

Experimental unicode mathematical typesetting: The unicode-math package

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Abstract

Warning! This package is experimental and subject to change without regard for backwards compatibility. Performance issues may be encountered until algorithms are refined.

This package is intended to be a complete implementation of unicode maths for \LaTeX using the \XeTeX (and later, \LuaTeX) typesetting engines. With this package, changing maths fonts will be as easy as changing text fonts — not that there are many unicode maths fonts yet.

Maths input is simplified with unicode since literal glyphs may be entered instead of control sequences.

Contents

1	Introduction	3	7.2	Setting math chars, math codes, etc.	29
2	Acknowledgements	3	7.3	The main <code>\setmathfont</code> macro	31
3	Getting started	3	7.4	(Big) operators	38
3.1	Package options	3	7.5	Radicals	41
4	Unicode maths font setup	4	7.6	Delimiters	41
4.1	Using multiple fonts	5	7.7	Maths accents	43
4.2	Script and scriptscript fonts/features	6	8	Font features	44
5	Maths input	6	8.1	OpenType maths font features	45
5.1	Math ‘style’	6	8.2	Script and scriptscript font options	45
5.2	Bold style	7	8.3	Range processing	45
5.3	Sans serif style	8	8.4	Resolving Greek symbol name control sequences	52
5.4	All (the rest) of the mathematical alphabets	9	9	Maths alphabets mapping definitions	52
5.5	Miscellanea	10	9.1	Alphabets	57
I	The unicode-math package	16	10	Definitions of the math symbols	68
6	Things we need	16	11	Epilogue	70
6.1	Options	24	12	stix table data extraction	82
6.2	Overcoming <code>\@on-</code> <code>lypreamble</code>	28	A	Documenting maths support in the NFSS	83
6.3	Assorted macros	28	B	X_YTeX math font dimensions	85
7	Fundamentals	29			
7.1	Enlarging the number of maths families	29			

1 Introduction

This document describes the unicode-math package, which is an *experimental* implementation of a macro to unicode glyph encoding for mathematical characters. Its intended use is for \XeTeX , although it is conjectured that some effort could be spent to create a cross-format package that would also work with $\text{Lua}\TeX$.

Users who desire to specify maths alphabets only (Greek and Latin letters) may wish to use Andrew Moschou’s `mathspec` package instead.

2 Acknowledgements

Many thanks to Microsoft for developing OpenType math as part of Office 2007; Jonathan Kew for implementing unicode math support in $\text{Xe}\TeX$; Barbara Beeton for her prodigious effort compiling the definitive list of unicode math glyphs and their $\text{L}\text{A}\text{T}\text{E}\text{X}$ names (inventing them where necessary), and also for her thoughtful replies to my sometimes incessant questions. Ross Moore and Chris Rowley have provided moral and technical support from the very early days with great insight into the issues we face trying to extend and use TEX in the future. Apostolos Syropoulos, Joel Salomon, and Khaled Hosny have been fantastic beta testers.

3 Getting started

Load unicode-math as a regular $\text{L}\text{A}\text{T}\text{E}\text{X}$ package. It should be loaded after any other maths or font-related package in case it needs to overwrite their definitions. Here’s an example:

```
\usepackage{amsmath} % if desired
\usepackage{unicode-math}
\setmathfont{Cambria Math}
```

3.1 Package options

Package options may be set when the package is loaded or at any later stage with the `\unimathsetup` command. Therefore, the following two examples are equivalent:

```
\usepackage[math-style=TeX]{unicode-math}
% OR
\usepackage{unicode-math}
\unimathsetup{math-style=TeX}
```

Table 1: Package options.

Option	Description	See...
<code>math-style</code>	Style of letters	section §5.1
<code>bold-style</code>	Style of bold letters	section §5.2
<code>sans-style</code>	Style of sans serif letters	section §5.3
<code>nabla</code>	Style of the nabla symbol	section §5.5.1
<code>partial</code>	Style of the partial symbol	section §5.5.2
<code>vargreek-shape</code>	Style of phi and epsilon	section §5.5.3
<code>colon</code>	Behaviour of <code>\colon</code>	section §5.5.6
<code>slash-delimiter</code>	Glyph to use for ‘stretchy’ slash	section §5.5.7

Note, however, that some package options affects how maths is initialised and changing an option such as `math-style` will not take effect until a new maths font is set up.

Package options may *also* be used when declaring new maths fonts, passed via options to the `\setmathfont` command. Therefore, the following two examples are equivalent:

```
\unimathsetup{math-style=TeX}
\setmathfont{Cambria Math}
% OR
\setmathfont[math-style=TeX]{Cambria Math}
```

A short list of package options is shown in table 1. See following sections for more information.

4 Unicode maths font setup

In the ideal case, a single unicode font will contain all maths glyphs we need. The file `unicode-math-table.tex` (based on Barbara Beeton’s `stix` table) provides the mapping between unicode maths glyphs and macro names (all 3298 — or however many — of them!). A single command

```
\setmathfont[<font features>]{<font name>}
```

implements this for every every symbol and alphabetic variant. That means `x` to x , `\xi` to ξ , `\leq` to \leq , etc., `\mathcal{H}` to \mathcal{H} and so on, all for unicode glyphs within a single font.

This package deals well with unicode characters for maths input. This includes using literal Greek letters in formulae, resolving to upright or italic depending on preference.

Font features specific to `unicode-math` are shown in table 2. Package options (see table 1) may also be used. Other `fontspec` features are also valid.

Table 2: Maths font options.

Option	Description	See...
<code>range</code>	Style of letters	section §4.1
<code>script-font</code>	Font to use for sub- and super-scripts	section §4.2
<code>script-features</code>	Font features for sub- and super-scripts	section §4.2
<code>sscript-font</code>	Font to use for nested sub- and super-scripts	section §4.2
<code>sscript-features</code>	Font features for nested sub- and super-scripts	section §4.2

4.1 Using multiple fonts

There will probably be few cases where a single unicode maths font suffices (simply due to glyph coverage). The upcoming `srix` font comes to mind as a possible exception. It will therefore be necessary to delegate specific unicode ranges of glyphs to separate fonts:

```
\setmathfont[range=<unicode range>,<font features>]{<font name>}
```

where *<unicode range>* is a comma-separated list of unicode slots and ranges such as `{"27D0-"27EB,"27FF,"295B-"297F}`. You may also use the macro for accessing the glyph, such as `\int`, or whole collection of symbols with the same math type, such as `\mathopen`, or complete math alphabets such as `\mathbb`. (Only numerical slots, however, can be used in ranged declarations.)

4.1.1 Control over maths alphabets

Exact control over maths alphabets can be somewhat involved. Here is the current plan.

- `[range=\mathbb]` to use the font for ‘bb’ letters only.
- `[range=\mathbfsfit/{greek,Greek}]` for Greek lowercase and uppercase only (with `latin`, `Latin`, `num` as well for Latin lower-/upper-case and numbers).
- `[range=\mathsf->\mathbfsfit]` to map to different output alphabet(s) (which is rather useless right now but will become less useless in the future).

And now the trick. If a particular math alphabet is not defined in the font, fall back onto the lower-base plane (i.e., upright) glyphs. Therefore, to use an ASCII-encoded fractur font, for example, write

```
\setmathfont[range=\mathfrak]{SomeFrakturFont}
```

and because the math plane fractur glyphs will be missing, unicode-math will know to use the ASCII ones instead. If necessary (but why?) this behaviour can be forced with `[range=\mathfrac->\mathup]`.

4.2 Script and scriptscript fonts/features

Cambria Math uses OpenType font features to activate smaller optical sizes for scriptsize and scriptscriptsize symbols (the B and C , respectively, in A_{B_C}). Other fonts will possibly use entirely separate fonts.

Not yet implemented: Both of these options must be taken into account. I hope this will be mostly automatic from the users' points of view. The `+ssty` feature can be detected and applied automatically, and appropriate optical size information embedded in the fonts will ensure this latter case. Fine tuning should be possible automatically with `fontspec` options. We might have to wait until MnMath, for example, before we really know.

5 Maths input

X_YTeX's unicode support allows maths input through two methods. Like classical TeX, macros such as `\alpha`, `\sum`, `\pm`, `\leq`, and so on, provide verbose access to the entire repertoire of characters defined by unicode. The literal characters themselves may be used instead, for more readable input files.

5.1 Math 'style'

Classically, TeX uses italic lowercase Greek letters and *upright* uppercase Greek letters for variables in mathematics. This is contrary to the ISO standards of using italic forms for both upper- and lowercase. Furthermore, the French (contrary again, *quelle surprise*) have been known to use upright uppercase *Latin* letters as well as upright upper- and lowercase Greek. Finally, it is not unknown to use upright letters for all characters, as seen in the Euler fonts.

The unicode-math package accommodates these possibilities with an interface heavily inspired by Walter Schmidt's `lucimatx` package: a package option `math-style` that takes one of four arguments: `TeX`, `ISO`, `French`, or `upright` (case insensitive).

The philosophy behind the interface to the mathematical alphabet symbols lies in L^ATeX's attempt of separating content and formatting. Because input source text may come from a variety of places, the upright and 'mathematical' italic Latin and Greek alphabets are *unified* from the point of view of having a specified meaning in the source text. That is, to get a mathematical ' x ', either the ascii ('keyboard') letter `x` may be typed, or the actual unicode character may be used. Similarly for Greek letters. The upright or italic forms are then chosen based on the `math-style` package option.

If glyphs are desired that do not map as per the package option (for example, an upright ' g ' is desired but typing `g` yields ' g '), *markup* is required to specify this; to follow from the example: `\mathup{g}`. Maths alphabets commands such as `\mathup` are detailed later.

Table 3: Effects of the `math-style` package option.

Package option	Example	
	Latin	Greek
<code>math-style=ISO</code>	(a, z, B, X)	$(\alpha, \beta, \Gamma, \Xi)$
<code>math-style=TeX</code>	(a, z, B, X)	$(\alpha, \beta, \Gamma, \Xi)$
<code>math-style=French</code>	(a, z, B, X)	$(\alpha, \beta, \Gamma, \Xi)$
<code>math-style=upright</code>	(a, z, B, X)	$(\alpha, \beta, \Gamma, \Xi)$

Alternative interface However, some users may not like this convention of normalising their input. For them, an upright x is an upright ‘ x ’ and that’s that. (This will be the case when obtaining source text from copy/pasting PDF or Microsoft Word documents, for example.) For these users, the `literal` option to `math-style` will effect this behaviour.

The `math-style` options’ effects are shown in brief in table 3.

5.2 Bold style

Similar as in the previous section, ISO standards differ somewhat to \TeX ’s conventions (and classical typesetting) for ‘boldness’ in mathematics. In the past, it has been customary to use bold *upright* letters to denote things like vectors and matrices. For example, $\mathbf{M} = (M_x, M_y, M_z)$. Presumably, this was due to the relatively scarcity of bold italic fonts in the pre-digital typesetting era. It has been suggested that *italic* bold symbols are used nowadays instead.

Bold Greek letters have simply been bold variant glyphs of their regular weight, as in $\xi = (\xi_r, \xi_\varphi, \xi_\theta)$. Confusingly, the syntax in \LaTeX has been different for these two examples: `\mathbf{f}` in the former (‘ \mathbf{M} ’), and `\bm` (or `\boldsymbol`, deprecated) in the latter (‘ ξ ’).

In `unicode-math`, the `\mathbf{f}` command works directly with both Greek and Latin maths alphabet characters and depending on package option either switches to upright for Latin letters (`bold-style=TeX`) as well or keeps them italic (`bold-style=ISO`).

To match the package options for non-bold characters, for `bold-style=upright` all bold characters are upright, and `bold-style=literal` does not change the upright/italic shape of the letter.

Upright and italic bold mathematical letters input as direct unicode characters are normalised with the same rules. For example, with `bold-style=TeX`, a literal bold italic latin character will be typeset upright.

Note that `bold-style` is independent of `math-style`, although if the former is not specified then sensible defaults are chosen based on the latter.

The `bold-style` options’ effects are shown in brief in table 4.

Table 4: Effects of the `bold-style` package option.

Package option	Example	
	Latin	Greek
<code>bold-style=ISO</code>	$(\boldsymbol{a}, \boldsymbol{z}, \boldsymbol{B}, \boldsymbol{X})$	$(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\Gamma}, \boldsymbol{\Xi})$
<code>bold-style=TeX</code>	$(\boldsymbol{a}, \boldsymbol{z}, \boldsymbol{B}, \boldsymbol{X})$	$(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\Gamma}, \boldsymbol{\Xi})$
<code>bold-style=upright</code>	$(\boldsymbol{a}, \boldsymbol{z}, \boldsymbol{B}, \boldsymbol{X})$	$(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\Gamma}, \boldsymbol{\Xi})$

5.3 Sans serif style

Unicode contains upright and italic, medium and bold mathematical alphabet characters. These may be explicitly selected with the `\mathsfup`, `\mathsfit`, `\mathbfsup`, and `\mathbfsfit` commands discussed in section §5.4.

How should the generic `\mathsf` behave? Unlike bold, sans serif is used much more sparingly in mathematics. I’ve seen recommendations to typeset tensors in sans serif italic or sans serif italic bold (e.g., examples in the `isomath` and `mattens` packages). But L^AT_EX’s `\mathsf` is *upright* sans serif.

Therefore I reluctantly add the package options `[sans-style=upright]` and `[sans-style=italic]` to control the behaviour of `\mathsf`. The `upright` style sets up the command to use the seemingly-useless upright sans serif, including Greek; the `italic` style switches to using italic in both Latin and Greek alphabets. In other words, this option simply changes the meaning of `\mathsf` to either `\mathsfup` or `\mathsfit`, respectively. Please let me know if more granular control is necessary here.

There is also a `[sans-style=literal]` setting, set automatically with `[math-style=literal]`, which retains the uprightness of the input characters used when selecting the sans serif output.

5.3.1 What about bold sans serif?

While you might want your bold upright and your sans serif italic, I don’t believe you’d also want your bold sans serif upright (or all vice versa, if that’s even conceivable). Therefore, bold sans serif follows from the setting for sans serif; it is completely independent of the setting for bold.

In other words, `\mathbfsf` is `\mathbfsup` or `\mathbfsfit` based on `[sans-style=upright]` or `[sans-style=italic]`, respectively. And `[sans-style=literal]` causes `\mathbfsf` to retain the same italic or upright shape as the input, and turns it bold sans serif.

Note well! There is no medium-weight sans serif Greek alphabet in unicode; therefore, `\mathsf{\alpha}` does not make sense (simply produces ‘ α ’) while `\mathbfsf{\alpha}` gives ‘ α ’.

Table 5: Mathematical alphabets defined in unicode. Black dots indicate an alphabet exists in the font specified; grey dots indicate shapes that should always be taken from the upright font even in the italic style. See main text for description of `\mathbbit`.

Font				Alphabet		
Style	Shape	Series	Switch	Latin	Greek	Numerals
Serif	Upright	Normal	<code>\mathup</code>	•	•	•
		Bold	<code>\mathbfup</code>	•	•	•
	Italic	Normal	<code>\mathit</code>	•	•	•
		Bold	<code>\mathbfit</code>	•	•	•
Sans serif	Upright	Normal	<code>\mathsfup</code>	•		•
	Italic	Normal	<code>\mathsfit</code>	•		•
	Upright	Bold	<code>\mathsfbfup</code>	•	•	•
	Italic	Bold	<code>\mathsfbfit</code>	•	•	•
Typewriter	Upright	Normal	<code>\mathtt</code>	•		•
Double-struck	Upright	Normal	<code>\mathbb</code>	•		•
	Italic	Normal	<code>\mathbbit</code>	•		
Script	Upright	Normal	<code>\mathscr</code>	•		
		Bold	<code>\matbfscr</code>	•		
Fraktur	Upright	Normal	<code>\mathfrak</code>	•		
		Bold	<code>\mathbffrac</code>	•		

5.4 All (the rest) of the mathematical alphabets

Unicode contains separate codepoints for most if not all variations of alphabet shape one may wish to use in mathematical notation. The complete list is shown in table 5. Some of these have been covered in the previous sections.

At present, the math font switching commands do not nest; therefore if you want sans serif bold, you must write `\mathsfbf{...}` rather than `\mathbf{\mathsf{...}}`. This may change in the future.

5.4.1 Double-struck

The double-struck alphabet (also known as ‘blackboard bold’) consists of upright Latin letters $\{a-z, A-Z\}$, numerals $\mathbb{0}-\mathbb{9}$, summation symbol $\mathbb{\Sigma}$, and four Greek letters only: $\{\mathbb{V}, \mathbb{W}, \mathbb{F}, \mathbb{M}\}$.

While `\mathbb{\sum}` does produce a double-struck summation symbol, its limits aren’t properly aligned (see section §??). Therefore, either the literal character or the control sequence `\Bbbsum` are recommended instead.

There are also five Latin *italic* double-struck letters: $\mathbb{D}, \mathbb{d}, \mathbb{E}, \mathbb{e}, \mathbb{J}$. These can be accessed (if not with their literal characters or control sequences) with the `\mathbbit`

Table 6: The various forms of nabla.

Description		Glyph
Upright	Serif	∇
	Bold serif	∇
	Bold sans	∇
Italic	Serif	∇
	Bold serif	∇
	Bold sans	∇

alphabet switch, but note that only those five letters will give the expected output.

5.5 Miscellanea

5.5.1 Nabla

The symbol ∇ comes in the six forms shown in table 6. We want an individual option to specify whether we want upright or italic nabla by default (when either upright or italic nabla is used in the source). \TeX classically uses an upright nabla, but iso standards differ (I think). The package options `nabla=upright` and `nabla=italic` switch between the two choices. This is then inherited through `\mathbf`; `\mathit` and `\mathup` can be used to force one way or the other.

`nabla=italic` is implicit when using `math-style=ISO` and `nabla=upright` follows both `math-style=TeX` and `math-style=French`.

5.5.2 Partial

The same applies to the symbols `u+2202` partial differential and `u+1D715` math italic partial differential.

At time of writing, both the Cambria Math and STIX fonts display these two glyphs in the same italic style, but this is hopefully a bug that will be corrected in the future — the ‘plain’ partial differential should really have an upright shape.

Use the `partial=upright` or `partial=italic` package options to specify which one you would like. The default is (always, unless someone requests and argues otherwise) `partial=italic`.¹

See table 7 for the variations on the partial differential symbol.

¹A good argument would revolve around some international standards body recommending upright over italic. I just don’t have the time right now to look it up.

Table 7: The various forms of the partial differential. Note that in the fonts used to display these glyphs, the first upright partial is incorrectly shown in an italic style.

Description		Glyph
Regular	Upright	∂
	Italic	∂
Bold	Upright	∂
	Italic	∂
Sans bold	Upright	
	Italic	

5.5.3 Epsilon and phi: ε vs. ϵ and φ vs. ϕ

\TeX defines `\epsilon` to look like ϵ and `\varepsilon` to look like ε . The Unicode glyph directly after delta and before zeta is ‘epsilon’ and looks like ε ; there is a subsequent variant of epsilon that looks like ϵ . This creates a problem. People who use unicode input won’t want their glyphs transforming; \TeX users will be confused that what they think as ‘normal epsilon’ is actual the ‘variant epsilon’. And the same problem exists for ‘phi’.

We have a package option to control this behaviour. With `\vargreek-shape=TeX`, `\phi` and `\epsilon` produce ϕ and ε and `\varphi` and `\varepsilon` produce ϕ and ϵ . With `\vargreek-shape=unicode`, these symbols are swapped. Note, however, that unicode characters are not affected by this option. That is, no remapping occurs of the characters/glyphs, only the control sequences.

The package default is to use `\vargreek-shape=TeX`.

5.5.4 Primes

Primes (x') may be input in several ways. You may use any combination of ASCII straight quote (’), unicode prime U+2032 (’), and `\prime`; when multiple primes occur next to each other, they chain together to form double, triple, or quadruple primes if the font contains pre-drawn glyphs. These may also be accessed with `\dprime`, `\trprime`, and `\qprime`, respectively.

If the font does not contain the pre-drawn glyphs or more than four primes are used, the single prime glyph is used multiple times with a negative kern to get the spacing right. There is no user interface to adjust this negative kern yet (because I haven’t decided what it should look like); if you need to, write something like this:

```
\ExplSyntaxOn
\muskip_gset:Nn \g_um_primekern_muskip { -\thinmuskip/2 }
\ExplSyntaxOff
```

A 0 1 2 3 4 5 6 7 8 9 + - = () i n Z

Figure 1: The unicode superscripts supported as input characters. These are the literal glyphs from Charis SIL, not the output seen when used for maths input. The ‘A’ and ‘Z’ are to provide context for the size and location of the superscript glyphs.

A 0 1 2 3 4 5 6 7 8 9 + - = () a e i o r u v x β γ ρ φ χ Z

Figure 2: The unicode subscripts supported as input characters. See note from figure 1.

Backwards or reverse primes behave in exactly the same way; use any of `ASCII` back tick (```), unicode reverse prime `u+2035` (`'`), or `\backprime` to access it. Multiple backwards primes can also be called with `\backdprime`, `\backtrprime`, and `\backqprime`.

5.5.5 Unicode subscripts and superscripts

You may, if you wish, use unicode subscripts and superscripts in your source document. For basic expressions, the use of these characters can make the input more readable. Adjacent sub- or super-scripts will be concatenated into a single expression.

The range of subscripts and superscripts supported by this package are shown in figures 1 and 2. Please request more if you think it is appropriate.

5.5.6 Colon

The colon is one of the few confusing characters of unicode maths. In $\text{T}_{\text{E}}\text{X}$, `:` is defined as a colon with relation spacing: `‘a : b’`. While `\colon` is defined as a colon with punctuation spacing: `‘a:b’`.

In unicode, `u+003A` colon is defined as a punctuation symbol, while `u+2236` ratio is the colon-like symbol used in mathematics to denote ratios and other things.

This breaks the usual straightforward mapping from control sequence to unicode input character to (the same) unicode glyph.

To preserve input compatibility, we remap the `ASCII` input character `‘:’` to `u+2236`. Typing a literal `u+2236` char will result in the same output. If `amsmath` is loaded, then the definition of `\colon` is inherited from there (it looks like a punctuation colon with additional space around it). Otherwise, `\colon` is made to output a colon with `\mathpunct` spacing.

Table 8: Slashes and backslashes.

Slot	Name	Glyph	Command
U+002F	SOLIDUS	/	<code>\solidus</code>
U+2044	FRACTION SLASH	/	<code>\fracslash</code>
U+2215	DIVISION SLASH	/	<code>\slash</code>
U+29F8	BIG SOLIDUS	/	<code>\xsol</code>
U+005C	REVERSE SOLIDUS	\	<code>\backslash</code>
U+2216	SET MINUS	\	<code>\smallsetminus</code>
U+29F5	REVERSE SOLIDUS OPERATOR	\	<code>\setminus</code>
U+29F9	BIG REVERSE SOLIDUS	\	<code>\xbsol</code>

The package option `colon=literal` forces ASCII input ‘:’ to be printed as `\mathcolon` instead.

5.5.7 Slashes and backslashes

There are several slash-like symbols defined in unicode. The complete list is shown in table 8.

In regular \LaTeX we can write `\left\slash...\right\backslash` and so on and obtain extensible delimiter-like symbols. Not all of the unicode slashes are suitable for this (and do not have the font support to do it).

Slash Of U+2044 fraction slash, TR25 says that it is:

...used to build up simple fractions in running text...however parsers of mathematical texts should be prepared to handle fraction slash when it is received from other sources.

U+2215 division slash should be used when division is represented without a built-up fraction; $\pi \approx 22/7$, for example.

U+29F8 big solidus is a ‘big operator’ (like Σ).

Backslash The U+005C reverse solidus character `\backslash` is used for denoting double cosets: $A \backslash B$. (So I’m led to believe.) It may be used as a ‘stretchy’ delimiter if supported by the font.

MathML uses U+2216 set minus like this: $A \setminus B$.² The \LaTeX command name `\smallsetminus` is used for backwards compatibility.

²§4.4.5.11 <http://www.w3.org/TR/2001/REC-MathML3/>

Presumably, u+29F5 reverse solidus operator is intended to be used in a similar way, but it could also (perhaps?) be used to represent ‘inverse division’: $\pi \approx 7 \setminus 22$.³ The L^AT_EX name for this character is `\setminus`.

Finally, u+29F9 big reverse solidus is a ‘big operator’ (like Σ).

How to use all of these things Unfortunately, font support for the above characters/glyphs is rather inconsistent. In Cambria Math, the only slash that grows (say when writing

$$\left[\begin{array}{cc} a & b \\ c & d \end{array} \right] / \left[\begin{array}{cc} 1 & 1 \\ 1 & 0 \end{array} \right]$$

is the `FRACTION SLASH`, which we just established above is sort of only supposed to be used in text.

Of the above characters, the following are allowed to be used after `\left`, `\middle`, and `\right`:

- `\solidus`;
- `\fracdash`;
- `\slash`; and,
- `\backslash` (the only reverse slash).

However, we assume that there is only *one* stretchy slash in the font; this is assumed by default to be u+002F solidus. Writing `\left/` or `\left\slash` or `\leftfracdash` will all result in the same stretchy delimiter being used.

The delimiter used can be changed with the `slash-delimiter` package option. Allowed values are `ascii`, `frac`, and `div`, corresponding to the respective unicode slots.

For example: as mentioned above, Cambria Math’s stretchy slash is u+2044 fraction slash. When using Cambria Math, then `unicode-math` should be loaded with the `slash-delimiter=frac` option. (This should be a font option rather than a package option, but it will change soon.)

5.5.8 Pre-drawn fraction characters

Pre-drawn fractions u+00BC – u+00BE , u+2150 – u+215E are not suitable for use in mathematics output. However, they can be useful as input characters to abbreviate common fractions.

$\frac{1}{4}$ $\frac{1}{2}$ $\frac{3}{4}$ $\frac{1}{3}$ $\frac{2}{3}$ $\frac{1}{5}$ $\frac{2}{5}$ $\frac{3}{5}$ $\frac{4}{5}$ $\frac{1}{6}$ $\frac{5}{6}$ $\frac{1}{8}$ $\frac{3}{8}$ $\frac{5}{8}$ $\frac{7}{8}$

For example, instead of writing ‘`\tfrac{12}{x}`’, it’s more readable to have ‘ $\frac{12}{x}$ ’ in the source instead.

³This is valid syntax in the Octave and Matlab programming languages, in which it means matrix inverse pre-multiplication. I.e., $A \setminus B \equiv A^{-1}B$.

Slot	Command	Glyph	Glyph	Command	Slot
U+00B7	<code>\cdotp</code>	.			
U+22C5	<code>\cdot</code>	.			
U+2219	<code>\vysmbkcircle</code>	•	◦	<code>\vysmwhtcircle</code>	U+2218
U+2022	<code>\smbkcircle</code>	•	◦	<code>\smwhtcircle</code>	U+25E6
U+2981	<code>\mdsmbkcircle</code>	●	◉	<code>\mdsmwhtcircle</code>	U+26AC
U+26AB	<code>\mdbkcircle</code>	●	◯	<code>\mdwhtcircle</code>	U+26AA
U+25CF	<code>\mdlgbkcircle</code>	●	◯	<code>\mdlgwhtcircle</code>	U+25CB
U+2B24	<code>\lgbkcircle</code>	●	◯	<code>\lgwhtcircle</code>	U+25EF

Table 9: Filled and hollow unicode circles.

If the `\tfrac` command exists (i.e., if `amsmath` is loaded or you have specially defined `\tfrac` for this purpose), it will be used to typeset the fractions. If not, regular `\frac` will be used. The command to use (`\tfrac` or `\frac`) can be forced either way with the package option `active-frac=small` or `active-frac=normalsize`, respectively.

5.5.9 Circles

Unicode defines a large number of different types of circles for a variety of mathematical purposes. There are thirteen alone just considering the all white and all black ones, shown in table 9.

L^AT_EX defines considerably fewer: `\circ` and `\bigcirc` for white; `\bullet` for black. This package maps those commands to `\vysmwhtcircle`, `\mdlgwhtcircle`, and `\smbkcircle`, respectively.

5.5.10 Triangles

While there aren't as many different sizes of triangle as there are circle, there's some important distinctions to make between a few similar characters. Namely, Δ and \triangle and Δ and Δ . See table 10 for the full summary.

These triangles all have different intended meanings. Note for backwards compatibility with T_EX, U+25B3 has *two* different mappings in unicode-math. `\bigtriangleup` is intended as a binary operator whereas `\triangle` is intended to be used as a letter-like symbol.

But you're better off if you're using the latter form to indicate an increment to use the glyph intended for this purpose: Δx .

Finally, given that Δ and Δ are provided for you already, it is better off to only use upright Greek Delta Δ if you're actually using it as a symbolic entity such as a variable on its own.

Slot	Command	Glyph	Class
U+25B5	<code>\vartriangle</code>	\triangle	binary
U+25B3	<code>\bigtriangleup</code>	\bigtriangleup	binary
U+25B3	<code>\triangle</code>	\triangle	ordinary
U+2206	<code>\increment</code>	Δ	ordinary
U+0394	<code>\mathup\Delta</code>	Δ	ordinary

Table 10: Different upwards pointing triangles.

5.5.11 Normalising some input characters

I believe all variant forms should be used as legal input that is normalised to a consistent output glyph, because we want to be fault-tolerant in the input. Here are the duplicates:

- U+251 latin small letter alpha
- U+25B latin small letter epsilon
- U+263 latin small letter gamma
- U+269 latin small letter iota
- U+278 latin small letter phi
- U+28A latin small letter upsilon
- U+190 latin capital letter epsilon
- U+194 latin capital letter gamma
- U+196 latin capital letter iota
- U+1B1 latin capital letter upsilon

(Not yet implemented.)

