

# Towards a list of mathematical glyphs\*

## This is not a finished document

Justin Ziegler  
ziegler@goofy.zdv.uni-mainz.de  
ziegler@educ.emse.fr

Started: 9 July 1993  
Printed: May 5, 1997  
Version: 3.00  
Filename: agreed.tex

### Abstract

The idea here is to try and list the contents of the new math encoding. For this I have tried to make logical glyph groupings. Please remember that this is a draft, and I used as my workbench. Some of it is out of date, and usually the comments are only for me. There are lots of spelling mistakes I know!

### 1 A global rule for boldface

We have decided not to mix lightface and bold face symbols, in the same encoding, but to generate a separate parallel boldface versions of all lightface math encoded fonts. This does not make it impossible to mix the two. For this, either one can use the `\boldsymbol` approach, or one can load an extra bold face font in a given family, and have it directly and permanently accessible.

### 2 Sans serif and typewriter fonts

Extra fonts could be designed in sans serif, or in typewriter using some of the new math encodings. An other solution is to load the Cork encoded sans fonts (or typewriter fonts) in a free family. In any case, the new math encod-

---

\*This is not a finished document. It contains many spelling mistakes, many typing mistakes, and many brain mistakes. Things have been forgotten. All comments are welcome.

ing will not have any slots containing specifically sans serif or typewriter glyphs.

### 3 Concerning the Euler shapes

Euler shapes could be a good example implementation of the new math encoding.

On the other hand all the Euler shapes could be grouped in a single font table. But this would not be part of the math encoding. It would just be an extra font that could be loaded in an extra family, just like the Dingbats could be.

### 4 The Cyrillic letters

These would be available, but not as part of the math encoding. They would be loaded as an extra family, with whatever encoding exists, together with suitable mathchardefs.

### 5 Extra font dimensions

- The design size,
- The default script size,
- The default scriptscript size,
- suggested value for `mathsurround` (in MC)
- `math_axis` (in every font)
- Thin mu skip,

- Med mu skip,
- Thick mu skip,
- recommended rule weight
- baselineskip: leadingheight,
- baselineskip: leadingdepth

## 6 The kerning

We *will* make better kerning possible in the latin math italic, *if possible*. In math mode, for things to get kerned as specified in the `.tfm` file the left atom must be of ordinary type. If the user interface redefines every thing that must be kerned as being ordinary, old documents may very well start looking different. To avoid this, the user interface could define a macro `\mathkerning{...}` that would use the kerning specified in the `.tfm` file.

This needs more thinking, but so far we can produce the following list of items that should be kerned:

- A bit of adjusting with [ and ( and ) and ] in order to produce better spacing when folowed by letters. (Memo: Transforming into mathord, and italic correction.)
- A bit of adjusting for the situation when letters are folowed by [ ] ( ). This is an important one.
- Keep the kerning with . , / for most letters !
- Keep kerning between = and upright  $\Gamma$  ! (I must have dreamt this one) Maybe add kerning for other punctuation characters.
- At least keep the kerning between d and Y,Z,j,f. Maybe add some others dx, dy, d $\alpha$ , d $\theta$ , d $\phi$  ...
- Introduce kerning of the integral with itself. This would only be available via the `\mathkerning` macro (see previous comment).
- Introduce kerning of the period with its self,
- Introduce kerning of the centered period with its self.

- Spivak and Jan M.R. are adamant that kerning is needed between Latin and Greek. More precise information is needed.

## 7 Compatibility

### 7.1 Document compatibility

We will not aim in beeing totally compatible. A lot of positions will change, so direct math chardefs will not always work. We will make sure that documented names from AMSL<sub>A</sub>T<sub>E</sub>X (this includes names from L<sub>A</sub>T<sub>E</sub>X, T<sub>E</sub>X, and AMST<sub>E</sub>X, and LAMST<sub>E</sub>X) are still suported.

### 7.2 Compatibility with other encodings

To enable easier font exchange between the T<sub>E</sub>X world and the rest of the world, the new math encoding will have a space in position 32 (decimal) in every font table encoding.

If there is a lot of free space, we may consider leaving positions from 0 to 32 empty.

## 8 Will be taken out of the present math encoding

- The old digits: 10.
- The 2 paragraph signs: ¶, §.
- The Yen sign: ¥.
- The double dagger sign †.
- The four card families: ♣, ♥, ♦, ♠.
- The musical signs: b, ♯, ♮
- The maltese cross. (AMS)
- The checkmark (AMS)
- the funy tie accent: ^
- The ^ seems not to be needed in maths. It could be put in the text companion font.
- The circled R must come out of the math symbols. (AMS)
- The raised asterisc is comming out of math.

- More ... ?

