

Date: 22 January 1999

To: Unicode Technical Committee
ISO/IEC JTC1/SC2/WG2

From: Barbara Beeton
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Subject: Addendum to L2/98-405: Request for assignment of codes to mathematical and technical symbols

References: L2/98-405, Request for assignment of codes to mathematical and technical symbols that do not appear in Unicode 2.0 or ISO/IEC 10646
L2/98-406, Proposal to encode mathematical variant tags

1 Action items resulting from the UTC meeting of December 1–3, 1998

Three action items were assigned at the December meeting:

36. Investigate “member of set” variants.
37. Indicate the composability of characters in revised proposal.
38. Identify possible typographic variants in revised proposal.

1.1 Action item 36, “member of set” variants

Ken Whistler has unearthed the information needed to clear this up. Documentation associated with the original assignments to U+220A and U+220D includes the names of SGML entities associated with the characters. Ken couldn’t identify the original document, but I suspect that it was either the public entities annex to ISO 8879, the SGML standard, or ISO TR 9573, Techniques for Using SGML. I worked with Charles Goldfarb to make sure the math symbols associated with T_EX were adequately covered in the SGML entity sets, and I recognize the entity names:

- `epsis` (U+220A) is the straight-backed epsilon.
- `bepsi` (U+220D) is the backwards straight-backed epsilon.

I have communicated this information to Ken, and he is making changes to the Unicode database to correct the information there. I believe that he will arrange for the shapes associated with these codes to be changed to reflect their originally intended purpose.

This removes from the list in document L2/98-405 the symbols identified as 6X00 and 2X0C.

1.2 Action items 37 and 38, composability and typographic variants

I have taken these two together.

The action items call for revision of the proposals; however, there are still some unanswered questions, and the two UTC members who have been advising me (Murray Sargent and Ken Whistler) have advocated somewhat different approaches, so I have chosen instead to prepare this addendum to the proposals indicating how I propose to revise them. In view of my understanding that the February UTC meeting will largely be taken up with preparations for Unicode version 3, I am not expecting final action on the math symbol proposals at that meeting; I do expect more questions, however, and will include answers to those in a complete revision of L2/98-405 for the June UTC meeting.

2 Addendum to L2/98-406: Proposed mathematical typographic variants

Alphabetic variants Alphabetic variants apply mainly to alphabetic characters, but may also apply to other symbols under some circumstances.

MV00 math upright (lightface)
 MV01 math italic
 MV02 math bold
 MV03 math bold italic
 MV04 math calligraphic (script)
 MV05 math bold calligraphic (script)
 MV06 math fraktur
 MV07 math open-face
 MV08 math open-face italic
 MV09 math sans serif
 MVOA math sans serif italic
 MVOB math sans serif bold
 MVOC math sans serif bold italic
 MVOD math monospace

Size variants Only one size variant is proposed. Its purpose is to transform a relation into an operator, which is indicated visually by an increase in size (as well as a change in location in a math expression). The requirement can be documented from existing mathematical literature.

MV10 math large (operator; normal size is a relation)

Shape/orientation variants The purpose of these variants is to add common modifiers to base symbols, or to modify the shape or orientation of existing elements of compound symbols.

MV11 math negation, oblique (default)
 [U+0337 and/or U+0338 might serve, but it seems preferable to have a unique combination and leave the size questions to the font/glyph resolution]
 MV12 math negation, upright
 [U+20D2 and/or U+20D3, similarly to <MV11>]

- MV13 combining single equals
(default; horizontal rule below a character of equal width)
- MV14 combining double equals below
- MV15 combining single equals above
- MV16 combining double equals above
- MV17 slant/conforming equals (modifies existing equals)
- MV18 equals doubler (modifies existing equals)

3 Addendum to L2/98-405: Proposed symbols composable from subelements

In the following lists, several different types of decomposition may be indicated:

- base symbol plus math variant(s) as proposed in the Addendum to L2/98-406
- base symbol plus Unicode diacritic(s)
- multiple instances of a repeated symbol
- multiple Unicode diacritics

For some symbols which may be decomposed in more than one way, by additive application of math variants, a second decomposition is indicated.