File I

The unicode-math package

This is the package.

```

1 \ProvidesPackage{unicode-math}
2 [2009/10/27 v0.4 Unicode maths in XeLaTeX]
```

6 Things we need

Packages


```

3 \RequirePackage{expl3}[2009/08/12]
4 \RequirePackage{xparse}[2009/08/31]
5 \RequirePackage{fontspec}
6 \RequirePackage{scr1file}

    Start using LATEX3 — finally!
7 \ExplSyntaxOn

```

Extra expl3 variants

```

8 \cs_generate_variant:Nn \tl_put_right:Nn {cx}
9 \cs_generate_variant:Nn \seq_if_in:NnTF {NV}
10 \cs_generate_variant:Nn \prop_gput:Nnn {Nxn}
11 \cs_generate_variant:Nn \prop_get:NnN {cxN}
12 \cs_generate_variant:Nn \prop_if_in:NnTF {cx}

```

Conditionals

```

13 \bool_new:N \l_um_fontspec_feature_bool
14 \bool_new:N \l_um_ot_math_bool
15 \bool_new:N \l_um_init_bool
16 \bool_new:N \l_um_implicit_alph_bool

```

For math-style:

```

17 \bool_new:N \g_um_literal_bool
18 \bool_new:N \g_um_upLatin_bool
19 \bool_new:N \g_um_uplatin_bool
20 \bool_new:N \g_um_upGreek_bool
21 \bool_new:N \g_um_upgreek_bool

```

For bold-style:

```

22 \bool_new:N \g_um_bfliteral_bool
23 \bool_new:N \g_um_bfupLatin_bool
24 \bool_new:N \g_um_bfuplatin_bool
25 \bool_new:N \g_um_bfupGreek_bool
26 \bool_new:N \g_um_bfupgreek_bool

```

For sans-style:

```

27 \bool_new:N \g_um_upsans_bool
28 \bool_new:N \g_um_sfliteral_bool

```

For assorted package options:

```

29 \bool_new:N \g_um_upNabla_bool
30 \bool_new:N \g_um_uppartial_bool
31 \bool_new:N \g_um_texgreek_bool
32 \bool_new:N \l_um_smallfrac_bool
33 \bool_new:N \g_um_literal_colon_bool

```

Variables

```
34 \int_new:N \g_um_fam_int
35 \tl_set:Nn \g_um_math_alphabet_name_latin_tl {Latin,~lowercase}
36 \tl_set:Nn \g_um_math_alphabet_name_Latin_tl {Latin,~uppercase}
37 \tl_set:Nn \g_um_math_alphabet_name_greek_tl {Greek,~lowercase}
38 \tl_set:Nn \g_um_math_alphabet_name_Greek_tl {Greek,~uppercase}
39 \tl_set:Nn \g_um_math_alphabet_name_num_tl {Numerals}
40 \tl_set:Nn \g_um_math_alphabet_name_misc_tl {Misc.}
```

6.0.12 Alphabet unicode positions

Before we begin, let's define the positions of the various unicode alphabets so that our code is a little more readable.⁴

Rather than 'readable', in the end, this makes the code more extensible.

```
41 \cs_new:Nn \usv_set:nnn {
42   \tl_set:cn { \um_to_usv:nn {#1}{#2} } {#3}
43 }
44 \cs_new:Nn \um_to_usv:nn { g_um_#1_#2_usv }
```

Alphabets

```
45 \usv_set:nnn {up}{num}{48}
46 \usv_set:nnn {up}{Latin}{65}
47 \usv_set:nnn {up}{latin}{97}
48 \usv_set:nnn {up}{Greek}{"391}
49 \usv_set:nnn {up}{greek}{"3B1}
50 \usv_set:nnn {it}{Latin}{"1D434}
51 \usv_set:nnn {it}{latin}{"1D44E}
52 \usv_set:nnn {it}{Greek}{"1D6E2}
53 \usv_set:nnn {it}{greek}{"1D6FC}
54 \usv_set:nnn {bb}{num}{"1D7D8}
55 \usv_set:nnn {bb}{Latin}{"1D538}
56 \usv_set:nnn {bb}{latin}{"1D552}
57 \usv_set:nnn {scr}{Latin}{"1D49C}
58 \usv_set:nnn {scr}{latin}{"1D4B6}
59 \usv_set:nnn {frak}{Latin}{"1D504}
60 \usv_set:nnn {frak}{latin}{"1D51E}
61 \usv_set:nnn {sf}{num}{"1D7E2}
62 \usv_set:nnn {sfup}{num}{"1D7E2}
63 \usv_set:nnn {sfit}{num}{"1D7E2}
64 \usv_set:nnn {sfup}{Latin}{"1D5A0}
65 \usv_set:nnn {sf}{Latin}{"1D5A0}
66 \usv_set:nnn {sfup}{latin}{"1D5BA}
67 \usv_set:nnn {sf}{latin}{"1D5BA}
```

⁴'u.s.v.' stands for 'unicode scalar value'.

```

68 \usv_set:nnn {sfit}{Latin}{ "1D608}
69 \usv_set:nnn {sfit}{latin}{ "1D622}
70 \usv_set:nnn {tt}{num}{ "1D7F6}
71 \usv_set:nnn {tt}{Latin}{ "1D670}
72 \usv_set:nnn {tt}{latin}{ "1D68A}

```

Bold:

```

73 \usv_set:nnn {bf}{num}{ "1D7CE}
74 \usv_set:nnn {bfup}{num}{ "1D7CE}
75 \usv_set:nnn {bfit}{num}{ "1D7CE}
76 \usv_set:nnn {bfup}{Latin}{ "1D400}
77 \usv_set:nnn {bfup}{latin}{ "1D41A}
78 \usv_set:nnn {bfup}{Greek}{ "1D6A8}
79 \usv_set:nnn {bfup}{greek}{ "1D6C2}
80 \usv_set:nnn {bfit}{Latin}{ "1D468}
81 \usv_set:nnn {bfit}{latin}{ "1D482}
82 \usv_set:nnn {bfit}{Greek}{ "1D71C}
83 \usv_set:nnn {bfit}{greek}{ "1D736}
84 \usv_set:nnn {bffrak}{Latin}{ "1D56C}
85 \usv_set:nnn {bffrak}{latin}{ "1D586}
86 \usv_set:nnn {bfscr}{Latin}{ "1D4D0}
87 \usv_set:nnn {bfscr}{latin}{ "1D4EA}
88 \usv_set:nnn {bfsf}{num}{ "1D7EC}
89 \usv_set:nnn {bfsfup}{num}{ "1D7EC}
90 \usv_set:nnn {bfsfit}{num}{ "1D7EC}
91 \usv_set:nnn {bfsfup}{Latin}{ "1D5D4}
92 \usv_set:nnn {bfsfup}{latin}{ "1D5EE}
93 \usv_set:nnn {bfsfup}{Greek}{ "1D756}
94 \usv_set:nnn {bfsfup}{greek}{ "1D770}
95 \usv_set:nnn {bfsfit}{Latin}{ "1D63C}
96 \usv_set:nnn {bfsfit}{latin}{ "1D656}
97 \usv_set:nnn {bfsfit}{Greek}{ "1D790}
98 \usv_set:nnn {bfsfit}{greek}{ "1D7AA}

```

```

99 \usv_set:nnn {bfsf}{Latin}{ \bool_if:NTF \g_um_upLatin_bool \g_um_bfsfup_Latin_usv \g_um_bfsf
100 \usv_set:nnn {bfsf}{latin}{ \bool_if:NTF \g_um_uplatin_bool \g_um_bfsfup_latin_usv \g_um_bfsf
101 \usv_set:nnn {bfsf}{Greek}{ \bool_if:NTF \g_um_upGreek_bool \g_um_bfsfup_Greek_usv \g_um_bfsf
102 \usv_set:nnn {bfsf}{greek}{ \bool_if:NTF \g_um_upgreek_bool \g_um_bfsfup_greek_usv \g_um_bfsf
103 \usv_set:nnn {bf}{Latin}{ \bool_if:NTF \g_um_bfupLatin_bool \g_um_bfup_Latin_usv \g_um_bfit_L
104 \usv_set:nnn {bf}{latin}{ \bool_if:NTF \g_um_bfuplatin_bool \g_um_bfup_latin_usv \g_um_bfit_l
105 \usv_set:nnn {bf}{Greek}{ \bool_if:NTF \g_um_bfupGreek_bool \g_um_bfup_Greek_usv \g_um_bfit_G
106 \usv_set:nnn {bf}{greek}{ \bool_if:NTF \g_um_bfupgreek_bool \g_um_bfup_greek_usv \g_um_bfit_g

```

Greek variants:

```

107 \usv_set:nnn {up}{varTheta}{ "3F4}
108 \usv_set:nnn {up}{Digamma}{ "3DC}
109 \usv_set:nnn {up}{varepsilon}{ "3F5}
110 \usv_set:nnn {up}{vartheta}{ "3D1}

```

111 \usv_set:nnn {up}{varkappa}{ "3F0}
 112 \usv_set:nnn {up}{varphi}{ "3D5}
 113 \usv_set:nnn {up}{varrho}{ "3F1}
 114 \usv_set:nnn {up}{varpi}{ "3D6}
 115 \usv_set:nnn {up}{digamma}{ "3DD}

Bold:

116 \usv_set:nnn {bfup}{varTheta}{ "1D6B9}
 117 \usv_set:nnn {bfup}{Digamma}{ "1D7CA}
 118 \usv_set:nnn {bfup}{varepsilon}{ "1D6DC}
 119 \usv_set:nnn {bfup}{vartheta}{ "1D6DD}
 120 \usv_set:nnn {bfup}{varkappa}{ "1D6DE}
 121 \usv_set:nnn {bfup}{varphi}{ "1D6DF}
 122 \usv_set:nnn {bfup}{varrho}{ "1D6E0}
 123 \usv_set:nnn {bfup}{varpi}{ "1D6E1}
 124 \usv_set:nnn {bfup}{digamma}{ "1D7CB}

Italic Greek variants:

125 \usv_set:nnn {it}{varTheta}{ "1D6F3}
 126 \usv_set:nnn {it}{varepsilon}{ "1D716}
 127 \usv_set:nnn {it}{vartheta}{ "1D717}
 128 \usv_set:nnn {it}{varkappa}{ "1D718}
 129 \usv_set:nnn {it}{varphi}{ "1D719}
 130 \usv_set:nnn {it}{varrho}{ "1D71A}
 131 \usv_set:nnn {it}{varpi}{ "1D71B}

Bold italic:

132 \usv_set:nnn {bfit}{varTheta}{ "1D72D}
 133 \usv_set:nnn {bfit}{varepsilon}{ "1D750}
 134 \usv_set:nnn {bfit}{vartheta}{ "1D751}
 135 \usv_set:nnn {bfit}{varkappa}{ "1D752}
 136 \usv_set:nnn {bfit}{varphi}{ "1D753}
 137 \usv_set:nnn {bfit}{varrho}{ "1D754}
 138 \usv_set:nnn {bfit}{varpi}{ "1D755}

Bold sans:

139 \usv_set:nnn {bfsfup}{varTheta}{ "1D767}
 140 \usv_set:nnn {bfsfup}{varepsilon}{ "1D78A}
 141 \usv_set:nnn {bfsfup}{vartheta}{ "1D78B}
 142 \usv_set:nnn {bfsfup}{varkappa}{ "1D78C}
 143 \usv_set:nnn {bfsfup}{varphi}{ "1D78D}
 144 \usv_set:nnn {bfsfup}{varrho}{ "1D78E}
 145 \usv_set:nnn {bfsfup}{varpi}{ "1D78F}

Bold sans italic:

146 \usv_set:nnn {bfsfit}{varTheta}{ "1D7A1}
 147 \usv_set:nnn {bfsfit}{varepsilon}{ "1D7C4}
 148 \usv_set:nnn {bfsfit}{vartheta}{ "1D7C5}
 149 \usv_set:nnn {bfsfit}{varkappa}{ "1D7C6}

```

150 \usv_set:nnn {bfsfit}{varphi} {"1D7C7}
151 \usv_set:nnn {bfsfit}{varrho} {"1D7C8}
152 \usv_set:nnn {bfsfit}{varpi} {"1D7C9}

```

Nabla:

```

153 \usv_set:nnn {up}    {Nabla}{"02207}
154 \usv_set:nnn {it}    {Nabla}{"1D6FB}
155 \usv_set:nnn {bfup}  {Nabla}{"1D6C1}
156 \usv_set:nnn {bfit}  {Nabla}{"1D735}
157 \usv_set:nnn {bfsfup}{Nabla}{"1D76F}
158 \usv_set:nnn {bfsfit}{Nabla}{"1D7A9}

```

Partial:

```

159 \usv_set:nnn {up}    {partial}{"02202}
160 \usv_set:nnn {it}    {partial}{"1D715}
161 \usv_set:nnn {bfup}  {partial}{"1D6DB}
162 \usv_set:nnn {bfit}  {partial}{"1D74F}
163 \usv_set:nnn {bfsfup}{partial}{"1D789}
164 \usv_set:nnn {bfsfit}{partial}{"1D7C3}

```

Exceptions These are need for mapping with the exceptions in other alphabets:
(coming up)

```

165 \usv_set:nnn {up}{B}{`\B}
166 \usv_set:nnn {up}{C}{`\C}
167 \usv_set:nnn {up}{D}{`\D}
168 \usv_set:nnn {up}{E}{`\E}
169 \usv_set:nnn {up}{F}{`\F}
170 \usv_set:nnn {up}{H}{`\H}
171 \usv_set:nnn {up}{I}{`\I}
172 \usv_set:nnn {up}{L}{`\L}
173 \usv_set:nnn {up}{M}{`\M}
174 \usv_set:nnn {up}{N}{`\N}
175 \usv_set:nnn {up}{P}{`\P}
176 \usv_set:nnn {up}{Q}{`\Q}
177 \usv_set:nnn {up}{R}{`\R}
178 \usv_set:nnn {up}{Z}{`\Z}

179 \usv_set:nnn {it}{B}{"1D435}
180 \usv_set:nnn {it}{C}{"1D436}
181 \usv_set:nnn {it}{D}{"1D437}
182 \usv_set:nnn {it}{E}{"1D438}
183 \usv_set:nnn {it}{F}{"1D439}
184 \usv_set:nnn {it}{H}{"1D43B}
185 \usv_set:nnn {it}{I}{"1D43C}
186 \usv_set:nnn {it}{L}{"1D43F}
187 \usv_set:nnn {it}{M}{"1D440}
188 \usv_set:nnn {it}{N}{"1D441}

```

```

189 \usv_set:nnn {it}{P}{1D443}
190 \usv_set:nnn {it}{Q}{1D444}
191 \usv_set:nnn {it}{R}{1D445}
192 \usv_set:nnn {it}{Z}{1D44D}

193 \usv_set:nnn {up}{d}{`d}
194 \usv_set:nnn {up}{e}{`e}
195 \usv_set:nnn {up}{g}{`g}
196 \usv_set:nnn {up}{h}{`h}
197 \usv_set:nnn {up}{i}{`i}
198 \usv_set:nnn {up}{j}{`j}
199 \usv_set:nnn {up}{o}{`o}

200 \usv_set:nnn {it}{d}{1D451}
201 \usv_set:nnn {it}{e}{1D452}
202 \usv_set:nnn {it}{g}{1D454}
203 \usv_set:nnn {it}{h}{0210E}
204 \usv_set:nnn {it}{i}{1D456}
205 \usv_set:nnn {it}{j}{1D457}
206 \usv_set:nnn {it}{o}{1D45C}

```

Latin ‘h’:

```

207 \usv_set:nnn {bb} {h}{1D559}
208 \usv_set:nnn {tt} {h}{1D691}
209 \usv_set:nnn {scr} {h}{1D4BD}
210 \usv_set:nnn {frak} {h}{1D525}
211 \usv_set:nnn {bfup} {h}{1D421}
212 \usv_set:nnn {bfit} {h}{1D489}
213 \usv_set:nnn {sfup} {h}{1D5C1}
214 \usv_set:nnn {sfit} {h}{1D629}
215 \usv_set:nnn {bffrak}{h}{1D58D}
216 \usv_set:nnn {bfscr} {h}{1D4F1}
217 \usv_set:nnn {bfsfup}{h}{1D5F5}
218 \usv_set:nnn {bfsfit}{h}{1D65D}

```

Dotless ‘i’ and ‘j’:

```

219 \usv_set:nnn {up}{dotlessi}{00131}
220 \usv_set:nnn {up}{dotlessj}{00237}
221 \usv_set:nnn {it}{dotlessi}{1D6A4}
222 \usv_set:nnn {it}{dotlessj}{1D6A5}

```

Blackboard:

```

223 \usv_set:nnn {bb}{C}{2102}
224 \usv_set:nnn {bb}{H}{210D}
225 \usv_set:nnn {bb}{N}{2115}
226 \usv_set:nnn {bb}{P}{2119}
227 \usv_set:nnn {bb}{Q}{211A}
228 \usv_set:nnn {bb}{R}{211D}
229 \usv_set:nnn {bb}{Z}{2124}

```

```

230 \usv_set:nnn {up}{Pi}      {"003A0}
231 \usv_set:nnn {up}{pi}     {"003C0}
232 \usv_set:nnn {up}{Gamma}  {"00393}
233 \usv_set:nnn {up}{gamma}  {"003B3}
234 \usv_set:nnn {up}{summation}{02211}
235 \usv_set:nnn {it}{Pi}     {"1D6F1}
236 \usv_set:nnn {it}{pi}     {"1D70B}
237 \usv_set:nnn {it}{Gamma}  {"1D6E4}
238 \usv_set:nnn {it}{gamma}  {"1D6FE}
239 \usv_set:nnn {bb}{Pi}     {"0213F}
240 \usv_set:nnn {bb}{pi}     {"0213C}
241 \usv_set:nnn {bb}{Gamma}  {"0213E}
242 \usv_set:nnn {bb}{gamma}  {"0213D}
243 \usv_set:nnn {bb}{summation}{02140}

```

Italic blackboard:

```

244 \usv_set:nnn {bbit}{D}{2145}
245 \usv_set:nnn {bbit}{d}{2146}
246 \usv_set:nnn {bbit}{e}{2147}
247 \usv_set:nnn {bbit}{i}{2148}
248 \usv_set:nnn {bbit}{j}{2149}

```

Script exceptions:

```

249 \usv_set:nnn {scr}{B}{212C}
250 \usv_set:nnn {scr}{E}{2130}
251 \usv_set:nnn {scr}{F}{2131}
252 \usv_set:nnn {scr}{H}{210B}
253 \usv_set:nnn {scr}{I}{2110}
254 \usv_set:nnn {scr}{L}{2112}
255 \usv_set:nnn {scr}{M}{2133}
256 \usv_set:nnn {scr}{R}{211B}
257 \usv_set:nnn {scr}{e}{212F}
258 \usv_set:nnn {scr}{g}{210A}
259 \usv_set:nnn {scr}{o}{2134}

```

Fraktur exceptions:

```

260 \usv_set:nnn {frak}{C}{212D}
261 \usv_set:nnn {frak}{H}{210C}
262 \usv_set:nnn {frak}{I}{2111}
263 \usv_set:nnn {frak}{R}{211C}
264 \usv_set:nnn {frak}{Z}{2128}

```

Complete u.s.v. ranges These might be needed (with a whole bunch more) later:

```

265 \tl_new:Nn \g_um_mathup_latin_usv_range_tl {\a-`z}
266 \tl_new:Nn \g_um_mathup_Latin_usv_range_tl {\A-`Z}
267 \tl_new:Nn \g_um_mathup_greek_usv_range_tl {"3B1-"3C9,"3F5,"3D1,"3F0,"3D5,"3F1,"3D6,"3DD}
268 \tl_new:Nn \g_um_mathup_Greek_usv_range_tl {"391-"3A9,"3F4,"3DC}

```

```

269 \tl_new:Nn \g_um_mathup_num_usv_range_tl {\0-`9}
270 \tl_new:Nn \g_um_mathit_latin_usv_range_tl {"1D44E-"1D467,\g_um_it_h_usv}
271 \tl_new:Nn \g_um_mathit_Latin_usv_range_tl {"1D434-"1D44C}
272 \tl_new:Nn \g_um_mathit_greek_usv_range_tl {"1D6FC-"1D714,"1D716-1D71B}
273 \tl_new:Nn \g_um_mathit_Greek_usv_range_tl {"1D6E2-"1D6FA}

```

6.1 Options

xkeyval's package support is used here. I'll switch over to l3keys2e at some stage.

`\unimathsetup` This macro can be used in lieu of or later to override options declared when the package is loaded.

```

274 \DeclareDocumentCommand \unimathsetup {m} {
275   \setkeys{unicode-math.sty}{#1}
276 }

```

math-style

```

277 \define@choicekey*{unicode-math.sty}
278   {math-style}[\@tempa\@tempb]{iso,tex,french,upright,literal}{
279   \bool_set_false:N \g_um_literal_bool
280   \ifcase\@tempb\relax
281     \bool_set_false:N \g_um_upGreek_bool
282     \bool_set_false:N \g_um_upgreek_bool
283     \bool_set_false:N \g_um_upLatin_bool
284     \bool_set_false:N \g_um_uplatin_bool
285     \setkeys{unicode-math.sty}{
286       bold-style=iso,
287       sans-style=italic,
288       nabla=italic,
289       partial=italic,
290     }
291   \or
292     \bool_set_true:N \g_um_upGreek_bool
293     \bool_set_false:N \g_um_upgreek_bool
294     \bool_set_false:N \g_um_upLatin_bool
295     \bool_set_false:N \g_um_uplatin_bool
296     \setkeys{unicode-math.sty}{
297       bold-style=tex,
298       sans-style=upright,
299       nabla=upright,
300       partial=italic,
301     }
302   \or
303     \bool_set_true:N \g_um_upGreek_bool
304     \bool_set_true:N \g_um_upgreek_bool
305     \bool_set_true:N \g_um_upLatin_bool

```



```

306 \bool_set_false:N \g_um_uplatin_bool
307 \setkeys{unicode-math.sty}{,
308   bold-style=upright,
309   sans-style=upright,
310   nabla=upright,
311   partial=upright,
312 }
313 \or
314 \bool_set_true:N \g_um_upGreek_bool
315 \bool_set_true:N \g_um_upgreek_bool
316 \bool_set_true:N \g_um_upLatin_bool
317 \bool_set_true:N \g_um_uplatin_bool
318 \setkeys{unicode-math.sty}{,
319   bold-style=upright,
320   sans-style=upright,
321   nabla=upright,
322   partial=upright,
323 }
324 \or
325 \bool_set_true:N \g_um_literal_bool
326 \setkeys{unicode-math.sty}{bold-style=literal}
327 \setkeys{unicode-math.sty}{sans-style=literal}
328 \setkeys{unicode-math.sty}{colon=literal}
329 \fi
330 }

```

bold-style

```

331 \define@choicekey*{unicode-math.sty}{bold-style}[\@tempa\@tempb]{iso,tex,upright,literal}{
332 \bool_set_false:N \g_um_bfliteral_bool
333 \ifcase\@tempb\relax
334   \bool_set_false:N \g_um_bfupGreek_bool
335   \bool_set_false:N \g_um_bfupgreek_bool
336   \bool_set_false:N \g_um_bfupLatin_bool
337   \bool_set_false:N \g_um_bfuplatin_bool
338 \or
339   \bool_set_true:N \g_um_bfupGreek_bool
340   \bool_set_false:N \g_um_bfupgreek_bool
341   \bool_set_true:N \g_um_bfupLatin_bool
342   \bool_set_true:N \g_um_bfuplatin_bool
343 \or
344   \bool_set_true:N \g_um_bfupGreek_bool
345   \bool_set_true:N \g_um_bfupgreek_bool
346   \bool_set_true:N \g_um_bfupLatin_bool
347   \bool_set_true:N \g_um_bfuplatin_bool
348 \or
349   \bool_set_true:N \g_um_bfliteral_bool

```

```

350 \fi
351 }

```

sans-style

```

352 \define@choicekey*{unicode-math.sty}
353   {sans-style}[\@tempa\@tempb]{italic,upright,literal}{
354   \ifcase\@tempb\relax
355     \bool_set_false:N \g_um_upsans_bool
356   \or
357     \bool_set_true:N \g_um_upsans_bool
358   \or
359     \bool_set_true:N \g_um_sfliteral_bool
360   \fi
361 }

```

Symbol obliqueness

```

362 \define@choicekey*{unicode-math.sty}{nabla}[\@tempa\@tempb]{upright,italic}{
363   \ifcase\@tempb
364     \bool_set_true:N \g_um_upNabla_bool
365     \tl_set:Nn \g_um_Nabla_up_or_it_usv { \g_um_up_Nabla_usv }
366     \tl_set:Nn \g_um_bfNabla_up_or_it_usv { \g_um_bfup_Nabla_usv }
367     \tl_set:Nn \g_um_bfsfNabla_up_or_it_usv { \g_um_bfsfup_Nabla_usv }
368   \or
369     \bool_set_false:N \g_um_upNabla_bool
370     \tl_set:Nn \g_um_Nabla_up_or_it_usv { \g_um_it_Nabla_usv }
371     \tl_set:Nn \g_um_bfNabla_up_or_it_usv { \g_um_bfit_Nabla_usv }
372     \tl_set:Nn \g_um_bfsfNabla_up_or_it_usv { \g_um_bfsfit_Nabla_usv }
373   \fi
374 }

375 \define@choicekey*{unicode-math.sty}{partial}[\@tempa\@tempb]{upright,italic}{
376   \ifcase\@tempb
377     \bool_set_true:N \g_um_uppartial_bool
378     \tl_set:Nn \g_um_partial_up_or_it_usv { \g_um_up_partial_usv }
379     \tl_set:Nn \g_um_bfpartial_up_or_it_usv { \g_um_bfup_partial_usv }
380     \tl_set:Nn \g_um_bfsfpartial_up_or_it_usv { \g_um_bfsfup_partial_usv }
381   \or
382     \bool_set_false:N \g_um_uppartial_bool
383     \tl_set:Nn \g_um_partial_up_or_it_usv { \g_um_it_partial_usv }
384     \tl_set:Nn \g_um_bfpartial_up_or_it_usv { \g_um_bfit_partial_usv }
385     \tl_set:Nn \g_um_bfsfpartial_up_or_it_usv { \g_um_bfsfit_partial_usv }
386   \fi
387 }

```

Epsilon and phi shapes

```

388 \define@choicekey*{unicode-math.sty}{vargreek-shape}[\@tempa\@tempb]{unicode,TeX}{
389   \ifcase\@tempb
390     \bool_set_false:N \g_um_texgreek_bool
391   \or
392     \bool_set_true:N \g_um_texgreek_bool
393   \fi
394 }

```

Colon style

```

395 \define@choicekey*{unicode-math.sty}{colon}[\@tempa\@tempb]{literal,TeX}{
396   \ifcase\@tempb
397     \bool_set_true:N \g_um_literal_colon_bool
398   \or
399     \bool_set_false:N \g_um_literal_colon_bool
400   \fi
401 }

```

Slash delimiter style

```

402 \define@choicekey*{unicode-math.sty}{slash-delimiter}[\@tempa\@tempb]{ascii,frac,div}{
403   \ifcase\@tempb
404     \tl_set:Nn \g_um_slash_delimiter_usv {"002F}
405   \or
406     \tl_set:Nn \g_um_slash_delimiter_usv {"2044}
407   \or
408     \tl_set:Nn \g_um_slash_delimiter_usv {"2215}
409   \fi
410 }

```

Active fraction style

```

411 \define@choicekey*{unicode-math.sty}{active-fraction}[\@tempa\@tempb]{small,normalsize}{
412   \ifcase\@tempb
413     \cs_if_exist:NTF \tfrac {
414       \bool_set_true:N \l_um_smallfrac_bool
415     }{
416       \PackageWarning{unicode-math}{Small~ fraction~ command~ \pro-
417         tect\tfrac\space not~ defined.~ Perhaps~ load~ amsmath?}
418       \bool_set_false:N \l_um_smallfrac_bool
419     }
420   \or
421     \bool_set_false:N \l_um_smallfrac_bool
422   \fi
423   \um_setup_active_frac:
424 }

```

Debug/tracing

```

424 \define@choicekey*{unicode-math.sty}{trace}[\@tempa\@tempb]{on,off}{
425   \ifcase\@tempb
426     \cs_set:Nn \um_debug:n { \typeout{##1} }
427   \or
428     \cs_set:Nn \um_debug:n { }
429   \fi
430 }
431 \ExecuteOptionsX{math-style=TeX,slash-delimiter=ascii,trace=off}
432 \AtEndOfPackage{
433   \cs_if_exist:NT \tfrac {
434     \unimathsetup{active-frac=small}
435   }
436 }
437 \ProcessOptionsX

```

6.2 Overcoming \@onlypreamble

The requirement of only setting up the maths fonts in the preamble is now removed. The following list might be overly ambitious.

```

438 \tl_map_inline:nn {
439   \new@mathgroup\cdp@list\cdp@elt\DeclareMathSizes
440   \@DeclareMathSizes\newmathalphabet\newmathalphabet@@\newmathalphabet@@@
441   \DeclareMathVersion\define@mathalphabet\define@mathgroup\addtoversion
442   \version@list\version@elt\alpha@list\alpha@elt
443   \restore@mathversion\init@restore@version\dorestore@version\process@table
444   \new@mathversion\DeclareSymbolFont\group@list\group@elt
445   \new@symbolfont\SetSymbolFont\SetSymbolFont@\get@cdp
446   \DeclareMathAlphabet\new@mathalphabet\SetMathAlphabet\SetMathAlphabet@
447   \DeclareMathAccent\set@mathaccent\DeclareMathSymbol\set@mathchar
448   \set@mathsymbol\DeclareMathDelimiter\@xxDeclareMathDelimiter
449   \@DeclareMathDelimiter\@xDeclareMathDelimiter\set@mathdelimiter
450   \set@@mathdelimiter\DeclareMathRadical\mathchar@type
451   \DeclareSymbolFontAlphabet\DeclareSymbolFontAlphabet@
452 }{
453   \tl_remove_in:Nn \@preamblecmds {\do#1}
454 }

```

6.3 Assorted macros

`\um_fontdimen_to_percent:nn` **#1** : Font dimen number
`\fontdimens 10, 11, and 65` aren't actually dimensions, they're percentage values given in units of sp. This macro takes a font dimension number and outputs the decimal value of the associated parameter.

```

455 \def\um_fontdimen_to_percent:nn#1#2{

```

```

456 0.\strip@pt\dimexpr\fontdimen#1#2 *65536\relax
457 }

\um@scaled@apply #1 : A math style
                  #2 : Macro that takes a non-delimited length argument (like \kern)
                  #3 : Length control sequence to be scaled according to the math style
This macro is used to scale the lengths reported by \fontdimen according to the
scale factor for script- and scriptscript-size objects.
458 \def\um@scaled@apply#1#2#3{
459   \ifx#1\scriptstyle
460     #2\um_fontdimen_to_percent:nn{10}\l_um_font#3
461   \else
462     \ifx#1\scriptscriptstyle
463       #2\um_fontdimen_to_percent:nn{11}\l_um_font#3
464     \else
465       #2#3%
466     \fi
467   \fi
468 }

```

7 Fundamentals

7.1 Enlarging the number of maths families

To start with, we've got a power of two as many \fams as before. So (from `ltxssbas.dtx`) we want to redefine

```

469 \def\new@mathgroup{\alloc@8\mathgroup\chardef\@cclvi}
470 \let\newfam\new@mathgroup

```

This is sufficient for L^AT_EX's \DeclareSymbolFont-type commands to be able to define 256 named maths fonts.

