isomath

Mathematical style for science and technology

Günter Milde

2012-09-04

The *isomath* package provides tools for a mathematical style that conforms to the International Standard ISO 80000-2 and is common in science and technology. It changes the default shape of capital Greek letters to italic, sets up bold italic and sans-serif bold italic math alphabets with Latin and Greek characters, and defines macros for markup of vector, matrix and tensor symbols.

Contents

1 Features

In their style guides, e. g. [typefaces], [checklist], [SI], [fonts_for_symbols], [Red-Book], [Green-Book], many international scientific organisations recommend layout rules for mathematics in line with the International Standard [ISO-80000-2].

> **International standard layout rules**
>
> - The overall rule is that symbols representing physical quantities (or variables) are italic, but symbols representing units, or labels, are roman.
> - Symbols for vectors and matrices are bold italic, symbols for tensors are sans-serif bold italic.
> - The above rules apply equally to letter symbols from the Greek and the Latin alphabet.

TeX's default mathematical style deviates from this rules in several points:

- Capital Greek letters default to upright shape,
- small Greek letters are excluded from font changes with the math alphabet commands, and
- the `\vec` command produces an arrow accent.

The *isomath* package implements an "ISO" math style, provides new math alphabets with *bold italic* and *sans-serif bold italic* type and macros for semantic markup of vector, matrix and tensor symbols. It can be combined with most packages for mathematical typesetting (see isomath-test.tex and the sections on alternatives and conflicts).

1.1 "ISO" math style

Isomath builds on the package fixmath by Walter Schmidt to change the default mathematics layout to the "ISO" math style:

- Capital Greek letters are typeset in italic shape by default.
- Both, Greek and Latin letters change shape if a different math alphabet is used.

Caution!

Be careful with Greek letters in the argument of `\mathit`, `\mathrm`, `\mathbf`, `\mathsf`, and `\mathtt`. By default, these math alphabets use text fonts. Fonts in OT1 text font encoding have capital (but not small) Greek letters at the expected places, T1 encoded text fonts have no Greek letters at all.
See the examples section on how to get upright small Greek letters in mathematical context.

1.2 New math alphabets

Isomath defines the new math alphabets:

`\mathbfit`	boldface italic	vector and matrix symbols
`\mathsfit`	sans-serif italic	optional (see OMLmath*_ options)
`\mathsfbfit`	sans-serif bold italic	tensor symbols

For compatibility with earlier versions and related packages, the new math alphabets are also available under the aliases `\mathbold`, `\mathsans`, and `\mathboldsans`.

The rmdefault and sfdefault options set the font family used for these alphabets.

Caution!

Using the new math alphabets for numbers can result in upright old-style numbers instead of italic ones, because some italic math fonts (e. g., `cmr`, `cmbr`) contain old-style in place of italic digits.

1.3 Semantic markup

The following commands set the argument in an ISO-conforming math alphabet:

`\vectorsym, \matrixsym`	bold italic for Greek and Latin letters, bold upright for numbers
`\tensorsym`	sans-serif bold italic

2 Usage

Make sure that LaTeX can find `isomath.sty` and load it with:

```
\usepackage{isomath}
```

Optionally redefine the standard vector macro `\vec`:

```
\renewcommand{\vec}{\vectorsym}
```

(see also Options, Examples, and isomath-test.tex).

2.1 Options

2.1.1 rmdefault

Family for serif math fonts (`\mathrm`, `\mathbf`, `\mathit`, `\mathbfit`). The default is to use the corresponding text font family (the value of `\rmdefault`). The font must be available in OML font encoding (cf. Table 3).

2.1.2 sfdefault

Family for sans-serif math fonts. The default is `cmbr` because most sans-serif fonts define the Computer Roman font *cmm* as OML substitution (see Table 4).

