

THE MATHALFA PACKAGE

MICHAEL SHARPE

The math alphabets normally addressed via the macros `\mathcal`, `\mathbb`, `\mathfrak` and `\mathscr` are in a number of cases not well-adapted to the L^AT_EX math font structure. Some suffer from one or more of the following defects:

- font sizes are locked into a sequence that was appropriate for metafont-generated rather than scalable fonts;
- there is no option in the loading package to enable scaling;
- the font metrics are designed for text rather than math mode, leading to awkward spacing, subscript placement and accent placement when used for the latter;
- the means of selecting a set of math alphabets varies from package to package.

The goal of this package is to provide remedies for the above, where possible. This means, in effect, providing virtual fonts with my personal effort at correcting the metric issues, rewriting the font-loading macros usually found in a `.sty` and/or `.fd` files to admit a scale factor in all cases, and providing a `.sty` file which is extensible and from which any such math alphabet may be specified using a standard recipe.

For example, the following fonts are potentially suitable as targets for `\mathcal` or `\mathscr` and are either included as part of T_EXLive 2010, as free downloads from CTAN or other free sources, or from commercial sites.

```
cm % Computer Modern Math Italic (cmsy)
euler % euscript
rsfs % Ralph Smith Formal Script---heavily sloped
rsfso % based on rsfs, much less sloped
lucida % From Lucida New Math (commercial)
mathpi % Adobe Mathematical Pi or clones thereof (commercial)
mma % Mathematica fonts
mt % Mathtime (commercial)
mtc % Mathtime Curly (commercial)
zapfc % Adobe Zapf Chancery (URW clone is part of TeXLive)
esstix % ESSTIX-thirteen
boondox % calligraphic alphabet derived from stix fonts
boondoxo % based on boondox, but less oblique
```

Once you have installed the support packages for these fonts and the `mathalfa` package, you may select a particular calligraphic font for `\mathcal` using something like

```
\usepackage[cal=rsfso,calscaled=.96]{mathalfa}
```

which loads `rsfso` at 96% of natural size as the math calligraphic alphabet. You may at the same time select the output for `\mathbb`, `\mathfrak`, `\mathbf` (since the Mathematica fonts have a bold version of `bb`) and `\mathscr` with

```
\usepackage[cal=mathpi,
calscaled=.94,
bb=ams,
frak=mma,
frakscaled=.97,
scr=rsfs]{mathalfa}
```

As initially configured, `mathalfa` makes available the following options:

- cal=:** Select the calligraphic alphabet from the list above.
- calscaled=:** Select a scale factor for `cal`.
- scr=:** Select the script alphabet from `rsfs`, `rsfs`, `euler`, `lucida`, `mathpi`, `mma`, `mtc`, `zapfc`, `esstix`, `boondox`, `boondoxo`.
- scrscaled=:** Select a scale factor for `scr`.
- frak=:** Select the fraktur alphabet from `euler`, `lucida`, `mathpi`, `mma`, `mt`, `esstix`, `boondox`.
- frakscaled=:** Select a scale factor for `frak`.
- bb=:** Select the Blackboard bold alphabet from `ams`, `lucida`, `mathpi`, `mma`, `mt`, `mth`, `pazo`, `fourier`, `esstix`, `boondox`.
- bbscaled=:** Select a scale factor for `bb`.
- scaled=:** Select a scale for all alphabets chosen within `mathalfa`.
- showoptions:** This option throws an error and shows a list of all installed option values for `bb`, `cal`, `frak` and `scr` on the console.

NOTES

- If bold versions exist, they are loaded and may be used with the macros `\mathbcal`, `\mathbbb`, `\mathbfrak` and `\mathbscr`.
- Use of `zapfc` as a value for either `cal` or `scr` requires that you install the `urwchancal` package from <http://ctan.tug.org/tex-archive/fonts/urwchancal>. (It is distributed as part of T_EX Live as of March 2011.)
- Use of the `rsfs` as a value for either `cal` or `scr` requires that you install the `rsfs` package from <http://ctan.tug.org/tex-archive/fonts/rsfs>. (It is distributed as part of T_EX Live as of March 2011.)
- Use of `mma` as a value requires that you download and install the fonts from <http://support.wolfram.com/technotes/latestfonts.en.html>. The support files may be downloaded from <http://phong.informatik.uni-leipzig.de/~kuska/>. In particular, `wolfram.map` must be enabled. Virtual fonts with metrics that are suitable for math mode are also required. A TDS with the required files (including virtual fonts with tuned metrics) is available at <http://public.me.com/mjsharpe/mmaTDS.zip>.
- Use of `mathpi` requires that you purchase and install the Adobe Mathematical Pi fonts (#2 and #6) or clones thereof. If you choose to buy them, you may download support files,

including virtual fonts with tuned metrics, from
<http://public.me.com/mjsharpe/mathpiTDS.zip>.