7.2 Setting math chars, math codes, etc.

```

\um_set_mathsymbol:nNNn #1 : Symbol font number, e.g., \symoperators
                        #2 : Symbol macro, e.g., \alpha
                        #3 : Type, e.g., \mathalpha
                        #4 : Slot, e.g., "221E

```

If the symbol definition is for a macro. There are a bunch of tests to perform to process the various characters.

```

471 \cs_set:Nn \um_set_mathsymbol:nNNn {

```

Operators In the examples following, say we’re defining for the symbol $\sum(\Sigma)$.

```
472 \ifx\mathop#3\relax
```

In order for literal unicode characters to be used in the source and still have the correct limits behaviour, big operators are made math-active.

The active math char is defined to expand to the macro \sum_sym .

```
473 \begingroup
474 \char_make_active:n {#4}
475 \global\mathcode#4="8000\relax
476 \um@scanactivedef #4 \@nil { \csname\cs_to_str:N #2 _sym\endcsname }
477 \endgroup
```

Some of these require a \nolimits suffix. This is controlled by the $\um@nolimits$ macro, which contains a list of such characters. This list is checked dynamically because we’re not interested in efficiency. Or something. This allows the list to be updated in the middle of a document.

Declare the plain old mathchardef for the control sequence \sumop .

```
478 \expandafter\global\expandafter\XeTeXmathchardef
479 \csname\cs_to_str:N #2 op\endcsname =" \mathchar@type#3 #1 #4\relax
```

Now define \sum_sym as \sumop , followed by \nolimits if necessary.

```
480 \cs_gset:cpx { \cs_to_str:N #2 _sym } {
481 \exp_not:c { \cs_to_str:N #2 op}
482 \exp_not:n { \tl_if_in:NnT \l_um_nolimits_tl {#2} \nolimits}
483 }
```

Don’t forget that the actual \sum macro is simply defined in terms of the literal unicode symbol!

```
484 \else
```

Delimiters and radicals Sqrt radical is defined as a csmathopen.

```
485 \ifx\mathopen#3\relax
486 \tl_if_in:NnTF \l_um_radicals_tl #2 {
487 \cs_gset:cpn { \cs_to_str:N #2 sign} { \XeTeXradical #1 #4 \relax }
488 }{
489 \cs_gset:Npn #2 { \XeTeXdelimiter " \mathchar@type#3 #1 #4 \relax}
490 \global\XeTeXdelcode#4=#1 #4 \relax
491 \global\XeTeXmathcode#4=" \mathchar@type#3 #1 #4 \relax
492 }
493 \else
494 \ifx\mathclose#3\relax
495 \cs_gset:Npn #2 { \XeTeXdelimiter " \mathchar@type#3 #1 #4 \relax}
496 \global\XeTeXdelcode#4=#1 #4 \relax
497 \global\XeTeXmathcode#4=" \mathchar@type#3 #1 #4 \relax
498 \else
```

Fences

```

499     \ifx\mathfence#3
500     \global\XeTeXmathcode#4="\mathchar@type#3 #1 #4\relax
501     \global\XeTeXdelcode#4=#1 #4\relax
502     \cs_gset:cpn {l \cs_to_str:N #2} {\XeTeXdelimiter "\math-
char@type\mathopen #1 #4\relax}
503     \cs_gset:cpn {r \cs_to_str:N #2} {\XeTeXdelimiter "\math-
char@type\mathclose #1 #4\relax}
504     \else

```

Accents

```

505     \ifx\mathaccent#3\relax
506     \cs_gset:Npx #2 {\XeTeXmathaccent "\mathchar@type#3 #1 #4\relax}
507     \else

```

And finally, the general case. We define the unicode mathcode for the character. The macro is defined later on generically in terms of the unicode character.

```

508     \global\XeTeXmathcode#4="\mathchar@type#3 #1 #4\relax
509     \fi
510   \fi
511 \fi
512 \fi
513 \fi
514 }

```

`\um_set_mathcode:nnnn` Note that this declaration *isn't* global so that it can be constrained by grouping
`\um_set_mathchar:Nnnn` inside math alphabet switches.

```

515 \cs_set:Nn \um_set_mathcode:nnnn {
516   \XeTeXmathcode#1="\mathchar@type#2 \csname sym#3\endcsname #4\relax
517 }
518 \cs_set:Nn \um_set_mathchar:Nnnn {
519   \XeTeXmathchardef #1 = "\mathchar@type#2 \csname sym#3\endcsname #4\relax
520 }

```

7.3 The main `\setmathfont` macro

Using a range including large character sets such as `\mathrel`, `\mathalpha`, *etc.*, is *very slow*! I hope to improve the performance somehow.

`\setmathfont` [**#1**]: font features

#2 : font name

```

521 \DeclareDocumentCommand \setmathfont { O{ } m } {

```

- Erase any conception \LaTeX has of previously defined math symbol fonts; this allows `\DeclareSymbolFont` at any point in the document.

```

522     \let\glb@currsizel\relax

```

- To start with, assume we're defining the font for every math symbol character.

```

523 \bool_set_true:N \l_um_init_bool
524 \seq_clear:N \l_um_char_range_seq
525 \let\um@char@num@range\@empty

```

- Grab the current size information (is this robust enough? Maybe it should be preceded by `\normalsize`).

```

526 \csname S@\f@size\endcsname

```

- Set the name of the math version being defined. (obviously more needs to be done here!)

```

527 \tl_set:Nn \l_um_mversion_tf {normal}
528 \DeclareMathVersion{\l_um_mversion_tf}

```

Define default font features for the script and scriptscript font.

```

529 \tl_set:Nn \l_um_script_features_tl {ScriptStyle}
530 \tl_set:Nn \l_um_sscript_features_tl {ScriptScriptStyle}
531 \tl_set:Nn \l_um_script_font_tl {#2}
532 \tl_set:Nn \l_um_sscript_font_tl {#2}

```

Use `fontspec` to select a font to use. The macro `\S@{size}` contains the definitions of the sizes used for maths letters, subscripts and subsubscripts in `\tf@size`, `\sf@size`, and `\ssf@size`, respectively.

```

533 \setkeys*{unicode-math.sty}{#1}
534 \cs_set:Npx \um_tmp: {
535   \exp_not:N \setkeys*[um]{options}{\exp_not:V \XKV@rm}
536 }
537 \um_tmp:
538 \cs_set:Npx \um_tmp: {
539   \exp_not:N \zf@fontspec {
540     BoldFont = {}, ItalicFont = {},
541     Script = Math,
542     SizeFeatures = {
543       {Size = \tf@size-} ,
544       {Size = \sf@size-\tf@size ,
545         Font = \l_um_script_font_tl ,
546         \l_um_script_features_tl
547       } ,
548       {Size = -\sf@size ,
549         Font = \l_um_sscript_font_tl ,
550         \l_um_sscript_features_tl
551       }
552     },

```



```

553     \XKV@rm
554   }{#2}
555 }
556 \bool_set_true:N \l_um_fontspec_feature_bool
557 \um_tmp:
558 \bool_set_false:N \l_um_fontspec_feature_bool
Check for the correct number of \fontdimens:
559 \font\l_um_font="#2"\relax
560 %% \ifdim \dimexpr\fontdimen9\l_um_font*65536\relax =65pt\relax
561 %% \bool_set_true:N \l_um_ot_math_bool
562 %% \else
563 %% \bool_set_false:N \l_um_ot_math_bool
564 %% \PackageWarningNoLine{unicode-math}{
565 %%   The~ font~ '#2' ~is~ not~ a~ valid~ OpenType~ maths~ font.~
566 %%   Some~ maths~ features~ will~ not~ be~ available~ or~ behave~
567 %%   in~ a~ substandard~ manner
568 %% }
569 %% \fi

```

If we're defining the full unicode math repertoire, then we skip all the parsing processing needed if we're only defining a subset.

- Math symbols are defined with `\UnicodeMathSymbol`; see section §7.3.1 for the individual definitions

```

570 \bool_if:NTF \l_um_init_bool {
571   \tl_set:Nn \um_symfont_tl {um_allsym}
572   \PackageInfo{unicode-math}{Defining~ the~ default~ maths~ font~ as~ '#2'}
573   \cs_set_eq:NN \UnicodeMathSymbol \um_process_symbol_noparse:nnnn
574   \cs_set_eq:NN \um_mathmap:Nnn \um_mathmap_noparse:Nnn
575   \cs_set_eq:NN \um_remap_symbol:nnn \um_remap_symbol_noparse:nnn
576   \cs_set_eq:NN \um_maybe_init_alphabet:n \um_init_alphabet:n
577   \cs_set_eq:NN \um_map_char_internal:nn \um_map_char_noparse:nn
578 }{
579   \int_incr:N \g_um_fam_int
580   \tl_set:Nx \um_symfont_tl {um_fam\int_use:N\g_um_fam_int}
581   \cs_set_eq:NN \UnicodeMathSymbol \um_process_symbol_parse:nnnn
582   \cs_set_eq:NN \um_mathmap:Nnn \um_mathmap_parse:Nnn
583   \cs_set_eq:NN \um_remap_symbol:nnn \um_remap_symbol_parse:nnn
584   \cs_set_eq:NN \um_maybe_init_alphabet:n \use_none:n
585   \cs_set_eq:NN \um_map_char_internal:nn \um_map_char_parse:nn
586 }

```

Now defined `\um_symfont_tl` as the L^AT_EX math font to access everything:

```

587 \DeclareSymbolFont{\um_symfont_tl}
588 {\encodingdefault}{\zf@family}{\mddefault}{\updefault}

```

And now we input every single maths char. See File 12 for the source to `unicode-math.tex` which is used to create `unicode-math-table.tex`.

```
589 \@input{unicode-math-table.tex}
```

Finally,

- Remap symbols that don't take their natural mathcode
- Activate any symbols that need to be math-active
- Assign delimiter codes for symbols that need to grow
- Setup the maths alphabets (`\mathbf` etc.)

```
590 \um_remap_symbols:
591 \um_setup_mathactives:
592 \um_setup_delcodes:
593 \um_setup_alphabets:
594 }
```

7.3.1 Functions for setting up symbols with mathcodes

`\um_process_symbol_noparse:nnnn` If the range font feature has been used, then only a subset of the unicode glyphs
`\um_process_symbol_parse:nnnn` are to be defined. See section §8.3 for the code that enables this.

```
595 \cs_set:Nn \um_process_symbol_noparse:nnnn {
596   \exp_args:Nc \um_set_mathsymbol:nNNn {sym\um_symfont_tl}#2#3{#1}
597 }
598 \cs_set:Nn \um_process_symbol_parse:nnnn {
599   \um@parse@term{#1}{#2}{#3}{
600     \um_process_symbol_noparse:nnnn{#1}{#2}{#3}{#4}
601   }
602 }
```

`\um_remap_symbols:` This function is used to define the mathcodes for those chars which should be
`\um_remap_symbol_noparse:nnn` mapped to a different glyph than themselves.
`\um_remap_symbol_parse:nnn`

```
603 \cs_new:Nn \um_remap_symbols: {
604   \um_remap_symbol:nnn{`-}{\mathbin}{"02212}% hyphen to minus
605   \um_remap_symbol:nnn{`*}{\mathbin}{"02217}% text asterisk to "cen-
        tred asterisk"
606   \bool_if:NF \g_um_literal_colon_bool {
607     \um_remap_symbol:nnn{`:}{\mathrel}{"02236}% colon to ratio (i.e., punct to rel)
608   }
609   \bool_if:NTF \g_um_literal_bool {
610     \um_remap_symbol:nnn {\g_um_up_Nabla_usv}{\mathord}{\g_um_up_Nabla_usv}
611     \um_remap_symbol:nnn {\g_um_it_Nabla_usv}{\mathord}{\g_um_it_Nabla_usv}
612     \um_remap_symbol:nnn {\g_um_up_partial_usv}{\mathord}{\g_um_up_partial_usv}
613     \um_remap_symbol:nnn {\g_um_it_partial_usv}{\mathord}{\g_um_it_partial_usv}
614   }{
615     \um_remap_symbol:nnn {\g_um_up_Nabla_usv,\g_um_it_Nabla_usv}{\mathord}{\g_um_Nabla_up_or_
616     \um_remap_symbol:nnn {\g_um_up_partial_usv,\g_um_it_partial_usv}{\mathord}{\g_um_partial_
617   }
```

Some of these in the `bfliteral` block may be redundant, but that's okay:

```

618 \bool_if:NTF \g_um_bfliteral_bool {
619   \um_remap_symbol:nnn {\g_um_bfup_Nabla_usv} {\mathord}{\g_um_bfup_Nabla_usv}
620   \um_remap_symbol:nnn {\g_um_bfit_Nabla_usv} {\mathord}{\g_um_bfit_Nabla_usv}
621   \um_remap_symbol:nnn {\g_um_bfsfup_Nabla_usv} {\mathord}{\g_um_bfsfup_Nabla_usv}
622   \um_remap_symbol:nnn {\g_um_bfsfit_Nabla_usv} {\mathord}{\g_um_bfsfit_Nabla_usv}
623   \um_remap_symbol:nnn {\g_um_bfup_partial_usv} {\mathord}{\g_um_bfup_partial_usv}
624   \um_remap_symbol:nnn {\g_um_bfit_partial_usv} {\mathord}{\g_um_bfit_partial_usv}
625   \um_remap_symbol:nnn {\g_um_bfsfup_partial_usv} {\mathord}{\g_um_bfsfup_partial_usv}
626   \um_remap_symbol:nnn {\g_um_bfsfit_partial_usv} {\mathord}{\g_um_bfsfit_partial_usv}
627 }{
628   \um_remap_symbol:nnn {\g_um_bfup_Nabla_usv,\g_um_bfit_Nabla_usv} {\mathord}{\g_um_bfNabla_
629   \um_remap_symbol:nnn {\g_um_bfsfup_Nabla_usv,\g_um_bfsfit_Nabla_usv} {\mathord}{\g_um_bfsf
630   \um_remap_symbol:nnn {\g_um_bfup_partial_usv,\g_um_bfit_partial_usv} {\mathord}{\g_um_bfpa
631   \um_remap_symbol:nnn {\g_um_bfsfup_partial_usv,\g_um_bfsfit_partial_usv} {\mathord}{\g_um_
632 }
633 }

```

Where `\um_remap_symbol:nnn` is defined to be one of these two, depending on the range setup:

```

634 \cs_new:Nn \um_remap_symbol_parse:nnn {
635   \um@parse@term {#3} {\@nil} {#2} {
636     \um_remap_symbol_noparse:nnn {#1} {#2} {#3}
637   }
638 }
639 \cs_new:Nn \um_remap_symbol_noparse:nnn {
640   \clist_map_inline:nn {#1} {
641     \um_set_mathcode:nnnn {##1} {#2} {\um_symfont_tl} {#3}
642   }
643 }

```

7.3.2 Active math characters

There are more math active chars later in the subscript/superscript section. But they don't need to be able to be typeset directly.

`\um_setup_mathactives:`

```

644 \cs_new:Nn \um_setup_mathactives: {
645   \um_make_mathactive:nnn {"2032} \um_prime_single_mchar \mathord
646   \um_make_mathactive:nnn {"2033} \um_prime_double_mchar \mathord
647   \um_make_mathactive:nnn {"2034} \um_prime_triple_mchar \mathord
648   \um_make_mathactive:nnn {"2057} \um_prime_quad_mchar \mathord
649   \um_make_mathactive:nnn {"2035} \um_backprime_single_mchar \mathord
650   \um_make_mathactive:nnn {"2036} \um_backprime_double_mchar \mathord
651   \um_make_mathactive:nnn {"2037} \um_backprime_triple_mchar \mathord
652   \XeTeXmathcodenum `` = "1FFFFF \scan_stop:
653 }

```

`\um_make_mathactive:nNN` : TODO : hook into range feature Makes #1 a mathactive char, and gives cs #2 the meaning of mathchar #1 with class #3. You are responsible for giving active #1 a particular meaning!

```

654 \cs_new:Nn \um_make_mathactive:nNN {
655   \um_set_mathchar:Nnnn #2 {#3} {\um_symfont_t1} {#1}
656   \XeTeXmathcodenum #1 = "1FFFFF \scan_stop:
657 }

```

7.3.3 Delimiter codes

Some symbols that aren't mathopen/mathclose still need to have delimiter codes assigned. The list of vertical arrows may be incomplete. On the other hand, many fonts won't support them all being stretchy. And some of them are probably not meant to stretch, either. But adding them here doesn't hurt.

`\um_setup_delcodes:`

```

658 \cs_new:Nn \um_setup_delcodes: {
659   \um_set_delcode:nn {\`\/} {\g_um_slash_delimiter_usv}
660   \um_set_delcode:nn {"2044} {\g_um_slash_delimiter_usv} % fracslash
661   \um_set_delcode:nn {"2215} {\g_um_slash_delimiter_usv} % divslash
662   \um_set_delcode:n {"005C} % backslash
663   \um_set_delcode:nn {\`<} {"27E8} % angle brackets with ascii notation
664   \um_set_delcode:nn {\`>} {"27E9} % angle brackets with ascii notation
665   \um_set_delcode:n {"2191} % up arrow
666   \um_set_delcode:n {"2193} % down arrow
667   \um_set_delcode:n {"2195} % updown arrow
668   \um_set_delcode:n {"219F} % up arrow twohead
669   \um_set_delcode:n {"21A1} % down arrow twohead
670   \um_set_delcode:n {"21A5} % up arrow from bar
671   \um_set_delcode:n {"21A7} % down arrow from bar
672   \um_set_delcode:n {"21A8} % updown arrow from bar
673   \um_set_delcode:n {"21BE} % up harpoon right
674   \um_set_delcode:n {"21BF} % up harpoon left
675   \um_set_delcode:n {"21C2} % down harpoon right
676   \um_set_delcode:n {"21C3} % down harpoon left
677   \um_set_delcode:n {"21C5} % arrows up down
678   \um_set_delcode:n {"21F5} % arrows down up
679   \um_set_delcode:n {"21C8} % arrows up up
680   \um_set_delcode:n {"21CA} % arrows down down
681   \um_set_delcode:n {"21D1} % double up arrow
682   \um_set_delcode:n {"21D3} % double down arrow
683   \um_set_delcode:n {"21D5} % double updown arrow
684   \um_set_delcode:n {"21DE} % up arrow double stroke
685   \um_set_delcode:n {"21DF} % down arrow double stroke
686   \um_set_delcode:n {"21E1} % up arrow dashed
687   \um_set_delcode:n {"21E3} % down arrow dashed

```

```

688 \um_set_delcode:n {"21E7} % up white arrow
689 \um_set_delcode:n {"21E9} % down white arrow
690 \um_set_delcode:n {"21EA} % up white arrow from bar
691 \um_set_delcode:n {"21F3} % updown white arrow
692 }

```

`\um_set_delcode:nn` : TODO : hook into range feature

```

\um_set_delcode:n
693 \cs_new:Nn \um_set_delcode:nn {
694   \XeTeXdelcode#1 = \csname sym\um_symfont_tl\endcsname #2
695 }
696 \cs_new:Nn \um_set_delcode:n {
697   \XeTeXdelcode#1 = \csname sym\um_symfont_tl\endcsname #1
698 }

```

7.3.4 Maths alphabets' character mapping

7.3.5 Functions for setting up the maths alphabets

`\um_mathmap_noparse:Nnn` #1 : Maths alphabet, *e.g.*, `\mathbb`
 #2 : Input slot(s), *e.g.*, the slot for 'A' (comma separated)
 #3 : Output slot, *e.g.*, the slot for 'A'
 Adds `\um_set_mathcode:nnnn` declarations to the specified maths alphabet's definition.

```

699 \cs_set:Nn \um_mathmap_noparse:Nnn {
700   \clist_map_inline:nn {#2} {
701     \tl_put_right:cx {um_setup\cs_to_str:N #1:} {
702       \exp_not:N\um_set_mathcode:nnnn{##1}{\exp_not:N\mathalpha}{\um_symfont_tl}{#3}
703     }
704   }
705 }

```

`\um_mathmap_parse:Nnn` #1 : Maths alphabet, *e.g.*, `\mathbb`
 #2 : Input slot(s), *e.g.*, the slot for 'A' (comma separated)
 #3 : Output slot, *e.g.*, the slot for 'A'
 When `\um@parse@term` is executed, it populates the `\um@char@num@range` macro with slot numbers corresponding to the specified range. This range is used to conditionally add `\um_set_mathcode:nnnn` declarations to the maths alphabet definition.

```

706 \cs_set:Nn \um_mathmap_parse:Nnn {
707   \clist_map_inline:Nn \um@char@num@range {
708     \ifnum##1=#3\relax
709       \um_mathmap_noparse:Nnn {#1}{#2}{#3}
710     \fi
711   }
712 }

```


























7.4 (Big) operators
















Turns out that \XeTeX is clever enough to deal with big operators for us automatically with `\XeTeXmathchardef`. Amazing!


However, the limits aren't set automatically; that is, we want to define, a la Plain \TeX *etc.*, `\def\int{\intop\nolimits}`, so there needs to be a transformation from `\int` to `\intop` during the expansion of `\UnicodeMathSymbol` in the appropriate contexts.

Following is a table of every math operator (`\mathop`) defined in `unicode-math-table.tex`, from which a subset need to be flagged for `\nolimits` adjustments. The limits behaviour as specified by `unicode-math` are shown (with grey 'scripts').

USV	Ex.	Macro	Description
U+02140	$\sum\limits_0^1$	<code>\Bbbsum</code>	DOUBLE-STRUCK N-ARY SUMMATION
U+0220F	$\prod\limits_0^1$	<code>\prod</code>	PRODUCT OPERATOR
U+02210	$\coprod\limits_0^1$	<code>\coprod</code>	COPRODUCT OPERATOR
U+02211	$\sum\limits_0^1$	<code>\sum</code>	SUMMATION OPERATOR
U+0222B	$\int\limits_0^1$	<code>\int</code>	INTEGRAL OPERATOR
U+0222C	$\iint\limits_0^1$	<code>\iint</code>	DOUBLE INTEGRAL OPERATOR
U+0222D	$\iiint\limits_0^1$	<code>\iiint</code>	TRIPLE INTEGRAL OPERATOR
U+0222E	$\oint\limits_0^1$	<code>\oint</code>	CONTOUR INTEGRAL OPERATOR
U+0222F	$\oiint\limits_0^1$	<code>\oiint</code>	DOUBLE CONTOUR INTEGRAL OPERATOR
U+02230	$\oiiint\limits_0^1$	<code>\oiiint</code>	TRIPLE CONTOUR INTEGRAL OPERATOR
U+02231	$\int\limits_0^1$	<code>\intclockwise</code>	CLOCKWISE INTEGRAL
U+02232	$\oint\limits_0^1$	<code>\varointclockwise</code>	CONTOUR INTEGRAL, CLOCKWISE
U+02233	$\oint\limits_0^1$	<code>\ointctrcclockwise</code>	CONTOUR INTEGRAL, ANTICLOCKWISE
U+022C0	$\bigwedge\limits_0^1$	<code>\bigwedge</code>	LOGICAL OR OPERATOR
U+022C1	$\bigvee\limits_0^1$	<code>\bigvee</code>	LOGICAL AND OPERATOR
U+022C2	$\bigcap\limits_0^1$	<code>\bigcap</code>	INTERSECTION OPERATOR
U+022C3	$\bigcup\limits_0^1$	<code>\bigcup</code>	UNION OPERATOR
U+027D5	$\left\lrcorner\limits_0^1$	<code>\leftouterjoin</code>	LEFT OUTER JOIN
U+027D6	$\right\lrcorner\limits_0^1$	<code>\rightouterjoin</code>	RIGHT OUTER JOIN

U+027D7		<code>\fullouterjoin</code>	FULL OUTER JOIN
U+027D8		<code>\bigbot</code>	LARGE UP TACK
U+027D9		<code>\bigtop</code>	LARGE DOWN TACK
U+029F8		<code>\xsol</code>	BIG SOLIDUS
U+029F9		<code>\xbsol</code>	BIG REVERSE SOLIDUS
U+02A00		<code>\bigodot</code>	N-ARY CIRCLED DOT OPERATOR
U+02A01		<code>\bigoplus</code>	N-ARY CIRCLED PLUS OPERATOR
U+02A02		<code>\bigotimes</code>	N-ARY CIRCLED TIMES OPERATOR
U+02A03		<code>\bigcupdot</code>	N-ARY UNION OPERATOR WITH DOT
U+02A04		<code>\biguplus</code>	N-ARY UNION OPERATOR WITH PLUS
U+02A05		<code>\bigsqcap</code>	N-ARY SQUARE INTERSECTION OPERATOR
U+02A06		<code>\bigsqcup</code>	N-ARY SQUARE UNION OPERATOR
U+02A07		<code>\conjquant</code>	TWO LOGICAL AND OPERATOR
U+02A08		<code>\disjquant</code>	TWO LOGICAL OR OPERATOR
U+02A09		<code>\bigtimes</code>	N-ARY TIMES OPERATOR
U+02A0B		<code>\sumint</code>	SUMMATION WITH INTEGRAL
U+02A0C		<code>\iiint</code>	QUADRUPLE INTEGRAL OPERATOR
U+02A0D		<code>\intbar</code>	FINITE PART INTEGRAL
U+02A0E		<code>\intBar</code>	INTEGRAL WITH DOUBLE STROKE
U+02A0F		<code>\fint</code>	INTEGRAL AVERAGE WITH SLASH
U+02A10		<code>\cirfnint</code>	CIRCULATION FUNCTION
U+02A11		<code>\awint</code>	ANTICLOCKWISE INTEGRATION LINE INTEGRATION WITH RECTANGULAR
U+02A12		<code>\rppoint</code>	PATH AROUND POLE LINE INTEGRATION WITH SEMICIRCULAR
U+02A13		<code>\scpoint</code>	PATH AROUND POLE LINE INTEGRATION NOT INCLUDING THE
U+02A14		<code>\npoint</code>	POLE

U+02A15		<code>\pointint</code>	INTEGRAL AROUND A POINT OPERATOR
U+02A16		<code>\sqint</code>	QUATERNION INTEGRAL OPERATOR
U+02A17		<code>\intlarhk</code>	HOOK
U+02A18		<code>\intx</code>	INTEGRAL WITH TIMES SIGN
U+02A19		<code>\intcap</code>	INTEGRAL WITH INTERSECTION
U+02A1A		<code>\intcup</code>	INTEGRAL WITH UNION
U+02A1B		<code>\upint</code>	INTEGRAL WITH OVERBAR
U+02A1C		<code>\lowint</code>	INTEGRAL WITH UNDERBAR
U+02A1D		<code>\Join</code>	JOIN
U+02A1E		<code>\bigtriangleleft</code>	LARGE LEFT TRIANGLE OPERATOR
U+02A1F		<code>\zcmp</code>	Z NOTATION SCHEMA COMPOSITION
U+02A20		<code>\zpipe</code>	Z NOTATION SCHEMA PIPING
U+02A21		<code>\zproject</code>	Z NOTATION SCHEMA PROJECTION
U+02AFC		<code>\biginterleave</code>	LARGE TRIPLE VERTICAL BAR OPERATOR
U+02AFF		<code>\bigtalloblong</code>	N-ARY WHITE VERTICAL BAR

`\l_um_nolimits_tl` This macro is a sequence containing those maths operators that require a `\nolimits` suffix. This list is used when processing `unicode-math-table.tex` to define such commands automatically (see the macro `\um_set_mathsymbol:nNNn`). I've chosen essentially just the operators that look like integrals; hopefully a better mathematician can help me out here. I've a feeling that it's more useful *not* to include the multiple integrals such as , but that might be a matter of preference.

```

713 \tl_new:Nn \l_um_nolimits_tl {
714   \int\iint\iiint\iiiiint\oint\oiint\oiiint
715   \intclockwise\varointclockwise\ointctr\clockwise\sumint
716   \intbar\intBar\oint\circfnint\awint\rppoint
717   \scpoint\ncpoint\pointint\sqint\intlarhk\intx
718   \intcap\intcup\upint\lowint
719 }

```

`\addnolimits` This macro appends material to the macro containing the list of operators that don't take limits.

```

720 \DeclareDocumentCommand \addnolimits {m} {
721   \tl_put_right:Nn \l_um_nolimits_tl {#1}
722 }

```

`\removenolimits` Can this macro be given a better name? It removes an item from the `nolimits` list.


```

723 \DeclareDocumentCommand \removenolimits {m} {
724   \tl_remove_all_in:Nn \l_um_nolimits_tl {#1}
725 }

```

7.5 Radicals

The radical for square root is organised in `\um_set_mathsymbol:nNNn` on page ?? . I think it's the only radical ever. (Actually, there is also `\cuberoot` and `\fourthroot`, but they don't seem to behave as proper radicals.)

Also, what about right-to-left square roots?

`\um@radicals` We organise radicals in the same way as `nolimits-operators`; that is, in a comma-list.

```
726 \tl_new:Nn \l_um_radicals_tl {\sqrt}
```

$$[2]1 + [3]1 + x$$

```
\setmathfont{Cambria Math}
\[ \sqrt[2]{1+\sqrt[3]{1+x}} \]
```

7.6 Delimiters

`\left` We redefine the primitive to be preceded by `\mathopen`; this gives much better spacing in cases such as `\sin\left...` Courtesy of Frank Mittelbach:

0000://0000.000000-00000000.000/000-000/0000000020000?00=00000/3853&00000000/3754





```
727 \let\left@primitive\left
```

```
728 \def\left{\mathopen{}\left@primitive}
```



No re-definition is made for `\right` because it's not necessary.