There are only few sans serif fonts in OML font encoding:

Name	Package	Comment
`cmbr`	cmbright	*Computer Modern Bright*, bitmap, slightly lighter than cmss (Type 1 fonts with hfbright)
`fav`	arev	*Arev* (*Vera Sans*), large x-height
`hvm`	hvmath	*Helvetica Math*, commercial, free bitmap version
`iwona`	iwona	*Iwona*, humanistic sans serif, some shapes very similar to roman
`jkpss`	kpfonts	*Kepler Sans*, quite light
`llcmss`	lxfonts	*LX Fonts*, "slide fonts", very wide, large x-height

2.1.3 scaled

To improve the chances of finding a matching sans serif math font, the fonts `fav`, `iwona`, `jkpss`, and `llcmss` can be scaled with the `scaled` option (cf. Examples). For other fonts, the option is ignored.

2.1.4 reuseMathAlphabets

The definition of new math alphabets can lead to a "too many math alphabets used in version normal" error. As a workaround, this option tells *isomath* to re-use the existing `\mathbf` and

`\mathsf` alphabets for italic bold and sans-serif bold.[1]

2.1.5 OMLmathrm, OMLmathbf, OMLmathsf, OMLmathsfit, OMLmathtt

The `OMLmath*` options bind the corresponding `\math*` command to an OML-encoded font.

The `\mathsfit` alphabet is not required for ISO conforming mathematical layout and therefore only defined if the `OMLmathsfit` argument is used.

The predefined math alphabets `\mathrm`, `\mathbf`, and `\mathtt` use OT1 encoded text fonts with ligatures and accents in place of the small Greek letters. The `OMLmath*` options enable the use of small Greek letters in math alphabet commands, e. g. `\mathrm{\pi}`, if the corresponding font is available in OML font encoding. Table 3 lists font families supporting the OML encoding.

> **Caution!**
> If no matching OML encoded font is found, LaTeX's substitute mechanism selects a font with different font attributes (for all letters, not only Greek). Currently, only the mathdesign package provides upright fonts in OML encoding. Many font packages define an *italic* font as OML substitute for roman fonts.
> With some packages, these options can result in a "too many math alphabets used in version normal" error.

2.2 Examples

- Use scaled arev fonts for the sans serif math alphabets (adapt the scaling factor to your needs):

  ```
  \usepackage[sfdefault=fav,scaled=0.875]{isomath}
  ```

- Define the `\mathsfit` sans-serif italic math alphabet:

  ```
  \usepackage[OMLmathsfit]{isomath}
  ```

- The `\mathbfit` and `\mathsfbfit` alphabets do not have a different weight in the `bold` math version because the number of LaTeX math fonts providing *extrabold* or *ultrabold* series is negligible.

  As a workaround, use the heavier arev font, scaled to 0,875, in the bold version of `\mathsfbfit`:

  ```
  \usepackage{isomath}
  \DeclareFontShape{OML}{fav}{bx}{it}{<-> s * [0.875] zavmbi7m}{}
  \SetMathAlphabet{\mathsfbfit}{bold}{OML}{fav}{bx}{it}
  ```

[1] To access the upright shapes, the corresponding `\textbf` and `\textsf` commands might be used. Watch for side-effects, as these commands switch to text mode so that the font settings in the embedding text apply.

See also the isomath-test.tex test document.

2.2.1 How to get upright small Greek letters

Of the following methods, only the first requires *isomath*:

a) Use *isomath* and the mathdesign package:

```
\usepackage[utopia]{mathdesign}
\usepackage[OMLmathrm,OMLmathbf]{isomath}
```

Now, e. g., `\mathrm{\pi}` and `\mathbf{\pi}` work as expected.

b) To get upright small Greek letters without affecting other fonts, set the math alphabet manually to one of the three mathdesign fonts, e. g.:

```
\SetMathAlphabet{\mathbf}{normal}{OML}{mdput}{b}{n}
```

(check if the letter shapes match with the rest of the document).