- The ESSTIX collection is a creation of Elsevier Publishing in 2000, though never officially released by them. Before development was complete, the collection was donated to the STIX math font project, to which it seems to have been a precursor. Distribution has since been deprecated, but in my opinion, math alphabet fonts, especially math script fonts, are so rare that none should be allowed to become extinct. The BlackBoard Bold ESSTIX font (ESSTIX14) is close to both the mathpi and Fourier Blackboard Bold fonts, and the fraktur ESSTIX font (ESSTIX15) is similar to mathpi fraktur. However, the ESSTIX script font (ESSTIX13) seems to be a distinct and interesting face. The PostScript versions of these fonts have been hard to find, but the TrueType versions may be found embedded within the Amaya project, available at <http://www.w3.org/Amaya/>. The ESSTIX PostScript fonts, virtual math fonts and L^AT_EX support files may be downloaded now from <http://mirror.ctan.org/fonts/esstix>. This provides virtual fonts with tfm names `esstixcal`, `esstixbb` and `esstixfrak`. As of May 2011, the `esstix` package is distributed as a part of T_EX Live.
- The STIX fonts are currently (May 2011) distributed only in OpenType format. The PostScript BOONDOX fonts (in the USA, *the boondocks* and *the sticks* are essentially synonymous) containing their calligraphic, fraktur and double-struck (blackboard bold) alphabets in regular and bold weights were manufactured from STIX `.otf` fonts using FontForge. Virtual fonts were then created using `fontinst` to customize the metrics for positioning accents and subscripts. A TDS package with the fonts and support files may be downloaded from <http://mirror.ctan.org/fonts/boondox>.

The following are my opinions. No objective judgment should be inferred.

- If your interest in math fonts goes beyond the basic level, you should look into the commercial products Lucida from <http://www.tug.org/store/lucida/order.html> and Mathtime Pro 2 from <http://pctex.com>. Both are high quality products, and are excellent values for the prices. Even if you only use small pieces of the collections, these are much better buys than most commercial text fonts.
- The Mathematica fonts are not of very high quality as a collection, but they have some good parts. In particular, the calligraphic math font may be turned into a useful target for `\mathcal` after its metrics have been fine-tuned. You are missing out on some good stuff if you don't install this free collection.
- The `rsfs` package is not suitable for `\mathcal`, being much too slanted. The best options for `\mathcal` are `rsfs`, `esstix`, `boondoxo` and `mt`, the latter requiring the (non-free) `mtpro2` collection.
- If you own the `mtpro2` collection, look into the 'curly' script font, which seems useful, though a bit heavy.
- It is questionable whether there is value in the Mathpi fonts given that there are free close approximants to each of them.

- The STIX (BOONDOX) calligraphic font is quite handsome. I prefer it to be less sloped, along the lines of `rsfso`. This is provided by the option `boondoxo`, which provides virtual fonts sloped approximately like `rsfso`.

HEIGHT COMPARISONS:

The `CapHeight` of a font is supposed to represent the height of capital letters in the font in units where 1000 is equal to `1em`, the size of `\quad` which, for a font of nominal size `10pt` is in most cases equal to `10pt`. Script fonts often have irregularly sized capital letters, and the `CapHeight` should perhaps represent the median height of capitals. This is not always so. For example, `pzc` (Adobe Zapf Chancery) and `uzc` (its URW clone) have the same glyph metrics, but their `CapHeights` are listed respectively as 708 and 573. These numbers, taken from their AFM files, represent in the first case the second greatest height of capital letters and the second case the second smallest. If the `CapHeight` is to provide useful information about scaling the font, a more central value is 595, indicating that in most cases, Zapf Chancery usually needs to be scaled up by about 15%.

For the purpose of making scale factors to mediate between these disparate fonts, the following chart may be helpful.