All these will be put in to the “Text symbols” encoding, that would come in many faces, and be text dependent. Other things will be put in this “Text symbols” font:

- More numerals,
- The perthousand sign.
- Maybe this is a good place for the ‘fraction’ characters from adobe.
- <florin>, <ellipsis> etc.
- The superior and inferior digits, and put in kerning so that <onesuperior><fraction><twoinferior> produces a 1/2.
- The single dagger finds a place here although it is in maths as well. This makes them two different symbols, and enables both to have more specific shapes.
- A real copyright symbol, TM (trademark) and SM (service mark).
- An interrabang (a combination of ? and !) new. (bb)
- ...

Alan jeffrey has work on the text symbol font. Actually it is now called the companion text font. He has written more about the subject. “alanje@cogs.susx.ac.uk”

## 9 The Greek glyphs: 124

We will include the following shapes:

- All the Uppercase in upright. 24
- All the Uppercase in italic. 24
- All the Lowercase in upright. 24
- All the Lowercase in italic face. 24. So far:  $24 * 4 = 96$
- All the variable shapes in upright. 10
- All the variable shapes in italic. 10
- All the special numeric letters in upright.

3

- All the special numeric letters in italic. If lack of space problems, prefer the italic shapes to the upright ones. 3.
- Some control glyphs: 2

### 9.1 Variable shapes: 10

This list comes basicly from: Jörg Knappen. All listed here including the ones that are already in the cm:

1. Lowercase Phi,
2. Lowercase Pi,
3. Lowercase Kappa, (AMS)
4. Lowercase beta (new),
5. Lowercase Rho,
6. Lowercase Epsilon,
7. Lowercase Sigma,
8. Lowercase Theta.
9. Upper case chi (new),
10. Upper case for upsilon.

### 9.2 Extra letters for numerals: 3

Source: Jörg Knappen. All listed here including the ones that are already in the cm, and the ams. Must be given in uppercase<sup>1</sup>, and lowercase.

1. Qoppa (new),
2. Sampi/Sanpi (new) (Jörg Knappen),
3. Digamma (AMS).

### 9.3 Some control glyphs to access the different greek faces: 2

1. An italic control glyph, i.e. the folowing Greek letter is not taken from the upright, but from the italic Greek,

---

<sup>1</sup>Uppercase greek numerals exist, although extremely rare. For the sake of completeness one could fill them in. But they are surely not the hottest characters needed. Jörg

2. A variable shape control glyph, i.e. the following Greek letter is not taken from the normal set of letters, but from the variant shape set. This will not work for all letters. Thus maybe not a good idea.

**Note:** From Alan about the control slots for Greek, “Er, I’m not very sure about those, since they’ll affect kerning. I’d prefer to have the choice between italic / upright made by the document designer. And I’m not sure why anyone would want to get at an upper case  $\xi$  by a macro `\uppercasegreek{\xi}`!” — “True they will effect the kerning. But one could use them differently from what you suggested. Although i’m not sure it is interesting, the ligature mecanism does not have to be visible for the user. (ei, he can still type `\Gamma`, which is expanded to `\up\gamma`.”

## 10 Extra Greek like material: 14

This group of glyphs should not really be separated from the rest of the Greek material.

1. An upright partial sign,
2. An italic partial sign,
3. An upright partial sign with a slanted bar, AMS `\eth`
4. A `\thorn` WASY’151 but no very good. Better in the dcmr’136. (Jörg)
5. An italic partial sign with a ? bar, ??  
Jörg says no. ??????
6. A barred upright lambda, ?????? (probably not Jörg)
7. A barred italic lambda, this is prefered. (Jörg)
8. An upright mho sign (upside down Omega),
9. The back to front epsilon: AMS `”7F \backepsilon`,
10. The Weierstrass symbol:  $\wp$  only in one style,
11. Arabic letter dal: looks something like a back to front c.
12. Hebrew letter ’151 in msbm,
13. Hebrew letter ’152 in msbm,
14. Hebrew letter ’153 in msbm,
15. The  $\aleph$  or `\aleph` in position ’100 of CMSY,
16. The Nabla,  $\nabla$  in CMSY’162
17. More ?

The barred partial signs may be obtained by ligatures, or could be constructed with kerning. In any case some slots for ligatures must be left free.

## 11 The latin letters: One set= 54 glyphs

We shall assume here that all lower case alphabets contain an ‘i’ and a ‘j’ without dots, so that they can take other accents if wanted.

- The usual cmmi italic shape. Uppercase and lowercase.
- The calligraphic shapes. Uppercase and lowercase. I believe that the lowercase shapes are presently not available.
- The script shapes. Uppercase and lowercase. Here as well I believe that the lowercase shapes are presently not available.
- The black board bold shapes. Uppercase and lowercase.
- The Fraktur style. Uppercase, and lowercase.

### 11.1 The calligraphic and/or script styles

BB: “How are “calligraphic” and “script” different here? I’ve never seen what Knuth calls calligraphic and what most mathematicians call script (the “curly” style) used in the same context, so they are presumably not distinct from one another in actual usage.”