Here are all `\mathopen` characters:

USV	Ex.	Macro	Description
U+00028	(	<code>\lparen</code>	LEFT PARENTHESIS
U+0005B	[	<code>\lbrack</code>	LEFT SQUARE BRACKET
U+0007B	{	<code>\lbrace</code>	LEFT CURLY BRACKET
U+0221A	√	<code>\sqrt</code>	RADICAL
U+0221B	∛	<code>\cuberoot</code>	CUBE ROOT
U+0221C	∜	<code>\fourthroot</code>	FOURTH ROOT
U+02308	⌈	<code>\lceil</code>	LEFT CEILING
U+0230A	⌋	<code>\lfloor</code>	LEFT FLOOR
U+0231C	⌞	<code>\ulcorner</code>	UPPER LEFT CORNER
U+0231E	⏟	<code>\llcorner</code>	LOWER LEFT CORNER

			LIGHT LEFT TORTOISE SHELL BRACKET
U+02772		<code>\lbrbrak</code>	ORNAMENT
U+027C5		<code>\lbag</code>	LEFT S-SHAPED BAG DELIMITER
U+027CC		<code>\longdivision</code>	LONG DIVISION
U+027E6		<code>\lBrack</code>	MATHEMATICAL LEFT WHITE SQUARE BRACKET
U+027E8		<code>\langle</code>	MATHEMATICAL LEFT ANGLE BRACKET
U+027EA		<code>\lAngle</code>	MATHEMATICAL LEFT DOUBLE ANGLE BRACKET
U+027EC		<code>\Lbrbrak</code>	MATHEMATICAL LEFT WHITE TORTOISE SHELL BRACKET
U+02983		<code>\lBrace</code>	SHELL BRACKET
U+02985		<code>\lParen</code>	LEFT WHITE CURLY BRACKET
U+02987		<code>\llparenthesis</code>	LEFT WHITE PARENTHESIS
U+02989		<code>\llangle</code>	Z NOTATION LEFT IMAGE BRACKET
U+0298B		<code>\lbrackubar</code>	Z NOTATION LEFT BINDING BRACKET
U+0298D		<code>\lbrackultick</code>	LEFT SQUARE BRACKET WITH UNDERBAR
U+0298F		<code>\lbracklltick</code>	LEFT SQUARE BRACKET WITH TICK IN TOP
U+02991		<code>\langedot</code>	CORNER
U+02993		<code>\lparenless</code>	LEFT SQUARE BRACKET WITH TICK IN
U+02995		<code>\Lparengtr</code>	BOTTOM CORNER
U+02997		<code>\lblkbrbrak</code>	LEFT ANGLE BRACKET WITH DOT
U+029D8		<code>\lvzigzag</code>	LEFT ARC LESS-THAN BRACKET
U+029DA		<code>\Lvzigzag</code>	DOUBLE LEFT ARC GREATER-THAN BRACKET
U+029FC		<code>\lcurvyangle</code>	LEFT BLACK TORTOISE SHELL BRACKET
U+03014		<code>\lbrbrak</code>	LEFT WIGGLY FENCE
U+03018		<code>\Lbrbrak</code>	LEFT DOUBLE WIGGLY FENCE

And `\mathclose`:

USV	Ex.	Macro	Description
U+00029	)	<code>\rparen</code>	RIGHT PARENTHESIS
U+0005D	]	<code>\rbrack</code>	RIGHT SQUARE BRACKET
U+0007D	}	<code>\rbrace</code>	RIGHT CURLY BRACKET
U+02309	⌈	<code>\rceil</code>	RIGHT CEILING
U+0230B	⌋	<code>\rfloor</code>	RIGHT FLOOR
U+0231D	⌞	<code>\urcorner</code>	UPPER RIGHT CORNER
U+0231F	⌟	<code>\lrcorner</code>	LOWER RIGHT CORNER
U+02773		<code>\rbrbrak</code>	LIGHT RIGHT TORTOISE SHELL BRACKET
U+027C6		<code>\rbag</code>	ORNAMENT
U+027E7		<code>\rBrack</code>	RIGHT S-SHAPED BAG DELIMITER

U+027E9	\rangle	<code>\rangle</code>	MATHEMATICAL RIGHT ANGLE BRACKET MATHEMATICAL RIGHT DOUBLE ANGLE
U+027EB	$\rangle\rangle$	<code>\rangle\rangle</code>	BRACKET MATHEMATICAL RIGHT WHITE TORTOISE
U+027ED	\Rbrbrak	<code>\Rbrbrak</code>	SHELL BRACKET
U+02984	$\}$	<code>\rBrace</code>	RIGHT WHITE CURLY BRACKET
U+02986	$)$	<code>\rParen</code>	RIGHT WHITE PARENTHESIS
U+02988	\rangle	<code>\rrparenthesis</code>	Z NOTATION RIGHT IMAGE BRACKET
U+0298A	\rangle	<code>\rrangle</code>	Z NOTATION RIGHT BINDING BRACKET
U+0298C	$\]$	<code>\rbrackubar</code>	RIGHT SQUARE BRACKET WITH UNDERBAR RIGHT SQUARE BRACKET WITH TICK IN
U+0298E	$\]$	<code>\rbracklrtick</code>	BOTTOM CORNER RIGHT SQUARE BRACKET WITH TICK IN TOP
U+02990	$\]$	<code>\rbrackurtick</code>	CORNER
U+02992	$\rangle\cdot$	<code>\rangledot</code>	RIGHT ANGLE BRACKET WITH DOT
U+02994	\rangle	<code>\rpangtr</code>	RIGHT ARC GREATER-THAN BRACKET
U+02996	\rangle	<code>\Rparenless</code>	DOUBLE RIGHT ARC LESS-THAN BRACKET
U+02998	\rangle	<code>\rblkrbrak</code>	RIGHT BLACK TORTOISE SHELL BRACKET
U+029D9	$\}$	<code>\rvzigzag</code>	RIGHT WIGGLY FENCE
U+029DB	$\}$	<code>\Rvzigzag</code>	RIGHT DOUBLE WIGGLY FENCE
U+029FD	\rangle	<code>\rcurvyangle</code>	RIGHT POINTING CURVED ANGLE BRACKET
U+03015	$\}$	<code>\rbrbrak</code>	RIGHT BROKEN BRACKET
U+03019	$\}$	<code>\Rbrbrak</code>	RIGHT WHITE TORTOISE SHELL BRACKET

7.7 Maths accents

Maths accents should just work *if they are available in the font*.

USV	Ex.	Macro	Description
U+00300	\grave{x}	<code>\grave</code>	GRAVE ACCENT
U+00301	\acute{x}	<code>\acute</code>	ACUTE ACCENT
U+00302	\hat{x}	<code>\hat</code>	CIRCUMFLEX ACCENT
U+00303	\tilde{x}	<code>\tilde</code>	TILDE
U+00304	\bar{x}	<code>\bar</code>	MACRON
U+00305	\overline{x}	<code>\overbar</code>	OVERBAR EMBELLISHMENT
U+00306	\breve{x}	<code>\breve</code>	BREVE
U+00307	\dot{x}	<code>\dot</code>	DOT ABOVE
U+00308	\ddot{x}	<code>\ddot</code>	DIERESIS
U+00309	$\overset{\circ}{x}$	<code>\ovhook</code>	COMBINING HOOK ABOVE
U+0030A	$\overset{\circ}{x}$	<code>\ocirc</code>	RING
U+0030C	\check{x}	<code>\check</code>	CARON
U+00310	\check{x}	<code>\candra</code>	CANDRABINDU (NON-SPACING)
U+00312	\check{x}	<code>\oturnedcomma</code>	COMBINING TURNED COMMA ABOVE

U+00313	\acute{x}	<code>\osmooth</code>	GREEK PSILI (SMOOTH BREATHING) (NON-SPACING)
U+00314	\grave{x}	<code>\orough</code>	GREEK DASIA (ROUGH BREATHING) (NON-SPACING)
U+00315	\mathring{x}	<code>\ocommatopright</code>	COMBINING COMMA ABOVE RIGHT
U+0031A	\mathring{x}	<code>\droang</code>	LEFT ANGLE ABOVE (NON-SPACING) UNDER TILDE ACCENT (MULTIPLE
U+00330	\textasciitilde	<code>\wideutilde</code>	CHARACTERS AND NON-SPACING)
U+00331	\textasciitilde	<code>\underbar</code>	COMBINING MACRON BELOW
U+00338	\textasciitilde	<code>\not</code>	COMBINING LONG SOLIDUS OVERLAY
U+020D0	\overrightarrow{x}	<code>\leftharpoonaccent</code>	COMBINING LEFT HARPOON ABOVE
U+020D1	\overrightarrow{x}	<code>\rightharpoonaccent</code>	COMBINING RIGHT HARPOON ABOVE
U+020D2	\overline{x}	<code>\vertoverlay</code>	COMBINING LONG VERTICAL LINE OVERLAY
U+020D6	\overleftarrow{x}	<code>\overleftarrow</code>	COMBINING LEFT ARROW ABOVE
U+020D7	\overrightarrow{x}	<code>\vec</code>	COMBINING RIGHT ARROW ABOVE
U+020DB	\textasciitilde	<code>\dddot</code>	COMBINING THREE DOTS ABOVE
U+020DC	\textasciitilde	<code>\ddddot</code>	COMBINING FOUR DOTS ABOVE
U+020E1	\overleftrightarrow{x}	<code>\overleftrightharpoon</code>	COMBINING LEFT RIGHT ARROW ABOVE
U+020E7	\textasciitilde	<code>\annuity</code>	COMBINING ANNUITY SYMBOL
U+020E8	\textasciitilde	<code>\threeunderdot</code>	COMBINING TRIPLE UNDERDOT
U+020E9	\textasciitilde	<code>\widebridgeabove</code>	COMBINING WIDE BRIDGE ABOVE COMBINING RIGHTWARDS HARPOON WITH
U+020EC	\textasciitilde	<code>\underrightharpoondown</code>	BARB DOWNWARDS COMBINING LEFTWARDS HARPOON WITH
U+020ED	\textasciitilde	<code>\underleftharpoondown</code>	BARB DOWNWARDS
U+020EE	\textasciitilde	<code>\underleftarrow</code>	COMBINING LEFT ARROW BELOW
U+020EF	\textasciitilde	<code>\underrightarrow</code>	COMBINING RIGHT ARROW BELOW
U+020F0	\textasciitilde	<code>\asteraccent</code>	COMBINING ASTERISK ABOVE

8 Font features

`\um@zf@feature` Use the same method as `fontspec` for feature definition (*i.e.*, using `xkeyval`) but with a conditional to restrict the scope of these features to unicode-math commands.

```

729 \newcommand\um@zf@feature[2]{
730   \define@key[zf]{options}{#1}[] {
731     \bool_if:NTF \l_um_fontspec_feature_bool {
732       #2
733     } {
734       \PackageError{fontspec/unicode-math}
735       {The ‘#1’ font feature can only be used for maths fonts}
736       {The feature you tried to use can only be in commands
737       like \protect\setmathfont}

```

```

738     }
739   }
740 }

```

8.1 OpenType maths font features

```

741 \um@zf@feature{ScriptStyle}{
742   \zf@update@ff{+ssty=0}
743 }
744 \um@zf@feature{ScriptScriptStyle}{
745   \zf@update@ff{+ssty=1}
746 }

```

8.2 Script and scriptscript font options

```

747 \define@cmdkey[um]{options}[um@]{script-features}{}
748 \define@cmdkey[um]{options}[um@]{sscript-features}{}
749 \define@cmdkey[um]{options}[um@]{script-font}{}
750 \define@cmdkey[um]{options}[um@]{sscript-font}{}

```

8.3 Range processing

The ‘ALL’ branch here is deprecated and happens automatically.

```

751 \seq_new:N \l_um_mathalph_seq
752 \seq_new:N \l_um_char_range_seq
753 \define@choicekey+[um]{options}{range}[\@tempa\@tempb]{ALL}{
754   \ifcase\@tempb\relax
755     \bool_set_true:N \l_um_init_bool
756   \fi
757 }{
758   \bool_set_false:N \l_um_init_bool
759   \seq_clear:N \l_um_char_range_seq
760   \seq_clear:N \l_um_mathalph_seq
761   \clist_map_inline:nn {#1} {
762     \um_if_mathalph_decl:nTF {##1} {
763       \seq_put_right:Nx \l_um_mathalph_seq { {\exp_not:V\l_um_tmpa_tl} {\exp_not:V\l_um_tmpb_tl} }
764     }{
765       \seq_put_right:Nn \l_um_char_range_seq {##1}
766     }
767   }
768 }
769 \prg_new_conditional:Nnn \um_if_mathalph_decl:n {TF} {
770   \tl_set:Nn \l_um_tmpa_tl {#1}
771   \tl_set:Nn \l_um_tmpb_tl {}
772   \tl_set:Nn \l_um_tmpc_tl {}
773   \tl_if_in:NnT \l_um_tmpa_tl {->} {
774     \exp_after:wN \um_split_arrow:w \l_um_tmpa_tl \q_nil
775   }

```

```

776 \tl_if_in:NnT \l_um_tpa_tl {/} {
777   \exp_after:wN \um_split_slash:w \l_um_tpa_tl \q_nil
778 }
779 \seq_if_in:NVTF \g_um_mathalph_seq \l_um_tpa_tl {
780   \prg_return_true:
781 }{
782   \prg_return_false:
783 }
784 }
785 \cs_set:Npn \um_split_arrow:w #1->#2 \q_nil {
786   \tl_set:Nn \l_um_tpa_tl {#1}
787   \tl_set:Nn \l_um_tpc_tl {#2}
788 }
789 \cs_set:Npn \um_split_slash:w #1/#2 \q_nil {
790   \tl_set:Nn \l_um_tpa_tl {#1}
791   \tl_set:Nn \l_um_tpb_tl {#2}
792 }

```

Pretty basic comma separated range processing. Donald Arseneau’s `selectp` package has a cleverer technique.

`\um@parse@term` #1 : unicode character slot
 #2 : control sequence (character macro)
 #3 : control sequence (math type)
 #4 : code to execute

This macro expands to #4 if any of its arguments are contained in `\l_um_char_range_seq`. This list can contain either character ranges (for checking with #1) or control sequences. These latter can either be the command name of a specific character, *or* the math type of one (*e.g.*, `\mathbin`).

Character ranges are passed to `\um@parse@range`, which accepts input in the form shown in table 15.

Table 15: Ranges accepted by `\um@parse@range`.

Input	Range
x	$r = x$
$x-$	$r \geq x$
$-y$	$r \leq y$
$x-y$	$x \leq r \leq y$

Start by iterating over the commalist, ignoring empties, and initialising the scratch conditional:

```

793 \newcommand\um@parse@term[4]{
794   \seq_map_variable:NNn \l_um_char_range_seq \@ii {
795     \unless\ifx\@ii\@empty
796       \@tempswafalse

```

Match to either the character macro (`\alpha`) or the math type (`\mathbin`):

```

797     \expandafter\um@firstchar\expandafter{\@ii}
798     \ifx\@tempa\um@backslash
799         \expandafter\ifx\@ii#2\relax
800             \@tempswatrue
801         \else
802             \expandafter\ifx\@ii#3\relax
803                 \@tempswatrue
804             \fi
805         \fi

```

Otherwise, we have a number range, which is passed to another macro:

```

806     \else
807         \expandafter\um@parse@range\@ii-\@marker-\@nil#1\@nil
808     \fi

```

If we have a match, execute the code! It also populates the `\um@char@num@range` macro, which is used when defining `\mathbf` (*etc.*) `\mathchar` remappings.

```

809     \if@tempswa
810         \ifx\um@char@num@range\@empty
811             \g@addto@macro\um@char@num@range{#1}
812         \else
813             \g@addto@macro\um@char@num@range{,#1}
814         \fi
815         #4%
816     \fi
817 \fi
818 }
819 }
820 \def\um@firstof#1#2\@nil{#1}
821 \edef\um@backslash{\expandafter\um@firstof\string\string\@nil}
822 \def\um@firstchar#1{\edef\@tempa{\expandafter\um@firstof\string#1\@nil}}

```

`\um@parse@range` Weird syntax. As shown previously in table 15, this macro can be passed four different input types via `\um@parse@term`.

```

823 \def\um@parse@range#1-#2-#3\@nil#4\@nil{
824     \def\@tempa{#1}
825     \def\@tempb{#2}

```

Range	$r = x$
C-list input	<code>\@ii=X</code>
Macro input	<code>\um@parse@range X-\@marker-\@nil#1\@nil</code>
Arguments	<code>#1-#2-#3 = X-\@marker-{ }</code>

```

826     \expandafter\ifx\expandafter\@marker\@tempb\relax
827         \ifnum#4=#1\relax
828             \@tempswatrue
829         \fi
830     \else

```

Range $r \geq x$
C-list input \@ii=X-
Macro input \um@parse@range X--\@marker-\@nil#1\@nil
Arguments #1-#2-#3 = X-{}-\@marker-

```

831 \ifx\@empty\@tempb
832 \ifnum#4>\numexpr#1-1\relax
833 \@tempwattrue
834 \fi
835 \else

```

Range $r \leq y$
C-list input \@ii=-Y
Macro input \um@parse@range -Y-\@marker-\@nil#1\@nil
Arguments #1-#2-#3 = {}-Y-\@marker-

```

836 \ifx\@empty\@tempa
837 \ifnum#4<\numexpr#2+1\relax
838 \@tempwattrue
839 \fi

```

Range $x \leq r \leq y$
C-list input \@ii=X-Y
Macro input \um@parse@range X-Y-\@marker-\@nil#1\@nil
Arguments #1-#2-#3 = X-Y-\@marker-

```

840 \else
841 \ifnum#4>\numexpr#1-1\relax
842 \ifnum#4<\numexpr#2+1\relax
843 \@tempwattrue
844 \fi
845 \fi
846 \fi
847 \fi
848 \fi
849 }

```

\um_map_char:nn #1 : Number of iterations
\um_map_chars_xxvi:nn #2 : Starting input char(s)
\um_map_chars_xxiii:nn #3 : Starting output char
Loops through character ranges setting \mathcode.

```

850 \cs_set:Nn \um_map_chars_range:nnn {
851 \clist_map_inline:nn {#2} {
852 \prg_stepwise_inline:nnnn {0}{1}{#1} {
853 \um_map_char_internal:nn {##1+####1}{#3+####1}
854 }
855 }
856 }
857 \cs_new:Nn \um_map_char_noparse:nn {
858 \um_set_mathcode:nnnn

```



```

859     {\numexpr #1 \relax}{\mathalpha}{\um_symfont_t1}{\numexpr #2 \relax}
860 }
861 \cs_new:Nn \um_map_char_parse:nn {
862   \um@parse@term {#1} {\@nil} {\mathalpha} {
863     \um_map_char_noparse:nn {#1}{#2}
864   }
865 }
866 \cs_set:Nn \um_map_chars_xxvi:nn {
867   \um_map_chars_range:nnn {25}{#1}{#2}
868 }
869 \cs_set:Nn \um_map_chars_xxiii:nn {
870   \um_map_chars_range:nnn {24}{#1}{#2}
871 }
872 \cs_set:Nn \um_map_chars_x:nn {
873   \um_map_chars_range:nnn {9}{#1}{#2}
874 }
875 \cs_set:Nn \um_map_chars_Latin:nn {
876   \clist_map_inline:nn {#1} {
877     \um_map_chars_xxvi:cc { \um_to_usv:nn{##1}{Latin} }{ \um_to_usv:nn{#2}{Latin} }
878   }
879 }
880 \cs_set:Nn \um_map_chars_latin:nn {
881   \clist_map_inline:nn {#1} {
882     \um_map_chars_xxvi:cc { \um_to_usv:nn{##1}{latin} }{ \um_to_usv:nn{#2}{latin} }
883   }
884 }
885 \cs_set:Nn \um_map_chars_greek:nn {
886   \clist_map_inline:nn {#1} {
887     \um_map_chars_xxiii:cc {g_um_ ##1 _greek_usv}{g_um_ #2 _greek_usv}
888     \um_map_char:cc { \um_to_usv:nn{##1}{varepsilon} }{ \um_to_usv:nn{#2}{varepsilon} }
889     \um_map_char:cc { \um_to_usv:nn{##1}{vartheta} }{ \um_to_usv:nn{#2}{vartheta} }
890     \um_map_char:cc { \um_to_usv:nn{##1}{varkappa} }{ \um_to_usv:nn{#2}{varkappa} }
891     \um_map_char:cc { \um_to_usv:nn{##1}{varphi} }{ \um_to_usv:nn{#2}{varphi} }
892     \um_map_char:cc { \um_to_usv:nn{##1}{varrho} }{ \um_to_usv:nn{#2}{varrho} }
893     \um_map_char:cc { \um_to_usv:nn{##1}{varpi} }{ \um_to_usv:nn{#2}{varpi} }
894   }
895 }
896 \cs_set:Nn \um_map_chars_Greek:nn {
897   \clist_map_inline:nn {#1} {
898     \um_map_chars_xxiii:cc { \um_to_usv:nn{##1}{Greek} }{ \um_to_usv:nn{#2}{Greek} }
899     \um_map_char:cc { \um_to_usv:nn{##1}{varTheta} }{ \um_to_usv:nn{#2}{varTheta} }
900   }
901 }
902 \cs_set:Nn \um_map_chars_numbers:nn {
903   \um_map_chars_x:cc { \um_to_usv:nn{#1}{num} }{ \um_to_usv:nn{#2}{num} }
904 }

```

```

905 \cs_set:Nn \um_map_char:nn {
906   \um_map_chars_range:nnn {0}{#1}{#2}
907 }
908 \cs_set:Nn \um_map_single:nnn {
909   \clist_map_inline:nn {#2} {
910     \um_map_char:cc { \um_to_usv:nn{##1}{#1} }{ \um_to_usv:nn{#3}{#1} }
911   }
912 }
913 \cs_generate_variant:Nn \um_map_char:nn {cc}
914 \cs_generate_variant:Nn \um_map_chars_xxiii:nn {cc}
915 \cs_generate_variant:Nn \um_map_chars_xxvi:nn {cc}
916 \cs_generate_variant:Nn \um_map_chars_x:nn {cc}

```

\um_set_mathalphabet_char:Nnn #1 : Maths alphabet

#2 : Input char(s)

#3 : Output char

Loops through character ranges setting \mathcode.

```

917 \cs_set:Npn \exp_args:Nnff {\::n\::f\::f\:::}
918 \cs_new:Nn \um_set_mathalphabet_char:Nnn {
919   \clist_map_variable:nNn {#2} \l_um_input_num {
920     \exp_args:Nnff \um_mathmap:Nnn {#1}
921     {\number\numexpr\l_um_input_num\relax} {\number\numexpr#3\relax}
922   }
923 }

```

\um_set_mathalph_range:Nnn [*(Number of iterations)*] #1 : Maths alphabet

#2 : Starting input char(s)

#3 : Starting output char

Loops through character ranges setting \mathcode.

```

924 \cs_new:Nn \um_set_mathalph_range:nNnn {
925   \clist_map_variable:nNn {#3} \l_um_input_num {
926     \errorcontextlines=999
927     \prg_stepwise_variable:nnnNn {0}{1}{#1} \l_um_inc_num {
928       \exp_args:Nnff \um_mathmap:Nnn {#2}
929       {\number\numexpr \l_um_inc_num + \l_um_input_num \relax}
930       {\number\numexpr \l_um_inc_num + #4 \relax}
931     }
932   }
933 }
934 \cs_new:Nn \um_set_mathalphabet_x:Nnn {
935   \um_set_mathalph_range:nNnn {9}{#1}{#2}{#3}
936 }
937 \cs_new:Nn \um_set_mathalphabet_xxvi:Nnn {
938   \um_set_mathalph_range:nNnn {25}{#1}{#2}{#3}
939 }
940 \cs_new:Nn \um_set_mathalphabet_xxiii:Nnn {

```

```

941 \um_set_mathalph_range:nNnn {24}{#1}{#2}{#3}
942 }
943
944 \cs_new:Nn \um_set_mathalphabet_pos:Nnnn {
945   \cs_if_exist:cT { \um_to_usv:nn {#4}{#2} } {
946     \clist_map_inline:nn {#3} {
947       \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{#2} } { \um_to_usv:nn {#4}{#2} }
948     }
949   }
950 }
951 \cs_new:Nn \um_set_mathalphabet_numbers:Nnn {
952   \clist_map_inline:nn {#2} {
953     \um_set_mathalphabet_x:Ncc #1 { \um_to_usv:nn {##1}{num} } { \um_to_usv:nn {#3}{num} }
954   }
955 }
956 \cs_new:Nn \um_set_mathalphabet_Latin:Nnn {
957   \clist_map_inline:nn {#2} {
958     \um_set_mathalphabet_xxvi:Ncc #1 { \um_to_usv:nn {##1}{Latin} } { \um_to_usv:nn {#3}{Latin} }
959   }
960 }
961 \cs_new:Nn \um_set_mathalphabet_latin:Nnn {
962   \clist_map_inline:nn {#2} {
963     \um_set_mathalphabet_xxvi:Ncc #1 { \um_to_usv:nn {##1}{latin} } { \um_to_usv:nn {#3}{latin} }
964     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{h} } { \um_to_usv:nn {#3}{h} }
965   }
966 }
967 \cs_new:Nn \um_set_mathalphabet_Greek:Nnn {
968   \clist_map_inline:nn {#2} {
969     \um_set_mathalphabet_xxiii:Ncc #1 { \um_to_usv:nn {##1}{Greek} } { \um_to_usv:nn {#3}{Gree
970       \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{var-
971       Theta} } { \um_to_usv:nn {#3}{varTheta} }
972     }
973   }
974 }
975 \cs_new:Nn \um_set_mathalphabet_greek:Nnn {
976   \clist_map_inline:nn {#2} {
977     \um_set_mathalphabet_xxiii:Ncc #1 { \um_to_usv:nn {##1}{greek} } { \um_to_usv:nn {#3}{gre
978     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{varep-
979     silon} } { \um_to_usv:nn {#3}{varepsilon} }
980     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{var-
981     theta} } { \um_to_usv:nn {#3}{vartheta} }
982     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{varkappa} } { \um_to_usv:nn {#3}{va
983     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{varphi} } { \um_to_usv:nn {#3}{var
984     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{var-
985     rho} } { \um_to_usv:nn {#3}{varrho} }
986     \um_set_mathalphabet_char:Ncc #1 { \um_to_usv:nn {##1}{varpi} } { \um_to_usv:nn {#3}{var
987   }

```

```

983 }
984 \cs_generate_variant:Nn \um_set_mathalphabet_char:Nnn {Ncc}
985 \cs_generate_variant:Nn \um_set_mathalphabet_xxiii:Nnn {Ncc}
986 \cs_generate_variant:Nn \um_set_mathalphabet_xxvi:Nnn {Ncc}
987 \cs_generate_variant:Nn \um_set_mathalphabet_x:Nnn {Ncc}

```

8.4 Resolving Greek symbol name control sequences

`\um_resolve_greek:` This macro defines `\Alpha...``\omega` as their corresponding unicode (mathematical italic) character. Remember that the mapping to upright or italic happens with the mathcode definitions, whereas these macros just stand for the literal unicode characters.

```

988 \AtBeginDocument{\um_resolve_greek:}
989 \cs_new:Nn \um_resolve_greek: {
990   \clist_map_inline:nn {
991     Alpha,Beta,Gamma,Delta,Epsilon,Zeta,Eta,Theta,Iota,Kappa,Lambda,
992     alpha,beta,gamma,delta,          zeta,eta,theta,iota,kappa,lambda,
993     Mu,Nu,Xi,Omicron,Pi,Rho,Sigma,Tau,Upsilon,Phi,Chi,Psi,Omega,
994     mu,nu,xi,omicron,pi,rho,sigma,tau,upsilon,    chi,psi,omega,
995     varTheta,
996     varsigma,vartheta,varkappa,varrho,varpi
997   }{
998     \tl_set:cx {##1} { \exp_not:c { mit ##1 } }
999   }
1000   \tl_set:Nn \epsilon {
1001     \bool_if:NTF \g_um_texgreek_bool \mitvarepsilon \mitepsilon
1002   }
1003   \tl_set:Nn \phi {
1004     \bool_if:NTF \g_um_texgreek_bool \mitvarphi \mitphi
1005   }
1006   \tl_set:Nn \varepsilon {
1007     \bool_if:NTF \g_um_texgreek_bool \mitepsilon \mitvarepsilon
1008   }
1009   \tl_set:Nn \varphi {
1010     \bool_if:NTF \g_um_texgreek_bool \mitphi \mitvarphi
1011   }
1012 }

```

9 Maths alphabets mapping definitions

Algorithm for setting alphabet fonts. By default, when `range` is empty, we are in *implicit* mode. If `range` contains the name of the math alphabet, we are in *explicit* mode and do things slightly differently.

Implicit mode:

- Try and set all of the alphabet shapes.
- Check for the first glyph of each alphabet to detect if the font supports each alphabet shape.
- For alphabets that do exist, overwrite whatever’s already there.
- For alphabets that are not supported, *do nothing*. (This includes leaving the old alphabet definition in place.)

Explicit mode:

- Only set the alphabets specified.
- Check for the first glyph of the alphabet to detect if the font contains the alphabet shape in the unicode math plane.
- For unicode math alphabets, overwrite whatever’s already there.
- Otherwise, use the ASCII letters instead.