c) Use a package that provides macros for upright Greek letters in math mode:

fourier	`\otheralpha ... \otherOmega`
kpfonts	`\alphaup ... \Omegaup`
mathdesign	`\alphaup ... \Omegaup`
upgreek	`\upalpha ... \upOmega`

d) Use an upright text character (requires a matching LGR-encoded Greek text font). The following lines redefine `\pi` to set the mathematical constant pi upright:

```
\usepackage[LGR,T1]{fontenc}
\usepackage[greek,british]{babel}
\usepackage{amsmath}
\let\mathpi\pi
\renewcommand{\pi}{\text{\textrm{\greektext p }}}
```

e) Use the text character with the *alphabeta* package from the lgrx bundle:

```
\usepackage{amsmath}
\usepackage{alphabeta}
```

and in the body

```
$ u = 2 \text{\pi} r $
```

3 Related packages

3.1 Requirements

fixmath by Walter Schmidt defines Greek letters as alphabetic symbols.

kvoptions by Heiko Oberdiek facilitates the setup of package options and provides a key=value interface (based on keyval).

3.2 Recommendations

cmbright by Walter Schmidt provides sans serif and sans-serif bold fonts for the `\mathsfit` and `\mathsfbfit` alphabets that match with Computer Modern and derivatives. Free Type 1 versions of the fonts are provided by hfbright.

arev by Stephen Hartke provides the not-so-light *Arev* sans serif font with letters that are clearly distinguishable from the roman or italic counterparts (important if used to distinguish vectors and tensors).

Arev has a large x-height. For many fonts, either small or capital letters will not match in size.

3.3 Alternatives

The TUGboat article by Claudio Beccari [becc97] discusses tricks and commands for physicists and engineers in order to satisfy the international regulations and to distinguish similar symbols with different meanings.

See Table 2 for other packages that implement the "ISO" math style and Table 6 for packages that provide bold italic math fonts.

"In-line math versions" can be used as ISO-conforming replacement for `\vec`:

- `\bm` from the bm package. Combining *bm* and *isomath* may lead to the too many math alphabets used in version normal error.
- `\boldsymbol` from amsbsy (part of amsmath, the near-indispensable adjunct to serious mathematical typesetting in LaTeX),

amsmath provides the command `\text`, that can be used to get, e. g., upright or sans-serif bold italic Greek symbols from a text font into a formula (see How to get upright small Greek letters).

unicode-math for XeTeX and LuaTeX allows mathematical typesetting using OpenType math fonts. It supports the "ISO" math style and all mathematical characters in the Unicode standard.

unicode-math cannot be used together with *isomath*. It can, however, replace all of isomath's functionality. See the discussion of the unicode-math package below.

3.4 Conflicts

"too many math alphabets used in version normal" This error occurs if the combination of packages tries to load more than 16 fonts into the `normal` math version.

Isomath can reduce the number of math alphabet definitions with the reuseMathAlphabets option (see there for side-effects).

Examples for problematic combinations:

- The kpfonts, pxfonts, and txfonts packages define many additional math alphabets (*kpfonts* works with *isomath*, if it is loaded with `\usepackage[nomathscript]{kpfonts}`).
- The bm package normally allocates several symbol fonts for bold and heavy fonts. Their number can be customised by defining `\bmmax` and `\hmmax` before loading the package.

fourier provides upright and italic Greek letters, but uses non-standard math font encodings. It cannot be used with *isomath*.

However, it is possible to use the non-alphanumeric symbols from fourier together with math alphabets from another package, e.g mathdesign:

```
\usepackage{fourier}
\usepackage[OMLmathbf,rmdefault=mdput,
            sfdefault=arev,scaled=0.85]{isomath}
```

sansmath defines a `sans` math version using **text** fonts in OT1 or T1 font encoding. As fixmath/isomath expect math fonts in OML font encoding, Greek letters will not work inside the `sans` math version defined by sansmath.

4 Background

This section discusses LaTeX math font selection, the OML font encoding, and the relation of LaTeX and Unicode mathematical typesetting.

4.1 Math font selection

There are three complementary methods to set font attributes in LaTeX math mode: *LaTeX 2e font selection* [fntguide] describes math alphabets and math versions, several extension packages provide alternative math styles.

