General Public License as published by
00021  the Free Software Foundation, either version 2 of the License, or
00022  (at your option) any later version.
00023
00024  This program is distributed in the hope that it will be useful,
00025  but WITHOUT ANY WARRANTY; without even the implied warranty of

```

```

00026 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00027 GNU General Public License for more details.
00028
00029 You should have received a copy of the GNU General Public License
00030 along with this program. If not, see <http://www.gnu.org/licenses/>.
00031 */
00032
00033 /*
00034 2016 (Paul Hardy): Modified in Unifont 9.0.01 release to remove non-existent
00035 "-p" option and empty example from help printout.
00036
00037 2018 (Paul Hardy): Modified to cover entire Unicode range, not just Plane 0.
00038
00039 11 May 2019: [Paul Hardy] changed strcpy function call to strncpy
00040 for better error handling.
00041
00042 31 May 2019: [Paul Hardy] replaced strcpy call with strncpy
00043 for compilation on more systems.
00044
00045 4 June 2022: [Paul Hardy] Adjusted column spacing for better alignment
00046 of Unicode Plane 1-15 scripts. Added "-n" option to print number of
00047 glyphs in each range instead of percent coverage.
00048
00049 18 September 2022: [Paul Hardy] in nextrange function, initialize retval.
00050
00051 21 October 2023: [Paul Hardy]
00052 Added full function prototype for nextrange function in main function.
00053 */
00054
00055 #include <stdio.h>
00056 #include <stdlib.h>
00057 #include <string.h>
00058
00059 #define MAXBUF 256 ///< Maximum input line length - 1
00060
00061 /**
00062 @brief The main function.
00063
00064 @param[in] argc The count of command line arguments.
00065 @param[in] argv Pointer to array of command line arguments.
00066 @return This program exits with status 0.
00067 */
00068 int
00069 main (int argc, char *argv[])
00070 {
00071     int print_n=0; /* print # of glyphs, not percentage */
00072     unsigned i; /* loop variable */
00073     unsigned slen; /* string length of coverage file line */
00074     char inbuf[256]; /* input buffer */
00075     unsigned thischar; /* the current character */
00076
00077     char *infile="", *outfile=""; /* names of input and output files */
00078     FILE *infp, *outfp; /* file pointers of input and output files */
00079     FILE *coveragefp; /* file pointer to coverage.dat file */
00080     int cstart, cend; /* current coverage start and end code points */
00081     char coverstring[MAXBUF]; /* description of current coverage range */
00082     int nglyphs; /* number of glyphs in this section */
00083
00084     /* to get next range & name of Unicode glyphs */
00085     int nextrange (FILE *coveragefp, int *cstart, int *cend, char *coverstring);
00086
00087     void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00088         int cstart, int cend, char *coverstring);
00089
00090     if ((coveragefp = fopen ("coverage.dat", "r")) == NULL) {
00091         fprintf (stderr, "\nError: data file \"coverage.dat\" not found.\n\n");
00092         exit (0);
00093     }
00094
00095     if (argc > 1) {
00096         for (i = 1; i < argc; i++) {
00097             if (argv[i][0] == '-') { /* this is an option argument */
00098                 switch (argv[i][1]) {
00099                     case 'i': /* name of input file */
00100                         infile = &argv[i][2];
00101                         break;
00102                     case 'n': /* print number of glyphs instead of percentage */
00103                         print_n = 1;

```

```

00107         case 'o': /* name of output file */
00108             outfile = &argv[i][2];
00109             break;
00110         default: /* if unrecognized option, print list and exit */
00111             fprintf(stderr, "\nSyntax:\n\n");
00112             fprintf(stderr, "  %s -p<Unicode_Page> ", argv[0]);
00113             fprintf(stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00114             exit (1);
00115     }
00116 }
00117 }
00118 }
00119 /*
00120 Make sure we can open any I/O files that were specified before
00121 doing anything else.
00122 */
00123 if (strlen (infile) > 0) {
00124     if ((infp = fopen (infile, "r")) == NULL) {
00125         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00126         exit (1);
00127     }
00128 }
00129 else {
00130     infp = stdin;
00131 }
00132 if (strlen (outfile) > 0) {
00133     if ((outfp = fopen (outfile, "w")) == NULL) {
00134         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00135         exit (1);
00136     }
00137 }
00138 else {
00139     outfp = stdout;
00140 }
00141
00142 /*
00143 Print header row.
00144 */
00145 if (print_n) {
00146     fprintf (outfp, "# Glyphs      Range      Script\n");
00147     fprintf (outfp, "-----      ----      ----\n");
00148 }
00149 else {
00150     fprintf (outfp, "Covered      Range      Script\n");
00151     fprintf (outfp, "-----      ----      ----\n");
00152 }
00153
00154 slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00155 nglyphs = 0;
00156
00157 /*
00158 Read in the glyphs in the file
00159 */
00160 while (slen != 0 && fgetc (inbuf, MAXBUF-1, infp) != NULL) {
00161     sscanf (inbuf, "%x", &thischar);
00162
00163     /* Read a character beyond end of current script. */
00164     while (cend < thischar && slen != 0) {
00165         print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00166
00167         /* start new range total */
00168         slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00169         nglyphs = 0;
00170     }
00171     nglyphs++;
00172 }
00173
00174 print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00175
00176 exit (0);
00177 }
00178
00179 /**
00180 @brief Get next Unicode range.
00181
00182 This function reads the next Unicode script range to count its
00183 glyph coverage.
00184
00185 @param[in] coveragefp File pointer to Unicode script range data file.
00186 @param[in] cstart Starting code point in current Unicode script range.
00187 @param[in] cend Ending code point in current Unicode script range.

```

```

00188 @param[out] coverstring String containing <cstart>-<cend> substring.
00189 @return Length of the last string read, or 0 for end of file.
00190 */
00191 int
00192 nextrange (FILE *coveragefp,
00193            int *cstart, int *cend,
00194            char *coverstring)
00195 {
00196     int i;
00197     static char inbuf[MAXBUF];
00198     int retval; /* the return value */
00199
00200     retval = 0;
00201
00202     do {
00203         if (fgets (inbuf, MAXBUF-1, coveragefp) != NULL) {
00204             retval = strlen (inbuf);
00205             if ((inbuf[0] >= '0' && inbuf[0] <= '9') ||
00206                 (inbuf[0] >= 'A' && inbuf[0] <= 'F') ||
00207                 (inbuf[0] >= 'a' && inbuf[0] <= 'f')) {
00208                 sscanf (inbuf, "%x-%x", cstart, cend);
00209                 i = 0;
00210                 while (inbuf[i] != ' ') i++; /* find first blank */
00211                 while (inbuf[i] == ' ') i++; /* find next non-blank */
00212                 strncpy (coverstring, &inbuf[i], MAXBUF);
00213             }
00214             else retval = 0;
00215         }
00216         else retval = 0;
00217     } while (retval == 0 && !feof (coveragefp));
00218
00219     return (retval);
00220 }
00221
00222
00223 /**
00224 @brief Print the subtotal for one Unicode script range.
00225
00226 @param[in] outfp Pointer to output file.
00227 @param[in] print_n 1 = print number of glyphs, 0 = print percentage.
00228 @param[in] nglyphs Number of glyphs in current range.
00229 @param[in] cstart Starting code point for current range.
00230 @param[in] cend Ending code point for current range.
00231 @param[in] coverstring Character string of "<cstart>-<cend>".
00232 */
00233 void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00234                     int cstart, int cend, char *coverstring) {
00235
00236     /* print old range total */
00237     if (print_n) { /* Print number of glyphs, not percentage */
00238         fprintf (outfp, " %6d ", nglyphs);
00239     }
00240     else {
00241         fprintf (outfp, " %5.1f%%", 100.0*nglyphs/(1+cend-cstart));
00242     }
00243
00244     if (cend < 0x10000)
00245         fprintf (outfp, " U+%04X..U+%04X  %s",
00246                 cstart, cend, coverstring);
00247     else
00248         fprintf (outfp, " U+%05X..U+%05X  %s",
00249                 cstart, cend, coverstring);
00250
00251     return;
00252 }

```

5.17 src/unidup.c File Reference

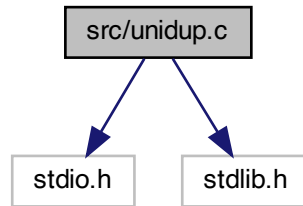
unidup - Check for duplicate code points in sorted unifont.hex file

```

#include <stdio.h>
#include <stdlib.h>

```

Include dependency graph for unidup.c:



Macros

- `#define` [MAXBUF](#) 256
Maximum input line length - 1.

Functions

- `int` [main](#) (int argc, char **argv)
The main function.

5.17.1 Detailed Description

unidup - Check for duplicate code points in sorted unifont.hex file

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

Copyright (C) 2007, 2008, 2013 Paul Hardy

This program reads a sorted list of glyphs in Unifont .hex format and prints duplicate code points on stderr if any were detected.

Synopsis: unidup < unifont_file.hex

[Hopefully there won't be any output!]

Definition in file [unidup.c](#).

5.17.2 Macro Definition Documentation

5.17.2.1 MAXBUF

`#define` [MAXBUF](#) 256

Maximum input line length - 1.

Definition at line [37](#) of file [unidup.c](#).

5.17.3 Function Documentation

5.17.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 48 of file `unidup.c`.

```
00049 {
00050
00051     int ix, iy;
00052     char inbuf[MAXBUF];
00053     char *infile; /* the input file name */
00054     FILE *infilep; /* file pointer to input file */
00055
00056     if (argc > 1) {
00057         infile = argv[1];
00058         if ((infilep = fopen (infile, "r")) == NULL) {
00059             fprintf (stderr, "\nERROR: Can't open file %s\n\n", infile);
00060             exit (EXIT_FAILURE);
00061         }
00062     }
00063     else {
00064         infilep = stdin;
00065     }
00066
00067     ix = -1;
00068
00069     while (fgets (inbuf, MAXBUF-1, infilep) != NULL) {
00070         sscanf (inbuf, "%X", &iy);
00071         if (ix == iy) fprintf (stderr, "Duplicate code point: %04X\n", ix);
00072         else ix = iy;
00073     }
00074     exit (0);
00075 }
```

5.18 unidup.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unidup.c
00003
00004 @brief unidup - Check for duplicate code points in sorted unifont.hex file
00005
00006 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00007
00008 @copyright Copyright (C) 2007, 2008, 2013 Paul Hardy
00009
00010 This program reads a sorted list of glyphs in Unifont .hex format
00011 and prints duplicate code points on stderr if any were detected.
00012
00013 Synopsis: unidup < unifont_file.hex
00014
00015 [Hopefully there won't be any output!]
00016 */
00017 /*
00018 LICENSE:
00019
00020 This program is free software: you can redistribute it and/or modify
00021 it under the terms of the GNU General Public License as published by
00022 the Free Software Foundation, either version 2 of the License, or
00023 (at your option) any later version.
00024
00025 This program is distributed in the hope that it will be useful,
00026 but WITHOUT ANY WARRANTY; without even the implied warranty of
00027 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00028 GNU General Public License for more details.
00029
00030 You should have received a copy of the GNU General Public License
00031 along with this program. If not, see <http://www.gnu.org/licenses/>.
00032 */
00033
00034 #include <stdio.h>
00035 #include <stdlib.h>
00036
00037 #define MAXBUF 256 ///< Maximum input line length - 1
00038
00039
00040 /**
00041 @brief The main function.
00042
00043 @param[in] argc The count of command line arguments.
00044 @param[in] argv Pointer to array of command line arguments.
00045 @return This program exits with status 0.
00046 */
00047 int
00048 main (int argc, char **argv)
00049 {
00050     int ix, iy;
00051     char inbuf[MAXBUF];
00052     char *infile; /* the input file name */
00053     FILE *infilep; /* file pointer to input file */
00054
00055     if (argc > 1) {
00056         infile = argv[1];
00057         if ((infilep = fopen (infile, "r")) == NULL) {
00058             fprintf (stderr, "\nERROR: Can't open file %s\n", infile);
00059             exit (EXIT_FAILURE);
00060         }
00061     }
00062     else {
00063         infilep = stdin;
00064     }
00065
00066     ix = -1;
00067
00068     while (fgets (inbuf, MAXBUF-1, infilep) != NULL) {
00069         sscanf (inbuf, "%X", &iy);
00070         if (ix == iy) fprintf (stderr, "Duplicate code point: %04X\n", ix);
00071         else ix = iy;
00072     }
00073     exit (0);
00074 }
00075 }

```

5.19 src/unifont-support.c File Reference

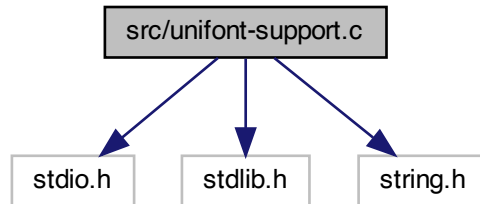
: Support functions for Unifont .hex files.

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unifont-support.c:



Functions

- void [parse_hex](#) (char *hexstring, int *width, unsigned *codept, unsigned char glyph[16][2])
Decode a Unifont .hex file into Unioctde code point and glyph.
- void [glyph2bits](#) (int width, unsigned char glyph[16][2], unsigned char glyphbits[16][16])
Convert a Unifont binary glyph into a binary glyph array of bits.
- void [hexpose](#) (int width, unsigned char glyphbits[16][16], unsigned char transpose[2][16])
Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.
- void [glyph2string](#) (int width, unsigned codept, unsigned char glyph[16][2], char *outstring)
Convert a glyph code point and byte array into a Unifont .hex string.
- void [xglyph2string](#) (int width, unsigned codept, unsigned char transpose[2][16], char *outstring)
Convert a code point and transposed glyph into a Unifont .hex string.

5.19.1 Detailed Description

: Support functions for Unifont .hex files.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [unifont-support.c](#).

5.19.2 Function Documentation

5.19.2.1 glyph2bits()

```
void glyph2bits (
    int width,
    unsigned char glyph[16][2],
    unsigned char glyphbits[16][16] )
```

Convert a Unifont binary glyph into a binary glyph array of bits.

This function takes a Unifont 16-row by 1- or 2-byte wide binary glyph and returns an array of 16 rows by 16 columns. For each output array element, a 1 indicates the corresponding bit was set in the binary glyph, and a 0 indicates the corresponding bit was not set.

Parameters

in	width	The number of columns in the glyph.
in	glyph	The binary glyph, as a 16-row by 2-byte array.
out	glyphbits	The converted glyph, as a 16-row, 16-column array.

Definition at line 91 of file [unifont-support.c](#).

```
00093     {
00094
00095     unsigned char tmp_byte;
00096     unsigned char mask;
00097     int row, column;
00098
00099     for (row = 0; row < 16; row++) {
00100         tmp_byte = glyph [row][0];
00101         mask = 0x80;
00102         for (column = 0; column < 8; column++) {
00103             glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00104             mask »= 1;
00105         }
00106
00107         if (width > 8)
00108             tmp_byte = glyph [row][1];
00109         else
00110             tmp_byte = 0x00;
00111
00112         mask = 0x80;
00113         for (column = 8; column < 16; column++) {
```

```

00114     glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00115     mask »= 1;
00116   }
00117 }
00118
00119
00120 return;
00121 }

```

5.19.2.2 glyph2string()

```

void glyph2string (
    int width,
    unsigned codept,
    unsigned char glyph[16][2],
    char * outstring )

```

Convert a glyph code point and byte array into a Unifont .hex string.

This function takes a code point and a 16-row by 1- or 2-byte binary glyph, and converts it into a Unifont .hex format character array.

Parameters

in	width	The number of columns in the glyph.
in	codept	The code point to appear in the output .hex string.
in	glyph	The glyph, with each of 16 rows 1 or 2 bytes wide.

Parameters

out	outstring	The out-put string, in Unifont .hex format.
-----	-----------	---

Definition at line 221 of file [unifont-support.c](#).

```

00223     {
00224
00225     int i;          /* index into outstring array */
00226     int row;
00227
00228     if (codept <= 0xFFFF) {
00229         sprintf (outstring, "%04X:", codept);
00230         i = 5;
00231     }
00232     else {
00233         sprintf (outstring, "%06X:", codept);
00234         i = 7;
00235     }
00236
00237     for (row = 0; row < 16; row++) {
00238         sprintf (&outstring[i], "%02X", glyph [row][0]);
00239         i += 2;
00240
00241         if (width > 8) {
00242             sprintf (&outstring[i], "%02X", glyph [row][1]);
00243             i += 2;
00244         }
00245     }
00246
00247     outstring[i] = '\0'; /* terminate output string */
00248
00249
00250     return;
00251 }
```

5.19.2.3 hexpose()

```

void hexpose (
    int width,
    unsigned char glyphbits[16][16],
    unsigned char transpose[2][16] )
```

Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.

This function takes a 16-by-16 cell bit array made from a Unifont glyph (as created by the `glyph2bits` function) and outputs a transposed array of 2 sets of 8 or 16 columns, depending on the glyph width. This format simplifies outputting these bit patterns on a graphics display with a controller chip designed to output a column of 8 pixels at a time.

For a line of text with Unifont output, first all glyphs can have their first 8 rows of pixels displayed on a line. Then the second 8 rows of all glyphs on the line can be displayed. This simplifies code for such controller chips that are designed to automatically increment input bytes of column data by one column at a time for each successive byte.

The `glyphbits` array contains a '1' in each cell where the corresponding non-transposed glyph has a pixel set, and 0 in each cell where a pixel is not set.

Parameters

in	width	The number of columns in the glyph.
in	glyphbits	The 16-by-16 pixel glyph bits.
out	transpose	The array of 2 sets of 8 or 16 columns of 8 pixels.

Definition at line 150 of file [unifont-support.c](#).

```

00152                                     {
00153
00154     int column;
00155
00156     for (column = 0; column < 8; column++) {
00157         transpose[0][column] =
00158             (glyphbits[0][column] « 7) |
00159             (glyphbits[1][column] « 6) |
00160             (glyphbits[2][column] « 5) |
00161             (glyphbits[3][column] « 4) |
00162             (glyphbits[4][column] « 3) |
00163             (glyphbits[5][column] « 2) |
00164             (glyphbits[6][column] « 1) |
00165             (glyphbits[7][column] );
00166         transpose[1][column] =
00167             (glyphbits[8][column] « 7) |
00168             (glyphbits[9][column] « 6) |
00169             (glyphbits[10][column] « 5) |
00170             (glyphbits[11][column] « 4) |
00171             (glyphbits[12][column] « 3) |
00172             (glyphbits[13][column] « 2) |
00173             (glyphbits[14][column] « 1) |
00174             (glyphbits[15][column] );
00175     }
00176 }
00177 if (width > 8) {
00178     for (column = 8; column < width; column++) {
00179         transpose[0][column] =
00180             (glyphbits[0][column] « 7) |
00181             (glyphbits[1][column] « 6) |
00182             (glyphbits[2][column] « 5) |
00183             (glyphbits[3][column] « 4) |
00184             (glyphbits[4][column] « 3) |
00185             (glyphbits[5][column] « 2) |
00186             (glyphbits[6][column] « 1) |
00187             (glyphbits[7][column] );
00188         transpose[1][column] =
00189             (glyphbits[8][column] « 7) |
00190             (glyphbits[9][column] « 6) |
00191             (glyphbits[10][column] « 5) |
00192             (glyphbits[11][column] « 4) |
00193             (glyphbits[12][column] « 3) |
00194             (glyphbits[13][column] « 2) |
00195             (glyphbits[14][column] « 1) |
00196             (glyphbits[15][column] );

```

```

00197     }
00198   }
00199   else {
00200     for (column = 8; column < width; column++)
00201       transpose [0][column] = transpose [1][column] = 0x00;
00202   }
00203
00204
00205   return;
00206 }

```

5.19.2.4 parse_hex()

```

void parse_hex (
    char * hexstring,
    int * width,
    unsigned * codept,
    unsigned char glyph[16][2] )

```

Decode a Unifont .hex file into Unioctde code point and glyph.

This function takes one line from a Unifont .hex file and decodes it into a code point followed by a 16-row glyph array. The glyph array can be one byte (8 columns) or two bytes (16 columns).

Parameters

in	hexstring	The Uni-code .hex string for one code point.
out	width	The number of columns in a glyph with 16 rows.
out	codept	The code point, contained in the first .hex file field.

Parameters

out	glyph	The Uni- font glyph, as 16 rows by 1 or 2 bytes wide.
-----	-------	--

Definition at line 44 of file [unifont-support.c](#).

```

00047         {
00048
00049     int i;
00050     int row;
00051     int length;
00052
00053     sscanf (hexstring, "%X", codept);
00054     length = strlen (hexstring);
00055     for (i = length - 1; i > 0 && hexstring[i] != '\n'; i--);
00056     hexstring[i] = '\0';
00057     for (i = 0; i < 9 && hexstring[i] != ':'; i++);
00058     i++; /* Skip over ':' */
00059     *width = (length - i) * 4 / 16; /* 16 rows per glyphbits */
00060
00061     for (row = 0; row < 16; row++) {
00062         sscanf (&hexstring[i], "%2hhX", &glyph [row][0]);
00063         i += 2;
00064         if (*width > 8) {
00065             sscanf (&hexstring[i], "%2hhX", &glyph [row][1]);
00066             i += 2;
00067         }
00068         else {
00069             glyph [row][1] = 0x00;
00070         }
00071     }
00072
00073
00074     return;
00075 }

```

5.19.2.5 xglyph2string()

```

void xglyph2string (
    int width,
    unsigned codept,
    unsigned char transpose[2][16],
    char * outstring )

```

Convert a code point and transposed glyph into a Unifont .hex string.

This function takes a code point and a transposed Unifont glyph of 2 rows of 8 pixels in a column, and converts it into a Unifont .hex format character array.

Parameters

in	width	The num- ber of columns in the glyph.
----	-------	--

Parameters

in	codept	The code point to appear in the output .hex string.
in	transpose	The transposed glyph, with 2 sets of 8-row data.
out	outstring	The output string, in Uni-font .hex format.

Definition at line 267 of file [unifont-support.c](#).

```

00269     {
00270
00271     int i;           /* index into outstring array */
00272     int column;
00273
00274     if (codept <= 0xFFFF) {
00275         sprintf (outstring, "%04X:", codept);
00276         i = 5;
00277     }
00278     else {
00279         sprintf (outstring, "%06X:", codept);
00280         i = 7;
00281     }
00282
00283     for (column = 0; column < 8; column++) {
00284         sprintf (&outstring[i], "%02X", transpose [0][column]);
00285         i += 2;
00286     }
00287     if (width > 8) {
00288         for (column = 8; column < 16; column++) {
00289             sprintf (&outstring[i], "%02X", transpose [0][column]);
00290             i += 2;
00291         }
00292     }
00293     for (column = 0; column < 8; column++) {
00294         sprintf (&outstring[i], "%02X", transpose [1][column]);
00295         i += 2;
00296     }
00297     if (width > 8) {
00298         for (column = 8; column < 16; column++) {
00299             sprintf (&outstring[i], "%02X", transpose [1][column]);
00300             i += 2;
00301         }

```

```

00302 }
00303
00304 outstring[i] = '\0'; /* terminate output string */
00305
00306
00307 return;
00308 }

```

5.20 unifont-support.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file: unifont-support.c
00003
00004 @brief: Support functions for Unifont .hex files.
00005
00006 @author Paul Hardy
00007
00008 @copyright Copyright © 2023 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program. If not, see <http://www.gnu.org/licenses/>.
00025 */
00026 #include <stdio.h>
00027 #include <stdlib.h>
00028 #include <string.h>
00029
00030
00031 /**
00032 @brief Decode a Unifont .hex file into Unioctode code point and glyph.
00033
00034 This function takes one line from a Unifont .hex file and decodes
00035 it into a code point followed by a 16-row glyph array. The glyph
00036 array can be one byte (8 columns) or two bytes (16 columns).
00037
00038 @param[in] hexstring The Unicode .hex string for one code point.
00039 @param[out] width The number of columns in a glyph with 16 rows.
00040 @param[out] codept The code point, contained in the first .hex file field.
00041 @param[out] glyph The Unifont glyph, as 16 rows by 1 or 2 bytes wide.
00042 */
00043 void
00044 parse_hex (char *hexstring,
00045            int *width,
00046            unsigned *codept,
00047            unsigned char glyph[16][2]) {
00048
00049     int i;
00050     int row;
00051     int length;
00052
00053     sscanf (hexstring, "%X", codept);
00054     length = strlen (hexstring);
00055     for (i = length - 1; i > 0 && hexstring[i] != '\n'; i--);
00056     hexstring[i] = '\0';
00057     for (i = 0; i < 9 && hexstring[i] != ':'; i++);
00058     i++; /* Skip over ':' */
00059     *width = (length - i) * 4 / 16; /* 16 rows per glyphbits */
00060
00061     for (row = 0; row < 16; row++) {
00062         sscanf (&hexstring[i], "%2hhX", &glyph [row][0]);
00063         i += 2;
00064         if (*width > 8) {
00065             sscanf (&hexstring[i], "%2hhX", &glyph [row][1]);
00066             i += 2;
00067         }
00068     }
00069 }

```

```

00068     else {
00069         glyph [row][1] = 0x00;
00070     }
00071 }
00072
00073
00074 return;
00075 }
00076
00077 /**
00078 @brief Convert a Unifont binary glyph into a binary glyph array of bits.
00079
00080 This function takes a Unifont 16-row by 1- or 2-byte wide binary glyph
00081 and returns an array of 16 rows by 16 columns. For each output array
00082 element, a 1 indicates the corresponding bit was set in the binary
00083 glyph, and a 0 indicates the corresponding bit was not set.
00084
00085 @param[in] width The number of columns in the glyph.
00086 @param[in] glyph The binary glyph, as a 16-row by 2-byte array.
00087 @param[out] glyphbits The converted glyph, as a 16-row, 16-column array.
00088 */
00089 void
00090 glyph2bits (int width,
00091             unsigned char glyph[16][2],
00092             unsigned char glyphbits [16][16]) {
00093
00094     unsigned char tmp_byte;
00095     unsigned char mask;
00096     int row, column;
00097
00098     for (row = 0; row < 16; row++) {
00099         tmp_byte = glyph [row][0];
00100         mask = 0x80;
00101         for (column = 0; column < 8; column++) {
00102             glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00103             mask »= 1;
00104         }
00105     }
00106
00107     if (width > 8)
00108         tmp_byte = glyph [row][1];
00109     else
00110         tmp_byte = 0x00;
00111
00112     mask = 0x80;
00113     for (column = 8; column < 16; column++) {
00114         glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00115         mask »= 1;
00116     }
00117 }
00118
00119
00120 return;
00121 }
00122
00123 /**
00124 @brief Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.
00125
00126 This function takes a 16-by-16 cell bit array made from a Unifont
00127 glyph (as created by the glyph2bits function) and outputs a transposed
00128 array of 2 sets of 8 or 16 columns, depending on the glyph width.
00129 This format simplifies outputting these bit patterns on a graphics
00130 display with a controller chip designed to output a column of 8 pixels
00131 at a time.
00132
00133 For a line of text with Unifont output, first all glyphs can have
00134 their first 8 rows of pixels displayed on a line. Then the second
00135 8 rows of all glyphs on the line can be displayed. This simplifies
00136 code for such controller chips that are designed to automatically
00137 increment input bytes of column data by one column at a time for
00138 each successive byte.
00139
00140 The glyphbits array contains a '1' in each cell where the corresponding
00141 non-transposed glyph has a pixel set, and 0 in each cell where a pixel
00142 is not set.
00143
00144 @param[in] width The number of columns in the glyph.
00145 @param[in] glyphbits The 16-by-16 pixel glyph bits.
00146 @param[out] transpose The array of 2 sets of 8 or 16 columns of 8 pixels.
00147 */

```

```

00149 void
00150 hexpose (int width,
00151          unsigned char glyphbits [16][16],
00152          unsigned char transpose [2][16]) {
00153
00154     int column;
00155
00156     for (column = 0; column < 8; column++) {
00157         transpose [0][column] =
00158             (glyphbits [ 0][column] « 7) |
00159             (glyphbits [ 1][column] « 6) |
00160             (glyphbits [ 2][column] « 5) |
00161             (glyphbits [ 3][column] « 4) |
00162             (glyphbits [ 4][column] « 3) |
00163             (glyphbits [ 5][column] « 2) |
00164             (glyphbits [ 6][column] « 1) |
00165             (glyphbits [ 7][column] );
00166         transpose [1][column] =
00167             (glyphbits [ 8][column] « 7) |
00168             (glyphbits [ 9][column] « 6) |
00169             (glyphbits [10][column] « 5) |
00170             (glyphbits [11][column] « 4) |
00171             (glyphbits [12][column] « 3) |
00172             (glyphbits [13][column] « 2) |
00173             (glyphbits [14][column] « 1) |
00174             (glyphbits [15][column] );
00175     }
00176     if (width > 8) {
00177         for (column = 8; column < width; column++) {
00178             transpose [0][column] =
00179                 (glyphbits [0][column] « 7) |
00180                 (glyphbits [1][column] « 6) |
00181                 (glyphbits [2][column] « 5) |
00182                 (glyphbits [3][column] « 4) |
00183                 (glyphbits [4][column] « 3) |
00184                 (glyphbits [5][column] « 2) |
00185                 (glyphbits [6][column] « 1) |
00186                 (glyphbits [7][column] );
00187             transpose [1][column] =
00188                 (glyphbits [8][column] « 7) |
00189                 (glyphbits [9][column] « 6) |
00190                 (glyphbits [10][column] « 5) |
00191                 (glyphbits [11][column] « 4) |
00192                 (glyphbits [12][column] « 3) |
00193                 (glyphbits [13][column] « 2) |
00194                 (glyphbits [14][column] « 1) |
00195                 (glyphbits [15][column] );
00196         }
00197     }
00198     else {
00199         for (column = 8; column < width; column++)
00200             transpose [0][column] = transpose [1][column] = 0x00;
00201     }
00202     return;
00203 }
00204
00205 /**
00206  * @brief Convert a glyph code point and byte array into a Unifont .hex string.
00207  *
00208  * This function takes a code point and a 16-row by 1- or 2-byte binary
00209  * glyph, and converts it into a Unifont .hex format character array.
00210  *
00211  * @param[in] width The number of columns in the glyph.
00212  * @param[in] codept The code point to appear in the output .hex string.
00213  * @param[in] glyph The glyph, with each of 16 rows 1 or 2 bytes wide.
00214  * @param[out] outstring The output string, in Unifont .hex format.
00215  */
00216 void
00217 glyph2string (int width, unsigned codept,
00218              unsigned char glyph [16][2],
00219              char *outstring) {
00220
00221     int i;          /* index into outstring array */
00222     int row;
00223
00224     if (codept <= 0xFFFF) {
00225         sprintf (outstring, "%04X:", codept);

```

```

00230     i = 5;
00231 }
00232 else {
00233     sprintf (outstring, "%06X:", codept);
00234     i = 7;
00235 }
00236
00237 for (row = 0; row < 16; row++) {
00238     sprintf (&outstring[i], "%02X", glyph [row][0]);
00239     i += 2;
00240
00241     if (width > 8) {
00242         sprintf (&outstring[i], "%02X", glyph [row][1]);
00243         i += 2;
00244     }
00245 }
00246
00247 outstring[i] = '\\0'; /* terminate output string */
00248
00249 return;
00250 }
00251 }
00252
00253 /**
00254 @brief Convert a code point and transposed glyph into a Unifont .hex string.
00255
00256 This function takes a code point and a transposed Unifont glyph
00257 of 2 rows of 8 pixels in a column, and converts it into a Unifont
00258 .hex format character array.
00259
00260 @param[in] width The number of columns in the glyph.
00261 @param[in] codept The code point to appear in the output .hex string.
00262 @param[in] transpose The transposed glyph, with 2 sets of 8-row data.
00263 @param[out] outstring The output string, in Unifont .hex format.
00264 */
00265 void
00266 xglyph2string (int width, unsigned codept,
00267               unsigned char transpose [2][16],
00268               char *outstring) {
00269
00270     int i; /* index into outstring array */
00271     int column;
00272
00273     if (codept <= 0xFFFF) {
00274         sprintf (outstring, "%04X:", codept);
00275         i = 5;
00276     }
00277     else {
00278         sprintf (outstring, "%06X:", codept);
00279         i = 7;
00280     }
00281
00282     for (column = 0; column < 8; column++) {
00283         sprintf (&outstring[i], "%02X", transpose [0][column]);
00284         i += 2;
00285     }
00286     if (width > 8) {
00287         for (column = 8; column < 16; column++) {
00288             sprintf (&outstring[i], "%02X", transpose [0][column]);
00289             i += 2;
00290         }
00291     }
00292
00293     for (column = 0; column < 8; column++) {
00294         sprintf (&outstring[i], "%02X", transpose [1][column]);
00295         i += 2;
00296     }
00297     if (width > 8) {
00298         for (column = 8; column < 16; column++) {
00299             sprintf (&outstring[i], "%02X", transpose [1][column]);
00300             i += 2;
00301         }
00302     }
00303
00304     outstring[i] = '\\0'; /* terminate output string */
00305
00306     return;
00307 }
00308 }
00309

```

5.21 src/unifont1per.c File Reference

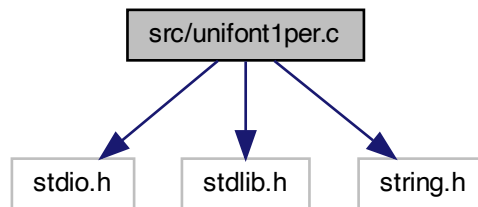
unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unifont1per.c:



Macros

- `#define` [MAXSTRING](#) 266
- `#define` [MAXFILENAME](#) 20

Functions

- `int` [main](#) ()
The main function.

5.21.1 Detailed Description

unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2016

Copyright

Copyright (C) 2016, 2017 Paul Hardy

Each glyph is 16 pixels tall, and can be 8, 16, 24, or 32 pixels wide. The width of each output graphic file is determined automatically by the width of each Unifont hex representation.

This program creates files of the form "U+<codepoint>.bmp", 1 per glyph.

Synopsis: `unifont1per < unifont.hex`

Definition in file [unifont1per.c](#).

5.21.2 Macro Definition Documentation

5.21.2.1 MAXFILENAME

```
#define MAXFILENAME 20
```

Maximum size of a filename of the form "U+%06X.bmp".

Definition at line 60 of file [unifont1per.c](#).

5.21.2.2 MAXSTRING

```
#define MAXSTRING 266
```

Maximum size of an input line in a Unifont .hex file - 1.

Definition at line 57 of file [unifont1per.c](#).

5.21.3 Function Documentation

5.21.3.1 main()

```
int main ( )
```

The main function.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 69 of file [unifont1per.c](#).

```
00069     {
00070
00071     int i; /* loop variable */
00072
00073     /*
00074     Define bitmap header bytes
00075     */
00076     unsigned char header [62] = {
00077     /*
00078     Bitmap File Header -- 14 bytes
00079     */
00080         'B', 'M', /* Signature */
00081         0x7E, 0, 0, 0, /* File Size */
00082         0, 0, 0, 0, /* Reserved */
00083         0x3E, 0, 0, 0, /* Pixel Array Offset */
00084
00085     /*
00086     Device Independent Bitmap Header -- 40 bytes
00087
00088     Image Width and Image Height are assigned final values
00089     based on the dimensions of each glyph.
00090     */
00091         0x28, 0, 0, 0, /* DIB Header Size */
00092         0x10, 0, 0, 0, /* Image Width = 16 pixels */
00093         0xF0, 0xFF, 0xFF, 0xFF, /* Image Height = -16 pixels */
00094         0x01, 0, /* Planes */
00095         0x01, 0, /* Bits Per Pixel */
00096         0, 0, 0, 0, /* Compression */
00097         0x40, 0, 0, 0, /* Image Size */
00098         0x14, 0x0B, 0, 0, /* X Pixels Per Meter = 72 dpi */
00099         0x14, 0x0B, 0, 0, /* Y Pixels Per Meter = 72 dpi */
00100         0x02, 0, 0, 0, /* Colors In Color Table */
00101         0, 0, 0, 0, /* Important Colors */
00102
00103     /*
00104     Color Palette -- 8 bytes
00105     */
00106         0xFF, 0xFF, 0xFF, 0, /* White */
00107         0, 0, 0, 0 /* Black */
00108     };
00109
00110     char instring[MAXSTRING]; /* input string */
00111     int code_point; /* current Unicode code point */
00112     char glyph[MAXSTRING]; /* bitmap string for this glyph */
00113     int glyph_height=16; /* for now, fixed at 16 pixels high */
```

```

00114 int glyph_width; /* 8, 16, 24, or 32 pixels wide */
00115 char filename[MAXFILENAME]; /* name of current output file */
00116 FILE *outfp; /* file pointer to current output file */
00117
00118 int string_index; /* pointer into hexadecimal glyph string */
00119 int nextbyte; /* next set of 8 bits to print out */
00120
00121 /* Repeat for each line in the input stream */
00122 while (fgets (instr, MAXSTRING - 1, stdin) != NULL) {
00123 /* Read next Unifont ASCII hexadecimal format glyph description */
00124 sscanf (instr, "%X:%s", &code_point, glyph);
00125 /* Calculate width of a glyph in pixels; 4 bits per ASCII hex digit */
00126 glyph_width = strlen (glyph) / (glyph_height / 4);
00127 snprintf (filename, MAXFILENAME, "U+%06X.bmp", code_point);
00128 header [18] = glyph_width; /* bitmap width */
00129 header [22] = -glyph_height; /* negative height --> draw top to bottom */
00130 if ((outfp = fopen (filename, "w")) != NULL) {
00131 for (i = 0; i < 62; i++) fputc (header[i], outfp);
00132 /*
00133 Bitmap, with each row padded with zeroes if necessary
00134 so each row is four bytes wide. (Each row must end
00135 on a four-byte boundary, and four bytes is the maximum
00136 possible row length for up to 32 pixels in a row.)
00137 */
00138 string_index = 0;
00139 for (i = 0; i < glyph_height; i++) {
00140 /* Read 2 ASCII hexadecimal digits (1 byte of output pixels) */
00141 sscanf (&glyph[string_index], "%2X", &nextbyte);
00142 string_index += 2;
00143 fputc (nextbyte, outfp); /* write out the 8 pixels */
00144 if (glyph_width <= 8) { /* pad row with 3 zero bytes */
00145 fputc (0x00, outfp); fputc (0x00, outfp); fputc (0x00, outfp);
00146 }
00147 else { /* get 8 more pixels */
00148 sscanf (&glyph[string_index], "%2X", &nextbyte);
00149 string_index += 2;
00150 fputc (nextbyte, outfp); /* write out the 8 pixels */
00151 if (glyph_width <= 16) { /* pad row with 2 zero bytes */
00152 fputc (0x00, outfp); fputc (0x00, outfp);
00153 }
00154 else { /* get 8 more pixels */
00155 sscanf (&glyph[string_index], "%2X", &nextbyte);
00156 string_index += 2;
00157 fputc (nextbyte, outfp); /* write out the 8 pixels */
00158 if (glyph_width <= 24) { /* pad row with 1 zero byte */
00159 fputc (0x00, outfp);
00160 }
00161 else { /* get 8 more pixels */
00162 sscanf (&glyph[string_index], "%2X", &nextbyte);
00163 string_index += 2;
00164 fputc (nextbyte, outfp); /* write out the 8 pixels */
00165 } /* glyph is 32 pixels wide */
00166 } /* glyph is 24 pixels wide */
00167 } /* glyph is 16 pixels wide */
00168 } /* glyph is 8 pixels wide */
00169
00170 fclose (outfp);
00171 }
00172 }
00173
00174 exit (EXIT_SUCCESS);
00175 }

```

5.22 unifont1per.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unifont1per.c
00003
00004 @brief unifont1per - Read a Unifont .hex file from standard input and
00005 produce one glyph per ".bmp" bitmap file as output
00006
00007 @author Paul Hardy, unfoundry <at> unfoundry.com, December 2016
00008
00009 @copyright Copyright (C) 2016, 2017 Paul Hardy
00010
00011 Each glyph is 16 pixels tall, and can be 8, 16, 24,
00012 or 32 pixels wide. The width of each output graphic

```

```

00013 file is determined automatically by the width of each
00014 Unifont hex representation.
00015
00016 This program creates files of the form "U+<codepoint>.bmp", 1 per glyph.
00017
00018 Synopsis: unifont1per < unifont.hex
00019 */
00020 /*
00021 LICENSE:
00022
00023 This program is free software: you can redistribute it and/or modify
00024 it under the terms of the GNU General Public License as published by
00025 the Free Software Foundation, either version 2 of the License, or
00026 (at your option) any later version.
00027
00028 This program is distributed in the hope that it will be useful,
00029 but WITHOUT ANY WARRANTY; without even the implied warranty of
00030 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00031 GNU General Public License for more details.
00032
00033 You should have received a copy of the GNU General Public License
00034 along with this program. If not, see <http://www.gnu.org/licenses/>.
00035
00036 Example:
00037
00038 mkdir my-bmp
00039 cd my-bmp
00040 unifont1per < ../glyphs.hex
00041
00042 */
00043 /*
00044 */
00045 11 May 2019 [Paul Hardy]:
00046 - Changed sprintf function call to snprintf for writing
00047 "filename" character string.
00048 - Defined MAXFILENAME to hold size of "filename" array
00049 for snprintf function call.
00050 */
00051
00052 #include <stdio.h>
00053 #include <stdlib.h>
00054 #include <string.h>
00055
00056 /** Maximum size of an input line in a Unifont .hex file - 1. */
00057 #define MAXSTRING 266
00058
00059 /** Maximum size of a filename of the form "U+%06X.bmp". */
00060 #define MAXFILENAME 20
00061
00062
00063 /**
00064 @brief The main function.
00065
00066 @return This program exits with status EXIT_SUCCESS.
00067 */
00068 int
00069 main () {
00070     int i; /* loop variable */
00071
00072     /*
00073     Define bitmap header bytes
00074     */
00075     unsigned char header [62] = {
00076         /*
00077         Bitmap File Header -- 14 bytes
00078         */
00079         'B', 'M', /* Signature */
00080         0x7E, 0, 0, 0, /* File Size */
00081         0, 0, 0, 0, /* Reserved */
00082         0x3E, 0, 0, 0, /* Pixel Array Offset */
00083
00084         /*
00085         Device Independent Bitmap Header -- 40 bytes
00086         */
00087         Image Width and Image Height are assigned final values
00088         based on the dimensions of each glyph.
00089         */
00090         0x28, 0, 0, 0, /* DIB Header Size */
00091         0x10, 0, 0, 0, /* Image Width = 16 pixels */
00092         0xF0, 0xFF, 0xFF, 0xFF, /* Image Height = -16 pixels */
00093     };

```

```

00094     0x01, 0, /* Planes */
00095     0x01, 0, /* Bits Per Pixel */
00096     0, 0, 0, 0, /* Compression */
00097     0x40, 0, 0, 0, /* Image Size */
00098     0x14, 0x0B, 0, 0, /* X Pixels Per Meter = 72 dpi */
00099     0x14, 0x0B, 0, 0, /* Y Pixels Per Meter = 72 dpi */
00100     0x02, 0, 0, 0, /* Colors In Color Table */
00101     0, 0, 0, 0, /* Important Colors */
00102
00103 /*
00104 Color Palette -- 8 bytes
00105 */
00106     0xFF, 0xFF, 0xFF, 0, /* White */
00107     0, 0, 0, 0 /* Black */
00108 };
00109
00110 char instring[MAXSTRING]; /* input string */
00111 int code_point; /* current Unicode code point */
00112 char glyph[MAXSTRING]; /* bitmap string for this glyph */
00113 int glyph_height=16; /* for now, fixed at 16 pixels high */
00114 int glyph_width; /* 8, 16, 24, or 32 pixels wide */
00115 char filename[MAXFILENAME]; /* name of current output file */
00116 FILE *outfp; /* file pointer to current output file */
00117
00118 int string_index; /* pointer into hexadecimal glyph string */
00119 int nextbyte; /* next set of 8 bits to print */
00120
00121 /* Repeat for each line in the input stream */
00122 while (fgets (instring, MAXSTRING - 1, stdin) != NULL) {
00123     /* Read next Unifont ASCII hexadecimal format glyph description */
00124     sscanf (instring, "%X:%s", &code_point, glyph);
00125     /* Calculate width of a glyph in pixels; 4 bits per ASCII hex digit */
00126     glyph_width = strlen (glyph) / (glyph_height / 4);
00127     snprintf (filename, MAXFILENAME, "U+%06X.bmp", code_point);
00128     header [18] = glyph_width; /* bitmap width */
00129     header [22] = -glyph_height; /* negative height --> draw top to bottom */
00130     if ((outfp = fopen (filename, "w")) != NULL) {
00131         for (i = 0; i < 62; i++) fputc (header[i], outfp);
00132         /*
00133         Bitmap, with each row padded with zeroes if necessary
00134         so each row is four bytes wide. (Each row must end
00135         on a four-byte boundary, and four bytes is the maximum
00136         possible row length for up to 32 pixels in a row.)
00137         */
00138         string_index = 0;
00139         for (i = 0; i < glyph_height; i++) {
00140             /* Read 2 ASCII hexadecimal digits (1 byte of output pixels) */
00141             sscanf (&glyph[string_index], "%2X", &nextbyte);
00142             string_index += 2;
00143             fputc (nextbyte, outfp); /* write out the 8 pixels */
00144             if (glyph_width <= 8) { /* pad row with 3 zero bytes */
00145                 fputc (0x00, outfp); fputc (0x00, outfp); fputc (0x00, outfp);
00146             }
00147             else { /* get 8 more pixels */
00148                 sscanf (&glyph[string_index], "%2X", &nextbyte);
00149                 string_index += 2;
00150                 fputc (nextbyte, outfp); /* write out the 8 pixels */
00151                 if (glyph_width <= 16) { /* pad row with 2 zero bytes */
00152                     fputc (0x00, outfp); fputc (0x00, outfp);
00153                 }
00154                 else { /* get 8 more pixels */
00155                     sscanf (&glyph[string_index], "%2X", &nextbyte);
00156                     string_index += 2;
00157                     fputc (nextbyte, outfp); /* write out the 8 pixels */
00158                     if (glyph_width <= 24) { /* pad row with 1 zero byte */
00159                         fputc (0x00, outfp);
00160                     }
00161                     else { /* get 8 more pixels */
00162                         sscanf (&glyph[string_index], "%2X", &nextbyte);
00163                         string_index += 2;
00164                         fputc (nextbyte, outfp); /* write out the 8 pixels */
00165                     } /* glyph is 32 pixels wide */
00166                 } /* glyph is 24 pixels wide */
00167             } /* glyph is 16 pixels wide */
00168         } /* glyph is 8 pixels wide */
00169         fclose (outfp);
00170     }
00171 }
00172 }
00173
00174 exit (EXIT_SUCCESS);

```

```
00175 }
```

5.23 src/unifontpic.c File Reference

unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap

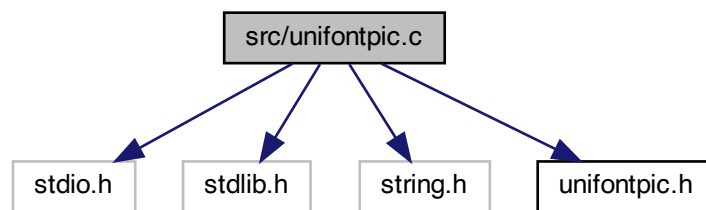
```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

```
#include "unifontpic.h"
```

Include dependency graph for unifontpic.c:



Macros

- #define [HDR_LEN](#) 33

Functions

- int [main](#) (int argc, char **argv)
The main function.
- void [output4](#) (int thisword)
Output a 4-byte integer in little-endian order.
- void [output2](#) (int thisword)
Output a 2-byte integer in little-endian order.
- void [gethex](#) (char *instring, int plane_array[0x10000][16], int plane)
Read a Unifont .hex-format input file from stdin.
- void [genlongbmp](#) (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
Generate the BMP output file in long format.
- void [genwidebmp](#) (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
Generate the BMP output file in wide format.

5.23.1 Detailed Description

unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap

Author

Paul Hardy, 2013

Copyright

Copyright (C) 2013, 2017 Paul Hardy

Definition in file [unifontpic.c](#).

5.23.2 Macro Definition Documentation

5.23.2.1 HDR_LEN

```
#define HDR_LEN 33
```

Define length of header string for top of chart.

Definition at line [73](#) of file [unifontpic.c](#).

5.23.3 Function Documentation

5.23.3.1 genlongbmp()

```
void genlongbmp (
    int plane_array[0x10000][16],
    int dpi,
    int tinynum,
    int plane )
```

Generate the BMP output file in long format.

This function generates the BMP output file from a bitmap parameter. This is a long bitmap, 16 glyphs wide by 4,096 glyphs tall.

Parameters

in	plane_array	The array of glyph bitmaps for a plane.
in	dpi	Dots per inch, for encoding in the BMP output file header.

Parameters

in	tinynum	Whether to generate tiny numbers in wide grid (unused).
in	plane	The Uni-code plane, 0..17.

Definition at line 303 of file [unifontpic.c](#).

```

00304 {
00305
00306     char header_string[HDR_LEN]; /* centered header */
00307     char raw_header[HDR_LEN]; /* left-aligned header */
00308     int header[16][16]; /* header row, for chart title */
00309     int hdrlen; /* length of HEADER_STRING */
00310     int startcol; /* column to start printing header, for centering */
00311
00312     unsigned leftcol[0x1000][16]; /* code point legend on left side of chart */
00313     int d1, d2, d3, d4; /* digits for filling leftcol[][] legend */
00314     int codept; /* current starting code point for legend */
00315     int thisrow; /* glyph row currently being rendered */
00316     unsigned toprow[16][16]; /* code point legend on top of chart */
00317     int digitrow; /* row we're in (0..4) for the above hexdigit digits */
00318
00319     /*
00320     DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00321     */
00322     int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00323     int ImageSize;
00324     int FileSize;
00325     int Width, Height; /* bitmap image width and height in pixels */
00326     int ppm; /* integer pixels per meter */
00327
00328     int i, j, k;
00329
00330     unsigned bytesout;
00331
00332     void output4(int), output2(int);
00333
00334     /*
00335     Image width and height, in pixels.
00336
00337     N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00338     */
00339     Width = 18 * 16; /* (2 legend + 16 glyphs) * 16 pixels/glyph */
00340     Height = 4099 * 16; /* (1 header + 4096 glyphs) * 16 rows/glyph */
00341
00342     ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00343
00344     FileSize = DataOffset + ImageSize;
00345
00346     /* convert dots/inch to pixels/meter */
00347     if (dpi == 0) dpi = 96;
00348     ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00349
00350     /*
00351     Generate the BMP Header
00352     */

```

```

00353 putchar ('B');
00354 putchar ('M');
00355
00356 /*
00357 Calculate file size:
00358
00359 BMP Header + InfoHeader + Color Table + Raster Data
00360 */
00361 output4 (FileSize); /* FileSize */
00362 output4 (0x0000); /* reserved */
00363
00364 /* Calculate DataOffset */
00365 output4 (DataOffset);
00366
00367 /*
00368 InfoHeader
00369 */
00370 output4 (40); /* Size of InfoHeader */
00371 output4 (Width); /* Width of bitmap in pixels */
00372 output4 (Height); /* Height of bitmap in pixels */
00373 output2 (1); /* Planes (1 plane) */
00374 output2 (1); /* BitCount (1 = monochrome) */
00375 output4 (0); /* Compression (0 = none) */
00376 output4 (ImageSize); /* ImageSize, in bytes */
00377 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00378 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00379 output4 (2); /* ColorsUsed (= 2) */
00380 output4 (2); /* ColorsImportant (= 2) */
00381 output4 (0x00000000); /* black (reserved, B, G, R) */
00382 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00383
00384 /*
00385 Create header row bits.
00386 */
00387 snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00388 memset ((void *)header, 0, 16 * 16 * sizeof (int)); /* fill with white */
00389 memset ((void *)header_string, ' ', 32 * sizeof (char)); /* 32 spaces */
00390 header_string[32] = '\0'; /* null-terminated */
00391
00392 hdrlen = strlen (raw_header);
00393 if (hdrlen > 32) hdrlen = 32; /* only 32 columns to print header */
00394 startcol = 16 - ((hdrlen + 1) >> 1); /* to center header */
00395 /* center up to 32 chars */
00396 memcpy (&header_string[startcol], raw_header, hdrlen);
00397
00398 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00399 /* Each glyph must be single-width, to fit two glyphs in 16 pixels */
00400 for (j = 0; j < 16; j++) {
00401     for (i = 0; i < 16; i++) {
00402         header[i][j] =
00403             (ascii_bits[header_string[j+j ] & 0x7F][i] & 0xFF00) |
00404             (ascii_bits[header_string[j+j+1] & 0x7F][i] >> 8);
00405     }
00406 }
00407
00408 /*
00409 Create the left column legend.
00410 */
00411 memset ((void *)leftcol, 0, 4096 * 16 * sizeof (unsigned));
00412
00413 for (codept = 0x0000; codept < 0x10000; codept += 0x10) {
00414     d1 = (codept >> 12) & 0xF; /* most significant hex digit */
00415     d2 = (codept >> 8) & 0xF;
00416     d3 = (codept >> 4) & 0xF;
00417
00418     thisrow = codept >> 4; /* rows of 16 glyphs */
00419
00420     /* fill in first and second digits */
00421     for (digitrow = 0; digitrow < 5; digitrow++) {
00422         leftcol[thisrow][2 + digitrow] =
00423             (hexdigit[d1][digitrow] << 10) |
00424             (hexdigit[d2][digitrow] << 4);
00425     }
00426
00427     /* fill in third digit */
00428     for (digitrow = 0; digitrow < 5; digitrow++) {
00429         leftcol[thisrow][9 + digitrow] = hexdigit[d3][digitrow] << 10;
00430     }
00431     leftcol[thisrow][9 + 4] |= 0xF << 4; /* underscore as 4th digit */
00432
00433     for (i = 0; i < 15; i++) {

```

```

00434     leftcol[thisrow][i] |= 0x00000002;    /* right border */
00435 }
00436
00437     leftcol[thisrow][15] = 0x0000FFFE;    /* bottom border */
00438
00439     if (d3 == 0xF) {                      /* 256-point boundary */
00440         leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00441     }
00442
00443     if ((thisrow % 0x40) == 0x3F) {       /* 1024-point boundary */
00444         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00445     }
00446 }
00447
00448 /*
00449 Create the top row legend.
00450 */
00451     memset((void *)toprow, 0, 16 * 16 * sizeof(unsigned));
00452
00453     for (codept = 0x0; codept <= 0xF; codept++) {
00454         d1 = (codept » 12) & 0xF; /* most significant hex digit */
00455         d2 = (codept » 8) & 0xF;
00456         d3 = (codept » 4) & 0xF;
00457         d4 = codept & 0xF; /* least significant hex digit */
00458
00459         /* fill in last digit */
00460         for (digitrow = 0; digitrow < 5; digitrow++) {
00461             toprow[6 + digitrow][codept] = hexdigit[d4][digitrow] « 6;
00462         }
00463     }
00464
00465     for (j = 0; j < 16; j++) {
00466         /* force bottom pixel row to be white, for separation from glyphs */
00467         toprow[15][j] = 0x0000;
00468     }
00469
00470     /* 1 pixel row with left-hand legend line */
00471     for (j = 0; j < 16; j++) {
00472         toprow[14][j] |= 0xFFFF;
00473     }
00474
00475     /* 14 rows with line on left to fill out this character row */
00476     for (i = 13; i >= 0; i--) {
00477         for (j = 0; j < 16; j++) {
00478             toprow[i][j] |= 0x0001;
00479         }
00480     }
00481
00482 /*
00483 Now write the raster image.
00484
00485 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00486 */
00487
00488 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00489     for (i = 0xFFFF; i >= 0; i -= 0x10) {
00490         thisrow = i » 4; /* 16 glyphs per row */
00491         for (j = 15; j >= 0; j--) {
00492             /* left-hand legend */
00493             putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00494             putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00495             putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00496             putchar (~leftcol[thisrow][j] & 0xFF);
00497             /* Unifont glyph */
00498             for (k = 0; k < 16; k++) {
00499                 bytesout = ~plane_array[i+k][j] & 0xFFFF;
00500                 putchar ((bytesout » 8) & 0xFF);
00501                 putchar (bytesout & 0xFF);
00502             }
00503         }
00504     }
00505
00506 /*
00507 Write the top legend.
00508 */
00509     /* i == 15: bottom pixel row of header is output here */
00510     /* left-hand legend: solid black line except for right-most pixel */
00511     putchar (0x00);
00512     putchar (0x00);
00513     putchar (0x00);
00514     putchar (0x01);

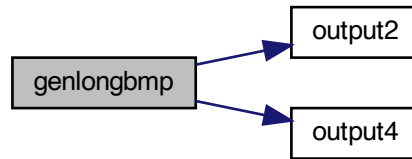
```

```

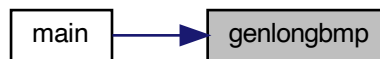
00515     for (j = 0; j < 16; j++) {
00516         putchar ((~toprow[15][j] » 8) & 0xFF);
00517         putchar ( ~toprow[15][j]      & 0xFF);
00518     }
00519
00520     putchar (0xFF);
00521     putchar (0xFF);
00522     putchar (0xFF);
00523     putchar (0xFC);
00524     for (j = 0; j < 16; j++) {
00525         putchar ((~toprow[14][j] » 8) & 0xFF);
00526         putchar ( ~toprow[14][j]      & 0xFF);
00527     }
00528
00529     for (i = 13; i >= 0; i--) {
00530         putchar (0xFF);
00531         putchar (0xFF);
00532         putchar (0xFF);
00533         putchar (0xFD);
00534         for (j = 0; j < 16; j++) {
00535             putchar ((~toprow[i][j] » 8) & 0xFF);
00536             putchar ( ~toprow[i][j]      & 0xFF);
00537         }
00538     }
00539
00540     /*
00541     Write the header.
00542     */
00543
00544     /* 7 completely white rows */
00545     for (i = 7; i >= 0; i--) {
00546         for (j = 0; j < 18; j++) {
00547             putchar (0xFF);
00548             putchar (0xFF);
00549         }
00550     }
00551
00552     for (i = 15; i >= 0; i--) {
00553         /* left-hand legend */
00554         putchar (0xFF);
00555         putchar (0xFF);
00556         putchar (0xFF);
00557         putchar (0xFF);
00558         /* header glyph */
00559         for (j = 0; j < 16; j++) {
00560             bytesout = ~header[i][j] & 0xFFFF;
00561             putchar ((bytesout » 8) & 0xFF);
00562             putchar ( bytesout      & 0xFF);
00563         }
00564     }
00565
00566     /* 8 completely white rows at very top */
00567     for (i = 7; i >= 0; i--) {
00568         for (j = 0; j < 18; j++) {
00569             putchar (0xFF);
00570             putchar (0xFF);
00571         }
00572     }
00573
00574     return;
00575 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.23.3.2 genwidebmp()

```
void genwidebmp (
    int plane_array[0x10000][16],
    int dpi,
    int tinynum,
    int plane )
```

Generate the BMP output file in wide format.