The lists are compressed from the lists in the original proposal. Meanings/descriptions are excluded, as are the codes for most characters not considered to be composable; ellipses are inserted where codes have been omitted.

In addition to composable symbols, any symbol from the original proposal for which a satisfactory existing Unicode has been identified is listed, with the notation “[remove]”.

The subelement “combining triangle” does not now exist in Unicode, but a proposal for one was submitted to the December UTC meeting; it is assumed here that that proposal will be accepted.

Block 6X, Alphabets

```

6X00 ==> U+220A      [remove]
...
6X02 ==> U+03DD      [remove]
6X03 ==> U+03DB      [remove]
6X04 ==> U+03DF      [remove]
6X05 ==> U+03E1      [remove]

6X10 ==> U+0066 + <MV01>
...
6X13 ==> U+004C + <MV09>
...

```

6X16 ==> U+0053 + <MV09>
6X17

6X20 ==> U+0030 + <MV07>
6X21 ==> U+0031 + <MV07>
* 6X22 ==> U+0044 + <MV08>
 U+0044 + <MV01> + <MV07>
* 6X23 ==> U+0064 + <MV08>
 U+0064 + <MV01> + <MV07>
* 6X24 ==> U+0065 + <MV08>
 U+0065 + <MV01> + <MV07>
* 6X25 ==> U+0069 + <MV08>
 U+0069 + <MV01> + <MV07>
6X26 ==> U+006A + <MV08>
 U+006A + <MV01> + <MV07>
6X27 ==> U+03B3 + <MV07>
6X28 ==> U+03C0 + <MV07>
6X29 ==> U+2211 + <MV07>

* Neil Soiffer requested that these be coded as distinct characters because they're used heavily in symbolic algebra.

6X30..6X49 ==> U+0041..005A + <MV07>
6X50..6X69 ==> U+0061..007A + <MV07>
6X70..6X89 ==> U+0041..005A + <MV04>
6X90..6XA9 ==> U+0061..007A + <MV04>
6XB0..6XC9 ==> U+0041..005A + <MV06>
6XD0..6XE9 ==> U+0061..007A + <MV06>

Block 1X0, Arrows

1X00
...
1X05 ==> U+21D4 [remove]
...
1X31 ==> 1X30 + <MV11>
1X32 ==> U+219D + <MV11>
...
1X6C

Block 1X7, Combinations with arrows

No changes

Block 1X8, Fishtails

No changes

Block 2X0, Membership

```

2X00
...
2X03 ==> U+2208 + U+0307
2X04 ==> U+2208 + U+0332
2X05 ==> U+220A + <MV11>
2X06 ==> U+2208 + <MV12>
2X07 ==> U+220A + U+0305
2X08 ==> U+2208 + U+0305
2X09 ==> 2X03 + <MV11>
        U+2208 + U+0307 + <MV11>
...
2X0B ==> 2X0A + <MV11>
2X0C ==> 220D [remove]
...
2X10 ==> 220D + <MV11>
2X11 ==> 220D + U+0305
2X12 ==> 220B + U+0305

```

Block 2X2, Large operators

```

2X20 ==> U+2299 + <MV10>
2X21 ==> U+2295 + <MV10>
2X22 ==> U+2297 + <MV10>
2X23 ==> U+228D + <MV10>
2X24 ==> U+228E + <MV10>
2X25 ==> U+2293 + <MV10>
2X26 ==> U+2294 + <MV10>
2X27 ==> 2X78 + <MV10>
2X28 ==> 2X77 + <MV10>
2X29 ==> U+00D7 + <MV10>
...
2X2B ==> U+222B + U+222B + U+222B + U+222B
...
2X3A ==> U+222B + U+0305
2X3B ==> U+222B + U+0332
2X3C ==> U+22C8 + <MV10>
2X3D ==> U+25C1 + <MV10>