We will include the two if there is not enough space for symbols. Otherwise we will only have one. i.e: putting the two instead of one means adding an extra family in which case there would be more place for symbols.

The reason why that means adding an extra family, is because the letters should be in the usual Cork letter position.

## 11.2 A hyphen char ?

These Latin letters are not ment for typesetting words. We shall assume that all multiletter words will be typeset using the text fonts, not the math fonts. Thus we will not have any hyphen character in the math encoding.

## 11.3 Computer science and identifiers

It looks as though the new math encoding will not contain anything specially designed for computer science. Computer scientists will have to use `cmti*` in an extra family for their long identifiers.

## 11.4 Chemists and chemical formulae

Considering the fact that chemists do use a lot of mathematical expressions, they need the total math mode as it is. But on top of that they need a special mode for writing their chemical equations. One of the particularities of this chemical mode is the different placing of sub- and superscript. A possible implementation is something like *enter-chemical-mode* and *textemexit-chemical-mode*, which would in actual fact load a new set of fonts (or only th font in family 2), in order to have a different value for the font dimensions in family 2.

## 12 Latin like material: 5

This group should live next to the Latin letter set.

1. An upright d. This is needed for the standard for mathematical typesetting.
2. A horizontally barred italic h, for physicists.
3. A slanted barred italic h, for physicists.
4. An italic uppercase Vee with a bar, the bar is ment to be horizontal.

5. An upright uppercase Vee with a bar, the bar is ment to be horizontal, and extends through both sides of the Vee almost like a strikeout.
6. ??????? The powerset symbol from Martin.Ward@durham.ac.uk. Something like this:

```

XXXXXXXXXXXX
XXXXXXXXXX  XXXX
XXXXXX      XXXX
XXXXXX      XXXX
XXXXXXXXXX  XXXX
XXX  XXX      XX
XX  XXXXXXXX XXXXXX
XX  XXXXXXXXXXXX
XX  XXXX
XX  XXXX
XX  XXXX
XXXX  XXXX
XXXX  XXXX
XXXX  XXXX
XXXX  XXXX
XXXXXX

```

## 13 The different ways needed to write numbers

- The normal set of numbers in the `cmmi`: upright lining.
- The black board bold numbers. (This is used in physics. And a field of maths. See alan J. for more details.) [Note: I think that presently no satisfactory `bbb` numbers exist.]

## 14 Empty slots?

We can include some free slots so that people can put their ligatures in, when they are trying to convert fonts coming from other worlds.

Alan J. can give good explanations for this.

## 15 Arrows

We shall enable this sort of construction. But to make sure it does not fail when used in different sizes, every single glyph used for this

purpose, will be *specifically* designed for this use. *All of them will be in the same font table.* This does not mean that a given construction block can't be used for different types of arrows. That sort of thing just has to be thought of, and forecasted. What this does mean, is that those construction blocks will not be used for any other purpose — like for instance the equal or minus sign.

All arrows from cm, and from ms, will be taken if necessary. Maybe some others too.

### 15.1 The “Plain horizontal arrows” group: 14

The next 6 are in cmmi'050 to '055

1. leftharpoonup
2. leftharpoondown
3. rightharpoondown
4. rightharpoonup
5. lhook
6. rhook

Now we are in cmsy:

7. leftarrow '40
8. Leftarrow '50
9. leftrightarrow '44
10. Leftrightarrow '54
11. rightarrow '41
12. Rightarrow '51
13. CMSY'67 this is the `\mapstochar`
14. CMSY'66 the negation sign/slash: 1

### 15.2 Extra arrows for use with plain arrows: 5

1. I think it would be reasonable to add a `\mapsfromchar` in order to build things like:  $\leftarrow|$ : 1
2. I think it would be reasonable to add a `\Mapstochar` that could go with the double arrows to build things like  $|=>$  : 1
3. I think it would be reasonable to add a `\Mapsfromchar` that could go with the double arrows to build things like  $\leftarrow|$  : 1

4. a - for extending arrows: 1

5. a = for extending arrows: 1

### 15.3 The “Plain vertical arrows” group: 6

- CMSY'154 to '155: 2
- CMSY'42 to '43 :2
- CMSY'52 to '53 :2

### 15.4 The “Plain oblique arrows” group: 4

1. CMSY'45
2. CMSY'46
3. CMSY'55
4. CMSY'56

### 15.5 The “Ams obliques” group: 2

1. msbm'36
2. msbm'37

### 15.6 The “Latex arrows heads” group: 4

LASY: The four characters in position '50 to '53 from the lasy font (These appear in the wasy font as well) must be put with the arrows. They are arrow heads. 4

### 15.7 The “Ams arrows” group: 12

- MSAM: '10 to '11 :2
- MSAM:'24 to '27 : 4
- MSAM:'30, '31 '36, '37 :4
- MSAM:'113 '114 : 2 ??