This function generates the BMP output file from a bitmap parameter. This is a wide bitmap, 256 glyphs wide by 256 glyphs tall.

Parameters

in	plane_array	The array of glyph bitmaps for a plane.
----	-------------	---

Parameters

in	dpi	Dots per inch, for encoding in the BMP output file header.
in	tinynum	Whether to generate tiny numbers in 256x256 grid.
in	plane	The Unicode plane, 0..17.

Definition at line 590 of file [unifontpic.c](#).

```

00591 {
00592
00593     char header_string[257];
00594     char raw_header[HDR_LEN];
00595     int header[16][256]; /* header row, for chart title */
00596     int hdrlen;          /* length of HEADER_STRING */
00597     int startcol;        /* column to start printing header, for centering */
00598
00599     unsigned leftcol[0x100][16]; /* code point legend on left side of chart */
00600     int d1, d2, d3, d4;          /* digits for filling leftcol[][] legend */
00601     int codept;                 /* current starting code point for legend */
00602     int thisrow;               /* glyph row currently being rendered */
00603     unsigned toprow[32][256];   /* code point legend on top of chart */
00604     int digitrow;              /* row we're in (0..4) for the above hexdigit digits */
00605     int hexalpha1, hexalpha2;  /* to convert hex digits to ASCII */
00606
00607     /*
00608     DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00609     */
00610     int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00611     int ImageSize;
00612     int FileSize;
00613     int Width, Height; /* bitmap image width and height in pixels */
00614     int ppm;           /* integer pixels per meter */
00615
00616     int i, j, k;
00617
00618     unsigned bytesout;
00619
00620     void output4(int), output2(int);
00621
00622     /*
00623     Image width and height, in pixels.
00624

```

```

00625 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00626 */
00627 Width = 258 * 16; /* (      2 legend + 256 glyphs) * 16 pixels/glyph */
00628 Height = 260 * 16; /* (2 header + 2 legend + 256 glyphs) * 16 rows/glyph */
00629
00630 ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00631
00632 FileSize = DataOffset + ImageSize;
00633
00634 /* convert dots/inch to pixels/meter */
00635 if (dpi == 0) dpi = 96;
00636 ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00637
00638 /*
00639 Generate the BMP Header
00640 */
00641 putchar ('B');
00642 putchar ('M');
00643 /*
00644 Calculate file size:
00645
00646 BMP Header + InfoHeader + Color Table + Raster Data
00647 */
00648 output4 (FileSize); /* FileSize */
00649 output4 (0x0000); /* reserved */
00650 /* Calculate DataOffset */
00651 output4 (DataOffset);
00652
00653 /*
00654 InfoHeader
00655 */
00656 output4 (40); /* Size of InfoHeader */
00657 output4 (Width); /* Width of bitmap in pixels */
00658 output4 (Height); /* Height of bitmap in pixels */
00659 output2 (1); /* Planes (1 plane) */
00660 output2 (1); /* BitCount (1 = monochrome) */
00661 output4 (0); /* Compression (0 = none) */
00662 output4 (ImageSize); /* ImageSize, in bytes */
00663 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00664 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00665 output4 (2); /* ColorsUsed (= 2) */
00666 output4 (2); /* ColorsImportant (= 2) */
00667 output4 (0x00000000); /* black (reserved, B, G, R) */
00668 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00669
00670 /*
00671 Create header row bits.
00672 */
00673 snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00674 memset ((void *)header, 0, 256 * 16 * sizeof (int)); /* fill with white */
00675 memset ((void *)header_string, ' ', 256 * sizeof (char)); /* 256 spaces */
00676 header_string[256] = '\0'; /* null-terminated */
00677
00678 hdrlen = strlen (raw_header);
00679 /* Wide bitmap can print 256 columns, but limit to 32 columns for long bitmap. */
00680 if (hdrlen > 32) hdrlen = 32;
00681 startcol = 127 - ((hdrlen - 1) » 1); /* to center header */
00682 /* center up to 32 chars */
00683 memcpy (&header_string[startcol], raw_header, hdrlen);
00684
00685 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00686 for (j = 0; j < 256; j++) {
00687     for (i = 0; i < 16; i++) {
00688         header[i][j] = ascii_bits[header_string[j] & 0x7F][i];
00689     }
00690 }
00691
00692 /*
00693 Create the left column legend.
00694 */
00695 memset ((void *)leftcol, 0, 256 * 16 * sizeof (unsigned));
00696
00697 for (codept = 0x0000; codept < 0x10000; codept += 0x100) {
00698     d1 = (codept » 12) & 0xF; /* most significant hex digit */
00699     d2 = (codept » 8) & 0xF;
00700
00701     thisrow = codept » 8; /* rows of 256 glyphs */
00702
00703     /* fill in first and second digits */
00704
00705     if (tinynum) { /* use 4x5 pixel glyphs */

```

```

00706         for (digitrow = 0; digitrow < 5; digitrow++) {
00707             leftcol[thisrow][6 + digitrow] =
00708                 (hexdigit[d1][digitrow] « 10) |
00709                 (hexdigit[d2][digitrow] « 4);
00710         }
00711     }
00712     else { /* bigger numbers -- use glyphs from Unifont itself */
00713         /* convert hexadecimal digits to ASCII equivalent */
00714         hexalpha1 = d1 < 0xA ? '0' + d1 : 'A' + d1 - 0xA;
00715         hexalpha2 = d2 < 0xA ? '0' + d2 : 'A' + d2 - 0xA;
00716
00717         for (i = 0 ; i < 16; i++) {
00718             leftcol[thisrow][i] =
00719                 (ascii_bits[hexalpha1][i] « 2) |
00720                 (ascii_bits[hexalpha2][i] » 6);
00721         }
00722     }
00723
00724     for (i = 0; i < 15; i++) {
00725         leftcol[thisrow][i] |= 0x00000002; /* right border */
00726     }
00727
00728     leftcol[thisrow][15] = 0x0000FFFE; /* bottom border */
00729
00730     if (d2 == 0xF) { /* 4096-point boundary */
00731         leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00732     }
00733
00734     if ((thisrow % 0x40) == 0x3F) { /* 16,384-point boundary */
00735         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00736     }
00737 }
00738
00739 /*
00740 Create the top row legend.
00741 */
00742 memset((void *)toprow, 0, 32 * 256 * sizeof(unsigned));
00743
00744 for (codept = 0x00; codept <= 0xFF; codept++) {
00745     d3 = (codept » 4) & 0xF;
00746     d4 = codept & 0xF; /* least significant hex digit */
00747
00748     if (tinynum) {
00749         for (digitrow = 0; digitrow < 5; digitrow++) {
00750             toprow[16 + 6 + digitrow][codept] =
00751                 (hexdigit[d3][digitrow] « 10) |
00752                 (hexdigit[d4][digitrow] « 4);
00753         }
00754     }
00755     else {
00756         /* convert hexadecimal digits to ASCII equivalent */
00757         hexalpha1 = d3 < 0xA ? '0' + d3 : 'A' + d3 - 0xA;
00758         hexalpha2 = d4 < 0xA ? '0' + d4 : 'A' + d4 - 0xA;
00759         for (i = 0 ; i < 16; i++) {
00760             toprow[14 + i][codept] =
00761                 (ascii_bits[hexalpha1][i] ) |
00762                 (ascii_bits[hexalpha2][i] » 7);
00763         }
00764     }
00765 }
00766
00767 for (j = 0; j < 256; j++) {
00768     /* force bottom pixel row to be white, for separation from glyphs */
00769     toprow[16 + 15][j] = 0x0000;
00770 }
00771
00772 /* 1 pixel row with left-hand legend line */
00773 for (j = 0; j < 256; j++) {
00774     toprow[16 + 14][j] |= 0xFFFF;
00775 }
00776
00777 /* 14 rows with line on left to fill out this character row */
00778 for (i = 13; i >= 0; i--) {
00779     for (j = 0; j < 256; j++) {
00780         toprow[16 + i][j] |= 0x0001;
00781     }
00782 }
00783
00784 /* Form the longer tic marks in top legend */
00785 for (i = 8; i < 16; i++) {
00786     for (j = 0x0F; j < 0x100; j += 0x10) {

```

```

00787     toprow[i][j] |= 0x0001;
00788 }
00789 }
00790
00791 /*
00792 Now write the raster image.
00793
00794 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00795 */
00796
00797 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00798 for (i = 0xFF00; i >= 0; i -= 0x100) {
00799     thisrow = i » 8; /* 256 glyphs per row */
00800     for (j = 15; j >= 0; j--) {
00801         /* left-hand legend */
00802         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00803         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00804         putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00805         putchar (~leftcol[thisrow][j] & 0xFF);
00806         /* Unifont glyph */
00807         for (k = 0x00; k < 0x100; k++) {
00808             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00809             putchar ((bytesout » 8) & 0xFF);
00810             putchar ( bytesout      & 0xFF);
00811         }
00812     }
00813 }
00814
00815 /*
00816 Write the top legend.
00817 */
00818 /* i == 15: bottom pixel row of header is output here */
00819 /* left-hand legend: solid black line except for right-most pixel */
00820 putchar (0x00);
00821 putchar (0x00);
00822 putchar (0x00);
00823 putchar (0x01);
00824 for (j = 0; j < 256; j++) {
00825     putchar ((~toprow[16 + 15][j] » 8) & 0xFF);
00826     putchar (~toprow[16 + 15][j] & 0xFF);
00827 }
00828
00829 putchar (0xFF);
00830 putchar (0xFF);
00831 putchar (0xFF);
00832 putchar (0xFC);
00833 for (j = 0; j < 256; j++) {
00834     putchar ((~toprow[16 + 14][j] » 8) & 0xFF);
00835     putchar (~toprow[16 + 14][j] & 0xFF);
00836 }
00837
00838 for (i = 16 + 13; i >= 0; i--) {
00839     if (i >= 8) { /* make vertical stroke on right */
00840         putchar (0xFF);
00841         putchar (0xFF);
00842         putchar (0xFF);
00843         putchar (0xFD);
00844     }
00845     else { /* all white */
00846         putchar (0xFF);
00847         putchar (0xFF);
00848         putchar (0xFF);
00849         putchar (0xFF);
00850     }
00851     for (j = 0; j < 256; j++) {
00852         putchar ((~toprow[i][j] » 8) & 0xFF);
00853         putchar (~toprow[i][j] & 0xFF);
00854     }
00855 }
00856
00857 /*
00858 Write the header.
00859 */
00860
00861 /* 8 completely white rows */
00862 for (i = 7; i >= 0; i--) {
00863     for (j = 0; j < 258; j++) {
00864         putchar (0xFF);
00865         putchar (0xFF);
00866     }
00867 }

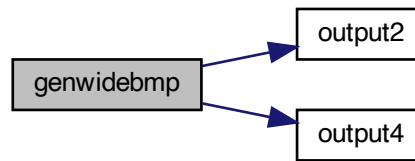
```

```

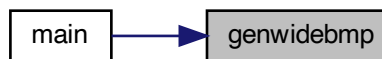
00868
00869  for (i = 15; i >= 0; i--) {
00870      /* left-hand legend */
00871      putchar (0xFF);
00872      putchar (0xFF);
00873      putchar (0xFF);
00874      putchar (0xFF);
00875      /* header glyph */
00876      for (j = 0; j < 256; j++) {
00877          bytesout = ~header[i][j] & 0xFFFF;
00878          putchar ((bytesout » 8) & 0xFF);
00879          putchar ( bytesout      & 0xFF);
00880      }
00881  }
00882
00883  /* 8 completely white rows at very top */
00884  for (i = 7; i >= 0; i--) {
00885      for (j = 0; j < 258; j++) {
00886          putchar (0xFF);
00887          putchar (0xFF);
00888      }
00889  }
00890
00891  return;
00892 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.23.3.3 gethex()

```

void gethex (
    char * instring,
    int plane_array[0x10000][16],
    int plane )

```

Read a Unifont .hex-format input file from stdin.

Each glyph can be 2, 4, 6, or 8 ASCII hexadecimal digits wide. [Glyph](#) height is fixed at 16 pixels.

Parameters

in	instring	One line from a Uni-font .hex-format file.
in,out	plane__array	Bitmap for this plane, one bitmap row per element.
in	plane	The Uni-code plane, 0..17.

Definition at line 224 of file [unifontpic.c](#).

```

00225 {
00226     char *bitstring; /* pointer into instring for glyph bitmap */
00227     int i; /* loop variable */
00228     int codept; /* the Unicode code point of the current glyph */
00229     int glyph_plane; /* Unicode plane of current glyph */
00230     int ndigits; /* number of ASCII hexadecimal digits in glyph */
00231     int bytespl; /* bytes per line of pixels in a glyph */
00232     int temprow; /* 1 row of a quadruple-width glyph */
00233     int newrow; /* 1 row of double-width output pixels */
00234     unsigned bitmask; /* to mask off 2 bits of long width glyph */
00235
00236     /*
00237     Read each input line and place its glyph into the bit array.
00238     */
00239     sscanf (instring, "%X", &codept);
00240     glyph_plane = codept » 16;
00241     if (glyph_plane == plane) {
00242         codept &= 0xFFFF; /* array index will only have 16 bit address */
00243         /* find the colon separator */
00244         for (i = 0; (i < 9) && (instring[i] != ':'); i++);
00245         i++; /* position past it */
00246         bitstring = &instring[i];
00247         ndigits = strlen (bitstring);
00248         /* don't count '\n' at end of line if present */
00249         if (bitstring[ndigits - 1] == '\n') ndigits--;
00250         bytespl = ndigits » 5; /* 16 rows per line, 2 digits per byte */
00251
00252         if (bytespl >= 1 && bytespl <= 4) {
00253             for (i = 0; i < 16; i++) { /* 16 rows per glyph */
00254                 /* Read correct number of hexadecimal digits given glyph width */
00255                 switch (bytespl) {
00256                     case 1: sscanf (bitstring, "%2X", &temprow);
00257                             bitstring += 2;
00258                             temprow «= 8; /* left-justify single-width glyph */
00259                             break;
00260                     case 2: sscanf (bitstring, "%4X", &temprow);
00261                             bitstring += 4;
00262                             break;
00263                     /* cases 3 and 4 widths will be compressed by 50% (see below) */
00264                     case 3: sscanf (bitstring, "%6X", &temprow);
00265                             bitstring += 6;

```

```

00266         temprow «= 8; /* left-justify */
00267         break;
00268     case 4: sscanf (bitstring, "%8X", &temprow);
00269         bitstring += 8;
00270         break;
00271 } /* switch on number of bytes per row */
00272 /* compress glyph width by 50% if greater than double-width */
00273 if (bytespl > 2) {
00274     newrow = 0x0000;
00275     /* mask off 2 bits at a time to convert each pair to 1 bit out */
00276     for (bitmask = 0xC0000000; bitmask != 0; bitmask »= 2) {
00277         newrow «= 1;
00278         if ((temprow & bitmask) != 0) newrow |= 1;
00279     }
00280     temprow = newrow;
00281 } /* done conditioning glyphs beyond double-width */
00282 plane_array[codept][i] = temprow; /* store glyph bitmap for output */
00283 } /* for each row */
00284 } /* if 1 to 4 bytes per row/line */
00285 } /* if this is the plane we are seeking */
00286
00287 return;
00288 }

```

Here is the caller graph for this function:



5.23.3.4 main()

```

int main (
    int argc,
    char ** argv )

```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status `EXIT_SUCCESS`.

Definition at line 93 of file `unifontpic.c`.

```

00094 {
00095     /* Input line buffer */
00096     char instring[MAXSTRING];
00097
00098     /* long and dpi are set from command-line options */
00099     int wide=1; /* =1 for a 256x256 grid, =0 for a 16x4096 grid */
00100     int dpi=96; /* change for 256x256 grid to fit paper if desired */
00101     int tinynum=0; /* whether to use tiny labels for 256x256 grid */
00102
00103     int i, j; /* loop variables */
00104
00105     int plane=0; /* Unicode plane, 0..17; Plane 0 is default */
00106     /* 16 pixel rows for each of 65,536 glyphs in a Unicode plane */
00107     int plane_array[0x10000][16];
00108
00109     void gethex (char *instring, int plane_array[0x10000][16], int plane);
00110     void genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum,
00111                     int plane);
00112     void genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum,
00113                     int plane);
00114
00115     if (argc > 1) {
00116         for (i = 1; i < argc; i++) {
00117             if (strcmp (argv[i], "-l", 2) == 0) { /* long display */
00118                 wide = 0;
00119             }
00120             else if (strcmp (argv[i], "-d", 2) == 0) {
00121                 dpi = atoi (&argv[i][2]); /* dots/inch specified on command line */
00122             }
00123             else if (strcmp (argv[i], "-t", 2) == 0) {
00124                 tinynum = 1;
00125             }
00126             else if (strcmp (argv[i], "-P", 2) == 0) {
00127                 /* Get Unicode plane */
00128                 for (j = 2; argv[i][j] != '\0'; j++) {
00129                     if (argv[i][j] < '0' || argv[i][j] > '9') {
00130                         fprintf (stderr,
00131                                 "ERROR: Specify Unicode plane as decimal number.\n\n");
00132                         exit (EXIT_FAILURE);
00133                     }
00134                 }
00135                 plane = atoi (&argv[i][2]); /* Unicode plane, 0..17 */
00136                 if (plane < 0 || plane > 17) {
00137                     fprintf (stderr,
00138                             "ERROR: Plane out of Unicode range [0,17].\n\n");
00139                     exit (EXIT_FAILURE);
00140                 }
00141             }
00142         }
00143     }
00144
00145     /*
00146     00147 Initialize the ASCII bitmap array for chart titles
00148     */
00149     for (i = 0; i < 128; i++) {
00150         /* convert Unifont hexadecimal string to bitmap */
00151         gethex ((char *)ascii_hex[i], plane_array, 0);
00152         for (j = 0; j < 16; j++) ascii_bits[i][j] = plane_array[i][j];
00153     }
00154
00155     /*
00156     00157 Read in the Unifont hex file to render from standard input
00158     */
00159     memset ((void *)plane_array, 0, 0x10000 * 16 * sizeof (int));
00160     while (fgets (instring, MAXSTRING, stdin) != NULL) {
00161         gethex (instring, plane_array, plane); /* read .hex input file and fill plane_array with glyph data */
00162     } /* while not EOF */
00163
00164     /*
00165     00166 Write plane_array glyph data to BMP file as wide or long bitmap.
00167     */
00168     if (wide) {
00169         genwidebmp (plane_array, dpi, tinynum, plane);

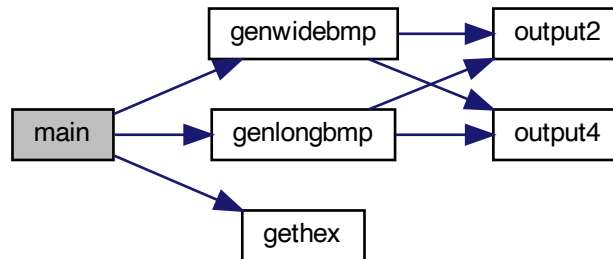
```

```

00170 }
00171 else {
00172     genlongbmp (plane_array, dpi, tinynum, plane);
00173 }
00174
00175 exit (EXIT_SUCCESS);
00176 }

```

Here is the call graph for this function:



5.23.3.5 output2()

```

void output2 (
    int thisword )

```

Output a 2-byte integer in little-endian order.

Parameters

in	thisword	The 2-byte integer to output as binary data.

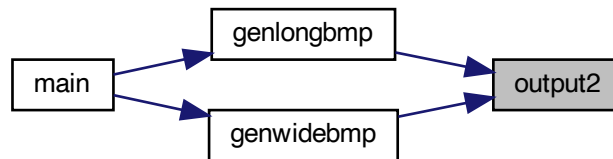
Definition at line 203 of file [unifontpic.c](#).

```

00204 {
00205
00206     putchar ( thisword & 0xFF);
00207     putchar ((thisword » 8) & 0xFF);
00208
00209     return;
00210 }

```

Here is the caller graph for this function:



5.23.3.6 `output4()`

```
void output4 (  
    int thisword )
```

Output a 4-byte integer in little-endian order.

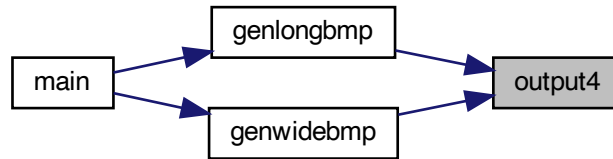
Parameters

in	thisword	The 4-byte integer to output as binary data.

Definition at line 185 of file [unifontpic.c](#).

```
00186 {  
00187  
00188     putchar ( thisword      & 0xFF);  
00189     putchar ((thisword » 8) & 0xFF);  
00190     putchar ((thisword » 16) & 0xFF);  
00191     putchar ((thisword » 24) & 0xFF);  
00192  
00193     return;  
00194 }
```

Here is the caller graph for this function:



5.24 unifontpic.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unifontpic.c
00003
00004  @brief unifontpic - See the "Big Picture": the entire Unifont
00005  in one BMP bitmap
00006
00007  @author Paul Hardy, 2013
00008
00009  @copyright Copyright (C) 2013, 2017 Paul Hardy
00010  */
00011 /*
00012  LICENSE:
00013
00014  This program is free software: you can redistribute it and/or modify
00015  it under the terms of the GNU General Public License as published by
00016  the Free Software Foundation, either version 2 of the License, or
00017  (at your option) any later version.
00018
00019  This program is distributed in the hope that it will be useful,
00020  but WITHOUT ANY WARRANTY; without even the implied warranty of
00021  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00022  GNU General Public License for more details.
00023
00024  You should have received a copy of the GNU General Public License
00025  along with this program. If not, see <http://www.gnu.org/licenses/>.
00026  */
00027
00028 /*
00029  11 June 2017 [Paul Hardy]:
00030  - Modified to take glyphs that are 24 or 32 pixels wide and
00031  compress them horizontally by 50%.
00032
00033  8 July 2017 [Paul Hardy]:
00034  - Modified to print Unifont charts above Unicode Plane 0.
00035  - Adds "-P" option to specify Unicode plane in decimal,
00036  as "-P0" through "-P17". Omitting this argument uses
00037  plane 0 as the default.
00038  - Appends Unicode plane number to chart title.
00039  - Reads in "unifontpic.h", which was added mainly to
00040  store ASCII chart title glyphs in an embedded array
00041  rather than requiring these ASCII glyphs to be in
00042  the ".hex" file that is read in for the chart body
00043  (which was the case previously, when all that was
00044  able to print was Unicode place 0).
00045  - Fixes truncated header in long bitmap format, making
00046  the long chart title glyphs single-spaced. This leaves
00047  room for the Unicode plane to appear even in the narrow
00048  chart title of the "long" format chart. The wide chart
00049  title still has double-spaced ASCII glyphs.
00050  - Adjusts centering of title on long and wide charts.
00051
00052  11 May 2019 [Paul Hardy]:
00053  - Changed strncpy calls to memcpy.

```

```

00054 - Added "HDR_LEN" to define length of header string
00055 for use in sprintf function call.
00056 - Changed sprintf function calls to sprintf function
00057 calls for writing chart header string.
00058
00059 21 October 2023 [Paul Hardy]:
00060 - Added full function prototypes in main function for
00061 functions gethex, genlongbmp, and genwidebmp.
00062 - Typecast ascii_hex[i] to char * in gethex function call
00063 to avoid warning about const char * conversion.
00064 */
00065
00066
00067 #include <stdio.h>
00068 #include <stdlib.h>
00069 #include <string.h>
00070 #include "unifontpic.h"
00071
00072 /** Define length of header string for top of chart. */
00073 #define HDR_LEN 33
00074
00075
00076 /*
00077 Stylistic Note:
00078
00079 Many variables in this program use multiple words scrunched
00080 together, with each word starting with an upper-case letter.
00081 This is only done to match the canonical field names in the
00082 Windows Bitmap Graphics spec.
00083 */
00084
00085 /**
00086 @brief The main function.
00087
00088 @param[in] argc The count of command line arguments.
00089 @param[in] argv Pointer to array of command line arguments.
00090 @return This program exits with status EXIT_SUCCESS.
00091 */
00092 int
00093 main (int argc, char **argv)
00094 {
00095     /* Input line buffer */
00096     char instring[MAXSTRING];
00097
00098     /* long and dpi are set from command-line options */
00099     int wide=1; /* =1 for a 256x256 grid, =0 for a 16x4096 grid */
00100     int dpi=96; /* change for 256x256 grid to fit paper if desired */
00101     int tinynum=0; /* whether to use tiny labels for 256x256 grid */
00102
00103     int i, j; /* loop variables */
00104
00105     int plane=0; /* Unicode plane, 0..17; Plane 0 is default */
00106     /* 16 pixel rows for each of 65,536 glyphs in a Unicode plane */
00107     int plane_array[0x10000][16];
00108
00109     void gethex (char *instring, int plane_array[0x10000][16], int plane);
00110     void genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum,
00111                     int plane);
00112     void genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum,
00113                     int plane);
00114
00115     if (argc > 1) {
00116         for (i = 1; i < argc; i++) {
00117             if (strncmp (argv[i], "-l", 2) == 0) { /* long display */
00118                 wide = 0;
00119             }
00120             else if (strncmp (argv[i], "-d", 2) == 0) {
00121                 dpi = atoi (&argv[i][2]); /* dots/inch specified on command line */
00122             }
00123             else if (strncmp (argv[i], "-t", 2) == 0) {
00124                 tinynum = 1;
00125             }
00126             else if (strncmp (argv[i], "-P", 2) == 0) {
00127                 /* Get Unicode plane */
00128                 for (j = 2; argv[i][j] != '\0'; j++) {
00129                     if (argv[i][j] < '0' || argv[i][j] > '9') {
00130                         fprintf (stderr,
00131                                 "ERROR: Specify Unicode plane as decimal number.\n\n");
00132                         exit (EXIT_FAILURE);
00133                     }
00134                 }
00135             }
00136         }
00137     }

```

```

00135         plane = atoi (&argv[i][2]); /* Unicode plane, 0..17 */
00136         if (plane < 0 || plane > 17) {
00137             fprintf (stderr,
00138                 "ERROR: Plane out of Unicode range [0,17].\n\n");
00139             exit (EXIT_FAILURE);
00140         }
00141     }
00142 }
00143 }
00144 }
00145
00146 /*
00147 Initialize the ASCII bitmap array for chart titles
00148 */
00149 for (i = 0; i < 128; i++) {
00150     /* convert Unifont hexadecimal string to bitmap */
00151     gethex ((char *)ascii_hex[i], plane_array, 0);
00152     for (j = 0; j < 16; j++) ascii_bits[i][j] = plane_array[i][j];
00153 }
00154
00155 /*
00156 Read in the Unifont hex file to render from standard input
00157 */
00158
00159 memset ((void *)plane_array, 0, 0x10000 * 16 * sizeof (int));
00160 while (fgets (instring, MAXSTRING, stdin) != NULL) {
00161     gethex (instring, plane_array, plane); /* read .hex input file and fill plane_array with glyph data */
00162 } /* while not EOF */
00163
00164 /*
00165 Write plane_array glyph data to BMP file as wide or long bitmap.
00166 */
00167
00168 if (wide) {
00169     genwidebmp (plane_array, dpi, tinynum, plane);
00170 }
00171 else {
00172     genlongbmp (plane_array, dpi, tinynum, plane);
00173 }
00174
00175 exit (EXIT_SUCCESS);
00176 }
00177
00178 /**
00179 @brief Output a 4-byte integer in little-endian order.
00180
00181 @param[in] thisword The 4-byte integer to output as binary data.
00182 */
00183 void
00184 output4 (int thisword)
00185 {
00186     putchar (thisword & 0xFF);
00187     putchar ((thisword » 8) & 0xFF);
00188     putchar ((thisword » 16) & 0xFF);
00189     putchar ((thisword » 24) & 0xFF);
00190
00191     return;
00192 }
00193
00194 /**
00195 @brief Output a 2-byte integer in little-endian order.
00196
00197 @param[in] thisword The 2-byte integer to output as binary data.
00198 */
00199 void
00200 output2 (int thisword)
00201 {
00202     putchar (thisword & 0xFF);
00203     putchar ((thisword » 8) & 0xFF);
00204
00205     return;
00206 }
00207
00208 /**
00209 @brief Read a Unifont .hex-format input file from stdin.
00210
00211
00212
00213
00214
00215

```

```

00216 Each glyph can be 2, 4, 6, or 8 ASCII hexadecimal digits wide.
00217 Glyph height is fixed at 16 pixels.
00218
00219 @param[in] instring One line from a Unifont .hex-format file.
00220 @param[in,out] plane_array Bitmap for this plane, one bitmap row per element.
00221 @param[in] plane The Unicode plane, 0..17.
00222 */
00223 void
00224 gethex (char *instring, int plane_array[0x10000][16], int plane)
00225 {
00226     char *bitstring; /* pointer into instring for glyph bitmap */
00227     int i; /* loop variable */
00228     int codept; /* the Unicode code point of the current glyph */
00229     int glyph_plane; /* Unicode plane of current glyph */
00230     int ndigits; /* number of ASCII hexadecimal digits in glyph */
00231     int bytespl; /* bytes per line of pixels in a glyph */
00232     int temprow; /* 1 row of a quadruple-width glyph */
00233     int newrow; /* 1 row of double-width output pixels */
00234     unsigned bitmask; /* to mask off 2 bits of long width glyph */
00235
00236     /*
00237     Read each input line and place its glyph into the bit array.
00238     */
00239     sscanf (instring, "%X", &codept);
00240     glyph_plane = codept » 16;
00241     if (glyph_plane == plane) {
00242         codept &= 0xFFFF; /* array index will only have 16 bit address */
00243         /* find the colon separator */
00244         for (i = 0; (i < 9) && (instring[i] != ':'); i++);
00245         i++; /* position past it */
00246         bitstring = &instring[i];
00247         ndigits = strlen (bitstring);
00248         /* don't count '\n' at end of line if present */
00249         if (bitstring[ndigits - 1] == '\n') ndigits--;
00250         bytespl = ndigits » 5; /* 16 rows per line, 2 digits per byte */
00251
00252         if (bytespl >= 1 && bytespl <= 4) {
00253             for (i = 0; i < 16; i++) { /* 16 rows per glyph */
00254                 /* Read correct number of hexadecimal digits given glyph width */
00255                 switch (bytespl) {
00256                     case 1: sscanf (bitstring, "%2X", &temprow);
00257                             bitstring += 2;
00258                             temprow «= 8; /* left-justify single-width glyph */
00259                             break;
00260                     case 2: sscanf (bitstring, "%4X", &temprow);
00261                             bitstring += 4;
00262                             break;
00263                     /* cases 3 and 4 widths will be compressed by 50% (see below) */
00264                     case 3: sscanf (bitstring, "%6X", &temprow);
00265                             bitstring += 6;
00266                             temprow «= 8; /* left-justify */
00267                             break;
00268                     case 4: sscanf (bitstring, "%8X", &temprow);
00269                             bitstring += 8;
00270                             break;
00271                 } /* switch on number of bytes per row */
00272                 /* compress glyph width by 50% if greater than double-width */
00273                 if (bytespl > 2) {
00274                     newrow = 0x0000;
00275                     /* mask off 2 bits at a time to convert each pair to 1 bit out */
00276                     for (bitmask = 0xC0000000; bitmask != 0; bitmask »= 2) {
00277                         newrow «= 1;
00278                         if ((temprow & bitmask) != 0) newrow |= 1;
00279                     }
00280                     temprow = newrow;
00281                 } /* done conditioning glyphs beyond double-width */
00282                 plane_array[codept][i] = temprow; /* store glyph bitmap for output */
00283             } /* for each row */
00284         } /* if 1 to 4 bytes per row/line */
00285     } /* if this is the plane we are seeking */
00286
00287     return;
00288 }
00289
00290
00291 /**
00292 @brief Generate the BMP output file in long format.
00293
00294 This function generates the BMP output file from a bitmap parameter.
00295 This is a long bitmap, 16 glyphs wide by 4,096 glyphs tall.
00296

```

```

00297 @param[in] plane_array The array of glyph bitmaps for a plane.
00298 @param[in] dpi Dots per inch, for encoding in the BMP output file header.
00299 @param[in] tinynum Whether to generate tiny numbers in wide grid (unused).
00300 @param[in] plane The Unicode plane, 0..17.
00301 */
00302 void
00303 genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
00304 {
00305
00306     char header_string[HDR_LEN]; /* centered header */
00307     char raw_header[HDR_LEN]; /* left-aligned header */
00308     int header[16][16]; /* header row, for chart title */
00309     int hdrlen; /* length of HEADER_STRING */
00310     int startcol; /* column to start printing header, for centering */
00311
00312     unsigned leftcol[0x1000][16]; /* code point legend on left side of chart */
00313     int d1, d2, d3, d4; /* digits for filling leftcol[][] legend */
00314     int codept; /* current starting code point for legend */
00315     int thisrow; /* glyph row currently being rendered */
00316     unsigned toprow[16][16]; /* code point legend on top of chart */
00317     int digitrow; /* row we're in (0..4) for the above hexdigit digits */
00318
00319     /*
00320     DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00321     */
00322     int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00323     int ImageSize;
00324     int FileSize;
00325     int Width, Height; /* bitmap image width and height in pixels */
00326     int ppm; /* integer pixels per meter */
00327
00328     int i, j, k;
00329
00330     unsigned bytesout;
00331
00332     void output4(int), output2(int);
00333
00334     /*
00335     Image width and height, in pixels.
00336
00337     N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00338     */
00339     Width = 18 * 16; /* (2 legend + 16 glyphs) * 16 pixels/glyph */
00340     Height = 4099 * 16; /* (1 header + 4096 glyphs) * 16 rows/glyph */
00341
00342     ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00343
00344     FileSize = DataOffset + ImageSize;
00345
00346     /* convert dots/inch to pixels/meter */
00347     if (dpi == 0) dpi = 96;
00348     ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00349
00350     /*
00351     Generate the BMP Header
00352     */
00353     putchar ('B');
00354     putchar ('M');
00355
00356     /*
00357     Calculate file size:
00358
00359     BMP Header + InfoHeader + Color Table + Raster Data
00360     */
00361     output4 (FileSize); /* FileSize */
00362     output4 (0x0000); /* reserved */
00363
00364     /* Calculate DataOffset */
00365     output4 (DataOffset);
00366
00367     /*
00368     InfoHeader
00369     */
00370     output4 (40); /* Size of InfoHeader */
00371     output4 (Width); /* Width of bitmap in pixels */
00372     output4 (Height); /* Height of bitmap in pixels */
00373     output2 (1); /* Planes (1 plane) */
00374     output2 (1); /* BitCount (1 = monochrome) */
00375     output4 (0); /* Compression (0 = none) */
00376     output4 (ImageSize); /* ImageSize, in bytes */
00377     output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */

```

```

00378 output4 (ppm);          /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00379 output4 (2);            /* ColorsUsed (= 2) */
00380 output4 (2);            /* ColorsImportant (= 2) */
00381 output4 (0x00000000);    /* black (reserved, B, G, R) */
00382 output4 (0x00FFFFFF);   /* white (reserved, B, G, R) */
00383
00384 /*
00385 Create header row bits.
00386 */
00387 snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00388 memset ((void *)header, 0, 16 * 16 * sizeof (int)); /* fill with white */
00389 memset ((void *)header_string, ' ', 32 * sizeof (char)); /* 32 spaces */
00390 header_string[32] = '\0'; /* null-terminated */
00391
00392 hdrlen = strlen (raw_header);
00393 if (hdrlen > 32) hdrlen = 32; /* only 32 columns to print header */
00394 startcol = 16 - ((hdrlen + 1) >> 1); /* to center header */
00395 /* center up to 32 chars */
00396 memcpy (&header_string[startcol], raw_header, hdrlen);
00397
00398 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00399 /* Each glyph must be single-width, to fit two glyphs in 16 pixels */
00400 for (j = 0; j < 16; j++) {
00401     for (i = 0; i < 16; i++) {
00402         header[i][j] =
00403             (ascii_bits[header_string[j+j ] & 0x7F][i] & 0xFF00) |
00404             (ascii_bits[header_string[j+j+1] & 0x7F][i] >> 8);
00405     }
00406 }
00407
00408 /*
00409 Create the left column legend.
00410 */
00411 memset ((void *)leftcol, 0, 4096 * 16 * sizeof (unsigned));
00412
00413 for (codept = 0x0000; codept < 0x10000; codept += 0x10) {
00414     d1 = (codept >> 12) & 0xF; /* most significant hex digit */
00415     d2 = (codept >> 8) & 0xF;
00416     d3 = (codept >> 4) & 0xF;
00417
00418     thisrow = codept >> 4; /* rows of 16 glyphs */
00419
00420     /* fill in first and second digits */
00421     for (digitrow = 0; digitrow < 5; digitrow++) {
00422         leftcol[thisrow][2 + digitrow] =
00423             (hexdigit[d1][digitrow] << 10) |
00424             (hexdigit[d2][digitrow] << 4);
00425     }
00426
00427     /* fill in third digit */
00428     for (digitrow = 0; digitrow < 5; digitrow++) {
00429         leftcol[thisrow][9 + digitrow] = hexdigit[d3][digitrow] << 10;
00430     }
00431     leftcol[thisrow][9 + 4] |= 0xF << 4; /* underscore as 4th digit */
00432
00433     for (i = 0; i < 15; i++) {
00434         leftcol[thisrow][i] |= 0x00000002; /* right border */
00435     }
00436
00437     leftcol[thisrow][15] = 0x0000FFFE; /* bottom border */
00438
00439     if (d3 == 0xF) { /* 256-point boundary */
00440         leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00441     }
00442
00443     if ((thisrow % 0x40) == 0x3F) { /* 1024-point boundary */
00444         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00445     }
00446 }
00447
00448 /*
00449 Create the top row legend.
00450 */
00451 memset ((void *)toprow, 0, 16 * 16 * sizeof (unsigned));
00452
00453 for (codept = 0x0; codept <= 0xF; codept++) {
00454     d1 = (codept >> 12) & 0xF; /* most significant hex digit */
00455     d2 = (codept >> 8) & 0xF;
00456     d3 = (codept >> 4) & 0xF;
00457     d4 = codept & 0xF; /* least significant hex digit */
00458

```

```

00459     /* fill in last digit */
00460     for (digitrow = 0; digitrow < 5; digitrow++) {
00461         toprow[6 + digitrow][codept] = hexdigit[d4][digitrow] « 6;
00462     }
00463 }
00464
00465 for (j = 0; j < 16; j++) {
00466     /* force bottom pixel row to be white, for separation from glyphs */
00467     toprow[15][j] = 0x0000;
00468 }
00469
00470 /* 1 pixel row with left-hand legend line */
00471 for (j = 0; j < 16; j++) {
00472     toprow[14][j] |= 0xFFFF;
00473 }
00474
00475 /* 14 rows with line on left to fill out this character row */
00476 for (i = 13; i >= 0; i--) {
00477     for (j = 0; j < 16; j++) {
00478         toprow[i][j] |= 0x0001;
00479     }
00480 }
00481
00482 /*
00483 Now write the raster image.
00484
00485 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00486 */
00487
00488 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00489 for (i = 0xFFF0; i >= 0; i -= 0x10) {
00490     thisrow = i » 4; /* 16 glyphs per row */
00491     for (j = 15; j >= 0; j--) {
00492         /* left-hand legend */
00493         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00494         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00495         putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00496         putchar (~leftcol[thisrow][j] & 0xFF);
00497         /* Unifont glyph */
00498         for (k = 0; k < 16; k++) {
00499             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00500             putchar ((bytesout » 8) & 0xFF);
00501             putchar ( bytesout & 0xFF);
00502         }
00503     }
00504 }
00505
00506 /*
00507 Write the top legend.
00508 */
00509 /* i == 15: bottom pixel row of header is output here */
00510 /* left-hand legend: solid black line except for right-most pixel */
00511 putchar (0x00);
00512 putchar (0x00);
00513 putchar (0x00);
00514 putchar (0x01);
00515 for (j = 0; j < 16; j++) {
00516     putchar ((~toprow[15][j] » 8) & 0xFF);
00517     putchar (~toprow[15][j] & 0xFF);
00518 }
00519
00520 putchar (0xFF);
00521 putchar (0xFF);
00522 putchar (0xFF);
00523 putchar (0xFC);
00524 for (j = 0; j < 16; j++) {
00525     putchar ((~toprow[14][j] » 8) & 0xFF);
00526     putchar (~toprow[14][j] & 0xFF);
00527 }
00528
00529 for (i = 13; i >= 0; i--) {
00530     putchar (0xFF);
00531     putchar (0xFF);
00532     putchar (0xFF);
00533     putchar (0xFD);
00534     for (j = 0; j < 16; j++) {
00535         putchar ((~toprow[i][j] » 8) & 0xFF);
00536         putchar (~toprow[i][j] & 0xFF);
00537     }
00538 }
00539

```

```

00540  /*
00541  Write the header.
00542  */
00543
00544  /* 7 completely white rows */
00545  for (i = 7; i >= 0; i--) {
00546      for (j = 0; j < 18; j++) {
00547          putchar (0xFF);
00548          putchar (0xFF);
00549      }
00550  }
00551
00552  for (i = 15; i >= 0; i--) {
00553      /* left-hand legend */
00554      putchar (0xFF);
00555      putchar (0xFF);
00556      putchar (0xFF);
00557      putchar (0xFF);
00558      /* header glyph */
00559      for (j = 0; j < 16; j++) {
00560          bytesout = ~header[i][j] & 0xFFFF;
00561          putchar ((bytesout » 8) & 0xFF);
00562          putchar ( bytesout      & 0xFF);
00563      }
00564  }
00565
00566  /* 8 completely white rows at very top */
00567  for (i = 7; i >= 0; i--) {
00568      for (j = 0; j < 18; j++) {
00569          putchar (0xFF);
00570          putchar (0xFF);
00571      }
00572  }
00573
00574  return;
00575 }
00576
00577
00578 /**
00579 @brief Generate the BMP output file in wide format.
00580
00581 This function generates the BMP output file from a bitmap parameter.
00582 This is a wide bitmap, 256 glyphs wide by 256 glyphs tall.
00583
00584 @param[in] plane_array The array of glyph bitmaps for a plane.
00585 @param[in] dpi Dots per inch, for encoding in the BMP output file header.
00586 @param[in] tinynum Whether to generate tiny numbers in 256x256 grid.
00587 @param[in] plane The Unicode plane, 0..17.
00588 */
00589 void
00590 genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
00591 {
00592     char header_string[257];
00593     char raw_header[HDR_LEN];
00594     int header[16][256]; /* header row, for chart title */
00595     int hdrlen;          /* length of HEADER_STRING */
00596     int startcol;        /* column to start printing header, for centering */
00597
00598     unsigned leftcol[0x100][16]; /* code point legend on left side of chart */
00599     int d1, d2, d3, d4;          /* digits for filling leftcol[][] legend */
00600     int codept;                  /* current starting code point for legend */
00601     int thisrow;                 /* glyph row currently being rendered */
00602     unsigned toprow[32][256];    /* code point legend on top of chart */
00603     int digitrow;                /* row we're in (0..4) for the above hexdigit digits */
00604     int hexalpha1, hexalpha2;    /* to convert hex digits to ASCII */
00605
00606     /*
00607     DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00608     */
00609     int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00610     int ImageSize;
00611     int FileSize;
00612     int Width, Height; /* bitmap image width and height in pixels */
00613     int ppm;           /* integer pixels per meter */
00614
00615     int i, j, k;
00616
00617     unsigned bytesout;
00618
00619     void output4(int), output2(int);

```

```

00621
00622  /*
00623 Image width and height, in pixels.
00624
00625 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00626 */
00627 Width = 258 * 16; /* (      2 legend + 256 glyphs) * 16 pixels/glyph */
00628 Height = 260 * 16; /* (2 header + 2 legend + 256 glyphs) * 16 rows/glyph */
00629
00630 ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00631
00632 FileSize = DataOffset + ImageSize;
00633
00634 /* convert dots/inch to pixels/meter */
00635 if (dpi == 0) dpi = 96;
00636 ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00637
00638 /*
00639 Generate the BMP Header
00640 */
00641 putchar ('B');
00642 putchar ('M');
00643 /*
00644 Calculate file size:
00645
00646 BMP Header + InfoHeader + Color Table + Raster Data
00647 */
00648 output4 (FileSize); /* FileSize */
00649 output4 (0x0000); /* reserved */
00650 /* Calculate DataOffset */
00651 output4 (DataOffset);
00652
00653 /*
00654 InfoHeader
00655 */
00656 output4 (40); /* Size of InfoHeader */
00657 output4 (Width); /* Width of bitmap in pixels */
00658 output4 (Height); /* Height of bitmap in pixels */
00659 output2 (1); /* Planes (1 plane) */
00660 output2 (1); /* BitCount (1 = monochrome) */
00661 output4 (0); /* Compression (0 = none) */
00662 output4 (ImageSize); /* ImageSize, in bytes */
00663 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00664 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00665 output4 (2); /* ColorsUsed (= 2) */
00666 output4 (2); /* ColorsImportant (= 2) */
00667 output4 (0x00000000); /* black (reserved, B, G, R) */
00668 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00669
00670 /*
00671 Create header row bits.
00672 */
00673 snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00674 memset ((void *)header, 0, 256 * 16 * sizeof (int)); /* fill with white */
00675 memset ((void *)header_string, ' ', 256 * sizeof (char)); /* 256 spaces */
00676 header_string[256] = '\0'; /* null-terminated */
00677
00678 hdrlen = strlen (raw_header);
00679 /* Wide bitmap can print 256 columns, but limit to 32 columns for long bitmap. */
00680 if (hdrlen > 32) hdrlen = 32;
00681 startcol = 127 - ((hdrlen - 1) » 1); /* to center header */
00682 /* center up to 32 chars */
00683 memcpy (&header_string[startcol], raw_header, hdrlen);
00684
00685 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00686 for (j = 0; j < 256; j++) {
00687     for (i = 0; i < 16; i++) {
00688         header[i][j] = ascii_bits[header_string[j] & 0x7F][i];
00689     }
00690 }
00691
00692 /*
00693 Create the left column legend.
00694 */
00695 memset ((void *)leftcol, 0, 256 * 16 * sizeof (unsigned));
00696
00697 for (codept = 0x0000; codept < 0x10000; codept += 0x100) {
00698     d1 = (codept » 12) & 0xF; /* most significant hex digit */
00699     d2 = (codept » 8) & 0xF;
00700
00701     thisrow = codept » 8; /* rows of 256 glyphs */

```

```

00702
00703     /* fill in first and second digits */
00704
00705     if (tinynum) { /* use 4x5 pixel glyphs */
00706         for (digitrow = 0; digitrow < 5; digitrow++) {
00707             leftcol[thisrow][6 + digitrow] =
00708                 (hexdigit[d1][digitrow] « 10) |
00709                 (hexdigit[d2][digitrow] « 4);
00710         }
00711     }
00712     else { /* bigger numbers -- use glyphs from Unifont itself */
00713         /* convert hexadecimal digits to ASCII equivalent */
00714         hexalpha1 = d1 < 0xA ? '0' + d1 : 'A' + d1 - 0xA;
00715         hexalpha2 = d2 < 0xA ? '0' + d2 : 'A' + d2 - 0xA;
00716
00717         for (i = 0; i < 16; i++) {
00718             leftcol[thisrow][i] =
00719                 (ascii_bits[hexalpha1][i] « 2) |
00720                 (ascii_bits[hexalpha2][i] « 6);
00721         }
00722     }
00723
00724     for (i = 0; i < 15; i++) {
00725         leftcol[thisrow][i] |= 0x00000002; /* right border */
00726     }
00727
00728     leftcol[thisrow][15] = 0x0000FFFE; /* bottom border */
00729
00730     if (d2 == 0xF) { /* 4096-point boundary */
00731         leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00732     }
00733
00734     if ((thisrow % 0x40) == 0x3F) { /* 16,384-point boundary */
00735         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00736     }
00737 }
00738
00739 /*
00740 Create the top row legend.
00741 */
00742 memset ((void *)toprow, 0, 32 * 256 * sizeof (unsigned));
00743
00744 for (codept = 0x00; codept <= 0xFF; codept++) {
00745     d3 = (codept » 4) & 0xF;
00746     d4 = codept & 0xF; /* least significant hex digit */
00747
00748     if (tinynum) {
00749         for (digitrow = 0; digitrow < 5; digitrow++) {
00750             toprow[16 + 6 + digitrow][codept] =
00751                 (hexdigit[d3][digitrow] « 10) |
00752                 (hexdigit[d4][digitrow] « 4);
00753         }
00754     }
00755     else {
00756         /* convert hexadecimal digits to ASCII equivalent */
00757         hexalpha1 = d3 < 0xA ? '0' + d3 : 'A' + d3 - 0xA;
00758         hexalpha2 = d4 < 0xA ? '0' + d4 : 'A' + d4 - 0xA;
00759         for (i = 0; i < 16; i++) {
00760             toprow[14 + i][codept] =
00761                 (ascii_bits[hexalpha1][i] ) |
00762                 (ascii_bits[hexalpha2][i] » 7);
00763         }
00764     }
00765 }
00766
00767 for (j = 0; j < 256; j++) {
00768     /* force bottom pixel row to be white, for separation from glyphs */
00769     toprow[16 + 15][j] = 0x0000;
00770 }
00771
00772 /* 1 pixel row with left-hand legend line */
00773 for (j = 0; j < 256; j++) {
00774     toprow[16 + 14][j] |= 0xFFFF;
00775 }
00776
00777 /* 14 rows with line on left to fill out this character row */
00778 for (i = 13; i >= 0; i--) {
00779     for (j = 0; j < 256; j++) {
00780         toprow[16 + i][j] |= 0x0001;
00781     }
00782 }

```

```

00783
00784 /* Form the longer tic marks in top legend */
00785 for (i = 8; i < 16; i++) {
00786     for (j = 0x0F; j < 0x100; j += 0x10) {
00787         toprow[i][j] |= 0x0001;
00788     }
00789 }
00790
00791 /*
00792 Now write the raster image.
00793
00794 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00795 */
00796
00797 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00798 for (i = 0xFF00; i >= 0; i -= 0x100) {
00799     thisrow = i » 8; /* 256 glyphs per row */
00800     for (j = 15; j >= 0; j--) {
00801         /* left-hand legend */
00802         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00803         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00804         putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00805         putchar (~leftcol[thisrow][j] & 0xFF);
00806         /* Unifont glyph */
00807         for (k = 0x00; k < 0x100; k++) {
00808             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00809             putchar ((bytesout » 8) & 0xFF);
00810             putchar (bytesout & 0xFF);
00811         }
00812     }
00813 }
00814
00815 /*
00816 Write the top legend.
00817 */
00818 /* i == 15: bottom pixel row of header is output here */
00819 /* left-hand legend: solid black line except for right-most pixel */
00820 putchar (0x00);
00821 putchar (0x00);
00822 putchar (0x00);
00823 putchar (0x01);
00824 for (j = 0; j < 256; j++) {
00825     putchar ((~toprow[16 + 15][j] » 8) & 0xFF);
00826     putchar (~toprow[16 + 15][j] & 0xFF);
00827 }
00828
00829 putchar (0xFF);
00830 putchar (0xFF);
00831 putchar (0xFF);
00832 putchar (0xFC);
00833 for (j = 0; j < 256; j++) {
00834     putchar ((~toprow[16 + 14][j] » 8) & 0xFF);
00835     putchar (~toprow[16 + 14][j] & 0xFF);
00836 }
00837
00838 for (i = 16 + 13; i >= 0; i--) {
00839     if (i >= 8) { /* make vertical stroke on right */
00840         putchar (0xFF);
00841         putchar (0xFF);
00842         putchar (0xFF);
00843         putchar (0xFD);
00844     }
00845     else { /* all white */
00846         putchar (0xFF);
00847         putchar (0xFF);
00848         putchar (0xFF);
00849         putchar (0xFF);
00850     }
00851     for (j = 0; j < 256; j++) {
00852         putchar ((~toprow[i][j] » 8) & 0xFF);
00853         putchar (~toprow[i][j] & 0xFF);
00854     }
00855 }
00856
00857 /*
00858 Write the header.
00859 */
00860
00861 /* 8 completely white rows */
00862 for (i = 7; i >= 0; i--) {
00863     for (j = 0; j < 256; j++) {

```

```

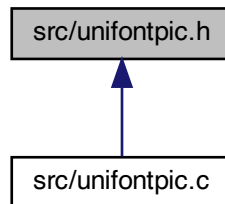
00864     putchar (0xFF);
00865     putchar (0xFF);
00866 }
00867 }
00868
00869 for (i = 15; i >= 0; i--) {
00870     /* left-hand legend */
00871     putchar (0xFF);
00872     putchar (0xFF);
00873     putchar (0xFF);
00874     putchar (0xFF);
00875     /* header glyph */
00876     for (j = 0; j < 256; j++) {
00877         bytesout = ~header[i][j] & 0xFFFF;
00878         putchar ((bytesout » 8) & 0xFF);
00879         putchar ( bytesout      & 0xFF);
00880     }
00881 }
00882
00883 /* 8 completely white rows at very top */
00884 for (i = 7; i >= 0; i--) {
00885     for (j = 0; j < 256; j++) {
00886         putchar (0xFF);
00887         putchar (0xFF);
00888     }
00889 }
00890
00891 return;
00892 }
00893

```

5.25 src/unifontpic.h File Reference

[unifontpic.h](#) - Header file for [unifontpic.c](#)

This graph shows which files directly or indirectly include this file:



Macros

- `#define` [MAXSTRING](#) 256
Maximum input string allowed.
- `#define` [HEADER_STRING](#) "GNU Unifont 16.0.03"
To be printed as chart title.