9.0.1 Macros

This is every math alphabet known to unicode-math:

`\g_um_mathalph_seq`

```

1013 \seq_new:N \g_um_mathalph_seq
1014 \tl_map_inline:nn {
1015   \mathup\mathit\mathbb\mathbbit
1016   \mathscr\mathfrak\mathtt
1017   \mathsf\mathsfup\mathsfit
1018   \mathbf\mathbfup\mathbfit
1019   \mathbfscr\mathbffrac
1020   \mathbfsf\mathbfsfup\mathbfsfit
1021 }{
1022   \seq_put_right:Nn \g_um_mathalph_seq {#1}
1023 }

1024 \seq_new:N \g_um_default_mathalph_seq
1025 \clist_map_inline:nn {
1026   {\mathup    } {latin, Latin, greek, Greek, num, misc} {\mathup    } ,
1027   {\mathit    } {latin, Latin, greek, Greek, misc}     {\mathit    } ,
1028   {\mathbb    } {latin, Latin, num, misc}               {\mathbb    } ,
1029   {\mathbbit  } {misc}                                 {\mathbbit  } ,
1030   {\mathscr   } {latin, Latin}                         {\mathscr   } ,
1031   {\mathfrak  } {latin, Latin}                         {\mathfrak  } ,
1032   {\mathtt    } {latin, Latin, num}                    {\mathtt    } ,
1033   {\mathsfup  } {latin, Latin, num}                    {\mathsfup  } ,
1034   {\mathsfit  } {latin, Latin}                         {\mathsfit  } ,

```

```

1035 {\mathbfup } {latin, Latin, greek, Greek, num, misc} {\mathbfup } ,
1036 {\mathbfit } {latin, Latin, greek, Greek, misc} {\mathbfit } ,
1037 {\mathbfscr } {latin, Latin} {\mathbfscr } ,
1038 {\mathbffrak} {latin, Latin} {\mathbffrak} ,
1039 {\mathbfsfup} {latin, Latin, greek, Greek, num, misc} {\mathbfsfup} ,
1040 {\mathbfsfit} {latin, Latin, greek, Greek, misc} {\mathbfsfit}
1041 }{
1042 \seq_put_right:Nn \g_um_default_mathalph_seq {#1}
1043 }

```

\um_setup_alphabets: Variables:

```

1044 \seq_new:N \l_um_missing_alph_seq
1045 \cs_new:Nn \um_setup_alphabets: {
1046 \seq_clear:N \l_um_missing_alph_seq
1047 \seq_if_empty:NTF \l_um_mathalph_seq {
1048 (trace) \um_debug:n {Setup~ alphabets:~ implicit~ mode}
1049 \seq_set_eq:NN \l_um_mathalph_seq \g_um_default_mathalph_seq
1050 \bool_set_true:N \l_um_implicit_alph_bool
1051 \um_maybe_init_alphabet:n {sf}
1052 \um_maybe_init_alphabet:n {bf}
1053 \um_maybe_init_alphabet:n {bfsf}
1054 }{
1055 (trace) \um_debug:n {Setup~ alphabets:~ explicit~ mode}
1056 \bool_set_false:N \l_um_implicit_alph_bool
1057 \cs_set_eq:NN \um_mathmap:Nnn \um_mathmap_noparse:Nnn
1058 }
1059 \seq_map_inline:Nn \l_um_mathalph_seq {
1060 \tl_set:No \l_um_tmpa_tl { \use_i:nnn ##1 }
1061 \tl_set:No \l_um_tmpb_tl { \use_ii:nnn ##1 }
1062 \tl_set:No \l_um_remap_alphabet_tl { \use_iii:nnn ##1 }
1063 \tl_if_empty:NTF \l_um_remap_alphabet_tl {
1064 \tl_set:Nx \l_um_remap_alphabet_tl {\exp_after:wN \token_to_str:N \l_um_tmpa_tl}
1065 }{
1066 \tl_set:Nx \l_um_remap_alphabet_tl {\exp_after:wN \token_to_str:N \l_um_remap_alphabet_tl}
1067 }
1068 \tl_set:Nx \l_um_remap_alphabet_tl {\exp_after:wN \use_none:nnnnn \l_um_remap_alphabet_tl}
1069 \tl_if_empty:NT \l_um_tmpb_tl {
1070 \cs_set_eq:NN \um_maybe_init_alphabet:n \um_init_alphabet:n
1071 \tl_set:Nn \l_um_tmpb_tl { latin, Latin, greek, Greek, num, misc }
1072 }
1073 \um_setup_math_alphabet:VVV \l_um_tmpa_tl \l_um_tmpb_tl \l_um_remap_alphabet_tl
1074 }
1075 \um_warn_missing_alphabets:
1076 }
1077 \cs_new:Nn \um_warn_missing_alphabets: {
1078 \seq_if_empty:NF \l_um_missing_alph_seq {

```

```

1079 \typeout{
1080   Package~unicode-math~Warning:~
1081   missing~math~alphabets~in~font~ \fontname\l_um_font
1082 }
1083 \seq_map_inline:Nn \l_um_missing_alph_seq {
1084   \typeout{\space\space\space\space##1}
1085 }
1086 }
1087 }

```

`\um_setup_math_alphabet:Nnn` #1 : Math font family name (e.g., `\mathbb`)

#2 : Math alphabets, comma separated of {latin, Latin, greek, Greek, num}

#3 : Math alphabets output string (usually same as input `bb`)

First check that at least one of the alphabets for the font shape is defined, and then loop through them defining the individual ranges.

```

1088 \cs_new:Nn \um_setup_math_alphabet:Nnn {
1089   \tl_set:Nx \l_um_tmpa_tl {\cs_to_str:N #1}
1090   \tl_set:Nx \l_um_tmpb_tl {\exp_after:wN \use_none:nnnn \l_um_tmpa_tl}
1091   \clist_map_inline:nn {#2} {
1092     \cs_if_exist:cT {um_config_ \l_um_tmpa_tl _##1:n} {
1093       \tl_if_eq:nnTF {##1}{misc} {
1094         \exp_args:NV \um_maybe_init_alphabet:n \l_um_tmpb_tl
1095         \clist_map_break:
1096       }{
1097         \um_glyph_if_exist:cT { \um_to_usv:nn {#3}{##1} }{
1098           \exp_args:NV \um_maybe_init_alphabet:n \l_um_tmpb_tl
1099           \clist_map_break:
1100         }
1101       }
1102     }
1103   }
1104   \clist_map_inline:nn {#2} {
1105     \cs_if_exist:cT {um_config_ \l_um_tmpa_tl _##1:n} {
1106       \tl_if_eq:nnTF {##1}{misc} {
1107         (trace) \um_debug:n {Setup~ alphabet:~ \l_um_tmpa_tl\space (##1)}
1108         \use:c {um_config_ \l_um_tmpa_tl _##1:n} {#3}
1109       }{
1110         \um_glyph_if_exist:cTF { \um_to_usv:nn {#3}{##1} } {
1111         (trace) \um_debug:n {Setup~ alphabet:~ \l_um_tmpa_tl\space (##1)}
1112         \use:c {um_config_ \l_um_tmpa_tl _##1:n} {#3}
1113       }{
1114         \bool_if:NTF \l_um_implicit_alph_bool {
1115           \seq_put_right:Nx \l_um_missing_alph_seq {
1116             \@backslashchar
1117             \l_um_tmpa_tl\space(\tl_use:c{g_um_math_alphabet_name_##1_tl})
1118           }

```

```

1119         }{
1120         \use:c {um_config_ \l_um_tmpa_tl _##1:n} {up}
1121         }
1122     }
1123 }
1124 }
1125 }
1126 }
1127 \cs_generate_variant:Nn \um_setup_math_alphabet:Nnn {NV,VVV}

1128 \cs_set:Nn \um_init_alphabet:n {
1129   ⚡ \um_debug:n {Initialiasing~\@backslashchar math#1}
1130   \um_prepare_alph:n {#1}
1131   \cs_set_eq:CN {um_setup_math#1:} \prg_do_nothing:
1132 }

```

`\um_glyph_if_exist:nTF` : TODO: Generalise for arbitrary fonts! `\um@font` is not always the one used for a specific glyph!!

```

1133 \prg_new_conditional:Nnn \um_glyph_if_exist:n {p,TF,T,F} {
1134   \etex_iffontchar:D \l_um_font #1 \scan_stop: \prg_return_true: \else: \prg_return_false: \fi:
1135 }
1136 \cs_generate_variant:Nn \um_glyph_if_exist_p:n {c}
1137 \cs_generate_variant:Nn \um_glyph_if_exist:nTF {c}
1138 \cs_generate_variant:Nn \um_glyph_if_exist:nT {c}
1139 \cs_generate_variant:Nn \um_glyph_if_exist:nF {c}

```

`\um_prepare_alph:n` If `\mathXY` hasn't been (re-)declared yet, then define it in terms of unicode-math definitions. Use `\bgroup/\egroup` so s'scripts scan the whole thing.

```

1140 \cs_new:Nn \um_prepare_alph:n {
1141   \cs_if_exist:cF {um_math#1:n} {
1142     \cs_set:cpn {um_math#1:n} ##1 {
1143       \use:c {um_setup_math#1:} ##1 \egroup
1144     }
1145     \cs_set_protected:cpn {math#1} {
1146       \bgroup
1147       \mode_if_math:F {
1148         \egroup\expandafter
1149         \non@alpher\expandafter{\csname math#1\endcsname\space}
1150       }
1151       \use:c {um_math#1:n}
1152     }
1153   }
1154 }

```


9.1 Alphabets

9.1.1 Upright: \mathup

```
1155 \cs_new:Nn \um_config_mathup_num:n {
1156   \um_map_chars_numbers:nn {up}{#1}
1157   \um_set_mathalphabet_numbers:Nnn \mathup {up}{#1}
1158 }
1159 \cs_new:Nn \um_config_mathup_Latin:n {
1160   \bool_if:NTF \g_um_literal_bool {
1161     \um_map_chars_Latin:nn {up} {#1}
1162   }{
1163     \bool_if:NT \g_um_upLatin_bool {
1164       \um_map_chars_Latin:nn {up,it} {#1}
1165     }
1166   }
1167   \um_set_mathalphabet_Latin:Nnn \mathup {up,it}{#1}
1168 }
1169 \cs_new:Nn \um_config_mathup_latin:n {
1170   \bool_if:NTF \g_um_literal_bool {
1171     \um_map_chars_latin:nn {up} {#1}
1172   }{
1173     \bool_if:NT \g_um_uplatin_bool {
1174       \um_map_chars_latin:nn {up,it} {#1}
1175       \um_map_single:nnn {h}{up,it}{#1}
1176       \um_map_single:nnn {dotlessi}{up,it}{#1}
1177       \um_map_single:nnn {dotlessj}{up,it}{#1}
1178     }
1179   }
1180   \um_set_mathalphabet_latin:Nnn \mathup {up,it}{#1}
1181 }
1182 \cs_new:Nn \um_config_mathup_Greek:n {
1183   \bool_if:NTF \g_um_literal_bool {
1184     \um_map_chars_Greek:nn {up}{#1}
1185   }{
1186     \bool_if:NT \g_um_upGreek_bool {
1187       \um_map_chars_Greek:nn {up,it}{#1}
1188     }
1189   }
1190   \um_set_mathalphabet_Greek:Nnn \mathup {up,it}{#1}
1191 }
1192 \cs_new:Nn \um_config_mathup_greek:n {
1193   \bool_if:NTF \g_um_literal_bool {
1194     \um_map_chars_greek:nn {up} {#1}
1195   }{
1196     \bool_if:NT \g_um_upgreek_bool {
1197       \um_map_chars_greek:nn {up,it} {#1}
```

```

1198     }
1199   }
1200   \um_set_mathalphabet_greek:Nnn \mathup {up,it} {#1}
1201 }
1202 \cs_new:Nn \um_config_mathup_misc:n {
1203   \um_set_mathalphabet_pos:Nnnn \mathup {partial} {up,it}{#1}
1204   \um_set_mathalphabet_pos:Nnnn \mathup {Nabla} {up,it}{#1}
1205   \um_set_mathalphabet_pos:Nnnn \mathup {dotlessi}{up,it}{#1}
1206   \um_set_mathalphabet_pos:Nnnn \mathup {dotlessj}{up,it}{#1}
1207 }

```

9.1.2 Italic: `\mathit`

```

1208 \cs_new:Nn \um_config_mathit_Latin:n {
1209   \bool_if:NTF \g_um_literal_bool {
1210     \um_map_chars_Latin:nn {it} {#1}
1211   }{
1212     \bool_if:NF \g_um_uplatin_bool {
1213       \um_map_chars_Latin:nn {up,it} {#1}
1214     }
1215   }
1216   \um_set_mathalphabet_Latin:Nnn \mathit {up,it}{#1}
1217 }
1218 \cs_new:Nn \um_config_mathit_latin:n {
1219   \bool_if:NTF \g_um_literal_bool {
1220     \um_map_chars_latin:nn {it} {#1}
1221     \um_map_single:nnn {h}{it}{#1}
1222   }{
1223     \bool_if:NF \g_um_uplatin_bool {
1224       \um_map_chars_latin:nn {up,it} {#1}
1225       \um_map_single:nnn {h}{up,it}{#1}
1226       \um_map_single:nnn {dotlessi}{up,it}{#1}
1227       \um_map_single:nnn {dotlessj}{up,it}{#1}
1228     }
1229   }
1230   \um_set_mathalphabet_latin:Nnn \mathit {up,it}{#1}
1231   \um_set_mathalphabet_pos:Nnnn \mathit {dotlessi}{up,it}{#1}
1232   \um_set_mathalphabet_pos:Nnnn \mathit {dotlessj}{up,it}{#1}
1233 }
1234 \cs_new:Nn \um_config_mathit_Greek:n {
1235   \bool_if:NTF \g_um_literal_bool {
1236     \um_map_chars_Greek:nn {it}{#1}
1237   }{
1238     \bool_if:NF \g_um_upgreek_bool {
1239       \um_map_chars_Greek:nn {up,it}{#1}
1240     }
1241   }

```

```

1242 \um_set_mathalphabet_Greek:Nnn \mathit {up,it}{#1}
1243 }
1244 \cs_new:Nn \um_config_mathit_greek:n {
1245   \bool_if:NTF \g_um_literal_bool {
1246     \um_map_chars_greek:nn {it} {#1}
1247   }{
1248     \bool_if:NF \g_um_upgreek_bool {
1249       \um_map_chars_greek:nn {it,up} {#1}
1250     }
1251   }
1252   \um_set_mathalphabet_greek:Nnn \mathit {up,it} {#1}
1253 }
1254 \cs_new:Nn \um_config_mathit_misc:n {
1255   \um_set_mathalphabet_pos:Nnnn \mathit {partial} {up,it}{#1}
1256   \um_set_mathalphabet_pos:Nnnn \mathit {Nabla} {up,it}{#1}
1257 }

```

9.1.3 Blackboard or double-struck: `\mathbb` and `\mathbbbit`

```

1258 \cs_new:Nn \um_config_mathbb_latin:n {
1259   \um_set_mathalphabet_latin:Nnn \mathbb {up,it}{#1}
1260 }
1261 \cs_new:Nn \um_config_mathbb_Latin:n {
1262   \um_set_mathalphabet_Latin:Nnn \mathbb {up,it}{#1}
1263   \um_set_mathalphabet_pos:Nnnn \mathbb {C} {up,it} {#1}
1264   \um_set_mathalphabet_pos:Nnnn \mathbb {H} {up,it} {#1}
1265   \um_set_mathalphabet_pos:Nnnn \mathbb {N} {up,it} {#1}
1266   \um_set_mathalphabet_pos:Nnnn \mathbb {P} {up,it} {#1}
1267   \um_set_mathalphabet_pos:Nnnn \mathbb {Q} {up,it} {#1}
1268   \um_set_mathalphabet_pos:Nnnn \mathbb {R} {up,it} {#1}
1269   \um_set_mathalphabet_pos:Nnnn \mathbb {Z} {up,it} {#1}
1270 }
1271 \cs_new:Nn \um_config_mathbb_num:n {
1272   \um_set_mathalphabet_numbers:Nnn \mathbb {up}{#1}
1273 }
1274 \cs_new:Nn \um_config_mathbb_misc:n {
1275   \um_set_mathalphabet_pos:Nnnn \mathbb {Pi} {up,it} {#1}
1276   \um_set_mathalphabet_pos:Nnnn \mathbb {pi} {up,it} {#1}
1277   \um_set_mathalphabet_pos:Nnnn \mathbb {Gamma} {up,it} {#1}
1278   \um_set_mathalphabet_pos:Nnnn \mathbb {gamma} {up,it} {#1}
1279   \um_set_mathalphabet_pos:Nnnn \mathbb {summation} {up} {#1}
1280 }
1281 \cs_new:Nn \um_config_mathbbbit_misc:n {
1282   \um_set_mathalphabet_pos:Nnnn \mathbbbit {D} {up,it} {#1}
1283   \um_set_mathalphabet_pos:Nnnn \mathbbbit {d} {up,it} {#1}
1284   \um_set_mathalphabet_pos:Nnnn \mathbbbit {e} {up,it} {#1}
1285   \um_set_mathalphabet_pos:Nnnn \mathbbbit {i} {up,it} {#1}

```

```

1286 \um_set_mathalphabet_pos:Nnnn \mathbbit {j} {up,it} {#1}
1287 }

```

9.1.4 Script or caligraphic: `\mathscr` and `\mathcal`

```

1288 \cs_new:Nn \um_config_mathscr_Latin:n {
1289   \um_set_mathalphabet_Latin:Nnn \mathscr {up,it}{#1}
1290   \um_set_mathalphabet_pos:Nnnn \mathscr {B}{up,it}{#1}
1291   \um_set_mathalphabet_pos:Nnnn \mathscr {E}{up,it}{#1}
1292   \um_set_mathalphabet_pos:Nnnn \mathscr {F}{up,it}{#1}
1293   \um_set_mathalphabet_pos:Nnnn \mathscr {H}{up,it}{#1}
1294   \um_set_mathalphabet_pos:Nnnn \mathscr {I}{up,it}{#1}
1295   \um_set_mathalphabet_pos:Nnnn \mathscr {L}{up,it}{#1}
1296   \um_set_mathalphabet_pos:Nnnn \mathscr {M}{up,it}{#1}
1297   \um_set_mathalphabet_pos:Nnnn \mathscr {R}{up,it}{#1}
1298 }
1299 \cs_new:Nn \um_config_mathscr_latin:n {
1300   \um_set_mathalphabet_latin:Nnn \mathscr {up,it}{#1}
1301   \um_set_mathalphabet_pos:Nnnn \mathscr {e}{up,it}{#1}
1302   \um_set_mathalphabet_pos:Nnnn \mathscr {g}{up,it}{#1}
1303   \um_set_mathalphabet_pos:Nnnn \mathscr {o}{up,it}{#1}
1304 }

```

9.1.5 Fraktur or fraktur or blackletter: `\mathfrak`

```

1305 \cs_new:Nn \um_config_mathfrak_Latin:n {
1306   \um_set_mathalphabet_Latin:Nnn \mathfrak {up,it}{#1}
1307   \um_set_mathalphabet_pos:Nnnn \mathfrak {C}{up,it}{#1}
1308   \um_set_mathalphabet_pos:Nnnn \mathfrak {H}{up,it}{#1}
1309   \um_set_mathalphabet_pos:Nnnn \mathfrak {I}{up,it}{#1}
1310   \um_set_mathalphabet_pos:Nnnn \mathfrak {R}{up,it}{#1}
1311   \um_set_mathalphabet_pos:Nnnn \mathfrak {Z}{up,it}{#1}
1312 }
1313 \cs_new:Nn \um_config_mathfrak_latin:n {
1314   \um_set_mathalphabet_latin:Nnn \mathfrak {up,it}{#1}
1315 }

```

9.1.6 Sans serif upright: `\mathsfup`

```

1316 \cs_new:Nn \um_config_mathsfup_num:n {
1317   \um_set_mathalphabet_numbers:Nnn \mathsf {up}{#1}
1318   \um_set_mathalphabet_numbers:Nnn \mathsfup {up}{#1}
1319 }
1320 \cs_new:Nn \um_config_mathsfup_Latin:n {
1321   \bool_if:NTF \g_um_sf literal_bool {
1322     \um_map_chars_Latin:nn {sfup} {#1}
1323     \um_set_mathalphabet_Latin:Nnn \mathsf {up}{#1}
1324   }{
1325     \bool_if:NT \g_um_upsans_bool {

```

```

1326     \um_map_chars_Latin:nn {sfup,sfit} {#1}
1327     \um_set_mathalphabet_Latin:Nnn \mathsf {up,it}{#1}
1328   }
1329 }
1330 \um_set_mathalphabet_Latin:Nnn \mathsfup {up,it}{#1}
1331 }
1332 \cs_new:Nn \um_config_mathsfup_latin:n {
1333   \bool_if:NTF \g_um_sfliteral_bool {
1334     \um_map_chars_latin:nn {sfup} {#1}
1335     \um_set_mathalphabet_latin:Nnn \mathsf {up}{#1}
1336   }{
1337     \bool_if:NT \g_um_upsans_bool {
1338       \um_map_chars_latin:nn {sfup,sfit} {#1}
1339       \um_set_mathalphabet_latin:Nnn \mathsf {up,it}{#1}
1340     }
1341   }
1342   \um_set_mathalphabet_latin:Nnn \mathsfup {up,it}{#1}
1343 }

```

9.1.7 Sans serif italic: `\mathsf`

```

1344 \cs_new:Nn \um_config_mathsf_Latin:n {
1345   \bool_if:NTF \g_um_sfliteral_bool {
1346     \um_map_chars_Latin:nn {sfit} {#1}
1347     \um_set_mathalphabet_Latin:Nnn \mathsf {it}{#1}
1348   }{
1349     \bool_if:NF \g_um_upsans_bool {
1350       \um_map_chars_Latin:nn {sfup,sfit} {#1}
1351       \um_set_mathalphabet_Latin:Nnn \mathsf {up,it}{#1}
1352     }
1353   }
1354   \um_set_mathalphabet_Latin:Nnn \mathsfit {up,it}{#1}
1355 }
1356 \cs_new:Nn \um_config_mathsf_latin:n {
1357   \bool_if:NTF \g_um_sfliteral_bool {
1358     \um_map_chars_latin:nn {sfit} {#1}
1359     \um_set_mathalphabet_latin:Nnn \mathsf {it}{#1}
1360   }{
1361     \bool_if:NF \g_um_upsans_bool {
1362       \um_map_chars_latin:nn {sfup,sfit} {#1}
1363       \um_set_mathalphabet_latin:Nnn \mathsf {up,it}{#1}
1364     }
1365   }
1366   \um_set_mathalphabet_latin:Nnn \mathsfit {up,it}{#1}
1367 }

```

9.1.8 Typewriter or monospaced: `\mathtt`

```

1368 \cs_new:Nn \um_config_mathtt_num:n {
1369   \um_set_mathalphabet_numbers:Nnn \mathtt {up}{#1}
1370 }
1371 \cs_new:Nn \um_config_mathtt_Latin:n {
1372   \um_set_mathalphabet_Latin:Nnn \mathtt {up,it}{#1}
1373 }
1374 \cs_new:Nn \um_config_mathtt_latin:n {
1375   \um_set_mathalphabet_latin:Nnn \mathtt {up,it}{#1}
1376 }

```

9.1.9 Bold Italic: `\mathbfit`

```

1377 \cs_new:Nn \um_config_mathbfit_Latin:n {
1378   \bool_if:NF \g_um_bfupLatin_bool {
1379     \um_map_chars_Latin:nn {bfup,bfit} {#1}
1380   }
1381   \um_set_mathalphabet_Latin:Nnn \mathbfit {up,it}{#1}
1382   \bool_if:NTF \g_um_bfliteral_bool {
1383     \um_map_chars_Latin:nn {bfit} {#1}
1384     \um_set_mathalphabet_Latin:Nnn \mathbf {it}{#1}
1385   }{
1386     \bool_if:NF \g_um_bfupLatin_bool {
1387       \um_map_chars_Latin:nn {bfup,bfit} {#1}
1388       \um_set_mathalphabet_Latin:Nnn \mathbf {up,it}{#1}
1389     }
1390   }
1391 }
1392 \cs_new:Nn \um_config_mathbfit_latin:n {
1393   \bool_if:NF \g_um_bfuplatin_bool {
1394     \um_map_chars_latin:nn {bfup,bfit} {#1}
1395   }
1396   \um_set_mathalphabet_latin:Nnn \mathbfit {up,it}{#1}
1397   \bool_if:NTF \g_um_bfliteral_bool {
1398     \um_map_chars_latin:nn {bfit} {#1}
1399     \um_set_mathalphabet_latin:Nnn \mathbf {it}{#1}
1400   }{
1401     \bool_if:NF \g_um_bfuplatin_bool {
1402       \um_map_chars_latin:nn {bfup,bfit} {#1}
1403       \um_set_mathalphabet_latin:Nnn \mathbf {up,it}{#1}
1404     }
1405   }
1406 }
1407 \cs_new:Nn \um_config_mathbfit_Greek:n {
1408   \um_set_mathalphabet_Greek:Nnn \mathbfit {up,it}{#1}
1409   \bool_if:NTF \g_um_bfliteral_bool {
1410     \um_map_chars_Greek:nn {bfit}{#1}
1411     \um_set_mathalphabet_Greek:Nnn \mathbf {it}{#1}

```

```

1412 }{
1413   \bool_if:NF \g_um_bfupGreek_bool {
1414     \um_map_chars_Greek:nn {bfup,bfit}{#1}
1415     \um_set_mathalphabet_Greek:Nnn \mathbf {up,it}{#1}
1416   }
1417 }
1418 }
1419 \cs_new:Nn \um_config_mathbfit_greek:n {
1420   \um_set_mathalphabet_greek:Nnn \mathbfit {up,it} {#1}
1421   \bool_if:NTF \g_um_bfliteral_bool {
1422     \um_map_chars_greek:nn {bfit} {#1}
1423     \um_set_mathalphabet_greek:Nnn \mathbf {it} {#1}
1424   }{
1425     \bool_if:NF \g_um_bfupgreek_bool {
1426       \um_map_chars_greek:nn {bfit,bfup} {#1}
1427       \um_set_mathalphabet_greek:Nnn \mathbf {up,it} {#1}
1428     }
1429   }
1430 }
1431 \cs_new:Nn \um_config_mathbfit_misc:n {
1432   \um_set_mathalphabet_pos:Nnnn \mathbfit {partial} {up,it}{#1}
1433   \um_set_mathalphabet_pos:Nnnn \mathbfit {Nabla} {up,it}{#1}
1434   \bool_if:NTF \g_um_bfliteral_bool {
1435     \um_set_mathalphabet_pos:Nnnn \mathbf {partial} {it}{#1}
1436     \um_set_mathalphabet_pos:Nnnn \mathbf {Nabla} {it}{#1}
1437   }{
1438     \bool_if:NF \g_um_upNabla_bool {
1439       \um_set_mathalphabet_pos:Nnnn \mathbf {Nabla} {up,it}{#1}
1440     }
1441     \bool_if:NF \g_um_uppartial_bool {
1442       \um_set_mathalphabet_pos:Nnnn \mathbf {partial} {up,it}{#1}
1443     }
1444   }
1445 }

```

9.1.10 Bold Upright: `\mathbfup`

```

1446 \cs_new:Nn \um_config_mathbfup_num:n {
1447   \um_set_mathalphabet_numbers:Nnn \mathbf {up}{#1}
1448   \um_set_mathalphabet_numbers:Nnn \mathbfup {up}{#1}
1449 }
1450 \cs_new:Nn \um_config_mathbfup_Latin:n {
1451   \bool_if:NT \g_um_bfupLatin_bool {
1452     \um_map_chars_Latin:nn {bfup,bfit} {#1}
1453   }
1454   \um_set_mathalphabet_Latin:Nnn \mathbfup {up,it}{#1}
1455   \bool_if:NTF \g_um_bfliteral_bool {

```

```

1456 \um_map_chars_Latin:nn {bfup} {#1}
1457 \um_set_mathalphabet_Latin:Nnn \mathbf {up}{#1}
1458 }{
1459 \bool_if:NT \g_um_bfupLatin_bool {
1460 \um_map_chars_Latin:nn {bfup,bfit} {#1}
1461 \um_set_mathalphabet_Latin:Nnn \mathbf {up,it}{#1}
1462 }
1463 }
1464 }
1465 \cs_new:Nn \um_config_mathbfup_latin:n {
1466 \bool_if:NT \g_um_bfuplatin_bool {
1467 \um_map_chars_latin:nn {bfup,bfit} {#1}
1468 }
1469 \um_set_mathalphabet_latin:Nnn \mathbfup {up,it}{#1}
1470 \bool_if:NTF \g_um_bfliteral_bool {
1471 \um_map_chars_latin:nn {bfup} {#1}
1472 \um_set_mathalphabet_latin:Nnn \mathbf {up}{#1}
1473 }{
1474 \bool_if:NT \g_um_bfuplatin_bool {
1475 \um_map_chars_latin:nn {bfup,bfit} {#1}
1476 \um_set_mathalphabet_latin:Nnn \mathbf {up,it}{#1}
1477 }
1478 }
1479 }
1480 \cs_new:Nn \um_config_mathbfup_greek:n {
1481 \um_set_mathalphabet_greek:Nnn \mathbfup {up,it}{#1}
1482 \bool_if:NTF \g_um_bfliteral_bool {
1483 \um_map_chars_greek:nn {bfup}{#1}
1484 \um_set_mathalphabet_greek:Nnn \mathbf {up}{#1}
1485 }{
1486 \bool_if:NT \g_um_bfupgreek_bool {
1487 \um_map_chars_greek:nn {bfup,bfit}{#1}
1488 \um_set_mathalphabet_greek:Nnn \mathbf {up,it}{#1}
1489 }
1490 }
1491 }
1492 \cs_new:Nn \um_config_mathbfup_greek:n {
1493 \um_set_mathalphabet_greek:Nnn \mathbfup {up,it} {#1}
1494 \bool_if:NTF \g_um_bfliteral_bool {
1495 \um_map_chars_greek:nn {bfup} {#1}
1496 \um_set_mathalphabet_greek:Nnn \mathbf {up} {#1}
1497 }{
1498 \bool_if:NT \g_um_bfupgreek_bool {
1499 \um_map_chars_greek:nn {bfup,bfit} {#1}
1500 \um_set_mathalphabet_greek:Nnn \mathbf {up,it} {#1}
1501 }

```



```

1502 }
1503 }
1504 \cs_new:Nn \um_config_mathbfup_misc:n {
1505   \um_set_mathalphabet_pos:Nnnn \mathbfup {partial} {up,it}{#1}
1506   \um_set_mathalphabet_pos:Nnnn \mathbfup {Nabla} {up,it}{#1}
1507   \um_set_mathalphabet_pos:Nnnn \mathbfup {digamma} {up}{#1}
1508   \um_set_mathalphabet_pos:Nnnn \mathbfup {Digamma} {up}{#1}
1509   \um_set_mathalphabet_pos:Nnnn \mathbf {digamma} {up}{#1}
1510   \um_set_mathalphabet_pos:Nnnn \mathbf {Digamma} {up}{#1}
1511   \bool_if:NTF \g_um_bfliteral_bool {
1512     \um_set_mathalphabet_pos:Nnnn \mathbf {partial} {up}{#1}
1513     \um_set_mathalphabet_pos:Nnnn \mathbf {Nabla} {up}{#1}
1514   }{
1515     \bool_if:NT \g_um_upNabla_bool {
1516       \um_set_mathalphabet_pos:Nnnn \mathbf {Nabla} {up,it}{#1}
1517     }
1518     \bool_if:NT \g_um_uppartial_bool {
1519       \um_set_mathalphabet_pos:Nnnn \mathbf {partial} {up,it}{#1}
1520     }
1521   }
1522 }

```

9.1.11 Bold fractur or fraktur or blackletter: `\mathbffrak`

```

1523 \cs_new:Nn \um_config_mathbffrak_Latin:n {
1524   \um_set_mathalphabet_Latin:Nnn \mathbffrak {up,it}{#1}
1525 }
1526 \cs_new:Nn \um_config_mathbffrak_latin:n {
1527   \um_set_mathalphabet_latin:Nnn \mathbffrak {up,it}{#1}
1528 }

```

9.1.12 Bold script or calligraphic: `\mathbfscr`

```

1529 \cs_new:Nn \um_config_mathbfscr_Latin:n {
1530   \um_set_mathalphabet_Latin:Nnn \mathbfscr {up,it}{#1}
1531 }
1532 \cs_new:Nn \um_config_mathbfscr_latin:n {
1533   \um_set_mathalphabet_latin:Nnn \mathbfscr {up,it}{#1}
1534 }

```

9.1.13 Bold upright sans serif: `\mathbfsfup`

```

1535 \cs_new:Nn \um_config_mathbfsfup_num:n {
1536   \um_set_mathalphabet_numbers:Nnn \mathbfsf {up}{#1}
1537   \um_set_mathalphabet_numbers:Nnn \mathbfsfup {up}{#1}
1538 }
1539 \cs_new:Nn \um_config_mathbfsfup_Latin:n {
1540   \bool_if:NTF \g_um_sfliteral_bool {
1541     \um_map_chars_Latin:nn {bfsfup} {#1}