## 15.8 AMS horizontal arrows: 22

This includes all the arrows horizontal arrows and the negated ones, that are listed page 280 of “The joy of tex”.

1. leftarrowtail
2. leftleftarrows
3. leftrightarrows
4. leftrightsquigarrow
5. lefttrightharpoons
6. Lleftarrow
7. looparrowleft
8. looparrowright
9. nleftarrow
10. nLeftarrow
11. nLeftrightarrow
12. nleftrightarrow
13. nrightarrow
14. nRrightarrow
15. rightharrowtail
16. righthleftarrows
17. righthleftarpoons
18. rightrightarrows
19. rightsquigarrow
20. Rrightarrow
21. twoheadleftarrow
22. twoheadrightarrow

## 15.9 The slashed and bared arrow

Alan J. is dealing with the arrows, and the possibility of baring them with a slash. Different slants and sizes of the slash should be available, depending on the the glyph that is being slashed. It can be done with kerning, and/or ligatures. I guess we can count for 4 different types of slashing glyphs.

## 15.10 Some control glyphs for access to arrows

These do not appear in the dvi file, they just enable the construction of some arrows and slashed arrows using the ligature mechanism.

## 15.11 Free space for special arrow ligatures:

## 16 Accents: approx 85

### 16.1 Basic size accents: 19

- All those that have been created by macros in the ams: the 3 dotted accent, and the 4 dotted accent. 2
- The ones in T<sub>E</sub>X: e` e´ e˘ eˇ e<sup>-</sup> e<sup>o</sup> e<sup>^</sup> e<sup>¨</sup> e<sup>~</sup> e<sup>¨</sup>? e<sup>˘</sup>. They all come from cmr except for the last two from cmmi. 12
- Extra: a back to front vector arrow, 1
- Extra: a double sided type vector arrow, 1
- Extra: a square bracket used as an accent, 1
- Extra: The previous one turned upside down, 1
- Extra: an arc is requested by AMS, 1

**Note:** Jörg says that e<sup>¨</sup> is not needed in math. ??????

**Note:** The <sup>^</sup> seems not to be needed in maths. It could be put in the text companion font.

### 16.2 Some double accents: 7

1. A bar and a dot on top,
2. A dot and a bar on top,
3. 2 dots with a bar on top,
4. A bar with 2 dots on top,
5. A hat and a tilde on top,
6. A hat and bar on top,
7. A double bar,

**Note:** For the double accents, Spivak and Ralf (rey) could do some archive research at the AMS. Similar research could be done at the APS, and the CUP.

### 16.3 Variable size accents: $7 * 8 = 56$

Variable size has ment 5 different sizes until today, we could raise that number to 8.

**Note:** If the accents are in a font that is loaded in three different sizes, the choice mecanism of `\mathaccent` will only look in the current style size (unlike the delimiter choice mecanism). Thus although one could hope to multiply the number of available sizes by three, in actual fact in a given style the number of automatically available sizes would not be multiplied. All the same this *would* give different results in each style. I can forsee better quality typesetting, but *problems of compatibility* e.i. formulae heights and widths may change. Even if not done in an automatic way, the user would still have a larger range of accents to choose from. Compatibility problems could be avoided by redefine `mathaccent` to a `mathchoice`. Thus the accents could always come from `textstyle`, and the accented material could come from the durrent style. But this does not work either. In doing so one would no longer be able to take the base accents from the current style. Although one could make two macros. See paper “Repacing `cmex?`” by the same author.

1.  $e^{\vec{}}$  the vector. 8
2.  $e^{\sim}$  the tilde. 8
3.  $e^{\hat{}}$  the hat. 8
4.  $e^{\bar{}}$  the bar. 8
5. Some people request a variable size arc. 8
6. The back to front vector arrow, 8
7. The double sided vector arrow, 8

### 16.4 Underaccents: 3 so far

So far I have had requests for:

1. A tilde,

2. A breve ( $\acute{}$ )

3. A bar

Like for the double accents, research could be done at the AMS... ??????????

## 17 Core symbols

This is the only name I thought of to identify the symbols that have some reason to live with the default math material. There are mainly two reasons for them to be there: one is kerning, and the other is design similarity.

### 17.1 For kerning reasons: 14

1. The period . CMMI
2. The coma , CMMI
3. The semi colon ; CMR
4. The colon : CMR
5. The exclamation mark ! CMR
6. The (
7. and the ) respectively opening-class and closing-class, CMR
8. The [
9. an the ] respectively opening-class and closing-class, CMR
10. The {,
11. And the } (design similarity reasons also in positions '146 and '147 of CMSY,
12. The ‘/’ as a delimiter<sup>2</sup>, and as fraction sign, CMR

### 17.2 Basic geometric delimiters: 12

Should go in the core, for kerning reasons, like the other ( ) and [ ]. I they don't fit in the core, they must go with the basics. The ones listed here are all in CMSY, around '142, and '150.