Variables

- `const char *` [ascii_hex](#) [128]
Array of Unifont ASCII glyphs for chart row & column headings.
- `int` [ascii_bits](#) [128][16]

- Array to hold ASCII bitmaps for chart title.
char [hexdigit](#) [16][5]
Array of 4x5 hexadecimal digits for legend.

5.25.1 Detailed Description

[unifontpic.h](#) - Header file for [unifontpic.c](#)

Author

Paul Hardy, July 2017

Copyright

Copyright (C) 2017 Paul Hardy

Definition in file [unifontpic.h](#).

5.25.2 Macro Definition Documentation

5.25.2.1 HEADER_STRING

```
#define HEADER_STRING "GNU Unifont 16.0.03"
```

To be printed as chart title.
Definition at line [32](#) of file [unifontpic.h](#).

5.25.2.2 MAXSTRING

```
#define MAXSTRING 256
```

Maximum input string allowed.
Definition at line [30](#) of file [unifontpic.h](#).

5.25.3 Variable Documentation

5.25.3.1 ascii_bits

```
int ascii_bits[128][16]
```

Array to hold ASCII bitmaps for chart title.
This array will be created from the strings in `ascii_hex[]` above.
Definition at line [179](#) of file [unifontpic.h](#).

5.25.3.2 ascii_hex

```
const char* ascii_hex[128]
```

Array of Unifont ASCII glyphs for chart row & column headings.
Define the array of Unifont ASCII glyphs, code points 0 through 127. This allows using unifontpic to print charts of glyphs above Unicode Plane 0. These were copied from font/plane00/unifont-base.hex, plus U+0020 (ASCII space character).
Definition at line [42](#) of file [unifontpic.h](#).

5.25.3.3 hexdigit

```
char hexdigit[16][5]
```

Initial value:

```
= {
    {0x6,0x9,0x9,0x9,0x6},
    {0x2,0x6,0x2,0x2,0x7},
    {0xF,0x1,0xF,0x8,0xF},
    {0xE,0x1,0x7,0x1,0xE},
    {0x9,0x9,0xF,0x1,0x1},
    {0xF,0x8,0xF,0x1,0xF},
    {0x6,0x8,0xE,0x9,0x6},
    {0xF,0x1,0x2,0x4,0x4},
    {0x6,0x9,0x6,0x9,0x6},
    {0x6,0x9,0x7,0x1,0x6},
    {0xF,0x9,0xF,0x9,0x9},
    {0xE,0x9,0xE,0x9,0xE},
    {0x7,0x8,0x8,0x8,0x7},
    {0xE,0x9,0x9,0x9,0xE},
    {0xF,0x8,0xE,0x8,0xF},
    {0xF,0x8,0xE,0x8,0x8}
}
```

Array of 4x5 hexadecimal digits for legend.

hexdigit contains 4x5 pixel arrays of tiny digits for the legend. See [unihexgen.c](#) for a more detailed description in the comments.

Definition at line 188 of file [unifontpic.h](#).

5.26 unifontpic.h

[Go to the documentation of this file.](#)

```
00001 /**
00002  @file unifontpic.h
00003
00004  @brief unifontpic.h - Header file for unifontpic.c
00005
00006  @author Paul Hardy, July 2017
00007
00008  @copyright Copyright (C) 2017 Paul Hardy
00009 */
00010 /*
00011  LICENSE:
00012
00013  This program is free software: you can redistribute it and/or modify
00014  it under the terms of the GNU General Public License as published by
00015  the Free Software Foundation, either version 2 of the License, or
00016  (at your option) any later version.
00017
00018  This program is distributed in the hope that it will be useful,
00019  but WITHOUT ANY WARRANTY; without even the implied warranty of
00020  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00021  GNU General Public License for more details.
00022
00023  You should have received a copy of the GNU General Public License
00024  along with this program. If not, see <http://www.gnu.org/licenses/>.
00025 */
00026
00027 #ifndef __UNIFONTPIC_H_
00028 #define __UNIFONTPIC_H_
00029
00030 #define MAXSTRING 256 ///< Maximum input string allowed.
00031
00032 #define HEADER_STRING "GNU Unifont 16.0.03" ///< To be printed as chart title.
00033
00034 /**
00035  @brief Array of Unifont ASCII glyphs for chart row & column headings.
00036
00037  Define the array of Unifont ASCII glyphs, code points 0 through 127.
00038  This allows using unifontpic to print charts of glyphs above Unicode
00039  Plane 0. These were copied from font/plane00/unifont-base.hex, plus
00040  U+0020 (ASCII space character).
00041 */
00042 const char *ascii_hex [128] = {
00043     "0000:AAAA00018000000180004A51EA505A51C99E00018000000180005555",
00044     "0001:AAAA00018000000180003993C252325F8A5271938000000180005555",
00045     "0002:AAAA00018000000180003BA5C1243119892471258000000180005555",
```

```
00046 "0003:AAAA00018000000180007BA5C1247919C1247925800000018000000180005555",
00047 "0004:AAAA000180000001800079BFC2487A49C2487989800000018000000180005555",
00048 "0005:AAAA00018000000180007A4DC2527B53C2D67A4F800000018000000180005555",
00049 "0006:AAAA000180000001800031A5CA287A31CA2849A5800000018000000180005555",
00050 "0007:AAAA000180000001800073D1CA1073D1CA1073DF800000018000000180005555",
00051 "0008:AAAA00018000000180001E3991401E3191081E71800000018000000180005555",
00052 "0009:AAAA000180000001800022F9A2203E21A2202221800000018000000180005555",
00053 "000A:AAAA000180000001800020F9A08020F9A0803E81800000018000000180005555",
00054 "000B:AAAA000180000001800022F9A220222194200821800000018000000180005555",
00055 "000C:AAAA00018000000180003EF9A0803EF9A0802081800000018000000180005555",
00056 "000D:AAAA00018000000180001EF1A08820F1A0901E89800000018000000180005555",
00057 "000E:AAAA00018000000180001E71A0881C8982883C71800000018000000180005555",
00058 "000F:AAAA00018000000180001EF9A0201C2182203CF9800000018000000180005555",
00059 "0010:AAAA0001800000018000391DA510251DA51039DD800000018000000180005555",
00060 "0011:AAAA00018000000180007189CA184A09CA08719D800000018000000180005555",
00061 "0012:AAAA00018000000180007199CA044A09CA10719D800000018000000180005555",
00062 "0013:AAAA00018000000180007199CA044A19CA047199800000018000000180005555",
00063 "0014:AAAA00018000000180007185CA0C4A15CA1C7185800000018000000180005555",
00064 "0015:AAAA00018000000180004993EA546A59DBD44A53800000018000000180005555",
00065 "0016:AAAA00018000000180003453C29A311789127113800000018000000180005555",
00066 "0017:AAAA00018000000180007BB9C1247939C1247939800000018000000180005555",
00067 "0018:AAAA00018000000180003325C4B447ADC4A434A5800000018000000180005555",
00068 "0019:AAAA00018000000180003E89A0D83EA9A0883E89800000018000000180005555",
00069 "001A:AAAA00018000000180003A5DC252325D8A52719D800000018000000180005555",
00070 "001B:AAAA000180000001800079CFC2107991C0507B8F800000018000000180005555",
00071 "001C:AAAA00018000000180001E7190801E61901010E1800000018000000180005555",
00072 "001D:AAAA00018000000180000E719080166192100EE1800000018000000180005555",
00073 "001E:AAAA00018000000180001C7192801C61941012E1800000018000000180005555",
00074 "001F:AAAA000180000001800012719280126192100CE1800000018000000180005555",
00075 "0020:0000000000000000000000000000000000000000",
00076 "0021:00000000080808080808080808000000",
00077 "0022:0000222222220000000000000000000000",
00078 "0023:000000001212127E24247E4848480000",
00079 "0024:00000000083E4948380E09493E080000",
00080 "0025:00000000314A4A340808162929460000",
00081 "0026:000000001C2222141829454246390000",
00082 "0027:0000080808080800000000000000000000",
00083 "0028:00000004080810101010101008080400",
00084 "0029:00000020101008080808080810102000",
00085 "002A:00000000000008492A1C2A4908000000",
00086 "002B:0000000000000808087F080808000000",
00087 "002C:0000000000000000000000000000000018080810",
00088 "002D:00000000000000000000003C000000000000",
00089 "002E:000000000000000000000000000018180000",
00090 "002F:00000000020204080810102040400000",
00091 "0030:00000000182442464A52624224180000",
00092 "0031:000000000818280808080808083E0000",
00093 "0032:000000003C4242020C102040407E0000",
00094 "0033:000000003C4242021C020242423C0000",
00095 "0034:00000000040C142444447E0404040000",
00096 "0035:000000007E4040407C020202423C0000",
00097 "0036:000000001C2040407C424242423C0000",
00098 "0037:000000007E0202040404080808080000",
00099 "0038:000000003C4242423C424242423C0000",
00100 "0039:000000003C4242423E02020204380000",
00101 "003A:00000000000018180000001818000000",
00102 "003B:00000000000018180000001808081000",
00103 "003C:00000000000204081020100804020000",
00104 "003D:00000000000007E0000007E00000000",
00105 "003E:00000000004020100804081020400000",
00106 "003F:000000003C4242020408080008080000",
00107 "0040:000000001C224A565252524E201E0000",
00108 "0041:0000000018242442427E424242420000",
00109 "0042:000000007C4242427C424242427C0000",
00110 "0043:000000003C42424040404042423C0000",
00111 "0044:00000000784442424242424244780000",
00112 "0045:000000007E4040407C404040407E0000",
00113 "0046:000000007E4040407C40404040400000",
00114 "0047:000000003C424240404E4242463A0000",
00115 "0048:00000000424242427E42424242420000",
00116 "0049:000000003E08080808080808083E0000",
00117 "004A:000000001F040404040404444380000",
00118 "004B:00000000424448506060504844420000",
00119 "004C:0000000040404040404040407E0000",
00120 "004D:00000000424266665A5A424242420000",
00121 "004E:0000000042626252524A4A4646420000",
00122 "004F:000000003C424242424242423C0000",
00123 "0050:000000007C4242427C40404040400000",
00124 "0051:000000003C4242424242425A663C0300",
00125 "0052:000000007C4242427C48444442420000",
00126 "0053:000000003C424240300C0242423C0000",
```

```

00127 "0054:000000007F08080808080808080000",
00128 "0055:0000000042424242424242423C0000",
00129 "0056:00000000414141222222141408080000",
00130 "0057:00000000424242425A5A666642420000",
00131 "0058:000000004242424181824242420000",
00132 "0059:000000004141222214080808080000",
00133 "005A:000000007E02020408102040407E0000",
00134 "005B:00000000E0808080808080808080E00",
00135 "005C:00000000404020101008080402020000",
00136 "005D:000000701010101010101010107000",
00137 "005E:000018244200000000000000000000",
00138 "005F:0000000000000000000000000000F00",
00139 "0060:002010080000000000000000000000",
00140 "0061:0000000000003C42023E4242463A0000",
00141 "0062:0000004040405C6242424242625C0000",
00142 "0063:000000000003C4240404040423C0000",
00143 "0064:000000202023A4642424242463A0000",
00144 "0065:000000000003C42427E4040423C0000",
00145 "0066:000000C1010107C101010101010000",
00146 "0067:000000000023A44444438203C42423C",
00147 "0068:0000004040405C6242424242420000",
00148 "0069:000000080800180808080808083E0000",
00149 "006A:000000404000C040404040404044830",
00150 "006B:00000040404044485060504844420000",
00151 "006C:000000180808080808080808083E0000",
00152 "006D:00000000000076494949494949490000",
00153 "006E:0000000000005C6242424242420000",
00154 "006F:000000000003C4242424242423C0000",
00155 "0070:0000000000005C6242424242625C4040",
00156 "0071:0000000000003A4642424242463A0202",
00157 "0072:0000000000005C6242404040400000",
00158 "0073:000000000003C4240300C02423C0000",
00159 "0074:000000001010107C10101010100C0000",
00160 "0075:0000000000004242424242463A0000",
00161 "0076:0000000000004242424242418180000",
00162 "0077:00000000000041494949494949360000",
00163 "0078:0000000000004242418182442420000",
00164 "0079:0000000000004242424242261A02023C",
00165 "007A:0000000000007E0204081020407E0000",
00166 "007B:0000000C10100808102010080810100C",
00167 "007C:000008080808080808080808080808",
00168 "007D:00000030080810100804081010080830",
00169 "007E:000000314946000000000000000000",
00170 "007F:AAAA000180000001800073D1CA104BD1CA1073DF800000018000000180005555"
00171 };
00172
00173
00174 /**
00175 @brief Array to hold ASCII bitmaps for chart title.
00176
00177 This array will be created from the strings in ascii_hex[] above.
00178 */
00179 int ascii_bits[128][16];
00180
00181
00182 /**
00183 @brief Array of 4x5 hexadecimal digits for legend.
00184
00185 hexdigit contains 4x5 pixel arrays of tiny digits for the legend.
00186 See unihexgen.c for a more detailed description in the comments.
00187 */
00188 char hexdigit[16][5] = {
00189 {0x6,0x9,0x9,0x9,0x6}, /* 0x0 */
00190 {0x2,0x6,0x2,0x2,0x7}, /* 0x1 */
00191 {0xF,0x1,0xF,0x8,0xF}, /* 0x2 */
00192 {0xE,0x1,0x7,0x1,0xE}, /* 0x3 */
00193 {0x9,0x9,0xF,0x1,0x1}, /* 0x4 */
00194 {0xF,0x8,0xF,0x1,0xF}, /* 0x5 */
00195 {0x6,0x8,0xE,0x9,0x6}, /* 0x6 */
00196 {0xF,0x1,0x2,0x4,0x4}, /* 0x7 */
00197 {0x6,0x9,0x6,0x9,0x6}, /* 0x8 */
00198 {0x6,0x9,0x7,0x1,0x6}, /* 0x9 */
00199 {0xF,0x9,0xF,0x9,0x9}, /* 0xA */
00200 {0xE,0x9,0xE,0x9,0xE}, /* 0xB */
00201 {0x7,0x8,0x8,0x8,0x7}, /* 0xC */
00202 {0xE,0x9,0x9,0x9,0xE}, /* 0xD */
00203 {0xF,0x8,0xE,0x8,0xF}, /* 0xE */
00204 {0xF,0x8,0xE,0x8,0x8} /* 0xF */
00205 };
00206
00207 #endif

```

5.27 src/unigen-hangul.c File Reference

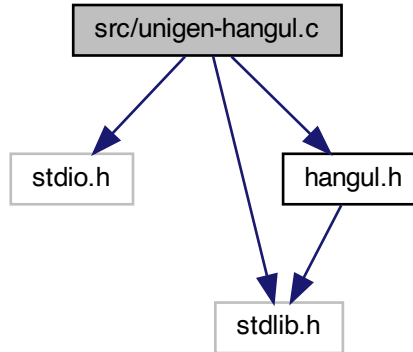
Generate arbitrary hangul syllables.

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include "hangul.h"
```

Include dependency graph for unigen-hangul.c:



Data Structures

- struct [PARAMS](#)

Functions

- int [main](#) (int argc, char *argv[])
Program entry point.
- void [parse_args](#) (int argc, char *argv[], struct [PARAMS](#) *params)
Parse command line arguments.
- void [get_hex_range](#) (char *instring, unsigned *start, unsigned *end)
Scan a hexadecimal range from a character string.

5.27.1 Detailed Description

Generate arbitrary hangul syllables.

Input is a Unifont .hex file such as the "hangul-base.hex" file that is included in the Unifont package.

The default program parameters will generate the Unicode Hangul Syllables range of U+AC00..U+D7A3.

The syllables will appear in this order:

```

For each modern choseong {
  For each modern jungseong {
    Output syllable of choseong and jungseong
    For each modern jongseong {
      Output syllable of choseong + jungseong + jongseong
    }
  }
}

```

By starting the jongseong code point at one before the first valid jongseong, the first inner loop iteration will add a blank glyph for the jongseong portion of the syllable, so only the current choseong and jungseong will be output first.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [unigen-hangul.c](#).

5.27.2 Function Documentation

5.27.2.1 get_hex_range()

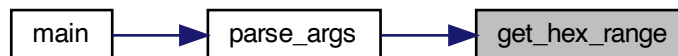
```
void get_hex_range (
    char * instring,
    unsigned * start,
    unsigned * end )
```

Scan a hexadecimal range from a character string.

Definition at line [354](#) of file [unigen-hangul.c](#).

```
00354 {
00355
00356     int i; /* String index variable. */
00357
00358     /* Get first number in range. */
00359     sscanf (instring, "%X", start);
00360     for (i = 0;
00361          instring [i] != '\0' && instring [i] != '-';
00362          i++);
00363     /* Get last number in range. */
00364     if (instring [i] == '-') {
00365         i++;
00366         sscanf (&instring [i], "%X", end);
00367     }
00368     else {
00369         *end = *start;
00370     }
00371
00372     return;
00373 }
```

Here is the caller graph for this function:



5.27.2.2 main()

```
int main (
    int argc,
    char * argv[] )
```

Program entry point.

Default parameters for Hangul syllable generation.

Definition at line 69 of file [unigen-hangul.c](#).

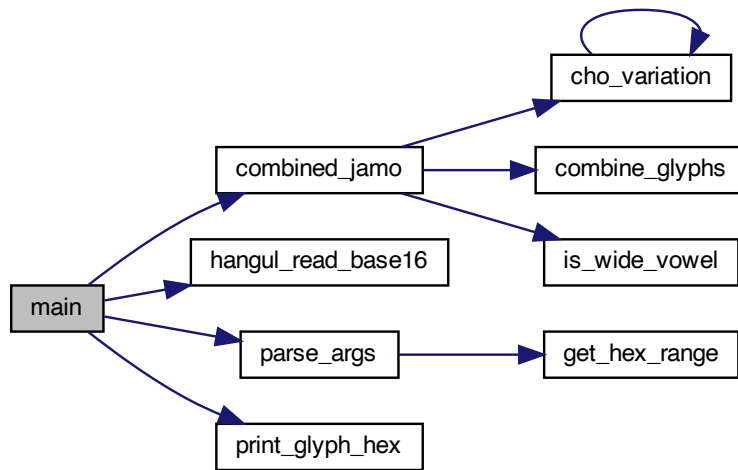
```
00069     {
00070
00071     int i; /* loop variable */
00072     unsigned codept;
00073     unsigned max_codept;
00074     unsigned glyph[MAX_GLYPHS][16];
00075     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00076     int cho, jung, jong; /* The 3 components in a Hangul syllable. */
00077
00078     /// Default parameters for Hangul syllable generation.
00079     struct PARAMS params = { 0xAC00, /* Starting output Unicode code point */
00080                             0x1100, /* First modern choseong */
00081                             0x1112, /* Last modern choseong */
00082                             0x1161, /* First modern jungseong */
00083                             0x1175, /* Last modern jungseong */
00084                             0x11A7, /* One before first modern jongseong */
00085                             0x11C2, /* Last modern jongseong */
00086                             stdin, /* Default input file pointer */
00087                             stdout /* Default output file pointer */
00088     };
00089
00090     void parse_args (int argc, char *argv[], struct PARAMS *params);
00091
00092     unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00093
00094     void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00095
00096     void combined_jamo (unsigned glyph [MAX_GLYPHS][16],
00097                        unsigned cho, unsigned jung, unsigned jong,
00098                        unsigned *combined_glyph);
00099
00100
00101     if (argc > 1) {
00102         parse_args (argc, argv, &params);
00103
00104     #ifdef DEBUG
00105         fprintf (stderr,
00106                 "Range: (U+%04X, U+%04X, U+%04X) to (U+%04X, U+%04X, U+%04X)\n",
00107                 params.cho_start, params.jung_start, params.jong_start,
00108                 params.cho_end, params.jung_end, params.jong_end);
00109     #endif
00110     }
00111
00112     /*
00113     Initialize glyph array to all zeroes.
00114     */
00115     for (codept = 0; codept < MAX_GLYPHS; codept++) {
00116         for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00117     }
00118
00119     /*
00120     Read Hangul base glyph file.
00121     */
00122     max_codept = hangul_read_base16 (params.infp, glyph);
00123     if (max_codept > 0x8FFF) {
00124         fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00125     }
00126
00127     codept = params.starting_codept; /* First code point to output */
00128
00129     for (cho = params.cho_start; cho <= params.cho_end; cho++) {
00130         for (jung = params.jung_start; jung <= params.jung_end; jung++) {
00131             for (jong = params.jong_start; jong <= params.jong_end; jong++) {
00132
00133             #ifdef DEBUG
00134                 fprintf (params.outfp,
00135                         "(U+%04X, U+%04X, U+%04X)\n",
00136                         cho, jung, jong);
00137             #endif
00138                 combined_jamo (glyph, cho, jung, jong, tmp_glyph);
```

```

00139     print_glyph_hex (params.outfp, codept, tmp_glyph);
00140     codept++;
00141     if (jong == JONG_UNICODE_END)
00142         jong = JONG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00143     }
00144     if (jung == JUNG_UNICODE_END)
00145         jung = JUNG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00146     }
00147     if (cho == CHO_UNICODE_END)
00148         cho = CHO_EXTB_UNICODE_START - 1; /* Start Extended-A range */
00149     }
00150
00151     if (params.infp != stdin) fclose (params.infp);
00152     if (params.outfp != stdout) fclose (params.outfp);
00153
00154     exit (EXIT_SUCCESS);
00155 }

```

Here is the call graph for this function:



5.27.2.3 parse_args()

```

void parse_args (
    int argc,
    char * argv[],
    struct PARAMS * params )

```

Parse command line arguments.

Definition at line 163 of file unigen-hangul.c.

```

00163     {
00164     int arg_count; /* Current index into argv[] */
00165
00166     void get_hex_range (char *instring, unsigned *start, unsigned *end);
00167
00168     int strcmp (const char *s1, const char *s2, size_t n);
00169
00170
00171     arg_count = 1;
00172
00173     while (arg_count < argc) {
00174         /* If all 600,000+ Hangul syllables are requested. */
00175         if (strcmp (argv [arg_count], "-all", 4) == 0) {

```

```

00176     params->starting_codept = 0x0001;
00177     params->cho_start = CHO_UNICODE_START; /* First modern choseong */
00178     params->cho_end = CHO_EXTB_UNICODE_END; /* Last ancient choseong */
00179     params->jung_start = JUNG_UNICODE_START; /* First modern jungseong */
00180     params->jung_end = JUNG_EXTB_UNICODE_END; /* Last ancient jungseong */
00181     params->jong_start = JONG_UNICODE_START - 1; /* One before first modern jongseong */
00182     params->jong_end = JONG_EXTB_UNICODE_END; /* Last ancient jongseong */
00183 }
00184 /* If starting code point for output Unifont hex file is specified. */
00185 else if (strcmp (argv [arg_count], "-c", 2) == 0) {
00186     arg_count++;
00187     if (arg_count < argc) {
00188         sscanf (argv [arg_count], "%X", &params->starting_codept);
00189     }
00190 }
00191 /* If initial consonant (choseong) range, "jamo 1", get range. */
00192 else if (strcmp (argv [arg_count], "-j1", 3) == 0) {
00193     arg_count++;
00194     if (arg_count < argc) {
00195         get_hex_range (argv [arg_count],
00196             &params->cho_start, &params->cho_end);
00197     }
00198     Allow one initial blank glyph at start of a loop, none at end.
00199     /*
00200         if (params->cho_start < CHO_UNICODE_START) {
00201             params->cho_start = CHO_UNICODE_START - 1;
00202         }
00203         else if (params->cho_start > CHO_UNICODE_END &&
00204             params->cho_start < CHO_EXTB_UNICODE_START) {
00205             params->cho_start = CHO_EXTB_UNICODE_START - 1;
00206         }
00207     */
00208     Do not go past desired Hangul choseong range,
00209     Hangul Jamo or Hangul Jamo Extended-A choseong.
00210     /*
00211         if (params->cho_end > CHO_EXTB_UNICODE_END) {
00212             params->cho_end = CHO_EXTB_UNICODE_END;
00213         }
00214         else if (params->cho_end > CHO_UNICODE_END &&
00215             params->cho_end < CHO_EXTB_UNICODE_START) {
00216             params->cho_end = CHO_UNICODE_END;
00217         }
00218     */
00219 }
00220 /* If medial vowel (jungseong) range, "jamo 2", get range. */
00221 else if (strcmp (argv [arg_count], "-j2", 3) == 0) {
00222     arg_count++;
00223     if (arg_count < argc) {
00224         get_hex_range (argv [arg_count],
00225             &params->jung_start, &params->jung_end);
00226     }
00227     Allow one initial blank glyph at start of a loop, none at end.
00228     /*
00229         if (params->jung_start < JUNG_UNICODE_START) {
00230             params->jung_start = JUNG_UNICODE_START - 1;
00231         }
00232         else if (params->jung_start > JUNG_UNICODE_END &&
00233             params->jung_start < JUNG_EXTB_UNICODE_START) {
00234             params->jung_start = JUNG_EXTB_UNICODE_START - 1;
00235         }
00236     */
00237     Do not go past desired Hangul jungseong range,
00238     Hangul Jamo or Hangul Jamo Extended-B jungseong.
00239     /*
00240         if (params->jung_end > JUNG_EXTB_UNICODE_END) {
00241             params->jung_end = JUNG_EXTB_UNICODE_END;
00242         }
00243         else if (params->jung_end > JUNG_UNICODE_END &&
00244             params->jung_end < JUNG_EXTB_UNICODE_START) {
00245             params->jung_end = JUNG_UNICODE_END;
00246         }
00247     */
00248 }
00249 /* If final consonant (jongseong) range, "jamo 3", get range. */
00250 else if (strcmp (argv [arg_count], "-j3", 3) == 0) {
00251     arg_count++;
00252     if (arg_count < argc) {
00253         get_hex_range (argv [arg_count],
00254             &params->jong_start, &params->jong_end);
00255     }
00256     Allow one initial blank glyph at start of a loop, none at end.

```

```

00257 */
00258     if (params->jong_start < JONG_UNICODE_START) {
00259         params->jong_start = JONG_UNICODE_START - 1;
00260     }
00261     else if (params->jong_start > JONG_UNICODE_END &&
00262             params->jong_start < JONG_EXTB_UNICODE_START) {
00263         params->jong_start = JONG_EXTB_UNICODE_START - 1;
00264     }
00265     /*
00266     Do not go past desired Hangul jongseong range,
00267     Hangul Jamo or Hangul Jamo Extended-B jongseong.
00268     */
00269     if (params->jong_end > JONG_EXTB_UNICODE_END) {
00270         params->jong_end = JONG_EXTB_UNICODE_END;
00271     }
00272     else if (params->jong_end > JONG_UNICODE_END &&
00273             params->jong_end < JONG_EXTB_UNICODE_START) {
00274         params->jong_end = JONG_UNICODE_END;
00275     }
00276 }
00277 }
00278 /* If input file is specified, open it for read access. */
00279 else if (strcmp (argv [arg_count], "-i", 2) == 0) {
00280     arg_count++;
00281     if (arg_count < argc) {
00282         params->infp = fopen (argv [arg_count], "r");
00283         if (params->infp == NULL) {
00284             fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00285                     argv [arg_count]);
00286             exit (EXIT_FAILURE);
00287         }
00288     }
00289 }
00290 /* If output file is specified, open it for write access. */
00291 else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00292     arg_count++;
00293     if (arg_count < argc) {
00294         params->outfp = fopen (argv [arg_count], "w");
00295         if (params->outfp == NULL) {
00296             fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00297                     argv [arg_count]);
00298             exit (EXIT_FAILURE);
00299         }
00300     }
00301 }
00302 /* If help is requested, print help message and exit. */
00303 else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00304         strcmp (argv [arg_count], "--help", 6) == 0) {
00305     printf ("nunigen-hangul [options]\n\n");
00306     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00307     printf ("    in Johab 6/3/1 format. By default, the output is the Unicode Hangul\n");
00308     printf ("    Syllables range, U+AC00..U+D7A3. Options allow the user to specify\n");
00309     printf ("    a starting code point for the output Unifont .hex file, and ranges\n");
00310     printf ("    in hexadecimal of the starting and ending Hangul Jamo code points:\n\n");
00311
00312     printf ("    * 1100-115E Initial consonants (choseong)\n");
00313     printf ("    * 1161-11A7 Medial vowels (jungseong)\n");
00314     printf ("    * 11A8-11FF Final consonants (jongseong).\n\n");
00315
00316     printf ("    A single code point or 0 to omit can be specified instead of a range.\n\n");
00317
00318     printf ("Option  Parameters  Function\n");
00319     printf ("-----  -\n");
00320     printf (" -h, --help      Print this message and exit.\n");
00321     printf (" -all            Generate all Hangul syllables, using all modern and\n");
00322     printf ("                ancient Hangul in the Unicode range U+1100..U+11FF,\n");
00323     printf ("                U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00324     printf ("                WARNING: this will generate over 1,600,000 syllables\n");
00325     printf ("                in a 115 megabyte Unifont .hex format file. The\n");
00326     printf ("                default is to only output modern Hangul syllables.\n");
00327     printf (" -c      code_point  Starting code point in hexadecimal for output file.\n");
00328     printf (" -j1     start-end   Choseong (jamo 1) start-end range in hexadecimal.\n");
00329     printf (" -j2     start-end   Jungseong (jamo 2) start-end range in hexadecimal.\n");
00330     printf (" -j3     start-end   Jongseong (jamo 3) start-end range in hexadecimal.\n");
00331     printf (" -i      input_file  Unifont hangul-base.hex formatted input file.\n");
00332     printf (" -o      output_file Unifont .hex format output file.\n\n");
00333     printf ("    Example:\n");
00334     printf ("    unigen-hangul -c 1 -j3 11AB-11AB -i hangul-base.hex -o nieun-only.hex\n");
00335     printf ("    Generates Hangul syllables using all modern choseong and jungseong,\n");
00336     printf ("    and only the jongseong nieun (Unicode code point U+11AB). The output\n");
00337     printf ("    Unifont .hex file will contain code points starting at 1. Instead of\n");

```

```

00338     printf ("    specifying \"-j3 11AB-11AB\", simply using \"-j3 11AB\" will also suffice.\n\n");
00339
00340     exit (EXIT_SUCCESS);
00341 }
00342
00343     arg_count++;
00344 }
00345
00346     return;
00347 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.28 unigen-hangul.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unigen-hangul.c
00003
00004  @brief Generate arbitrary hangul syllables.
00005
00006  Input is a Unifont .hex file such as the "hangul-base.hex" file that
00007  is included in the Unifont package.
00008
00009  The default program parameters will generate the Unicode
00010  Hangul Syllables range of U+AC00..U+D7A3. The syllables
00011  will appear in this order:
00012
00013  For each modern choseong {
00014  For each modern jungseong {
00015  Output syllable of choseong and jungseong
00016  For each modern jongseong {
00017  Output syllable of choseong + jungseong + jongseong
00018  }
00019  }
00020  }
00021
00022  By starting the jongseong code point at one before the first
00023  valid jongseong, the first inner loop iteration will add a
00024  blank glyph for the jongseong portion of the syllable, so
00025  only the current choseong and jungseong will be output first.
00026
00027  @author Paul Hardy
00028
00029  @copyright Copyright © 2023 Paul Hardy

```

```

00030 */
00031 /*
00032 LICENSE:
00033
00034 This program is free software: you can redistribute it and/or modify
00035 it under the terms of the GNU General Public License as published by
00036 the Free Software Foundation, either version 2 of the License, or
00037 (at your option) any later version.
00038
00039 This program is distributed in the hope that it will be useful,
00040 but WITHOUT ANY WARRANTY; without even the implied warranty of
00041 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00042 GNU General Public License for more details.
00043
00044 You should have received a copy of the GNU General Public License
00045 along with this program. If not, see <http://www.gnu.org/licenses/>.
00046 */
00047
00048 #include <stdio.h>
00049 #include <stdlib.h>
00050 #include "hangul.h"
00051
00052 // #define DEBUG
00053
00054
00055 struct PARAMS {
00056     unsigned starting_codept; /* First output Unicode code point. */
00057     unsigned cho_start, cho_end; /* Choseong start and end code points. */
00058     unsigned jung_start, jung_end; /* Jungseong start and end code points. */
00059     unsigned jong_start, jong_end; /* Jongseong start and end code points. */
00060     FILE *infp;
00061     FILE *outfp;
00062 };
00063
00064
00065 /**
00066 @brief Program entry point.
00067 */
00068 int
00069 main (int argc, char *argv[]) {
00070     int i; /* loop variable */
00071     unsigned codept;
00072     unsigned max_codept;
00073     unsigned glyph[MAX_GLYPHS][16];
00074     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00075     int cho, jung, jong; /* The 3 components in a Hangul syllable. */
00076
00077     /// Default parameters for Hangul syllable generation.
00078     struct PARAMS params = { 0xAC00, /* Starting output Unicode code point */
00079                             0x1100, /* First modern choseong */
00080                             0x1112, /* Last modern choseong */
00081                             0x1161, /* First modern jungseong */
00082                             0x1175, /* Last modern jungseong */
00083                             0x11A7, /* One before first modern jongseong */
00084                             0x11C2, /* Last modern jongseong */
00085                             stdin, /* Default input file pointer */
00086                             stdout /* Default output file pointer */
00087     };
00088
00089     void parse_args (int argc, char *argv[], struct PARAMS *params);
00090
00091     unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00092
00093     void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00094
00095     void combined_jamo (unsigned glyph [MAX_GLYPHS][16],
00096                        unsigned cho, unsigned jung, unsigned jong,
00097                        unsigned *combined_glyph);
00098
00099     if (argc > 1) {
00100         parse_args (argc, argv, &params);
00101     }
00102     #ifndef DEBUG
00103         fprintf (stderr,
00104                 "Range: (U+%04X, U+%04X, U+%04X) to (U+%04X, U+%04X, U+%04X)\n",
00105                 params.cho_start, params.jung_start, params.jong_start,
00106                 params.cho_end, params.jung_end, params.jong_end);
00107     #endif
00108 }

```

```

00111
00112  /*
00113 Initialize glyph array to all zeroes.
00114 */
00115 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00116     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00117 }
00118
00119  /*
00120 Read Hangul base glyph file.
00121 */
00122 max_codept = hangul_read_base16 (params.infp, glyph);
00123 if (max_codept > 0x8FFF) {
00124     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00125 }
00126
00127 codept = params.starting_codept; /* First code point to output */
00128
00129 for (cho = params.cho_start; cho <= params.cho_end; cho++) {
00130     for (jung = params.jung_start; jung <= params.jung_end; jung++) {
00131         for (jong = params.jong_start; jong <= params.jong_end; jong++) {
00132
00133 #ifdef DEBUG
00134             fprintf (params.outfp,
00135                     "(U+%04X, U+%04X, U+%04X)\n",
00136                     cho, jung, jong);
00137 #endif
00138             combined_jamo (glyph, cho, jung, jong, tmp_glyph);
00139             print_glyph_hex (params.outfp, codept, tmp_glyph);
00140             codept++;
00141             if (jong == JONG_UNICODE_END)
00142                 jong = JONG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00143         }
00144         if (jung == JUNG_UNICODE_END)
00145             jung = JUNG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00146     }
00147     if (cho == CHO_UNICODE_END)
00148         cho = CHO_EXTB_UNICODE_START - 1; /* Start Extended-A range */
00149 }
00150
00151 if (params.infp != stdin) fclose (params.infp);
00152 if (params.outfp != stdout) fclose (params.outfp);
00153
00154 exit (EXIT_SUCCESS);
00155 }
00156
00157
00158 /**
00159 @brief Parse command line arguments.
00160
00161 */
00162 void
00163 parse_args (int argc, char *argv[], struct PARAMS *params) {
00164     int arg_count; /* Current index into argv. */
00165
00166     void get_hex_range (char *instring, unsigned *start, unsigned *end);
00167
00168     int strncmp (const char *s1, const char *s2, size_t n);
00169
00170
00171     arg_count = 1;
00172
00173     while (arg_count < argc) {
00174         /* If all 600,000+ Hangul syllables are requested. */
00175         if (strcmp (argv [arg_count], "-all", 4) == 0) {
00176             params->starting_codept = 0x0001;
00177             params->cho_start = CHO_UNICODE_START; /* First modern choseong */
00178             params->cho_end = CHO_EXTB_UNICODE_END; /* Last ancient choseong */
00179             params->jung_start = JUNG_UNICODE_START; /* First modern jungseong */
00180             params->jung_end = JUNG_EXTB_UNICODE_END; /* Last ancient jungseong */
00181             params->jong_start = JONG_UNICODE_START - 1; /* One before first modern jongseong */
00182             params->jong_end = JONG_EXTB_UNICODE_END; /* Last ancient jongseong */
00183         }
00184         /* If starting code point for output Unifont hex file is specified. */
00185         else if (strcmp (argv [arg_count], "-c", 2) == 0) {
00186             arg_count++;
00187             if (arg_count < argc) {
00188                 sscanf (argv [arg_count], "%X", &params->starting_codept);
00189             }
00190         }
00191         /* If initial consonant (choseong) range, "jamo 1", get range. */

```

```

00192     else if (strcmp (argv [arg_count], "-j1", 3) == 0) {
00193         arg_count++;
00194         if (arg_count < argc) {
00195             get_hex_range (argv [arg_count],
00196                             &params->cho_start, &params->cho_end);
00197             /*
00198 Allow one initial blank glyph at start of a loop, none at end.
00199 */
00200             if (params->cho_start < CHO_UNICODE_START) {
00201                 params->cho_start = CHO_UNICODE_START - 1;
00202             }
00203             else if (params->cho_start > CHO_UNICODE_END &&
00204                     params->cho_start < CHO_EXT_A_UNICODE_START) {
00205                 params->cho_start = CHO_EXT_A_UNICODE_START - 1;
00206             }
00207             /*
00208 Do not go past desired Hangul choseong range,
00209 Hangul Jamo or Hangul Jamo Extended-A choseong.
00210 */
00211             if (params->cho_end > CHO_EXT_A_UNICODE_END) {
00212                 params->cho_end = CHO_EXT_A_UNICODE_END;
00213             }
00214             else if (params->cho_end > CHO_UNICODE_END &&
00215                     params->cho_end < CHO_EXT_A_UNICODE_START) {
00216                 params->cho_end = CHO_UNICODE_END;
00217             }
00218         }
00219     }
00220     /* If medial vowel (jungseong) range, "jamo 2", get range. */
00221     else if (strcmp (argv [arg_count], "-j2", 3) == 0) {
00222         arg_count++;
00223         if (arg_count < argc) {
00224             get_hex_range (argv [arg_count],
00225                             &params->jung_start, &params->jung_end);
00226             /*
00227 Allow one initial blank glyph at start of a loop, none at end.
00228 */
00229             if (params->jung_start < JUNG_UNICODE_START) {
00230                 params->jung_start = JUNG_UNICODE_START - 1;
00231             }
00232             else if (params->jung_start > JUNG_UNICODE_END &&
00233                     params->jung_start < JUNG_EXTB_UNICODE_START) {
00234                 params->jung_start = JUNG_EXTB_UNICODE_START - 1;
00235             }
00236             /*
00237 Do not go past desired Hangul jungseong range,
00238 Hangul Jamo or Hangul Jamo Extended-B jungseong.
00239 */
00240             if (params->jung_end > JUNG_EXTB_UNICODE_END) {
00241                 params->jung_end = JUNG_EXTB_UNICODE_END;
00242             }
00243             else if (params->jung_end > JUNG_UNICODE_END &&
00244                     params->jung_end < JUNG_EXTB_UNICODE_START) {
00245                 params->jung_end = JUNG_UNICODE_END;
00246             }
00247         }
00248     }
00249     /* If final consonant (jongseong) range, "jamo 3", get range. */
00250     else if (strcmp (argv [arg_count], "-j3", 3) == 0) {
00251         arg_count++;
00252         if (arg_count < argc) {
00253             get_hex_range (argv [arg_count],
00254                             &params->jong_start, &params->jong_end);
00255             /*
00256 Allow one initial blank glyph at start of a loop, none at end.
00257 */
00258             if (params->jong_start < JONG_UNICODE_START) {
00259                 params->jong_start = JONG_UNICODE_START - 1;
00260             }
00261             else if (params->jong_start > JONG_UNICODE_END &&
00262                     params->jong_start < JONG_EXTB_UNICODE_START) {
00263                 params->jong_start = JONG_EXTB_UNICODE_START - 1;
00264             }
00265             /*
00266 Do not go past desired Hangul jongseong range,
00267 Hangul Jamo or Hangul Jamo Extended-B jongseong.
00268 */
00269             if (params->jong_end > JONG_EXTB_UNICODE_END) {
00270                 params->jong_end = JONG_EXTB_UNICODE_END;
00271             }
00272             else if (params->jong_end > JONG_UNICODE_END &&

```

```

00273         params->jong_end < JONG_EXTB_UNICODE_START) {
00274     params->jong_end = JONG_UNICODE_END;
00275 }
00276 }
00277 }
00278 /* If input file is specified, open it for read access. */
00279 else if (strncmp (argv [arg_count], "-i", 2) == 0) {
00280     arg_count++;
00281     if (arg_count < argc) {
00282         params->infp = fopen (argv [arg_count], "r");
00283         if (params->infp == NULL) {
00284             fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00285                     argv [arg_count]);
00286             exit (EXIT_FAILURE);
00287         }
00288     }
00289 }
00290 /* If output file is specified, open it for write access. */
00291 else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00292     arg_count++;
00293     if (arg_count < argc) {
00294         params->outfp = fopen (argv [arg_count], "w");
00295         if (params->outfp == NULL) {
00296             fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00297                     argv [arg_count]);
00298             exit (EXIT_FAILURE);
00299         }
00300     }
00301 }
00302 /* If help is requested, print help message and exit. */
00303 else if (strncmp (argv [arg_count], "-h", 2) == 0 ||
00304          strncmp (argv [arg_count], "--help", 6) == 0) {
00305     printf ("\nunigen-hangul [options]\n\n");
00306     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00307     printf ("    in Johab 6/3/1 format.  By default, the output is the Unicode Hangul\n");
00308     printf ("    Syllables range, U+A000..U+D7A3.  Options allow the user to specify\n");
00309     printf ("    a starting code point for the output Unifont .hex file, and ranges\n");
00310     printf ("    in hexadecimal of the starting and ending Hangul Jamo code points:\n\n");
00311
00312     printf ("        * 1100-115E Initial consonants (choseong)\n");
00313     printf ("        * 1161-11A7 Medial vowels (jungseong)\n");
00314     printf ("        * 11A8-11FF Final consonants (jongseong).\n\n");
00315
00316     printf ("    A single code point or 0 to omit can be specified instead of a range.\n\n");
00317
00318     printf ("    Option  Parameters  Function\n");
00319     printf ("    -----\n");
00320     printf ("    -h, --help          Print this message and exit.\n\n");
00321     printf ("    -all                Generate all Hangul syllables, using all modern and\n");
00322     printf ("                        ancient Hangul in the Unicode range U+1100..U+11FF,\n");
00323     printf ("                        U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00324     printf ("                        WARNING: this will generate over 1,600,000 syllables\n");
00325     printf ("                        in a 115 megabyte Unifont .hex format file.  The\n");
00326     printf ("                        default is to only output modern Hangul syllables.\n\n");
00327     printf ("    -c    code_point    Starting code point in hexadecimal for output file.\n\n");
00328     printf ("    -j1    start-end     Choseong (jamo 1) start-end range in hexadecimal.\n\n");
00329     printf ("    -j2    start-end     Jungseong (jamo 2) start-end range in hexadecimal.\n\n");
00330     printf ("    -j3    start-end     Jongseong (jamo 3) start-end range in hexadecimal.\n\n");
00331     printf ("    -i    input_file     Unifont hangul-base.hex formatted input file.\n\n");
00332     printf ("    -o    output_file     Unifont .hex format output file.\n\n");
00333     printf ("    Example:\n\n");
00334     printf ("    unigen-hangul -c 1 -j3 11AB-11AB -i hangul-base.hex -o nieun-only.hex\n\n");
00335     printf ("    Generates Hangul syllables using all modern choseong and jungseong,\n");
00336     printf ("    and only the jongseong nieun (Unicode code point U+11AB).  The output\n");
00337     printf ("    Unifont .hex file will contain code points starting at 1.  Instead of\n");
00338     printf ("    specifying \"-j3 11AB-11AB\", simply using \"-j3 11AB\" will also suffice.\n\n");
00339
00340     exit (EXIT_SUCCESS);
00341 }
00342
00343     arg_count++;
00344 }
00345
00346 return;
00347 }
00348
00349
00350 /**
00351 @brief Scan a hexadecimal range from a character string.
00352 */
00353 void

```

```

00354 get_hex_range (char *instring, unsigned *start, unsigned *end) {
00355
00356     int i; /* String index variable. */
00357
00358     /* Get first number in range. */
00359     sscanf (instring, "%X", start);
00360     for (i = 0;
00361          instring [i] != '\0' && instring [i] != '-';
00362          i++);
00363     /* Get last number in range. */
00364     if (instring [i] == '-') {
00365         i++;
00366         sscanf (&instring [i], "%X", end);
00367     }
00368     else {
00369         *end = *start;
00370     }
00371
00372     return;
00373 }

```

5.29 src/unigencircles.c File Reference

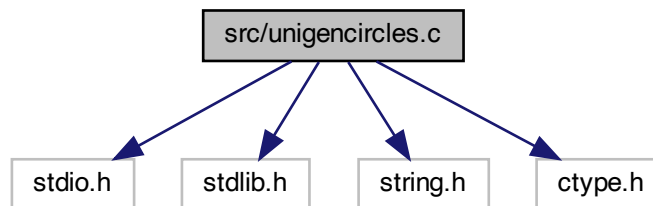
unigencircles - Superimpose dashed combining circles on combining glyphs

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>

```

Include dependency graph for unigencircles.c:



Macros

- `#define` [MAXSTRING](#) 256
Maximum input line length - 1.

Functions

- `int` [main](#) (int argc, char **argv)
The main function.
- `void` [add_single_circle](#) (char *glyphstring)
Superimpose a single-width dashed combining circle on a glyph bitmap.
- `void` [add_double_circle](#) (char *glyphstring, int offset)
Superimpose a double-width dashed combining circle on a glyph bitmap.

5.29.1 Detailed Description

unigencircles - Superimpose dashed combining circles on combining glyphs

Author

Paul Hardy

Copyright

Copyright (C) 2013, Paul Hardy.

Definition in file [unigencircles.c](#).

5.29.2 Macro Definition Documentation

5.29.2.1 MAXSTRING

```
#define MAXSTRING 256
```

Maximum input line length - 1.

Definition at line [62](#) of file [unigencircles.c](#).

5.29.3 Function Documentation

5.29.3.1 add_double_circle()

```
void add_double_circle (
    char * glyphstring,
    int offset )
```

Superimpose a double-width dashed combining circle on a glyph bitmap.

Parameters

in,out	glyphstring	A double-width glyph, 16x16 pixels.
--------	-------------	-------------------------------------

Definition at line [221](#) of file [unigencircles.c](#).

```
00222 {
00223
00224     char newstring[256];
00225     /* Circle hex string pattern is "00000008000024004200240000000000" */
00226
00227     /* For double diacritical glyphs (offset = -8) */
00228     /* Combining circle is left-justified. */
00229     char circle08[64]={0x0,0x0,0x0,0x0, /* row 1 */
00230                        0x0,0x0,0x0,0x0, /* row 2 */
00231                        0x0,0x0,0x0,0x0, /* row 3 */
00232                        0x0,0x0,0x0,0x0, /* row 4 */
00233                        0x0,0x0,0x0,0x0, /* row 5 */
00234                        0x0,0x0,0x0,0x0, /* row 6 */
00235                        0x2,0x4,0x0,0x0, /* row 7 */
00236                        0x0,0x0,0x0,0x0, /* row 8 */
00237                        0x4,0x2,0x0,0x0, /* row 9 */
00238                        0x0,0x0,0x0,0x0, /* row 10 */
```

```

00239         0x2,0x4,0x0,0x0, /* row 11 */
00240         0x0,0x0,0x0,0x0, /* row 12 */
00241         0x0,0x0,0x0,0x0, /* row 13 */
00242         0x0,0x0,0x0,0x0, /* row 14 */
00243         0x0,0x0,0x0,0x0, /* row 15 */
00244         0x0,0x0,0x0,0x0}; /* row 16 */
00245
00246 /* For all other combining glyphs (offset = -16) */
00247 /* Combining circle is centered in 16 columns. */
00248 char circle16[64]={0x0,0x0,0x0,0x0, /* row 1 */
00249                   0x0,0x0,0x0,0x0, /* row 2 */
00250                   0x0,0x0,0x0,0x0, /* row 3 */
00251                   0x0,0x0,0x0,0x0, /* row 4 */
00252                   0x0,0x0,0x0,0x0, /* row 5 */
00253                   0x0,0x0,0x0,0x0, /* row 6 */
00254                   0x0,0x2,0x4,0x0, /* row 7 */
00255                   0x0,0x0,0x0,0x0, /* row 8 */
00256                   0x0,0x4,0x2,0x0, /* row 9 */
00257                   0x0,0x0,0x0,0x0, /* row 10 */
00258                   0x0,0x2,0x4,0x0, /* row 11 */
00259                   0x0,0x0,0x0,0x0, /* row 12 */
00260                   0x0,0x0,0x0,0x0, /* row 13 */
00261                   0x0,0x0,0x0,0x0, /* row 14 */
00262                   0x0,0x0,0x0,0x0, /* row 15 */
00263                   0x0,0x0,0x0,0x0}; /* row 16 */
00264
00265 char *circle; /* points into circle16 or circle08 */
00266
00267 int digit1, digit2; /* corresponding digits in each string */
00268
00269 int i; /* index variables */
00270
00271
00272 /*
00273 Determine if combining circle is left-justified (offset = -8)
00274 or centered (offset = -16).
00275 */
00276 circle = (offset >= -8) ? circle08 : circle16;
00277
00278 /* for each character position, OR the corresponding circle glyph value */
00279 for (i = 0; i < 64; i++) {
00280     glyphstring[i] = toupper (glyphstring[i]);
00281
00282     /* Convert ASCII character to a hexadecimal integer */
00283     digit1 = (glyphstring[i] <= '9') ?
00284             (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00285
00286     /* Superimpose dashed circle */
00287     digit2 = digit1 | circle[i];
00288
00289     /* Convert hexadecimal integer to an ASCII character */
00290     newstring[i] = (digit2 <= 9) ?
00291                   ('0' + digit2) : ('A' + digit2 - 0xA);
00292 }
00293
00294 /* Terminate string for output */
00295 newstring[i++] = '\n';
00296 newstring[i++] = '\0';
00297
00298 memcpy (glyphstring, newstring, i);
00299
00300 return;
00301 }

```

Here is the caller graph for this function:



5.29.3.2 add_single_circle()

```
void add_single_circle (
    char * glyphstring )
```

Superimpose a single-width dashed combining circle on a glyph bitmap.

Parameters

in,out	glyphstring	A single- width glyph, 8x16 pixels.
--------	-------------	--

Definition at line 163 of file [unigencircles.c](#).

```
00164 {
00165
00166     char newstring[256];
00167     /* Circle hex string pattern is "00000008000024004200240000000000" */
00168     char circle[32]={0x0,0x0, /* row 1 */
00169                     0x0,0x0, /* row 2 */
00170                     0x0,0x0, /* row 3 */
00171                     0x0,0x0, /* row 4 */
00172                     0x0,0x0, /* row 5 */
00173                     0x0,0x0, /* row 6 */
00174                     0x2,0x4, /* row 7 */
00175                     0x0,0x0, /* row 8 */
00176                     0x4,0x2, /* row 9 */
00177                     0x0,0x0, /* row 10 */
00178                     0x2,0x4, /* row 11 */
00179                     0x0,0x0, /* row 12 */
00180                     0x0,0x0, /* row 13 */
00181                     0x0,0x0, /* row 14 */
00182                     0x0,0x0, /* row 15 */
00183                     0x0,0x0}; /* row 16 */
00184
00185     int digit1, digit2; /* corresponding digits in each string */
00186
00187     int i; /* index variables */
00188
00189     /* for each character position, OR the corresponding circle glyph value */
00190     for (i = 0; i < 32; i++) {
00191         glyphstring[i] = toupper (glyphstring[i]);
00192
00193         /* Convert ASCII character to a hexadecimal integer */
00194         digit1 = (glyphstring[i] <= '9') ?
00195                 (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00196
00197         /* Superimpose dashed circle */
00198         digit2 = digit1 | circle[i];
00199
00200         /* Convert hexadecimal integer to an ASCII character */
00201         newstring[i] = (digit2 <= 9) ?
00202                 ('0' + digit2) : ('A' + digit2 - 0xA);
00203     }
00204
00205     /* Terminate string for output */
00206     newstring[i++] = '\n';
00207     newstring[i++] = '\0';
00208
00209     memcpy (glyphstring, newstring, i);
00210
00211     return;
00212 }
```

Here is the caller graph for this function:



5.29.3.3 main()

```
int main (
    int argc,
    char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 73 of file [unigencircles.c](#).

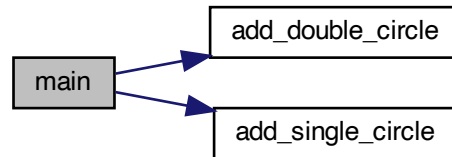
```
00074 {
00075
00076 char teststring[MAXSTRING]; /* current input line */
00077 int loc; /* Unicode code point of current input line */
00078 int offset; /* offset value of a combining character */
00079 char *gstart; /* glyph start, pointing into teststring */
00080
00081 char combining[0x110000]; /* 1 --> combining glyph; 0 --> non-combining */
00082 char x_offset [0x110000]; /* second value in *combining.txt files */
00083
00084 void add_single_circle(char *); /* add a single-width dashed circle */
00085 void add_double_circle(char *, int); /* add a double-width dashed circle */
00086
00087 FILE *infilep;
```

```

00088
00089 /*
00090 if (argc != 3) {
00091 fprintf (stderr,
00092 "\n\nUsage: %s combining.txt nonprinting.hex < unifont.hex > unifontfull.hex\n\n");
00093 exit (EXIT_FAILURE);
00094 }
00095 */
00096
00097 /*
00098 Read the combining characters list.
00099 */
00100 /* Start with no combining code points flagged */
00101 memset (combining, 0, 0x110000 * sizeof (char));
00102 memset (x_offset, 0, 0x110000 * sizeof (char));
00103
00104 if ((infilep = fopen (argv[1], "r")) == NULL) {
00105     fprintf (stderr, "ERROR - combining characters file %s not found.\n\n",
00106             argv[1]);
00107     exit (EXIT_FAILURE);
00108 }
00109
00110 /* Flag list of combining characters to add a dashed circle. */
00111 while (fscanf (infilep, "%X:%d", &loc, &offset) != EOF) {
00112     /*
00113     U+01107F and U+01D1A0 are not defined as combining characters
00114     in Unicode; they were added in a combining.txt file as the
00115     only way to make them look acceptable in proximity to other
00116     glyphs in their script.
00117     */
00118     if (loc != 0x01107F && loc != 0x01D1A0) {
00119         combining[loc] = 1;
00120         x_offset [loc] = offset;
00121     }
00122 }
00123 fclose (infilep); /* all done reading combining.txt */
00124
00125 /* Now read the non-printing glyphs; they never have dashed circles */
00126 if ((infilep = fopen (argv[2], "r")) == NULL) {
00127     fprintf (stderr, "ERROR - nonprinting characters file %s not found.\n\n",
00128             argv[1]);
00129     exit (EXIT_FAILURE);
00130 }
00131
00132 /* Reset list of nonprinting characters to avoid adding a dashed circle. */
00133 while (fscanf (infilep, "%X:%s", &loc) != EOF) combining[loc] = 0;
00134
00135 fclose (infilep); /* all done reading nonprinting.hex */
00136
00137 /*
00138 Read the hex glyphs.
00139 */
00140 teststring[MAXSTRING - 1] = '\0'; /* so there's no chance we leave array */
00141 while (fgets (teststring, MAXSTRING-1, stdin) != NULL) {
00142     sscanf (teststring, "%X", &loc); /* loc == the Unicode code point */
00143     gstart = strchr (teststring, ':') + 1; /* start of glyph bitmap */
00144     if (combining[loc]) { /* if a combining character */
00145         if (strlen (gstart) < 35)
00146             add_single_circle (gstart); /* single-width */
00147         else
00148             add_double_circle (gstart, x_offset[loc]); /* double-width */
00149     }
00150     printf ("%s", teststring); /* output the new character .hex string */
00151 }
00152
00153 exit (EXIT_SUCCESS);
00154 }

```

Here is the call graph for this function:



5.30 unigencircles.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unigencircles.c
00003
00004  @brief unigencircles - Superimpose dashed combining circles
00005  on combining glyphs
00006
00007  @author Paul Hardy
00008
00009  @copyright Copyright (C) 2013, Paul Hardy.
00010  */
00011 /*
00012  LICENSE:
00013
00014  This program is free software: you can redistribute it and/or modify
00015  it under the terms of the GNU General Public License as published by
00016  the Free Software Foundation, either version 2 of the License, or
00017  (at your option) any later version.
00018
00019  This program is distributed in the hope that it will be useful,
00020  but WITHOUT ANY WARRANTY; without even the implied warranty of
00021  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00022  GNU General Public License for more details.
00023
00024  You should have received a copy of the GNU General Public License
00025  along with this program. If not, see <http://www.gnu.org/licenses/>.
00026  */
00027
00028 /*
00029  8 July 2017 [Paul Hardy]:
00030  - Reads new second field that contains an x-axis offset for
00031  each combining character in "combining.txt" files.
00032  - Uses the above x-axis offset value for a combining character
00033  to print combining circle in the left half of a double
00034  diacritic combining character grid, or in the center for
00035  other combining characters.
00036  - Adds exceptions for U+01107F (Brahmi number joiner) and
00037  U+01D1A0 (vertical stroke musical ornament); they are in
00038  a combining.txt file for positioning, but are not actually
00039  Unicode combining characters.
00040  - Typo fix: "single-width"-->"double-width" in comment for
00041  add_double_circle function.
00042
00043  12 August 2017 [Paul Hardy]:
00044  - Hard-code Miao vowels to show combining circles after
00045  removing them from font/plane01/plane01-combining.txt.
00046
00047  26 December 2017 [Paul Hardy]:
00048  - Remove Miao hard-coding; they are back in unibmp2hex.c and
00049  in font/plane01/plane01-combining.txt.
00050
00051  11 May 2019 [Paul Hardy]:
00052  - Changed strncpy calls to mempcpy calls to avoid a compiler
00053  warning.
  