```

```

1542     \um_set_mathalphabet_Latin:Nnn \mathbfsf {up}{#1}
1543   }{
1544     \bool_if:NT \g_um_upsans_bool {
1545       \um_map_chars_Latin:nn {bfsfup,bfsfit} {#1}
1546       \um_set_mathalphabet_Latin:Nnn \mathbfsf {up,it}{#1}
1547     }
1548   }
1549   \um_set_mathalphabet_Latin:Nnn \mathbfsfup {up,it}{#1}
1550 }
1551 \cs_new:Nn \um_config_mathbfsfup_latin:n {
1552   \bool_if:NTF \g_um_sfliteral_bool {
1553     \um_map_chars_latin:nn {bfsfup} {#1}
1554     \um_set_mathalphabet_latin:Nnn \mathbfsf {up}{#1}
1555   }{
1556     \bool_if:NT \g_um_upsans_bool {
1557       \um_map_chars_latin:nn {bfsfup,bfsfit} {#1}
1558       \um_set_mathalphabet_latin:Nnn \mathbfsf {up,it}{#1}
1559     }
1560   }
1561   \um_set_mathalphabet_latin:Nnn \mathbfsfup {up,it}{#1}
1562 }
1563 \cs_new:Nn \um_config_mathbfsfup_greek:n {
1564   \bool_if:NTF \g_um_sfliteral_bool {
1565     \um_map_chars_greek:nn {bfsfup}{#1}
1566     \um_set_mathalphabet_greek:Nnn \mathbfsf {up}{#1}
1567   }{
1568     \bool_if:NT \g_um_upsans_bool {
1569       \um_map_chars_greek:nn {bfsfup,bfsfit}{#1}
1570       \um_set_mathalphabet_greek:Nnn \mathbfsf {up,it}{#1}
1571     }
1572   }
1573   \um_set_mathalphabet_greek:Nnn \mathbfsfup {up,it}{#1}
1574 }
1575 \cs_new:Nn \um_config_mathbfsfup_greek:n {
1576   \bool_if:NTF \g_um_sfliteral_bool {
1577     \um_map_chars_greek:nn {bfsfup} {#1}
1578     \um_set_mathalphabet_greek:Nnn \mathbfsf {up} {#1}
1579   }{
1580     \bool_if:NT \g_um_upsans_bool {
1581       \um_map_chars_greek:nn {bfsfup,bfsfit} {#1}
1582       \um_set_mathalphabet_greek:Nnn \mathbfsf {up,it} {#1}
1583     }
1584   }
1585   \um_set_mathalphabet_greek:Nnn \mathbfsfup {up,it} {#1}
1586 }
1587 \cs_new:Nn \um_config_mathbfsfup_misc:n {

```

```

1588 \um_set_mathalphabet_pos:Nnnn \mathbfsfup {partial} {up,it}{#1}
1589 \um_set_mathalphabet_pos:Nnnn \mathbfsfup {Nabla} {up,it}{#1}
1590 \bool_if:NTF \g_um_sfliteral_bool {
1591   \um_set_mathalphabet_pos:Nnnn \mathbfsf {partial} {up}{#1}
1592   \um_set_mathalphabet_pos:Nnnn \mathbfsf {Nabla} {up}{#1}
1593 }{
1594   \bool_if:NT \g_um_upNabla_bool {
1595     \um_set_mathalphabet_pos:Nnnn \mathbfsf {Nabla} {up,it}{#1}
1596   }
1597   \bool_if:NT \g_um_uppartial_bool {
1598     \um_set_mathalphabet_pos:Nnnn \mathbfsf {partial} {up,it}{#1}
1599   }
1600 }
1601 }

```

9.1.14 Bold italic sans serif: `\mathbfsfit`

```

1602 \cs_new:Nn \um_config_mathbfsfit_Latin:n {
1603   \bool_if:NTF \g_um_sfliteral_bool {
1604     \um_map_chars_Latin:nn {bfsfit} {#1}
1605     \um_set_mathalphabet_Latin:Nnn \mathbfsf {it}{#1}
1606   }{
1607     \bool_if:NF \g_um_upsans_bool {
1608       \um_map_chars_Latin:nn {bfsfup,bfsfit} {#1}
1609       \um_set_mathalphabet_Latin:Nnn \mathbfsf {up,it}{#1}
1610     }
1611   }
1612   \um_set_mathalphabet_Latin:Nnn \mathbfsfit {up,it}{#1}
1613 }
1614 \cs_new:Nn \um_config_mathbfsfit_latin:n {
1615   \bool_if:NTF \g_um_sfliteral_bool {
1616     \um_map_chars_latin:nn {bfsfit} {#1}
1617     \um_set_mathalphabet_latin:Nnn \mathbfsf {it}{#1}
1618   }{
1619     \bool_if:NF \g_um_upsans_bool {
1620       \um_map_chars_latin:nn {bfsfup,bfsfit} {#1}
1621       \um_set_mathalphabet_latin:Nnn \mathbfsf {up,it}{#1}
1622     }
1623   }
1624   \um_set_mathalphabet_latin:Nnn \mathbfsfit {up,it}{#1}
1625 }
1626 \cs_new:Nn \um_config_mathbfsfit_Greek:n {
1627   \bool_if:NTF \g_um_sfliteral_bool {
1628     \um_map_chars_Greek:nn {bfsfit}{#1}
1629     \um_set_mathalphabet_Greek:Nnn \mathbfsf {it}{#1}
1630   }{
1631     \bool_if:NF \g_um_upsans_bool {

```

```

1632     \um_map_chars_Greek:nn {bfsfup,bfsfit}{#1}
1633     \um_set_mathalphabet_Greek:Nnn \mathbfsf {up,it}{#1}
1634   }
1635 }
1636 \um_set_mathalphabet_Greek:Nnn \mathbfsfit {up,it}{#1}
1637 }
1638 \cs_new:Nn \um_config_mathbfsfit_greek:n {
1639   \bool_if:NTF \g_um_sfliteral_bool {
1640     \um_map_chars_greek:nn {bfsfit} {#1}
1641     \um_set_mathalphabet_greek:Nnn \mathbfsf {it} {#1}
1642   }{
1643     \bool_if:NF \g_um_upsans_bool {
1644       \um_map_chars_greek:nn {bfsfup,bfsfit} {#1}
1645       \um_set_mathalphabet_greek:Nnn \mathbfsf {up,it} {#1}
1646     }
1647   }
1648   \um_set_mathalphabet_greek:Nnn \mathbfsfit {up,it} {#1}
1649 }
1650 \cs_new:Nn \um_config_mathbfsfit_misc:n {
1651   \um_set_mathalphabet_pos:Nnnn \mathbfsfit {partial} {up,it}{#1}
1652   \um_set_mathalphabet_pos:Nnnn \mathbfsfit {Nabla} {up,it}{#1}
1653   \bool_if:NTF \g_um_sfliteral_bool {
1654     \um_set_mathalphabet_pos:Nnnn \mathbfsf {partial} {it}{#1}
1655     \um_set_mathalphabet_pos:Nnnn \mathbfsf {Nabla} {it}{#1}
1656   }{
1657     \bool_if:NF \g_um_upNabla_bool {
1658       \um_set_mathalphabet_pos:Nnnn \mathbfsf {Nabla} {up,it}{#1}
1659     }
1660     \bool_if:NF \g_um_uppartial_bool {
1661       \um_set_mathalphabet_pos:Nnnn \mathbfsf {partial} {up,it}{#1}
1662     }
1663   }
1664 }

```

10 Definitions of the math symbols

Here we define every unicode math codepoint an equivalent macro name. The two are equivalent, in a `\let\xyz=^^^^1234` kind of way.

`\um@scancharlet` We need to do some trickery to transform the `\UnicodeMathSymbol` argument
`\um@scanactivedef` "ABCDEF into the \LaTeX 'caret input' form `^^^^abcdef`. It is *very important* that the argument has five characters. Otherwise we need to change the number of ^ chars.

To do this, turn ^ into a regular 'other' character and define the macro to perform the lowercasing and `\let`. `\scantokens` changes the carets back into their original meaning after the group has ended and ^'s catcode returns to normal.

```

1665 \begingroup
1666   \char_make_other:N \^
1667   \cs_gset:Npn \um@scancharlet#1="#2\@nil {
1668     \lowercase{
1669       \tl_rescan:nn {
1670         \char_make_other:N \{
1671         \char_make_other:N \}
1672         \char_make_other:N \&
1673         \char_make_other:N \%
1674         \char_make_other:N \$
1675       }{
1676         \global\let#1=^^^#2
1677     }
1678   }
1679 }

```

Making `^` the right catcode isn't strictly necessary right now but it helps to future proof us with, e.g., `breqn`.

```

1680   \gdef\um@scanactivedef"#1\@nil#2{
1681     \lowercase{
1682       \tl_rescan:nn{
1683         \ExplSyntaxOn
1684         \char_make_math_superscript:N\^
1685       }{
1686         \global\def^^^#1{#2}
1687     }
1688   }
1689 }
1690 \endgroup

```

Now give `\UnicodeMathSymbol` a definition in terms of `\um@scancharlet` and we're good to go. Make sure `#` is an 'other' so that we don't get confused with `\mathoctothorpe`.

```

1691 \AtBeginDocument{
1692   \group_begin:
1693     \char_make_math_superscript:N\^
1694     \def\UnicodeMathSymbol#1#2#3#4{
1695       \um@scancharlet#2=#1\@nil\ignorespaces
1696     }
1697     \char_make_other:N \#
1698     \@input{unicode-math-table.tex}
1699   \group_end:
1700 }

```

Fix `\backslash`, which is defined as the escape char character above:

```

1701 \group_begin:
1702   \lcode` \*=` \

```

```

1703 \char_make_escape:N \
1704 \char_make_other:N \
1705 |lowercase{
1706   |AtBeginDocument{
1707     |let|backslash=*
1708   }
1709 }
1710 |group_end:
Fix \backslash:

```

11 Epilogue

Lots of little things to tidy up.

11.0.15 Primes

We need a new ‘prime’ algorithm. Unicode math has four pre-drawn prime glyphs.

```

u+2032 prime (\prime):  $x'$ 
u+2033 double prime (\dprime):  $x''$ 
u+2034 triple prime (\trprime):  $x'''$ 
u+2057 quadruple prime (\qprime):  $x''''$ 

```

As you can see, they’re all drawn at the correct height without being superscripted. However, in a correctly behaviour OpenType font with the MATH table, we also see different behaviour after the `ssty` feature is applied:

```

u+2032 prime in the ‘scriptstyle’ font:  $x'$ 

```

The shrinking and offsetting is done as it is turned into a superscript. This means, luckily, that by default things work nicely for single primes.

However, it would be nice to use the pre-composed primes above if they exist in the font; consider x''' vs. x''' . Our algorithm is

- Prime encountered; pcount=1.
- Scan ahead; if prime: pcount:=pcount+1; repeat.
- If not prime, stop scanning.
- If pcount=1, \prime, end.
- If pcount=2, check \dprime; if it exists, use it, end; if not, goto last step.
- Ditto pcount=3 & \trprime.

- Ditto pcount=4 & \qprime.
- If pcount>4 or the glyph doesn't exist, insert pcount \primes with \primekern between each.

```

1711 \muskip_new:N \g_um_primekern_muskip
1712 \muskip_gset:Nn \g_um_primekern_muskip { -\thinmuskip/2 }% arbitrary
1713 \num_new:N \l_um_primecount_num

1714 \cs_new:Nn \um_nprimes:Nn {
1715   ^{
1716     #1
1717     \prg_replicate:nn {#2-1} { \mskip \g_um_primekern_muskip #1 }
1718   }
1719 }
1720 \cs_new:Nn \um_nprimes_select:nn {
1721   \prg_case_int:nnn {#2}{
1722     {1} { ^{#1} }
1723     {2} {
1724       \um_glyph_if_exist:nTF {"2033} { ^{\um_prime_double_mchar} } {\um_nprimes:Nn #1 {#2}}
1725     }
1726     {3} {
1727       \um_glyph_if_exist:nTF {"2034} { ^{\um_prime_triple_mchar} } {\um_nprimes:Nn #1 {#2}}
1728     }
1729     {4} {
1730       \um_glyph_if_exist:nTF {"2057} { ^{\um_prime_quad_mchar} } {\um_nprimes:Nn #1 {#2}}
1731     }
1732   }{
1733     \um_nprimes:Nn #1 {#2}
1734   }
1735 }
1736 \cs_new:Nn \um_nbackprimes_select:nn {
1737   \prg_case_int:nnn {#2}{
1738     {1} { ^{#1} }
1739     {2} {
1740       \um_glyph_if_exist:nTF {"2033} { ^{\um_backprime_double_mchar} } {\um_nprimes:Nn #1 {#2}}
1741     }
1742     {3} {
1743       \um_glyph_if_exist:nTF {"2034} { ^{\um_backprime_triple_mchar} } {\um_nprimes:Nn #1 {#2}}
1744     }
1745   }{
1746     \um_nprimes:Nn #1 {#2}
1747   }
1748 }

```

Scanning is annoying because I'm too lazy to do it for the general case.

```

1749 \cs_new:Nn \um_scan_prime: {
1750   \num_zero:N \l_um_primecount_num

```

```

1751 \um_scanprime_collect:N \um_prime_single_mchar
1752 }
1753 \cs_new:Nn \um_scan_dprime: {
1754   \num_set:Nn \l_um_primecount_num {1}
1755   \um_scanprime_collect:N \um_prime_single_mchar
1756 }
1757 \cs_new:Nn \um_scan_trprime: {
1758   \num_set:Nn \l_um_primecount_num {2}
1759   \um_scanprime_collect:N \um_prime_single_mchar
1760 }
1761 \cs_new:Nn \um_scan_qprime: {
1762   \num_set:Nn \l_um_primecount_num {3}
1763   \um_scanprime_collect:N \um_prime_single_mchar
1764 }
1765 \cs_new:Nn \um_scanprime_collect:N {
1766   \num_incr:N \l_um_primecount_num
1767   \peek_meaning_remove:NTF ' {
1768     \um_scanprime_collect:N #1
1769   }{
1770     \peek_meaning_remove:NTF \um_scan_prime: {
1771       \um_scanprime_collect:N #1
1772     }{
1773       \peek_meaning_remove:NTF ^^^2032 {
1774         \um_scanprime_collect:N #1
1775       }{
1776         \peek_meaning_remove:NTF \um_scan_dprime: {
1777           \num_incr:N \l_um_primecount_num
1778           \um_scanprime_collect:N #1
1779         }{
1780           \peek_meaning_remove:NTF ^^^2033 {
1781             \num_incr:N \l_um_primecount_num
1782             \um_scanprime_collect:N #1
1783           }{
1784             \peek_meaning_remove:NTF \um_scan_trprime: {
1785               \num_add:Nn \l_um_primecount_num {2}
1786               \um_scanprime_collect:N #1
1787             }{
1788               \peek_meaning_remove:NTF ^^^2034 {
1789                 \num_add:Nn \l_um_primecount_num {2}
1790                 \um_scanprime_collect:N #1
1791               }{
1792                 \peek_meaning_remove:NTF \um_scan_qprime: {
1793                   \num_add:Nn \l_um_primecount_num {3}
1794                   \um_scanprime_collect:N #1
1795                 }{
1796                   \peek_meaning_remove:NTF ^^^2057 {

```



```

1797         \num_add:Nn \l_um_primecount_num {3}
1798         \um_scanprime_collect:N #1
1799     }{
1800         \um_nprimes_select:nn {#1} {\l_um_primecount_num}
1801     }
1802 }
1803 }
1804 }
1805 }
1806 }
1807 }
1808 }
1809 }
1810 }
1811 \cs_new:Nn \um_scan_backprime: {
1812     \num_zero:N \l_um_primecount_num
1813     \um_scanbackprime_collect:N \um_backprime_single_mchar
1814 }
1815 \cs_new:Nn \um_scan_backdprime: {
1816     \num_set:Nn \l_um_primecount_num {1}
1817     \um_scanbackprime_collect:N \um_backprime_single_mchar
1818 }
1819 \cs_new:Nn \um_scan_backtrprime: {
1820     \num_set:Nn \l_um_primecount_num {2}
1821     \um_scanbackprime_collect:N \um_backprime_single_mchar
1822 }
1823 \cs_new:Nn \um_scanbackprime_collect:N {
1824     \num_incr:N \l_um_primecount_num
1825     \peek_meaning_remove:NTF ` {
1826         \um_scanbackprime_collect:N #1
1827     }{
1828         \peek_meaning_remove:NTF \um_scan_backprime: {
1829             \um_scanbackprime_collect:N #1
1830         }{
1831             \peek_meaning_remove:NTF ^^^^2035 {
1832                 \um_scanbackprime_collect:N #1
1833             }{
1834                 \peek_meaning_remove:NTF \um_scan_backdprime: {
1835                     \num_incr:N \l_um_primecount_num
1836                     \um_scanbackprime_collect:N #1
1837                 }{
1838                     \peek_meaning_remove:NTF ^^^^2036 {
1839                         \num_incr:N \l_um_primecount_num
1840                         \um_scanbackprime_collect:N #1
1841                     }{
1842                         \peek_meaning_remove:NTF \um_scan_backtrprime: {

```

```

1843         \num_add:Nn \l_um_primecount_num {2}
1844         \um_scanbackprime_collect:N #1
1845     }{
1846         \peek_meaning_remove:NTF ^^^^2037 {
1847             \num_add:Nn \l_um_primecount_num {2}
1848             \um_scanbackprime_collect:N #1
1849         }{
1850             \um_nbackprimes_select:nn {#1} {\l_um_primecount_num}
1851         }
1852     }
1853 }
1854 }
1855 }
1856 }
1857 }
1858 }

1859 \cs_set_eq:NN \prime \um_scan_prime:
1860 \cs_set_eq:NN \drime \um_scan_dprime:
1861 \cs_set_eq:NN \trprime \um_scan_trprime:
1862 \cs_set_eq:NN \qprime \um_scan_qprime:
1863 \cs_set_eq:NN \backprime \um_scan_backprime:
1864 \cs_set_eq:NN \backdprime \um_scan_backdprime:
1865 \cs_set_eq:NN \backtrprime \um_scan_backtrprime:
1866 \group_begin:
1867     \char_make_active:N \ '
1868     \char_make_active:N \ `
1869     \char_make_active:n {"2032}
1870     \char_make_active:n {"2033}
1871     \char_make_active:n {"2034}
1872     \char_make_active:n {"2057}
1873     \char_make_active:n {"2035}
1874     \char_make_active:n {"2036}
1875     \char_make_active:n {"2037}
1876     \cs_gset_eq:NN ' \um_scan_prime:
1877     \cs_gset_eq:NN ^^^^2032 \um_scan_prime:
1878     \cs_gset_eq:NN ^^^^2033 \um_scan_dprime:
1879     \cs_gset_eq:NN ^^^^2034 \um_scan_trprime:
1880     \cs_gset_eq:NN ^^^^2057 \um_scan_qprime:
1881     \cs_gset_eq:NN ` \um_scan_backprime:
1882     \cs_gset_eq:NN ^^^^2035 \um_scan_backprime:
1883     \cs_gset_eq:NN ^^^^2036 \um_scan_backdprime:
1884     \cs_gset_eq:NN ^^^^2037 \um_scan_backtrprime:
1885 \group_end:

```

11.0.16 Unicode radicals

Undo the damage made to `\sqrt`:

```
1886 \DeclareRobustCommand\sqrt{\@ifnextchar[\@sqrt\sqrtsign}
```

`\r@@t` #1 : A mathstyle (for `\mathpalette`)

#2 : Leading superscript for the sqrt sign

A re-implementation of L^AT_EX's hard-coded n-root sign using the appropriate `\fontdimens`.

```
1887 \def\r@@t#1#2{
1888   \setbox\z@\hbox{$\m@th #1\sqrtsign{#2}$}
1889   \um@scaled@apply{#1}{\kern}{\fontdimen63\l_um_font}
1890   \raise \dimexpr(
1891     \um_fontdimen_to_percent:nn{65}{\l_um_font}\ht\z@-
1892     \um_fontdimen_to_percent:nn{65}{\l_um_font}\dp\z@
1893   )\relax
1894   \copy \rootbox
1895   \um@scaled@apply{#1}{\kern}{\fontdimen64\l_um_font}
1896   \box \z@
1897 }
```

11.0.17 Unicode sub- and super-scripts

The idea here is to enter a scanning state after a superscript or subscript is encountered. If subsequent superscripts or subscripts (resp.) are found, they are lumped together. Each sub/super has a corresponding regular size glyph which is used by X_YL_AT_EX to typeset the results; this means that the actual subscript/superscript glyphs are never seen in the output document — they are only used as input characters.

Open question: should the superscript-like ‘modifiers’ (U+1D2C modifier capital letter a and on) be included here?

First, the setup of each mathactive char:

```
1898 \prop_new:N \g_um_supers_prop
1899 \prop_new:N \g_um_subs_prop
1900
1901 \group_begin:
1902
1903 % Populate a property list with superscript characters; their mean-
1904 % ing as their key,
1905 % for reasons that will become apparent soon, and their replace-
1906 % ment as each key's value.
1907 % Then make the superscript active and bind it to the scanning function.
1908 %
1909 % \cs{scantokens} makes this process much simpler since we can acti-
1910 % vate the char
```

```

1908 % and assign its meaning in one step.
1909 \cs_set:Nn \um_setup_active_superscript:nn {
1910   \prop_gput:Nxn \g_um_supers_prop   {\meaning #1} {#2}
1911   \char_make_active:n {\`#1}
1912   \global\XeTeXmathcodenum `#1 = "1FFFFF \scan_stop:
1913   \scantokens{
1914     \cs_gset:Npn #1 {
1915       \tl_set:Nn \l_um_ss_chain_tl {#2}
1916       \cs_set_eq:NN \um_sub_or_super:n \sp
1917       \tl_set:Nn \l_um_tmpa_tl {supers}
1918       \um_scan_sscript:
1919     }
1920   }
1921 }
1922
1923 \um_setup_active_superscript:nn {^^^2070} {0}
1924 \um_setup_active_superscript:nn {^^^00b9} {1}
1925 \um_setup_active_superscript:nn {^^^00b2} {2}
1926 \um_setup_active_superscript:nn {^^^00b3} {3}
1927 \um_setup_active_superscript:nn {^^^2074} {4}
1928 \um_setup_active_superscript:nn {^^^2075} {5}
1929 \um_setup_active_superscript:nn {^^^2076} {6}
1930 \um_setup_active_superscript:nn {^^^2077} {7}
1931 \um_setup_active_superscript:nn {^^^2078} {8}
1932 \um_setup_active_superscript:nn {^^^2079} {9}
1933 \um_setup_active_superscript:nn {^^^207a} {+}
1934 \um_setup_active_superscript:nn {^^^207b} {-}
1935 \um_setup_active_superscript:nn {^^^207c} {=}
1936 \um_setup_active_superscript:nn {^^^207d} {(}
1937 \um_setup_active_superscript:nn {^^^207e} {)}
1938 \um_setup_active_superscript:nn {^^^2071} {i}
1939 \um_setup_active_superscript:nn {^^^207f} {n}
1940
1941 % Ditto above.
1942 \cs_set:Nn \um_setup_active_subscript:nn {
1943   \prop_gput:Nxn \g_um_subs_prop   {\meaning #1} {#2}
1944   \char_make_active:n {\`#1}
1945   \global\XeTeXmathcodenum `#1 = "1FFFFF \scan_stop:
1946   \scantokens{
1947     \cs_gset:Npn #1 {
1948       \tl_set:Nn \l_um_ss_chain_tl {#2}
1949       \cs_set_eq:NN \um_sub_or_super:n \sb
1950       \tl_set:Nn \l_um_tmpa_tl {subs}
1951       \um_scan_sscript:
1952     }
1953   }

```

```

1954 }
1955
1956 \um_setup_active_subscript:nn {^^^2080} {0}
1957 \um_setup_active_subscript:nn {^^^2081} {1}
1958 \um_setup_active_subscript:nn {^^^2082} {2}
1959 \um_setup_active_subscript:nn {^^^2083} {3}
1960 \um_setup_active_subscript:nn {^^^2084} {4}
1961 \um_setup_active_subscript:nn {^^^2085} {5}
1962 \um_setup_active_subscript:nn {^^^2086} {6}
1963 \um_setup_active_subscript:nn {^^^2087} {7}
1964 \um_setup_active_subscript:nn {^^^2088} {8}
1965 \um_setup_active_subscript:nn {^^^2089} {9}
1966 \um_setup_active_subscript:nn {^^^208a} {+}
1967 \um_setup_active_subscript:nn {^^^208b} {-}
1968 \um_setup_active_subscript:nn {^^^208c} {=}
1969 \um_setup_active_subscript:nn {^^^208d} {(}
1970 \um_setup_active_subscript:nn {^^^208e} {)}
1971 \um_setup_active_subscript:nn {^^^2090} {a}
1972 \um_setup_active_subscript:nn {^^^2091} {e}
1973 \um_setup_active_subscript:nn {^^^1d62} {i}
1974 \um_setup_active_subscript:nn {^^^2092} {o}
1975 \um_setup_active_subscript:nn {^^^1d63} {r}
1976 \um_setup_active_subscript:nn {^^^1d64} {u}
1977 \um_setup_active_subscript:nn {^^^1d65} {v}
1978 \um_setup_active_subscript:nn {^^^2093} {x}
1979 \um_setup_active_subscript:nn {^^^1d66} {\beta}
1980 \um_setup_active_subscript:nn {^^^1d67} {\gamma}
1981 \um_setup_active_subscript:nn {^^^1d68} {\rho}
1982 \um_setup_active_subscript:nn {^^^1d69} {\phi}
1983 \um_setup_active_subscript:nn {^^^1d6a} {\chi}
1984
1985 \group_end:
1986
1987 % The scanning command, evident in its purpose:
1988 \cs_new:Nn \um_scan_sscript: {
1989   \um_scan_sscript:TF {
1990     \um_scan_sscript:
1991   }{
1992     \um_sub_or_super:n {\l_um_ss_chain_tl}
1993   }
1994 }
1995
1996 % The main theme here is stolen from the source to the vari-
1997   ous \cs{peek_} functions.
1998 % Consider this function as simply boilerplate:
1999 \cs_new:Nn \um_scan_sscript:TF {

```

```

1999 \tl_set:Nx \l_peek_true_aux_tl { \exp_not:n{ #1 } }
2000 \tl_set_eq:NN \l_peek_true_tl \c_peek_true_remove_next_tl
2001 \tl_set:Nx \l_peek_false_tl {\exp_not:n{\group_align_safe_end: #2}}
2002 \group_align_safe_begin:
2003   \peek_after:NN \um_peek_execute_branches_ss:
2004 }
2005
2006 % We do not skip spaces when scanning ahead, and we explicitly wish to
2007 % bail out on encountering a space or a brace.
2008 \cs_new:Npn \um_peek_execute_branches_ss: {
2009   \bool_if:nTF {
2010     \token_if_eq_catcode_p:NN \l_peek_token \c_group_begin_token ||
2011     \token_if_eq_catcode_p:NN \l_peek_token \c_group_end_token ||
2012     \token_if_eq_meaning_p:NN \l_peek_token \c_space_token
2013   }
2014   { \l_peek_false_tl }
2015   { \um_peek_execute_branches_ss_aux: }
2016 }
2017
2018 % This is the actual comparison code.
2019 % Because the peeking has already tokenised the next token,
2020 % it's too late to extract its charcode directly. Instead,
2021 % we look at its meaning, which remains a `character' even
2022 % though it is itself math-active. If the character is ever
2023 % made fully active, this will break our assumptions!
2024 %
2025 % If the char's meaning exists as a property list key, we
2026 % build up a chain of sub-/superscripts and iterate. (If not, exit and
2027 % typeset what we've already collected.)
2028 \cs_new:Nn \um_peek_execute_branches_ss_aux: {
2029   \prop_if_in:cxTF
2030     {g_um_\l_um_tmpa_tl _prop}
2031     {\meaning\l_peek_token}
2032   {
2033     \prop_get:cxN
2034       {g_um_\l_um_tmpa_tl _prop}
2035       {\meaning\l_peek_token}
2036     \l_um_tmpb_tl
2037     \tl_put_right:NV \l_um_ss_chain_tl \l_um_tmpb_tl
2038     \l_peek_true_tl
2039   }
2040   {\l_peek_false_tl}
2041 }

```

11.0.18 Active fractions

Active fractions can be setup independently of any maths font definition; all it requires is a mapping from the unicode input chars to the relevant \LaTeX fraction declaration.

```
2042 \cs_new:Nn \um_setup_active_frac: {
2043   \group_begin:
2044   \um_define_active_frac:Nw ^^^^2152 1/{10}
2045   \um_define_active_frac:Nw ^^^^2151 1/9
2046   \um_define_active_frac:Nw ^^^^215b 1/8
2047   \um_define_active_frac:Nw ^^^^2150 1/7
2048   \um_define_active_frac:Nw ^^^^2159 1/6
2049   \um_define_active_frac:Nw ^^^^2155 1/5
2050   \um_define_active_frac:Nw ^^^^00bc 1/4
2051   \um_define_active_frac:Nw ^^^^2153 1/3
2052   \um_define_active_frac:Nw ^^^^215c 3/8
2053   \um_define_active_frac:Nw ^^^^2156 2/5
2054   \um_define_active_frac:Nw ^^^^00bd 1/2
2055   \um_define_active_frac:Nw ^^^^2157 3/5
2056   \um_define_active_frac:Nw ^^^^215d 5/8
2057   \um_define_active_frac:Nw ^^^^2154 2/3
2058   \um_define_active_frac:Nw ^^^^00be 3/4
2059   \um_define_active_frac:Nw ^^^^2158 4/5
2060   \um_define_active_frac:Nw ^^^^215a 5/6
2061   \um_define_active_frac:Nw ^^^^215e 7/8
2062   \group_end:
2063 }
2064 \cs_new:Npn \um_define_active_frac:Nw #1 #2/#3 {
2065   \char_make_active:n {`#1}
2066   \global\XeTeXmathcodenum `#1 = "1FFFFF \scan_stop:
2067   \tl_rescan:nn {
2068     \ExplSyntaxOn
2069   }{
2070     \cs_gset:Npx #1 {
2071       \bool_if:NTF \l_um_smallfrac_bool {\exp_not:N\tfrac} {\exp_not:N\frac}
2072       {#2} {#3}
2073     }
2074   }
2075 }
```

11.0.19 Synonyms and all the rest

We need to change \LaTeX 's idea of the font used to typeset things like `\sin` and `\cos`:

```
2076 \def\operator@font{\um_setup_mathup:}
```

```

2077 \def\to{\rightarrow}
2078 \def\overrightarrow{\vec}
2079 \def\le{\leq}
2080 \def\ge{\geq}
2081 \def\neq{\neq}
2082 \def\triangle{\mathord{\bigtriangleup}}
2083 \def\bigcirc{\mdlgwhtcircle}
2084 \def\circ{\vysmwhtcircle}
2085 \def\bullet{\smblkcircle}
2086 \def\mathyen{\yen}
2087 \def\mathsterling{\sterling}

```

`\colon` Define `\colon` as a mathpunct `‘:’`. This is wrong: it should be `U+003A` colon instead! We hope no-one will notice.

```

2088 \@ifpackageloaded{amsmath}{
2089   % define their own colon, perhaps I should just steal it. (It does look much bet-
2090   % ter.)
2091   }{
2092     \cs_set_protected:Npn \colon {
2093       \bool_if:NTF \g_um_literal_colon_bool {;} { \mathpunct{:} }
2094     }
2095   }

```

`\mathcal`

```

2095 \def\mathcal{\mathscr}

```

`\mathrm`

```

2096 \def\mathrm{\mathup}
2097 \let\mathfence\mathord

```

`\digamma` I might end up just changing these in the table.

```

\Digamma 2098 \def\digamma{\updigamma}
2099 \def\Digamma{\upDigamma}

```

11.0.20 Compatibility

Note that `amsmath` will always be loaded before `unicode-math`. (Conflicts occur if you try it the other way around.)

amsmath Since the mathcode of ``\-` is greater than eight bits, this piece of `\AtBeginDocument` code from `amsmath` dies if we try and set the maths font in the preamble:

```

2100 \cs_new:Nn \um_fix_amsmath: {
2101   \tl_remove_in:Nn \@begindocumenthook {
2102     \mathchardef\std@minus\mathcode`\-\relax

```



```

2103 \mathchardef\std@equal\mathcode`\=\relax
2104 }
2105 \def\std@minus{\XeTeXmathcharnum\XeTeXmathcodenum`\-\relax}
2106 \def\std@equal{\XeTeXmathcharnum\XeTeXmathcodenum`\=\relax}
2107 \def\@cdots{\mathinner{\cdots}}
2108 \cs_set_eq:NN \dotsb@ \cdots
2109 }
2110 \@ifpackageloaded {amsmath} {
2111   \um_fix_amsmath:
2112 }{
2113   \AfterPackage{amsmath}{\um_fix_amsmath:}
2114 }

```

amsopn This code is to improve the output of alphabetic symbols in text of operator names (`\sin`, `\cos`, etc.). Just comment out the offending lines for now:

```

2115 \cs_new:Nn \um_fix_amsopn: {
2116   \cs_set:Npn \newmcodes@ {
2117     \mathcode`\'39
2118     \mathcode`\*42
2119     \mathcode`\."613A%
2120   %% \ifnum\mathcode`\-=45 \else
2121   %%   \mathchardef\std@minus\mathcode`\-\relax
2122   %% \fi
2123     \mathcode`\-45
2124     \mathcode`\ /47
2125     \mathcode`\:"603A\relax
2126   }
2127 }
2128 \@ifpackageloaded {amsopn} {
2129   \um_fix_amsopn:
2130 }{
2131   \AfterPackage{amsopn}{\um_fix_amsopn:}
2132 }

```

Symbols `\mathinner` items:

```

2133 \cs_set:Npn \mathellipsis {\mathinner{\unicodeellipsis}}
2134 \cs_set:Npn \cdots {\mathinner{\unicodecdots}}

```

Accents

```

2135 \AtBeginDocument{
2136   \def\widehat{\hat}
2137   \def\widetilde{\tilde}
2138 }

```

beamer

```
2139 \@ifclassloaded{beamer}{
2140   \ifbeamer@suppressreplacements\else
2141     \PackageWarningNoLine{unicode-math}{
2142       Disabling~ beamer's~ math~ setup.^{^}
2143       Please~ load~ beamer~ with~ the~ [professionalfonts]~ class~ option
2144     }
2145     \beamer@suppressreplacementstrue
2146   \fi
2147 }{}
    The end.
2148 \ExplSyntaxOff
```

12 STIX table data extraction

The source for the \TeX names for the very large number of mathematical glyphs are provided via Barbara Beeton's table file for the STIX project ([ams.org/STIX](http://www.ams.org/STIX)). A version is located at <http://www.ams.org/STIX/bnb/stix-tbl.asc> but check <http://www.ams.org/STIX/> for more up-to-date info.