1. }

---

<sup>2</sup>This is not accessible via a single key. The key ‘/’ produces the sign / taken from `cmmi`.



2.  $\langle$
3.  $|$
4.  $\|$
5.  $\]$
6.  $[$
7.  $\]$
8.  $\lfloor$
9. The  $\backslash$  in position '156  
In actual fact maybe this does not belong here:
10. We could add the smallsetminus from msbm'162
11. The msbm nmid '055
12. The msbm nparallel '054

Test:  $|f|, \|f\|, \lfloor f \rfloor, \lceil f \rceil, \langle f \rangle, f[, f[, f\langle, f\backslash$   
strange that no kerning seems to be needed here, where as it is necessary for the bracket.

### 17.3 For design similarity reasons: 23

1. The question mark  $?$  must live with the ! CMR
2. The percent sign  $\%$  must live with the ! and  $?$  CMR
3. The at sign  $@$  must live with the  $\%$  CMR
4. The  $\$$  sign must live with the  $@$   $\%$   $?$  ! CMR
5. The  $\&$  must live with  $\$, \%$  .. CMR
6. The  $\#$  in CMR
7. the inverted  $\&$  don't know where to find this.
8. The  $\ell$  as a rounded 'l'. CMMI
9. The centered dot  $\cdot$  for use as a multiplication sign, must live with the period. CMSY
10. The asterisk  $*$  for use as a multiplication sign, in position '003 in CMSY.
11. The  $\infty$  sign must live with  $@$ ,  $\%$ ,  $\ell$ . In position '057 of CMSY.

12. The ' or prime in position '060 of CMSY, one can not separate the prime from the slots for the prime ligatures. (2 ligatures) Kerning of the prime letters is not possible, because the prime is set in superscript. ????????
13. The backprime form MSAM'070 should live with the prime. ????????
14. The  $\infty$  sign in position '061,
15. The  $\emptyset$  in position '073 of CMSY,
16. The  $\checkmark$  mark in MSAM'130, ??????
17. The  $\between$  double parentheses in MSAM'107 ?????? should go with the normal parentheses. ??????
18. The  $\Re$ ,
19. and the  $\Im$  in position '074, and '075 of CMSY,
20. The  $\dagger$  or dagger in CMSY'171, ??????
21. The smile, ????????
22. and the frown form CMMI ??????????
23. Could maybe include the circled S from MSAM'163. ??????

### 18 Symbols from lasy that must be kept:

The first four lasy symbols are in the msam. The ones in positions '50 through '53 are arrow heads, and are counted as such. Character '60 is in the msam. '61 is not in the msam, and should be kept. Char'62: same as msam'03 ? Char'63: same as msam'06? Lasy'72: same as msbm'163 or msam'166 ? Lasy'73: same as msam'40 ?

A list of what we shall keep of lasy:

- Character '61: 1
- ???

This makes a total of 1.

### 19 The “Subset” groups

**Note:** None of these have anything to do with the sim glyph.

### 19.1 The “subset plain” group: 4

- The  $\subseteq$  in position CMSY’022
- The  $\supseteq$  in position CMSY’023
- The  $\subset$  in position CMSY’032,
- The  $\supset$  in position CMSY’033,

### 19.2 The “subset ams” group: 12

- From MSBM’040 to MSBM’43 : 12

### 19.3 The “Inni plain” group: 2

1. The  $\in$  sign in position CMSY’062,
2. The  $\ni$  sign in position CMSY’063,

### 19.4 The “sqsubset plain & ams” group: 4

Don’t know where else to put these,

1. The  $\sqsubseteq$ , cmsy’166,
2. The  $\sqsupseteq$ , cmsy’167,
3. The sqsubset from MSAM’100,
4. The sqsupset from MSAM’101,

## 20 The “Greater than” group

### 20.1 The “Greater than Plain” group: 8

- The  $\leq$  in position CMSY’024,
- The  $\geq$  in position CMSY’025,
- The  $\ll$  in position CMSY’34,
- The  $\gg$  in position CMSY’35
- $<$  less than form CMMI’074,
- $>$  Greater than: CMMI’076,
- The alternative leq: msam’66
- The alternative geq: msam’76

### 20.2 The “greater than ams” group: 30

- From MSBM’000 to ’005: 6
- From MSBM’010 to ’015: 6
- From MSBM’024 to ’025: 4
- From MSBM’154 to ’155: 2
- From MSAM’060 to ’061: 2
- From MSAM’065 and ’067: 2
- From MSAM’075 and ’077: 2
- From MSAM’121 to ’124: 4
- From MSAM’156 to ’157: 2

### 20.3 The “greater than with sim” group: 8

1. MSBM’022,
2. MSBM’023,
3. MSBM’032,
4. MSBM’033.
5. MSAM’046,
6. MSAM’047,
7. MSAM’056,
8. MSAM’057

The shapee sim, and the geometric sim are now considered to be the same glyph.