```

Block 2X4, Binary operators

2X40 ==> U+002B + U+030A
 2X41 ==> U+002B + U+0302
 2X42 ==> U+002B + U+0303
 2X43 ==> U+002B + U+0323
 2X44 ==> U+002B + U+0330
 ...
 2X47 ==> U+2212 + U+0313
 2X48 ==> U+2212 + U+0323
 ...
 2X4B ==> U+00D7 + <MV02>
 2X4C
 2X4D ==> U+00D7 + U+0332
 ...
 2X52 ==> U+2297 + U+0302
 ...
 2X55 ==> U+00F7 + U+20DD
 2X56 ==> U+002B + <combining triangle>
 2X57 ==> U+2212 + <combining triangle>
 2X58 ==> U+00D7 + <combining triangle>
 ...
 2X5A ==> U+005C [remove]

 2X60
 ...
 2X62 ==> U+222A + U+0305
 2X63 ==> U+2229 + U+0305
 ...
 2X7D ==> U+2228 + U+0336
 2X7E ==> U+2227 + U+0336
 2X7F ==> U+2227 + U+033F
 2X80 ==> U+2227 + U+0332
 2X81 ==> U+2304 + U+0332
 2X82 ==> U+2228 + U+0333

Block 3X0, Relations: equal, similar, inequalities

3X00 ==> U+003D + U+0307
 3X01 ==> U+2250 + <MV11>
 U+003D + U+0307 + <MV11>
 ...
 3X04 ==> U+223C + U+0307
 3X05 ==> U+2242 + <MV11>
 3X06 ==> U+224B + <MV11>
 3X07 ==> U+2245 + U+0307
 3X08 ==> 3X07 + <MV11>

U+2245 + U+0307 + <MV11>
 3X09 ==> U+223D + <MV14>
 3X0A ==> U+2248 + U+0302
 3X0B ==> U+2248 + <MV14>
 3X0C ==> 3X0B + <MV11>
 U+2248 + <MV14> + <MV11>
 3X0D ==> U+002B + <MV16>
 3X0E ==> U+002B + <MV14>
 3X0F ==> U+223C + <MV16>
 ...
 3X12 ==> U+003D + U+0308 + U+0324
 3X13 ==> U+2261 + U+20DC
 ...
 3X18 ==> U+2264 + <MV17>
 3X19 ==> U+2265 + <MV17>
 3X1A ==> U+22D6 + <MV13> + <MV17>
 3X1B ==> U+22D7 + <MV13> + <MV17>
 3X1C ==> 3X18 + U+0307
 3X1D ==> 3X19 + U+0307
 ...
 3X26 ==> U+2264 + <MV11>
 3X27 ==> U+2265 + <MV11>
 3X28 ==> U+2266 + <MV11>
 3X29 ==> U+2267 + <MV11>
 3X2A ==> U+22DA + <MV17>
 3X2B ==> U+22DB + <MV17>
 3X2C ==> U+22DA + <MV18>
 3X2D ==> U+22DB + <MV18>
 3X2E ==> U+2272 + <MV13>
 3X2F ==> U+2273 + <MV13>
 ...
 3X32 ==> U+2276 + <MV14>
 3X33 ==> U+2277 + <MV14>
 ...
 3X36 ==> U+22DC + <MV17>
 3X37 ==> U+22DD + <MV17>
 3X38 ==> U+22D6 + <MV15> + <MV17>
 3X39 ==> U+22D7 + <MV15> + <MV17>
 ...
 3X3C ==> 3X3A + <MV14>
 3X3D ==> 3X3B + <MV14>
 ...
 3X42 ==> 3X40 + <MV13>
 3X43 ==> 3X40 + <MV11>
 3X44 ==> 3X41 + <MV11>
 3X45 ==> U+226A + <MV11>
 3X46 ==> U+226B + <MV11>
 3X47 ==> U+22D8 + <MV11>