4.1.1 Math alphabets

TeX's *math alphabets* correspond to the mathematical alphanumeric symbols block in Unicode. Both are "to be used for mathematical variables where style variations are important semantically". The font guide [fntguide] defines in section 3:

> Some math fonts are selected explicitly by one-argument commands such as `\mathsf{max}` or `\mathbf{vec}`; such fonts are called *math alphabets*.
>
> Math fonts [...] have the same five attributes as text fonts: encoding, family, series, shape and size. However, there are no commands that allow the attributes to be individually changed. Instead, the conversion from math fonts to these five attributes is controlled by the math version.
>
> The predefined math alphabets are:

`\mathnormal`	default[2]
`\mathrm`	roman[3]
`\mathbf`	bold roman
`\mathsf`	sans serif
`\mathit`	text italic
`\mathtt`	typewriter
`\mathcal`	calligraphic

Many packages define additional math alphabets (cf. Table 6).

In contrast to the similar named text commands, math alphabets are *not* orthogonal, e. g., the code `$\mathit{\mathbf{a}}$` sets the letter a in **upright** bold type.

4.1.2 Math versions

Math versions specify the mapping from commands for mathematical symbols and math alphabets to a set of mathematical fonts[4]. They are intended for mathematical content in a special context like a bold section heading. Selecting a math version resembles the individual selection of text font attributes.

Example: Some alternatives to set the letter a in a bold upright sans-serif font:

Text	**Math**
`\textbf{\textsf{a}}`	`$\bm{\mathsf{a}}$`

... continued on next page

[2] `\mathnormal` is used by default for alphanumeric characters in math mode. It sets the letter shape according to character class and math style. (Table 1 shows the default letter shapes for common math styles).

[3] The specifier "roman" is ambiguous: roman shape stands for *upright*, while roman type stands for *serif* (as opposed to sans serif).

Text	Math
`\bfseries \textsf{a}`	`\mathversion{bold}` `$\mathsf{a}$`
`\bfseries \sffamily a`	`$\mathsfbf{a}$`

The predefined math versions are `normal` and `bold` with the following defaults for non-specified font attributes:

attribute	**`normal`**	**`bold`**
type	serif	serif
weight	medium	bold
shape	upright	upright

Packages can define additional math versions, e. g., the kpfonts package defines a `sans` math version (another `sans` math version example is available from a comp.text.tex post‘) and the wrisym package defines a `mono` math version.

Math versions can only be changed outside of math mode. The commands `\boldsymbol` (amsmath) and `\bm` (bm) behave like “in-line math versions”: they typeset their argument using the fonts of the `bold` math version but can be used inside math mode.

4.1.3 Math styles

A *math style* is a document-level feature that determines the default letter shape in math mode (i. e. the shape attribute of letters in the `\mathnormal` math alphabet).[5] LaTeX defaults to the “TeX” math style (without naming it such). Alternative math styles are introduced by extension packages (Table 2).

Table 1: Default letter shapes for common math styles

math style	**latin**	**Latin**	**greek**	**Greek**
TeX	it	it	it	up
ISO	it	it	it	it

... continued on next page

[4] The number of mathematical symbols exceeds the maximal number of characters in a TeX font file by an order of magnitude: Unicode defines about 2500 mathematical characters [tr25], font files used by 8-bit TeX engines are limited to 256 characters. The standard math fonts adhere to the original limit of 128 characters. Grouping math fonts with common characteristics in math versions simplifies the setting of font attributes for mathematical expressions. TeX limits the number of (symbol + alphanumeric) fonts per math version to 16.

[5] The `math-style` option of unicode-math changes also the shape attribute of other math alphabets (see also section the unicode-math package).

Table 1: Default letter shapes for common math styles (... continued)

math style	latin	Latin	greek	Greek
French	it	up	up	up
upright	up	up	up	up

Table 2: Packages providing alternative math styles

math style	Package	Option(s)
ISO	fixmath	
	isomath	
	kpfonts	slantedGreeks
	lucimatx	math-style=iso
	mathdesign	greekuppercase=italicized
	mathpazo	slantedGreek
	mathptmx	slantedGreek
	unicode-math	math-style=ISO
French	fourier	upright
	kpfonts	frenchstyle (or upright)
	lucimatx	math-style=french
	mathdesign	uppercase=upright, greeklowercase=upright
	unicode-math	math-style=french
upright	eulervm	
	lucimatx	math-style=upright
	unicode-math	math-style=upright

4.2 OML font encoding

The equal treatment of Latin and Greek letters in the "ISO" math style is best achieved with a font that contains all required letters in one file.