This table is converted into a form suitable for reading by \XeTeX , and then hand-edited by the author; the result is `unicode-math-table.tex`.

A single file is produced containing all (more than 3298) symbols. Future optimisations might include generating various (possibly overlapping) subsets so not all definitions must be read just to redefine a small range of symbols. Performance for now seems to be acceptable without such measures.

```
2149 #!/bin/sh
2150
2151 cat stix-tbl.txt |
2152 awk '
```

If the USV isn't repeated (TODO: check this is valid!) and the entry isn't one of the weird ones in the big block at the end of the STIX table (TODO: check that out!)...

```
2153 {if (usv != substr($0,2,5) && substr($0,2,1) != " ")
2154   {usv = substr($0,2,5);
2155     texname = substr($0,84,25);
2156     class = substr($0,57,1);
2157     description = tolower(substr($0,233,350));
```

If the USV has a macro name, which isn't `\text...`, and isn't a single character macro (e.g., `\#`, `\S`, ...), and has a class, and it isn't reserved (*i.e.*, doubled up with a previously assigned glyph):

```
2158   if (texname ~ /[\\]/ &&
2159       substr(texname,0,5) != "\\text" &&
2160       substr(texname,0,4) != "\\ipa" &&
```

Print the actual entry corresponding to the unicode character:

Now replace the `stix` class abbreviations with their `TEX` macro names.

Fixing up a couple of things in the STIX table.

A Documenting maths support in the NFSS

Maths symbol fonts Fonts for symbols: α , \leq , \rightarrow

Declares a named maths font such as operators from which symbols are defined with `\DeclareMathSymbol`.

Maths alphabet fonts Fonts for $ABC-xyz$, $\mathfrak{A}\mathfrak{B}\mathfrak{C}-\mathfrak{X}\mathfrak{Y}\mathfrak{Z}$, etc.

For commands such as `\mathbf{f}`, accessed through maths mode that are unaffected by the current text font, and which are used for alphabetic symbols in the ASCII range.

83

Alternative (and optimisation) for `\DeclareMathAlphabet` if a single font is being used for both alphabetic characters (as above) and symbols.

Maths ‘versions’ Different maths weights can be defined with the following, switched in text with the `\mathversion{<maths version>}` command.

```
\SetSymbolFont{<name>}{<maths version>}{NFSS decl.}
\SetMathAlphabet{<cmd>}{<maths version>}{NFSS decl.}
```

Maths symbols Symbol definitions in maths for both characters (=) and macros (`\eqdef`): `\DeclareMathSymbol{<symbol>}{<type>}{<named font>}{<slot>}` This is the macro that actually defines which font each symbol comes from and how they behave.

Delimiters and radicals use wrappers around \TeX ’s `\delimiter`/`\radical` primitives, which are re-designed in $\X_{\mathbb{T}}\TeX$. The syntax used in \LaTeX ’s NFSS is therefore not so relevant here.

Delimiters A special class of maths symbol which enlarge themselves in certain contexts.

```
\DeclareMathDelimiter{<symbol>}{<type>}{<sym.font>}{<slot>}{<sym.font>}{<slot>}
```

Radicals Similar to delimiters (`\DeclareMathRadical` takes the same syntax) but behave ‘weirdly’. `\sqrt` might very well be the only one.

In those cases, glyph slots in *two* symbol fonts are required; one for the small (‘regular’) case, the other for situations when the glyph is larger. This is not the case in $\X_{\mathbb{T}}\TeX$.

Accents are not included yet.

Summary For symbols, something like:

```
\def\DeclareMathSymbol#1#2#3#4{
  \global\mathchardef#1"\mathchar@type#2
  \expandafter\hexnumber@\csname sym#2\endcsname
  {\hexnumber@{\count\z@}\hexnumber@{\count\tw@}}}
```

For characters, something like:

```
\def\DeclareMathSymbol#1#2#3#4{
  \global\mathcode`#1"\mathchar@type#2
  \expandafter\hexnumber@\csname sym#2\endcsname
  {\hexnumber@{\count\z@}\hexnumber@{\count\tw@}}}
```

B X_YTeX math font dimensions

These are the extended `\fontdimens` available for suitable fonts in X_YTeX. Note that LuaTeX takes an alternative route, and this package will eventually provide a wrapper interface to the two (I hope).

<code>\fontdimen</code>	Dimension name	Description
10	<code>SCRIPTPERCENTSCALEDOWN</code>	Percentage of scaling down for script level 1. Suggested value: 80%.
11	<code>SCRIPTSCRIPTPERCENTSCALEDOWN</code>	Percentage of scaling down for script level 2 (ScriptScript). Suggested value: 60%.
12	<code>DELIMITEDSUBFORMULAMINHEIGHT</code>	Minimum height required for a delimited expression to be treated as a subformula. Suggested value: normal line height \times 1.5.
13	<code>DISPLAYOPERATORMINHEIGHT</code>	Minimum height of n-ary operators (such as integral and summation) for formulas in display mode.
14	<code>MATHLEADING</code>	White space to be left between math formulas to ensure proper line spacing. For example, for applications that treat line gap as a part of line ascender, formulas with ink going above (<code>os2.sTypoAscender</code> + <code>os2.sTypoLineGap</code> – <code>MathLeading</code>) or with ink going below <code>os2.sTypoDescender</code> will result in increasing line height.
15	<code>AXISHEIGHT</code>	Axis height of the font.
16	<code>ACCENTBASEHEIGHT</code>	Maximum (ink) height of accent base that does not require raising the accents. Suggested: x-height of the font (<code>os2.sxHeight</code>) plus any possible overshots.
17	<code>FLATTENEDACCENTBASEHEIGHT</code>	Maximum (ink) height of accent base that does not require flattening the accents. Suggested: cap height of the font (<code>os2.sCapHeight</code>).
18	<code>SUBSCRIPTSHIFTDOWN</code>	The standard shift down applied to subscript elements. Positive for moving in the downward direction. Suggested: <code>os2.ySubscriptYOffset</code> .

\fontdimen	Dimension name	Description
19	SUBSCRIPTTOPMAX	Maximum allowed height of the (ink) top of subscripts that does not require moving subscripts further down. Suggested: $\frac{1}{5}$ x-height.
20	SUBSCRIPTBASELINEDROPMIN	Minimum allowed drop of the baseline of subscripts relative to the (ink) bottom of the base. Checked for bases that are treated as a box or extended shape. Positive for subscript baseline dropped below the base bottom.
21	SUPERSCRIPSHIFTUP	Standard shift up applied to superscript elements. Suggested: $os2.ySuperscriptYOffset$.
22	SUPERSCRIPSHIFTUPCRAMPED	Standard shift of superscripts relative to the base, in cramped style.
23	SUPERSCRIPBOTTOMMIN	Minimum allowed height of the (ink) bottom of superscripts that does not require moving subscripts further up. Suggested: $\frac{1}{4}$ x-height.
24	SUPERSCRIPBASELINEDROP-MAX	Maximum allowed drop of the baseline of superscripts relative to the (ink) top of the base. Checked for bases that are treated as a box or extended shape. Positive for superscript baseline below the base top.
25	SUBSUPERSCRIPGAPMIN	Minimum gap between the superscript and subscript ink. Suggested: $4 \times$ default rule thickness.
26	SUPERSCRIPBOTTOMMAX-WITHSUBSCRIPT	The maximum level to which the (ink) bottom of superscript can be pushed to increase the gap between superscript and subscript, before subscript starts being moved down. Suggested: $\frac{1}{5}$ x-height.
27	SPACEAFTERSCRIP	Extra white space to be added after each subscript and superscript. Suggested: 0.5pt for a 12 pt font.
28	UPPERLIMITGAPMIN	Minimum gap between the (ink) bottom of the upper limit, and the (ink) top of the base operator.
29	UPPERLIMITBASELINERISEMIN	Minimum distance between baseline of upper limit and (ink) top of the base operator.

\fontdimen	Dimension name	Description
30	LOWERLIMITGAPMIN	Minimum gap between (ink) top of the lower limit, and (ink) bottom of the base operator.
31	LOWERLIMITBASELINEDROP-MIN	Minimum distance between baseline of the lower limit and (ink) bottom of the base operator.
32	STACKTOPSHIFTUP	Standard shift up applied to the top element of a stack.
33	STACKTOPDISPLAYSTYLESHIFT-UP	Standard shift up applied to the top element of a stack in display style.
34	STACKBOTTOMSHIFTDOWN	Standard shift down applied to the bottom element of a stack. Positive for moving in the downward direction.
35	STACKBOTTOMDISPLAYSTYLE-SHIFTDOWN	Standard shift down applied to the bottom element of a stack in display style. Positive for moving in the downward direction.
36	STACKGAPMIN	Minimum gap between (ink) bottom of the top element of a stack, and the (ink) top of the bottom element. Suggested: 3×default rule thickness.
37	STACKDISPLAYSTYLEGAPMIN	Minimum gap between (ink) bottom of the top element of a stack, and the (ink) top of the bottom element in display style. Suggested: 7×default rule thickness.
38	STRETCHSTACKTOPSHIFTUP	Standard shift up applied to the top element of the stretch stack.
39	STRETCHSTACKBOTTOMSHIFT-DOWN	Standard shift down applied to the bottom element of the stretch stack. Positive for moving in the downward direction.
40	STRETCHSTACKGAPABOVEMIN	Minimum gap between the ink of the stretched element, and the (ink) bottom of the element above. Suggested: UpperLimitGapMin
41	STRETCHSTACKGAPBELOWMIN	Minimum gap between the ink of the stretched element, and the (ink) top of the element below. Suggested: LowerLimitGapMin.
42	FRACTIONNUMERATORSHIFTUP	Standard shift up applied to the numerator.

\fontdimen	Dimension name	Description
43	FRACTIONNUMERATOR- DISPLAYSTYLESHIFTUP	Standard shift up applied to the numerator in display style. Suggested: StackTopDisplayStyleShiftUp.
44	FRACTIONDENOMINATORSHIFT- DOWN	Standard shift down applied to the denominator. Positive for moving in the downward direction.
45	FRACTIONDENOMINATOR- DISPLAYSTYLESHIFTDOWN	Standard shift down applied to the denominator in display style. Positive for moving in the downward direction. Suggested: StackBottomDisplayStyleShiftDown.
46	FRACTIONNUMERATORGAP- MIN	Minimum tolerated gap between the (ink) bottom of the numerator and the ink of the fraction bar. Suggested: default rule thickness
47	FRACTIONNUMDISPLAYSTYLE- GAPMIN	Minimum tolerated gap between the (ink) bottom of the numerator and the ink of the fraction bar in display style. Suggested: 3×default rule thickness.
48	FRACTIONRULETHICKNESS	Thickness of the fraction bar. Suggested: default rule thickness.
49	FRACTIONDENOMINATORGAP- MIN	Minimum tolerated gap between the (ink) top of the denominator and the ink of the fraction bar. Suggested: default rule thickness
50	FRACTIONDENOMDISPLAY- STYLEGAPMIN	Minimum tolerated gap between the (ink) top of the denominator and the ink of the fraction bar in display style. Suggested: 3×default rule thickness.
51	SKewedFRACTION- HORIZONTALGAP	Horizontal distance between the top and bottom elements of a skewed fraction.
52	SKewedFRACTIONVERTICAL- GAP	Vertical distance between the ink of the top and bottom elements of a skewed fraction.
53	OVERBARVERTICALGAP	Distance between the overbar and the (ink) top of the base. Suggested: 3×default rule thickness.
54	OVERBARRULETHICKNESS	Thickness of overbar. Suggested: default rule thickness.

\fontdimen	Dimension name	Description
55	OVERBAREXTRAASCENDER	Extra white space reserved above the overbar. Suggested: default rule thickness.
56	UNDERBARVERTICALGAP	Distance between underbar and (ink) bottom of the base. Suggested: 3×default rule thickness.
57	UNDERBARRULETHICKNESS	Thickness of underbar. Suggested: default rule thickness.
58	UNDERBAREXTRADESCENDER	Extra white space reserved below the underbar. Always positive. Suggested: default rule thickness.
59	RADICALVERTICALGAP	Space between the (ink) top of the expression and the bar over it. Suggested: 1¼ default rule thickness.
60	RADICALDISPLAYSTYLE- VERTICALGAP	Space between the (ink) top of the expression and the bar over it. Suggested: default rule thickness + ¼ x-height.
61	RADICALRULETHICKNESS	Thickness of the radical rule. This is the thickness of the rule in designed or constructed radical signs. Suggested: default rule thickness.
62	RADICALEXTRAASCENDER	Extra white space reserved above the radical. Suggested: RadicalRuleThickness.
63	RADICALKERNBEFOREDEGREE	Extra horizontal kern before the degree of a radical, if such is present. Suggested: 5/18 of em.
64	RADICALKERNAFTERDEGREE	Negative kern after the degree of a radical, if such is present. Suggested: −10/18 of em.
65	RADICALDEGREEBOTTOM- RAISEPERCENT	Height of the bottom of the radical degree, if such is present, in proportion to the ascender of the radical sign. Suggested: 60%.

Index

Numbers written in *italic* refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

Symbols	
\"	2165
\#	1697
\\$	1674
\%	1673
\&	1672
\'	1867, 2117
*	605, 1702, 2118
\-	604, 2102, 2105, 2120, 2121, 2123
\.	2119
\/	659, 2124
\:	607, 2125
\:::	917
\::f	917
\::n	917
\<	663
\=	2103, 2106
\>	664
\@DeclareMathDelimiter	449
\@DeclareMathSizes	440
\@backslashchar	1116, 1129
\@begindocumenthook	2101
\@cclvi	469
\@cdots	2107
\@empty	525, 795, 810, 831, 836
\@ifclassloaded	2139
\@ifnextchar	1886
\@ifpackageloaded	2088, 2110, 2128
\@ii	794, 795, 797, 799, 802, 807
\@input	589, 1698
\@marker	807, 826
\@nil	476, 635, 807, 820–823, 862, 1667, 1680, 1695
\@preamblecmds	453
\@sqrt	1886
\@tempa	278, 331, 353, 362, 375, 388, 395, 402, 411, 424, 753, 798, 822, 824, 836
\@tempb	278, 280, 331, 333, 353, 354, 362, 363, 375, 376,
	388, 389, 395, 396, 402, 403, 411, 412, 424, 425, 753, 754, 825, 826, 831
\@tempswafalse	796
\@tempwattrue	800, 803, 828, 833, 838, 843
\@xDeclareMathDelimiter	449
\@xxDeclareMathDelimiter	448
\	1702, 1704, 2158–2161, 2165, 2171–2181
\{	1670
\}	1671
\^	1666, 1684, 1693, 2181
\`	652, 1868
\|	1703
Numbers	
\0	269
\9	269
_	2165–2168, 2171–2180
A	
\A	266
\a	265
\addnolimits	<u>720</u>
\addtoversion	441
\AfterPackage	2113, 2131
\alloc@	469
\alpha@elt	442
\alpha@list	442
\AtBeginDocument	988, 1691, 2135
\AtEndOfPackage	432
\awint	716
B	
\B	165
\backdprime	1864
\backprime	1863
\backtrprime	1865
\beamer@suppressreplacementstrue	2145
\begingroup	473, 1665
\beta	1979

\bgroup	1146	\char_make_math_superscript:N ...	1684, 1693
\bigcirc	2083	\char_make_other:N	1666, 1670–1674, 1697, 1704
\bigtriangleup	2082	\chardef	469
\bool_if:NF		\chi	1983
... 606, 1212, 1223, 1238, 1248,		\circ	2084
1349, 1361, 1378, 1386, 1393,		\cirfnint	716
1401, 1413, 1425, 1438, 1441,		\clist_map_break:	1095, 1099
1607, 1619, 1631, 1643, 1657, 1660		\clist_map_inline:Nn	707
\bool_if:NT . 1163, 1173, 1186, 1196,		\clist_map_inline:nn	
1325, 1337, 1451, 1459, 1466,		... 640, 700, 761, 851, 876,	
1474, 1486, 1498, 1515, 1518,		881, 886, 897, 909, 946, 952, 957,	
1544, 1556, 1568, 1580, 1594, 1597		962, 968, 974, 990, 1025, 1091, 1104	
\bool_if:NTF	99–106, 570,	\clist_map_variable:nNn	919, 925
609, 618, 731, 1001, 1004, 1007,		\colon	<u>2088</u>
1010, 1114, 1160, 1170, 1183,		\copy	1894
1193, 1209, 1219, 1235, 1245,		\cs	1907, 1996
1321, 1333, 1345, 1357, 1382,		\cs_generate_variant:Nn ...	8–12,
1397, 1409, 1421, 1434, 1455,		913–916, 984–987, 1127, 1136–1139	
1470, 1482, 1494, 1511, 1540,		\cs_gset:cpn	487, 502, 503
1552, 1564, 1576, 1590, 1603,		\cs_gset:cpx	480
1615, 1627, 1639, 1653, 2071, 2092		\cs_gset:Npn .. 489, 495, 1667, 1914, 1947	
\bool_if:nTF	2009	\cs_gset:Npx	506, 2070
\bool_new:N	13–33	\cs_gset_eq:NN	1876–1884
\bool_set_false:N		\cs_if_exist:cF	1141
... 279, 281–284, 293–295, 306,		\cs_if_exist:cT	945, 1092, 1105
332, 334–337, 340, 355, 369, 382,		\cs_if_exist:NT	433
390, 399, 417, 420, 558, 563, 758, 1056		\cs_if_exist:NTF	413
\bool_set_true:N 292, 303–305,		\cs_new:Nn	41, 44,
314–317, 325, 339, 341, 342,		603, 634, 639, 644, 654, 658, 693,	
344–347, 349, 357, 359, 364, 377,		696, 857, 861, 918, 924, 934, 937,	
392, 397, 414, 523, 556, 561, 755, 1050		940, 944, 951, 956, 961, 967, 973,	
\box	1896	989, 1045, 1077, 1088, 1140, 1155,	
\bullet	2085	1159, 1169, 1182, 1192, 1202,	
C			
\C	166	1208, 1218, 1234, 1244, 1254,	
\c_group_begin_token	2010	1258, 1261, 1271, 1274, 1281,	
\c_group_end_token	2011	1288, 1299, 1305, 1313, 1316,	
\c_peek_true_remove_next_tl ...	2000	1320, 1332, 1344, 1356, 1368,	
\c_space_token	2012	1371, 1374, 1377, 1392, 1407,	
\cdots	2107, 2108, 2134	1419, 1431, 1446, 1450, 1465,	
\cdp@elt	439	1480, 1492, 1504, 1523, 1526,	
\cdp@list	439	1529, 1532, 1535, 1539, 1551,	
\char_make_active:N	1867, 1868	1563, 1575, 1587, 1602, 1614,	
\char_make_active:n		1626, 1638, 1650, 1714, 1720,	
.. 474, 1869–1875, 1911, 1944, 2065		1736, 1749, 1753, 1757, 1761,	
\char_make_escape:N	1703		

1765, 1811, 1815, 1819, 1823, 1988, 1998, 2028, 2042, 2100, 2115	\digamma 2098
\cs_new:Npn 2008, 2064	\dimexpr 456, 560, 1890
\cs_set:cpn 1142	\do 453
\cs_set:Nn 426, 428, 471, 515, 518, 595, 598, 699, 706, 850, 866, 869, 872, 875, 880, 885, 896, 902, 905, 908, 1128, 1909, 1942	\dorestore@version 443
\cs_set:Npn 785, 789, 917, 2116, 2133, 2134	\dotsb@ 2108
\cs_set:Npx 534, 538	\dp 1892
\cs_set_eq:cN 1131	\drime 1860
\cs_set_eq:NN 573–577, 581–585, 1057, 1070, 1859–1865, 1916, 1949, 2108	
\cs_set_protected:cpn 1145	E
\cs_set_protected:Npn 2091	\E 168
\cs_to_str:N 476, 479–481, 487, 502, 503, 701, 1089	\e 194
\csname 476, 479, 516, 519, 526, 694, 697, 1149	\edef 821, 822
D	\egroup 1143, 1148
\D 167	\else 461, 464, 484, 493, 498, 504, 507, 562, 801, 806, 812, 830, 835, 840, 2120, 2140
\d 193	\else: 1134
\DeclareDocumentCommand 274, 521, 720, 723	\encodingdefault 588
\DeclareMathAccent 447	\endcsname 476, 479, 516, 519, 526, 694, 697, 1149
\DeclareMathAlphabet 446	\endgroup 477, 1690
\DeclareMathDelimiter 448	\epsilon 1000
\DeclareMathRadical 450	\errorcontextlines 926
\DeclareMathSizes 439	\etex_iffontchar:D 1134
\DeclareMathSymbol 447	\ExecuteOptionsX 431
\DeclareMathVersion 441, 528	\exp_after:wN 774, 777, 1064, 1066, 1068, 1090
\DeclareRobustCommand 1886	\exp_args:Nc 596
\DeclareSymbolFont 444, 587	\exp_args:Nnff 917, 920, 928
\DeclareSymbolFontAlphabet 451	\exp_args:NV 1094, 1098
\DeclareSymbolFontAlphabet@ 451	\exp_not:c 481, 998
\def 455, 458, 469, 728, 820, 822–825, 1686, 1694, 1887, 2076–2087, 2095, 2096, 2098, 2099, 2105–2107, 2136, 2137	\exp_not:N 535, 539, 702, 2071
\define@choicekey ... 277, 331, 352, 362, 375, 388, 395, 402, 411, 424, 753	\exp_not:n 482, 1999, 2001
\define@cmdkey 747–750	\exp_not:V 535, 763
\define@key 730	\expandafter 478, 797, 799, 802, 807, 821, 822, 826, 1148, 1149
\define@mathalphabet 441	\ExplSyntaxOff 2148
\define@mathgroup 441	\ExplSyntaxOn 7, 1683, 2068
\Digamma 2098	F
	\F 169
	\f@size 526
	\fi 329, 350, 360, 373, 386, 393, 400, 409, 421, 429, 466, 467, 509–513, 569, 710, 756, 804, 805, 808, 814, 816, 817, 829, 834, 839, 844–848, 2122, 2146

\fi:	1134	\g_um_bfupgreek_bool .....	.. 26, 106, 335, 340, 345, 1425, 1498
\fint	716	\g_um_bfupLatin_bool	23, 103,
\font	559		336, 341, 346, 1378, 1386, 1451, 1459
\fontdimen	456, 560, 1889, 1895	\g_um_bfuplatin_bool	24, 104,
\fontname	1081		337, 342, 347, 1393, 1401, 1466, 1474
\frac	2071	\g_um_default_mathalph_seq	1024, 1042, 1049
G			
\g	195	\g_um_fam_int	34, 579, 580
\g@addto@macro	811, 813	\g_um_it_h_usv	270
\g_um_bfit_Greek_usv	105	\g_um_it_Nabla_usv	370, 611, 615
\g_um_bfit_greek_usv	106	\g_um_it_partial_usv	383, 613, 616
\g_um_bfit_Latin_usv	103	\g_um_literal_bool .....	.. 17, 279, 325, 609, 1160, 1170,
\g_um_bfit_latin_usv	104		1183, 1193, 1209, 1219, 1235, 1245
\g_um_bfit_Nabla_usv	371, 620, 628	\g_um_literal_colon_bool	33, 397, 399, 606, 2092
\g_um_bfit_partial_usv ..	384, 624, 630	\g_um_math_alphabet_name_Greek_tl	38
\g_um_bfliteral_bool	22, 332,		37
	349, 618, 1382, 1397, 1409, 1421,	\g_um_math_alphabet_name_greek_tl	36
	1434, 1455, 1470, 1482, 1494, 1511		35
\g_um_bfNabla_up_or_it_usv	366, 371, 628	\g_um_math_alphabet_name_misc_tl	40
\g_um_bfpartial_up_or_it_usv	379, 384, 630	\g_um_math_alphabet_name_num_tl	39
\g_um_bfsfit_Greek_usv	101	\g_um_mathalph_seq	779, 1013
\g_um_bfsfit_greek_usv	102	\g_um_mathhit_Greek_usv_range_tl	273
\g_um_bfsfit_Latin_usv	99	\g_um_mathhit_greek_usv_range_tl	272
\g_um_bfsfit_latin_usv	100	\g_um_mathhit_Latin_usv_range_tl	271
\g_um_bfsfit_Nabla_usv ..	372, 622, 629	\g_um_mathhit_latin_usv_range_tl	270
\g_um_bfsfit_partial_usv	385, 626, 631	\g_um_mathup_Greek_usv_range_tl	268
\g_um_bfsfNabla_up_or_it_usv	367, 372, 629	\g_um_mathup_greek_usv_range_tl	267
\g_um_bfsfpartial_up_or_it_usv ..	380, 385, 631	\g_um_mathup_Latin_usv_range_tl	266
\g_um_bfsfup_Greek_usv	101	\g_um_mathup_latin_usv_range_tl	265
\g_um_bfsfup_greek_usv	102	\g_um_mathup_num_usv_range_tl	269
\g_um_bfsfup_Latin_usv	99	\g_um_Nabla_up_or_it_usv	365, 370, 615
\g_um_bfsfup_latin_usv	100	\g_um_partial_up_or_it_usv	378, 383, 616
\g_um_bfsfup_Nabla_usv ..	367, 621, 629	\g_um_primekern_muskip	1711, 1712, 1717
\g_um_bfsfup_partial_usv	380, 625, 631	\g_um_sfliteral_bool	28, 359, 1321, 1333, 1345,
\g_um_bfup_Greek_usv	105		1357, 1540, 1552, 1564, 1576,
\g_um_bfup_greek_usv	106		1590, 1603, 1615, 1627, 1639, 1653
\g_um_bfup_Latin_usv	103		
\g_um_bfup_latin_usv	104		
\g_um_bfup_Nabla_usv	366, 619, 628		
\g_um_bfup_partial_usv ..	379, 623, 630		
\g_um_bfupGreek_bool .....	.. 25, 105, 334, 339, 344, 1413, 1486		