```

```

00054 */
00055
00056
00057 #include <stdio.h>
00058 #include <stdlib.h>
00059 #include <string.h>
00060 #include <ctype.h>
00061
00062 #define MAXSTRING 256 ///< Maximum input line length - 1.
00063
00064
00065 /**
00066 @brief The main function.
00067
00068 @param[in] argc The count of command line arguments.
00069 @param[in] argv Pointer to array of command line arguments.
00070 @return This program exits with status EXIT_SUCCESS.
00071 */
00072 int
00073 main (int argc, char **argv)
00074 {
00075
00076     char teststring[MAXSTRING]; /* current input line */
00077     int loc; /* Unicode code point of current input line */
00078     int offset; /* offset value of a combining character */
00079     char *gstart; /* glyph start, pointing into teststring */
00080
00081     char combining[0x110000]; /* 1 --> combining glyph; 0 --> non-combining */
00082     char x_offset[0x110000]; /* second value in *combining.txt files */
00083
00084     void add_single_circle(char *); /* add a single-width dashed circle */
00085     void add_double_circle(char *, int); /* add a double-width dashed circle */
00086
00087     FILE *infilep;
00088
00089     /*
00090     if (argc != 3) {
00091         fprintf (stderr,
00092             "\n\nUsage: %s combining.txt nonprinting.hex < unifont.hex > unifontfull.hex\n\n");
00093         exit (EXIT_FAILURE);
00094     }
00095     */
00096
00097     /*
00098     Read the combining characters list.
00099     */
00100     /* Start with no combining code points flagged */
00101     memset (combining, 0, 0x110000 * sizeof (char));
00102     memset (x_offset, 0, 0x110000 * sizeof (char));
00103
00104     if ((infilep = fopen (argv[1], "r")) == NULL) {
00105         fprintf (stderr, "ERROR - combining characters file %s not found.\n\n",
00106             argv[1]);
00107         exit (EXIT_FAILURE);
00108     }
00109
00110     /* Flag list of combining characters to add a dashed circle. */
00111     while (fscanf (infilep, "%X:%d", &loc, &offset) != EOF) {
00112         /*
00113         U+01107F and U+01D1A0 are not defined as combining characters
00114         in Unicode; they were added in a combining.txt file as the
00115         only way to make them look acceptable in proximity to other
00116         glyphs in their script.
00117         */
00118         if (loc != 0x01107F && loc != 0x01D1A0) {
00119             combining[loc] = 1;
00120             x_offset[loc] = offset;
00121         }
00122     }
00123     fclose (infilep); /* all done reading combining.txt */
00124
00125     /* Now read the non-printing glyphs; they never have dashed circles */
00126     if ((infilep = fopen (argv[2], "r")) == NULL) {
00127         fprintf (stderr, "ERROR - nonprinting characters file %s not found.\n\n",
00128             argv[1]);
00129         exit (EXIT_FAILURE);
00130     }
00131
00132     /* Reset list of nonprinting characters to avoid adding a dashed circle. */
00133     while (fscanf (infilep, "%X:%s", &loc) != EOF) combining[loc] = 0;
00134

```

```

00135  fclose (infilep); /* all done reading nonprinting.hex */
00136
00137  /*
00138  Read the hex glyphs.
00139  */
00140  teststring[MAXSTRING - 1] = '\0'; /* so there's no chance we leave array */
00141  while (fgets (teststring, MAXSTRING-1, stdin) != NULL) {
00142      sscanf (teststring, "%X", &loc); /* loc == the Unicode code point */
00143      gstart = strchr (teststring, ':') + 1; /* start of glyph bitmap */
00144      if (combining[loc]) { /* if a combining character */
00145          if (strlen (gstart) < 35)
00146              add_single_circle (gstart); /* single-width */
00147          else
00148              add_double_circle (gstart, x_offset[loc]); /* double-width */
00149      }
00150      printf ("%s", teststring); /* output the new character .hex string */
00151  }
00152
00153  exit (EXIT_SUCCESS);
00154 }
00155
00156 /**
00157 @brief Superimpose a single-width dashed combining circle on a glyph bitmap.
00158
00159 @param[in,out] glyphstring A single-width glyph, 8x16 pixels.
00160 */
00161 void
00162 add_single_circle (char *glyphstring)
00163 {
00164     char newstring[256];
00165     /* Circle hex string pattern is "00000008000024004200240000000000" */
00166     char circle[32]={0x0,0x0, /* row 1 */
00167                     0x0,0x0, /* row 2 */
00168                     0x0,0x0, /* row 3 */
00169                     0x0,0x0, /* row 4 */
00170                     0x0,0x0, /* row 5 */
00171                     0x0,0x0, /* row 6 */
00172                     0x2,0x4, /* row 7 */
00173                     0x0,0x0, /* row 8 */
00174                     0x4,0x2, /* row 9 */
00175                     0x0,0x0, /* row 10 */
00176                     0x2,0x4, /* row 11 */
00177                     0x0,0x0, /* row 12 */
00178                     0x0,0x0, /* row 13 */
00179                     0x0,0x0, /* row 14 */
00180                     0x0,0x0, /* row 15 */
00181                     0x0,0x0}; /* row 16 */
00182
00183     int digit1, digit2; /* corresponding digits in each string */
00184
00185     int i; /* index variables */
00186
00187     /* for each character position, OR the corresponding circle glyph value */
00188     for (i = 0; i < 32; i++) {
00189         glyphstring[i] = toupper (glyphstring[i]);
00190         /* Convert ASCII character to a hexadecimal integer */
00191         digit1 = (glyphstring[i] <= '9') ?
00192             (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00193
00194         /* Superimpose dashed circle */
00195         digit2 = digit1 | circle[i];
00196
00197         /* Convert hexadecimal integer to an ASCII character */
00198         newstring[i] = (digit2 <= 9) ?
00199             ('0' + digit2) : ('A' + digit2 - 0xA);
00200     }
00201
00202     /* Terminate string for output */
00203     newstring[i++] = '\n';
00204     newstring[i++] = '\0';
00205
00206     memcpy (glyphstring, newstring, i);
00207
00208     return;
00209 }
00210
00211 /**

```

```

00216 @brief Superimpose a double-width dashed combining circle on a glyph bitmap.
00217
00218 @param[in,out] glyphstring A double-width glyph, 16x16 pixels.
00219 */
00220 void
00221 add_double_circle(char *glyphstring, int offset)
00222 {
00223     char newstring[256];
00224     /* Circle hex string pattern is "00000008000024004200240000000000" */
00225     /* For double diacritical glyphs (offset = -8) */
00226     /* Combining circle is left-justified. */
00227     char circle08[64] = {0x0,0x0,0x0,0x0, /* row 1 */
00228                          0x0,0x0,0x0,0x0, /* row 2 */
00229                          0x0,0x0,0x0,0x0, /* row 3 */
00230                          0x0,0x0,0x0,0x0, /* row 4 */
00231                          0x0,0x0,0x0,0x0, /* row 5 */
00232                          0x0,0x0,0x0,0x0, /* row 6 */
00233                          0x2,0x4,0x0,0x0, /* row 7 */
00234                          0x0,0x0,0x0,0x0, /* row 8 */
00235                          0x4,0x2,0x0,0x0, /* row 9 */
00236                          0x0,0x0,0x0,0x0, /* row 10 */
00237                          0x2,0x4,0x0,0x0, /* row 11 */
00238                          0x0,0x0,0x0,0x0, /* row 12 */
00239                          0x0,0x0,0x0,0x0, /* row 13 */
00240                          0x0,0x0,0x0,0x0, /* row 14 */
00241                          0x0,0x0,0x0,0x0, /* row 15 */
00242                          0x0,0x0,0x0,0x0}; /* row 16 */
00243
00244     /* For all other combining glyphs (offset = -16) */
00245     /* Combining circle is centered in 16 columns. */
00246     char circle16[64] = {0x0,0x0,0x0,0x0, /* row 1 */
00247                          0x0,0x0,0x0,0x0, /* row 2 */
00248                          0x0,0x0,0x0,0x0, /* row 3 */
00249                          0x0,0x0,0x0,0x0, /* row 4 */
00250                          0x0,0x0,0x0,0x0, /* row 5 */
00251                          0x0,0x0,0x0,0x0, /* row 6 */
00252                          0x0,0x2,0x4,0x0, /* row 7 */
00253                          0x0,0x0,0x0,0x0, /* row 8 */
00254                          0x0,0x4,0x2,0x0, /* row 9 */
00255                          0x0,0x0,0x0,0x0, /* row 10 */
00256                          0x0,0x2,0x4,0x0, /* row 11 */
00257                          0x0,0x0,0x0,0x0, /* row 12 */
00258                          0x0,0x0,0x0,0x0, /* row 13 */
00259                          0x0,0x0,0x0,0x0, /* row 14 */
00260                          0x0,0x0,0x0,0x0, /* row 15 */
00261                          0x0,0x0,0x0,0x0}; /* row 16 */
00262
00263     char *circle; /* points into circle16 or circle08 */
00264
00265     int digit1, digit2; /* corresponding digits in each string */
00266
00267     int i; /* index variables */
00268
00269     /*
00270     Determine if combining circle is left-justified (offset = -8)
00271     or centered (offset = -16).
00272     */
00273     circle = (offset >= -8) ? circle08 : circle16;
00274
00275     /* for each character position, OR the corresponding circle glyph value */
00276     for (i = 0; i < 64; i++) {
00277         glyphstring[i] = toupper (glyphstring[i]);
00278
00279         /* Convert ASCII character to a hexadecimal integer */
00280         digit1 = (glyphstring[i] <= '9') ?
00281             (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00282
00283         /* Superimpose dashed circle */
00284         digit2 = digit1 | circle[i];
00285
00286         /* Convert hexadecimal integer to an ASCII character */
00287         newstring[i] = (digit2 <= 9) ?
00288             ('0' + digit2) : ('A' + digit2 - 0xA);
00289     }
00290
00291     /* Terminate string for output */
00292     newstring[i++] = '\n';
00293     newstring[i++] = '\0';

```

```
00297
00298     memcpy (glyphstring, newstring, i);
00299
00300     return;
00301 }
00302
```

5.31 src/unigenwidth.c File Reference

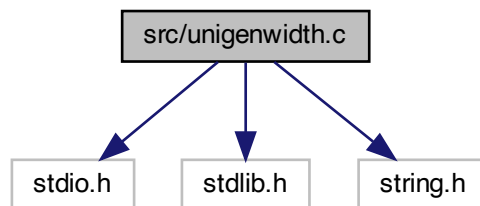
unigenwidth - IEEE 1003.1-2008 setup to calculate wchar_t string widths

#include <stdio.h>

#include <stdlib.h>

#include <string.h>

Include dependency graph for unigenwidth.c:



Macros

- #define `MAXSTRING` 256
Maximum input line length - 1.
- #define `PIKTO_START` 0x0F0E70
Start of Pikto code point range.
- #define `PIKTO_END` 0x0F11EF
End of Pikto code point range.
- #define `PIKTO_SIZE` (`PIKTO_END` - `PIKTO_START` + 1)

Functions

- int `main` (int argc, char **argv)
The main function.

5.31.1 Detailed Description

unigenwidth - IEEE 1003.1-2008 setup to calculate wchar_t string widths

Author

Paul Hardy.

Copyright

Copyright (C) 2013, 2017 Paul Hardy.

All glyphs are treated as 16 pixels high, and can be 8, 16, 24, or 32 pixels wide (resulting in widths of 1, 2, 3, or 4, respectively).

Definition in file [unigenwidth.c](#).

5.31.2 Macro Definition Documentation

5.31.2.1 MAXSTRING

```
#define MAXSTRING 256
```

Maximum input line length - 1.

Definition at line [46](#) of file [unigenwidth.c](#).

5.31.2.2 PIKTO__END

```
#define PIKTO__END 0x0F11EF
```

End of Pikto code point range.

Definition at line [50](#) of file [unigenwidth.c](#).

5.31.2.3 PIKTO__SIZE

```
#define PIKTO__SIZE (PIKTO__END - PIKTO__START + 1)
```

Number of code points in Pikto range.

Definition at line [52](#) of file [unigenwidth.c](#).

5.31.2.4 PIKTO__START

```
#define PIKTO__START 0x0F0E70
```

Start of Pikto code point range.

Definition at line [49](#) of file [unigenwidth.c](#).

5.31.3 Function Documentation

5.31.3.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 63 of file [unigenwidth.c](#).

```

00064 {
00065
00066     int i; /* loop variable */
00067
00068     char teststring[MAXSTRING];
00069     int loc;
00070     char *gstart;
00071
00072     char glyph_width[0x20000];
00073     char pikto_width[PIKTO_SIZE];
00074
00075     FILE *infilep;
00076
00077     if (argc != 3) {
00078         fprintf (stderr, "\n\nUsage: %s <unifont.hex> <combining.txt>\n\n", argv[0]);
00079         exit (EXIT_FAILURE);
00080     }
00081
00082     /*
00083     Read the collection of hex glyphs.
00084     */
00085     if ((infilep = fopen (argv[1], "r")) == NULL) {
00086         fprintf (stderr, "ERROR - hex input file %s not found.\n\n", argv[1]);
00087         exit (EXIT_FAILURE);
00088     }
00089
00090     /* Flag glyph as non-existent until found. */
00091     memset (glyph_width, -1, 0x20000 * sizeof (char));
00092     memset (pikto_width, -1, (PIKTO_SIZE) * sizeof (char));
00093
00094     teststring[MAXSTRING-1] = '\0';
00095     while (fgets (teststring, MAXSTRING-1, infilep) != NULL) {
00096         sscanf (teststring, "%X:%s", &loc);
00097         if (loc < 0x20000) {
00098             gstart = strchr (teststring, ':') + 1;
00099             /*
00100             16 rows per glyph, 2 ASCII hexadecimal digits per byte,
00101             so divide number of digits by 32 (shift right 5 bits).
00102             */
00103             glyph_width[loc] = (strlen (gstart) - 1) » 5;
00104         }
00105         else if ((loc >= PIKTO_START) && (loc <= PIKTO_END)) {
00106             gstart = strchr (teststring, ':') + 1;
00107             pikto_width[loc - PIKTO_START] = strlen (gstart) <= 34 ? 1 : 2;
00108         }
00109     }

```

```

00110
00111     fclose (infilefp);
00112
00113     /*
00114     Now read the combining character code points.  These have width of 0.
00115     */
00116     if ((infilefp = fopen (argv[2], "r")) == NULL) {
00117         fprintf (stderr, "ERROR - combining characters file %s not found.\n\n", argv[2]);
00118         exit (EXIT_FAILURE);
00119     }
00120
00121     while (fgets (teststring, MAXSTRING-1, infilefp) != NULL) {
00122         sscanf (teststring, "%X:%s", &loc);
00123         if (loc < 0x20000) glyph_width[loc] = 0;
00124     }
00125
00126     fclose (infilefp);
00127
00128     /*
00129     Code Points with Unusual Properties (Unicode Standard, Chapter 4).
00130
00131     As of Unifont 10.0.04, use the widths in the "nonprinting.hex"
00132     files.  If an application is smart enough to know how to handle
00133     these special cases, it will not render the "nonprinting" glyph
00134     and will treat the code point as being zero-width.
00135     */
00136     // glyph_width[0]=0; /* NULL character */
00137     // for (i = 0x0001; i <= 0x001F; i++) glyph_width[i]=-1; /* Control Characters */
00138     // for (i = 0x007F; i <= 0x009F; i++) glyph_width[i]=-1; /* Control Characters */
00139
00140     // glyph_width[0x034F]=0; /* combining grapheme joiner */
00141     // glyph_width[0x180B]=0; /* Mongolian free variation selector one */
00142     // glyph_width[0x180C]=0; /* Mongolian free variation selector two */
00143     // glyph_width[0x180D]=0; /* Mongolian free variation selector three */
00144     // glyph_width[0x180E]=0; /* Mongolian vowel separator */
00145     // glyph_width[0x200B]=0; /* zero width space */
00146     // glyph_width[0x200C]=0; /* zero width non-joiner */
00147     // glyph_width[0x200D]=0; /* zero width joiner */
00148     // glyph_width[0x200E]=0; /* left-to-right mark */
00149     // glyph_width[0x200F]=0; /* right-to-left mark */
00150     // glyph_width[0x202A]=0; /* left-to-right embedding */
00151     // glyph_width[0x202B]=0; /* right-to-left embedding */
00152     // glyph_width[0x202C]=0; /* pop directional formatting */
00153     // glyph_width[0x202D]=0; /* left-to-right override */
00154     // glyph_width[0x202E]=0; /* right-to-left override */
00155     // glyph_width[0x2060]=0; /* word joiner */
00156     // glyph_width[0x2061]=0; /* function application */
00157     // glyph_width[0x2062]=0; /* invisible times */
00158     // glyph_width[0x2063]=0; /* invisible separator */
00159     // glyph_width[0x2064]=0; /* invisible plus */
00160     // glyph_width[0x206A]=0; /* inhibit symmetric swapping */
00161     // glyph_width[0x206B]=0; /* activate symmetric swapping */
00162     // glyph_width[0x206C]=0; /* inhibit arabic form shaping */
00163     // glyph_width[0x206D]=0; /* activate arabic form shaping */
00164     // glyph_width[0x206E]=0; /* national digit shapes */
00165     // glyph_width[0x206F]=0; /* nominal digit shapes */
00166
00167     // /* Variation Selector-1 to Variation Selector-16 */
00168     // for (i = 0xFE00; i <= 0xFE0F; i++) glyph_width[i] = 0;
00169
00170     // glyph_width[0xFEFF]=0; /* zero width no-break space */
00171     // glyph_width[0xFFFF9]=0; /* interlinear annotation anchor */
00172     // glyph_width[0xFFFFA]=0; /* interlinear annotation separator */
00173     // glyph_width[0xFFFFB]=0; /* interlinear annotation terminator */
00174     /*
00175     Let glyph widths represent 0xFFFC (object replacement character)
00176     and 0xFFFFD (replacement character).
00177     */
00178
00179     /*
00180     Hangul Jamo:
00181
00182     Leading Consonant (Choseong): leave spacing as is.
00183
00184     Hangul Choseong Filler (U+115F): set width to 2.
00185
00186     Hangul Jungseong Filler, Hangul Vowel (Jungseong), and
00187     Final Consonant (Jongseong): set width to 0, because these
00188     combine with the leading consonant as one composite syllabic
00189     glyph.  As of Unicode 5.2, the Hangul Jamo block (U+1100..U+11FF)
00190     is completely filled.

```

```

00191 */
00192 // for (i = 0x1160; i <= 0x11FF; i++) glyph_width[i]=0; /* Vowels & Final Consonants */
00193
00194 /*
00195 Private Use Area -- the width is undefined, but likely
00196 to be 2 charcells wide either from a graphic glyph or
00197 from a four-digit hexadecimal glyph representing the
00198 code point. Therefore if any PUA glyph does not have
00199 a non-zero width yet, assign it a default width of 2.
00200 The Unicode Standard allows giving PUA characters
00201 default property values; see for example The Unicode
00202 Standard Version 5.0, p. 91. This same default is
00203 used for higher plane PUA code points below.
00204 */
00205 // for (i = 0xE000; i <= 0xF8FF; i++) {
00206 //     if (glyph_width[i] == 0) glyph_width[i]=2;
00207 // }
00208
00209 /*
00210 <not a character>
00211 */
00212 for (i = 0xFDD0; i <= 0xFDEF; i++) glyph_width[i] = -1;
00213 glyph_width[0xFFFF] = -1; /* Byte Order Mark */
00214 glyph_width[0xFFFF] = -1; /* Byte Order Mark */
00215
00216 /* Surrogate Code Points */
00217 for (i = 0xD800; i <= 0xDFFF; i++) glyph_width[i]=-1;
00218
00219 /* CJK Code Points */
00220 for (i = 0x4E00; i <= 0x9FFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00221 for (i = 0x3400; i <= 0x4DBF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00222 for (i = 0xF900; i <= 0xFAFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00223
00224 /*
00225 Now generate the output file.
00226 */
00227 printf ("/*\n");
00228 printf (" wewidth and wswidth functions, as per IEEE 1003.1-2008\n");
00229 printf (" System Interfaces, pp. 2241 and 2251.\n");
00230 printf (" Author: Paul Hardy, 2013\n");
00231 printf (" Copyright (c) 2013 Paul Hardy\n");
00232 printf (" LICENSE:\n");
00233 printf ("\n");
00234 printf (" This program is free software: you can redistribute it and/or modify\n");
00235 printf (" it under the terms of the GNU General Public License as published by\n");
00236 printf (" the Free Software Foundation, either version 2 of the License, or\n");
00237 printf (" (at your option) any later version.\n");
00238 printf ("\n");
00239 printf (" This program is distributed in the hope that it will be useful,\n");
00240 printf (" but WITHOUT ANY WARRANTY; without even the implied warranty of\n");
00241 printf (" MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the\n");
00242 printf (" GNU General Public License for more details.\n");
00243 printf ("\n");
00244 printf (" You should have received a copy of the GNU General Public License\n");
00245 printf (" along with this program. If not, see <http://www.gnu.org/licenses/>.\n");
00246 printf ("*/\n");
00247
00248 printf ("#include <wchar.h>\n");
00249 printf ("/* Definitions for Picto CSUR Private Use Area glyphs */\n");
00250 printf ("#define PIKTO_START\t0x%06X\n", PIKTO_START);
00251 printf ("#define PIKTO_END\t0x%06X\n", PIKTO_END);
00252 printf ("#define PIKTO_SIZE\t(PIKTO_END - PIKTO_START + 1)\n");
00253 printf ("\n");
00254 printf ("/* wewidth -- return charcell positions of one code point */\n");
00255 printf ("inline int nwcwidth (wchar_t wc)\n");
00256 printf ("    return (wswidth (&wc, 1));\n");
00257 printf ("}\n");
00258 printf ("\n");
00259 printf ("int nwcwidth (const wchar_t *pwcs, size_t n)\n");
00260 printf ("    int i; /* loop variable */\n");
00261 printf ("    unsigned codept; /* Unicode code point of current character */\n");
00262 printf ("    unsigned plane; /* Unicode plane, 0x00..0x10 */\n");
00263 printf ("    unsigned lower17; /* lower 17 bits of Unicode code point */\n");
00264 printf ("    unsigned lower16; /* lower 16 bits of Unicode code point */\n");
00265 printf ("    int lowpt, midpt, highpt; /* for binary searching in plane1zeroes[] */\n");
00266 printf ("    int found; /* for binary searching in plane1zeroes[] */\n");
00267 printf ("    int totalwidth; /* total width of string, in charcells (1 or 2/glyph) */\n");
00268 printf ("    int illegalchar; /* Whether or not this code point is illegal */\n");
00269 printf ("    putchar ('\n');
00270
00271 /*

```

```

00272 Print the glyph_width[] array for glyphs widths in the
00273 Basic Multilingual Plane (Plane 0).
00274 */
00275 printf (" char glyph_width[0x20000] = {");
00276 for (i = 0; i < 0x10000; i++) {
00277     if ((i & 0x1F) == 0)
00278         printf ("\n /* U+%04X */ ", i);
00279     printf ("%d,", glyph_width[i]);
00280 }
00281 for (i = 0x10000; i < 0x20000; i++) {
00282     if ((i & 0x1F) == 0)
00283         printf ("\n /* U+%06X */ ", i);
00284     printf ("%d", glyph_width[i]);
00285     if (i < 0x1FFFFF) putchar (',' );
00286 }
00287 printf ("\n }; \n\n");
00288
00289 /*
00290 Print the pikto_width[] array for Pikto glyph widths.
00291 */
00292 printf (" char pikto_width[PIKTO_SIZE] = {");
00293 for (i = 0; i < PIKTO_SIZE; i++) {
00294     if ((i & 0x1F) == 0)
00295         printf ("\n /* U+%06X */ ", PIKTO_START + i);
00296     printf ("%d", pikto_width[i]);
00297     if ((PIKTO_START + i) < PIKTO_END) putchar (',' );
00298 }
00299 printf ("\n }; \n\n");
00300
00301 /*
00302 Execution part of wcswidth.
00303 */
00304 printf ("\n");
00305 printf (" illegalchar = totalwidth = 0;\n");
00306 printf (" for (i = 0; !illegalchar && i < n; i++) {\n");
00307 printf ("     codept = pwcs[i];\n");
00308 printf ("     plane = codept » 16;\n");
00309 printf ("     lower17 = codept & 0x1FFFFF;\n");
00310 printf ("     lower16 = codept & 0xFFFF;\n");
00311 printf ("     if (plane < 2) { /* the most common case */\n");
00312 printf ("         if (glyph_width[lower17] < 0) illegalchar = 1;\n");
00313 printf ("         else totalwidth += glyph_width[lower17];\n");
00314 printf ("     }\n");
00315 printf ("     else { /* a higher plane or beyond Unicode range */\n");
00316 printf ("         if ((lower16 == 0xFFFE) || (lower16 == 0xFFFF)) {\n");
00317 printf ("             illegalchar = 1;\n");
00318 printf ("         }\n");
00319 printf ("         else if (plane < 4) { /* Ideographic Plane */\n");
00320 printf ("             totalwidth += 2; /* Default ideographic width */\n");
00321 printf ("         }\n");
00322 printf ("         else if (plane == 0x0F) { /* CSUR Private Use Area */\n");
00323 printf ("             if (lower16 <= 0x0E6F) { /* Kinya */\n");
00324 printf ("                 totalwidth++; /* all Kinya syllables have width 1 */\n");
00325 printf ("             }\n");
00326 printf ("             else if (lower16 <= (PIKTO_END & 0xFFFF)) { /* Pikto */\n");
00327 printf ("                 if (pikto_width[lower16 - (PIKTO_START & 0xFFFF)] < 0) illegalchar = 1;\n");
00328 printf ("                 else totalwidth += pikto_width[lower16 - (PIKTO_START & 0xFFFF)];\n");
00329 printf ("             }\n");
00330 printf ("         }\n");
00331 printf ("         else if (plane > 0x10) {\n");
00332 printf ("             illegalchar = 1;\n");
00333 printf ("         }\n");
00334 printf ("         /* Other non-printing in higher planes; return -1 as per IEEE 1003.1-2008. */\n");
00335 printf ("         else if (/* language tags */\n");
00336 printf ("             codept == 0x0E0001 || (codept >= 0x0E0020 && codept <= 0x0E007F) ||\n");
00337 printf ("             /* variation selectors, 0x0E0100..0x0E01EF */\n");
00338 printf ("             (codept >= 0x0E0100 && codept <= 0x0E01EF)) {\n");
00339 printf ("                 illegalchar = 1;\n");
00340 printf ("             }\n");
00341 printf ("         /*\n");
00342 printf ("             Unicode plane 0x02..0x10 printing character\n");
00343 printf ("             */\n");
00344 printf ("         else {\n");
00345 printf ("             illegalchar = 1; /* code is not in font */\n");
00346 printf ("         }\n");
00347 printf ("     }\n");
00348 printf ("     }\n");
00349 printf ("     }\n");
00350 printf ("     if (illegalchar) totalwidth = -1;\n");
00351 printf ("     }\n");
00352 printf ("     return (totalwidth);\n");

```

```

00353     printf ("\n");
00354     printf ("}\n");
00355
00356     exit (EXIT_SUCCESS);
00357 }

```

5.32 unigenwidth.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unigenwidth.c
00003
00004  @brief unigenwidth - IEEE 1003.1-2008 setup to calculate
00005  wchar_t string widths
00006
00007  @author Paul Hardy.
00008
00009  @copyright Copyright (C) 2013, 2017 Paul Hardy.
00010
00011  All glyphs are treated as 16 pixels high, and can be
00012  8, 16, 24, or 32 pixels wide (resulting in widths of
00013  1, 2, 3, or 4, respectively).
00014  */
00015  /*
00016  LICENSE:
00017
00018  This program is free software: you can redistribute it and/or modify
00019  it under the terms of the GNU General Public License as published by
00020  the Free Software Foundation, either version 2 of the License, or
00021  (at your option) any later version.
00022
00023  This program is distributed in the hope that it will be useful,
00024  but WITHOUT ANY WARRANTY; without even the implied warranty of
00025  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00026  GNU General Public License for more details.
00027
00028  You should have received a copy of the GNU General Public License
00029  along with this program. If not, see <http://www.gnu.org/licenses/>.
00030  */
00031
00032  /*
00033  20 June 2017 [Paul Hardy]:
00034  - Now handles glyphs that are 24 or 32 pixels wide.
00035
00036  8 July 2017 [Paul Hardy]:
00037  - Modifies sscanf format strings to ignore second field after
00038  the ":" field separator, newly added to "combining.txt" files
00039  and already present in "*.hex" files.
00040  */
00041
00042  #include <stdio.h>
00043  #include <stdlib.h>
00044  #include <string.h>
00045
00046  #define MAXSTRING 256 ///< Maximum input line length - 1.
00047
00048  /* Definitions for Pikto in Plane 15 */
00049  #define PIKTO_START 0x0F0E70 ///< Start of Pikto code point range.
00050  #define PIKTO_END 0x0F11EF ///< End of Pikto code point range.
00051  /** Number of code points in Pikto range. */
00052  #define PIKTO_SIZE (PIKTO_END - PIKTO_START + 1)
00053
00054
00055  /**
00056  @brief The main function.
00057
00058  @param[in] argc The count of command line arguments.
00059  @param[in] argv Pointer to array of command line arguments.
00060  @return This program exits with status EXIT_SUCCESS.
00061  */
00062  int
00063  main (int argc, char **argv)
00064  {
00065
00066     int i; /* loop variable */
00067
00068     char teststring[MAXSTRING];
00069     int loc;

```

```

00070 char *gstart;
00071
00072 char glyph_width[0x20000];
00073 char pikto_width[PIKTO_SIZE];
00074
00075 FILE *infilep;
00076
00077 if (argc != 3) {
00078     fprintf(stderr, "\n\nUsage: %s <unifont.hex> <combining.txt>\n\n", argv[0]);
00079     exit (EXIT_FAILURE);
00080 }
00081
00082 /*
00083 Read the collection of hex glyphs.
00084 */
00085 if ((infilep = fopen (argv[1], "r")) == NULL) {
00086     fprintf (stderr, "ERROR - hex input file %s not found.\n\n", argv[1]);
00087     exit (EXIT_FAILURE);
00088 }
00089
00090 /* Flag glyph as non-existent until found. */
00091 memset (glyph_width, -1, 0x20000 * sizeof (char));
00092 memset (pikto_width, -1, (PIKTO_SIZE) * sizeof (char));
00093
00094 teststring[MAXSTRING-1] = '\0';
00095 while (fgets (teststring, MAXSTRING-1, infilep) != NULL) {
00096     sscanf (teststring, "%X:%s", &loc);
00097     if (loc < 0x20000) {
00098         gstart = strchr (teststring, ':') + 1;
00099         /*
00100 16 rows per glyph, 2 ASCII hexadecimal digits per byte,
00101 so divide number of digits by 32 (shift right 5 bits).
00102 */
00103         glyph_width[loc] = (strlen (gstart) - 1) » 5;
00104     }
00105     else if ((loc >= PIKTO_START) && (loc <= PIKTO_END)) {
00106         gstart = strchr (teststring, ':') + 1;
00107         pikto_width[loc - PIKTO_START] = strlen (gstart) <= 34 ? 1 : 2;
00108     }
00109 }
00110
00111 fclose (infilep);
00112
00113 /*
00114 Now read the combining character code points. These have width of 0.
00115 */
00116 if ((infilep = fopen (argv[2], "r")) == NULL) {
00117     fprintf (stderr, "ERROR - combining characters file %s not found.\n\n", argv[2]);
00118     exit (EXIT_FAILURE);
00119 }
00120
00121 while (fgets (teststring, MAXSTRING-1, infilep) != NULL) {
00122     sscanf (teststring, "%X:%s", &loc);
00123     if (loc < 0x20000) glyph_width[loc] = 0;
00124 }
00125
00126 fclose (infilep);
00127
00128 /*
00129 Code Points with Unusual Properties (Unicode Standard, Chapter 4).
00130
00131 As of Unifont 10.0.04, use the widths in the "nonprinting.hex"
00132 files. If an application is smart enough to know how to handle
00133 these special cases, it will not render the "nonprinting" glyph
00134 and will treat the code point as being zero-width.
00135 */
00136 // glyph_width[0]=0; /* NULL character */
00137 // for (i = 0x0001; i <= 0x001F; i++) glyph_width[i]=-1; /* Control Characters */
00138 // for (i = 0x007F; i <= 0x009F; i++) glyph_width[i]=-1; /* Control Characters */
00139
00140 // glyph_width[0x034F]=0; /* combining grapheme joiner */
00141 // glyph_width[0x180B]=0; /* Mongolian free variation selector one */
00142 // glyph_width[0x180C]=0; /* Mongolian free variation selector two */
00143 // glyph_width[0x180D]=0; /* Mongolian free variation selector three */
00144 // glyph_width[0x180E]=0; /* Mongolian vowel separator */
00145 // glyph_width[0x200B]=0; /* zero width space */
00146 // glyph_width[0x200C]=0; /* zero width non-joiner */
00147 // glyph_width[0x200D]=0; /* zero width joiner */
00148 // glyph_width[0x200E]=0; /* left-to-right mark */
00149 // glyph_width[0x200F]=0; /* right-to-left mark */
00150 // glyph_width[0x202A]=0; /* left-to-right embedding */

```

```

00151 // glyph_width[0x202B]=0; /* right-to-left embedding */
00152 // glyph_width[0x202C]=0; /* pop directional formatting */
00153 // glyph_width[0x202D]=0; /* left-to-right override */
00154 // glyph_width[0x202E]=0; /* right-to-left override */
00155 // glyph_width[0x2060]=0; /* word joiner */
00156 // glyph_width[0x2061]=0; /* function application */
00157 // glyph_width[0x2062]=0; /* invisible times */
00158 // glyph_width[0x2063]=0; /* invisible separator */
00159 // glyph_width[0x2064]=0; /* invisible plus */
00160 // glyph_width[0x206A]=0; /* inhibit symmetric swapping */
00161 // glyph_width[0x206B]=0; /* activate symmetric swapping */
00162 // glyph_width[0x206C]=0; /* inhibit arabic form shaping */
00163 // glyph_width[0x206D]=0; /* activate arabic form shaping */
00164 // glyph_width[0x206E]=0; /* national digit shapes */
00165 // glyph_width[0x206F]=0; /* nominal digit shapes */
00166
00167 // /* Variation Selector-1 to Variation Selector-16 */
00168 // for (i = 0xFE00; i <= 0xFE0F; i++) glyph_width[i] = 0;
00169
00170 // glyph_width[0xFEFF]=0; /* zero width no-break space */
00171 // glyph_width[0xFF9]=0; /* interlinear annotation anchor */
00172 // glyph_width[0xFFA]=0; /* interlinear annotation separator */
00173 // glyph_width[0xFFB]=0; /* interlinear annotation terminator */
00174 /*
00175 Let glyph widths represent 0xFFFC (object replacement character)
00176 and 0xFFFD (replacement character).
00177 */
00178
00179 /*
00180 Hangul Jamo:
00181
00182 Leading Consonant (Choseong): leave spacing as is.
00183
00184 Hangul Choseong Filler (U+115F): set width to 2.
00185
00186 Hangul Jungseong Filler, Hangul Vowel (Jungseong), and
00187 Final Consonant (Jongseong): set width to 0, because these
00188 combine with the leading consonant as one composite syllabic
00189 glyph. As of Unicode 5.2, the Hangul Jamo block (U+1100..U+11FF)
00190 is completely filled.
00191 */
00192 // for (i = 0x1160; i <= 0x11FF; i++) glyph_width[i]=0; /* Vowels & Final Consonants */
00193
00194 /*
00195 Private Use Area -- the width is undefined, but likely
00196 to be 2 charcells wide either from a graphic glyph or
00197 from a four-digit hexadecimal glyph representing the
00198 code point. Therefore if any PUA glyph does not have
00199 a non-zero width yet, assign it a default width of 2.
00200 The Unicode Standard allows giving PUA characters
00201 default property values; see for example The Unicode
00202 Standard Version 5.0, p. 91. This same default is
00203 used for higher plane PUA code points below.
00204 */
00205 // for (i = 0xE000; i <= 0xF8FF; i++) {
00206 // if (glyph_width[i] == 0) glyph_width[i]=2;
00207 // }
00208
00209 /*
00210 <not a character>
00211 */
00212 for (i = 0xFDD0; i <= 0xFDEF; i++) glyph_width[i] = -1;
00213 glyph_width[0xFFFE] = -1; /* Byte Order Mark */
00214 glyph_width[0xFFFF] = -1; /* Byte Order Mark */
00215
00216 /* Surrogate Code Points */
00217 for (i = 0xD800; i <= 0xDFFF; i++) glyph_width[i]=-1;
00218
00219 /* CJK Code Points */
00220 for (i = 0x4E00; i <= 0x9FFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00221 for (i = 0x3400; i <= 0x4DBF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00222 for (i = 0xF900; i <= 0xFAFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00223
00224 /*
00225 Now generate the output file.
00226 */
00227 printf ("/*\n");
00228 printf (" wewidth and wcswidth functions, as per IEEE 1003.1-2008\n");
00229 printf (" System Interfaces, pp. 2241 and 2251.\n");
00230 printf (" Author: Paul Hardy, 2013\n");
00231 printf (" Copyright (c) 2013 Paul Hardy\n");

```

```

00232 printf (" LICENSE:\n");
00233 printf ("\n");
00234 printf (" This program is free software: you can redistribute it and/or modify\n");
00235 printf (" it under the terms of the GNU General Public License as published by\n");
00236 printf (" the Free Software Foundation, either version 2 of the License, or\n");
00237 printf (" (at your option) any later version.\n");
00238 printf ("\n");
00239 printf (" This program is distributed in the hope that it will be useful,\n");
00240 printf (" but WITHOUT ANY WARRANTY; without even the implied warranty of\n");
00241 printf (" MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the\n");
00242 printf (" GNU General Public License for more details.\n");
00243 printf ("\n");
00244 printf (" You should have received a copy of the GNU General Public License\n");
00245 printf (" along with this program. If not, see <http://www.gnu.org/licenses/>.\n");
00246 printf ("*/\n");
00247
00248 printf ("#include <wchar.h>\n");
00249 printf ("/* Definitions for Pikto CSUR Private Use Area glyphs */\n");
00250 printf ("#define PIKTO_START\t0x%06X\n", PIKTO_START);
00251 printf ("#define PIKTO_END\t0x%06X\n", PIKTO_END);
00252 printf ("#define PIKTO_SIZE\t(PIKTO_END - PIKTO_START + 1)\n");
00253 printf ("\n");
00254 printf ("/* wwidth -- return charcell positions of one code point */\n");
00255 printf ("inline int\ncmpwidth (wchar_t wc)\n{\n");
00256 printf (" return (wcswidth (&wc, 1));\n");
00257 printf ("}\n");
00258 printf ("\n");
00259 printf ("int\ncmpwidth (const wchar_t *pwcs, size_t n)\n{\n");
00260 printf (" int i; /* loop variable */\n");
00261 printf (" unsigned codept; /* Unicode code point of current character */\n");
00262 printf (" unsigned plane; /* Unicode plane, 0x00..0x10 */\n");
00263 printf (" unsigned lower17; /* lower 17 bits of Unicode code point */\n");
00264 printf (" unsigned lower16; /* lower 16 bits of Unicode code point */\n");
00265 printf (" int lowpt, midpt, highpt; /* for binary searching in plane1zeroes[] */\n");
00266 printf (" int found; /* for binary searching in plane1zeroes[] */\n");
00267 printf (" int totalwidth; /* total width of string, in charcells (1 or 2/glyph) */\n");
00268 printf (" int illegalchar; /* Whether or not this code point is illegal */\n");
00269 putchar ('\n');
00270
00271 /*
00272 Print the glyph_width[] array for glyphs widths in the
00273 Basic Multilingual Plane (Plane 0).
00274 */
00275 printf (" char glyph_width[0x20000] = {\n");
00276 for (i = 0; i < 0x10000; i++) {
00277 if ((i & 0x1F) == 0)
00278 printf ("\n /* U+%04X */ ", i);
00279 printf ("%d,", glyph_width[i]);
00280 }
00281 for (i = 0x10000; i < 0x20000; i++) {
00282 if ((i & 0x1F) == 0)
00283 printf ("\n /* U+%06X */ ", i);
00284 printf ("%d", glyph_width[i]);
00285 if (i < 0x1FFFF) putchar (',');
00286 }
00287 printf ("\n }; \n");
00288
00289 /*
00290 Print the pikto_width[] array for Pikto glyph widths.
00291 */
00292 printf (" char pikto_width[PIKTO_SIZE] = {\n");
00293 for (i = 0; i < PIKTO_SIZE; i++) {
00294 if ((i & 0x1F) == 0)
00295 printf ("\n /* U+%06X */ ", PIKTO_START + i);
00296 printf ("%d", pikto_width[i]);
00297 if ((PIKTO_START + i) < PIKTO_END) putchar (',');
00298 }
00299 printf ("\n }; \n");
00300
00301 /*
00302 Execution part of wwidth.
00303 */
00304 printf ("\n");
00305 printf (" illegalchar = totalwidth = 0;\n");
00306 printf (" for (i = 0; !illegalchar && i < n; i++) {\n");
00307 printf (" codept = pwcs[i];\n");
00308 printf (" plane = codept » 16;\n");
00309 printf (" lower17 = codept & 0x1FFFF;\n");
00310 printf (" lower16 = codept & 0xFFFF;\n");
00311 printf (" if (plane < 2) { /* the most common case */\n");
00312 printf (" if (glyph_width[lower17] < 0) illegalchar = 1;\n");

```

```

00313     printf ("        else totalwidth += glyph_width[lower17];\n");
00314     printf ("    }\n");
00315     printf ("    else { /* a higher plane or beyond Unicode range */\n");
00316     printf ("        if ((lower16 == 0xFFFE) || (lower16 == 0xFFFF)) {\n");
00317     printf ("            illegalchar = 1;\n");
00318     printf ("        }\n");
00319     printf ("        else if (plane < 4) { /* Ideographic Plane */\n");
00320     printf ("            totalwidth += 2; /* Default ideographic width */\n");
00321     printf ("        }\n");
00322     printf ("        else if (plane == 0x0F) { /* CSUR Private Use Area */\n");
00323     printf ("            if (lower16 <= 0x0E6F) { /* Kinya */\n");
00324     printf ("                totalwidth++; /* all Kinya syllables have width 1 */\n");
00325     printf ("            }\n");
00326     printf ("            else if (lower16 <= (PIKTO_END & 0xFFFF)) { /* Pikto */\n");
00327     printf ("                if (pikto_width[lower16 - (PIKTO_START & 0xFFFF)] < 0) illegalchar = 1;\n");
00328     printf ("                else totalwidth += pikto_width[lower16 - (PIKTO_START & 0xFFFF)];\n");
00329     printf ("            }\n");
00330     printf ("        }\n");
00331     printf ("        else if (plane > 0x10) {\n");
00332     printf ("            illegalchar = 1;\n");
00333     printf ("        }\n");
00334     printf ("        /* Other non-printing in higher planes; return -1 as per IEEE 1003.1-2008. */\n");
00335     printf ("        else if (/* language tags */\n");
00336     printf ("            codept == 0x0E0001 || (codept >= 0x0E0020 && codept <= 0x0E007F) ||\n");
00337     printf ("            /* variation selectors, 0x0E0100..0x0E01EF */\n");
00338     printf ("            (codept >= 0x0E0100 && codept <= 0x0E01EF)) {\n");
00339     printf ("                illegalchar = 1;\n");
00340     printf ("            }\n");
00341     printf ("        /*\n");
00342     printf ("            Unicode plane 0x02..0x10 printing character\n");
00343     printf ("        */\n");
00344     printf ("        else {\n");
00345     printf ("            illegalchar = 1; /* code is not in font */\n");
00346     printf ("        }\n");
00347     printf ("    }\n");
00348     printf ("    }\n");
00349     printf ("    }\n");
00350     printf ("    if (illegalchar) totalwidth = -1;\n");
00351     printf ("    }\n");
00352     printf ("    return (totalwidth);\n");
00353     printf ("    }\n");
00354     printf ("    }\n");
00355
00356     exit (EXIT_SUCCESS);
00357 }

```

5.33 src/unihangul-support.c File Reference

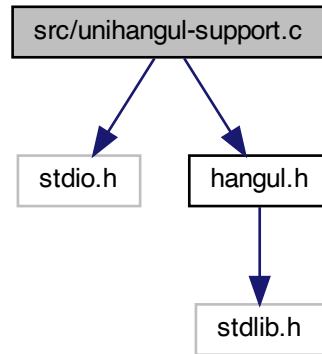
Functions for converting Hangul letters into syllables.

```

#include <stdio.h>
#include "hangul.h"

```

Include dependency graph for unihangul-support.c:



Functions

- unsigned [hangul_read_base8](#) (FILE *infp, unsigned char base[][32])
Read hangul-base.hex file into a unsigned char array.
- unsigned [hangul_read_base16](#) (FILE *infp, unsigned base[][16])
Read hangul-base.hex file into a unsigned array.
- void [hangul_decompose](#) (unsigned codept, int *initial, int *medial, int *final)
Decompose a Hangul Syllables code point into three letters.
- unsigned [hangul_compose](#) (int initial, int medial, int final)
Compose a Hangul syllable into a code point, or 0 if none exists.
- void [hangul_hex_indices](#) (int choseong, int jungseong, int jongseong, int *cho_index, int *jung_index, int *jong_index)
Determine index values to the bitmaps for a syllable's components.
- void [hangul_variations](#) (int choseong, int jungseong, int jongseong, int *cho_var, int *jung_var, int *jong_var)
Determine the variations of each letter in a Hangul syllable.
- int [cho_variation](#) (int choseong, int jungseong, int jongseong)
Return the Johab 6/3/1 choseong variation for a syllable.
- int [is_wide_vowel](#) (int vowel)
Whether vowel has rightmost vertical stroke to the right.
- int [jung_variation](#) (int choseong, int jungseong, int jongseong)
Return the Johab 6/3/1 jungseong variation.
- int [jong_variation](#) (int choseong, int jungseong, int jongseong)
Return the Johab 6/3/1 jongseong variation.
- void [hangul_syllable](#) (int choseong, int jungseong, int jongseong, unsigned char hangul_base[][32], unsigned char *syllable)
Given letters in a Hangul syllable, return a glyph.
- int [glyph_overlap](#) (unsigned *glyph1, unsigned *glyph2)
See if two glyphs overlap.

- void [combine_glyphs](#) (unsigned *glyph1, unsigned *glyph2, unsigned *combined_glyph)
Combine two glyphs into one glyph.
- void [print_glyph_txt](#) (FILE *fp, unsigned codept, unsigned *this_glyph)
Print one glyph in Unifont hexdraw plain text style.
- void [print_glyph_hex](#) (FILE *fp, unsigned codept, unsigned *this_glyph)
Print one glyph in Unifont hexdraw hexadecimal string style.
- void [one_jamo](#) (unsigned glyph_table[[MAX_GLYPHS](#)][16], unsigned jamo, unsigned *jamo_glyph)
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void [combined_jamo](#) (unsigned glyph_table[[MAX_GLYPHS](#)][16], unsigned cho, unsigned jung, unsigned jong, unsigned *combined_glyph)
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

5.33.1 Detailed Description

Functions for converting Hangul letters into syllables.

This file contains functions for reading in Hangul letters arranged in a Johab 6/3/1 pattern and composing syllables with them. One function maps an initial letter (choseong), medial letter (jungseong), and final letter (jongseong) into the Hangul Syllables Unicode block, U+AC00..U+D7A3. Other functions allow formation of glyphs that include the ancient Hangul letters that Hanterm supported. More can be added if desired, with appropriate changes to start positions and lengths defined in "hangul.h".

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [unihangul-support.c](#).

5.33.2 Function Documentation

5.33.2.1 cho_variation()

```
int cho_variation (
    int choseong,
    int jungseong,
    int jongseong )
```

Return the Johab 6/3/1 choseong variation for a syllable.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the initial consonant (choseong).

Each choseong has 6 variations:

Variation Occurrence

0 Choseong with a vertical vowel such as "A". 1 Choseong with a horizontal vowel such as "O". 2 Choseong with a vertical and horizontal vowel such as "WA". 3 Same as variation 0, but with jongseong (final consonant). 4 Same as variation 1, but with jongseong (final consonant). Also a horizontal vowel pointing down, such as U and YU. 5 Same as variation 2, but with jongseong (final consonant). Also a horizontal vowel pointing down with vertical element, such as WEO, WE, and WI.

In addition, if the vowel is horizontal and a downward-pointing stroke as in the modern letters U, WEO, WE, WI, and YU, and in archaic letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added to the initial variation of 0 to 2, resulting in a choseong variation of 3 to 5, respectively.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

The choseong variation, 0 to 5.

Definition at line 350 of file [unihangul-support.c](#).

```

00350                                     {
00351     int cho_variation; /* Return value */
00352
00353     /*
00354     The Choseong cho_var is determined by the
00355     21 modern + 50 ancient Jungseong, and whether
00356     or not the syllable contains a final consonant
00357     (Jongseong).
00358     */
00359     static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361         Modern Jungseong in positions 0..20.
00362         */
00363         /* Location Variations Unicode Range Vowel # Vowel Names */
00364         /* ----- */
00365         /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00366         /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00367         /* 0x30D */ 0, 0, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00368         /* 0x313 */ 1, // U+1169 -->[ 8] O
00369         /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00370         /* 0x31F */ 1, 4, // U+116D..U+116E-->[12..13] YO, U
00371         /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16] WEO, WE, WI
00372         /* 0x32E */ 4, 1, // U+1172..U+1173-->[17..18] YU, EU
00373         /* 0x334 */ 2, // U+1174 -->[19] YI
00374         /* 0x337 */ 0, // U+1175 -->[20] I
00375         /*
00376         Ancient Jungseong in positions 21..70.
00377         */
00378         /* Location Variations Unicode Range Vowel # Vowel Names */
00379         /* ----- */
00380         /* 0x33A */ 2, 5, 2, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00381         /* 0x343 */ 2, 2, 5, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00382         /* 0x34C */ 2, 2, 5, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00383         /* 0x355 */ 2, 5, 5, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00384         /* 0x35E */ 4, 4, 2, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00385         /* 0x367 */ 2, 2, 5, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00386         /* 0x370 */ 2, 5, 5, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00387         /* 0x379 */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00388         /* 0x382 */ 5, 5, 5, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00389         /* 0x38B */ 5, 5, 2, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00390         /* 0x394 */ 5, 2, 2, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00391         /* 0x39D */ 2, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,

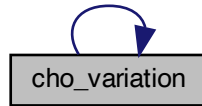
```

```

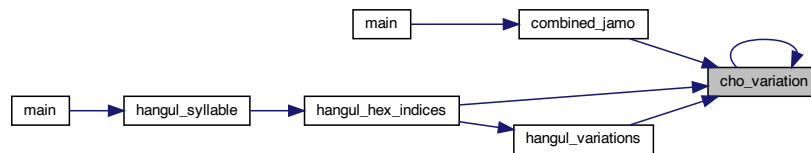
00392 /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00393 /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394 /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-ISSANGARAEA,
00395 /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00396 /* 0x3CA: */ 2, 2, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE,
00397 #ifdef EXTENDED_HANGUL
00398 /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00399 /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00400 /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00401 /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00405 /* 0x40F: */ 2, 2, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1 // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1 // Mark end of list of vowels.
00409 #endif
00410 };
00411
00412
00413 if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415 }
00416 else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419         cho_variation += 3;
00420 }
00421
00422
00423 return cho_variation;
00424 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.2 combine_glyphs()

```

void combine_glyphs (
    unsigned * glyph1,

```

```

    unsigned * glyph2,
    unsigned * combined_glyph )

```

Combine two glyphs into one glyph.

Parameters

in	glyph1	The first glyph to overlap.
in	glyph2	The second glyph to overlap.
out	combined_glyph	The returned combination glyph.

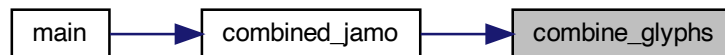
Definition at line 637 of file [unihangul-support.c](#).

```

00638     {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642         combined_glyph[i] = glyph1[i] | glyph2[i];
00643
00644     return;
00645 }

```

Here is the caller graph for this function:



5.33.2.3 combined_jamo()

```

void combined_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned cho,
    unsigned jung,

```

```

    unsigned jong,
    unsigned * combined_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

This function converts input Hangul choseong, jungseong, and jongseong Unicode code triplets into a Hangul syllable. Any of those with an out of range code point are assigned a blank glyph for combining. This function performs the following steps:

- 1) Determine the sequence number of choseong, jungseong, and jongseong, from 0 to the total number of choseong, jungseong, or jongseong, respectively, minus one. The sequence for each is as follows:
 - a) Choseong: Unicode code points of U+1100..U+115E and then U+A960..U+A97C.
 - b) Jungseong: Unicode code points of U+1161..U+11A7 and then U+D7B0..U+D7C6.
 - c) Jongseong: Unicode code points of U+11A8..U+11FF and then U+D7CB..U+D7FB.
- 2) From the choseong, jungseong, and jongseong sequence number, determine the variation of choseong and jungseong (there is only one jongseong variation, although it is shifted right by one column for some vowels with a pair of long vertical strokes on the right side).
- 3) Convert the variation numbers for the three syllable components to index locations in the glyph array.
- 4) Combine the glyph array glyphs into a syllable.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	cho	The choseong Unicode code point, 0 or 0x1100..0x115F.
in	jung	The jungseong Unicode code point, 0 or 0x1160..0x11A7.

Parameters

in	jong	The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
out	combined_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 787 of file [unihangul-support.c](#).