There is only one established LaTeX font encoding that contains Latin and Greek letters, the OML font encoding. The standard Greek font encoding *T7* is just a "reserved name" and the de-facto standard Greek text font encoding *LGR* has no Latin letters. Unfortunately, OML support is limited to a few (mostly italic) fonts.

4.2.1 Discussion

The *LaTeX font encodings* guide [encguide] names the OML encoding *TeX math italic* and defines:

> The OML encoding contains italic Latin and Greek letters for use in mathematical formulae (typically used for variables) together with some symbols.

The reference to *italic* shape is odd:

- No other font encoding is specific to a font shape.
- The different font selection and the semantic of font features in mathematical formulae do not interfere with the font *encoding*: Both, `\DeclareSymbolFont` and `\DeclareMathAlphabet` require a shape argument. Thus it is possible to set up OML encoded math alphabets in roman {n} as well as italic {it} shape without conflicts.

This seems to be more a remnant of pre-NFSS times than a necessary restriction – there is only one OML encoded font in Knuth's Computer Modern fonts: *Computer Modern Math Italic* (cmmi).

Proposals:

- Drop the *italic* from the definition. Optionally add an explanation:

  > The OML encoding contains Latin and Greek letters for use in mathematical formulae (typically used for variables) together with some symbols. It first appeared in the *Computer Modern Math Italic* (cmmi) font.

- The name *TeX math italic* can be interpreted as "the encoding **of** *Computer Modern Math Italic*" rather than "an encoding **for** math italic" fonts.

  A less confusing name would be *TeX math letters* or *Original/Old Math Letters*. The latter would also explain the acronym OML.

4.2.2 OML Support

Unfortunately, support for the OML encoding is missing for many font families even if the text font defines Greek letters. Supported font families can be found searching for `oml*.fd` files and grepping for `DeclareFont.*OML` in `*.sty` files.

Table 3 lists the findings for a selection of TeXLive 2012 + some additionally installed font packages.

- If there is an alias (substitution) from the text font to a math-variant, only the text font is listed.
- Many text fonts define substitutions also for upright shape, however mapping to an italic variant of the OML encoded font. These are not listed as supporting `m/n` or `bx/n` here.

Table 4 lists some fonts that define `cmm` as OML substitution. With *isomath*, a better matching substitution can be set using the rmdefault or sfdefault options.

Table 3: Font families supporting the OML encoding

Name	Family (package)	m/it	bx/it	m/n	bx/n
antt	Antykwa Torunska (anttor)	✓	✓		
cmr	Computer Modern	✓	✓		
ccr	Concrete Roman (concmath)	✓	✓		
cmbr	CM Bright (cmbright)	✓	✓		
hlh	Lucida	✓	✓		
hfor	CM with old-style digits	✓	✓		
iwona	Iwona (sans serif) (iwona)	✓	✓		
iwonal	Iwona light	✓	✓		
iwonac	Iwona condensed	✓	✓		
iwonalc	Iwona light condensed	✓	✓		
jkp	Kepler Serif (kpfonts)	✓	✓		
jkpw	Kepler Serif wide	✓	✓		
jkpvos	Kepler Serif oldstyle	✓	✓		
jkpvosw	Kepler Serif oldstyle wide	✓	✓		
jkpl	Kepler Serif light	✓	✓		
jkplw	Kepler Serif light wide	✓	✓		
jkplvos	Kepler Serif light oldstyle	✓	✓		
jkplvosw	Kepler Serif light os wide	✓	✓		
jkpss	Kepler Sans (kpfonts)	✓	✓		
jkpssvos	Kepler Sans oldstyle	✓	✓		
jtm	expanded Times (jamtimes)	✓	✓		
llcmm	LX Fonts (sans serif) (lxfonts)	✓	✓		
lmr	Latin Modern Roman (lmodern)	✓	✓		
mak	Kerkis (kerkis)	✓			
kurier	Kurier (sans serif) (kurier)	✓	✓		
kurierc	Kurier condensed	✓	✓		
kurierl	Kurier light	✓	✓		
kurierlc	Kurier light condensed	✓	✓		
mdbch	Math Design Charter (mathdesign)	✓	✓	✓	✓
mdput	Math Design Utopia	✓	✓	✓	✓
mdugm	Math Design Garamond	✓	✓	✓	✓