\backslash g_um_slash_delimiter_usv	197
404, 406, 408, 659–661	
\backslash g_um_subs_prop	809
1899, 1943	
\backslash g_um_supers_prop	2140
1898, 1910	
\backslash g_um_texgreek_bool	280, 333, 354,
31, 390, 392, 1001, 1004, 1007, 1010	363, 376, 389, 396, 403, 412, 425, 754
\backslash g_um_up_Nabla_usv	560
365, 610, 615	
\backslash g_um_up_partial_usv	708, 827, 832, 837, 841, 842, 2120
378, 612, 616	
\backslash g_um_upGreek_bool	459, 462, 472, 485, 494, 499, 505,
20, 101, 281, 292, 303, 314, 1186, 1238	795, 798, 799, 802, 810, 826, 831, 836
\backslash g_um_upgreek_bool	1695
21, 102, 282, 293, 304, 315, 1196, 1248	
\backslash g_um_upLatin_bool	714
18, 99, 283, 294, 305, 316, 1163, 1212	
\backslash g_um_uplatin_bool	714
19, 100, 284, 295, 306, 317, 1173, 1223	
\backslash g_um_upNabla_bool	714
29, 364, 369, 1438, 1515, 1594, 1657	
\backslash g_um_uppartial_bool	443
30, 377, 382, 1441, 1518, 1597, 1660	
\backslash g_um_upsans_bool	714
27, 355, 357, 1325,	
1337, 1349, 1361, 1544, 1556,	579
1568, 1580, 1607, 1619, 1631, 1643	
\backslash gamma	34
1980	
\backslash gdef	580
1680	
\backslash ge	716
2080	
\backslash geq	716
2080	
\backslash get@cdp	718
445	
\backslash glb@currsz	715
522	
\backslash global	718
475, 478, 490, 491, 496, 497, 500,	
501, 508, 1676, 1686, 1912, 1945, 2066	717
\backslash group@elt	717
444	
\backslash group@list	
444	
\backslash group_align_safe_begin:	
2002	
\backslash group_align_safe_end:	
2001	
\backslash group_begin:	
1692, 1701, 1866, 1901, 2043	
\backslash group_end:	
1699, 1885, 1985, 2062	
H	
\backslash H	
170	
\backslash h	
196	
\backslash hat	
2136	
\backslash hbox	
1888	
\backslash ht	
1891	
I	
\backslash I	
171	
\backslash i	
197	
\backslash if@tempswa	
809	
\backslash ifbeamer@suppressreplacements	
2140	
\backslash ifcase	
280, 333, 354,	
363, 376, 389, 396, 403, 412, 425, 754	
\backslash ifdim	
560	
\backslash ifnum	
708, 827, 832, 837, 841, 842, 2120	
\backslash ifx	
459, 462, 472, 485, 494, 499, 505,	
795, 798, 799, 802, 810, 826, 831, 836	
\backslash ignorespaces	
1695	
\backslash iiiint	
714	
\backslash iiint	
714	
\backslash iint	
714	
\backslash init@restore@version	
443	
\backslash int	
714	
\backslash int_incr:N	
579	
\backslash int_new:N	
34	
\backslash int_use:N	
580	
\backslash intBar	
716	
\backslash intbar	
716	
\backslash intcap	
718	
\backslash intclockwise	
715	
\backslash intcup	
718	
\backslash intlarhk	
717	
\backslash intx	
717	
J	
\backslash j	
198	
K	
\backslash kern	
1889, 1895	
L	
\backslash L	
172	
\backslash l_peek_false_tl	
2001, 2014, 2040	
\backslash l_peek_token	
2010–2012, 2031, 2035	
\backslash l_peek_true_aux_tl	
1999	
\backslash l_peek_true_tl	
2000, 2038	
\backslash l_um_char_range_seq	
524, 752, 759, 765, 794	
\backslash l_um_font	
460, 463, 559, 560,	
1081, 1134, 1889, 1891, 1892, 1895	
\backslash l_um_fontspec_feature_bool	
13, 556, 558, 731	
\backslash l_um_implicit_alph_bool	
16, 1050, 1056, 1114	
\backslash l_um_inc_num	
927, 929, 930	

<code>\l_um_init_bool</code> .. 15, 523, 570, 755, 758	<code>\mathbb</code> 1015, 1028,
<code>\l_um_input_num</code> 919, 921, 925, 929	1259, 1262–1269, 1272, 1275–1279
<code>\l_um_mathalph_seq</code>	<code>\mathbbbit</code> 1015, 1029, 1282–1286
.... 751, 760, 763, 1047, 1049, 1059	<code>\mathbbf</code> 1018, 1384,
<code>\l_um_missing_alph_seq</code>	1388, 1399, 1403, 1411, 1415,
.... 1044, 1046, 1078, 1083, 1115	1423, 1427, 1435, 1436, 1439,
<code>\l_um_mversion_tf</code> 527, 528	1442, 1447, 1457, 1461, 1472,
<code>\l_um_nolimits_tl</code> ... 482, <u>713</u> , 721, 724	1476, 1484, 1488, 1496, 1500,
<code>\l_um_ot_math_bool</code> 14, 561, 563	1509, 1510, 1512, 1513, 1516, 1519
<code>\l_um_primecount_num</code> 1713,	<code>\mathbbffrak</code> 1019, 1038, 1524, 1527
1750, 1754, 1758, 1762, 1766,	<code>\mathbbfit</code> 1018, 1036,
1777, 1781, 1785, 1789, 1793,	1381, 1396, 1408, 1420, 1432, 1433
1797, 1800, 1812, 1816, 1820,	<code>\mathbbfscr</code> 1019, 1037, 1530, 1533
1824, 1835, 1839, 1843, 1847, 1850	<code>\mathbbfsf</code> 1020, 1536, 1542, 1546, 1554,
<code>\l_um_radicals_tl</code> 486, 726	1558, 1566, 1570, 1578, 1582,
<code>\l_um_remap_alphabet_tl</code>	1591, 1592, 1595, 1598, 1605,
.... 1062–1064, 1066, 1068, 1073	1609, 1617, 1621, 1629, 1633,
<code>\l_um_script_features_tl</code> ... 529, 546	1641, 1645, 1654, 1655, 1658, 1661
<code>\l_um_script_font_tl</code> 531, 545	<code>\mathbbfsfit</code> 1020, 1040,
<code>\l_um_smallfrac_bool</code>	1612, 1624, 1636, 1648, 1651, 1652
..... 32, 414, 417, 420, 2071	<code>\mathbbfsfup</code> 1020, 1039, 1537,
<code>\l_um_ss_chain_tl</code> 1915, 1948, 1992, 2037	1549, 1561, 1573, 1585, 1588, 1589
<code>\l_um_sscript_features_tl</code> .. 530, 550	<code>\mathbbfup</code> 1018, 1035, 1448,
<code>\l_um_sscript_font_tl</code> 532, 549	1454, 1469, 1481, 1493, 1505–1508
<code>\l_um_tmpa_tl</code> 763, 770, 773,	<code>\mathbin</code> 604, 605
774, 776, 777, 779, 786, 790, 1060,	<code>\mathcal</code> <u>2095</u>
1064, 1073, 1089, 1090, 1092,	<code>\mathchar@type</code> 450, 479, 489, 491, 495,
1105, 1107, 1108, 1111, 1112,	497, 500, 502, 503, 506, 508, 516, 519
1117, 1120, 1917, 1950, 2030, 2034	<code>\mathchardef</code> 2102, 2103, 2121
<code>\l_um_tmpb_tl</code>	<code>\mathclose</code> 494, 503
. 763, 771, 791, 1061, 1069, 1071,	<code>\mathcode</code> 475,
1073, 1090, 1094, 1098, 2036, 2037	2102, 2103, 2117–2121, 2123–2125
<code>\l_um_tmpc_tl</code> 763, 772, 787	<code>\mathellipsis</code> 2133
<code>\lccode</code> 1702	<code>\mathfence</code> 499, 2097
<code>\le</code> 2079	<code>\mathfrak</code> .. 1016, 1031, 1306–1311, 1314
<code>\left</code> <u>727</u>	<code>\mathgroup</code> 469
<code>\left@primitive</code> 727, 728	<code>\mathinner</code> 2107, 2133, 2134
<code>\leq</code> 2079	<code>\mathit</code> 1015, 1027, 1216,
<code>\let</code> 470, 522, 525, 727, 1676, 2097	1230–1232, 1242, 1252, 1255, 1256
<code>\lowercase</code> 1668, 1681	<code>\mathop</code> 472
<code>\lowint</code> 718	<code>\mathopen</code> 485, 502, 728
M	
<code>\M</code> 173	<code>\mathord</code> . 610–613, 615, 616, 619–626,
<code>\m@th</code> 1888	628–631, 645–651, 2082, 2097
<code>\mathaccent</code> 505	<code>\mathpunct</code> 2092
<code>\mathalpha</code> 702, 859, 862	<code>\mathrel</code> 607
	<code>\mathrm</code> <u>2096</u>

<code>\mathscr</code>	1016,	<code>\number</code>	921, 929, 930
1030, 1289–1297, 1300–1303, 2095		<code>\numexpr</code>	
<code>\mathsf</code>	1017, 1317, 1323, 1327,	832, 837, 841, 842, 859, 921, 929, 930	
1335, 1339, 1347, 1351, 1359, 1363			
<code>\mathsf{fit}</code>	1017, 1034, 1354, 1366		
<code>\mathsf{fup}</code> ..	1017, 1033, 1318, 1330, 1342		
<code>\mathsterling</code>	2087		
<code>\mathhtt</code>	1016, 1032, 1369, 1372, 1375		
<code>\mathup</code>	1015, 1026, 1157, 1167,		
1180, 1190, 1200, 1203–1206, 2096			
<code>\mathyen</code>	2086		
<code>\mddefault</code>	588		
<code>\mdlgwhtcircle</code>	2083		
<code>\meaning</code>	1910, 1943, 2031, 2035		
<code>\mitepsilon</code>	1001, 1007		
<code>\mitphi</code>	1004, 1010		
<code>\mitvarepsilon</code>	1001, 1007		
<code>\mitvarphi</code>	1004, 1010		
<code>\mode_if_math:F</code>	1147		
<code>\mskip</code>	1717		
<code>\muskip_gset:Nn</code>	1712		
<code>\muskip_new:N</code>	1711		
	N		
<code>\N</code>	174		
<code>\ne</code>	2081		
<code>\neq</code>	2081		
<code>\new@mathalphabet</code>	446		
<code>\new@mathgroup</code>	439, 469, 470		
<code>\new@mathversion</code>	444		
<code>\new@symbolfont</code>	445		
<code>\newcommand</code>	729, 793		
<code>\newfam</code>	470		
<code>\newmathalphabet</code>	440		
<code>\newmathalphabet@@</code>	440		
<code>\newmathalphabet@@@</code>	440		
<code>\newmcodes@</code>	2116		
<code>\nolimits</code>	482		
<code>\non@alpherr</code>	1149		
<code>\npolint</code>	717		
<code>\num_add:Nn</code>			
. 1785, 1789, 1793, 1797, 1843, 1847			
<code>\num_incr:N</code>			
. 1766, 1777, 1781, 1824, 1835, 1839			
<code>\num_new:N</code>	1713		
<code>\num_set:Nn</code>	1754, 1758, 1762, 1816, 1820		
<code>\num_zero:N</code>	1750, 1812		
	O		
<code>\o</code>	199		
<code>\oiint</code>	714		
<code>\oint</code>	714		
<code>\ointctrclockwise</code>	715		
<code>\operator@font</code>	2076		
<code>\or</code>	291, 302,		
313, 324, 338, 343, 348, 356, 358,			
368, 381, 391, 398, 405, 407, 419, 427			
<code>\overrightarrow</code>	2078		
	P		
<code>\P</code>	175		
<code>\PackageError</code>	734		
<code>\PackageInfo</code>	572		
<code>\PackageWarning</code>	416		
<code>\PackageWarningNoLine</code>	564, 2141		
<code>\peek_after:NN</code>	2003		
<code>\peek_meaning_remove:NTF</code>			
. 1767, 1770, 1773, 1776, 1780,			
1784, 1788, 1792, 1796, 1825,			
1828, 1831, 1834, 1838, 1842, 1846			
<code>\phi</code>	1003, 1982		
<code>\pointint</code>	717		
<code>\prg_case_int:nnn</code>	1721, 1737		
<code>\prg_do_nothing:</code>	1131		
<code>\prg_new_conditional:Nnn</code> ..	769, 1133		
<code>\prg_replicate:nn</code>	1717		
<code>\prg_return_false:</code>	782, 1134		
<code>\prg_return_true:</code>	780, 1134		
<code>\prg_stepwise_inline:nnnn</code>	852		
<code>\prg_stepwise_variable:nnnNn</code>	927		
<code>\prime</code>	1859		
<code>\process@table</code>	443		
<code>\ProcessOptionsX</code>	437		
<code>\prop_get:cxN</code>	2033		
<code>\prop_get:NnN</code>	11		
<code>\prop_gput:Nnn</code>	10		
<code>\prop_gput:Nxn</code>	1910, 1943		
<code>\prop_if_in:cxTF</code>	2029		
<code>\prop_if_in:NnTF</code>	12		
<code>\prop_new:N</code>	1898, 1899		

\protect	416, 737	\set@mathaccent	447
\ProvidesPackage	1	\set@mathchar	447
Q			
\Q	176	\set@mathdelimiter	449
\q_nil	774, 777, 785, 789	\set@mathsymbol	448
\qprime	1862	\setbox	1888
R			
\R	177	\setkeys	275, 285, 296, 307, 318, 326–328, 533, 535
\r@@t	1887	\SetMathAlphabet	446
\raise	1890	\SetMathAlphabet@	446
\relax	280, 333, 354, 456, 472, 475, 479, 485, 487, 489–491, 494–497, 500–503, 505, 506, 508, 516, 519, 522, 559, 560, 708, 754, 799, 802, 826, 827, 832, 837, 841, 842, 859, 921, 929, 930, 1893, 2102, 2103, 2105, 2106, 2121, 2125	\setmathfont	521, 737
\removenolimits	723	\SetSymbolFont	445
\RequirePackage	3–6	\SetSymbolFont@	445
\restore@mathversion	443	\sf@size	544, 548
\rho	1981	\smbkcircle	2085
\rightarrow	2077	\sp	1916
\rootbox	1894	\space ..	416, 1084, 1107, 1111, 1117, 1149
\rppolint	716	\sqint	717
S			
\sb	1949	\sqrt	726, 1886
\scan_stop: .....	...	\sqrtsign .....	1886, 1888
...	652, 656, 1134, 1912, 1945, 2066	\std@equal	2103, 2106
\scantokens	1913, 1946	\std@minus	2102, 2105, 2121
\scpolint	717	\sterling	2087
\scriptscriptstyle	462	\string	821, 822
\scriptstyle	459	\strip@pt	456
\seq_clear:N	524, 759, 760, 1046	\sumint	715
\seq_if_empty:N	1078	T	
\seq_if_empty:NTF	1047	\tf@size	543, 544
\seq_if_in:NnTF	9	\tfrac	413, 416, 433, 2071
\seq_if_in:NVTF	779	\thinmuskip	1712
\seq_map_inline:Nn	1059, 1083	\tilde	2137
\seq_map_variable:Nn	794	\tl_if_empty:NT	1069
\seq_new:N	751, 752, 1013, 1024, 1044	\tl_if_empty:NTF	1063
\seq_put_right:Nn	765, 1022, 1042	\tl_if_eq:nntf	1093, 1106
\seq_put_right:Nx	763, 1115	\tl_if_in:NnT	482, 773, 776
\seq_set_eq:NN	1049	\tl_if_in:NnTF	486
\set@@mathdelimiter	450	\tl_map_inline:n	438, 1014
		\tl_new:Nn	265–273, 713, 726
		\tl_put_right:cx	701
		\tl_put_right:Nn	8, 721
		\tl_put_right:NV	2037
		\tl_remove_all_in:Nn	724
		\tl_remove_in:Nn	453, 2101
		\tl_rescan:nn	1669, 1682, 2067
		\tl_set:cn	42
		\tl_set:cx	998

<code>\tl_set:Nn</code>	35–40, 365–367, 370–372, 378–380, 383–385, 404, 406, 408, 527, 529–532, 571, 770–772, 786, 787, 790, 791, 1000, 1003, 1006, 1009, 1071, 1915, 1917, 1948, 1950	<code>\um_config_mathbfscr_Latin:n</code>	1532
<code>\tl_set:No</code>	1060–1062	<code>\um_config_mathbfsfit_Greek:n</code>	1626
<code>\tl_set:Nx</code>	580, 1064, 1066, 1068, 1089, 1090, 1999, 2001	<code>\um_config_mathbfsfit_greek:n</code>	1638
<code>\tl_set_eq:NN</code>	2000	<code>\um_config_mathbfsfit_Latin:n</code>	1602
<code>\tl_use:c</code>	1117	<code>\um_config_mathbfsfit_latin:n</code>	1614
<code>\to</code>	2077	<code>\um_config_mathbfsfit_misc:n</code>	1650
<code>\token_if_eq_catcode_p:NN</code>	2010, 2011	<code>\um_config_mathbfscup_Greek:n</code>	1563
<code>\token_if_eq_meaning_p:NN</code>	2012	<code>\um_config_mathbfscup_greek:n</code>	1575
<code>\token_to_str:N</code>	1064, 1066	<code>\um_config_mathbfscup_Latin:n</code>	1539
<code>\triangle</code>	2082	<code>\um_config_mathbfscup_latin:n</code>	1551
<code>\trprime</code>	1861	<code>\um_config_mathbfscup_misc:n</code>	1587
<code>\typeout</code>	426, 1079, 1084	<code>\um_config_mathbfscup_num:n</code>	1535
U			
<code>\um@backslash</code>	798, 821	<code>\um_config_mathbfup_Greek:n</code>	1480
<code>\um@char@num@range</code>	525, 707, 810, 811, 813	<code>\um_config_mathbfup_greek:n</code>	1492
<code>\um@firstchar</code>	797, 822	<code>\um_config_mathbfup_Latin:n</code>	1450
<code>\um@firsttof</code>	820–822	<code>\um_config_mathbfup_latin:n</code>	1465
<code>\um@parse@range</code>	807, 823	<code>\um_config_mathbfup_misc:n</code>	1504
<code>\um@parse@term</code>	599, 635, 793, 862	<code>\um_config_mathbfup_num:n</code>	1446
<code>\um@radicals</code>	726	<code>\um_config_mathfrak_Latin:n</code>	1305
<code>\um@scaled@apply</code>	458, 1889, 1895	<code>\um_config_mathfrak_latin:n</code>	1313
<code>\um@scanactivedef</code>	476, 1665	<code>\um_config_mathit_Greek:n</code>	1234
<code>\um@scancharlet</code>	1665, 1695	<code>\um_config_mathit_greek:n</code>	1244
<code>\um@zf@feature</code>	729, 741, 744	<code>\um_config_mathit_Latin:n</code>	1208
<code>\um_backprime_double_mchar</code>	650, 1740	<code>\um_config_mathit_latin:n</code>	1218
<code>\um_backprime_single_mchar</code>	649, 1813, 1817, 1821	<code>\um_config_mathit_misc:n</code>	1254
<code>\um_backprime_triple_mchar</code>	651, 1743	<code>\um_config_mathscr_Latin:n</code>	1288
<code>\um_config_mathbb_Latin:n</code>	1261	<code>\um_config_mathscr_latin:n</code>	1299
<code>\um_config_mathbb_latin:n</code>	1258	<code>\um_config_mathsf_Latin:n</code>	1344
<code>\um_config_mathbb_misc:n</code>	1274	<code>\um_config_mathsf_Latin:n</code>	1356
<code>\um_config_mathbb_num:n</code>	1271	<code>\um_config_mathsfup_Latin:n</code>	1320
<code>\um_config_mathbbit_misc:n</code>	1281	<code>\um_config_mathsfup_latin:n</code>	1332
<code>\um_config_mathbffrak_Latin:n</code>	1523	<code>\um_config_mathsfup_num:n</code>	1316
<code>\um_config_mathbffrak_latin:n</code>	1526	<code>\um_config_mathhtt_Latin:n</code>	1371
<code>\um_config_mathbfit_Greek:n</code>	1407	<code>\um_config_mathhtt_latin:n</code>	1374
<code>\um_config_mathbfit_greek:n</code>	1419	<code>\um_config_mathhtt_num:n</code>	1368
<code>\um_config_mathbfit_Latin:n</code>	1377	<code>\um_config_mathup_Greek:n</code>	1182
<code>\um_config_mathbfit_latin:n</code>	1392	<code>\um_config_mathup_greek:n</code>	1192
<code>\um_config_mathbfit_misc:n</code>	1431	<code>\um_config_mathup_Latin:n</code>	1159
<code>\um_config_mathbfscr_Latin:n</code>	1529	<code>\um_config_mathup_latin:n</code>	1169
		<code>\um_config_mathup_misc:n</code>	1202
		<code>\um_config_mathup_num:n</code>	1155
		<code>\um_debug:n</code>	426, 428, 1048, 1055, 1107, 1111, 1129
		<code>\um_define_active_frac:Nw</code>	2044–2061, 2064
		<code>\um_fix_amsmath:</code>	2100, 2111, 2113

\um_fix_amsopn:	2115, 2129, 2131	\um_map_chars_xxvi:nn	866, 915
\um_fontdimen_to_percent:nn		\um_map_chars_xxvi:nn_	<u>850</u>
.	<u>455</u> , 460, 463, 1891, 1892	\um_map_single:nnn	
\um_glyph_if_exist:cT	1097	. . . . .	908, 1175–1177, 1221, 1225–1227
\um_glyph_if_exist:cTF	1110	\um_mathmap:Nnn	574, 582, 920, 928, 1057
\um_glyph_if_exist:n	1133	\um_mathmap_noparse:Nnn	
\um_glyph_if_exist:nF	1139	. . . . .	574, <u>699</u> , 709, 1057
\um_glyph_if_exist:nT	1138	\um_mathmap_parse:Nnn	582, <u>706</u>
\um_glyph_if_exist:nTF		\um_maybe_init_alphabet:n	
.	<u>1133</u> , 1724, 1727, 1730, 1740, 1743	. . . . .	576, 584, 1051–1053, 1070, 1094, 1098
\um_glyph_if_exist_p:n	1136	\um_nbackprimes_select:nn	1736, 1850
\um_if_mathalph_decl:n	769	\um_nprimes:Nn	1714, 1724,
\um_if_mathalph_decl:nTF	762	. . . . .	1727, 1730, 1733, 1740, 1743, 1746
\um_init_alphabet:n	576, 1070, 1128	\um_nprimes_select:nn	1720, 1800
\um_make_mathactive:nnn	645–651, <u>654</u>	\um_peek_execute_branches_ss:	
\um_map_char:cc	888–893, 899, 910	. . . . .	2003, 2008
\um_map_char:nn	905, 913	\um_peek_execute_branches_ss_aux:	
\um_map_char:nn_	<u>850</u>	. . . . .	2015, 2028
\um_map_char_internal:nn	577, 585, 853	\um_prepare_alph:n	1130, <u>1140</u>
\um_map_char_noparse:nn	577, 857, 863	\um_prime_double_mchar	646, 1724
\um_map_char_parse:nn	585, 861	\um_prime_quad_mchar	648, 1730
\um_map_chars_Greek:nn	896, 1184,	\um_prime_single_mchar	
.	1187, 1236, 1239, 1410, 1414,	. . . . .	645, 1751, 1755, 1759, 1763
.	1483, 1487, 1565, 1569, 1628, 1632	\um_prime_triple_mchar	647, 1727
\um_map_chars_greek:nn	885, 1194,	\um_process_symbol_noparse:nnnn	
.	1197, 1246, 1249, 1422, 1426,	. . . . .	573, <u>595</u>
.	1495, 1499, 1577, 1581, 1640, 1644	\um_process_symbol_parse:nnnn	<u>581</u> , <u>595</u>
\um_map_chars_Latin:nn		\um_remap_symbol:nnn	
.	875, 1161, 1164,	. . . . .	575, 583, 604, 605, 607,
.	1210, 1213, 1322, 1326, 1346,	. . . . .	610–613, 615, 616, 619–626, 628–631
.	1350, 1379, 1383, 1387, 1452,	\um_remap_symbol_noparse:nnn	575, <u>603</u>
.	1456, 1460, 1541, 1545, 1604, 1608	\um_remap_symbol_parse:nnn	
\um_map_chars_latin:nn . . . . .		. . . . .	583, <u>603</u> , 634
.	880, 1171, 1174,	\um_remap_symbols:	<u>590</u> , <u>603</u>
.	1220, 1224, 1334, 1338, 1358,	\um_resolve_greek:	<u>988</u>
.	1362, 1394, 1398, 1402, 1467,	\um_scan_backdprime:	
.	1471, 1475, 1553, 1557, 1616, 1620	. . . . .	1815, 1834, 1864, 1883
\um_map_chars_numbers:nn	902, 1156	\um_scan_backprime:	
\um_map_chars_range:nnn . . . . .		. . . . .	1811, 1828, 1863, 1881, 1882
.	850, 867, 870, 873, 906	\um_scan_backtrprime:	
\um_map_chars_x:cc	903	. . . . .	1819, 1842, 1865, 1884
\um_map_chars_x:nn	872, 916	\um_scan_dprime:	1753, 1776, 1860, 1878
\um_map_chars_xxiii:cc	887, 898	\um_scan_prime:	
\um_map_chars_xxiii:nn	869, 914	. . . . .	1749, 1770, 1859, 1876, 1877
\um_map_chars_xxiii:nn_	<u>850</u>	\um_scan_qprime:	1761, 1792, 1862, 1880
\um_map_chars_xxvi:cc	877, 882	\um_scan_sscript:	1918, 1951, 1988, 1990

\um_scan_sscript:TF	..... 1989, 1998	1512, 1513, 1516, 1519, 1588,	
\um_scan_trprime:	1757, 1784, 1861, 1879	1589, 1591, 1592, 1595, 1598,	
\um_scanbackprime_collect:N	....	1651, 1652, 1654, 1655, 1658, 1661	
..	1813, 1817, 1821, 1823, 1826,	\um_set_mathalphabet_x:Ncc	..... 953
1829, 1832, 1836, 1840, 1844, 1848		\um_set_mathalphabet_x:Nnn	. 934, 987
\um_scanprime_collect:N	.....	\um_set_mathalphabet_xxiii:Ncc	..
.....	1751, 1755, 1759,	.....	969, 975
1763, 1765, 1768, 1771, 1774,		\um_set_mathalphabet_xxiii:Nnn	..
1778, 1782, 1786, 1790, 1794, 1798		.....	940, 985
\um_set_delcode:n	... 662, 665–691, <u>693</u>	\um_set_mathalphabet_xxvi:Ncc	958, 963
\um_set_delcode:nn	659–661, 663, 664, <u>693</u>	\um_set_mathalphabet_xxvi:Nnn	937, 986
\um_set_mathalph_range:Nnn	..... <u>924</u>	\um_set_mathchar:Nnnn	..... <u>515</u> , 655
\um_set_mathalph_range:nNnn	....	\um_set_mathcode:nnnn	<u>515</u> , 641, 702, 858
.....	924, 935, 938, 941	\um_set_mathsymbol:nNnn	.... <u>471</u> , 596
\um_set_mathalphabet_char:Ncc	...	\um_setup_active_frac:	.... 422, 2042
.....	947, 964, 970, 976–981	\um_setup_active_subscript:nn	...
\um_set_mathalphabet_char:Nnn	<u>917</u> , 984	.....	1942, 1956–1983
\um_set_mathalphabet_Greek:Nnn	..	\um_setup_active_superscript:nn	..
.....	967, 1190, 1242, 1408,	.....	1909, 1923–1939
1411, 1415, 1481, 1484, 1488,		\um_setup_alphabets:	..... <u>593</u> , <u>1044</u>
1566, 1570, 1573, 1629, 1633, 1636		\um_setup_delcodes:	..... <u>592</u> , <u>658</u>
\um_set_mathalphabet_greek:Nnn	..	\um_setup_math_alphabet:Nnn	... <u>1088</u>
.....	973, 1200, 1252, 1420,	\um_setup_math_alphabet:VVV	... <u>1073</u>
1423, 1427, 1493, 1496, 1500,		\um_setup_mathactives:	..... <u>591</u> , <u>644</u>
1578, 1582, 1585, 1641, 1645, 1648		\um_setup_mathup:	..... 2076
\um_set_mathalphabet_Latin:Nnn	..	\um_split_arrow:w	..... 774, 785
956, 1167, 1216, 1262, 1289, 1306,		\um_split_slash:w	..... 777, 789
1323, 1327, 1330, 1347, 1351,		\um_sub_or_super:n	.. 1916, 1949, 1992
1354, 1372, 1381, 1384, 1388,		\um_symfont_tl	..... 571, 580,
1454, 1457, 1461, 1524, 1530,		587, 596, 641, 655, 694, 697, 702, 859	
1542, 1546, 1549, 1605, 1609, 1612		\um_tmp:	..... 534, 537, 538, 557
\um_set_mathalphabet_latin:Nnn	..	\um_to_usv:nn	..... 42,
961, 1180, 1230, 1259, 1300, 1314,		44, 877, 882, 888–893, 898, 899,	
1335, 1339, 1342, 1359, 1363,		903, 910, 945, 947, 953, 958, 963,	
1366, 1375, 1396, 1399, 1403,		964, 969, 970, 975–981, 1097, 1110	
1469, 1472, 1476, 1527, 1533,		\um_warn_missing_alphabets:	1075, 1077
1554, 1558, 1561, 1617, 1621, 1624		\unicodeddots	..... 2134
\um_set_mathalphabet_numbers:Nnn	.....	\unicodeellipsis	..... 2133
.....	951, 1157, 1272, 1317,	\UnicodeMathSymbol	.... 573, 581, 1694
1318, 1369, 1447, 1448, 1536, 1537		\unimathsetup	..... <u>274</u> , 434
\um_set_mathalphabet_pos:Nnnn	944,	\unless	..... 795
1203–1206, 1231, 1232, 1255,		\updefault	..... 588
1256, 1263–1269, 1275–1279,		\upDigamma	..... 2099
1282–1286, 1290–1297, 1301–1303,		\updigamma	..... 2098
1307–1311, 1432, 1433, 1435,		\upint	..... 718
1436, 1439, 1442, 1505–1510,		\use:c	.... 1108, 1112, 1120, 1143, 1151

<code>\use_i:nnn</code>	1060		
<code>\use_ii:nnn</code>	1061		
<code>\use_iii:nnn</code>	1062		
<code>\use_none:n</code>	584		
<code>\use_none:nnnn</code>	1090		
<code>\use_none:nnnnn</code>	1068		
<code>\usv_set:nnn</code>	41, 45–264		
V			
<code>\varepsilon</code>	1006		
<code>\varointclockwise</code>	715		
<code>\varphi</code>	1009		
<code>\vec</code>	2078		
<code>\version@elt</code>	442		
<code>\version@list</code>	442		
<code>\vysmwhtcircle</code>	2084		
W			
<code>\widehat</code>	2136		
<code>\widetilde</code>	2137		
		X	
<code>\XeTeXdelcode</code> ...	490, 496, 501, 694, 697		
<code>\XeTeXdelimater</code>	489, 495, 502, 503		
<code>\XeTeXmathaccent</code>	506		
<code>\XeTeXmathchardef</code>	478, 519		
<code>\XeTeXmathcharnum</code>	2105, 2106		
<code>\XeTeXmathcode</code> ..	491, 497, 500, 508, 516		
<code>\XeTeXmathcodenum</code>	652, 656, 1912, 1945, 2066, 2105, 2106		
<code>\XeTeXradical</code>	487		
<code>\XKV@rm</code>	535, 553		
		Y	
<code>\yen</code>	2086		
		Z	
<code>\Z</code>	178, 266		
<code>\z</code>	265		
<code>\z@</code>	1888, 1891, 1892, 1896		
<code>\zf@family</code>	588		
<code>\zf@fontspec</code>	539		
<code>\zf@update@ff</code>	742, 745		