3X48 ==> U+22D9 + <MV11>
 ...
 3X4D ==> 3X4B + <MV13> + <MV17>
 3X4E ==> 3X4C + <MV13> + <MV17>
 ...
 3X52 ==> 3X50 + <MV13>
 3X53 ==> 3X51 + <MV13>
 3X54 ==> 3X50 + <MV13> + <MV17>
 3X55 ==> 3X51 + <MV13> + <MV17>
 3X56 ==> U+224E + <MV11>
 3X57 ==> U+224F + <MV11>
 3X58 ==> U+224F + <MV18>

Block 3X6, Relations: precede, succeed

3X60 ==> U+227B + <MV13>
 3X61 ==> U+227A + <MV13>
 3X62 ==> U+227A + <MV14>
 3X63 ==> U+227B + <MV14>
 ...
 3X6A ==> 3X61 + <MV11>
 3X6B ==> 3X60 + <MV11>
 3X6C ==> U+227E + <MV11>
 3X6D ==> U+227F + <MV11>
 ...
 3X6F

Block 3X7, Relations: subset, superset

3X70
 ...
 3X76 ==> U+2286 + U+0307
 3X77 ==> U+2287 + U+0307
 3X78 ==> U+2286 + <MV18>
 3X79 ==> U+2287 + <MV18>
 ...
 3X82 ==> U+2288 + <MV18>
 3X83 ==> U+2289 + <MV18>
 3X84 ==> U+228F + <MV11>
 3X85 ==> U+2290 + <MV11>
 ...
 3X88 ==> 3X86 + <MV13>
 3X89 ==> 3X87 + <MV13>
 ...
 3X8F

Block 3X9, Relations: forks

No changes

Block 4X0, Turnstiles

No changes

Block 4X1, Delimiters

4X10 ==>	U+007C	[remove]
4X11 ==>	U+007C	[remove]
4X12 ==>	U+2016	[remove]
4X13 ==>	U+2016	[remove]
4X14		
4X15 ==>	U+3018	[remove]
4X16 ==>	U+3019	[remove]
4X17 ==>	U+301A	[remove]
4X18 ==>	U+301B	[remove]
...		
4X29 ==>	U+2222	[remove]
...		
4X2C		
4X30 ==>	U+FE35	[remove]
4X31 ==>	U+FE36	[remove]
...		
4X34 ==>	U+FE37	[remove]
4X35 ==>	U+FE38	[remove]

Block 4X4, Vertical non-delimiters

4X40		
...		
* 4X47 ==>	4X14	[remove]
...		
4X4B		

* Current practice, per Ken Whistler, is to distinguish between delimiters and other symbols with the same shape; if that principle holds, this symbol (triple vertical) should not be removed.

Block 4X9, Angles

4X50		
...		

4X56 ==> U+2220 + <MV13>
 4X57 ==> 4X55 + <MV13>
 4X58 ==> U+2220 + <MV12>
 ...
 4X67

Block 5X0, Empty set, circles, squares, triangles

5X00
 5X01 ==> U+2205 + U+0305
 ...
 5X05 ==> U+25CB + U+0336
 5X06 ==> U+003D + U+20DD
 5X07 ==> U+233D [remove]
 5X08 ==> U+2223 + U+20DD
 5X09 ==> U+2225 + U+20DD
 5X0A ==> U+2216 + U+20DD
 ...
 5X10 ==> U+2218 + U+20DD
 5X11 ==> U+2219 + U+20DD
 ...
 5X16 ==> U+2571 + U+20DE
 5X17 ==> U+2572 + U+20DE
 5X18 ==> U+2217 + U+20DE
 5X19 ==> U+2218 + U+20DE
 ...
 5X20 ==> U+25B3 + U+0307
 5X21 ==> U+25B3 + U+0332
 5X22 ==> U+0073 + <combining triangle>
 ...
 5X24 ==> U+22B4 + <MV12>
 5X25 ==> U+22B5 + <MV12>
 ...
 5X29 ==> 5X27 + <MV11>
 5X2A ==> 5X28 + <MV11>