... continued on next page

Table 3: Font families supporting the OML encoding (... continued)

Name	Family (package)	m/it	bx/it	m/n	bx/n
neohellenic	Neohellenic (gfsneohellenic)	✓			
ntxmi	Times (newtx)	✓	✓		
nxlmi	Libertine (newtx)	✓	✓		
plcm	CM (PLaTeX)	✓			
ptmom	Times (Omega or MB-Times)	✓	✓		
ptmomu	Times (Omega or MB-Times)	✓	✓		
ptmcm	Times (mathptmx)	✓			
pxr	Palatino (pxfonts)	✓	✓		
qpl	Palatino/Pagella (qpxmath)	✓	✓		
qtm	Times/Termes (qtxmath)	✓	✓		
txr	Times (txfonts)	✓	✓		
udidot	Didot (gfsdidot)	✓			
ywclm	(greektex)	✓	✓		
zavm	Arev (Vera Sans-Serif)	✓	✓		
zplm	Palatino (mathpazo)	✓	✓		
zpple	Palatino	✓	✓		
ztmcm	Times (mathptmx)	✓			
zer	Computer Modern (zefonts)	✓	✓		

Table 4: Non-CM fonts with `cmm` as OML substitution

Family	Name
bch	Charter (psnfss)
pag	Avant Garde (psnfss)
pbk	Bookman (psnfss)
pcr	Courier (psnfss)
phv	Helvetica (psnfss)
pnc	New Century Schoolbook (psnfss)
ppl	Palatino (psnfss)
ptm	Times Roman (psnfss)
put	Utopia (psnfss)
pzc	Zapf Chancery (psnfss)

... continued on next page

Table 4: Non-CM fonts with `cmm` as OML substitution (... continued)

Family	Name
uag	Avant Garde (avantgar)
ubk	Bookman (bookman)
ucr	Courier (courier)
ucrs	Courier
unc	New Century Schoolbook (psnfss)
uni	Universal (universa)
uhv	Helvetica (helvetic)
upl	Palatino (palatino)
utm	Times (times)
uzc	Zapf Chancery (zapfchan)

4.3 Unicode mathematical typesetting

This section compares math font selection in LaTeX and Unicode. It suggests a set of 14 math alphabet commands that covers all Unicode mathematical alphanumeric symbols and discusses compatibility issues between math typesetting with traditional (8-bit) TeX engines versus the unicode-math package for Unicode-enabled TeX engines (XeTeX, LuaTeX).

The technical report [tr25] presents an in-depth discussion of the mathematical character repertoire of the Unicode Standard as well as mathematical notation in general.

4.3.1 Unicode mathematical alphabets

Chapter 2 *Mathematical Character Repertoire* of [tr25] lists 14 *Mathematical Alphabets* in Table 2.1. These mathematical alphabets are a superset of the predefined math alphabets in the LaTeX core.

Unicode assigns code points to most letters of the mathematical alphabets in the mathematical alphanumeric symbols Unicode block. The plain (upright) letters have been unified with the existing characters in the Basic Latin and Greek blocks.

Table 5 maps the 14 Unicode mathematical alphabets to LaTeX commands according to the naming scheme below. Table 6 lists the status of LaTeX support for the mathematical alphanumeric symbols.

Naming scheme The naming scheme is an extension of the predefined math alphabet commands with the established short-cuts:

bf	bold
it	italic
cal	script (calligraphic)
frak	fraktur
bb	double-struck (blackboard bold)
sf	sans serif

combined to commands in the form `\math<type><weight><shape>`.