```

00789     {
00790
00791     int i; /* Loop variable. */
00792     int cho_num, jung_num, jong_num;
00793     int cho_group, jung_group, jong_group;
00794     int cho_index, jung_index, jong_index;
00795
00796     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798     int cho_variation(int choseong, int jungseong, int jongseong);
00799
00800     void combine_glyphs(unsigned *glyph1, unsigned *glyph2,
00801                       unsigned *combined_glyph);
00802
00803
00804     /* Choose a blank glyph for each syllalbe by default. */
00805     cho_index = jung_index = jong_index = 0x000;
00806
00807     /*
00808     Convert Unicode code points to jamo sequence number
00809     of each letter, or -1 if letter is not in valid range.
00810     */
00811     if (cho >= 0x1100 && cho <= 0x115E)
00812         cho_num = cho - CHO_UNICODE_START;
00813     else if (cho >= CHO_EXTB_UNICODE_START &&
00814             cho < (CHO_EXTB_UNICODE_START + NCHO_EXTB))
00815         cho_num = cho - CHO_EXTB_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816     else
00817         cho_num = -1;
00818
00819     if (jung >= 0x1161 && jung <= 0x11A7)
00820         jung_num = jung - JUNG_UNICODE_START;
00821     else if (jung >= JUNG_EXTB_UNICODE_START &&
00822             jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823         jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824     else
00825         jung_num = -1;
00826
00827     if (jong >= 0x11A8 && jong <= 0x11FF)
00828         jong_num = jong - JONG_UNICODE_START;
00829     else if (jong >= JONG_EXTB_UNICODE_START &&
00830             jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831         jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832     else
00833         jong_num = -1;
00834
00835     /*
00836     Choose initial consonant (choseong) variation based upon

```

```

00837 the vowel (jungseong) if both are specified.
00838 */
00839 if (cho_num < 0) {
00840     cho_index = cho_group = 0; /* Use blank glyph for choseong. */
00841 }
00842 else {
00843     if (jung_num < 0 && jong_num < 0) { /* Choseong is by itself. */
00844         cho_group = 0;
00845         if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846             cho_index = cho_num + JAMO_HEX;
00847         else /* Choseong is in Hangul Jamo Extended-A range. */
00848             cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                             + JAMO_EXT_A_HEX;
00850     }
00851     else {
00852         if (jung_num >= 0) { /* Valid jungseong with choseong. */
00853             cho_group = cho_variation (cho_num, jung_num, jong_num);
00854         }
00855         else { /* Invalid vowel; see if final consonant is valid. */
00856             /*
00857              If initial consonant and final consonant are specified,
00858              set cho_group to 4, which is the group tha would apply
00859              to a horizontal-only vowel such as Hangul "O", so the
00860              consonant appears full-width.
00861              */
00862             cho_group = 0;
00863             if (jong_num >= 0) {
00864                 cho_group = 4;
00865             }
00866         }
00867         cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868                     cho_group;
00869     } /* Choseong combined with jungseong and/or jongseong. */
00870 } /* Valid choseong. */
00871
00872 /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876 jung_index = jung_group = 0; /* Use blank glyph for jungseong. */
00877
00878 if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) { /* Jungseong is by itself. */
00880         jung_group = 0;
00881         jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884         if (jong_num >= 0) { /* If there is a final consonant. */
00885             if (jong_num == 3) /* Nieun; choose variation 3. */
00886                 jung_group = 2;
00887             else
00888                 jung_group = 1;
00889         } /* Valid jongseong. */
00890         /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891         else if (cho_num >= 0)
00892             jung_group = 0;
00893     }
00894     jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895 }
00896
00897 /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901 if (jong_num < 0) {
00902     jong_index = jong_group = 0; /* Use blank glyph for jongseong. */
00903 }
00904 else { /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) { /* Jongseong is by itself. */
00906         jong_group = 0;
00907         jong_index = jung_num + 0x4A8;
00908     }
00909     else { /* There is only one jongseong variation if combined. */
00910         jong_group = 0;
00911         jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912                     jong_group;
00913     }
00914 }
00915
00916 /*
00917 Now that we know the index locations for choseong, jungseong, and

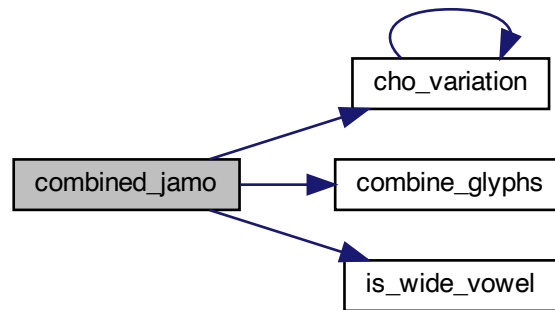
```

```

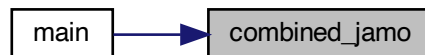
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920 combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921               combined_glyph);
00922
00923 if (jong_index > 0) {
00924     /*
00925     If the vowel has a vertical stroke that is one column
00926     away from the right border, shift this jongseung right
00927     by one column to line up with the rightmost vertical
00928     stroke in the vowel.
00929     */
00930     if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932             tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935                       combined_glyph);
00936     }
00937     else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939                       combined_glyph);
00940     }
00941 }
00942
00943 return;
00944 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.4 glyph_overlap()

```
int glyph_overlap (
    unsigned * glyph1,
    unsigned * glyph2 )
```

See if two glyphs overlap.

Parameters

in	glyph1	The first glyph, as a 16-row bitmap.
in	glyph2	The second glyph, as a 16-row bitmap.

Returns

0 if no overlaps between glyphs, 1 otherwise.

Definition at line 613 of file [unihangul-support.c](#).

```
00613     {
00614     int overlaps; /* Return value; 0 if no overlaps, -1 if overlaps. */
00615     int i;
00616
00617     /* Check for overlaps between the two glyphs. */
00618
00619     i = 0;
00620     do {
00621         overlaps = (glyph1[i] & glyph2[i]) != 0;
00622         i++;
00623     } while (i < 16 && overlaps == 0);
00624
00625     return overlaps;
00626 }
```

5.33.2.5 hangul_compose()

```
unsigned hangul_compose (
    int initial,
    int medial,
    int final )
```

Compose a Hangul syllable into a code point, or 0 if none exists.

This function takes three letters that can form a modern Hangul syllable and returns the corresponding Unicode Hangul Syllables code point in the range 0xAC00 to 0xD7A3.

If a three-letter combination includes one or more archaic letters, it will not map into the Hangul Syllables range. In that case, the returned code point will be 0 to indicate that no valid Hangul Syllables code point exists.

Parameters

in	initial	The first letter (choseong), 0 to 18.
in	medial	The second letter (jungseong), 0 to 20.
in	final	The third letter (jongseong), 0 to 26 or -1 if none.

Returns

The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.

Definition at line 201 of file [unihangul-support.c](#).

```

00201     {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial >= 0 && medial <= 20 &&
00207         final >= 0 && final <= 26) {
00208
00209         codept = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }
```

5.33.2.6 hangul_decompose()

```

void hangul_decompose (
    unsigned codept,
    int * initial,
    int * medial,
    int * final )
```

Decompose a Hangul Syllables code point into three letters.

Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:

- Choseong 0-19

- Jungseong 0-20
- Jongseong 0-27 or -1 if no jongseong

All letter values are set to -1 if the letters do not form a syllable in the Hangul Syllables range. This function only handles modern Hangul, because that is all that is in the Hangul Syllables range.

Parameters

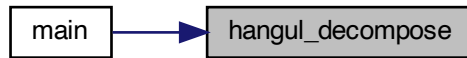
in	codept	The Uni-code code point to de-code, from 0xAC00 to 0xD7A3.
out	initial	The 1st letter (choseong) in the syllable.
out	initial	The 2nd letter (jungseong) in the syllable.
out	initial	The 3rd letter (jongseong) in the syllable.

Definition at line 167 of file [unihangul-support.c](#).

```

00167                                     {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept -= 0xAC00;
00174         *initial = codept / (28 * 21);
00175         *medial = (codept / 28) % 21;
00176         *final = codept % 28 - 1;
00177     }
00178
00179     return;
00180 }
```

Here is the caller graph for this function:



5.33.2.7 hangul_hex_indices()

```

void hangul_hex_indices (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_index,
    int * jung_index,
    int * jong_index )
  
```

Determine index values to the bitmaps for a syllable's components.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

These variations are then converted into index locations within the glyph array that was read in from the hangul-base.hex file. Those index locations can then be used to form a composite syllable.

There is no restriction to only use the modern Hangul letters.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.

Parameters

in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_index	Index location to the 1st letter variation from the hangul-base.hex file.
out	jung_index	Index location to the 2nd letter variation from the hangul-base.hex file.
out	jong_index	Index location to the 3rd letter variation from the hangul-base.hex file.

Definition at line 249 of file [unihangul-support.c](#).

```

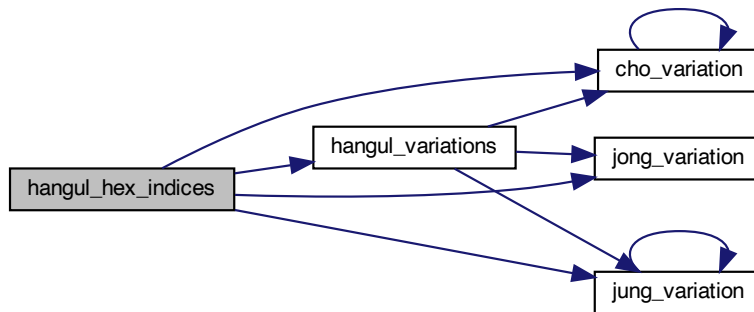
00250     {
00251
00252     int cho_variation, jung_variation, jong_variation; /* Letter variations */
00253
00254     void hangul_variations (int choseong, int jungseong, int jongseong,
```

```

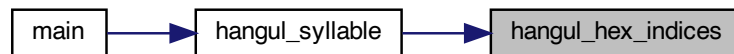
00255         int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257
00258     hangul_variations (choseong, jungseong, jongseong,
00259                       &cho_variation, &jung_variation, &jong_variation);
00260
00261     *cho_index = CHO_HEX + choseong * CHO_VARIATIONS + cho_variation;
00262     *jung_index = JUNG_HEX + jungseong * JUNG_VARIATIONS + jung_variation;;
00263     *jong_index = jongseong < 0 ? 0x0000 :
00264                     JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266     return;
00267 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.8 hangul_read_base16()

```

unsigned hangul_read_base16 (
    FILE * infp,
    unsigned base[][16] )

```

Read hangul-base.hex file into a unsigned array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).

- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 16 16-bit values per letter.

Returns

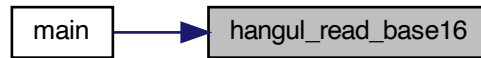
The maximum code point value read in the file.

Definition at line 116 of file [unihangul-support.c](#).

```

00116                                     {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int     i, j;
00120     char    instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126         sscanf (instring, "%X", &codept);
00127         codept -= PUA_START;
00128         /* If code point is within range, add it */
00129         if (codept < MAX_GLYPHS) {
00130             /* Find the start of the glyph bitmap. */
00131             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132             if (instring[i] == ':') {
00133                 i++; /* Skip over ':' to get to start of bitmap. */
00134                 for (j = 0; j < 16; j++) {
00135                     sscanf (&instring[i], "%4X", &base[codept][j]);
00136                     i += 4;
00137                 }
00138                 if (codept > max_codept) max_codept = codept;
00139             }
00140         }
00141     }
00142
00143     return max_codept;
00144 }
```

Here is the caller graph for this function:



5.33.2.9 hangul_read_base8()

```

unsigned hangul_read_base8 (
    FILE * infp,
    unsigned char base[][32] )
  
```

Read hangul-base.hex file into a unsigned char array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 32 8-bit values per letter.

Returns

The maximum code point value read in the file.

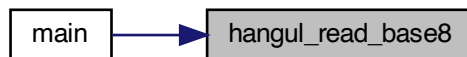
Definition at line 63 of file [unihangul-support.c](#).

```

00063     {
00064     unsigned codept;
00065     unsigned max_codept;
00066     int     i, j;
00067     char    instring[MAXLINE];
00068
00069
00070     max_codept = 0;
00071
00072     while (fgets (instring, MAXLINE, infp) != NULL) {
00073         sscanf (instring, "%X", &codept);
00074         codept -= PUA_START;
00075         /* If code point is within range, add it */
00076         if (codept < MAX_GLYPHS) {
00077             /* Find the start of the glyph bitmap. */
00078             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079             if (instring[i] == ':') {
00080                 i++; /* Skip over ':' to get to start of bitmap. */
00081                 for (j = 0; j < 32; j++) {
00082                     sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083                     i += 2;
00084                 }
00085                 if (codept > max_codept) max_codept = codept;
00086             }
00087         }
00088     }
00089     return max_codept;
00091 }

```

Here is the caller graph for this function:



5.33.2.10 hangul_syllable()

```

void hangul_syllable (
    int choseong,
    int jungseong,
    int jongseong,
    unsigned char hangul_base[][32],
    unsigned char * syllable )

```

Given letters in a Hangul syllable, return a glyph.

This function returns a glyph bitmap comprising up to three Hangul letters that form a syllable. It reads the three component letters (choseong, jungseong, and jongseong), then calls a function that determines the appropriate variation of each letter, returning the letter bitmap locations in the glyph array. Then these letter bitmaps are combined with a logical OR operation to produce a final bitmap, which forms a 16 row by 16 column bitmap glyph.

Parameters

in	choseong	The 1st letter in the composite glyph.
in	jungseong	The 2nd letter in the composite glyph.
in	jongseong	The 3rd letter in the composite glyph.
in	hangul_base	The glyphs read from the "hangul_base.hex" file.

Returns

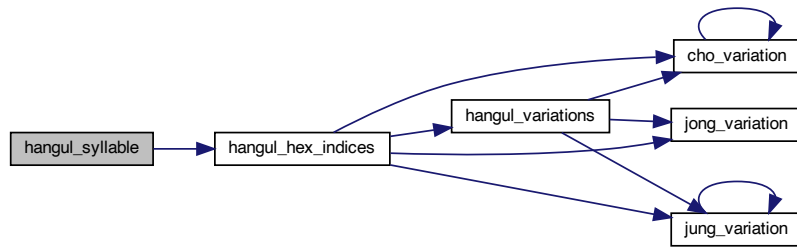
syllable The composite syllable, as a 16 by 16 pixel bitmap.

Definition at line 583 of file [unihangul-support.c](#).

```

00584                                     {
00585
00586     int    i; /* loop variable */
00587     int    cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                         &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595         glyph_byte = hangul_base [cho_hex][i];
00596         glyph_byte |= hangul_base [jung_hex][i];
00597         if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598         syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.11 hangul_variations()

```

void hangul_variations (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_var,
    int * jung_var,
    int * jong_var )
  
```

Determine the variations of each letter in a Hangul syllable.

Given the three letters that will form a syllable, return the variation of each letter used to form the composite glyph.

This function can determine variations for both modern and archaic Hangul letters; it is not limited to only the letters combinations that comprise the Unicode Hangul Syllables range.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_var	Variation of the 1st letter from the hangul-base.hex file.
out	jung_var	Variation of the 2nd letter from the hangul-base.hex file.
out	jong_var	Variation of the 3rd letter from the hangul-base.hex file.

Definition at line 298 of file [unihangul-support.c](#).

```

00299     {
00300
00301     int cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);

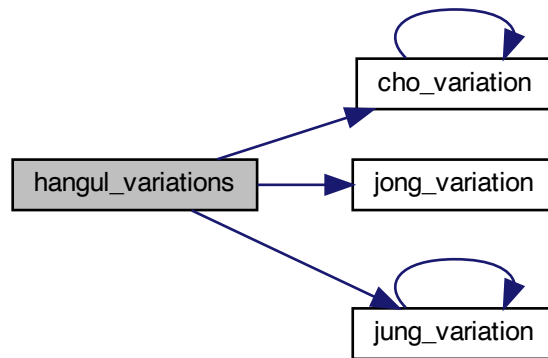
```

```

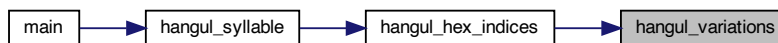
00303 int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305 /*
00306 Find the variation for each letter component.
00307 */
00308 *cho_var = cho_variation (choseong, jungseong, jongseong);
00309 *jung_var = jung_variation (choseong, jungseong, jongseong);
00310 *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313 return;
00314 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.12 is__wide__vowel()

```

int is__wide__vowel (
    int vowel )

```

Whether vowel has rightmost vertical stroke to the right.

Parameters

in	vowel	Vowel num- ber, from 0 to TOTAL_JUNG - 1.
----	-------	---

Returns

1 if this vowel's vertical stroke is wide on the right side; else 0.

Definition at line 434 of file [unihangul-support.c](#).

```

00434     {
00435     int retval; /* Return value. */
00436
00437     static int wide_vowel [TOTAL_JUNG + 1] = {
00438     /*
00439     Modern Jungseong in positions 0..20.
00440     */
00441     /* Location Variations Unicode Range Vowel # Vowel Names */
00442     /* ----- */
00443     /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00444     /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00445     /* 0x30D */ 0, 1, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00446     /* 0x313 */ 0, // U+1169 -->[ 8] O
00447     /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00448     /* 0x31F */ 0, 0, // U+116D..U+116E-->[12..13] YO, U
00449     /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16] WEO, WE, WI
00450     /* 0x32E */ 0, 0, // U+1172..U+1173-->[17..18] YU, EU
00451     /* 0x334 */ 0, // U+1174 -->[19] YI
00452     /* 0x337 */ 0, // U+1175 -->[20] I
00453     /*
00454     Ancient Jungseong in positions 21..70.
00455     */
00456     /* Location Variations Unicode Range Vowel # Vowel Names */
00457     /* ----- */
00458     /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00459     /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00460     /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00461     /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00462     /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00463     /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00464     /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00465     /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00466     /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00467     /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00468     /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00469     /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00470     /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00471     /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAE, ARAEA, ARAEA-EO,
00472     /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAE,
00473     /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00474     /* 0x3CA: */ 0, 1, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE
00475     #ifdef EXTENDED_HANGUL
00476     /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00477     /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00478     /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00479     /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00480     /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00481     /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00482     /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00483     /* 0x40F: */ 0, 1, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484     /* 0x415: */ -1 // Mark end of list of vowels.
00485     #else
00486     /* 0x310: */ -1 // Mark end of list of vowels.
00487     #endif
00488     };
00489
00490
00491     if (vowel >= 0 && vowel < TOTAL_JUNG) {

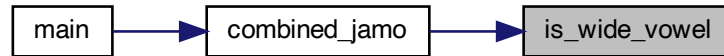
```

```

00492     retval = wide_vowel [vowel];
00493 }
00494 else {
00495     retval = 0;
00496 }
00497
00498
00499 return retval;
00500 }

```

Here is the caller graph for this function:



5.33.2.13 jong_variation()

```

int jong_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]

```

Return the Johab 6/3/1 jongseong variation.

There is only one jongseong variation, so this function always returns 0. It is a placeholder function for possible future adaptation to other johab encodings.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

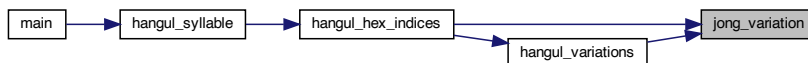
Returns

The jongseong variation, always 0.

Definition at line 558 of file [unihangul-support.c](#).

```
00558     {
00559
00560     return 0; /* There is only one Jongseong variation. */
00561 }
```

Here is the caller graph for this function:



5.33.2.14 jung_variation()

```
int jung_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]
```

Return the Johab 6/3/1 jungseong variation.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the vowel (jungseong).

Each jungseong has 3 variations:

Variation Occurrence

0 Jungseong with only chungseong (no jungseong). 1 Jungseong with chungseong and jungseong (except nieun). 2 Jungseong with chungseong and jungseong nieun.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

The jungseong variation, 0 to 2.

Definition at line 524 of file [unihangul-support.c](#).

```

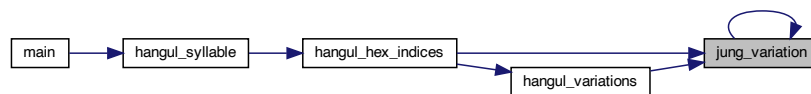
00524     {
00525     int jung__variation; /* Return value */
00526
00527     if (jungseong < 0) {
00528         jung__variation = -1;
00529     }
00530     else {
00531         jung__variation = 0;
00532         if (jongseong >= 0) {
00533             if (jongseong == 3)
00534                 jung__variation = 2; /* Vowel for final Nieun. */
00535             else
00536                 jung__variation = 1;
00537         }
00538     }
00539
00540
00541     return jung__variation;
00542 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.15 one_jamo()

```

void one_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned jamo,
    unsigned * jamo_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	jamo	The Unicode code point, 0 or 0x1100..0x115F.
out	jamo_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 717 of file [unihangul-support.c](#).

```

00718     {
00719
00720     int i; /* Loop variable */
00721     int glyph_index; /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {
00726         glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729         glyph_index = jamo - 0xA960 + JAMO_EXT_A_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732         glyph_index = jamo - 0x1100 + JAMO_EXT_B_HEX;
00733     }
00734     else {
00735         glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739         jamo_glyph[i] = glyph_table[glyph_index][i];
00740     }
00741
00742     return;
00743 }

```

5.33.2.16 print_glyph_hex()

```

void print_glyph_hex (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )

```

Print one glyph in Unifont hexdraw hexadecimal string style.

Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 692 of file [unihangul-support.c](#).

```

00692                                     {
00693
00694     int i;
00695
00696     fprintf (fp, "%04X:", codept);
00697
00698     /* for each this_glyph row */
00699     for (i = 0; i < 16; i++) {
00700         fprintf (fp, "%04X", this_glyph[i]);
00701     }
00702     fputc ('\n', fp);
00703
00704     return;
00705 }
00706

```

Here is the caller graph for this function:



5.33.2.17 `print_glyph_txt()`

```
void print_glyph_txt (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw plain text style.

Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 656 of file [unihangul-support.c](#).

```
00656                                     {
00657     int i;
00658     unsigned mask;
00659
00660     fprintf (fp, "%04X:", codept);
00661
00662     /* for each this_glyph row */
00663     for (i = 0; i < 16; i++) {
00664         mask = 0x8000;
00665         fputc ('\t', fp);
00666         while (mask != 0x0000) {
00667             if (mask & this_glyph[i]) {
00668                 fputc ('#', fp);
00669             }
00670             else {
00671                 fputc ('.', fp);
00672             }
00673             mask »= 1; /* shift to next bit in this_glyph row */
00674         }
00675         fputc ('\n', fp);
00676     }
00677     fputc ('\n', fp);
00678
00679     return;
00680 }
00681 }
```

5.34 unihangul-support.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unihangul-support.c
00003
00004 @brief Functions for converting Hangul letters into syllables
00005
00006 This file contains functions for reading in Hangul letters
00007 arranged in a Johab 6/3/1 pattern and composing syllables
00008 with them. One function maps an initial letter (choseong),
00009 medial letter (jungseong), and final letter (jongseong)
00010 into the Hangul Syllables Unicode block, U+AC00..U+D7A3.
00011 Other functions allow formation of glyphs that include
00012 the ancient Hangul letters that Hanterm supported. More
00013 can be added if desired, with appropriate changes to
00014 start positions and lengths defined in "hangul.h".
00015
00016 @author Paul Hardy
00017
00018 @copyright Copyright © 2023 Paul Hardy
00019 */
00020 /*
00021 LICENSE:
00022
00023 This program is free software: you can redistribute it and/or modify
00024 it under the terms of the GNU General Public License as published by
00025 the Free Software Foundation, either version 2 of the License, or
00026 (at your option) any later version.
00027
00028 This program is distributed in the hope that it will be useful,
00029 but WITHOUT ANY WARRANTY; without even the implied warranty of
00030 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00031 GNU General Public License for more details.
00032
00033 You should have received a copy of the GNU General Public License
00034 along with this program. If not, see <http://www.gnu.org/licenses/>.
00035 */
00036 #include <stdio.h>
00037 #include "hangul.h"
00038
00039
00040
00041 /**
00042 @brief Read hangul-base.hex file into a unsigned char array.
00043
00044 Read a Hangul base .hex file with separate choseong, jungseong,
00045 and jongseong glyphs for syllable formation. The order is:
00046
00047 - Empty glyph in 0x0000 position.
00048 - Initial consonants (choseong).
00049 - Medial vowels and diphthongs (jungseong).
00050 - Final consonants (jongseong).
00051 - Individual letter forms in isolation, not for syllable formation.
00052
00053 The letters are arranged with all variations for one letter
00054 before continuing to the next letter. In the current
00055 encoding, there are 6 variations of choseong, 3 of jungseong,
00056 and 1 of jongseong per letter.
00057
00058 @param[in] Input file pointer; can be stdin.
00059 @param[out] Array of bit patterns, with 32 8-bit values per letter.
00060 @return The maximum code point value read in the file.
00061 */
00062 unsigned
00063 hangul_read_base8 (FILE *infp, unsigned char base[][32]) {
00064     unsigned codept;
00065     unsigned max_codept;
00066     int i, j;
00067     char instring[MAXLINE];
00068
00069     max_codept = 0;
00070
00071     while (fgets (instring, MAXLINE, infp) != NULL) {
00072         sscanf (instring, "%X", &codept);
00073         codept -= PUA_START;
00074         /* If code point is within range, add it */
00075         if (codept < MAX_GLYPHS) {
00076             /* Find the start of the glyph bitmap. */

```

```

00078     for (i = 1; instrstring[i] != '\0' && instrstring[i] != ':'; i++);
00079     if (instrstring[i] == ':') {
00080         i++; /* Skip over ':' to get to start of bitmap. */
00081         for (j = 0; j < 32; j++) {
00082             sscanf (&instrstring[i], "%2hhX", &base[codept][j]);
00083             i += 2;
00084         }
00085         if (codept > max_codept) max_codept = codept;
00086     }
00087 }
00088 }
00089
00090 return max_codept;
00091 }
00092
00093 /**
00094  * @brief Read hangul-base.hex file into a unsigned array.
00095  * Read a Hangul base .hex file with separate choseong, jungseong,
00096  * and jongseong glyphs for syllable formation. The order is:
00097  * - Empty glyph in 0x0000 position.
00098  * - Initial consonants (choseong).
00099  * - Medial vowels and diphthongs (jungseong).
00100  * - Final consonants (jongseong).
00101  * - Individual letter forms in isolation, not for syllable formation.
00102  * The letters are arranged with all variations for one letter
00103  * before continuing to the next letter. In the current
00104  * encoding, there are 6 variations of choseong, 3 of jungseong,
00105  * and 1 of jongseong per letter.
00106  * @param[in] Input file pointer; can be stdin.
00107  * @param[out] Array of bit patterns, with 16 16-bit values per letter.
00108  * @return The maximum code point value read in the file.
00109  */
00110 unsigned
00111 hangul_read_base16 (FILE *infp, unsigned base[][16]) {
00112     unsigned codept;
00113     unsigned max_codept;
00114     int i, j;
00115     char instrstring[MAXLINE];
00116
00117     max_codept = 0;
00118
00119     while (fgets (instrstring, MAXLINE, infp) != NULL) {
00120         sscanf (instrstring, "%X", &codept);
00121         codept -= PUA_START;
00122         /* If code point is within range, add it */
00123         if (codept < MAX_GLYPHS) {
00124             /* Find the start of the glyph bitmap. */
00125             for (i = 1; instrstring[i] != '\0' && instrstring[i] != ':'; i++);
00126             if (instrstring[i] == ':') {
00127                 i++; /* Skip over ':' to get to start of bitmap. */
00128                 for (j = 0; j < 16; j++) {
00129                     sscanf (&instrstring[i], "%4X", &base[codept][j]);
00130                     i += 4;
00131                 }
00132                 if (codept > max_codept) max_codept = codept;
00133             }
00134         }
00135     }
00136
00137     return max_codept;
00138 }
00139
00140 /**
00141  * @brief Decompose a Hangul Syllables code point into three letters.
00142  * Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:
00143  * - Choseong 0-19
00144  * - Jungseong 0-20
00145  * - Jongseong 0-27 or -1 if no jongseong
00146  * All letter values are set to -1 if the letters do not
00147  * form a syllable in the Hangul Syllables range. This function
00148  * only handles modern Hangul, because that is all that is in

```

```

00159 the Hangul Syllables range.
00160
00161 @param[in] codept The Unicode code point to decode, from 0xAC00 to 0xD7A3.
00162 @param[out] initial The 1st letter (choseong) in the syllable.
00163 @param[out] medial The 2nd letter (jungseong) in the syllable.
00164 @param[out] final The 3rd letter (jongseong) in the syllable.
00165 */
00166 void
00167 hangul_decompose (unsigned codept, int *initial, int *medial, int *final) {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept -= 0xAC00;
00174         *initial = codept / (28 * 21);
00175         *medial = (codept / 28) % 21;
00176         *final = codept % 28 - 1;
00177     }
00178
00179     return;
00180 }
00181
00182
00183 /**
00184 @brief Compose a Hangul syllable into a code point, or 0 if none exists.
00185
00186 This function takes three letters that can form a modern Hangul
00187 syllable and returns the corresponding Unicode Hangul Syllables
00188 code point in the range 0xAC00 to 0xD7A3.
00189
00190 If a three-letter combination includes one or more archaic letters,
00191 it will not map into the Hangul Syllables range. In that case,
00192 the returned code point will be 0 to indicate that no valid
00193 Hangul Syllables code point exists.
00194
00195 @param[in] initial The first letter (choseong), 0 to 18.
00196 @param[in] medial The second letter (jungseong), 0 to 20.
00197 @param[in] final The third letter (jongseong), 0 to 26 or -1 if none.
00198 @return The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.
00199 */
00200 unsigned
00201 hangul_compose (int initial, int medial, int final) {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial >= 0 && medial <= 20 &&
00207         final >= 0 && final <= 26) {
00208
00209         codept = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }
00220
00221
00222 /**
00223 @brief Determine index values to the bitmaps for a syllable's components.
00224
00225 This function reads these input values for modern and ancient Hangul letters:
00226
00227 - Choseong number (0 to the number of modern and archaic choseong - 1.
00228 - Jungseong number (0 to the number of modern and archaic jungseong - 1.
00229 - Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.
00230
00231 It then determines the variation of each letter given the combination with
00232 the other two letters (or just choseong and jungseong if the jongseong value
00233 is -1).
00234
00235 These variations are then converted into index locations within the
00236 glyph array that was read in from the hangul-base.hex file. Those
00237 index locations can then be used to form a composite syllable.
00238
00239 There is no restriction to only use the modern Hangul letters.

```

```

00240
00241 @param[in] choseong The 1st letter in the syllable.
00242 @param[in] jungseong The 2nd letter in the syllable.
00243 @param[in] jongseong The 3rd letter in the syllable, or -1 if none.
00244 @param[out] cho_index Index location to the 1st letter variation from the hangul-base.hex file.
00245 @param[out] jung_index Index location to the 2nd letter variation from the hangul-base.hex file.
00246 @param[out] jong_index Index location to the 3rd letter variation from the hangul-base.hex file.
00247 */
00248 void
00249 hangul_hex_indices (int choseong, int jungseong, int jongseong,
00250                     int *cho_index, int *jung_index, int *jong_index) {
00251
00252     int cho_variation, jung_variation, jong_variation; /* Letter variations */
00253
00254     void hangul_variations (int choseong, int jungseong, int jongseong,
00255                             int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257     hangul_variations (choseong, jungseong, jongseong,
00258                        &cho_variation, &jung_variation, &jong_variation);
00259
00260     *cho_index = CHO_HEX + choseong * CHO_VARIATIONS + cho_variation;
00261     *jung_index = JUNG_HEX + jungseong * JUNG_VARIATIONS + jung_variation;;
00262     *jong_index = jongseong < 0 ? 0x0000 :
00263                     JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00264
00265     return;
00266 }
00267
00268
00269
00270 /**
00271 @brief Determine the variations of each letter in a Hangul syllable.
00272
00273 Given the three letters that will form a syllable, return the variation
00274 of each letter used to form the composite glyph.
00275
00276 This function can determine variations for both modern and archaic
00277 Hangul letters; it is not limited to only the letters combinations
00278 that comprise the Unicode Hangul Syllables range.
00279
00280 This function reads these input values for modern and ancient Hangul letters:
00281
00282 - Choseong number (0 to the number of modern and archaic choseong - 1.
00283 - Jungseong number (0 to the number of modern and archaic jungseong - 1.
00284 - Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.
00285
00286 It then determines the variation of each letter given the combination with
00287 the other two letters (or just choseong and jungseong if the jongseong value
00288 is -1).
00289
00290 @param[in] choseong The 1st letter in the syllable.
00291 @param[in] jungseong The 2nd letter in the syllable.
00292 @param[in] jongseong The 3rd letter in the syllable, or -1 if none.
00293 @param[out] cho_var Variation of the 1st letter from the hangul-base.hex file.
00294 @param[out] jung_var Variation of the 2nd letter from the hangul-base.hex file.
00295 @param[out] jong_var Variation of the 3rd letter from the hangul-base.hex file.
00296 */
00297 void
00298 hangul_variations (int choseong, int jungseong, int jongseong,
00299                   int *cho_var, int *jung_var, int *jong_var) {
00300
00301     int cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);
00303     int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305     /*
00306 Find the variation for each letter component.
00307 */
00308     *cho_var = cho_variation (choseong, jungseong, jongseong);
00309     *jung_var = jung_variation (choseong, jungseong, jongseong);
00310     *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312     return;
00313 }
00314
00315
00316
00317 /**
00318 @brief Return the Johab 6/3/1 choseong variation for a syllable.
00319
00320 This function takes the two or three (if jongseong is included)

```

```

00321 letters that comprise a syllable and determine the variation
00322 of the initial consonant (choseong).
00323
00324 Each choseong has 6 variations:
00325
00326 Variation   Occurrence
00327 -----
00328 0           Choseong with a vertical vowel such as "A".
00329 1           Choseong with a horizontal vowel such as "O".
00330 2           Choseong with a vertical and horizontal vowel such as "WA".
00331 3           Same as variation 0, but with jongseong (final consonant).
00332 4           Same as variation 1, but with jongseong (final consonant).
00333 Also a horizontal vowel pointing down, such as U and YU.
00334 5           Same as variation 2, but with jongseong (final consonant).
00335 Also a horizontal vowel pointing down with vertical element,
00336 such as WEO, WE, and WI.
00337
00338 In addition, if the vowel is horizontal and a downward-pointing stroke
00339 as in the modern letters U, WEO, WE, WI, and YU, and in archaic
00340 letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added
00341 to the initial variation of 0 to 2, resulting in a choseong variation
00342 of 3 to 5, respectively.
00343
00344 @param[in] choseong The 1st letter in the syllable.
00345 @param[in] jungseong The 2nd letter in the syllable.
00346 @param[in] jongseong The 3rd letter in the syllable.
00347 @return The choseong variation, 0 to 5.
00348 */
00349 int
00350 cho_variation (int choseong, int jungseong, int jongseong) {
00351     int cho_variation; /* Return value */
00352
00353     /*
00354     The Choseong cho_var is determined by the
00355     21 modern + 50 ancient Jungseong, and whether
00356     or not the syllable contains a final consonant
00357     (Jongseong).
00358     */
00359     static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361         Modern Jungseong in positions 0..20.
00362         */
00363         /* Location Variations Unicode Range Vowel # Vowel Names */
00364         /* ----- */
00365         /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00366         /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00367         /* 0x30D */ 0, 0, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00368         /* 0x313 */ 1, // U+1169 -->[ 8] O
00369         /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00370         /* 0x31F */ 1, 4, // U+116D..U+116E-->[12..13] YO, U
00371         /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16] WEO, WE, WI
00372         /* 0x32E */ 4, 1, // U+1172..U+1173-->[17..18] YU, EU
00373         /* 0x334 */ 2, // U+1174 -->[19] YI
00374         /* 0x337 */ 0, // U+1175 -->[20] I
00375         /*
00376         Ancient Jungseong in positions 21..70.
00377         */
00378         /* Location Variations Unicode Range Vowel # Vowel Names */
00379         /* ----- */
00380         /* 0x33A */ 2, 5, 2, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00381         /* 0x343 */ 2, 2, 5, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00382         /* 0x34C */ 2, 2, 5, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00383         /* 0x355 */ 2, 5, 5, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00384         /* 0x35E */ 4, 4, 2, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00385         /* 0x367 */ 2, 2, 5, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00386         /* 0x370 */ 2, 5, 5, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00387         /* 0x379 */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00388         /* 0x382 */ 5, 5, 5, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00389         /* 0x38B */ 5, 5, 2, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00390         /* 0x394 */ 5, 2, 2, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00391         /* 0x39D */ 2, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00392         /* 0x3A6 */ 2, 5, 2, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00393         /* 0x3AF */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394         /* 0x3B8 */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I, SSANGARAEA,
00395         /* 0x3C1 */ 2, 5, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00396         /* 0x3CA */ 2, 2, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE,
00397         #ifdef EXTENDED_HANGUL
00398         /* 0x3D0 */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00399         /* 0x3D9 */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00400         /* 0x3E2 */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00401         /* 0x3EB */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,

```

```

00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00405 /* 0x40F: */ 2, 2, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1 // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1 // Mark end of list of vowels.
00409 #endif
00410 };
00411
00412
00413 if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415 }
00416 else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jungseong >= 0 && cho_variation < 3)
00419         cho_variation += 3;
00420 }
00421
00422
00423 return cho_variation;
00424 }
00425
00426
00427 /**
00428 @brief Whether vowel has rightmost vertical stroke to the right.
00429
00430 @param[in] vowel Vowel number, from 0 to TOTAL_JUNG - 1.
00431 @return 1 if this vowel's vertical stroke is wide on the right side; else 0.
00432 */
00433 int
00434 is_wide_vowel (int vowel) {
00435     int retval; /* Return value. */
00436
00437     static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439 Modern Jungseong in positions 0..20.
00440 */
00441 /* Location Variations Unicode Range Vowel # Vowel Names */
00442 /* ----- */
00443 /* 0x2FB: */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00444 /* 0x304: */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00445 /* 0x30D: */ 0, 1, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00446 /* 0x313: */ 0, // U+1169 -->[ 8] O
00447 /* 0x316: */ 0, 1, 0, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00448 /* 0x31F: */ 0, 0, // U+116D..U+116E-->[12..13] YO, U
00449 /* 0x325: */ 0, 1, 0, // U+116F..U+1171-->[14..16] WEO, WE, WI
00450 /* 0x32E: */ 0, 0, // U+1172..U+1173-->[17..18] YU, EU
00451 /* 0x334: */ 0, // U+1174 -->[19] YI
00452 /* 0x337: */ 0, // U+1175 -->[20] I
00453 /*
00454 Ancient Jungseong in positions 21..70.
00455 */
00456 /* Location Variations Unicode Range Vowel # Vowel Names */
00457 /* ----- */
00458 /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00459 /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00460 /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00461 /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00462 /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00463 /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00464 /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00465 /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00466 /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00467 /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00468 /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00469 /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00470 /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00471 /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAE, ARAEA, ARAEA-EO,
00472 /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I, SSANGARAE,
00473 /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00474 /* 0x3CA: */ 0, 1, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE
00475 #ifndef EXTENDED_HANGUL
00476 /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00477 /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00478 /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00479 /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00480 /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00481 /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00482 /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,

```

```

00483 /* 0x40F: */ 0, 1, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484 /* 0x415: */ -1 // Mark end of list of vowels.
00485 #else
00486 /* 0x310: */ -1 // Mark end of list of vowels.
00487 #endif
00488 };
00489
00490
00491 if (vowel >= 0 && vowel < TOTAL_JUNG) {
00492     retval = wide_vowel [vowel];
00493 }
00494 else {
00495     retval = 0;
00496 }
00497
00498
00499 return retval;
00500 }
00501
00502
00503 /**
00504 @brief Return the Johab 6/3/1 jungseong variation.
00505
00506 This function takes the two or three (if jongseong is included)
00507 letters that comprise a syllable and determine the variation
00508 of the vowel (jungseong).
00509
00510 Each jungseong has 3 variations:
00511
00512 Variation Occurrence
00513 -----
00514 0 Jungseong with only chungseong (no jungseong).
00515 1 Jungseong with chungseong and jungseong (except nieun).
00516 2 Jungseong with chungseong and jungseong nieun.
00517
00518 @param[in] choseong The 1st letter in the syllable.
00519 @param[in] jungseong The 2nd letter in the syllable.
00520 @param[in] jongseong The 3rd letter in the syllable.
00521 @return The jungseong variation, 0 to 2.
00522 */
00523 inline int
00524 jung_variation (int choseong, int jungseong, int jongseong) {
00525     int jung_variation; /* Return value */
00526
00527     if (jungseong < 0) {
00528         jung_variation = -1;
00529     }
00530     else {
00531         jung_variation = 0;
00532         if (jongseong >= 0) {
00533             if (jongseong == 3)
00534                 jung_variation = 2; /* Vowel for final Nieun. */
00535             else
00536                 jung_variation = 1;
00537         }
00538     }
00539
00540
00541     return jung_variation;
00542 }
00543
00544
00545 /**
00546 @brief Return the Johab 6/3/1 jongseong variation.
00547
00548 There is only one jongseong variation, so this function
00549 always returns 0. It is a placeholder function for
00550 possible future adaptation to other johab encodings.
00551
00552 @param[in] choseong The 1st letter in the syllable.
00553 @param[in] jungseong The 2nd letter in the syllable.
00554 @param[in] jongseong The 3rd letter in the syllable.
00555 @return The jongseong variation, always 0.
00556 */
00557 inline int
00558 jong_variation (int choseong, int jungseong, int jongseong) {
00559
00560     return 0; /* There is only one Jongseong variation. */
00561 }
00562
00563

```

```

00564 /**
00565 @brief Given letters in a Hangul syllable, return a glyph.
00566
00567 This function returns a glyph bitmap comprising up to three
00568 Hangul letters that form a syllable. It reads the three
00569 component letters (choseong, jungseong, and jongseong),
00570 then calls a function that determines the appropriate
00571 variation of each letter, returning the letter bitmap locations
00572 in the glyph array. Then these letter bitmaps are combined
00573 with a logical OR operation to produce a final bitmap,
00574 which forms a 16 row by 16 column bitmap glyph.
00575
00576 @param[in] choseong The 1st letter in the composite glyph.
00577 @param[in] jungseong The 2nd letter in the composite glyph.
00578 @param[in] jongseong The 3rd letter in the composite glyph.
00579 @param[in] hangul_base The glyphs read from the "hangul_base.hex" file.
00580 @return syllable The composite syllable, as a 16 by 16 pixel bitmap.
00581 */
00582 void
00583 hangul_syllable (int choseong, int jungseong, int jongseong,
00584                 unsigned char hangul_base[][32], unsigned char *syllable) {
00585
00586     int i; /* loop variable */
00587     int cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                        &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595         glyph_byte = hangul_base [cho_hex][i];
00596         glyph_byte |= hangul_base [jung_hex][i];
00597         if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598         syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }
00603
00604
00605 /**
00606 @brief See if two glyphs overlap.
00607
00608 @param[in] glyph1 The first glyph, as a 16-row bitmap.
00609 @param[in] glyph2 The second glyph, as a 16-row bitmap.
00610 @return 0 if no overlaps between glyphs, 1 otherwise.
00611 */
00612 int
00613 glyph_overlap (unsigned *glyph1, unsigned *glyph2) {
00614     int overlaps; /* Return value; 0 if no overlaps, -1 if overlaps. */
00615     int i;
00616
00617     /* Check for overlaps between the two glyphs. */
00618
00619     i = 0;
00620     do {
00621         overlaps = (glyph1[i] & glyph2[i]) != 0;
00622         i++;
00623     } while (i < 16 && overlaps == 0);
00624
00625     return overlaps;
00626 }
00627
00628
00629 /**
00630 @brief Combine two glyphs into one glyph.
00631
00632 @param[in] glyph1 The first glyph to overlap.
00633 @param[in] glyph2 The second glyph to overlap.
00634 @param[out] combined_glyph The returned combination glyph.
00635 */
00636 void
00637 combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00638               unsigned *combined_glyph) {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642         combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644     return;

```

```

00645 }
00646
00647
00648 /**
00649 @brief Print one glyph in Unifont hexdraw plain text style.
00650
00651 @param[in] fp      The file pointer for output.
00652 @param[in] codept  The Unicode code point to print with the glyph.
00653 @param[in] this_glyph The 16-row by 16-column glyph to print.
00654 */
00655 void
00656 print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph) {
00657     int i;
00658     unsigned mask;
00659
00660     fprintf (fp, "%04X:", codept);
00661
00662     /* for each this_glyph row */
00663     for (i = 0; i < 16; i++) {
00664         mask = 0x8000;
00665         fputc ('\t', fp);
00666         while (mask != 0x0000) {
00667             if (mask & this_glyph[i]) {
00668                 fputc ('#', fp);
00669             }
00670             else {
00671                 fputc ('.', fp);
00672             }
00673             mask »= 1; /* shift to next bit in this_glyph row */
00674         }
00675         fputc ('\n', fp);
00676     }
00677     fputc ('\n', fp);
00678
00679     return;
00680 }
00681
00682
00683
00684 /**
00685 @brief Print one glyph in Unifont hexdraw hexadecimal string style.
00686
00687 @param[in] fp      The file pointer for output.
00688 @param[in] codept  The Unicode code point to print with the glyph.
00689 @param[in] this_glyph The 16-row by 16-column glyph to print.
00690 */
00691 void
00692 print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph) {
00693     int i;
00694
00695     fprintf (fp, "%04X:", codept);
00696
00697     /* for each this_glyph row */
00698     for (i = 0; i < 16; i++) {
00699         fprintf (fp, "%04X", this_glyph[i]);
00700     }
00701     fputc ('\n', fp);
00702
00703     return;
00704 }
00705
00706 }
00707
00708
00709 /**
00710 @brief Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
00711
00712 @param[in] glyph_table The collection of all jamo glyphs.
00713 @param[in] jamo        The Unicode code point, 0 or 0x1100..0x115F.
00714 @param[out] jamo_glyph The output glyph, 16 columns in each of 16 rows.
00715 */
00716 void
00717 one_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00718          unsigned jamo, unsigned *jamo_glyph) {
00719
00720     int i; /* Loop variable */
00721     int glyph_index; /* Location of glyph in "hangul-base.hex" array */
00722
00723     /* If jamo is invalid range, use blank glyph, */
00724     if (jamo >= 0x1100 && jamo <= 0x11FF) {

```

```

00726     glyph_index = jamo - 0x1100 + JAMO_HEX;
00727 }
00728 else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729     glyph_index = jamo - 0xA960 + JAMO_EXT_A_HEX;
00730 }
00731 else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732     glyph_index = jamo - 0x1100 + JAMO_EXT_B_HEX;
00733 }
00734 else {
00735     glyph_index = 0;
00736 }
00737
00738 for (i = 0; i < 16; i++) {
00739     jamo_glyph[i] = glyph_table[glyph_index][i];
00740 }
00741
00742 return;
00743 }
00744
00745 /**
00746  * @brief Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
00747  *
00748  * This function converts input Hangul choseong, jungseong, and jongseong
00749  * Unicode code triplets into a Hangul syllable. Any of those with an
00750  * out of range code point are assigned a blank glyph for combining.
00751  *
00752  * This function performs the following steps:
00753  *
00754  * 1) Determine the sequence number of choseong, jungseong,
00755  *    and jongseong, from 0 to the total number of choseong,
00756  *    jungseong, or jongseong, respectively, minus one. The
00757  *    sequence for each is as follows:
00758  *
00759  *    a) Choseong: Unicode code points of U+1100..U+115E
00760  *    and then U+A960..U+A97C.
00761  *
00762  *    b) Jungseong: Unicode code points of U+1161..U+11A7
00763  *    and then U+D7B0..U+D7C6.
00764  *
00765  *    c) Jongseong: Unicode code points of U+11A8..U+11FF
00766  *    and then U+D7CB..U+D7FB.
00767  *
00768  * 2) From the choseong, jungseong, and jongseong sequence number,
00769  *    determine the variation of choseong and jungseong (there is
00770  *    only one jongseong variation, although it is shifted right
00771  *    by one column for some vowels with a pair of long vertical
00772  *    strokes on the right side).
00773  *
00774  * 3) Convert the variation numbers for the three syllable
00775  *    components to index locations in the glyph array.
00776  *
00777  * 4) Combine the glyph array glyphs into a syllable.
00778  *
00779  * @param[in] glyph_table The collection of all jamo glyphs.
00780  * @param[in] cho The choseong Unicode code point, 0 or 0x1100..0x115F.
00781  * @param[in] jung The jungseong Unicode code point, 0 or 0x1160..0x11A7.
00782  * @param[in] jong The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
00783  * @param[out] combined_glyph The output glyph, 16 columns in each of 16 rows.
00784  */
00785 void
00786 combined_jamo(unsigned glyph_table[MAX_GLYPHS][16],
00787               unsigned cho, unsigned jung, unsigned jong,
00788               unsigned *combined_glyph) {
00789     int i; /* Loop variable. */
00790     int cho_num, jung_num, jong_num;
00791     int cho_group, jung_group, jong_group;
00792     int cho_index, jung_index, jong_index;
00793
00794     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00795
00796     int cho_variation(int choseong, int jungseong, int jongseong);
00797
00798     void combine_glyphs(unsigned *glyph1, unsigned *glyph2,
00799                        unsigned *combined_glyph);
00800
00801     /* Choose a blank glyph for each syllable by default. */
00802     cho_index = jung_index = jong_index = 0x000;
00803

```

```

00807  /*
00808  Convert Unicode code points to jamo sequence number
00809  of each letter, or -1 if letter is not in valid range.
00810  */
00811  if (cho >= 0x1100 && cho <= 0x115E)
00812      cho_num = cho - CHO_UNICODE_START;
00813  else if (cho >= CHO_EXT_A_UNICODE_START &&
00814           cho < (CHO_EXT_A_UNICODE_START + NCHO_EXT_A))
00815      cho_num = cho - CHO_EXT_A_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816  else
00817      cho_num = -1;
00818
00819  if (jung >= 0x1161 && jung <= 0x11A7)
00820      jung_num = jung - JUNG_UNICODE_START;
00821  else if (jung >= JUNG_EXT_B_UNICODE_START &&
00822           jung < (JUNG_EXT_B_UNICODE_START + NJUNG_EXT_B))
00823      jung_num = jung - JUNG_EXT_B_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824  else
00825      jung_num = -1;
00826
00827  if (jong >= 0x11A8 && jong <= 0x11FF)
00828      jong_num = jong - JONG_UNICODE_START;
00829  else if (jong >= JONG_EXT_B_UNICODE_START &&
00830           jong < (JONG_EXT_B_UNICODE_START + NJONG_EXT_B))
00831      jong_num = jong - JONG_EXT_B_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832  else
00833      jong_num = -1;
00834
00835  /*
00836  Choose initial consonant (choseong) variation based upon
00837  the vowel (jungseong) if both are specified.
00838  */
00839  if (cho_num < 0) {
00840      cho_index = cho_group = 0; /* Use blank glyph for choseong. */
00841  }
00842  else {
00843      if (jung_num < 0 && jong_num < 0) { /* Choseong is by itself. */
00844          cho_group = 0;
00845          if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846              cho_index = cho_num + JAMO_HEX;
00847          else /* Choseong is in Hangul Jamo Extended-A range. */
00848              cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                  + JAMO_EXT_A_HEX;
00850      }
00851      else {
00852          if (jung_num >= 0) { /* Valid jungseong with choseong. */
00853              cho_group = cho_variation(cho_num, jung_num, jong_num);
00854          }
00855          else { /* Invalid vowel; see if final consonant is valid. */
00856              /*
00857              If initial consonant and final consonant are specified,
00858              set cho_group to 4, which is the group tha would apply
00859              to a horizontal-only vowel such as Hangul "O", so the
00860              consonant appears full-width.
00861              */
00862              cho_group = 0;
00863              if (jong_num >= 0) {
00864                  cho_group = 4;
00865              }
00866              cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00867                  cho_group;
00868          } /* Choseong combined with jungseong and/or jongseong. */
00869      } /* Valid choseong. */
00870  }
00871
00872  /*
00873  Choose vowel (jungseong) variation based upon the choseong
00874  and jungseong.
00875  */
00876  jung_index = jung_group = 0; /* Use blank glyph for jungseong. */
00877
00878  if (jung_num >= 0) {
00879      if (cho_num < 0 && jong_num < 0) { /* Jungseong is by itself. */
00880          jung_group = 0;
00881          jung_index = jung_num + JUNG_UNICODE_START;
00882      }
00883      else {
00884          if (jong_num >= 0) { /* If there is a final consonant. */
00885              if (jong_num == 3) /* Nieun; choose variation 3. */
00886                  jung_group = 2;
00887              else

```

```

00888     jung_group = 1;
00889 } /* Valid jongseong. */
00890 /* If valid choseong but no jongseong, choose jongseong variation 0. */
00891 else if (cho_num >= 0)
00892     jung_group = 0;
00893 }
00894 jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895 }
00896
00897 /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jongseong are present.
00900 */
00901 if (jong_num < 0) {
00902     jung_index = jong_group = 0; /* Use blank glyph for jongseong. */
00903 }
00904 else { /* Valid jongseong. */
00905     if (cho_num < 0 && jong_num < 0) { /* Jongseong is by itself. */
00906         jung_group = 0;
00907         jung_index = jung_num + 0x4A8;
00908     }
00909     else { /* There is only one jongseong variation if combined. */
00910         jung_group = 0;
00911         jung_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912             jung_group;
00913     }
00914 }
00915
00916 /*
00917 Now that we know the index locations for choseong, jongseong, and
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920 combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921     combined_glyph);
00922
00923 if (jong_index > 0) {
00924     /*
00925     If the vowel has a vertical stroke that is one column
00926     away from the right border, shift this jongseung right
00927     by one column to line up with the rightmost vertical
00928     stroke in the vowel.
00929     */
00930     if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932             tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935             combined_glyph);
00936     }
00937     else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939             combined_glyph);
00940     }
00941 }
00942
00943 return;
00944 }
00945

```

5.35 src/unihex2bmp.c File Reference

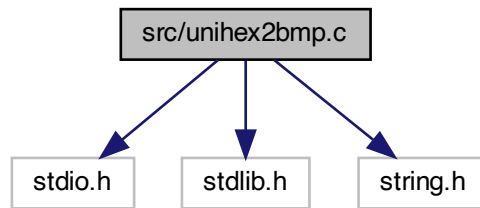
unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

```

Include dependency graph for unihex2bmp.c:



Macros

- `#define` `MAXBUF` 256

Functions

- `int` `main` (`int` argc, `char` *argv[])
The main function.
- `int` `hex2bit` (`char` *instring, `unsigned char` character[32][4])
Generate a bitmap for one glyph.
- `int` `init` (`unsigned char` bitmap[17 * 32][18 * 4])
Initialize the bitmap grid.

Variables

- `char` * `hex` [18]
GNU Unifont bitmaps for hexadecimal digits.
- `unsigned char` `hexbits` [18][32]
The digits converted into bitmaps.
- `unsigned` `unipage` = 0
Unicode page number, 0x00..0xff.
- `int` `flip` = 1
Transpose entire matrix as in Unicode book.

5.35.1 Detailed Description

unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

Copyright (C) 2007, 2008, 2013, 2017 Paul Hardy

This program reads in a GNU Unifont .hex file, extracts a range of 256 code points, and converts it a Microsoft Bitmap (.bmp) or Wireless Bitmap file.

Synopsis: unihex2bmp [-iin_file.hex] [-oout_file.bmp] [-f] [-phex_page_num] [-w]

Definition in file [unihex2bmp.c](#).

5.35.2 Macro Definition Documentation

5.35.2.1 MAXBUF

```
#define MAXBUF 256
```

Definition at line 50 of file [unihex2bmp.c](#).

5.35.3 Function Documentation

5.35.3.1 hex2bit()

```
int hex2bit (
    char * instring,
    unsigned char character[32][4] )
```

Generate a bitmap for one glyph.

Convert the portion of a hex string after the ':' into a character bitmap.

If string is ≥ 128 characters, it will fill all 4 bytes per row. If string is ≥ 64 characters and < 128 , it will fill 2 bytes per row. Otherwise, it will fill 1 byte per row.

Parameters

in	instring	The character array containing the glyph bitmap.
out	character	Glyph bitmap, 8, 16, or 32 columns by 16 rows tall.

Returns

Always returns 0.