Block 5X3, Bowtie, hourglass

No changes

Block 5X4, Miscellaneous relations

5X40
 ...
 5X42 ==> 5X41 + <MV13>
 5X43 ==> U+223E + <MV14>

...
 5X4D ==> 5X4C + U+0303
 ...
 5X4F

Block 7X0, Embellishments, diacritics, combining symbols

7X00
 7X01 ==> U+2032 + U+2032 + U+2032 + U+2032
 7X02 ==> U+0302 + U+0302
 7X03 ==> U+0303 + U+0303
 7X04 ==> U+0307 + U+0302
 7X05 ==> U+0304 + U+0308
 7X06 ==> U+0304 + U+0303
 ...
 7X08 ==> U+0332 + U+0332 + U+0332
 7X09 ==> U+0332 + U+0332 + U+0332 + U+0332
 7X0A ==> U+0331 + U+0330
 7X0B ==> U+0330 + U+0331
 7X0C

Block 7X1, Punctuation and similar

7X10
 ...
 7X16 ==> U+2215 + <MV10>
 7X17 ==> U+005C + <MV10>
 7X18 ==> U+2572 [remove]
 7X19 ==> U+2571 [remove]
 ...
 7X1D

Block 7X2, Miscellanea

7X20
 ...
 7X24 ==> U+25AE [remove]
 7X25

Block 7X3, Geometric shapes

7X30
 ...
 7X35 ==> U+25E3 [remove]
 7X36 ==> U+25E5 [remove]

```

...
7X39 ==> 7X38 [remove]
...
7X3E ==> U+2219 + U+20DF
...
7X4A

```

4 Errata: Errors in L2/98-405

4.1 Errors in glyph shapes

This list is not exhaustive. Errors are listed only if the image in the document is totally wrong or likely to mislead. A strong effort will be made in the revision to provide high-quality images.

- 6X12 should be a turned sans serif G (ᄁ), not a backwards one.
- 1X3D, 1X3E, 1X3F: the head of the short arrow in each instance should line up with the tail end of the long arrow.
- 2X0C should be a reversed straight-back epsilon (ᄃ).
- 3X93, 3X94: The base symbol should be shaped more like an anchor, constructed (approximately) like a perpendicular symbol with the lower bar replaced by U+2323. 3X93 (ᄄ) is slashed although not negative, and 3X94 (ᄅ), though negative, is without a slash.
- 5X4A is composed of two parts: white lower right triangle (30/60/90 degrees), with bar below.
- 7x1D should be a turned ampersand (ᄇ), not an upside-down one.

4.2 Errors in the tables

Again, this is not an exhaustive list. For the full revision, the descriptive text will be in a form suitable for use as an official Unicode name, including full uppercase.

- The heading “Binary operators” should be located between 2X3D and 2X40, not following 2X5A.
- New text for 3X93 and 3X94:


```

3X93  R forking (slashed, although positive)
3X94  R nonforking (negative, slash absent)

```
- New text for “white” (open) delimiters:


```

4X15  O left white parenthesis
4X16  C right white parenthesis
4X17  * O left white bracket
4X18  * C right white bracket
4X19  O left white brace

```

4X1A C right white brace
4X1B * O left white angular bracket
4X1C * C right white angular bracket

- Correct corrupted text:
5X4A R increases as; wedge over bar
- Correct code: the first one under “Punctuation and similar” should be 7X10, not 7X00.
- Correct text for 7X1D:
7X1D N turned ampersand
- New text for “white” (open) geometric shapes:
7X37 N large white square
7X3E N white diamond with centered dot
7X45 N error-barred white square
7X47 N error-barred white diamond
7X49 N error-barred white circle