The <*type*>, <*weight*>, and <*shape*> specifiers are optional (defaults depend on the math version). Their order matches the names of Unicode Mathematical Alphanumeric Symbols.

Examples:

```
\mathbf{d}     % MATHEMATICAL BOLD SMALL D
\mathsfbfit{d} % MATHEMATICAL SANS-SERIF BOLD ITALIC SMALL D.
```

Table 5: Mapping Unicode mathematical alphanumeric symbols to LaTeX math alphabets.

serifs	**weight**	**shape**	**symbols**	**math alphabet**
serif	*medium*	*upright*	Latin/Greek/digits[6]	`\mathrm`
	bold		Latin/Greek/digits	`\mathbf`
		italic	Latin/Greek	`\mathit`
	bold	italic	Latin/Greek	`\mathbfit`
		script	Latin	`\mathcal`
	bold	script	Latin	`\mathbfcal`
		fraktur	Latin	`\mathfrak`
		double-struck	Latin/digits	`\mathbb`
	bold	fraktur	Latin	`\mathbffrak`
sans serif			Latin/digits	`\mathsf`
sans serif	bold		Latin/Greek/digits	`\mathsfbf`
sans serif		italic	Latin	`\mathsfit`
sans serif	bold	italic	Latin/Greek	`\mathsfbfit`
		monospace	Latin/digits	`\mathtt`

[6] plain standard characters outside the *mathematical alphanumeric symbols* Unicode block.

LaTeX support Most commonly used math alphabets are supported either by the TeX kernel or additional packages. Full support is only provided by the unicode-math package.

Table 6: LaTeX support for mathematical alphanumeric symbols.

style	math alphabet	package, comment
plain[6]	`\mathrm`	predefined[7]
	`\mathup`	unicode-math, kpfonts
bf	`\mathbf`	predefined[7]
it	`\mathit`	predefined[7]
bf it	`\mathbfit`	isomath[8]
	`\mathbold`	fixmath, mathpazo, mathptmx, tmmath[8]
	`\boldsymbol`	amsmath
	`\bm`	bm
cal	`\mathcal`	predefined[9]
	`\mathscr`	mathrsfs, euscript, mathdesign
bf cal	`\mathbfscr`	unicode-math
frak	`\mathfrak`	amssymb, amsfonts, eufrak
bf frak	`\mathbffrak`	unicode-math
bb	`\mathbb`	amssymb, bbold, mathbbol, mb-board, mathpazo, sbbm
	`\mathbbm`	bbm
	`\mathds`	dsfont (doublestoke)
sf	`\mathsf`	predefined[7]
sf bf	`\mathbfsfup`	unicode-math
sf it	`\mathsfit`	isomath[8]
sf bf it	`\mathsfbfit`	isomath[8]
	`\mathbold`	cmbright, hvmath
	`\mathbfsfit`	unicode-math
tt	`\mathtt`	predefined[7]

[7] no small Greek, full Greek with OMLmath* options and OML-encoded fonts

[8] Some italic math fonts (e. g., cmr, cmbr) have old-style numbers in place of italic digits.

[9] formal script with calrsfs, eucal, fourier, small Latin letters only with urwchancal

4.3.2 The unicode-math package

Users of UTF-8 enabled TeX engines (XeTeX, LuaTeX) can typeset mathematics with the experimental unicode-math package by Will Robertson. It provides a LaTeX interface to OpenType fonts with math support, e. g., Asana Math, Cambria Math, New Euler or XITS, with commands to access the complete mathematical character repertoire of the Unicode Standard.

LaTeX math font selection methods with unicode-math:

- Math alphabets map to a range of the mathematical alphanumeric symbols block in the current font (or a substitution defined with the `range` math font option).

  Some command names differ from the predefined math alphabets or the above naming scheme:

LaTeX	**unicode-math**
`\mathbf`	`\mathbfup`
`\mathsf`	`\mathsfup`
`\mathsfbf`	`\mathbfsfup`
`\mathsfbfit`	`\mathbfsfit`

  With unicode-math, `\mathbf`, `\mathsf`, and `\mathsfbf` behave similar to "in-line math versions": they consider the math style for upright vs. italic shape. Compatibility can be achieved via the options `bold-style=upright` and `sans-style=upright`.