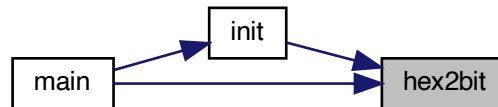
Definition at line 367 of file unihex2bmp.c.

```

00368 {
00369
00370     int i; /* current row in bitmap character */
00371     int j; /* current character in input string */
00372     int k; /* current byte in bitmap character */
00373     int width; /* number of output bytes to fill - 1: 0, 1, 2, or 3 */
00374
00375     for (i=0; i<32; i++) /* erase previous character */
00376         character[i][0] = character[i][1] = character[i][2] = character[i][3] = 0;
00377     j=0; /* current location is at beginning of instring */
00378
00379     if (strlen (instring) <= 34) /* 32 + possible '\r', '\n' */
00380         width = 0;
00381     else if (strlen (instring) <= 66) /* 64 + possible '\r', '\n' */
00382         width = 1;
00383     else if (strlen (instring) <= 98) /* 96 + possible '\r', '\n' */
00384         width = 3;
00385     else /* the maximum allowed is quadruple-width */
00386         width = 4;
00387
00388     k = (width > 1) ? 0 : 1; /* if width > double, start at index 1 else at 0 */
00389
00390     for (i=8; i<24; i++) { /* 16 rows per input character, rows 8..23 */
00391         sscanf (&instring[j], "%2hhx", &character[i][k]);
00392         j += 2;
00393         if (width > 0) { /* add next pair of hex digits to this row */
00394             sscanf (&instring[j], "%2hhx", &character[i][k+1]);
00395             j += 2;
00396             if (width > 1) { /* add next pair of hex digits to this row */
00397                 sscanf (&instring[j], "%2hhx", &character[i][k+2]);
00398                 j += 2;
00399                 if (width > 2) { /* quadruple-width is maximum width */
00400                     sscanf (&instring[j], "%2hhx", &character[i][k+3]);
00401                     j += 2;
00402                 }
00403             }
00404         }
00405     }
00406     return (0);
00408 }

```

Here is the caller graph for this function:



5.35.3.2 init()

```
int init (
    unsigned char bitmap[17 * 32][18 * 4] )
```

Initialize the bitmap grid.

Parameters

out	bitmap	The bitmap to generate, with 32x32 pixel glyph areas.
-----	--------	---

Returns

Always returns 0.

Definition at line 418 of file [unihex2bmp.c](#).

```

00419 {
00420     int i, j;
00421     unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00422     unsigned toppixelrow;
00423     unsigned thiscol;
00424     unsigned char pnybble0, pnybble1, pnybble2, pnybble3;
00425
00426     for (i=0; i<18; i++) { /* bitmaps for '0'-'9', 'A'-'F', 'u', '+' */
00427
00428         hex2bit (&hex[i][5], charbits); /* convert hex string to 32*4 bitmap */
00429
00430         for (j=0; j<32; j++) hexbits[i][j] = ~charbits[j][1];
00431     }
00432
00433     /*
00434     Initialize bitmap to all white.
00435     */
00436     for (toppixelrow=0; toppixelrow < 17*32; toppixelrow++) {
00437         for (thiscol=0; thiscol<18; thiscol++) {
00438             bitmap[toppixelrow][(thiscol « 2) ] = 0xff;
00439             bitmap[toppixelrow][(thiscol « 2) | 1] = 0xff;
00440             bitmap[toppixelrow][(thiscol « 2) | 2] = 0xff;
00441             bitmap[toppixelrow][(thiscol « 2) | 3] = 0xff;
00442         }
00443     }
00444     /*
00445     Write the "u+nnnn" table header in the upper left-hand corner,
00446     where nnnn is the upper 16 bits of a 32-bit Unicode assignment.
00447     */
00448     pnybble3 = (unipage » 20);
00449     pnybble2 = (unipage » 16) & 0xf;
00450     pnybble1 = (unipage » 12) & 0xf;
00451     pnybble0 = (unipage » 8) & 0xf;
00452     for (i=0; i<32; i++) {
00453         bitmap[i][1] = hexbits[16][i]; /* copy 'u' */
00454         bitmap[i][2] = hexbits[17][i]; /* copy '+' */
00455         bitmap[i][3] = hexbits[pnybble3][i];
00456         bitmap[i][4] = hexbits[pnybble2][i];
00457         bitmap[i][5] = hexbits[pnybble1][i];
00458         bitmap[i][6] = hexbits[pnybble0][i];
00459     }
00460     /*
00461     Write low-order 2 bytes of Unicode number assignments, as hex labels
00462     */
00463     pnybble3 = (unipage » 4) & 0xf; /* Highest-order hex digit */
00464     pnybble2 = (unipage » 0) & 0xf; /* Next highest-order hex digit */
00465     /*
00466     Write the column headers in bitmap[] (row headers if flipped)
00467     */
00468     toppixelrow = 32 * 17 - 1; /* maximum pixel row number */
00469     /*
00470     Label the column headers. The hexbits[] bytes are split across two
00471     bitmap[] entries to center a the hex digits in a column of 4 bytes.
00472     OR highest byte with 0xf0 and lowest byte with 0x0f to make outer
00473     nybbles white (0=black, 1=white).

```

```

00474 */
00475 for (i=0; i<16; i++) {
00476     for (j=0; j<32; j++) {
00477         if (flip) { /* transpose matrix */
00478             bitmap[j][((i+2) « 2) | 0] = (hexbits[pybble3][j] » 4) | 0xf0;
00479             bitmap[j][((i+2) « 2) | 1] = (hexbits[pybble3][j] « 4) |
00480                 (hexbits[pybble2][j] » 4);
00481             bitmap[j][((i+2) « 2) | 2] = (hexbits[pybble2][j] « 4) |
00482                 (hexbits[i][j] » 4);
00483             bitmap[j][((i+2) « 2) | 3] = (hexbits[i][j] « 4) | 0x0f;
00484         }
00485         else {
00486             bitmap[j][((i+2) « 2) | 1] = (hexbits[i][j] » 4) | 0xf0;
00487             bitmap[j][((i+2) « 2) | 2] = (hexbits[i][j] « 4) | 0x0f;
00488         }
00489     }
00490 }
00491 /*
00492 Now use the single hex digit column graphics to label the row headers.
00493 */
00494 for (i=0; i<16; i++) {
00495     toppixelrow = 32 * (i + 1) - 1; /* from bottom to top */
00496     for (j=0; j<32; j++) {
00497         if (!flip) { /* if not transposing matrix */
00498             bitmap[toppixelrow + j][4] = hexbits[pybble3][j];
00499             bitmap[toppixelrow + j][5] = hexbits[pybble2][j];
00500         }
00501         bitmap[toppixelrow + j][6] = hexbits[i][j];
00502     }
00503 }
00504 }
00505 /*
00506 Now draw grid lines in bitmap, around characters we just copied.
00507 */
00508 /* draw vertical lines 2 pixels wide */
00509 for (i=1*32; i<17*32; i++) {
00510     if ((i & 0x1f) == 7)
00511         i++;
00512     else if ((i & 0x1f) == 14)
00513         i += 2;
00514     else if ((i & 0x1f) == 22)
00515         i++;
00516     for (j=1; j<18; j++) {
00517         bitmap[i][j « 2 | 3] &= 0xfe;
00518     }
00519 }
00520 /* draw horizontal lines 1 pixel tall */
00521 for (i=1*32-1; i<18*32-1; i+=32) {
00522     for (j=2; j<18; j++) {
00523         bitmap[i][j « 2] = 0x00;
00524         bitmap[i][j « 2 | 1] = 0x81;
00525         bitmap[i][j « 2 | 2] = 0x81;
00526         bitmap[i][j « 2 | 3] = 0x00;
00527     }
00528 }
00529 /* fill in top left corner pixel of grid */
00530 bitmap[31][7] = 0xfe;
00531
00532 return (0);
00533 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



5.35.3.3 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 99 of file [unihex2bmp.c](#).

```

00100 {
00101
00102     int i, j;           /* loop variables */
00103     unsigned k0;        /* temp Unicode char variable */
00104     unsigned swap;      /* temp variable for swapping values */
00105     char inbuf[256];    /* input buffer */
00106     unsigned filesize;  /* size of file in bytes */
00107     unsigned bitmapsiz; /* size of bitmap image in bytes */
00108     unsigned thischar;  /* the current character */
00109     unsigned char thischarbyte; /* unsigned char lowest byte of Unicode char */
00110     int thischarrow;    /* row 0..15 where this character belongs */
00111     int thiscol;        /* column 0..15 where this character belongs */
00112     int toppixelrow;    /* pixel row, 0..16*32-1 */
00113     unsigned lastpage=0; /* the last Unicode page read in font file */

```

```

00114 int wbmp=0;          /* set to 1 if writing .wbmp format file */
00115
00116 unsigned char bitmap[17*32][18*4]; /* final bitmap */
00117 unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00118
00119 char *infile="", *outfile=""; /* names of input and output files */
00120 FILE *infp, *outfp; /* file pointers of input and output files */
00121
00122 /* initializes bitmap row/col labeling, &c. */
00123 int init (unsigned char bitmap[17*32][18*4]);
00124
00125 /* convert hex string --> bitmap */
00126 int hex2bit (char *instring, unsigned char character[32][4]);
00127
00128 bitmapsize = 17*32*18*4; /* 17 rows by 18 cols, each 4 bytes */
00129
00130 if (argc > 1) {
00131     for (i = 1; i < argc; i++) {
00132         if (argv[i][0] == '-') { /* this is an option argument */
00133             switch (argv[i][1]) {
00134                 case 'f': /* flip (transpose) glyphs in bitmap as in standard */
00135                     flip = !flip;
00136                     break;
00137                 case 'i': /* name of input file */
00138                     infile = &argv[i][2];
00139                     break;
00140                 case 'o': /* name of output file */
00141                     outfile = &argv[i][2];
00142                     break;
00143                 case 'p': /* specify a Unicode page other than default of 0 */
00144                     sscanf (&argv[i][2], "%x", &unipage); /* Get Unicode page */
00145                     break;
00146                 case 'w': /* write a .wbmp file instead of a .bmp file */
00147                     wbmp = 1;
00148                     break;
00149                 default: /* if unrecognized option, print list and exit */
00150                     fprintf (stderr, "\nSyntax:\n\n");
00151                     fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00152                     fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00153                     fprintf (stderr, " -w specifies .wbmp output instead of ");
00154                     fprintf (stderr, "default Windows .bmp output.\n\n");
00155                     fprintf (stderr, " -p is followed by 1 to 6 ");
00156                     fprintf (stderr, "Unicode page hex digits ");
00157                     fprintf (stderr, "(default is Page 0).\n\n");
00158                     fprintf (stderr, "\nExample:\n\n");
00159                     fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n",
00160                             argv[0]);
00161                     exit (1);
00162             }
00163         }
00164     }
00165 }
00166 /*
00167 Make sure we can open any I/O files that were specified before
00168 doing anything else.
00169 */
00170 if (strlen (infile) > 0) {
00171     if ((infp = fopen (infile, "r")) == NULL) {
00172         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00173         exit (1);
00174     }
00175 }
00176 else {
00177     infp = stdin;
00178 }
00179 if (strlen (outfile) > 0) {
00180     if ((outfp = fopen (outfile, "w")) == NULL) {
00181         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00182         exit (1);
00183     }
00184 }
00185 else {
00186     outfp = stdout;
00187 }
00188
00189 (void)init(bitmap); /* initialize bitmap with row/column headers, etc. */
00190
00191 /*
00192 Read in the characters in the page
00193 */
00194 while (lastpage <= unipage && fgets (inbuf, MAXBUF-1, infp) != NULL) {

```

```

00195     sscanf (inbuf, "%x", &thischar);
00196     lastpage = thischar » 8; /* keep Unicode page to see if we can stop */
00197     if (lastpage == unipage) {
00198         thischarbyte = (unsigned char)(thischar & 0xff);
00199         for (k0=0; inbuf[k0] != ':'; k0++);
00200         k0++;
00201         hex2bit (&inbuf[k0], charbits); /* convert hex string to 32*4 bitmap */
00202
00203     /*
00204     Now write character bitmap upside-down in page array, to match
00205     .bmp file order. In the .wbmp' and .bmp files, white is a '1'
00206     bit and black is a '0' bit, so complement charbits[].
00207     */
00208
00209     thiscol = (thischarbyte & 0xf) + 2; /* column number will be 1..16 */
00210     thischarrow = thischarbyte » 4; /* charcter row number, 0..15 */
00211     if (flip) { /* swap row and column placement */
00212         swap = thiscol;
00213         thiscol = thischarrow;
00214         thischarrow = swap;
00215         thiscol += 2; /* column index starts at 1 */
00216         thischarrow -= 2; /* row index starts at 0 */
00217     }
00218     toppixelrow = 32 * (thischarrow + 1) - 1; /* from bottom to top */
00219
00220     /*
00221     Copy the center of charbits[] because hex characters only
00222     occupy rows 8 to 23 and column byte 2 (and for 16 bit wide
00223     characters, byte 3). The charbits[] array was given 32 rows
00224     and 4 column bytes for completeness in the beginning.
00225     */
00226     for (i=8; i<24; i++) {
00227         bitmap[toppixelrow + i][(thiscol « 2) | 0] =
00228             ~charbits[i][0] & 0xff;
00229         bitmap[toppixelrow + i][(thiscol « 2) | 1] =
00230             ~charbits[i][1] & 0xff;
00231         bitmap[toppixelrow + i][(thiscol « 2) | 2] =
00232             ~charbits[i][2] & 0xff;
00233         /* Only use first 31 bits; leave vertical rule in 32nd column */
00234         bitmap[toppixelrow + i][(thiscol « 2) | 3] =
00235             ~charbits[i][3] & 0xfe;
00236     }
00237     /*
00238     Leave white space in 32nd column of rows 8, 14, 15, and 23
00239     to leave 16 pixel height upper, middle, and lower guides.
00240     */
00241     bitmap[toppixelrow + 8][(thiscol « 2) | 3] |= 1;
00242     bitmap[toppixelrow + 14][(thiscol « 2) | 3] |= 1;
00243     bitmap[toppixelrow + 15][(thiscol « 2) | 3] |= 1;
00244     bitmap[toppixelrow + 23][(thiscol « 2) | 3] |= 1;
00245 }
00246 }
00247 /*
00248 Now write the appropriate bitmap file format, either
00249 Wireless Bitmap or Microsoft Windows bitmap.
00250 */
00251 if (wbmp) { /* Write a Wireless Bitmap .wbmp format file */
00252     /*
00253     Write WBMP header
00254     */
00255     fprintf (outfp, "%c", 0x00); /* Type of image; always 0 (monochrome) */
00256     fprintf (outfp, "%c", 0x00); /* Reserved; always 0 */
00257     fprintf (outfp, "%c%c", 0x84, 0x40); /* Width = 576 pixels */
00258     fprintf (outfp, "%c%c", 0x84, 0x20); /* Height = 544 pixels */
00259     /*
00260     Write bitmap image
00261     */
00262     for (toppixelrow=0; toppixelrow <= 17*32-1; toppixelrow++) {
00263         for (j=0; j<18; j++) {
00264             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 0]);
00265             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00266             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00267             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00268         }
00269     }
00270 }
00271 else { /* otherwise, write a Microsoft Windows .bmp format file */
00272     /*
00273     Write the .bmp file -- start with the header, then write the bitmap
00274     */
00275

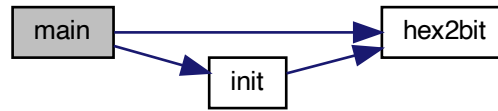
```

```

00276  /* 'B', 'M' appears at start of every .bmp file */
00277  fprintf (outfp, "%c%c", 0x42, 0x4d);
00278
00279  /* Write file size in bytes */
00280  filesize = 0x3E + bitmapsize;
00281  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x08) & 0xff));
00282  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x08) & 0xff));
00283  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x10) & 0xff));
00284  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x18) & 0xff));
00285
00286  /* Reserved - 0's */
00287  fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00288
00289  /* Offset from start of file to bitmap data */
00290  fprintf (outfp, "%c%c%c%c", 0x3E, 0x00, 0x00, 0x00);
00291
00292  /* Length of bitmap info header */
00293  fprintf (outfp, "%c%c%c%c", 0x28, 0x00, 0x00, 0x00);
00294
00295  /* Width of bitmap in pixels */
00296  fprintf (outfp, "%c%c%c%c", 0x40, 0x02, 0x00, 0x00);
00297
00298  /* Height of bitmap in pixels */
00299  fprintf (outfp, "%c%c%c%c", 0x20, 0x02, 0x00, 0x00);
00300
00301  /* Planes in bitmap (fixed at 1) */
00302  fprintf (outfp, "%c%c", 0x01, 0x00);
00303
00304  /* bits per pixel (1 = monochrome) */
00305  fprintf (outfp, "%c%c", 0x01, 0x00);
00306
00307  /* Compression (0 = none) */
00308  fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00309
00310  /* Size of bitmap data in bytes */
00311  fprintf (outfp, "%c", (unsigned char)((bitmapsize >> 0x08) & 0xff));
00312  fprintf (outfp, "%c", (unsigned char)((bitmapsize >> 0x08) & 0xff));
00313  fprintf (outfp, "%c", (unsigned char)((bitmapsize >> 0x10) & 0xff));
00314  fprintf (outfp, "%c", (unsigned char)((bitmapsize >> 0x18) & 0xff));
00315
00316  /* Horizontal resolution in pixels per meter */
00317  fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00318
00319  /* Vertical resolution in pixels per meter */
00320  fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00321
00322  /* Number of colors used */
00323  fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00324
00325  /* Number of important colors */
00326  fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00327
00328  /* The color black: B=0x00, G=0x00, R=0x00, Filler=0xFF */
00329  fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00330
00331  /* The color white: B=0xFF, G=0xFF, R=0xFF, Filler=0xFF */
00332  fprintf (outfp, "%c%c%c%c", 0xFF, 0xFF, 0xFF, 0x00);
00333
00334  /*
00335  Now write the raw data bits.  Data is written from the lower
00336  left-hand corner of the image to the upper right-hand corner
00337  of the image.
00338  */
00339  for (toppixelrow=17*32-1; toppixelrow >= 0; toppixelrow--) {
00340      for (j=0; j<18; j++) {
00341          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 0]);
00342          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 1]);
00343          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 2]);
00344
00345          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 3]);
00346      }
00347  }
00348  }
00349  exit (0);
00350  }

```

Here is the call graph for this function:



5.35.4 Variable Documentation

5.35.4.1 flip

```
int flip =1
```

Transpose entire matrix as in Unicode book.

Definition at line 88 of file [unihex2bmp.c](#).

5.35.4.2 hex

```
char* hex[18]
```

Initial value:

```
= {
    "0030:000000001824424242424224180000",
    "0031:0000000008182808080808083E0000",
    "0032:000000003C4242020C102040407E0000",
    "0033:000000003C4242021C020242423C0000",
    "0034:0000000040C14244447E0404040000",
    "0035:000000007E4040407C020202423C0000",
    "0036:000000001C2040407C424242423C0000",
    "0037:000000007E02020404080808080000",
    "0038:000000003C4242423C424242423C0000",
    "0039:000000003C4242423E02020204380000",
    "0041:0000000018242442427E424242420000",
    "0042:000000007C4242427C424242427C0000",
    "0043:000000003C42424040404042423C0000",
    "0044:000000007844424242424244780000",
    "0045:000000007E4040407C404040407E0000",
    "0046:000000007E4040407C404040400000",
    "0055:0000000042424242424242423C0000",
    "002B:00000000000808087F080808000000"
}
```

GNU Unifont bitmaps for hexadecimal digits.

These are the GNU Unifont hex strings for '0'-'9' and 'A'-'F', for encoding as bit strings in row and column headers.

Looking at the final bitmap as a grid of 32*32 bit tiles, the first row contains a hexadecimal character string of the first 3 hex digits in a 4 digit Unicode character name; the top column contains a hex character string of the 4th (low-order) hex digit of the Unicode character.

Definition at line 65 of file [unihex2bmp.c](#).

5.35.4.3 hexbits

```
unsigned char hexbits[18][32]
```

The digits converted into bitmaps.

Definition at line 85 of file [unihex2bmp.c](#).

5.35.4.4 unipage

unsigned unipage =0

Unicode page number, 0x00..0xff.

Definition at line 87 of file [unihex2bmp.c](#).

5.36 unihex2bmp.c

[Go to the documentation of this file.](#)

```
00001 /**
00002 @file unihex2bmp.c
00003
00004 @brief unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points
00005 into a bitmap for editing
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009 @copyright Copyright (C) 2007, 2008, 2013, 2017 Paul Hardy
00010
00011 This program reads in a GNU Unifont .hex file, extracts a range of
00012 256 code points, and converts it a Microsoft Bitmap (.bmp) or Wireless
00013 Bitmap file.
00014
00015 Synopsis: unihex2bmp [-iin_file.hex] [-oout_file.bmp]
00016 [-f] [-phex_page_num] [-w]
00017 */
00018 /*
00019 LICENSE:
00020
00021 This program is free software: you can redistribute it and/or modify
00022 it under the terms of the GNU General Public License as published by
00023 the Free Software Foundation, either version 2 of the License, or
00024 (at your option) any later version.
00025
00026 This program is distributed in the hope that it will be useful,
00027 but WITHOUT ANY WARRANTY; without even the implied warranty of
00028 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00029 GNU General Public License for more details.
00030
00031 You should have received a copy of the GNU General Public License
00032 along with this program. If not, see <http://www.gnu.org/licenses/>.
00033 */
00034
00035 /*
00036 20 June 2017 [Paul Hardy]:
00037 - Adds capability to output triple-width and quadruple-width (31 pixels
00038 wide, not 32) glyphs. The 32nd column in a glyph cell is occupied by
00039 the vertical cell border, so a quadruple-width glyph can only occupy
00040 the first 31 columns; the 32nd column is ignored.
00041
00042 21 October 2023 [Paul Hardy]:
00043 - Added full prototypes in main function for init and hex2bit functions.
00044 */
00045
00046 #include <stdio.h>
00047 #include <stdlib.h>
00048 #include <string.h>
00049
00050 #define MAXBUF 256
00051
00052
00053 /**
00054 @brief GNU Unifont bitmaps for hexadecimal digits.
00055
00056 These are the GNU Unifont hex strings for '0'-'9' and 'A'-'F',
00057 for encoding as bit strings in row and column headers.
00058
00059 Looking at the final bitmap as a grid of 32*32 bit tiles, the
00060 first row contains a hexadecimal character string of the first
00061 3 hex digits in a 4 digit Unicode character name; the top column
00062 contains a hex character string of the 4th (low-order) hex digit
00063 of the Unicode character.
```

```

00064 */
00065 char *hex[18]= {
00066     "0030:00000000182442424242424180000", /* Hex digit 0 */
00067     "0031:0000000008182808080808083E0000", /* Hex digit 1 */
00068     "0032:0000000003C4242020C102040407E0000", /* Hex digit 2 */
00069     "0033:0000000003C4242021C020242423C0000", /* Hex digit 3 */
00070     "0034:00000000040C142444447E0404040000", /* Hex digit 4 */
00071     "0035:0000000007E4040407C020202423C0000", /* Hex digit 5 */
00072     "0036:0000000001C2040407C424242423C0000", /* Hex digit 6 */
00073     "0037:0000000007E02020404080808080000", /* Hex digit 7 */
00074     "0038:0000000003C4242423C424242423C0000", /* Hex digit 8 */
00075     "0039:0000000003C4242423E02020204380000", /* Hex digit 9 */
00076     "0041:0000000018242442427E424242420000", /* Hex digit A */
00077     "0042:0000000007C4242427C424242427C0000", /* Hex digit B */
00078     "0043:0000000003C42424040404042423C0000", /* Hex digit C */
00079     "0044:000000007844424242424244780000", /* Hex digit D */
00080     "0045:0000000007E4040407C404040407E0000", /* Hex digit E */
00081     "0046:0000000007E4040407C4040404040000", /* Hex digit F */
00082     "0055:0000000042424242424242423C0000", /* Unicode 'U' */
00083     "002B:0000000000000808087F080808000000", /* Unicode '+' */
00084 };
00085 unsigned char hexbits[18][32]; ///< The digits converted into bitmaps.
00086
00087 unsigned unipage=0; ///< Unicode page number, 0x00..0xff.
00088 int flip=1;          ///< Transpose entire matrix as in Unicode book.
00089
00090
00091 /**
00092 @brief The main function.
00093
00094 @param[in] argc The count of command line arguments.
00095 @param[in] argv Pointer to array of command line arguments.
00096 @return This program exits with status 0.
00097 */
00098 int
00099 main (int argc, char *argv[])
00100 {
00101
00102     int i, j;          /* loop variables */
00103     unsigned k0;        /* temp Unicode char variable */
00104     unsigned swap;      /* temp variable for swapping values */
00105     char inbuf[256];    /* input buffer */
00106     unsigned filesize;  /* size of file in bytes */
00107     unsigned bitmapsiz; /* size of bitmap image in bytes */
00108     unsigned thischar;  /* the current character */
00109     unsigned char thischarbyte; /* unsigned char lowest byte of Unicode char */
00110     int thischarrow;    /* row 0..15 where this character belongs */
00111     int thiscol;        /* column 0..15 where this character belongs */
00112     int toppixelrow;    /* pixel row, 0..16*32-1 */
00113     unsigned lastpage=0; /* the last Unicode page read in font file */
00114     int wbmp=0;         /* set to 1 if writing .wbmp format file */
00115
00116     unsigned char bitmap[17*32][18*4]; /* final bitmap */
00117     unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00118
00119     char *infile="", *outfile=""; /* names of input and output files */
00120     FILE *infp, *outfp; /* file pointers of input and output files */
00121
00122     /* initializes bitmap row/col labeling, &c. */
00123     int init (unsigned char bitmap[17*32][18*4]);
00124
00125     /* convert hex string --> bitmap */
00126     int hex2bit (char *instr, unsigned char character[32][4]);
00127
00128     bitmapsiz = 17*32*18*4; /* 17 rows by 18 cols, each 4 bytes */
00129
00130     if (argc > 1) {
00131         for (i = 1; i < argc; i++) {
00132             if (argv[i][0] == '-') { /* this is an option argument */
00133                 switch (argv[i][1]) {
00134                     case 'f': /* flip (transpose) glyphs in bitmap as in standard */
00135                         flip = !flip;
00136                         break;
00137                     case 'i': /* name of input file */
00138                         infile = &argv[i][2];
00139                         break;
00140                     case 'o': /* name of output file */
00141                         outfile = &argv[i][2];
00142                         break;
00143                     case 'p': /* specify a Unicode page other than default of 0 */
00144                         sscanf (&argv[i][2], "%x", &unipage); /* Get Unicode page */

```

```

00145         break;
00146     case 'w': /* write a .wbmp file instead of a .bmp file */
00147         wbmp = 1;
00148         break;
00149     default: /* if unrecognized option, print list and exit */
00150         fprintf(stderr, "\nSyntax:\n\n");
00151         fprintf(stderr, " %s -p<Unicode_Page> ", argv[0]);
00152         fprintf(stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00153         fprintf(stderr, " -w specifies .wbmp output instead of ");
00154         fprintf(stderr, "default Windows .bmp output.\n\n");
00155         fprintf(stderr, " -p is followed by 1 to 6 ");
00156         fprintf(stderr, "Unicode page hex digits ");
00157         fprintf(stderr, "(default is Page 0).\n\n");
00158         fprintf(stderr, "\nExample:\n\n");
00159         fprintf(stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n",
00160             argv[0]);
00161         exit (1);
00162     }
00163 }
00164 }
00165 }
00166 /*
00167 Make sure we can open any I/O files that were specified before
00168 doing anything else.
00169 */
00170 if (strlen (infile) > 0) {
00171     if ((infp = fopen (infile, "r")) == NULL) {
00172         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00173         exit (1);
00174     }
00175 }
00176 else {
00177     infp = stdin;
00178 }
00179 if (strlen (outfile) > 0) {
00180     if ((outfp = fopen (outfile, "w")) == NULL) {
00181         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00182         exit (1);
00183     }
00184 }
00185 else {
00186     outfp = stdout;
00187 }
00188
00189 (void)init(bitmap); /* initialize bitmap with row/column headers, etc. */
00190
00191 /*
00192 Read in the characters in the page
00193 */
00194 while (lastpage <= unipage && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00195     sscanf (inbuf, "%x", &thischar);
00196     lastpage = thischar » 8; /* keep Unicode page to see if we can stop */
00197     if (lastpage == unipage) {
00198         thischarbyte = (unsigned char)(thischar & 0xff);
00199         for (k0=0; inbuf[k0] != '\0'; k0++);
00200         k0++;
00201         hex2bit (&inbuf[k0], charbits); /* convert hex string to 32*4 bitmap */
00202     }
00203     /*
00204 Now write character bitmap upside-down in page array, to match
00205 .bmp file order. In the .wbmp and .bmp files, white is a '1'
00206 bit and black is a '0' bit, so complement charbits[].
00207 */
00208
00209     thiscol = (thischarbyte & 0xf) + 2; /* column number will be 1..16 */
00210     thischarrow = thischarbyte » 4; /* character row number, 0..15 */
00211     if (flip) { /* swap row and column placement */
00212         swap = thiscol;
00213         thiscol = thischarrow;
00214         thischarrow = swap;
00215         thiscol += 2; /* column index starts at 1 */
00216         thischarrow -= 2; /* row index starts at 0 */
00217     }
00218     toppixelrow = 32 * (thischarrow + 1) - 1; /* from bottom to top */
00219
00220     /*
00221 Copy the center of charbits[] because hex characters only
00222 occupy rows 8 to 23 and column byte 2 (and for 16 bit wide
00223 characters, byte 3). The charbits[] array was given 32 rows
00224 and 4 column bytes for completeness in the beginning.
00225 */

```

```

00226     for (i=8; i<24; i++) {
00227         bitmap[toppixelrow + i][(thiscol « 2) | 0] =
00228             ~charbits[i][0] & 0xff;
00229         bitmap[toppixelrow + i][(thiscol « 2) | 1] =
00230             ~charbits[i][1] & 0xff;
00231         bitmap[toppixelrow + i][(thiscol « 2) | 2] =
00232             ~charbits[i][2] & 0xff;
00233         /* Only use first 31 bits; leave vertical rule in 32nd column */
00234         bitmap[toppixelrow + i][(thiscol « 2) | 3] =
00235             ~charbits[i][3] & 0xfe;
00236     }
00237     /*
00238     Leave white space in 32nd column of rows 8, 14, 15, and 23
00239     to leave 16 pixel height upper, middle, and lower guides.
00240     */
00241     bitmap[toppixelrow + 8][(thiscol « 2) | 3] |= 1;
00242     bitmap[toppixelrow + 14][(thiscol « 2) | 3] |= 1;
00243     bitmap[toppixelrow + 15][(thiscol « 2) | 3] |= 1;
00244     bitmap[toppixelrow + 23][(thiscol « 2) | 3] |= 1;
00245 }
00246 }
00247 /*
00248 Now write the appropriate bitmap file format, either
00249 Wireless Bitmap or Microsoft Windows bitmap.
00250 */
00251 if (wbmp) { /* Write a Wireless Bitmap .wbmp format file */
00252     /*
00253     Write WBMP header
00254     */
00255     fprintf (outfp, "%c", 0x00); /* Type of image; always 0 (monochrome) */
00256     fprintf (outfp, "%c", 0x00); /* Reserved; always 0 */
00257     fprintf (outfp, "%c%c", 0x84, 0x40); /* Width = 576 pixels */
00258     fprintf (outfp, "%c%c", 0x84, 0x20); /* Height = 544 pixels */
00259     /*
00260     Write bitmap image
00261     */
00262     for (toppixelrow=0; toppixelrow <= 17*32-1; toppixelrow++) {
00263         for (j=0; j<18; j++) {
00264             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)  ]);
00265             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00266             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00267             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00268         }
00269     }
00270 }
00271 else { /* otherwise, write a Microsoft Windows .bmp format file */
00272     /*
00273     Write the .bmp file -- start with the header, then write the bitmap
00274     */
00275     /* 'B', 'M' appears at start of every .bmp file */
00276     fprintf (outfp, "%c%c", 0x42, 0x4d);
00277
00278     /* Write file size in bytes */
00279     filesize = 0x3E + bitmapsize;
00280     fprintf (outfp, "%c", (unsigned char)((filesize      ) & 0xff));
00281     fprintf (outfp, "%c", (unsigned char)((filesize » 0x08) & 0xff));
00282     fprintf (outfp, "%c", (unsigned char)((filesize » 0x10) & 0xff));
00283     fprintf (outfp, "%c", (unsigned char)((filesize » 0x18) & 0xff));
00284
00285     /* Reserved - 0's */
00286     fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00287
00288     /* Offset from start of file to bitmap data */
00289     fprintf (outfp, "%c%c%c%c", 0x3E, 0x00, 0x00, 0x00);
00290
00291     /* Length of bitmap info header */
00292     fprintf (outfp, "%c%c%c%c", 0x28, 0x00, 0x00, 0x00);
00293
00294     /* Width of bitmap in pixels */
00295     fprintf (outfp, "%c%c%c%c", 0x40, 0x02, 0x00, 0x00);
00296
00297     /* Height of bitmap in pixels */
00298     fprintf (outfp, "%c%c%c%c", 0x20, 0x02, 0x00, 0x00);
00299
00300     /* Planes in bitmap (fixed at 1) */
00301     fprintf (outfp, "%c%c", 0x01, 0x00);
00302
00303     /* bits per pixel (1 = monochrome) */
00304     fprintf (outfp, "%c%c", 0x01, 0x00);
00305
00306

```

```

00307     /* Compression (0 = none) */
00308     fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00309
00310     /* Size of bitmap data in bytes */
00311     fprintf (outfp, "%c", (unsigned char)((bitmapsizesize) & 0xff));
00312     fprintf (outfp, "%c", (unsigned char)((bitmapsizesize » 0x08) & 0xff));
00313     fprintf (outfp, "%c", (unsigned char)((bitmapsizesize » 0x10) & 0xff));
00314     fprintf (outfp, "%c", (unsigned char)((bitmapsizesize » 0x18) & 0xff));
00315
00316     /* Horizontal resolution in pixels per meter */
00317     fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00318
00319     /* Vertical resolution in pixels per meter */
00320     fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00321
00322     /* Number of colors used */
00323     fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00324
00325     /* Number of important colors */
00326     fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00327
00328     /* The color black: B=0x00, G=0x00, R=0x00, Filler=0xFF */
00329     fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00330
00331     /* The color white: B=0xFF, G=0xFF, R=0xFF, Filler=0xFF */
00332     fprintf (outfp, "%c%c%c%c", 0xFF, 0xFF, 0xFF, 0x00);
00333
00334     /*
00335     Now write the raw data bits.  Data is written from the lower
00336     left-hand corner of the image to the upper right-hand corner
00337     of the image.
00338     */
00339     for (toppixelrow=17*32-1; topixelrow >= 0; topixelrow--) {
00340         for (j=0; j<18; j++) {
00341             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)   ]);
00342             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00343             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00344
00345             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00346         }
00347     }
00348 }
00349 exit (0);
00350 }
00351
00352 /**
00353 @brief Generate a bitmap for one glyph.
00354
00355 Convert the portion of a hex string after the ':' into a character bitmap.
00356
00357 If string is >= 128 characters, it will fill all 4 bytes per row.
00358 If string is >= 64 characters and < 128, it will fill 2 bytes per row.
00359 Otherwise, it will fill 1 byte per row.
00360
00361 @param[in] instring The character array containing the glyph bitmap.
00362 @param[out] character Glyph bitmap, 8, 16, or 32 columns by 16 rows tall.
00363 @return Always returns 0.
00364 */
00365 int
00366 hex2bit (char *instring, unsigned char character[32][4])
00367 {
00368     int i; /* current row in bitmap character */
00369     int j; /* current character in input string */
00370     int k; /* current byte in bitmap character */
00371     int width; /* number of output bytes to fill - 1: 0, 1, 2, or 3 */
00372
00373     for (i=0; i<32; i++) /* erase previous character */
00374         character[i][0] = character[i][1] = character[i][2] = character[i][3] = 0;
00375     j=0; /* current location is at beginning of instring */
00376
00377     if (strlen (instring) <= 34) /* 32 + possible '\r', '\n' */
00378         width = 0;
00379     else if (strlen (instring) <= 66) /* 64 + possible '\r', '\n' */
00380         width = 1;
00381     else if (strlen (instring) <= 98) /* 96 + possible '\r', '\n' */
00382         width = 3;
00383     else /* the maximum allowed is quadruple-width */
00384         width = 4;
00385 }

```

```

00388 k = (width > 1) ? 0 : 1; /* if width > double, start at index 1 else at 0 */
00389
00390 for (i=8; i<24; i++) { /* 16 rows per input character, rows 8..23 */
00391     sscanf (&instring[j], "%2hhx", &character[i][k]);
00392     j += 2;
00393     if (width > 0) { /* add next pair of hex digits to this row */
00394         sscanf (&instring[j], "%2hhx", &character[i][k+1]);
00395         j += 2;
00396         if (width > 1) { /* add next pair of hex digits to this row */
00397             sscanf (&instring[j], "%2hhx", &character[i][k+2]);
00398             j += 2;
00399             if (width > 2) { /* quadruple-width is maximum width */
00400                 sscanf (&instring[j], "%2hhx", &character[i][k+3]);
00401                 j += 2;
00402             }
00403         }
00404     }
00405 }
00406
00407 return (0);
00408 }
00409
00410
00411 /**
00412 @brief Initialize the bitmap grid.
00413
00414 @param[out] bitmap The bitmap to generate, with 32x32 pixel glyph areas.
00415 @return Always returns 0.
00416 */
00417 int
00418 init (unsigned char bitmap[17*32][18*4])
00419 {
00420     int i, j;
00421     unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00422     unsigned toppixelrow;
00423     unsigned thiscol;
00424     unsigned char pnybble0, pnybble1, pnybble2, pnybble3;
00425
00426     for (i=0; i<18; i++) { /* bitmaps for '0'..'9', 'A'..'F', 'u', '+' */
00427
00428         hex2bit (&hex[i][5], charbits); /* convert hex string to 32*4 bitmap */
00429
00430         for (j=0; j<32; j++) hexbits[i][j] = ~charbits[j][1];
00431     }
00432
00433     /*
00434     Initialize bitmap to all white.
00435     */
00436     for (toppixelrow=0; toppixelrow < 17*32; toppixelrow++) {
00437         for (thiscol=0; thiscol<18; thiscol++) {
00438             bitmap[toppixelrow][(thiscol << 2) ] = 0xff;
00439             bitmap[toppixelrow][(thiscol << 2) | 1] = 0xff;
00440             bitmap[toppixelrow][(thiscol << 2) | 2] = 0xff;
00441             bitmap[toppixelrow][(thiscol << 2) | 3] = 0xff;
00442         }
00443     }
00444     /*
00445     Write the "u+nnnn" table header in the upper left-hand corner,
00446     where nnnn is the upper 16 bits of a 32-bit Unicode assignment.
00447     */
00448     pnybble3 = (unipage >> 20);
00449     pnybble2 = (unipage >> 16) & 0xf;
00450     pnybble1 = (unipage >> 12) & 0xf;
00451     pnybble0 = (unipage >> 8) & 0xf;
00452     for (i=0; i<32; i++) {
00453         bitmap[i][1] = hexbits[16][i]; /* copy 'u' */
00454         bitmap[i][2] = hexbits[17][i]; /* copy '+' */
00455         bitmap[i][3] = hexbits[pnybble3][i];
00456         bitmap[i][4] = hexbits[pnybble2][i];
00457         bitmap[i][5] = hexbits[pnybble1][i];
00458         bitmap[i][6] = hexbits[pnybble0][i];
00459     }
00460     /*
00461     Write low-order 2 bytes of Unicode number assignments, as hex labels
00462     */
00463     pnybble3 = (unipage >> 4) & 0xf; /* Highest-order hex digit */
00464     pnybble2 = (unipage >> 0) & 0xf; /* Next highest-order hex digit */
00465     /*
00466     Write the column headers in bitmap[] (row headers if flipped)
00467     */
00468     toppixelrow = 32 * 17 - 1; /* maximum pixel row number */

```

```

00469  /*
00470  Label the column headers. The hexbits[][] bytes are split across two
00471  bitmap[][] entries to center a the hex digits in a column of 4 bytes.
00472  OR highest byte with 0xf0 and lowest byte with 0x0f to make outer
00473  nybbles white (0=black, 1=white).
00474  */
00475  for (i=0; i<16; i++) {
00476      for (j=0; j<32; j++) {
00477          if (!flip) { /* transpose matrix */
00478              bitmap[j][((i+2) « 2) | 0] = (hexbits[pnybble3][j] « 4) | 0xf0;
00479              bitmap[j][((i+2) « 2) | 1] = (hexbits[pnybble3][j] « 4) |
00480                  (hexbits[pnybble2][j] « 4);
00481              bitmap[j][((i+2) « 2) | 2] = (hexbits[pnybble2][j] « 4) |
00482                  (hexbits[i][j] « 4);
00483              bitmap[j][((i+2) « 2) | 3] = (hexbits[i][j] « 4) | 0x0f;
00484          }
00485          else {
00486              bitmap[j][((i+2) « 2) | 1] = (hexbits[i][j] « 4) | 0xf0;
00487              bitmap[j][((i+2) « 2) | 2] = (hexbits[i][j] « 4) | 0x0f;
00488          }
00489      }
00490  }
00491  /*
00492  Now use the single hex digit column graphics to label the row headers.
00493  */
00494  for (i=0; i<16; i++) {
00495      toppixelrow = 32 * (i + 1) - 1; /* from bottom to top */
00496
00497      for (j=0; j<32; j++) {
00498          if (!flip) { /* if not transposing matrix */
00499              bitmap[toppixelrow + j][4] = hexbits[pnybble3][j];
00500              bitmap[toppixelrow + j][5] = hexbits[pnybble2][j];
00501          }
00502          bitmap[toppixelrow + j][6] = hexbits[i][j];
00503      }
00504  }
00505  /*
00506  Now draw grid lines in bitmap, around characters we just copied.
00507  */
00508  /* draw vertical lines 2 pixels wide */
00509  for (i=1*32; i<17*32; i+=32) {
00510      if ((i & 0x1f) == 7)
00511          i++;
00512      else if ((i & 0x1f) == 14)
00513          i += 2;
00514      else if ((i & 0x1f) == 22)
00515          i++;
00516      for (j=1; j<18; j++) {
00517          bitmap[i][j « 2 | 3] &= 0xfe;
00518      }
00519  }
00520  /* draw horizontal lines 1 pixel tall */
00521  for (i=1*32-1; i<18*32-1; i+=32) {
00522      for (j=2; j<18; j++) {
00523          bitmap[i][j « 2] = 0x00;
00524          bitmap[i][j « 2 | 1] = 0x81;
00525          bitmap[i][j « 2 | 2] = 0x81;
00526          bitmap[i][j « 2 | 3] = 0x00;
00527      }
00528  }
00529  /* fill in top left corner pixel of grid */
00530  bitmap[31][7] = 0xfe;
00531
00532  return (0);
00533  }

```

5.37 src/unihexgen.c File Reference

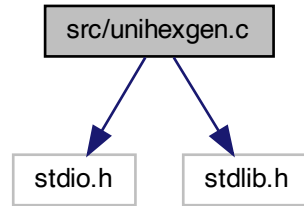
unihexgen - Generate a series of glyphs containing hexadecimal code points

```

#include <stdio.h>
#include <stdlib.h>

```

Include dependency graph for unihexgen.c:



Functions

- int [main](#) (int argc, char *argv[])
The main function.
- void [hexprint4](#) (int thiscp)
Generate a bitmap containing a 4-digit Unicode code point.
- void [hexprint6](#) (int thiscp)
Generate a bitmap containing a 6-digit Unicode code point.

Variables

- char [hexdigit](#) [16][5]
Bitmap pattern for each hexadecimal digit.

5.37.1 Detailed Description

unihexgen - Generate a series of glyphs containing hexadecimal code points

Author

Paul Hardy

Copyright

Copyright (C) 2013 Paul Hardy

This program generates glyphs in Unifont .hex format that contain four- or six-digit hexadecimal numbers in a 16x16 pixel area. These are rendered as white digits on a black background. `argv[1]` is the starting code point (as a hexadecimal string, with no leading "0x". `argv[2]` is the ending code point (as a hexadecimal string, with no leading "0x".

For example:

```
unihexgen e000 f8ff > pua.hex
```

This generates the Private Use Area glyph file.

This utility program works in Roman Czyborra's unifont.hex file format, the basis of the GNU Unifont package.

Definition in file [unihexgen.c](#).

5.37.2 Function Documentation

5.37.2.1 hexprint4()

```
void hexprint4 (
    int thiscp )
```

Generate a bitmap containing a 4-digit Unicode code point.

Takes a 4-digit Unicode code point as an argument and prints a unifont.hex string for it to stdout.

Parameters

in	thiscp	The current code point for which to generate a glyph.
----	--------	---

Definition at line 160 of file [unihexgen.c](#).

```
00161 {
00162
00163     int grid[16]; /* the glyph grid we'll build */
00164
00165     int row;      /* row number in current glyph */
00166     int digitrow; /* row number in current hex digit being rendered */
00167     int rowbits;  /* 1 & 0 bits to draw current glyph row */
00168
00169     int d1, d2, d3, d4; /* four hexadecimal digits of each code point */
00170
00171     d1 = (thiscp » 12) & 0xF;
00172     d2 = (thiscp » 8) & 0xF;
00173     d3 = (thiscp » 4) & 0xF;
00174     d4 = (thiscp ) & 0xF;
00175
00176     /* top and bottom rows are white */
00177     grid[0] = grid[15] = 0x0000;
00178
00179     /* 14 inner rows are 14-pixel wide black lines, centered */
00180     for (row = 1; row < 15; row++) grid[row] = 0x7FFE;
00181
00182     printf ("%04X:", thiscp);
00183
00184     /*
00185     Render the first row of 2 hexadecimal digits
00186     */
00187     digitrow = 0; /* start at top of first row of digits to render */
00188     for (row = 2; row < 7; row++) {
00189         rowbits = (hexdigit[d1][digitrow] « 9) |
00190                 (hexdigit[d2][digitrow] « 3);
00191         grid[row] ^= rowbits; /* digits appear as white on black background */
00192         digitrow++;
00193     }
00194
00195     /*
00196     Render the second row of 2 hexadecimal digits
00197     */
00198     digitrow = 0; /* start at top of first row of digits to render */
00199     for (row = 9; row < 14; row++) {
00200         rowbits = (hexdigit[d3][digitrow] « 9) |
00201                 (hexdigit[d4][digitrow] « 3);
00202         grid[row] ^= rowbits; /* digits appear as white on black background */
00203         digitrow++;
```

```

00204 }
00205
00206 for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00207
00208 putchar ('\n');
00209
00210 return;
00211 }

```

Here is the caller graph for this function:



5.37.2.2 hexprint6()

```

void hexprint6 (
    int thiscp )

```

Generate a bitmap containing a 6-digit Unicode code point.

Takes a 6-digit Unicode code point as an argument and prints a unifont.hex string for it to stdout.

Parameters

in	thiscp	The current code point for which to generate a glyph.

Definition at line 223 of file unihexgen.c.

```

00224 {
00225
00226     int grid[16]; /* the glyph grid we'll build */
00227
00228     int row;      /* row number in current glyph */
00229     int digitrow; /* row number in current hex digit being rendered */
00230     int rowbits;  /* 1 & 0 bits to draw current glyph row */
00231
00232     int d1, d2, d3, d4, d5, d6; /* six hexadecimal digits of each code point */
00233
00234     d1 = (thiscp » 20) & 0xF;
00235     d2 = (thiscp » 16) & 0xF;
00236     d3 = (thiscp » 12) & 0xF;
00237     d4 = (thiscp » 8) & 0xF;
00238     d5 = (thiscp » 4) & 0xF;
00239     d6 = (thiscp ) & 0xF;
00240
00241     /* top and bottom rows are white */
00242     grid[0] = grid[15] = 0x0000;

```

```

00243
00244  /* 14 inner rows are 16-pixel wide black lines, centered */
00245  for (row = 1; row < 15; row++) grid[row] = 0xFFFF;
00246
00247  printf ("%06X:", thiscp);
00248
00249  /*
00250  /*
00251  Render the first row of 3 hexadecimal digits
00252  */
00253  digitrow = 0; /* start at top of first row of digits to render */
00254  for (row = 2; row < 7; row++) {
00255      rowbits = (hexdigit[d1][digitrow] « 11) |
00256               (hexdigit[d2][digitrow] « 6) |
00257               (hexdigit[d3][digitrow] « 1);
00258      grid[row] ^= rowbits; /* digits appear as white on black background */
00259      digitrow++;
00260  }
00261
00262  /*
00263  Render the second row of 3 hexadecimal digits
00264  */
00265  digitrow = 0; /* start at top of first row of digits to render */
00266  for (row = 9; row < 14; row++) {
00267      rowbits = (hexdigit[d4][digitrow] « 11) |
00268               (hexdigit[d5][digitrow] « 6) |
00269               (hexdigit[d6][digitrow] « 1);
00270      grid[row] ^= rowbits; /* digits appear as white on black background */
00271      digitrow++;
00272  }
00273
00274  for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00275
00276  putchar ('\n');
00277
00278  return;
00279 }

```

Here is the caller graph for this function:



5.37.2.3 main()

```

int main (
    int argc,
    char * argv[] )

```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments (code point range).

Returns

This program exits with status `EXIT_SUCCESS`.

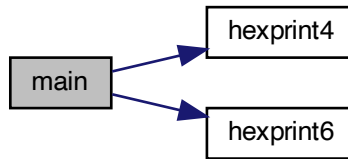
Definition at line 112 of file [unihexgen.c](#).