## 21 The “Succ” groups

### 21.1 The “Succ without sim plain” group: 4

1. CMSY’026,
2. CMSY’027,
3. CMSY’036,
4. CMSY’037

## 21.2 The “Succ without sim ams” group: 10

- MSBM’006, ’007: 2
- MSBM’016, ’017: 2
- MSBM’026, ’027: 2
- MSAM’062 - ’064: 3
- MSAM’074: 1

## 21.3 The “Succ with sim ams” group: 8

- MSBM’020, ’021: 2
- MSBM’030, ’031: 2
- MSBM’166, ’167: 2
- MSAM’45,
- MSAM’55,

The shapee sim, and the geometric sim are now considered to be the same glyph.

## 22 The “Sim” group: 12

1. sim CMSY’030
2. approx CMSY ’31
3. simeq CMSY’047
4. wr CMSY’157
5. The bold MSBM’034
6. MSBM’035
7. MSBM’150
8. The bold MSBM’163
9. The bold MSBM’164
10. MSBM’165
11. MSAM’166, backsim
12. MSAM’167, backsimeq

## 23 Binops

### 23.1 The “Small binops plain” group: 20

1. cap CMSY
2. cup CMSY
3. uplus CMSY
4. sqcap CMSY
5. sqcup CMSY
6. big circle CMSY
7. big triangle up CMSY
8. big triangle down CMSY
9. vee CMSY
10. wedge CMSY
11. oplus CMSY
12. ominus CMSY
13. otimes CMSY
14. oslash CMSY
15. odot CMSY
16. amalg CMSY
17. bullet CMSY
18. circ CMSY
19. diamond CMSY
20. star (5 branches): CMMI’77

### 23.2 Small plain left right triangles: 2

I think these should be replaced by the ones in ams

1. triangle left: CMMI’56
2. triangle right CMMI’57

### 23.3 AMS left right open triangles: 8

These are also in LASY.

- vartriangle left
  - vartriangle right
  - triangle left eq
  - triangle right eq
- The previous four are in msam
- Same 4 negated msbm: 4

## 24 Basic Symbols: 23

A group of symbols that are used for typesetting basic mathematics. These are mainly geometrics, some have been added for alikeness reasons:

1. = The equals sign, CMR'075
2. - The minus sign, CMSY'00
3. + The plus sign, CMR'053
4. The  $\times$  multiplication sign CMSY'002,
5. The  $\div$  sign  $\div$  CMSY'004
6. The  $\div$  sign from msbm'076 should live with divide and times.
7. The  $\times$  sign from msbm'157 should live with the times.
8. The  $\times$  sign from msbm'156 should live with the times.
9. The  $\pm$  sign in position CMSY'006,
10. The  $\mp$  sign in position CMSY'007,
11. The  $\equiv$  in position CMSY'021, Difficult to separate from other similar relations.
12. The  $\forall$  sign in position '070,
13. The  $\exists$  sign in position '071,
14. The nexists sign from msbm'100
15. The  $\neg$  sign CMSY'072,
16. The  $\varpropto$  from AMS "5F. ????? or should we leave this as geometric????
17. The varemptyset from MSBM'77, ????

18. Could go here: the upside down F: Finv from msbm'140 ???????
19. and the back to front G: Game from Msbm'141 ???????
20. unary minus like en dash, could be CMR'173 but I personally think it should be shorter.
21. The  $\varnothing$  from MSBM'77,
22. The  $\perp$  perp or bot sign in position '077,
23. top sign CMSY'076

## 25 The radicals: 8

Currently available in cmex are:

- Five radical signs: 5
  - The vertical bit needed to construct the big radical '165 : 1
  - The top bit of the constructed radical. '166 : 1
- New:
- In cmsy there is the basic size of the radical. This is always, and has always been loaded in three sizes. If we take the radical sign out of cmsy, and put in MX, then we must take that into consideration. I remind the reader here that MX should be designed in such a way that it can be loaded in one size, and everything works as before. So we must add three sizes of the radical sign in MX: 3

## 26 The integrals family: 18

### 26.1 Big 'bigops' size: 7

1. The single integral.
2. The double integral. Could be done with kerning.
3. The triple integral. Could be done with kenring.
4. The single O integral.
5. The double O integral.
6. The sigma integral. For physics: Jörg.
7. The slash integral. For physics: Jörg.

## 26.2 Small ‘bigops’ size: 7

The same as in big ‘bigops’ size.

## 26.3 Small size: 7

This refers to the size of the `\smallint` in CMSY.