  `\mathbfsfit` reverses the order of the `sf` and `bf` selectors, so that, e. g., the Unicode character MATHEMATICAL SANS-SERIF BOLD ITALIC CAPITAL A is selected by the non-mnemonic `\mathbfsfit{A}`.

- Math versions can be set up using the syntax `\setmathfont[version=<version name>,<font features>]{<font name>}`
- Several math styles are supported with the `math-style` package option that accepts the values `TeX`, `ISO`, `french`, `upright`, and `literal`.

4.4 Conclusions and outlook

It is hoped, that in the future more font families will support the OML encoding in normal and bold weight as well as upright and italic shape. This would be a major step towards a LaTeX equivalent of the mathematical alphanumeric symbols Unicode block.

This should be (relatively) easy to achieve via virtual fonts when the glyphs for the Greek letters already exist. Examples are Latin Modern, Kerkis, GFS Neohellenic, LX Fonts and KP-Serif.

Upright small Greek letters in `\mathrm` would enable the specification of the constant pi, Myons, Pions, alpha-particles, photons, and neutrinos with math alphabets. (With mathdesign

fonts, this is already possible today.)

With the development of the unicode-math package, an interesting alternative for ISO-conforming math typesetting became available to users of Unicode-enabled TeX engines (XeTeX or LuaTeX).

5 References

[ISO-80000-2] *Quantities and units – Part 2: Mathematical signs and symbols to be used in the natural sciences and technology*: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=31887.

[ISO-31] *Quantities and units*, Superseded by [ISO-80000].

[typefaces] National Institute of Standards and Technology (NIST), *Typefaces for Symbols in Scientific Manuscripts*: http://physics.nist.gov/cuu/pdf/typefaces.pdf.

[checklist] National Institute of Standards and Technology (NIST), *SI Unit rules and style conventions* Check List for Reviewing Manuscripts: http://physics.nist.gov/cuu/Units/checklist.html.

[fonts_for_symbols] International Union of Pure and Applied Chemistry (IUPAC), *On the use of italic and roman fonts for symbols in scientific text*, (Revised December 1999): http://old.iupac.org/standing/idcns/fonts_for_symbols.html.

[SI] Bureau international des poids et mesures (BIPM), *The International System of Units (SI)*: http://www.bipm.org/en/si/si_brochure/.

[Green-Book] International Union of Pure and Applied Chemistry (IUPAC), *Quantities, Units and Symbols in Physical Chemistry*, 3rd edition, RSC Publishing, Cambridge 2007: [ISBN 0 85404 433 7; ISBN-13 978 0 85404 433 7].

[Red-Book] International Union of Pure and Applied Physics (IUPAP), *Symbols, Units, Nomenclature and Fundamental Constants in Physics*: http://metrology.wordpress.com/measurement-process-index/iupap-red-book/index-iupap-red-book/.

[becc97] Claudio Beccari, *Typesetting mathematics for science and technology according to ISO 31 XI*, TUGboat, Volume 18, 1997, No. 1: http://www.tug.org/TUGboat/tb18-1/tb54becc.pdf.

[encguide] Frank Mittelbach, Robin Fairbairns, Werner Lemberg, LaTeX3 Project Team, *LaTeX font encodings*: http://mirror.ctan.org/macros/latex/doc/encguide.pdf.

[fntguide] LaTeX3 Project Team, *LaTeX 2e font selection*: http://mirror.ctan.org/macros/latex/doc/fntguide.pdf.

[tr25] Barbara Beeton, Asmus Freytag, Murray Sargent III, *Unicode Support for Mathematics*, Unicode Technical Report #25: http://www.unicode.org/reports/tr25/.

[beeton:2000] Barbara Beeton: *Unicode and math, a combination whose time has come – Finally!*, TUGBoat, 21#3, 2000: http://www.tug.org/TUGboat/Articles/tb21-3/tb68beet.pdf.