```

00113 {
00114
00115     int startcp, endcp, thiscp;
00116     void hexprint4(int); /* function to print one 4-digit unifont.hex code point */
00117     void hexprint6(int); /* function to print one 6-digit unifont.hex code point */
00118
00119     if (argc != 3) {
00120         fprintf (stderr, "\n%s - generate unifont.hex code points as\n", argv[0]);
00121         fprintf (stderr, "four-digit hexadecimal numbers in a 2 by 2 grid.\n");
00122         fprintf (stderr, "or six-digit hexadecimal numbers in a 3 by 2 grid.\n");
00123         fprintf (stderr, "Syntax:\n\n");
00124         fprintf (stderr, "    %s first_code_point last_code_point > glyphs.hex\n\n", argv[0]);
00125         fprintf (stderr, "Example (to generate glyphs for the Private Use Area):\n\n");
00126         fprintf (stderr, "    %s e000 f8ff > pua.hex\n\n", argv[0]);
00127         exit (EXIT_FAILURE);
00128     }
00129
00130     sscanf (argv[1], "%x", &startcp);
00131     sscanf (argv[2], "%x", &endcp);
00132
00133     startcp &= 0xFFFFF; /* limit to 6 hex digits */
00134     endcp   &= 0xFFFFF; /* limit to 6 hex digits */
00135
00136     /*
00137     For each code point in the desired range, generate a glyph.
00138     */
00139     for (thiscp = startcp; thiscp <= endcp; thiscp++) {
00140         if (thiscp <= 0xFFFF) {
00141             hexprint4 (thiscp); /* print digits 2/line, 2 lines */
00142         }
00143         else {
00144             hexprint6 (thiscp); /* print digits 3/line, 2 lines */
00145         }
00146     }
00147     exit (EXIT_SUCCESS);
00148 }

```

Here is the call graph for this function:



5.37.3 Variable Documentation

5.37.3.1 hexdigit

```
char hexdigit[16][5]
```

Initial value:

```

= {
    {0x6,0x9,0x9,0x9,0x6},
    {0x2,0x6,0x2,0x2,0x7},
    {0xF,0x1,0xF,0x8,0xF},
    {0xE,0x1,0x7,0x1,0xE},
    {0x9,0x9,0xF,0x1,0x1},
    {0xF,0x8,0xF,0x1,0xF},
    {0x6,0x8,0xE,0x9,0x6},
    {0xF,0x1,0x2,0x4,0x4},
    {0x6,0x9,0x6,0x9,0x6},
    {0x6,0x9,0x7,0x1,0x6},
    {0xF,0x9,0xF,0x9,0x9},
    {0xE,0x9,0xE,0x9,0xE},
    {0x7,0x8,0x8,0x8,0x7},
    {0xE,0x9,0x9,0x9,0xE},
    {0xF,0x8,0xE,0x8,0xF},
    {0xF,0x8,0xE,0x8,0x8}
}
  
```

Bitmap pattern for each hexadecimal digit.

hexdigit[] definition: the bitmap pattern for each hexadecimal digit.

Each digit is drawn as a 4 wide by 5 high bitmap, so each digit row is one hexadecimal digit, and each entry has 5 rows.

For example, the entry for digit 1 is:

```
{0x2,0x6,0x2,0x2,0x7},
```

which corresponds graphically to:

```

-#- ==> 0010 ==> 0x2 -##- ==> 0110 ==> 0x6 -#- ==> 0010 ==> 0x2 -#- ==> 0010 ==> 0x2
-### ==> 0111 ==> 0x7
  
```

These row values will then be exclusive-ORed with four one bits (binary 1111, or 0xF) to form white digits on a black background.

Functions hexprint4 and hexprint6 share the hexdigit array; they print four-digit and six-digit hexadecimal code points in a single glyph, respectively.

Definition at line 84 of file [unihexgen.c](#).

5.38 unihexgen.c

[Go to the documentation of this file.](#)

```
00001 /**
```

```

00002 @file unihexgen.c
00003
00004 @brief unihexgen - Generate a series of glyphs containing
00005 hexadecimal code points
00006
00007 @author Paul Hardy
00008
00009 @copyright Copyright (C) 2013 Paul Hardy
00010
00011 This program generates glyphs in Unifont .hex format that contain
00012 four- or six-digit hexadecimal numbers in a 16x16 pixel area. These
00013 are rendered as white digits on a black background.
00014
00015 argv[1] is the starting code point (as a hexadecimal
00016 string, with no leading "0x".
00017
00018 argv[2] is the ending code point (as a hexadecimal
00019 string, with no leading "0x".
00020
00021 For example:
00022
00023 unihexgen e000 f8ff > pua.hex
00024
00025 This generates the Private Use Area glyph file.
00026
00027 This utility program works in Roman Czyborra's unifont.hex file
00028 format, the basis of the GNU Unifont package.
00029 */
00030 /*
00031 This program is released under the terms of the GNU General Public
00032 License version 2, or (at your option) a later version.
00033
00034 LICENSE:
00035
00036 This program is free software: you can redistribute it and/or modify
00037 it under the terms of the GNU General Public License as published by
00038 the Free Software Foundation, either version 2 of the License, or
00039 (at your option) any later version.
00040
00041 This program is distributed in the hope that it will be useful,
00042 but WITHOUT ANY WARRANTY; without even the implied warranty of
00043 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00044 GNU General Public License for more details.
00045
00046 You should have received a copy of the GNU General Public License
00047 along with this program. If not, see <http://www.gnu.org/licenses/>.
00048 */
00049
00050 #include <stdio.h>
00051 #include <stdlib.h>
00052
00053
00054 /**
00055 @brief Bitmap pattern for each hexadecimal digit.
00056
00057 hexdigit[][] definition: the bitmap pattern for
00058 each hexadecimal digit.
00059
00060 Each digit is drawn as a 4 wide by 5 high bitmap,
00061 so each digit row is one hexadecimal digit, and
00062 each entry has 5 rows.
00063
00064 For example, the entry for digit 1 is:
00065
00066 {0x2,0x6,0x2,0x2,0x7},
00067
00068 which corresponds graphically to:
00069
00070 --#- ==> 0010 ==> 0x2
00071 -##- ==> 0110 ==> 0x6
00072 --#- ==> 0010 ==> 0x2
00073 --#- ==> 0010 ==> 0x2
00074 -### ==> 0111 ==> 0x7
00075
00076 These row values will then be exclusive-ORed with four one bits
00077 (binary 1111, or 0xF) to form white digits on a black background.
00078
00079
00080 Functions hexprint4 and hexprint6 share the hexdigit array;
00081 they print four-digit and six-digit hexadecimal code points
00082 in a single glyph, respectively.

```

```

00083 */
00084 char hexdigit[16][5] = {
00085     {0x6,0x9,0x9,0x9,0x6}, /* 0x0 */
00086     {0x2,0x6,0x2,0x2,0x7}, /* 0x1 */
00087     {0xF,0x1,0xF,0x8,0xF}, /* 0x2 */
00088     {0xE,0x1,0x7,0x1,0xE}, /* 0x3 */
00089     {0x9,0x9,0xF,0x1,0x1}, /* 0x4 */
00090     {0xF,0x8,0xF,0x1,0xF}, /* 0x5 */
00091     {0x6,0x8,0xE,0x9,0x6}, /* 0x6 */ // {0x8,0x8,0xF,0x9,0xF} [alternate square form of 6]
00092     {0xF,0x1,0x2,0x4,0x4}, /* 0x7 */
00093     {0x6,0x9,0x6,0x9,0x6}, /* 0x8 */
00094     {0x6,0x9,0x7,0x1,0x6}, /* 0x9 */ // {0xF,0x9,0xF,0x1,0x1} [alternate square form of 9]
00095     {0xF,0x9,0xF,0x9,0x9}, /* 0xA */
00096     {0xE,0x9,0xE,0x9,0xE}, /* 0xB */
00097     {0x7,0x8,0x8,0x8,0x7}, /* 0xC */
00098     {0xE,0x9,0x9,0x9,0xE}, /* 0xD */
00099     {0xF,0x8,0xE,0x8,0xF}, /* 0xE */
00100     {0xF,0x8,0xE,0x8,0x8} /* 0xF */
00101 };
00102
00103
00104 /**
00105  @brief The main function.
00106
00107  @param[in] argc The count of command line arguments.
00108  @param[in] argv Pointer to array of command line arguments (code point range).
00109  @return This program exits with status EXIT_SUCCESS.
00110  */
00111 int
00112 main (int argc, char *argv[])
00113 {
00114
00115     int startcp, endcp, thiscp;
00116     void hexprint4(int); /* function to print one 4-digit unifont.hex code point */
00117     void hexprint6(int); /* function to print one 6-digit unifont.hex code point */
00118
00119     if (argc != 3) {
00120         fprintf (stderr, "\n%s - generate unifont.hex code points as\n", argv[0]);
00121         fprintf (stderr, "four-digit hexadecimal numbers in a 2 by 2 grid.\n");
00122         fprintf (stderr, "or six-digit hexadecimal numbers in a 3 by 2 grid.\n");
00123         fprintf (stderr, "Syntax:\n");
00124         fprintf (stderr, "%s first_code_point last_code_point > glyphs.hex\n", argv[0]);
00125         fprintf (stderr, "Example (to generate glyphs for the Private Use Area):\n");
00126         fprintf (stderr, "%s e000 f8ff > pua.hex\n", argv[0]);
00127         exit (EXIT_FAILURE);
00128     }
00129
00130     sscanf (argv[1], "%x", &startcp);
00131     sscanf (argv[2], "%x", &endcp);
00132
00133     startcp &= 0xFFFFF; /* limit to 6 hex digits */
00134     endcp &= 0xFFFFF; /* limit to 6 hex digits */
00135
00136     /*
00137     For each code point in the desired range, generate a glyph.
00138     */
00139     for (thiscp = startcp; thiscp <= endcp; thiscp++) {
00140         if (thiscp <= 0xFFFF) {
00141             hexprint4 (thiscp); /* print digits 2/line, 2 lines */
00142         }
00143         else {
00144             hexprint6 (thiscp); /* print digits 3/line, 2 lines */
00145         }
00146     }
00147     exit (EXIT_SUCCESS);
00148 }
00149
00150
00151 /**
00152  @brief Generate a bitmap containing a 4-digit Unicode code point.
00153
00154  Takes a 4-digit Unicode code point as an argument
00155  and prints a unifont.hex string for it to stdout.
00156
00157  @param[in] thiscp The current code point for which to generate a glyph.
00158  */
00159 void
00160 hexprint4 (int thiscp)
00161 {
00162
00163     int grid[16]; /* the glyph grid we'll build */

```

```

00164
00165     int row;          /* row number in current glyph */
00166     int digitrow;     /* row number in current hex digit being rendered */
00167     int rowbits;      /* 1 & 0 bits to draw current glyph row */
00168
00169     int d1, d2, d3, d4; /* four hexadecimal digits of each code point */
00170
00171     d1 = (thiscp » 12) & 0xF;
00172     d2 = (thiscp » 8) & 0xF;
00173     d3 = (thiscp » 4) & 0xF;
00174     d4 = (thiscp ) & 0xF;
00175
00176     /* top and bottom rows are white */
00177     grid[0] = grid[15] = 0x0000;
00178
00179     /* 14 inner rows are 14-pixel wide black lines, centered */
00180     for (row = 1; row < 15; row++) grid[row] = 0x7FFE;
00181
00182     printf ("%04X:", thiscp);
00183
00184     /*
00185 Render the first row of 2 hexadecimal digits
00186 */
00187     digitrow = 0; /* start at top of first row of digits to render */
00188     for (row = 2; row < 7; row++) {
00189         rowbits = (hexdigit[d1][digitrow] « 9) |
00190             (hexdigit[d2][digitrow] « 3);
00191         grid[row] ^= rowbits; /* digits appear as white on black background */
00192         digitrow++;
00193     }
00194
00195     /*
00196 Render the second row of 2 hexadecimal digits
00197 */
00198     digitrow = 0; /* start at top of first row of digits to render */
00199     for (row = 9; row < 14; row++) {
00200         rowbits = (hexdigit[d3][digitrow] « 9) |
00201             (hexdigit[d4][digitrow] « 3);
00202         grid[row] ^= rowbits; /* digits appear as white on black background */
00203         digitrow++;
00204     }
00205
00206     for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00207
00208     putchar ('\n');
00209
00210     return;
00211 }
00212
00213 /**
00214 @brief Generate a bitmap containing a 6-digit Unicode code point.
00215
00216 Takes a 6-digit Unicode code point as an argument
00217 and prints a unifont.hex string for it to stdout.
00218
00219 @param[in] thiscp The current code point for which to generate a glyph.
00220 */
00221 void
00222 hexprint6 (int thiscp)
00223 {
00224     {
00225         int grid[16]; /* the glyph grid we'll build */
00226
00227         int row;      /* row number in current glyph */
00228         int digitrow; /* row number in current hex digit being rendered */
00229         int rowbits;  /* 1 & 0 bits to draw current glyph row */
00230
00231         int d1, d2, d3, d4, d5, d6; /* six hexadecimal digits of each code point */
00232
00233         d1 = (thiscp » 20) & 0xF;
00234         d2 = (thiscp » 16) & 0xF;
00235         d3 = (thiscp » 12) & 0xF;
00236         d4 = (thiscp » 8) & 0xF;
00237         d5 = (thiscp » 4) & 0xF;
00238         d6 = (thiscp ) & 0xF;
00239
00240         /* top and bottom rows are white */
00241         grid[0] = grid[15] = 0x0000;
00242
00243         /* 14 inner rows are 16-pixel wide black lines, centered */

```

```

00245  for (row = 1; row < 15; row++) grid[row] = 0xFFFF;
00246
00247
00248  printf ("%06X:", thiscp);
00249
00250  /*
00251  Render the first row of 3 hexadecimal digits
00252  */
00253  digitrow = 0; /* start at top of first row of digits to render */
00254  for (row = 2; row < 7; row++) {
00255      rowbits = (hexdigit[d1][digitrow] « 11) |
00256              (hexdigit[d2][digitrow] « 6) |
00257              (hexdigit[d3][digitrow] « 1);
00258      grid[row] ^= rowbits; /* digits appear as white on black background */
00259      digitrow++;
00260  }
00261
00262  /*
00263  Render the second row of 3 hexadecimal digits
00264  */
00265  digitrow = 0; /* start at top of first row of digits to render */
00266  for (row = 9; row < 14; row++) {
00267      rowbits = (hexdigit[d4][digitrow] « 11) |
00268              (hexdigit[d5][digitrow] « 6) |
00269              (hexdigit[d6][digitrow] « 1);
00270      grid[row] ^= rowbits; /* digits appear as white on black background */
00271      digitrow++;
00272  }
00273
00274  for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00275
00276  putchar ('\n');
00277
00278  return;
00279 }
00280

```

5.39 unihexpose.c

```

00001  /**
00002  @file: unihettranspose.c
00003
00004  @brief: Transpose Unifont glyph bitmaps.
00005
00006  This program takes Unifont .hex format glyphs and converts those
00007  glyphs so that each byte (two hexadecimal digits in the .hex file)
00008  represents a column of 8 rows. This simplifies use with graphics
00009  display controllers that write lines consisting of 8 rows at a time
00010  to a display.
00011
00012  The bytes are ordered as first all the columns for the glyph in
00013  the first 8 rows, then all the columns in the next 8 rows, with
00014  columns ordered from left to right.
00015
00016  This file must be linked with functions in unifont-support.c.
00017
00018  @author Paul Hardy
00019
00020  @copyright Copyright © 2023 Paul Hardy
00021  */
00022  /*
00023  LICENSE:
00024
00025  This program is free software: you can redistribute it and/or modify
00026  it under the terms of the GNU General Public License as published by
00027  the Free Software Foundation, either version 2 of the License, or
00028  (at your option) any later version.
00029
00030  This program is distributed in the hope that it will be useful,
00031  but WITHOUT ANY WARRANTY; without even the implied warranty of
00032  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00033  GNU General Public License for more details.
00034
00035  You should have received a copy of the GNU General Public License
00036  along with this program. If not, see <http://www.gnu.org/licenses/>.
00037  */
00038  #include <stdio.h>
00039  #include <stdlib.h>

```

```

00040
00041 #define MAXWIDTH 128
00042
00043 int
00044 main (int argc, char *argv[]) {
00045     unsigned codept; /* Unicode code point for glyph */
00046     char instring [MAXWIDTH]; /* input Unifont hex string */
00047     char outstring [MAXWIDTH]; /* output Unfont hex string */
00048     int width; /* width of current glyph */
00049     unsigned char glyph [16][2];
00050     unsigned char glyphbits [16][16]; /* One glyphbits row, for transposing */
00051     unsigned char transpose [2][16]; /* Transposed glyphbits bitmap */
00052
00053     void print_syntax ();
00054
00055     void parse_hex (char *hexstring,
00056                    int *width,
00057                    unsigned *codept,
00058                    unsigned char glyph[16][2]);
00059
00060     void glyph2bits (int width,
00061                     unsigned char glyph[16][2],
00062                     unsigned char glyphbits [16][16]);
00063
00064     void hexpose (int width,
00065                  unsigned char glyphbits [16][16],
00066                  unsigned char transpose [2][16]);
00067
00068     void xglyph2string (int width, unsigned codept,
00069                        unsigned char transpose [2][16],
00070                        char *outstring);
00071
00072     if (argc > 1) {
00073         print_syntax ();
00074         exit (EXIT_FAILURE);
00075     }
00076
00077     while (fgets (instring, MAXWIDTH, stdin) != NULL) {
00078         parse_hex (instring, &width, &codept, glyph);
00079
00080         glyph2bits (width, glyph, glyphbits);
00081
00082         hexpose (width, glyphbits, transpose);
00083
00084         xglyph2string (width, codept, transpose, outstring);
00085
00086         fprintf (stdout, "%s\n", outstring);
00087     }
00088
00089     exit (EXIT_SUCCESS);
00090 }
00091
00092
00093 void
00094 print_syntax () {
00095
00096     fprintf (stderr, "\nSyntax: unihexpose < input.hex > output.hex\n\n");
00097
00098     return;
00099 }
00100

```

5.40 src/unijohab2html.c File Reference

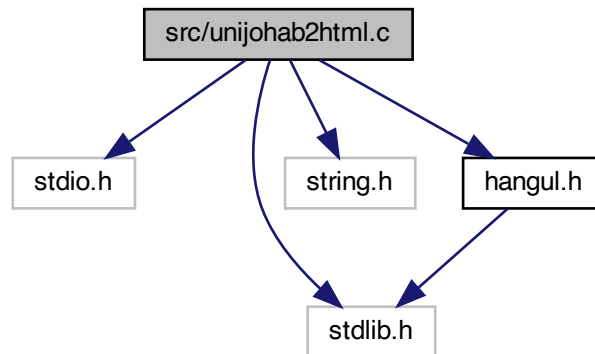
Display overlapped Hangul letter combinations in a grid.

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hangul.h"

```

Include dependency graph for unijohab2html.c:



Macros

- `#define` [MAXFILENAME](#) 1024
- `#define` [START_JUNG](#) 0
Vowel index of first vowel with which to begin.
- `#define` [RED](#) 0xCC0000
Color code for slightly unsaturated HTML red.
- `#define` [GREEN](#) 0x00CC00
Color code for slightly unsaturated HTML green.
- `#define` [BLUE](#) 0x0000CC
Color code for slightly unsaturated HTML blue.
- `#define` [BLACK](#) 0x000000
Color code for HTML black.
- `#define` [WHITE](#) 0xFFFFFFFF
Color code for HTML white.

Functions

- `int` [main](#) (int argc, char *argv[])
The main function.
- `void` [parse_args](#) (int argc, char *argv[], int *inindex, int *outindex, int *modern_only)
Parse command line arguments.

5.40.1 Detailed Description

Display overlapped Hangul letter combinations in a grid.

This displays overlapped letters that form Unicode Hangul Syllables combinations, as a tool to determine bounding boxes for all combinations. It works with both modern and archaic Hangul letters.

Input is a Unifont .hex file such as the "hangul-base.hex" file that is part of the Unifont package. Glyphs are all processed as being 16 pixels wide and 16 pixels tall.

Output is an HTML file containing 16 by 16 pixel grids showing overlaps in table format, arranged by variation of the initial consonant (choseong).

Initial consonants (choseong) have 6 variations. In general, the first three are for combining with vowels (jungseong) that are vertical, horizontal, or vertical and horizontal, respectively; the second set of three variations are for combinations with a final consonant.

The output HTML file can be viewed in a web browser.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [unijohab2html.c](#).

5.40.2 Macro Definition Documentation

5.40.2.1 BLACK

```
#define BLACK 0x000000
```

Color code for HTML black.

Definition at line [62](#) of file [unijohab2html.c](#).

5.40.2.2 BLUE

```
#define BLUE 0x0000CC
```

Color code for slightly unsaturated HTML blue.

Definition at line [61](#) of file [unijohab2html.c](#).

5.40.2.3 GREEN

```
#define GREEN 0x00CC00
```

Color code for slightly unsaturated HTML green.

Definition at line [60](#) of file [unijohab2html.c](#).

5.40.2.4 MAXFILENAME

```
#define MAXFILENAME 1024
```

Definition at line [52](#) of file [unijohab2html.c](#).

5.40.2.5 RED

```
#define RED 0xCC0000
```

Color code for slightly unsaturated HTML red.

Definition at line [59](#) of file [unijohab2html.c](#).

5.40.2.6 START_JUNG

```
#define START_JUNG 0
```

Vowel index of first vowel with which to begin.

Definition at line 54 of file [unijohab2html.c](#).

5.40.2.7 WHITE

```
#define WHITE 0xFFFFFF
```

Color code for HTML white.

Definition at line 63 of file [unijohab2html.c](#).

5.40.3 Function Documentation

5.40.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Definition at line 70 of file [unijohab2html.c](#).

```
00070     {
00071     int i, j; /* loop variables */
00072     unsigned codept;
00073     unsigned max_codept;
00074     int modern_only = 0; /* To just use modern Hangul */
00075     int group, consonant1, vowel, consonant2;
00076     int vowel_variation;
00077     unsigned glyph[MAX_GLYPHS][16];
00078     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00079     unsigned mask;
00080     unsigned overlapped; /* To find overlaps */
00081     int ancient_choseong; /* Flag when within ancient choseong range. */
00082
00083     /*
00084     16x16 pixel grid for each Choseong group, for:
00085
00086     Group 0 to Group 5 with no Jongseong
00087     Group 3 to Group 5 with Jongseong except Nieun
00088     Group 3 to Group 5 with Jongseong Nieun
00089
00090     12 grids total.
00091
00092     Each grid cell will hold a 32-bit HTML RGB color.
00093     */
00094     unsigned grid[12][16][16];
00095
00096     /*
00097     Matrices to detect and report overlaps. Identify vowel
00098     variations where an overlap occurred. For most vowel
00099     variations, there will be no overlap. Then go through
00100     choseong, and then jongseong to find the overlapping
00101     combinations. This saves storage space as an alternative
00102     to storing large 2- or 3-dimensional overlap matrices.
00103     */
00104     // jungcho: Jungseong overlap with Choseong
00105     unsigned jungcho [TOTAL_JUNG * JUNG_VARIATIONS];
00106     // jongjung: Jongseong overlap with Jungseong -- for future expansion
00107     // unsigned jongjung [TOTAL_JUNG * JUNG_VARIATIONS];
00108
00109     int glyphs_overlap; /* If glyph pair being considered overlap. */
00110     int cho_overlaps = 0; /* Number of choseong+vowel overlaps. */
00111     // int jongjung_overlaps = 0; /* Number of vowel+jongseong overlaps. */
00112
00113     int inindex = 0;
00114     int outindex = 0;
00115     FILE *infp, *outfp; /* Input and output file pointers. */
00116
```

```

00117 void    parse_args (int argc, char *argv[], int *inindex, int *outindex,
00118                  int *modern_only);
00119 int     cho_variation (int cho, int jung, int jong);
00120 unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00121 int     glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00122
00123 void    combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00124                  unsigned *combined_glyph);
00125 void    print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00126
00127
00128 /*
00129 Parse command line arguments to open input & output files, if given.
00130 */
00131 if (argc > 1) {
00132     parse_args (argc, argv, &inindex, &outindex, &modern_only);
00133 }
00134
00135 if (inindex == 0) {
00136     infp = stdin;
00137 }
00138 else {
00139     infp = fopen (argv[inindex], "r");
00140     if (infp == NULL) {
00141         fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00142                 argv[inindex]);
00143         exit (EXIT_FAILURE);
00144     }
00145 }
00146 if (outindex == 0) {
00147     outfp = stdout;
00148 }
00149 else {
00150     outfp = fopen (argv[outindex], "w");
00151     if (outfp == NULL) {
00152         fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00153                 argv[outindex]);
00154         exit (EXIT_FAILURE);
00155     }
00156 }
00157
00158 /*
00159 Initialize glyph array to all zeroes.
00160 */
00161 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00162     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00163 }
00164
00165 /*
00166 Initialize overlap matrices to all zeroes.
00167 */
00168 for (i = 0; i < TOTAL_JUNG * JUNG_VARIATIONS; i++) {
00169     jungcho [i] = 0;
00170 }
00171 // jongjung is reserved for expansion.
00172 // for (i = 0; i < TOTAL_JONG * JONG_VARIATIONS; i++) {
00173 //     jongjung [i] = 0;
00174 // }
00175
00176 /*
00177 Read Hangul base glyph file.
00178 */
00179 max_codept = hangul_read_base16 (infp, glyph);
00180 if (max_codept > 0x8FFF) {
00181     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00182 }
00183
00184 /*
00185 If only examining modern Hangul, fill the ancient glyphs
00186 with blanks to guarantee they won't overlap. This is
00187 not as efficient as ending loops sooner, but is easier
00188 to verify for correctness.
00189 */
00190 if (modern_only) {
00191     for (i = 0x0073; i < JUNG_HEX; i++) {
00192         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00193     }
00194     for (i = 0x027A; i < JONG_HEX; i++) {
00195         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00196     }
00197     for (i = 0x032B; i < 0x0400; i++) {

```

```

00198     for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00199 }
00200 }
00201
00202 /*
00203 Initialize grids to all black (no color) for each of
00204 the 12 Choseong groups.
00205 */
00206 for (group = 0; group < 12; group++) {
00207     for (i = 0; i < 16; i++) {
00208         for (j = 0; j < 16; j++) {
00209             grid[group][i][j] = BLACK; /* No color at first */
00210         }
00211     }
00212 }
00213
00214 /*
00215 Superimpose all Choseong glyphs according to group.
00216 Each grid spot with choseong will be blue.
00217 */
00218 for (group = 0; group < 6; group++) {
00219     for (consonant1 = CHO_HEX + group;
00220          consonant1 < CHO_HEX +
00221                CHO_VARIATIONS * TOTAL_CHO;
00222          consonant1 += CHO_VARIATIONS) {
00223         for (i = 0; i < 16; i++) { /* For each glyph row */
00224             mask = 0x8000;
00225             for (j = 0; j < 16; j++) {
00226                 if (glyph[consonant1][i] & mask) grid[group][i][j] |= BLUE;
00227                 mask »= 1; /* Get next bit in glyph row */
00228             }
00229         }
00230     }
00231 }
00232
00233 /*
00234 Fill with Choseong (initial consonant) to prepare
00235 for groups 3-5 with jongseong except niuen (group+3),
00236 then for groups 3-5 with jongseong nieun (group+6).
00237 */
00238 for (group = 3; group < 6; group++) {
00239     for (i = 0; i < 16; i++) {
00240         for (j = 0; j < 16; j++) {
00241             grid[group + 3][i][j] = grid[group + 3][i][j]
00242                 = grid[group][i][j];
00243         }
00244     }
00245 }
00246
00247 /*
00248 For each Jungseong, superimpose first variation on
00249 appropriate Choseong group for grids 0 to 5.
00250 */
00251 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00252     group = cho_variation(-1, vowel, -1);
00253     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00254
00255     for (i = 0; i < 16; i++) { /* For each glyph row */
00256         mask = 0x8000;
00257         for (j = 0; j < 16; j++) {
00258             if (glyph[JUNG_HEX + JUNG_VARIATIONS * vowel][i] & mask) {
00259                 /*
00260                  If there was already blue in this grid cell,
00261                  mark this vowel variation as having overlap
00262                  with choseong (initial consonant) letter(s).
00263                 */
00264                 if (grid[group][i][j] & BLUE) glyphs_overlap = 1;
00265
00266                 /* Add green to grid cell color. */
00267                 grid[group][i][j] |= GREEN;
00268             }
00269             mask »= 1; /* Mask for next bit in glyph row */
00270         } /* for j */
00271     } /* for i */
00272     if (glyphs_overlap) {
00273         jungcho [JUNG_VARIATIONS * vowel] = 1;
00274         cho_overlaps++;
00275     }
00276 } /* for each vowel */
00277
00278 /*

```

```

00279 For each Jungseong, superimpose second variation on
00280 appropriate Choseong group for grids 6 to 8.
00281 */
00282 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00283     /*
00284     The second vowel variation is for combination with
00285     a final consonant (Jongseong), with initial consonant
00286     (Choseong) variations (or "groups") 3 to 5. Thus,
00287     if the vowel type returns an initial Choseong group
00288     of 0 to 2, add 3 to it.
00289     */
00290     group = cho_variation (-1, vowel, -1);
00291     /*
00292     Groups 0 to 2 don't use second vowel variation,
00293     so increment if group is below 2.
00294     */
00295     if (group < 3) group += 3;
00296     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00297
00298     for (i = 0; i < 16; i++) { /* For each glyph row */
00299         mask = 0x8000; /* Start mask at leftmost glyph bit */
00300         for (j = 0; j < 16; j++) { /* For each column in this row */
00301             /* " + 1" is to get each vowel's second variation */
00302             if (glyph [JUNG_HEX +
00303                     JUNG_VARIATIONS * vowel + 1][i] & mask) {
00304                 /* If this cell has blue already, mark as overlapped. */
00305                 if (grid [group + 3][i][j] & BLUE) glyphs_overlap = 1;
00306
00307                 /* Superimpose green on current cell color. */
00308                 grid [group + 3][i][j] |= GREEN;
00309             }
00310             mask »= 1; /* Get next bit in glyph row */
00311         } /* for j */
00312     } /* for i */
00313     if (glyphs_overlap) {
00314         jungcho [JUNG_VARIATIONS * vowel + 1] = 1;
00315         cho_overlaps++;
00316     }
00317 } /* for each vowel */
00318
00319 /*
00320 For each Jungseong, superimpose third variation on
00321 appropriate Choseong group for grids 9 to 11 for
00322 final consonant (Jongseong) of Nieun.
00323 */
00324 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00325     group = cho_variation (-1, vowel, -1);
00326     if (group < 3) group += 3;
00327     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00328
00329     for (i = 0; i < 16; i++) { /* For each glyph row */
00330         mask = 0x8000;
00331         for (j = 0; j < 16; j++) {
00332             if (glyph [JUNG_HEX +
00333                     JUNG_VARIATIONS * vowel + 2][i] & mask) {
00334                 /* If this cell has blue already, mark as overlapped. */
00335                 if (grid [group + 6][i][j] & BLUE) glyphs_overlap = 1;
00336
00337                 grid [group + 6][i][j] |= GREEN;
00338             }
00339             mask »= 1; /* Get next bit in glyph row */
00340         } /* for j */
00341     } /* for i */
00342     if (glyphs_overlap) {
00343         jungcho [JUNG_VARIATIONS * vowel + 2] = 1;
00344         cho_overlaps++;
00345     }
00346 } /* for each vowel */
00347
00348 /*
00349 Superimpose all final consonants except nieun for grids 6 to 8.
00350 */
00351 for (consonant2 = 0; consonant2 < TOTAL_JONG; consonant2++) {
00352     /*
00353     Skip over Jongseong Nieun, because it is covered in
00354     grids 9 to 11 after this loop.
00355     */
00356     if (consonant2 == 3) consonant2++;
00357
00358     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */

```

```

00360     for (i = 0; i < 16; i++) { /* For each glyph row */
00361         mask = 0x8000;
00362         for (j = 0; j < 16; j++) {
00363             if (glyph [JONG_HEX +
00364                     JONG_VARIATIONS * consonant2[i] & mask) {
00365                 if (grid[6][i][j] & GREEN ||
00366                     grid[7][i][j] & GREEN ||
00367                     grid[8][i][j] & GREEN) glyphs_overlap = 1;
00368
00369                 grid[6][i][j] |= RED;
00370                 grid[7][i][j] |= RED;
00371                 grid[8][i][j] |= RED;
00372             }
00373             mask »= 1; /* Get next bit in glyph row */
00374         } /* for j */
00375     } /* for i */
00376     // jongjung is for expansion
00377     // if (glyphs_overlap) {
00378     //     jongjung [JONG_VARIATIONS * consonant2] = 1;
00379     //     jongjung_overlaps++;
00380     // }
00381 } /* for each final consonant except nieun */
00382
00383 /*
00384 Superimpose final consonant 3 (Jongseong Nieun) on
00385 groups 9 to 11.
00386 */
00387 codept = JONG_HEX + 3 * JONG_VARIATIONS;
00388
00389 for (i = 0; i < 16; i++) { /* For each glyph row */
00390     mask = 0x8000;
00391     for (j = 0; j < 16; j++) {
00392         if (glyph[codept][i] & mask) {
00393             grid[ 9][i][j] |= RED;
00394             grid[10][i][j] |= RED;
00395             grid[11][i][j] |= RED;
00396         }
00397         mask »= 1; /* Get next bit in glyph row */
00398     }
00399 }
00400
00401
00402 /*
00403 Turn the black (uncolored) cells into white for better
00404 visibility of grid when displayed.
00405 */
00406 for (group = 0; group < 12; group++) {
00407     for (i = 0; i < 16; i++) {
00408         for (j = 0; j < 16; j++) {
00409             if (grid[group][i][j] == BLACK) grid[group][i][j] = WHITE;
00410         }
00411     }
00412 }
00413
00414
00415 /*
00416 Generate HTML output.
00417 */
00418 fprintf (outfp, "<html>\n");
00419 fprintf (outfp, "<head>\n");
00420 fprintf (outfp, "  <title>Johab 6/3/1 Overlaps</title>\n");
00421 fprintf (outfp, "</head>\n");
00422 fprintf (outfp, "<body bgcolor=\"#FFFFCC\">\n");
00423
00424 fprintf (outfp, "<center>\n");
00425 fprintf (outfp, "  <h1>Unifont Hangul Jamo Syllable Components</h1>\n");
00426 fprintf (outfp, "  <h2>Johab 6/3/1 Overlap</h2><br><br>\n");
00427
00428 /* Print the color code key for the table. */
00429 fprintf (outfp, "  <table border=\"1\" cellpadding=\"10\">\n");
00430 fprintf (outfp, "    <tr><th colspan=\"2\" align=\"center\" bgcolor=\"#FFCC80\">>");
00431 fprintf (outfp, "    <font size=\"+1\">Key</font></th></tr>\n");
00432 fprintf (outfp, "    <tr>\n");
00433 fprintf (outfp, "      <th align=\"center\" bgcolor=\"#FFFF80\">Color</th>\n");
00434 fprintf (outfp, "      <th align=\"center\" bgcolor=\"#FFFF80\">Letter</th>\n");
00435 fprintf (outfp, "    </tr>\n");
00436
00437 fprintf (outfp, "      <tr><td bgcolor=\"#006600\">, BLUE);
00438 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00439 fprintf (outfp, "<td>Choseong (Initial Consonant)</td></tr>\n");
00440

```

```

00441 fprintf (outfp, "    <tr><td bgcolor=\"#06X\">", GREEN);
00442 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00443 fprintf (outfp, "<td>Jungseong (Medial Vowel/Diphthong)</td></tr>\n");
00444
00445 fprintf (outfp, "    <tr><td bgcolor=\"#06X\">", RED);
00446 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00447 fprintf (outfp, "<td>Jongseong (Final Consonant)</td></tr>\n");
00448
00449 fprintf (outfp, "    <tr><td bgcolor=\"#06X\">", BLUE | GREEN);
00450 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00451 fprintf (outfp, "<td>Choseong + Jungseong Overlap</td></tr>\n");
00452
00453 fprintf (outfp, "    <tr><td bgcolor=\"#06X\">", GREEN | RED);
00454 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00455 fprintf (outfp, "<td>Jungseong + Jongseong Overlap</td></tr>\n");
00456
00457 fprintf (outfp, "    <tr><td bgcolor=\"#06X\">", RED | BLUE);
00458 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00459 fprintf (outfp, "<td>Choseong + Jongseong Overlap</td></tr>\n");
00460
00461 fprintf (outfp, "    <tr><td bgcolor=\"#06X\">", RED | GREEN | BLUE);
00462 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00463 fprintf (outfp, "<td>Choseong + Jungseong + Jongseong Overlap</td></tr>\n");
00464
00465 fprintf (outfp, "  </table>\n");
00466 fprintf (outfp, "  <br><br>\n");
00467
00468
00469 for (group = 0; group < 12; group++) {
00470     /* Arrange tables 3 across, 3 down. */
00471     if ((group % 3) == 0) {
00472         fprintf (outfp, "    <table border=\"0\" cellpadding=\"10\">\n");
00473         fprintf (outfp, "      <tr>\n");
00474     }
00475
00476     fprintf (outfp, "        <td>\n");
00477     fprintf (outfp, "          <table border=\"3\" cellpadding=\"2\">\n");
00478     fprintf (outfp, "            <tr><th colspan=\"16\" bgcolor=\"#FFFF80\">");
00479     fprintf (outfp, "Choseong Group %d, %s %s</th></tr>\n",
00480             group < 6 ? group : (group > 8 ? group - 6 : group - 3),
00481             group < 6 ? (group < 3 ? "No" : "Without") : "With",
00482             group < 9 ? "Jongseong" : "Nieun");
00483
00484     for (i = 0; i < 16; i++) {
00485         fprintf (outfp, "          <tr>\n");
00486         for (j = 0; j < 16; j++) {
00487             fprintf (outfp, "            <td bgcolor=\"#06X\">",
00488                     grid[group][i][j]);
00489             fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>\n");
00490         }
00491         fprintf (outfp, "          </tr>\n");
00492     }
00493
00494     fprintf (outfp, "        </td>\n");
00495     fprintf (outfp, "      </tr>\n");
00496     fprintf (outfp, "    </table>\n");
00497     fprintf (outfp, "  </td>\n");
00498
00499     if ((group % 3) == 2) {
00500         fprintf (outfp, "    </tr>\n");
00501         fprintf (outfp, "  </table>\n <br>\n");
00502     }
00503 }
00504
00505 /* Wrap up HTML table output. */
00506 fprintf (outfp, "</center>\n");
00507
00508 /*
00509 Print overlapping initial consonant + vowel combinations.
00510 */
00511 fprintf (outfp, "<h2>%d Vowel Overlaps with Initial Consonants Found</h2>",
00512         cho_overlaps);
00513 fprintf (outfp, "<font size=\"+1\"><pre>\n");
00514
00515 for (i = JUNG_HEX;
00516      i < JUNG_HEX + TOTAL_JUNG * JUNG_VARIATIONS;
00517      i++) {
00518     /*
00519 If this vowel variation (Jungseong) had overlaps
00520 with one or more initial consonants (Choseong),
00521 find and print them.

```

```

00522 */
00523 if (jungcho [i - JUNG_HEX]) {
00524     ancient_choseong = 0; /* Not within ancient choseong range yet. */
00525     fprintf (outfp, "<font color=\"#0000FF\"><b>");
00526     if (i >= JUNG_ANCIENT_HEX) {
00527         if (i >= JUNG_EXTB_HEX) fprintf (outfp, "Extended-B ");
00528         fprintf (outfp, "Ancient ");
00529     }
00530     fprintf (outfp, "Vowel at 0x%04X and&hellip;</b>", i + PUA_START);
00531     fprintf (outfp, "</font>\n\n");
00532
00533     /*
00534     Get current vowel number, 0 to (TOTAL_JUNG - 1), and
00535     current vowel variation, 0 or 1, or 2 for final nieun.
00536     */
00537     vowel = (i - JUNG_HEX) / JUNG_VARIATIONS;
00538     vowel_variation = (i - JUNG_HEX) % JUNG_VARIATIONS;
00539
00540     /* Get first Choseong group for this vowel, 0 to 5. */
00541     group = cho_variation (-1, vowel, -1);
00542
00543     /*
00544     If this vowel variation is used with a final consonant
00545     (Jongseong) and the default initial consonant (Choseong)
00546     group for this vowel is < 3, add 3 to current Chosenong
00547     group.
00548     */
00549     if (vowel_variation > 0 && group < 3) group += 3;
00550
00551     for (consonant1 = 0; consonant1 < TOTAL_CHO; consonant1++) {
00552         overlapped = glyph_overlap (glyph [i],
00553                                     glyph [consonant1 * CHO_VARIATIONS
00554                                             + CHO_HEX + group]);
00555
00556         /*
00557         If we just entered ancient choseong range, flag it.
00558         */
00559         if (overlapped && consonant1 >= 19 && ancient_choseong == 0) {
00560             fprintf (outfp, "<font color=\"#0000FF\"><b>");
00561             fprintf (outfp, "&hellip;Ancient Choseong&hellip;</b></font>\n");
00562             ancient_choseong = 1;
00563         }
00564         /*
00565         If overlapping choseong found, print combined glyph.
00566         */
00567         if (overlapped != 0) {
00568             combine_glyphs (glyph [i],
00569                             glyph [consonant1 * CHO_VARIATIONS
00570                                     + CHO_HEX + group],
00571                             tmp_glyph);
00572
00573             print_glyph_txt (outfp,
00574                             PUA_START +
00575                             consonant1 * CHO_VARIATIONS +
00576                             CHO_HEX + group,
00577                             tmp_glyph);
00578
00579             } /* If overlapping pixels found. */
00580         } /* For each initial consonant (Choseong) */
00581     } /* Find the initial consonant that overlapped this vowel variation. */
00582 } /* For each variation of each vowel (Jungseong) */
00583
00584
00585 fputc ('\n', outfp);
00586
00587 fprintf (outfp, "</pre></font>\n");
00588 fprintf (outfp, "</body>\n");
00589 fprintf (outfp, "</html>\n");
00590
00591 fclose (infp);
00592 fclose (outfp);
00593
00594
00595 exit (EXIT_SUCCESS);
00596 }

```

5.40.3.2 parse_args()

```
void parse_args (
    int argc,
    char * argv[],
    int * inindex,
    int * outindex,
    int * modern_only )
```

Parse command line arguments.

Parameters

in	argc	The argc parameter to the main function.
in	argv	The argv command line arguments to the main function.
in,out	infile	The input file-name; defaults to NULL.
in,out	outfile	The output file-name; defaults to NULL.

Definition at line 608 of file unijohab2html.c.

```
00609     {
00610     int arg_count; /* Current index into argv[]. */
00611
00612     int strncmp (const char *s1, const char *s2, size_t n);
00613
```

```

00614
00615     arg_count = 1;
00616
00617     while (arg_count < argc) {
00618         /* If input file is specified, open it for read access. */
00619         if (strcmp (argv [arg_count], "-i", 2) == 0) {
00620             arg_count++;
00621             if (arg_count < argc) {
00622                 *inindex = arg_count;
00623             }
00624         }
00625         /* If only modern Hangul is desired, set modern_only flag. */
00626         else if (strcmp (argv [arg_count], "-m", 2) == 0 ||
00627                 strcmp (argv [arg_count], "--modern", 8) == 0) {
00628             *modern_only = 1;
00629         }
00630         /* If output file is specified, open it for write access. */
00631         else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00632             arg_count++;
00633             if (arg_count < argc) {
00634                 *outindex = arg_count;
00635             }
00636         }
00637         /* If help is requested, print help message and exit. */
00638         else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00639                 strcmp (argv [arg_count], "--help", 6) == 0) {
00640             printf ("\nunjohab2html [options]\n\n");
00641             printf ("    Generates an HTML page of overlapping Hangul letters from an input\n");
00642             printf ("    Unifont .hex file encoded in Johab 6/3/1 format.\n\n");
00643
00644             printf ("    Option      Parameters  Function\n");
00645             printf ("    -----      -\n");
00646             printf ("    -h, --help          Print this message and exit.\n\n");
00647             printf ("    -i          input_file  Unifont hangul-base.hex formatted input file.\n\n");
00648             printf ("    -o          output_file  HTML output file showing overlapping letters.\n\n");
00649             printf ("    -m, --modern          Only examine modern Hangul letters.\n\n");
00650             printf ("    Example:\n\n");
00651             printf ("        unijohab2html -i hangul-base.hex -o hangul-syllables.html\n\n");
00652
00653             exit (EXIT_SUCCESS);
00654         }
00655
00656         arg_count++;
00657     }
00658
00659     return;
00660 }

```

5.41 unijohab2html.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unijohab2html.c
00003
00004  @brief Display overlapped Hangul letter combinations in a grid.
00005
00006  This displays overlapped letters that form Unicode Hangul Syllables
00007  combinations, as a tool to determine bounding boxes for all combinations.
00008  It works with both modern and archaic Hangul letters.
00009
00010  Input is a Unifont .hex file such as the "hangul-base.hex" file that
00011  is part of the Unifont package.  Glyphs are all processed as being
00012  16 pixels wide and 16 pixels tall.
00013
00014  Output is an HTML file containing 16 by 16 pixel grids showing
00015  overlaps in table format, arranged by variation of the initial
00016  consonant (choseong).
00017
00018  Initial consonants (choseong) have 6 variations.  In general, the
00019  first three are for combining with vowels (jungseong) that are
00020  vertical, horizontal, or vertical and horizontal, respectively;
00021  the second set of three variations are for combinations with a final
00022  consonant.
00023
00024  The output HTML file can be viewed in a web browser.
00025
00026  @author Paul Hardy
00027

```

```

00028 @copyright Copyright © 2023 Paul Hardy
00029 */
00030 /*
00031 LICENSE:
00032
00033 This program is free software: you can redistribute it and/or modify
00034 it under the terms of the GNU General Public License as published by
00035 the Free Software Foundation, either version 2 of the License, or
00036 (at your option) any later version.
00037
00038 This program is distributed in the hope that it will be useful,
00039 but WITHOUT ANY WARRANTY; without even the implied warranty of
00040 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00041 GNU General Public License for more details.
00042
00043 You should have received a copy of the GNU General Public License
00044 along with this program. If not, see <http://www.gnu.org/licenses/>.
00045 */
00046
00047 #include <stdio.h>
00048 #include <stdlib.h>
00049 #include <string.h>
00050 #include "hangul.h"
00051
00052 #define MAXFILENAME 1024
00053
00054 #define START_JUNG 0 ///< Vowel index of first vowel with which to begin.
00055 // #define START_JUNG 21 /* Use this #define for just ancient vowels */
00056
00057
00058 /* (Red, Green, Blue) HTML color coordinates. */
00059 #define RED 0xCC0000 ///< Color code for slightly unsaturated HTML red.
00060 #define GREEN 0x00CC00 ///< Color code for slightly unsaturated HTML green.
00061 #define BLUE 0x0000CC ///< Color code for slightly unsaturated HTML blue.
00062 #define BLACK 0x000000 ///< Color code for HTML black.
00063 #define WHITE 0xFFFFFF ///< Color code for HTML white.
00064
00065
00066 /**
00067 @brief The main function.
00068 */
00069 int
00070 main (int argc, char *argv[]) {
00071     int i, j; /* loop variables */
00072     unsigned codept;
00073     unsigned max_codept;
00074     int modern_only = 0; /* To just use modern Hangul */
00075     int group, consonant1, vowel, consonant2;
00076     int vowel_variation;
00077     unsigned glyph[MAX_GLYPHS][16];
00078     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00079     unsigned mask;
00080     unsigned overlapped; /* To find overlaps */
00081     int ancient_choseong; /* Flag when within ancient choseong range. */
00082
00083     /*
00084     16x16 pixel grid for each Choseong group, for:
00085
00086     Group 0 to Group 5 with no Jongseong
00087     Group 3 to Group 5 with Jongseong except Nieun
00088     Group 3 to Group 5 with Jongseong Nieun
00089
00090     12 grids total.
00091
00092     Each grid cell will hold a 32-bit HTML RGB color.
00093     */
00094     unsigned grid[12][16][16];
00095
00096     /*
00097     Matrices to detect and report overlaps. Identify vowel
00098     variations where an overlap occurred. For most vowel
00099     variations, there will be no overlap. Then go through
00100     choseong, and then jongseong to find the overlapping
00101     combinations. This saves storage space as an alternative
00102     to storing large 2- or 3-dimensional overlap matrices.
00103     */
00104     // jungcho: Jongseong overlap with Choseong
00105     unsigned jungcho [TOTAL_JUNG * JUNG_VARIATIONS];
00106     // jongjung: Jongseong overlap with Jongseong -- for future expansion
00107     // unsigned jongjung [TOTAL_JUNG * JUNG_VARIATIONS];
00108

```

```

00109 int glyphs_overlap; /* If glyph pair being considered overlap. */
00110 int cho_overlaps = 0; /* Number of choseong+vowel overlaps. */
00111 // int jongjung_overlaps = 0; /* Number of vowel+jongseong overlaps. */
00112
00113 int inindex = 0;
00114 int outindex = 0;
00115 FILE *infp, *outfp; /* Input and output file pointers. */
00116
00117 void parse_args (int argc, char *argv[], int *inindex, int *outindex,
00118                 int *modern_only);
00119 int cho_variation (int cho, int jung, int jong);
00120 unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00121 int glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00122
00123 void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00124                    unsigned *combined_glyph);
00125 void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00126
00127 /*
00128 Parse command line arguments to open input & output files, if given.
00129 */
00130 if (argc > 1) {
00131     parse_args (argc, argv, &inindex, &outindex, &modern_only);
00132 }
00133
00134 if (inindex == 0) {
00135     infp = stdin;
00136 }
00137 else {
00138     infp = fopen (argv[inindex], "r");
00139     if (infp == NULL) {
00140         fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00141                 argv[inindex]);
00142         exit (EXIT_FAILURE);
00143     }
00144 }
00145
00146 if (outindex == 0) {
00147     outfp = stdout;
00148 }
00149 else {
00150     outfp = fopen (argv[outindex], "w");
00151     if (outfp == NULL) {
00152         fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00153                 argv[outindex]);
00154         exit (EXIT_FAILURE);
00155     }
00156 }
00157
00158 /*
00159 Initialize glyph array to all zeroes.
00160 */
00161 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00162     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00163 }
00164
00165 /*
00166 Initialize overlap matrices to all zeroes.
00167 */
00168 for (i = 0; i < TOTAL_JUNG * JUNG_VARIATIONS; i++) {
00169     jungcho [i] = 0;
00170 }
00171 // jongjung is reserved for expansion.
00172 // for (i = 0; i < TOTAL_JONG * JONG_VARIATIONS; i++) {
00173 //     jongjung [i] = 0;
00174 // }
00175
00176 /*
00177 Read Hangul base glyph file.
00178 */
00179 max_codept = hangul_read_base16 (infp, glyph);
00180 if (max_codept > 0x8FFF) {
00181     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00182 }
00183
00184 /*
00185 If only examining modern Hangul, fill the ancient glyphs
00186 with blanks to guarantee they won't overlap. This is
00187 not as efficient as ending loops sooner, but is easier
00188 to verify for correctness.
00189 */

```

```

00190 if (modern_only) {
00191     for (i = 0x0073; i < JUNG_HEX; i++) {
00192         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00193     }
00194     for (i = 0x027A; i < JONG_HEX; i++) {
00195         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00196     }
00197     for (i = 0x032B; i < 0x0400; i++) {
00198         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00199     }
00200 }
00201
00202 /*
00203 Initialize grids to all black (no color) for each of
00204 the 12 Choseong groups.
00205 */
00206 for (group = 0; group < 12; group++) {
00207     for (i = 0; i < 16; i++) {
00208         for (j = 0; j < 16; j++) {
00209             grid[group][i][j] = BLACK; /* No color at first */
00210         }
00211     }
00212 }
00213
00214 /*
00215 Superimpose all Choseong glyphs according to group.
00216 Each grid spot with choseong will be blue.
00217 */
00218 for (group = 0; group < 6; group++) {
00219     for (consonant1 = CHO_HEX + group;
00220          consonant1 < CHO_HEX +
00221                CHO_VARIATIONS * TOTAL_CHO;
00222          consonant1 += CHO_VARIATIONS) {
00223         for (i = 0; i < 16; i++) { /* For each glyph row */
00224             mask = 0x8000;
00225             for (j = 0; j < 16; j++) {
00226                 if (glyph[consonant1][i] & mask) grid[group][i][j] |= BLUE;
00227                 mask >>= 1; /* Get next bit in glyph row */
00228             }
00229         }
00230     }
00231 }
00232
00233 /*
00234 Fill with Choseong (initial consonant) to prepare
00235 for groups 3-5 with jongseong except niuen (group+3),
00236 then for groups 3-5 with jongseong nieun (group+6).
00237 */
00238 for (group = 3; group < 6; group++) {
00239     for (i = 0; i < 16; i++) {
00240         for (j = 0; j < 16; j++) {
00241             grid[group + 6][i][j] = grid[group + 3][i][j]
00242                               = grid[group][i][j];
00243         }
00244     }
00245 }
00246
00247 /*
00248 For each Jungseong, superimpose first variation on
00249 appropriate Choseong group for grids 0 to 5.
00250 */
00251 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00252     group = cho_variation(-1, vowel, -1);
00253     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00254
00255     for (i = 0; i < 16; i++) { /* For each glyph row */
00256         mask = 0x8000;
00257         for (j = 0; j < 16; j++) {
00258             if (glyph[JUNG_HEX + JUNG_VARIATIONS * vowel][i] & mask) {
00259                 /*
00260 If there was already blue in this grid cell,
00261 mark this vowel variation as having overlap
00262 with choseong (initial consonant) letter(s).
00263 */
00264                 if (grid[group][i][j] & BLUE) glyphs_overlap = 1;
00265
00266                 /* Add green to grid cell color. */
00267                 grid[group][i][j] |= GREEN;
00268             }
00269             mask >>= 1; /* Mask for next bit in glyph row */
00270         }
00271     }

```

```

00271     } /* for i */
00272     if (glyphs_overlap) {
00273         jungcho [JUNG_VARIATIONS * vowel] = 1;
00274         cho_overlaps++;
00275     }
00276 } /* for each vowel */
00277
00278 /*
00279 For each Jungseong, superimpose second variation on
00280 appropriate Choseong group for grids 6 to 8.
00281 */
00282 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00283     /*
00284 The second vowel variation is for combination with
00285 a final consonant (Jongseong), with initial consonant
00286 (Choseong) variations (or "groups") 3 to 5. Thus,
00287 if the vowel type returns an initial Choseong group
00288 of 0 to 2, add 3 to it.
00289 */
00290     group = cho_variation (-1, vowel, -1);
00291     /*
00292 Groups 0 to 2 don't use second vowel variation,
00293 so increment if group is below 2.
00294 */
00295     if (group < 3) group += 3;
00296     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00297
00298     for (i = 0; i < 16; i++) { /* For each glyph row */
00299         mask = 0x8000; /* Start mask at leftmost glyph bit */
00300         for (j = 0; j < 16; j++) { /* For each column in this row */
00301             /* " + 1" is to get each vowel's second variation */
00302             if (glyph [JUNG_HEX +
00303                     JUNG_VARIATIONS * vowel + 1][i] & mask) {
00304                 /* If this cell has blue already, mark as overlapped. */
00305                 if (grid [group + 3][i][j] & BLUE) glyphs_overlap = 1;
00306
00307                 /* Superimpose green on current cell color. */
00308                 grid [group + 3][i][j] |= GREEN;
00309             }
00310             mask »= 1; /* Get next bit in glyph row */
00311         } /* for j */
00312     } /* for i */
00313     if (glyphs_overlap) {
00314         jungcho [JUNG_VARIATIONS * vowel + 1] = 1;
00315         cho_overlaps++;
00316     }
00317 } /* for each vowel */
00318
00319 /*
00320 For each Jungseong, superimpose third variation on
00321 appropriate Choseong group for grids 9 to 11 for
00322 final consonant (Jongseong) of Nieun.
00323 */
00324 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00325     group = cho_variation (-1, vowel, -1);
00326     if (group < 3) group += 3;
00327     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00328
00329     for (i = 0; i < 16; i++) { /* For each glyph row */
00330         mask = 0x8000;
00331         for (j = 0; j < 16; j++) {
00332             if (glyph [JUNG_HEX +
00333                     JUNG_VARIATIONS * vowel + 2][i] & mask) {
00334                 /* If this cell has blue already, mark as overlapped. */
00335                 if (grid [group + 6][i][j] & BLUE) glyphs_overlap = 1;
00336
00337                 grid [group + 6][i][j] |= GREEN;
00338             }
00339             mask »= 1; /* Get next bit in glyph row */
00340         } /* for j */
00341     } /* for i */
00342     if (glyphs_overlap) {
00343         jungcho [JUNG_VARIATIONS * vowel + 2] = 1;
00344         cho_overlaps++;
00345     }
00346 } /* for each vowel */
00347
00348 /*
00349
00350 Superimpose all final consonants except nieun for grids 6 to 8.
00351 */

```

```

00352     for (consonant2 = 0; consonant2 < TOTAL__JONG; consonant2++) {
00353         /*
00354         Skip over Jongseong Nieun, because it is covered in
00355         grids 9 to 11 after this loop.
00356         */
00357         if (consonant2 == 3) consonant2++;
00358
00359         glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00360         for (i = 0; i < 16; i++) { /* For each glyph row */
00361             mask = 0x8000;
00362             for (j = 0; j < 16; j++) {
00363                 if (glyph [JONG_HEX +
00364                     JONG_VARIATIONS * consonant2][i] & mask) {
00365                     if (grid[6][i][j] & GREEN ||
00366                         grid[7][i][j] & GREEN ||
00367                         grid[8][i][j] & GREEN) glyphs_overlap = 1;
00368
00369                     grid[6][i][j] |= RED;
00370                     grid[7][i][j] |= RED;
00371                     grid[8][i][j] |= RED;
00372                 }
00373                 mask »= 1; /* Get next bit in glyph row */
00374             } /* for j */
00375         } /* for i */
00376         // jongjung is for expansion
00377         // if (glyphs_overlap) {
00378         //     jongjung [JONG_VARIATIONS * consonant2] = 1;
00379         //     jongjung_overlaps++;
00380         // }
00381     } /* for each final consonant except nieun */
00382
00383     /*
00384     Superimpose final consonant 3 (Jongseong Nieun) on
00385     groups 9 to 11.
00386     */
00387     codept = JONG_HEX + 3 * JONG_VARIATIONS;
00388
00389     for (i = 0; i < 16; i++) { /* For each glyph row */
00390         mask = 0x8000;
00391         for (j = 0; j < 16; j++) {
00392             if (glyph[codept][i] & mask) {
00393                 grid[ 9][i][j] |= RED;
00394                 grid[10][i][j] |= RED;
00395                 grid[11][i][j] |= RED;
00396             }
00397             mask »= 1; /* Get next bit in glyph row */
00398         }
00399     }
00400
00401     /*
00402     Turn the black (uncolored) cells into white for better
00403     visibility of grid when displayed.
00404     */
00405     for (group = 0; group < 12; group++) {
00406         for (i = 0; i < 16; i++) {
00407             for (j = 0; j < 16; j++) {
00408                 if (grid[group][i][j] == BLACK) grid[group][i][j] = WHITE;
00409             }
00410         }
00411     }
00412 }
00413
00414 /*
00415 Generate HTML output.
00416 */
00417 fprintf (outfp, "<html>\n");
00418 fprintf (outfp, "<head>\n");
00420 fprintf (outfp, "    <title>Johab 6/3/1 Overlaps</title>\n");
00421 fprintf (outfp, "</head>\n");
00422 fprintf (outfp, "<body bgcolor=\"#FFFFCC\">\n");
00423
00424 fprintf (outfp, "<center>\n");
00425 fprintf (outfp, "    <h1>Unifont Hangul Jamo Syllable Components</h1>\n");
00426 fprintf (outfp, "    <h2>Johab 6/3/1 Overlap</h2><br><br>\n");
00427
00428 /* Print the color code key for the table. */
00429 fprintf (outfp, "    <table border=\"1\" cellpadding=\"10\">\n");
00430 fprintf (outfp, "        <tr><th colspan=\"2\" align=\"center\" bgcolor=\"#FFCC80\"></th>\n");
00431 fprintf (outfp, "        <font size=\"+1\">Key</font></th></tr>\n");
00432 fprintf (outfp, "        <tr>\n");

```

```

00433 fprintf (outfp, "    <th align=\"center\" bgcolor=\"\#FFFF80\">Color</th>\n");
00434 fprintf (outfp, "    <th align=\"center\" bgcolor=\"\#FFFF80\">Letter(s)</th>\n");
00435 fprintf (outfp, "    </tr>\n");
00436
00437 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", BLUE);
00438 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00439 fprintf (outfp, "<td>Choseong (Initial Consonant)</td></tr>\n");
00440
00441 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", GREEN);
00442 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00443 fprintf (outfp, "<td>Jungseong (Medial Vowel/Diphthong)</td></tr>\n");
00444
00445 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", RED);
00446 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00447 fprintf (outfp, "<td>Jongseong (Final Consonant)</td></tr>\n");
00448
00449 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", BLUE | GREEN);
00450 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00451 fprintf (outfp, "<td>Choseong + Jungseong Overlap</td></tr>\n");
00452
00453 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", GREEN | RED);
00454 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00455 fprintf (outfp, "<td>Jungseong + Jongseong Overlap</td></tr>\n");
00456
00457 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", RED | BLUE);
00458 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00459 fprintf (outfp, "<td>Choseong + Jongseong Overlap</td></tr>\n");
00460
00461 fprintf (outfp, "    <tr><td bgcolor=\"\#06X\">", RED | GREEN | BLUE);
00462 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00463 fprintf (outfp, "<td>Choseong + Jungseong + Jongseong Overlap</td></tr>\n");
00464
00465 fprintf (outfp, "    </table>\n");
00466 fprintf (outfp, "    <br><br>\n");
00467
00468
00469 for (group = 0; group < 12; group++) {
00470     /* Arrange tables 3 across, 3 down. */
00471     if ((group % 3) == 0) {
00472         fprintf (outfp, "    <table border=\"0\" cellpadding=\"10\">\n");
00473         fprintf (outfp, "        <tr>\n");
00474     }
00475
00476     fprintf (outfp, "            <td>\n");
00477     fprintf (outfp, "                <table border=\"3\" cellpadding=\"2\">\n");
00478     fprintf (outfp, "                    <tr><th colspan=\"16\" bgcolor=\"\#FFFF80\">",
00479     fprintf (outfp, "Choseong Group %d, %s %s</th></tr>\n",
00480     group < 6 ? group : (group > 8 ? group - 6 : group - 3),
00481     group < 6 ? (group < 3 ? "No" : "Without") : "With",
00482     group < 9 ? "Jongseong" : "Nieun");
00483
00484     for (i = 0; i < 16; i++) {
00485         fprintf (outfp, "                <tr>\n");
00486         for (j = 0; j < 16; j++) {
00487             fprintf (outfp, "                    <td bgcolor=\"\#06X\">",
00488             grid[group][i][j]);
00489             fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>\n");
00490         }
00491         fprintf (outfp, "                </tr>\n");
00492     }
00493
00494     fprintf (outfp, "            </td>\n");
00495     fprintf (outfp, "        </tr>\n");
00496     fprintf (outfp, "    </table>\n");
00497     fprintf (outfp, "    </td>\n");
00498
00499     if ((group % 3) == 2) {
00500         fprintf (outfp, "        </tr>\n");
00501         fprintf (outfp, "    </table>\n <br>\n");
00502     }
00503 }
00504
00505 /* Wrap up HTML table output. */
00506 fprintf (outfp, "</center>\n");
00507
00508 /*
00509 Print overlapping initial consonant + vowel combinations.
00510 */
00511 fprintf (outfp, "<h2>%d Vowel Overlaps with Initial Consonants Found</h2>",
00512     cho_overlaps);
00513 fprintf (outfp, "<font size=\"+1\"><pre>\n");

```