1. The single normal integral.
2. The single O integral.
3. Double O integral. ??? (Jörg thinks yes)
4. Double normal integral ??? (Jörg thinks yes) Could be done with kerning.
5. Triple normal integral ??? (Jörg thinks yes) Could be done with kerning.
6. The sigma integral. ????
7. The slash integral. ????

Mail from HSS:

`\doubleoint` is used by Becker in "electromagnetic fields and interactions" (Dover). i also saw `\tripleoint` used in electromagnetic theory books although both are somewhat archaic.

Concerning the small version (in cmsy), i suggested this solely for reasons of completeness. The need for it is less now that cmex will be loaded in three sizes. but the small version of `\int` & `\oint` look a bit large when used in inline formulas. the `\smallint` & `\smalloint` etc. may be a choice for some authors there.

YH also pointed out, the upright versions of integrals are very common in textbooks. since the integral sign is one of the most common symbols used in math, it may not be a bad idea to include upright versions of \*all\* integral signs in cmex (with corresponding small versions in cmsy) again for reasons of completeness.

## 27 Ams Vdash group: 10

1. MSBM'056
2. MSBM'057
3. MSBM'061
4. MSBM'062
5. MSBM'063
6. MSBM'160
7. MSBM'161
8. MSAM'015
9. MSAM'016
10. MSAM'017

## 28 Plain miscellaneous geometric symbols: 5

1. CMSY'20
2. CMSY'140
3. CMSY'141 Should live with the two previous:
4. MSBM'060 What about the back to front version of this ????
5. lasy'061 the bow tie

## 29 AMS equals friends: 10

1. msam'155
2. msam'154
3. msam'120
4. msam'73
5. msam'72
6. msam'54
7. msam'53
8. msam'52
9. msam'51
10. msam'44

## 30 Ams miscellaneous geometric symbols: 21

1. msam'174
2. msam'173
3. msam'171
4. msam'170
5. msam'165
6. msam'164
7. msam'161
8. msam'160
9. msam'151
10. msam'150

11. msam'147
12. msam'146
13. msam'141
14. msam'140
15. msam'136
16. msam'135
17. msam'134
18. msam'133
19. msam'132
20. msam'131
21. msam'050
22. msam'005

### 31 AMS boxes and friends: 15

1. MSAM'000
2. MSAM'001
3. MSAM'002
4. MSAM'003
5. MSAM'004
6. MSAM'006
7. MSAM'007
8. MSAM'014
9. MSAM'106
10. MSAM'110
11. MSAM'111
12. MSAM'112
13. MSAM'115
14. MSAM'116
15. MSAM'117

### 32 The curly braces: 8

Their design should be the same as the vertical braces. Add two horizontal extension modules for them, since if they are drawn with rules, digitization errors may cause them not to line up with the horizontal brace glyphs. What's more, this would enable the designer to choose there boldness.

Plus two extra middle bits. So that the designer is not restricted by the number of slots.

### 33 Non classified existing symbols

Here are listed some symbols that do not have a place elsewhere:

- The diferent shapes of # should find a place, although one is already in the core.

### 34 A list of new glyphs

The following symbols should be added in the mathfonts. Some have already been designed by various people, so it should be possible to find them...

#### 34.1 New basic size delimiters: 8

Basic size means the same size as the parentheses and brackets in cmr.

1. a ||| for use as |||f||| a norme:
2. Unicode contains another style of brackets, they call them tortoise shell brackets. They look like  

$$\begin{array}{c} / \backslash \\ | | \\ \backslash / \end{array}$$
These are like parentheses, but with straight lines. No curves !
3. The previous ones in Bbb.
4. Multi set brackets { | and }

#### 34.2 Basic size operators: 2

Basic size means the same size as the operators in cmsy.

1. Something like \cupdot and

2. Something like `\capdot` See Frank to justify these.

### 34.3 New multi-sized, and extensible delimiters: 60

A multi-sized delimiter means: 4 sizes for each side : 8 glyphs. Plus and extensible version: top botom extension module for both sides:6 glyphs. Sometimes also a middle: 8 glyphs. Total: 16 or 14.

1. Semantic brackets `[` and `]` must be extensible: 14
2. An extensible version of `|||` for use as `|||f|||` (a norme). Just the extension module: 1
3. Unicode contains another style of brackets, they call them tortoise shell brackets. They look like
 

```

/ \
| |
\ /
: 14

```
4. The previous ones in Bbb: 14
5. Multi set brackets `{` and `}`: 16
6. For both multisized curly braces there is only one extensible module. This works for DEK's curly braces, probably because they are symmetrical. But this may not be the case for an other design. So we must include a slot for the other extensible module: 1

### 34.4 New double sized 'bigops': 26

All these would come in two sizes, in the same font, like the present `\bigcup`. One for display style, and one for text style. That makes two glyphs for each one.