Computer Modern Roman (<code>cmr10</code>)	683
Zapf Chancery (<code>pzcmi/uzcmi</code>)	595
Euler fraktur(<code>eufm10</code>)	690
Euler script(<code>eusm10</code>)	695
<code>rsfs/rsfso</code>	710
Computer Modern calligraphic (<code>cmsy10</code>)	703
Mathpi calligraphic (<code>mh2scr</code>)	720
Mathpi fraktur (<code>mh2</code>)	762
Mathpi Blackboard bold (<code>mh6</code>)	720
Lucida calligraphic (<code>lbms</code>)	723
Lucida Blackboard bold (<code>lbma</code>)	723
Lucida fraktur (<code>lbl</code>)	741
<code>mtpro2</code> calligraphic (<code>mt2mst</code>)	702
<code>mtpro2</code> curly (<code>mt2mct</code>)	702
<code>mtpro2</code> Blackboard bold (<code>mt2bbt</code>)	690
<code>mtpro2</code> Holey Roman (<code>mt2hrbt</code>)	690
Mathematica calligraphic (<code>Mathematica5</code>)	685
Mathematica fraktur (<code>Mathematica6</code>)	690
Mathematica Blackboard bold (<code>Mathematica7</code>)	662
Mathpazo Blackboard bold (<code>fplmbb</code>)	692
Fourier Blackboard bold (<code>fourier-bb</code>)	693
ESSTIX Calligraphic (<code>ESSTIX13</code>)	692
ESSTIX Blackboard bold (<code>ESSTIX14</code>)	696
ESSTIX fraktur (<code>ESSTIX15</code>)	700
BOONDOX Calligraphic	687
BOONDOX Blackboard bold	662
BOONDOX fraktur	695

Here are some samples from the fonts mentioned above:

Fraktur:

esstix (ESSTIX fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mathpi (Mathpi fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mt (Mathtime Pro 2 fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

euler (Euler fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

lucida (Lucida fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mma (Mathematica fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondox (BOONDOX fraktur):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

euler (Euler fraktur-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mma (Mathematica fraktur-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mt (Mathtime Pro 2 fraktur-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondox (BOONDOX fraktur-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Calligraphic:

UPRIGHT:

euler (Euler script):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

euler (Euler script-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mtc (Mathtime Pro 2 Curly script):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

RESTRAINED:

cm (CM calligraphic, cmsy):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

cm (CM calligraphic-bold, cmbsty):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

zapfc (Zapf Chancery):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

lucida (Lucida calligraphic):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

lucida (Lucida calligraphic-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mma (Mathematica script):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mma (Mathematica script-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

EMBELLISHED:

mt (Mathtime Pro 2 script):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mt (Mathtime Pro 2 script-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mathpi (Mathpi script):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

esstix (ESSTIX Calligraphic):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

rsfs:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondoxo (BOONDOX Calligraphic Oblique):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondoxo (BOONDOX Calligraphic Oblique-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

HEAVILY SLOPED:

boondox (BOONDOX Calligraphic):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondox (BOONDOX Calligraphic-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

rsfs:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Double-Struck (Blackboard Bold):

HOLLOWED-OUT SHAPES:

ams (AMS bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mth (Mathtime Pro 2 Holey Roman):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

GEOMETRIC SHAPES:

lucida (Lucida bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mathpi (Mathpi bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mt (Mathtime Pro 2 bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mma (Mathematica bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

pazo (Mathpazo bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

fourier (Fourier bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

esstix (ESSTIX bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondox (BOONDOX bb):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

boondox (BOONDOX bb-bold):

C D H N P Q R Z (few glyphs available.)

mt (Mathtime Pro 2 bb-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mth (Mathtime Pro 2 Holey Roman-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

mma (Mathematica bb-bold):

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

NOTES:

- Lucida fonts generally need to be reduced in scale to match other math and text fonts.
- Zapf Chancery need to be scaled up by 15% or so. This font is not really suited for use as a math alphabet due to the disparate heights and depths and the long tails on some glyphs. Use with care.
- Mathematica fraktur is quite readable, but not very attractive, seeming to have random variations in baseline and height. It's also a bit too heavy to be a good match to most other fonts. Similar comments could apply to Lucida fraktur, which has a very distinctive appearance with some features more similar to Duc de Berry than to other fraktur fonts.
- The calligraphic fonts break down into four natural groups—(i) the upright styled Euler and Curly; (ii) the less-embellished CM, Lucida, Zapf Chancery, ESSTIX and Mathematica; (iii) the moderately sloped but more embellished Mathpi, Mathtime, rsfs and boondoxo; (iv) the heavily sloped rsfs and the slightly less sloped boondox. My preference, if not using `mathtime` or `lucida`, is to set `\mathcal` to one from group (ii) and `\mathscr` to one from group (iii).

- Blackboard bold can look poor in some cases. In my opinion, AMS bb and some of the others show up as ghostly (gray and indistinct) especially on the screen and may not appear to match the weights of other math glyphs. (Both AMS bb and Mathtime Pro 2 Holey Roman appear to be formed by removing the interiors of solid glyphs from a bold, serifed font. Mathtime Pro 2 Holey Roman Bold is a much better fit to most math fonts of weight heavier than Computer Modern.) Fourier, Mathpi, ESSTIX and boondox bb appear to be very close in style, with mathpi bb a bit less sharp. Mathpazo bb and Mathematica bb have a heavier appearance and should work better with fonts other than Computer Modern.

E-mail address: msharpe at ucsd dot edu