```

00514
00515     for (i = JUNG_HEX;
00516          i < JUNG_HEX + TOTAL_JUNG * JUNG_VARIATIONS;
00517          i++) {
00518         /*
00519         If this vowel variation (Jungseong) had overlaps
00520         with one or more initial consonants (Choseong),
00521         find and print them.
00522         */
00523         if (jungcho [i - JUNG_HEX]) {
00524             ancient_choseong = 0; /* Not within ancient choseong range yet. */
00525             fprintf (outfp, "<font color=\\"#0000FF\\"><b>");
00526             if (i >= JUNG_ANCIENT_HEX) {
00527                 if (i >= JUNG_EXTB_HEX) fprintf (outfp, "Extended-B ");
00528                 fprintf (outfp, "Ancient ");
00529             }
00530             fprintf (outfp, "Vowel at 0x%04X and&hellip;</b>", i + PUA_START);
00531             fprintf (outfp, "</font>\n\n");
00532
00533             /*
00534             Get current vowel number, 0 to (TOTAL_JUNG - 1), and
00535             current vowel variation, 0 or 1, or 2 for final nieun.
00536             */
00537             vowel = (i - JUNG_HEX) / JUNG_VARIATIONS;
00538             vowel_variation = (i - JUNG_HEX) % JUNG_VARIATIONS;
00539
00540             /* Get first Choseong group for this vowel, 0 to 5. */
00541             group = cho_variation (-1, vowel, -1);
00542
00543             /*
00544             If this vowel variation is used with a final consonant
00545             (Jongseong) and the default initial consonant (Choseong)
00546             group for this vowel is < 3, add 3 to current Chosenong
00547             group.
00548             */
00549             if (vowel_variation > 0 && group < 3) group += 3;
00550
00551             for (consonant1 = 0; consonant1 < TOTAL_CHO; consonant1++) {
00552                 overlapped = glyph_overlap (glyph [i],
00553                                             glyph [consonant1 * CHO_VARIATIONS
00554                                                       + CHO_HEX + group]);
00555
00556                 /*
00557                 If we just entered ancient choseong range, flag it.
00558                 */
00559                 if (overlapped && consonant1 >= 19 && ancient_choseong == 0) {
00560                     fprintf (outfp, "<font color=\\"#0000FF\\"><b>");
00561                     fprintf (outfp, "&hellip;Ancient Choseong&hellip;</b></font>\n");
00562                     ancient_choseong = 1;
00563                 }
00564                 /*
00565                 If overlapping choseong found, print combined glyph.
00566                 */
00567                 if (overlapped != 0) {
00568
00569                     combine_glyphs (glyph [i],
00570                                     glyph [consonant1 * CHO_VARIATIONS
00571                                               + CHO_HEX + group],
00572                                     tmp_glyph);
00573
00574                     print_glyph_txt (outfp,
00575                                     PUA_START +
00576                                     consonant1 * CHO_VARIATIONS +
00577                                     CHO_HEX + group,
00578                                     tmp_glyph);
00579
00580                 } /* If overlapping pixels found. */
00581             } /* For each initial consonant (Choseong) */
00582         } /* Find the initial consonant that overlapped this vowel variation. */
00583     } /* For each variation of each vowel (Jungseong) */
00584
00585     fputc ('\n', outfp);
00586
00587     fprintf (outfp, "</pre></font>\n");
00588     fprintf (outfp, "</body>\n");
00589     fprintf (outfp, "</html>\n");
00590
00591     fclose (infp);
00592     fclose (outfp);
00593
00594

```

```

00595     exit (EXIT_SUCCESS);
00596 }
00597
00598
00599 /**
00600 @brief Parse command line arguments.
00601
00602 @param[in] argc The argc parameter to the main function.
00603 @param[in] argv The argv command line arguments to the main function.
00604 @param[in,out] infile The input filename; defaults to NULL.
00605 @param[in,out] outfile The output filename; defaults to NULL.
00606 */
00607 void
00608 parse_args (int argc, char *argv[], int *inindex, int *outindex,
00609             int *modern_only) {
00610     int arg_count; /* Current index into argv[] */
00611
00612     int strcmp (const char *s1, const char *s2, size_t n);
00613
00614
00615     arg_count = 1;
00616
00617     while (arg_count < argc) {
00618         /* If input file is specified, open it for read access. */
00619         if (strcmp (argv [arg_count], "-i", 2) == 0) {
00620             arg_count++;
00621             if (arg_count < argc) {
00622                 *inindex = arg_count;
00623             }
00624         }
00625         /* If only modern Hangul is desired, set modern_only flag. */
00626         else if (strcmp (argv [arg_count], "-m", 2) == 0 ||
00627                 strcmp (argv [arg_count], "--modern", 8) == 0) {
00628             *modern_only = 1;
00629         }
00630         /* If output file is specified, open it for write access. */
00631         else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00632             arg_count++;
00633             if (arg_count < argc) {
00634                 *outindex = arg_count;
00635             }
00636         }
00637         /* If help is requested, print help message and exit. */
00638         else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00639                 strcmp (argv [arg_count], "--help", 6) == 0) {
00640             printf ("\nunijohab2html [options]\n\n");
00641             printf ("    Generates an HTML page of overlapping Hangul letters from an input\n");
00642             printf ("    Unifont .hex file encoded in Johab 6/3/1 format.\n\n");
00643
00644             printf ("    Option      Parameters  Function\n");
00645             printf ("    -----      -\n");
00646             printf ("    -h, --help          Print this message and exit.\n\n");
00647             printf ("    -i          input_file  Unifont hangul-base.hex formatted input file.\n\n");
00648             printf ("    -o          output_file  HTML output file showing overlapping letters.\n\n");
00649             printf ("    -m, --modern        Only examine modern Hangul letters.\n\n");
00650             printf ("    Example:\n\n");
00651             printf ("    unijohab2html -i hangul-base.hex -o hangul-syllables.html\n\n");
00652
00653             exit (EXIT_SUCCESS);
00654         }
00655
00656         arg_count++;
00657     }
00658
00659     return;
00660 }
00661

```

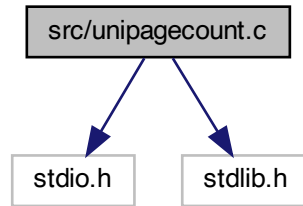
5.42 src/unipagecount.c File Reference

unipagecount - Count the number of glyphs defined in each page of 256 code points

#include <stdio.h>

#include <stdlib.h>

Include dependency graph for unipagecount.c:



Macros

- `#define` [MAXBUF](#) 256
Maximum input line size - 1.

Functions

- `int` [main](#) (int argc, char *argv[])
The main function.
- `void` [mkftable](#) (unsigned plane, int pagecount[256], int links)
Create an HTML table linked to PNG images.

5.42.1 Detailed Description

unipagecount - Count the number of glyphs defined in each page of 256 code points

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

Copyright (C) 2007, 2008, 2013, 2014 Paul Hardy

This program counts the number of glyphs that are defined in each "page" of 256 code points, and prints the counts in an 8 x 8 grid. Input is from stdin. Output is to stdout.

The background color of each cell in a 16-by-16 grid of 256 code points is shaded to indicate percentage coverage. Red indicates 0% coverage, green represents 100% coverage, and colors in between pure red and pure green indicate partial coverage on a scale.

Each code point range number can be a hyperlink to a PNG file for that 256-code point range's corresponding bitmap glyph image.

Synopsis:

```

unipagecount < font_file.hex > count.txt
unipagecount -phex_page_num < font_file.hex -- just 256 points
unipagecount -h < font_file.hex -- HTML table
unipagecount -P1 -h < font.hex > count.html -- Plane 1, HTML out
unipagecount -l < font_file.hex -- linked HTML table
  
```

Definition in file [unipagecount.c](#).

5.42.2 Macro Definition Documentation

5.42.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input line size - 1.

Definition at line 59 of file [unipagecount.c](#).

5.42.3 Function Documentation

5.42.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 70 of file [unipagecount.c](#).

```
00071 {
00072
00073     char inbuf[MAXBUF]; /* Max 256 characters in an input line */
00074     int i, j; /* loop variables */
00075     unsigned plane=0; /* Unicode plane number, 0 to 0x16 */
00076     unsigned page; /* unicode page (256 bytes wide) */
00077     unsigned unichar; /* unicode character */
00078     int pagecount[256] = {256 * 0};
00079     int onepage=0; /* set to one if printing character grid for one page */
00080     int pageno=0; /* page number selected if only examining one page */
00081     int html=0; /* =0: print plain text; =1: print HTML */
00082     int links=0; /* =1: print HTML links; =0: don't print links */
00083
00084     /* make (print) flipped HTML table */
00085     void mkftable (unsigned plane, int pagecount[256], int links);
00086 }
```

```

00087     size_t strlen();
00088
00089     if (argc > 1 && argv[1][0] == '-') { /* Parse option */
00090         plane = 0;
00091         for (i = 1; i < argc; i++) {
00092             switch (argv[i][1]) {
00093                 case 'p': /* specified -p<hexpage> -- use given page number */
00094                     sscanf (&argv[1][2], "%x", &pageno);
00095                     if (pageno >= 0 && pageno <= 255) onepage = 1;
00096                     break;
00097                 case 'h': /* print HTML table instead of text table */
00098                     html = 1;
00099                     break;
00100                 case 'l': /* print hyperlinks in HTML table */
00101                     links = 1;
00102                     html = 1;
00103                     break;
00104                 case 'P': /* Plane number specified */
00105                     plane = atoi(&argv[1][2]);
00106                     break;
00107             }
00108         }
00109     }
00110     /*
00111     Initialize pagecount to account for noncharacters.
00112     */
00113     if (!onepage && plane==0) {
00114         pagecount[0xfd] = 32; /* for U+FDD0..U+FDEF */
00115     }
00116     pagecount[0xff] = 2; /* for U+nnFFFE, U+nnFFFF */
00117     /*
00118     Read one line at a time from input. The format is:
00119
00120     <hexpos>:<hexbitmap>
00121
00122     where <hexpos> is the hexadecimal Unicode character position
00123     in the range 00..FF and <hexbitmap> is the sequence of hexadecimal
00124     digits of the character, laid out in a grid from left to right,
00125     top to bottom. The character is assumed to be 16 rows of variable
00126     width.
00127     */
00128     while (fgets (inbuf, MAXBUF-1, stdin) != NULL) {
00129         sscanf (inbuf, "%X", &unichar);
00130         page = unichar » 8;
00131         if (onepage) { /* only increment counter if this is page we want */
00132             if (page == pageno) { /* character is in the page we want */
00133                 pagecount[unichar & 0xff]++; /* mark character as covered */
00134             }
00135         }
00136         else { /* counting all characters in all pages */
00137             if (plane == 0) {
00138                 /* Don't add in noncharacters (U+FDD0..U+FDEF, U+FFFE, U+FFFF) */
00139                 if (unichar < 0xfdd0 || (unichar > 0xfdef && unichar < 0xfffe))
00140                     pagecount[page]++;
00141             }
00142             else {
00143                 if ((page » 8) == plane) { /* code point is in desired plane */
00144                     pagecount[page & 0xFF]++;
00145                 }
00146             }
00147         }
00148     }
00149     if (html) {
00150         mkftable (plane, pagecount, links);
00151     }
00152     else { /* Otherwise, print plain text table */
00153         if (plane > 0) fprintf (stdout, " ");
00154         fprintf (stdout,
00155             " 0 1 2 3 4 5 6 7 8 9 A B C D E F\n");
00156         for (i=0; i<0x10; i++) {
00157             fprintf (stdout, "%02X%X ", plane, i); /* row header */
00158             for (j=0; j<0x10; j++) {
00159                 if (onepage) {
00160                     if (pagecount[i*16+j])
00161                         fprintf (stdout, " * ");
00162                     else
00163                         fprintf (stdout, " . ");
00164                 }
00165                 else {
00166                     fprintf (stdout, "%3X ", pagecount[i*16+j]);
00167                 }

```

```

00168     }
00169     fprintf (stdout, "\n");
00170 }
00171
00172 }
00173 exit (0);
00174 }

```

Here is the call graph for this function:



5.42.3.2 mkftable()

```

void mkftable (
    unsigned plane,
    int pagecount[256],
    int links )

```

Create an HTML table linked to PNG images.

This function creates an HTML table to show PNG files in a 16 by 16 grid. The background color of each "page" of 256 code points is shaded from red (for 0% coverage) to green (for 100% coverage).

Parameters

in	plane	The Uni-code plane, 0..17.
in	pagecount	Array with count of glyphs in each 256 code point range.

Parameters

in	links	1 = generate hyperlinks, 0 = do not generate hyperlinks.
----	-------	--

Definition at line 190 of file [unipagecount.c](#).

```

00191 {
00192     int i, j;
00193     int count;
00194     unsigned bgcolor;
00195
00196     printf("<html>\n");
00197     printf("<body>\n");
00198     printf("<table border=\"3\" align=\"center\">\n");
00199     printf("  <tr><th colspan=\"16\" bgcolor=\"#ffcc80\">");
00200     printf("GNU Unifont Glyphs<br>with Page Coverage for Plane %d<br>(Green=100%%, Red=0%%)</th></tr>\n",
plane);
00201     for (i = 0x0; i <= 0xF; i++) {
00202         printf("  <tr>\n");
00203         for (j = 0x0; j <= 0xF; j++) {
00204             count = pagecount[ (i « 4) | j ];
00205
00206             /* print link in cell if links == 1 */
00207             if (plane != 0 || (i < 0xd || (i == 0xd && j < 0x8) || (i == 0xf && j > 0x8))) {
00208                 /* background color is light green if completely done */
00209                 if (count == 0x100) bgcolor = 0xccffcc;
00210                 /* otherwise background is a shade of yellow to orange to red */
00211                 else bgcolor = 0xff0000 | (count « 8) | (count » 1);
00212                 printf("    <td bgcolor=\"#%06X\">", bgcolor);
00213                 if (plane == 0)
00214                     printf("  <a href=\"png/plane%02X/uni%02X%X%X.png\">%X%X</a>", plane, plane, i, j, j);
00215                 else
00216                     printf("  <a href=\"png/plane%02X/uni%02X%X%X.png\">%02X%X%X</a>", plane, plane, i, j, plane, i, j);
00217                 printf("    </td>\n");
00218             }
00219             else if (i == 0xd) {
00220                 if (j == 0x8) {
00221                     printf("      <td align=\"center\" colspan=\"8\" bgcolor=\"#cccccc\">");
00222                     printf("      <b>Surrogate Pairs</b>");
00223                     printf("    </td>\n");
00224                 } /* otherwise don't print anything more columns in this row */
00225             }
00226             else if (i == 0xe) {
00227                 if (j == 0x0) {
00228                     printf("      <td align=\"center\" colspan=\"16\" bgcolor=\"#cccccc\">");
00229                     printf("      <b>Private Use Area</b>");
00230                     printf("    </td>\n");
00231                 } /* otherwise don't print any more columns in this row */
00232             }
00233             else if (i == 0xf) {
00234                 if (j == 0x0) {
00235                     printf("      <td align=\"center\" colspan=\"9\" bgcolor=\"#cccccc\">");
00236                     printf("      <b>Private Use Area</b>");
00237                     printf("    </td>\n");
00238                 }
00239             }
00240         }
00241         printf("  </tr>\n");
00242     }
00243     printf("</table>\n");
00244     printf("</body>\n");
00245     printf("</html>\n");
00246
00247     return;
00248 }

```

Here is the caller graph for this function:



5.43 unipagecount.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unipagecount.c
00003
00004  @brief unipagecount - Count the number of glyphs defined in each page
00005  of 256 code points
00006
00007  @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009  @copyright Copyright (C) 2007, 2008, 2013, 2014 Paul Hardy
00010
00011  This program counts the number of glyphs that are defined in each
00012  "page" of 256 code points, and prints the counts in an 8 x 8 grid.
00013  Input is from stdin. Output is to stdout.
00014
00015  The background color of each cell in a 16-by-16 grid of 256 code points
00016  is shaded to indicate percentage coverage. Red indicates 0% coverage,
00017  green represents 100% coverage, and colors in between pure red and pure
00018  green indicate partial coverage on a scale.
00019
00020  Each code point range number can be a hyperlink to a PNG file for
00021  that 256-code point range's corresponding bitmap glyph image.
00022
00023  Synopsis:
00024
00025  unipagecount < font_file.hex > count.txt
00026  unipagecount -phex_page_num < font_file.hex -- just 256 points
00027  unipagecount -h < font_file.hex -- HTML table
00028  unipagecount -P1 -h < font_file.hex > count.html -- Plane 1, HTML out
00029  unipagecount -l < font_file.hex -- linked HTML table
00030  */
00031  /*
00032  LICENSE:
00033
00034  This program is free software: you can redistribute it and/or modify
00035  it under the terms of the GNU General Public License as published by
00036  the Free Software Foundation, either version 2 of the License, or
00037  (at your option) any later version.
00038
00039  This program is distributed in the hope that it will be useful,
00040  but WITHOUT ANY WARRANTY; without even the implied warranty of
00041  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00042  GNU General Public License for more details.
00043
00044  You should have received a copy of the GNU General Public License
00045  along with this program. If not, see <http://www.gnu.org/licenses/>.
00046  */
00047  /*
00048  /*
00049  2018, Paul Hardy: Changed "Private Use" to "Private Use Area" in
00050  output HTML file.
00051
00052  21 October 2023 [Paul Hardy]:
00053  - Added full prototype for mkftable function in main function.
00054  */
00055
00056  #include <stdio.h>
00057  #include <stdlib.h>
00058

```

```

00059 #define MAXBUF 256 ///< Maximum input line size - 1.
00060
00061
00062 /**
00063 @brief The main function.
00064
00065 @param[in] argc The count of command line arguments.
00066 @param[in] argv Pointer to array of command line arguments.
00067 @return This program exits with status 0.
00068 */
00069 int
00070 main (int argc, char *argv[])
00071 {
00072
00073     char inbuf[MAXBUF]; /* Max 256 characters in an input line */
00074     int i, j; /* loop variables */
00075     unsigned plane=0; /* Unicode plane number, 0 to 0x16 */
00076     unsigned page; /* unicode page (256 bytes wide) */
00077     unsigned unichar; /* unicode character */
00078     int pagecount[256] = {256 * 0};
00079     int onepage=0; /* set to one if printing character grid for one page */
00080     int pageno=0; /* page number selected if only examining one page */
00081     int html=0; /* =0: print plain text; =1: print HTML */
00082     int links=0; /* =1: print HTML links; =0: don't print links */
00083
00084     /* make (print) flipped HTML table */
00085     void mkftable (unsigned plane, int pagecount[256], int links);
00086
00087     size_t strlen();
00088
00089     if (argc > 1 && argv[1][0] == '-') { /* Parse option */
00090         plane = 0;
00091         for (i = 1; i < argc; i++) {
00092             switch (argv[i][1]) {
00093                 case 'p': /* specified -p<hexpage> -- use given page number */
00094                     sscanf (&argv[1][2], "%x", &pageno);
00095                     if (pageno >= 0 && pageno <= 255) onepage = 1;
00096                     break;
00097                 case 'h': /* print HTML table instead of text table */
00098                     html = 1;
00099                     break;
00100                 case 'l': /* print hyperlinks in HTML table */
00101                     links = 1;
00102                     html = 1;
00103                     break;
00104                 case 'P': /* Plane number specified */
00105                     plane = atoi(&argv[1][2]);
00106                     break;
00107             }
00108         }
00109     }
00110     /*
00111     Initialize pagecount to account for noncharacters.
00112     */
00113     if (!onepage && plane==0) {
00114         pagecount[0xfd] = 32; /* for U+FDD0..U+FDEF */
00115     }
00116     pagecount[0xff] = 2; /* for U+nnFFFE, U+nnFFFF */
00117     /*
00118     Read one line at a time from input. The format is:
00119
00120     <hexpos>:<hexbitmap>
00121
00122     where <hexpos> is the hexadecimal Unicode character position
00123     in the range 00..FF and <hexbitmap> is the sequence of hexadecimal
00124     digits of the character, laid out in a grid from left to right,
00125     top to bottom. The character is assumed to be 16 rows of variable
00126     width.
00127     */
00128     while (fgets (inbuf, MAXBUF-1, stdin) != NULL) {
00129         sscanf (inbuf, "%X", &unichar);
00130         page = unichar » 8;
00131         if (onepage) { /* only increment counter if this is page we want */
00132             if (page == pageno) { /* character is in the page we want */
00133                 pagecount[unichar & 0xff]++; /* mark character as covered */
00134             }
00135         }
00136         else { /* counting all characters in all pages */
00137             if (plane == 0) {
00138                 /* Don't add in noncharacters (U+FDD0..U+FDEF, U+FFFE, U+FFFF) */
00139                 if (unichar < 0xfdd0 || (unichar > 0xfdef && unichar < 0xfffe))

```

```

00140         pagecount[plane]++;
00141     }
00142     else {
00143         if ((page » 8) == plane) { /* code point is in desired plane */
00144             pagecount[plane & 0xFF]++;
00145         }
00146     }
00147 }
00148 }
00149 if (html) {
00150     mkftable (plane, pagecount, links);
00151 }
00152 else { /* Otherwise, print plain text table */
00153     if (plane > 0) fprintf (stdout, " ");
00154     fprintf (stdout,
00155         " 0 1 2 3 4 5 6 7 8 9 A B C D E F\n");
00156     for (i=0; i<0x10; i++) {
00157         fprintf (stdout,"%02X%X ", plane, i); /* row header */
00158         for (j=0; j<0x10; j++) {
00159             if (onepage) {
00160                 if (pagecount[i*16+j])
00161                     fprintf (stdout, " * ");
00162                 else
00163                     fprintf (stdout, " . ");
00164             }
00165             else {
00166                 fprintf (stdout, "%3X ", pagecount[i*16+j]);
00167             }
00168         }
00169         fprintf (stdout, "\n");
00170     }
00171 }
00172 }
00173 exit (0);
00174 }
00175
00176 /**
00177  * @brief Create an HTML table linked to PNG images.
00178  *
00179  * This function creates an HTML table to show PNG files
00180  * in a 16 by 16 grid. The background color of each "page"
00181  * of 256 code points is shaded from red (for 0% coverage)
00182  * to green (for 100% coverage).
00183  *
00184  * @param[in] plane The Unicode plane, 0..17.
00185  * @param[in] pagecount Array with count of glyphs in each 256 code point range.
00186  * @param[in] links 1 = generate hyperlinks, 0 = do not generate hyperlinks.
00187  */
00188 void
00189 mkftable (unsigned plane, int pagecount[256], int links)
00190 {
00191     int i, j;
00192     int count;
00193     unsigned bgcolor;
00194
00195     printf("<html>\n");
00196     printf("<body>\n");
00197     printf("<table border='3' align='center'>\n");
00198     printf("  <tr><th colspan='16' bgcolor='&#xffcc80'>");
00199     printf("GNU Unifont Glyphs<br>with Page Coverage for Plane %d<br>(Green=100%%, Red=0%%)</th></tr>\n",
00200         plane);
00201     for (i = 0x0; i <= 0xF; i++) {
00202         printf("  <tr>\n");
00203         for (j = 0x0; j <= 0xF; j++) {
00204             count = pagecount[ (i « 4) | j ];
00205
00206             /* print link in cell if links == 1 */
00207             if (plane != 0 || (i < 0xd || (i == 0xd && j < 0x8) || (i == 0xf && j > 0x8))) {
00208                 /* background color is light green if completely done */
00209                 if (count == 0x100) bgcolor = 0xccffcc;
00210                 /* otherwise background is a shade of yellow to orange to red */
00211                 else bgcolor = 0xff0000 | (count « 8) | (count » 1);
00212                 printf("    <td bgcolor='&#x%06X'>", bgcolor);
00213                 if (plane == 0)
00214                     printf("    <a href='&#xpng/plane%02X/uni%02X%X%X.png'>%X%X</a>", plane, plane, i, j, j);
00215                 else
00216                     printf("    <a href='&#xpng/plane%02X/uni%02X%X%X.png'>%02X%X%X</a>", plane, plane, i, j, plane, i, j);
00217                 printf("    </td>\n");
00218             }
00219             else if (i == 0xd) {

```

```
00220         if (j == 0x8) {
00221             printf ("    <td align=\"center\" colspan=\"8\" bgcolor=\"#cccccc\">");
00222             printf ("<b>Surrogate Pairs</b>");
00223             printf ("</td>\n");
00224         } /* otherwise don't print anything more columns in this row */
00225     }
00226     else if (i == 0xe) {
00227         if (j == 0x0) {
00228             printf ("    <td align=\"center\" colspan=\"16\" bgcolor=\"#cccccc\">");
00229             printf ("<b>Private Use Area</b>");
00230             printf ("</td>\n");
00231         } /* otherwise don't print any more columns in this row */
00232     }
00233     else if (i == 0xf) {
00234         if (j == 0x0) {
00235             printf ("    <td align=\"center\" colspan=\"9\" bgcolor=\"#cccccc\">");
00236             printf ("<b>Private Use Area</b>");
00237             printf ("</td>\n");
00238         }
00239     }
00240     }
00241     printf (" </tr>\n");
00242 }
00243 printf ("</table>\n");
00244 printf ("</body>\n");
00245 printf ("</html>\n");
00246
00247 return;
00248 }
```

Index

- add_double_circle
 - unigencircles.c, [320](#)
- add_single_circle
 - unigencircles.c, [322](#)
- addByte
 - hex2otf.c, [81](#)
- addTable
 - hex2otf.c, [87](#)
- allBuffers
 - hex2otf.c, [159](#)
- ASCENDER
 - hex2otf.c, [81](#)
- ascii_bits
 - unifontpic.h, [304](#)
- ascii_hex
 - unifontpic.h, [304](#)
- B0
 - hex2otf.c, [81](#)
- B1
 - hex2otf.c, [81](#)
- begin
 - Buffer, [17](#)
- bitmap
 - Glyph, [20](#)
 - Options, [23](#)
- bits_per_pixel
 - unibmp2hex.c, [215](#)
- BLACK
 - unijohab2html.c, [410](#)
- blankOutline
 - Options, [23](#)
- BLUE
 - unijohab2html.c, [410](#)
- bmp_header
 - unibmp2hex.c, [216](#)
- Buffer, [17](#)
 - begin, [17](#)
 - capacity, [17](#)
 - end, [18](#)
 - hex2otf.c, [84](#)
 - next, [18](#)
- bufferCount
 - hex2otf.c, [159](#)
- buildOutline
 - hex2otf.c, [88](#)
- BX
 - hex2otf.c, [82](#)
- byCodePoint
 - hex2otf.c, [91](#)
- byTableTag
 - hex2otf.c, [91](#)
- byte
 - hex2otf.c, [84](#)
- byteCount
 - Glyph, [21](#)
- cacheBuffer
 - hex2otf.c, [92](#)
- cacheBytes
 - hex2otf.c, [93](#)
- cacheCFFOperand
 - hex2otf.c, [94](#)
- cacheStringAsUTF16BE
 - hex2otf.c, [96](#)
- cacheU16
 - hex2otf.c, [97](#)
- cacheU32
 - hex2otf.c, [99](#)
- cacheU8
 - hex2otf.c, [100](#)
- cacheZeros
 - hex2otf.c, [101](#)
- capacity
 - Buffer, [17](#)
- cff
 - Options, [24](#)
- checksum
 - TableRecord, [29](#)
- CHO_ANCIENT_HEX
 - hangul.h, [35](#)
- cho_end
 - PARAMS, [26](#)
- CHO_EXT_A_HEX
 - hangul.h, [35](#)
- CHO_EXT_A_UNICODE_END
 - hangul.h, [35](#)
- CHO_EXT_A_UNICODE_START
 - hangul.h, [35](#)
- CHO_HEX

- hangul.h, [36](#)
- CHO_LAST_HEX
 - hangul.h, [36](#)
- cho_start
 - PARAMS, [26](#)
- CHO_UNICODE_END
 - hangul.h, [36](#)
- CHO_UNICODE_START
 - hangul.h, [36](#)
- cho_variation
 - hangul.h, [45](#)
 - unihangul-support.c, [341](#)
- CHO_VARIATIONS
 - hangul.h, [36](#)
- cleanBuffers
 - hex2otf.c, [102](#)
- codePoint
 - Glyph, [21](#)
- color_table
 - unibmp2hex.c, [216](#)
- combine_glyphs
 - hangul.h, [48](#)
 - unihangul-support.c, [343](#)
- combined_jamo
 - hangul.h, [49](#)
 - unihangul-support.c, [344](#)
- combining
 - Glyph, [21](#)
- compression
 - unibmp2hex.c, [216](#)
- content
 - Table, [28](#)
- ContourOp
 - hex2otf.c, [85](#)
- DEFAULT_ID0
 - hex2otf.h, [193](#)
- DEFAULT_ID1
 - hex2otf.h, [193](#)
- DEFAULT_ID11
 - hex2otf.h, [194](#)
- DEFAULT_ID13
 - hex2otf.h, [194](#)
- DEFAULT_ID14
 - hex2otf.h, [194](#)
- DEFAULT_ID2
 - hex2otf.h, [194](#)
- DEFAULT_ID5
 - hex2otf.h, [194](#)
- defaultNames
 - hex2otf.h, [195](#)
- defineStore
 - hex2otf.c, [82](#), [103](#)
- DESCENDER
 - hex2otf.c, [82](#)
- end
 - Buffer, [18](#)
- ensureBuffer
 - hex2otf.c, [103](#)
- EXTENDED_HANGUL
 - hangul.h, [37](#)
- fail
 - hex2otf.c, [105](#)
- file_size
 - unibmp2hex.c, [216](#)
- filetype
 - unibmp2hex.c, [216](#)
- FILL_LEFT
 - hex2otf.c, [86](#)
- FILL_RIGHT
 - hex2otf.c, [86](#)
- fillBitmap
 - hex2otf.c, [106](#)
- fillBlankOutline
 - hex2otf.c, [108](#)
- fillCFF
 - hex2otf.c, [110](#)
- fillCmapTable
 - hex2otf.c, [114](#)
- fillGposTable
 - hex2otf.c, [116](#)
- fillGsubTable
 - hex2otf.c, [117](#)
- fillHeadTable
 - hex2otf.c, [118](#)
- fillHheaTable
 - hex2otf.c, [120](#)
- fillHmtxTable
 - hex2otf.c, [122](#)
- fillMaxpTable
 - hex2otf.c, [123](#)
- fillNameTable
 - hex2otf.c, [125](#)
- fillOS2Table
 - hex2otf.c, [127](#)
- fillPostTable
 - hex2otf.c, [129](#)
- FillSide
 - hex2otf.c, [86](#)
- fillTrueType
 - hex2otf.c, [130](#)
- flip
 - unibmp2hex.c, [216](#)
 - unihex2bmp.c, [390](#)
- Font, [18](#)
 - glyphCount, [19](#)
 - glyphs, [19](#)

- maxWidth, [19](#)
 - tables, [19](#)
- forcewide
 - unibmp2hex.c, [216](#)
- freeBuffer
 - hex2otf.c, [133](#)
- FU
 - hex2otf.c, [82](#)
- FUPEM
 - hex2otf.c, [82](#)
- genlongbmp
 - unifontpic.c, [276](#)
- genwidebmp
 - unifontpic.c, [281](#)
- get_bytes
 - unibmpbump.c, [229](#)
- get_hex_range
 - unigen-hangul.c, [309](#)
- gethex
 - unifontpic.c, [286](#)
- Glyph, [20](#)
 - bitmap, [20](#)
 - byteCount, [21](#)
 - codePoint, [21](#)
 - combining, [21](#)
 - hex2otf.c, [84](#)
 - lsb, [21](#)
 - pos, [21](#)
- glyph2bits
 - unifont-support.c, [258](#)
- glyph2string
 - unifont-support.c, [260](#)
- GLYPH_HEIGHT
 - hex2otf.c, [82](#)
- GLYPH_MAX_BYTE_COUNT
 - hex2otf.c, [83](#)
- GLYPH_MAX_WIDTH
 - hex2otf.c, [83](#)
- glyph_overlap
 - hangul.h, [53](#)
 - unihangul-support.c, [348](#)
- glyphCount
 - Font, [19](#)
- glyphs
 - Font, [19](#)
- gpos
 - Options, [24](#)
- GREEN
 - unijohab2html.c, [410](#)
- gsub
 - Options, [24](#)
- hangul.h
 - CHO_ANCIENT_HEX, [35](#)
 - CHO_EXT_A_HEX, [35](#)
 - CHO_EXT_A_UNICODE_END, [35](#)
 - CHO_EXT_A_UNICODE_START, [35](#)
 - CHO_HEX, [36](#)
 - CHO_LAST_HEX, [36](#)
 - CHO_UNICODE_END, [36](#)
 - CHO_UNICODE_START, [36](#)
 - cho_variation, [45](#)
 - CHO_VARIATIONS, [36](#)
 - combine_glyphs, [48](#)
 - combined_jamo, [49](#)
 - EXTENDED_HANGUL, [37](#)
 - glyph_overlap, [53](#)
 - hangul_compose, [54](#)
 - hangul_decompose, [55](#)
 - hangul_hex_indices, [57](#)
 - hangul_read_base16, [59](#)
 - hangul_read_base8, [61](#)
 - hangul_syllable, [62](#)
 - hangul_variations, [64](#)
 - is_wide_vowel, [66](#)
 - JAMO_END, [37](#)
 - JAMO_EXT_A_END, [37](#)
 - JAMO_EXT_A_HEX, [37](#)
 - JAMO_EXT_B_END, [37](#)
 - JAMO_EXT_B_HEX, [38](#)
 - JAMO_HEX, [38](#)
 - JONG_ANCIENT_HEX, [38](#)
 - JONG_EXT_B_HEX, [38](#)
 - JONG_EXT_B_UNICODE_END, [38](#)
 - JONG_EXT_B_UNICODE_START, [39](#)
 - JONG_HEX, [39](#)
 - JONG_LAST_HEX, [39](#)
 - JONG_UNICODE_END, [39](#)
 - JONG_UNICODE_START, [39](#)
 - jong_variation, [68](#)
 - JONG_VARIATIONS, [40](#)
 - JUNG_ANCIENT_HEX, [40](#)
 - JUNG_EXT_B_HEX, [40](#)
 - JUNG_EXT_B_UNICODE_END, [40](#)
 - JUNG_EXT_B_UNICODE_START, [40](#)
 - JUNG_HEX, [41](#)
 - JUNG_LAST_HEX, [41](#)
 - JUNG_UNICODE_END, [41](#)
 - JUNG_UNICODE_START, [41](#)
 - jung_variation, [69](#)
 - JUNG_VARIATIONS, [41](#)
 - MAX_GLYPHS, [42](#)
 - MAXLINE, [42](#)
 - NCHO_ANCIENT, [42](#)
 - NCHO_EXT_A, [42](#)
 - NCHO_EXT_A_RSRVD, [42](#)
 - NCHO_MODERN, [43](#)
 - NJONG_ANCIENT, [43](#)

- NJONG_EXTB, [43](#)
- NJONG_EXTB_RSRVD, [43](#)
- NJONG_MODERN, [43](#)
- NJUNG_ANCIENT, [44](#)
- NJUNG_EXTB, [44](#)
- NJUNG_EXTB_RSRVD, [44](#)
- NJUNG_MODERN, [44](#)
- one_jamo, [70](#)
- print_glyph_hex, [71](#)
- print_glyph_txt, [72](#)
- PUA_END, [44](#)
- PUA_START, [45](#)
- TOTAL_CHO, [45](#)
- TOTAL_JONG, [45](#)
- TOTAL_JUNG, [45](#)
- hangul_compose
 - hangul.h, [54](#)
 - unihangul-support.c, [349](#)
- hangul_decompose
 - hangul.h, [55](#)
 - unihangul-support.c, [350](#)
- hangul_hex_indices
 - hangul.h, [57](#)
 - unihangul-support.c, [352](#)
- hangul_read_base16
 - hangul.h, [59](#)
 - unihangul-support.c, [354](#)
- hangul_read_base8
 - hangul.h, [61](#)
 - unihangul-support.c, [356](#)
- hangul_syllable
 - hangul.h, [62](#)
 - unihangul-support.c, [357](#)
- hangul_variations
 - hangul.h, [64](#)
 - unihangul-support.c, [359](#)
- HDR_LEN
 - unifontpic.c, [276](#)
- HEADER_STRING
 - unifontpic.h, [304](#)
- height
 - unibmp2hex.c, [216](#)
- hex
 - Options, [24](#)
 - unihex2bmp.c, [390](#)
- hex2bit
 - unihex2bmp.c, [382](#)
- hex2otf.c
 - addByte, [81](#)
 - addTable, [87](#)
 - allBuffers, [159](#)
 - ASCENDER, [81](#)
 - B0, [81](#)
 - B1, [81](#)
 - Buffer, [84](#)
 - bufferCount, [159](#)
 - buildOutline, [88](#)
 - BX, [82](#)
 - byCodePoint, [91](#)
 - byTableTag, [91](#)
 - byte, [84](#)
 - cacheBuffer, [92](#)
 - cacheBytes, [93](#)
 - cacheCFFOperand, [94](#)
 - cacheStringAsUTF16BE, [96](#)
 - cacheU16, [97](#)
 - cacheU32, [99](#)
 - cacheU8, [100](#)
 - cacheZeros, [101](#)
 - cleanBuffers, [102](#)
 - ContourOp, [85](#)
 - defineStore, [82](#), [103](#)
 - DESCENDER, [82](#)
 - ensureBuffer, [103](#)
 - fail, [105](#)
 - FILL_LEFT, [86](#)
 - FILL_RIGHT, [86](#)
 - fillBitmap, [106](#)
 - fillBlankOutline, [108](#)
 - fillCFF, [110](#)
 - fillCmapTable, [114](#)
 - fillGposTable, [116](#)
 - fillGsubTable, [117](#)
 - fillHeadTable, [118](#)
 - fillHheaTable, [120](#)
 - fillHmtxTable, [122](#)
 - fillMaxpTable, [123](#)
 - fillNameTable, [125](#)
 - fillOS2Table, [127](#)
 - fillPostTable, [129](#)
 - FillSide, [86](#)
 - fillTrueType, [130](#)
 - freeBuffer, [133](#)
 - FU, [82](#)
 - FUPEM, [82](#)
 - Glyph, [84](#)
 - GLYPH_HEIGHT, [82](#)
 - GLYPH_MAX_BYTE_COUNT, [83](#)
 - GLYPH_MAX_WIDTH, [83](#)
 - initBuffers, [133](#)
 - LOCA_OFFSET16, [86](#)
 - LOCA_OFFSET32, [87](#)
 - LocaFormat, [86](#)
 - main, [134](#)
 - matchToken, [136](#)
 - MAX_GLYPHS, [83](#)
 - MAX_NAME_IDS, [83](#)
 - NameStrings, [84](#)

- newBuffer, 137
- nextBufferIndex, 159
- OP_CLOSE, 85
- OP_POINT, 85
- Options, 84
- organizeTables, 140
- parseOptions, 141
- pixels_t, 85
- positionGlyphs, 144
- prepareOffsets, 146
- prepareStringIndex, 147
- PRI_CP, 83
- printHelp, 148
- printVersion, 149
- PW, 83
- readCodePoint, 149
- readGlyphs, 150
- sortGlyphs, 152
- static_assert, 83
- Table, 85
- U16MAX, 84
- U32MAX, 84
- VERSION, 84
- writeBytes, 153
- writeFont, 154
- writeU16, 157
- writeU32, 158
- hex2otf.h
 - DEFAULT_ID0, 193
 - DEFAULT_ID1, 193
 - DEFAULT_ID11, 194
 - DEFAULT_ID13, 194
 - DEFAULT_ID14, 194
 - DEFAULT_ID2, 194
 - DEFAULT_ID5, 194
 - defaultNames, 195
 - NAMEPAIR, 194
 - UNIFONT_VERSION, 194
- hexbits
 - unihex2bmp.c, 390
- hexdigit
 - unibmp2hex.c, 216
 - unifontpic.h, 304
 - unihexgen.c, 403
- hexpose
 - unifont-support.c, 261
- hexprint4
 - unihexgen.c, 399
- hexprint6
 - unihexgen.c, 400
- id
 - NamePair, 22
- image_offset
 - unibmp2hex.c, 217
- image_size
 - unibmp2hex.c, 217
- important_colors
 - unibmp2hex.c, 217
- info_size
 - unibmp2hex.c, 217
- infp
 - PARAMS, 26
- init
 - unihex2bmp.c, 383
- initBuffers
 - hex2otf.c, 133
- is_wide_vowel
 - hangul.h, 66
 - unihangul-support.c, 361
- JAMO_END
 - hangul.h, 37
- JAMO_EXT_A_END
 - hangul.h, 37
- JAMO_EXT_A_HEX
 - hangul.h, 37
- JAMO_EXT_B_END
 - hangul.h, 37
- JAMO_EXT_B_HEX
 - hangul.h, 38
- JAMO_HEX
 - hangul.h, 38
- johab2syllables.c
 - main, 197
 - print_help, 199
- JONG_ANCIENT_HEX
 - hangul.h, 38
- jong_end
 - PARAMS, 26
- JONG_EXT_B_HEX
 - hangul.h, 38
- JONG_EXT_B_UNICODE_END
 - hangul.h, 38
- JONG_EXT_B_UNICODE_START
 - hangul.h, 39
- JONG_HEX
 - hangul.h, 39
- JONG_LAST_HEX
 - hangul.h, 39
- jong_start
 - PARAMS, 26
- JONG_UNICODE_END
 - hangul.h, 39
- JONG_UNICODE_START
 - hangul.h, 39
- jong_variation
 - hangul.h, 68

- unihangul-support.c, [363](#)
- JONG_VARIATIONS
 - hangul.h, [40](#)
- JUNG_ANCIENT_HEX
 - hangul.h, [40](#)
- PARAMS, [26](#)
- JUNG_EXTB_HEX
 - hangul.h, [40](#)
- JUNG_EXTB_UNICODE_END
 - hangul.h, [40](#)
- JUNG_EXTB_UNICODE_START
 - hangul.h, [40](#)
- JUNG_HEX
 - hangul.h, [41](#)
- JUNG_LAST_HEX
 - hangul.h, [41](#)
- PARAMS, [27](#)
- JUNG_UNICODE_END
 - hangul.h, [41](#)
- JUNG_UNICODE_START
 - hangul.h, [41](#)
- hangul.h, [69](#)
 - unihangul-support.c, [364](#)
- JUNG_VARIATIONS
 - hangul.h, [41](#)
- length
 - TableRecord, [29](#)
- LOCA_OFFSET16
 - hex2otf.c, [86](#)
- LOCA_OFFSET32
 - hex2otf.c, [87](#)
- LocaFormat
 - hex2otf.c, [86](#)
- lsb
 - Glyph, [21](#)
- main
 - hex2otf.c, [134](#)
 - johab2syllables.c, [197](#)
 - unibdf2hex.c, [203](#)
 - unibmp2hex.c, [208](#)
 - unibmpbump.c, [230](#)
 - unicoverage.c, [245](#)
 - unidup.c, [256](#)
 - unifont1per.c, [271](#)
 - unifontpic.c, [288](#)
 - unigen-hangul.c, [309](#)
 - unigencircles.c, [323](#)
 - unigenwidth.c, [330](#)
 - unihex2bmp.c, [386](#)
 - unihexgen.c, [401](#)
 - unijohab2html.c, [411](#)
 - unipagecount.c, [429](#)
- matchToken
 - hex2otf.c, [136](#)
- MAX_COMPRESSION_METHOD
 - unibmpbump.c, [228](#)
- MAX_GLYPHS
 - hangul.h, [42](#)
 - hex2otf.c, [83](#)
- MAX_NAME_IDS
 - hex2otf.c, [83](#)
- MAXBUF
 - unibdf2hex.c, [203](#)
 - unibmp2hex.c, [207](#)
 - unicoverage.c, [245](#)
 - unidup.c, [255](#)
 - unihex2bmp.c, [382](#)
 - unipagecount.c, [429](#)
- MAXFILENAME
 - unifont1per.c, [270](#)
 - unijohab2html.c, [410](#)
- MAXLINE
 - hangul.h, [42](#)
- MAXSTRING
 - unifont1per.c, [271](#)
 - unifontpic.h, [304](#)
 - unigencircles.c, [320](#)
 - unigenwidth.c, [330](#)
- maxWidth
 - Font, [19](#)
- mkftable
 - unipagecount.c, [431](#)
- NAMEPAIR
 - hex2otf.h, [194](#)
- NamePair, [22](#)
 - id, [22](#)
 - str, [22](#)
- NameStrings
 - hex2otf.c, [84](#)
- nameStrings
 - Options, [24](#)
- NCHO_ANCIENT
 - hangul.h, [42](#)
- NCHO_EXT_A
 - hangul.h, [42](#)
- NCHO_EXT_A_RSRVD
 - hangul.h, [42](#)
- NCHO_MODERN
 - hangul.h, [43](#)
- ncolors
 - unibmp2hex.c, [217](#)
- newBuffer
 - hex2otf.c, [137](#)

- next
 - Buffer, [18](#)
- nextBufferIndex
 - hex2otf.c, [159](#)
- nextrange
 - unicoverage.c, [248](#)
- NJONG_ANCIENT
 - hangul.h, [43](#)
- NJONG_EXTB
 - hangul.h, [43](#)
- NJONG_EXTB_RSRVD
 - hangul.h, [43](#)
- NJONG_MODERN
 - hangul.h, [43](#)
- NJUNG_ANCIENT
 - hangul.h, [44](#)
- NJUNG_EXTB
 - hangul.h, [44](#)
- NJUNG_EXTB_RSRVD
 - hangul.h, [44](#)
- NJUNG_MODERN
 - hangul.h, [44](#)
- nplanes
 - unibmp2hex.c, [217](#)
- offset
 - TableRecord, [29](#)
- one_jamo
 - hangul.h, [70](#)
 - unihangul-support.c, [365](#)
- OP_CLOSE
 - hex2otf.c, [85](#)
- OP_POINT
 - hex2otf.c, [85](#)
- Options, [23](#)
 - bitmap, [23](#)
 - blankOutline, [23](#)
 - cff, [24](#)
 - gpos, [24](#)
 - gsub, [24](#)
 - hex, [24](#)
 - hex2otf.c, [84](#)
 - nameStrings, [24](#)
 - out, [24](#)
 - pos, [25](#)
 - truetype, [25](#)
- organizeTables
 - hex2otf.c, [140](#)
- out
 - Options, [24](#)
- outfp
 - PARAMS, [27](#)
- output2
 - unifontpic.c, [290](#)
- output4
 - unifontpic.c, [291](#)
- PARAMS, [25](#)
 - cho_end, [26](#)
 - cho_start, [26](#)
 - infp, [26](#)
 - jong_end, [26](#)
 - jong_start, [26](#)
 - jung_end, [26](#)
 - jung_start, [27](#)
 - outfp, [27](#)
 - starting_codept, [27](#)
- parse_args
 - unigen-hangul.c, [311](#)
 - unijohab2html.c, [417](#)
- parse_hex
 - unifont-support.c, [263](#)
- parseOptions
 - hex2otf.c, [141](#)
- PIKTO_END
 - unigenwidth.c, [330](#)
- PIKTO_SIZE
 - unigenwidth.c, [330](#)
- PIKTO_START
 - unigenwidth.c, [330](#)
- pixels_t
 - hex2otf.c, [85](#)
- planeset
 - unibmp2hex.c, [217](#)
- pos
 - Glyph, [21](#)
 - Options, [25](#)
- positionGlyphs
 - hex2otf.c, [144](#)
- prepareOffsets
 - hex2otf.c, [146](#)
- prepareStringIndex
 - hex2otf.c, [147](#)
- PRI_CP
 - hex2otf.c, [83](#)
- print_glyph_hex
 - hangul.h, [71](#)
 - unihangul-support.c, [366](#)
- print_glyph_txt
 - hangul.h, [72](#)
 - unihangul-support.c, [367](#)
- print_help
 - johab2syllables.c, [199](#)
- print_subtotal
 - unicoverage.c, [250](#)
- printHelp
 - hex2otf.c, [148](#)
- printVersion

- hex2otf.c, [149](#)
- PUA_END
 - hangul.h, [44](#)
- PUA_START
 - hangul.h, [45](#)
- PW
 - hex2otf.c, [83](#)
- readCodePoint
 - hex2otf.c, [149](#)
- readGlyphs
 - hex2otf.c, [150](#)
- RED
 - unijohab2html.c, [410](#)
- regrid
 - unibmpbump.c, [235](#)
- sortGlyphs
 - hex2otf.c, [152](#)
- src/hangul.h, [31](#), [74](#)
- src/hex2otf.c, [76](#), [159](#)
- src/hex2otf.h, [192](#), [195](#)
- src/johab2syllables.c, [196](#), [200](#)
- src/unibdf2hex.c, [202](#), [205](#)
- src/unibmp2hex.c, [206](#), [218](#)
- src/unibmpbump.c, [227](#), [237](#)
- src/unicoverage.c, [244](#), [251](#)
- src/unidup.c, [254](#), [257](#)
- src/unifont-support.c, [258](#), [266](#)
- src/unifont1per.c, [270](#), [272](#)
- src/unifontpic.c, [275](#), [292](#)
- src/unifontpic.h, [303](#), [305](#)
- src/unigen-hangul.c, [308](#), [314](#)
- src/unigencircles.c, [319](#), [325](#)
- src/unigenwidth.c, [329](#), [335](#)
- src/unihangul-support.c, [339](#), [369](#)
- src/unihex2bmp.c, [380](#), [391](#)
- src/unihexgen.c, [397](#), [403](#)
- src/unihexpose.c, [407](#)
- src/unijohab2html.c, [408](#), [419](#)
- src/unipagecount.c, [427](#), [433](#)
- START_JUNG
 - unijohab2html.c, [410](#)
- starting_codept
 - PARAMS, [27](#)
- static_assert
 - hex2otf.c, [83](#)
- str
 - NamePair, [22](#)
- Table, [27](#)
 - content, [28](#)
 - hex2otf.c, [85](#)
 - tag, [28](#)
- TableRecord, [28](#)
- checksum, [29](#)
- length, [29](#)
- offset, [29](#)
- tag, [29](#)
- tables
 - Font, [19](#)
- tag
 - Table, [28](#)
 - TableRecord, [29](#)
- TOTAL_CHO
 - hangul.h, [45](#)
- TOTAL_JONG
 - hangul.h, [45](#)
- TOTAL_JUNG
 - hangul.h, [45](#)
- truetype
 - Options, [25](#)
- U16MAX
 - hex2otf.c, [84](#)
- U32MAX
 - hex2otf.c, [84](#)
- unibdf2hex.c
 - main, [203](#)
 - MAXBUF, [203](#)
 - UNISTART, [203](#)
 - UNISTOP, [203](#)
- unibmp2hex.c
 - bits_per_pixel, [215](#)
 - bmp_header, [216](#)
 - color_table, [216](#)
 - compression, [216](#)
 - file_size, [216](#)
 - filetype, [216](#)
 - flip, [216](#)
 - forcewide, [216](#)
 - height, [216](#)
 - hexdigit, [216](#)
 - image_offset, [217](#)
 - image_size, [217](#)
 - important_colors, [217](#)
 - info_size, [217](#)
 - main, [208](#)
 - MAXBUF, [207](#)
 - ncolors, [217](#)
 - nplanes, [217](#)
 - planeset, [217](#)
 - unidigit, [217](#)
 - uniplane, [217](#)
 - width, [218](#)
 - x_ppm, [218](#)
 - y_ppm, [218](#)
- unibmpbump.c
 - get_bytes, [229](#)

- main, [230](#)
- MAX_COMPRESSION_METHOD, [228](#)
- regrid, [235](#)
- VERSION, [229](#)
- unicoverage.c
 - main, [245](#)
 - MAXBUF, [245](#)
 - nextrange, [248](#)
 - print_subtotal, [250](#)
- unidigit
 - unibmp2hex.c, [217](#)
- unidup.c
 - main, [256](#)
 - MAXBUF, [255](#)
- unifont-support.c
 - glyph2bits, [258](#)
 - glyph2string, [260](#)
 - hexpose, [261](#)
 - parse_hex, [263](#)
 - xglyph2string, [264](#)
- unifont1per.c
 - main, [271](#)
 - MAXFILENAME, [270](#)
 - MAXSTRING, [271](#)
- UNIFONT_VERSION
 - hex2otf.h, [194](#)
- unifontpic.c
 - genlongbmp, [276](#)
 - genwidebmp, [281](#)
 - gethex, [286](#)
 - HDR_LEN, [276](#)
 - main, [288](#)
 - output2, [290](#)
 - output4, [291](#)
- unifontpic.h
 - ascii_bits, [304](#)
 - ascii_hex, [304](#)
 - HEADER_STRING, [304](#)
 - hexdigit, [304](#)
 - MAXSTRING, [304](#)
- unigen-hangul.c
 - get_hex_range, [309](#)
 - main, [309](#)
 - parse_args, [311](#)
- unigencircles.c
 - add_double_circle, [320](#)
 - add_single_circle, [322](#)
 - main, [323](#)
 - MAXSTRING, [320](#)
- unigenwidth.c
 - main, [330](#)
 - MAXSTRING, [330](#)
 - PIKTO_END, [330](#)
 - PIKTO_SIZE, [330](#)
 - PIKTO_START, [330](#)
- unihangul-support.c
 - cho_variation, [341](#)
 - combine_glyphs, [343](#)
 - combined_jamo, [344](#)
 - glyph_overlap, [348](#)
 - hangul_compose, [349](#)
 - hangul_decompose, [350](#)
 - hangul_hex_indices, [352](#)
 - hangul_read_base16, [354](#)
 - hangul_read_base8, [356](#)
 - hangul_syllable, [357](#)
 - hangul_variations, [359](#)
 - is_wide_vowel, [361](#)
 - jong_variation, [363](#)
 - jung_variation, [364](#)
 - one_jamo, [365](#)
 - print_glyph_hex, [366](#)
 - print_glyph_txt, [367](#)
- unihex2bmp.c
 - flip, [390](#)
 - hex, [390](#)
 - hex2bit, [382](#)
 - hexbits, [390](#)
 - init, [383](#)
 - main, [386](#)
 - MAXBUF, [382](#)
 - unipage, [391](#)
- unihexgen.c
 - hexdigit, [403](#)
 - hexprint4, [399](#)
 - hexprint6, [400](#)
 - main, [401](#)
- unijohab2html.c
 - BLACK, [410](#)
 - BLUE, [410](#)
 - GREEN, [410](#)
 - main, [411](#)
 - MAXFILENAME, [410](#)
 - parse_args, [417](#)
 - RED, [410](#)
 - START_JUNG, [410](#)
 - WHITE, [411](#)
- unipage
 - unihex2bmp.c, [391](#)
- unipagecount.c
 - main, [429](#)
 - MAXBUF, [429](#)
 - mkftable, [431](#)
- uniplane
 - unibmp2hex.c, [217](#)
- UNISTART
 - unibdf2hex.c, [203](#)
- UNISTOP

unibdf2hex.c, [203](#)

VERSION

hex2otf.c, [84](#)

unibmpbump.c, [229](#)

WHITE

unijohab2html.c, [411](#)

width

unibmp2hex.c, [218](#)

writeBytes

hex2otf.c, [153](#)

writeFont

hex2otf.c, [154](#)

writeU16

hex2otf.c, [157](#)

writeU32

hex2otf.c, [158](#)

x_ppm

unibmp2hex.c, [218](#)

xglyph2string

unifont-support.c, [264](#)

y_ppm

unibmp2hex.c, [218](#)