1. A double sized `\sqcap` `\big\sqcap` `cspex`
2. Two sized  $\bigcirc$  with  $\bigvee$  inside.  $\bigcirc$  proposed name: `\ovee`, and `\bigovee`. `cspex` and `stmary`
3. Two sized  $\bigcirc$  with  $\bigwedge$  inside.  $\bigcirc$  `cspex` proposed name `\owedge`, and `\bigowedge`. comment from Alan:

“As far as I'm aware nobody has \*ever\* used these glyphs in a paper. I put them in St Mary's Road because I needed them at the time, but I shortly abandoned writing the paper they were going to be used in. Please don't include them! (If we are going to, we need to include `\ovee`, and `\owedge`, as well as `\bigovee`, and `\bigowedge`, which are the ones you described.)”

4. Dijkstra choice: `\CSPEX`
5. A wide Dijkstra choice. `CSPEX` . Comment from alan:

If this is the glyph I think it is, it's not quite a wide Dijkstra choice in shape (although mathematically it's the same thing as Dijkstra choice). The two glyphs are:

`<dijkstrachoice>` looks remarkably like `[` and `]` glued together.

`<oblong>` looks like `<sqcap>` but with the square completed.

`<oblong>` is used in CSP in conjunction with `<sqcap>`, so it's quite important that they look the same. In particular, they need to be of the same width because if they're not formulae sometimes don't line up properly...

6. Parallel `\bigparallel` just a double sized version of `parallel`.
7. Interleaving  $\big\|$  : `\biginterleaving` [bb: I'm not sure about the spacing or meaning but we've had requests for triple verts as delimiters.]

'Interleaving' and 'parallel' are used in (at least) three different ways:

- as delimiters `||foo||` and `|||foo|||`. These should come in basic-sized and extensible versions.

- as binary operators  $p \parallel q$  and  $p \parallel\parallel q$ . These can be the same glyphs as for the basic-sized delimiters.
- As ‘big’ operators  $\parallel_i p_i$  and  $\parallel\parallel_i p_i$  similar to `\bigcup`. These should come in `textstyle` and `display style` versions.

The big operators aren’t the same glyphs as the extensible delimiters.

8. `\bigcupdot`: A ‘U’ with a dot in it. Something like:  $\bigcup\cdot$
9. `\bigcapdot`: an upside down ‘U’ with a dot in it. Something like:  $\bigcap\cdot$
10. An inverted  $\&$ . `\dnasrepma`
11. Large operator symbols based on, asterisk sign.
12. Large operator symbols based on, a hash sign.
13. Large operator symbols based on, an ampersand sign.

### 34.5 Geometrics: 21

1. Don’t forget the ams smaller or equal and greater or equal.
2. Linear is implied by if  $o-$  and  $o-o$  [bb: There are also versions of these with filled-in circles.]
3. From JMR: something like this:  $\perp$  maybe the same upside down.
4. From JMR: Something like this:  $\lrcorner$  maybe the same upside down.
5. More ?

### 34.6 New arrows

- alan J wrote: `\arrownot` and `\Arrownot`, so that for example `\arrownot\mapsto` is visually compatible with `\rightarrow`. Describing the same thing he wrote as well: Add the ‘building blocks’ for the AMS negated relations, for example a `\arrownot` to build `\nlongrightarrow` and `\rightarrowfill`.

- The building blocks to make `\mapsfrom` `\Mapsto` `\Mapsto` and `\Mapsfrom` `\leq`
- `Lfloor`, `Rfloor`, `Lceil`, `Rceil` like  $\lfloor$
- Arrows with triangles on the end.

$\langle\!\!\langle$ ,  $\!\!\!\rangle$ ,  $\langle\!\!\!\rangle$

- Equals like symbol:  $\langle\!\!\langle$  with  $\equiv$  underneath.

### 34.7 Non geometrics: 19

1. Possibly something like ( and ) if the bar was touching, the parentheses.
2. Banana brackets: look (sort of) like ( and ). Or they look like bananas if you believe Jeremy... Alan: The St. Mary Road font includes samples of them, in a line-drawing style. Since I have not seen them in real use, I cannot comment, if this style or rather the look of  $\&$  in `cmr` is appropriate.
3. lightning (wasy) — I don’t think this belongs in maths. Alan: It is actually used though! It means ‘interrupt’ in process theory, c.f. *Communicating Sequential Processes*, Hoare, Prentice Hall 1985. I don’t know how widely used outside process theory it is though...
4. A nice powerset symbol:  $\wp^3$ ?
5. Katakana character that looks like a spiral. (bb)
6. A lowercase sigma with a long tail that goes a little bit below the baseline.
7. Must not forget the two versions of the # hash sign. I believe one is geometric, and one isn’t: the slanted hash sign and the upright hash sign.
8. An `\inviota` is sometimes requested on the net. I’ll send you a reference file for it. (Joerg)
9. More ?

---

<sup>3</sup>Martin.Ward@durham.ac.uk