MathTime™
Professional

PostScript fonts
for typesetting
mathematics
with TeX

Font Supplement A

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The *MathTıme*™ *Professional* Fonts
Font Supplement A

Introduction

Font Supplement A for the *MathTıme Professional* fonts* provides Times-compatible versions of the various operators on the AMS's `msam` and `msbm` fonts, as well as several different complete "blackboard bold" fonts, with both uppercase and lowercase letters, as well as numerals. In addition, all the other symbols are available in a bold version, as well as a heavy one (not particularly recommended for these frequently complicated symbols).

To access these fonts with LaTeX, use `mtpams.sty`, which is documented in `mtpams.pdf` (with full implementation details available in the source file `mtpams.dtx`). The rest of this document is intended for `plain` TeX users. To make use of these fonts in `plain` TeX, you should have

        \input mtpa

in your file, at some point after the `\input mtp` line.

I. "Blackboard Bold"

Two different varieties of "blackboard bold" alphabets are provided.

The first version, *MathTıme* **h**oley **r**oman **b**old, is a "bold open" font, formed by hollowing out bold letters:

$$\text{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$
$$\text{abcdefghijklmnopqrstuvwxyz0123456789}$$

By contrast, the *MathTıme* **b**lack **b**oard **b**old font is the sort of alphabet that one might actually write on a blackboard:

$$\text{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$
$$\text{abcdefghijklmnopqrstuvwxyz0123456789}$$

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Or you might prefer one of the dark versions, **h**oley **r**oman **b**old **d**ark:

$$\text{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$
$$\text{abcdefghijklmnopqrstuvwxyz0123456789}$$

or **b**lack **b**oard **b**old **d**ark:

$$\text{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$$
$$\text{abcdefghijklmnopqrstuvwxyz0123456789}$$

To use the **h**oley **r**oman **b**old font, first put

        \loadhrb

in your file. This will load the appropriate fonts and define a control sequence \hrb with one argument, so that `$\hrb a,\ldots,\hrb Z,\hrb0,` `\ldots,\hrb9$` gives $\mathbb{a},\ldots,\mathbb{Z},\mathbb{0},\ldots,\mathbb{9}$. You can also type `\hrb\imath` to get $\imath$ and `\hrb\jmath` for $\jmath$. Similarly,

        \loadbbb

will load the appropriate **b**lack **b**oard **b**old fonts, and define a control sequence \bbb, while \loadhrbd and \hrbd are used for the **h**oley **r**oman **b**old **d**ark fonts, and \loadbbbd and \bbbd are used for the **b**lack **b**oard **b**old **d**ark fonts.

II. New Symbols

All the other symbols from Font Supplement A can be accessed by typing

        \loadsya

after `\input mtpa`; this command loads the necessary fonts and defines names for all the new symbols.

1. For technical reasons (see the final footnote of **IV**), three of the symbols, ¥ (\yen), the old Greek letter F (\digamma), and $\hbar$ (\hslash), have actually been placed on the latest versions of the *MathTime Professional* basic fonts,

along with the $\hbar$ (\hbar) already appearing there, and their definitions appear in the latest version of `mtp.tex`, so you don't need the supplementary fonts to use them. \yen is normally used outside of math mode, but it can also be used in math mode, as another letter; \digamma, \hslash, and \hbar are letters that can only be used in math mode.

The new symbols

✓	\checkmark	✠	\maltese
®	\circledR		

are normally used outside of math mode, though they too can be used in math mode.

Three other special letters for math mode are the Hebrew

ℶ	\beth	ℷ	\gimel
ℸ	\daleth		

There are also four special delimiters (which occur in only one size):

⌜	\ulcorner	⌝	\urcorner
⌞	\llcorner	⌟	\lrcorner

The remaining new symbols fall into various groups.

2. Most of the new symbols are binary operators or relations, but first we have a miscellaneous group of **ordinary symbols**.

‵	\backprime	∅	\varnothing
△	\vartriangle	▲	\blacktriangle
▽	\triangledown	▼	\blacktriangledown
□	\square	■	\blacksquare
◇	\lozenge	◆	\blacklozenge
◇	\Diamond		
Ⓢ	\circledS	★	\bigstar
∡	\measuredangle	⊲	\sphericalangle
∄	\nexists	∁	\complement
℧	\mho	ð	\eth
⅂	\Finv	⅁	\Game
╱	\diagup	╲	\diagdown

Remember that the plain ∠ (\angle) already appears on the *MathTime Professional* basic fonts. On the other hand, ◇ (\Diamond) doesn't appear on the AMS fonts, although a similar symbol occurs on the LaTeX symbol font.

3. Next come **binary operators**.

$\dotplus$	`\dotplus`	$\smallsetminus$	`\smallsetminus`
$\ltimes$	`\ltimes`	$\rtimes$	`\rtimes`
$\Cap$	`\Cap, \doublecap`	$\Cup$	`\Cup, \doublecup`
$\leftthreetimes$	`\leftthreetimes`	$\rightthreetimes$	`\rightthreetimes`
$\barwedge$	`\barwedge`	$\veebar$	`\veebar`
$\doublebarwedge$	`\doublebarwedge`		
$\curlywedge$	`\curlywedge`	$\curlyvee$	`\curlyvee`
$\boxplus$	`\boxplus`	$\boxminus$	`\boxminus`
$\boxtimes$	`\boxtimes`	$\boxdot$	`\boxdot`
$\circleddash$	`\circleddash`	$\circledast$	`\circledast`
$\circledcirc$	`\circledcirc`	$\divideontimes$	`\divideontimes`
$\centerdot$	`\centerdot`	$\intercal$	`\intercal`

`\smallsetminus` is actually just a synonym used by `mtpa` for `\setdif` on the *MathTime Professional* basic fonts.

4. Binary relations.

In the list below, note that $\sqsubset$ (`\sqsubset`) and $\sqsupset$ (`\sqsupset`) are new symbols, while the more complicated $\sqsubseteq$ (`\sqsubseteq`) and $\sqsupseteq$ (`\sqsupseteq`) already exist on the basic fonts!

Note also that $\smallsmile$ (`\smallsmile`) and $\smallfrown$ (`\smallfrown`) are different from the symbols $\cupprod$ (`\cupprod`) and $\capprod$ (`\capprod`), and that the old $\models$ (`\models`) is different from $\vDash$ (`\vDash`).

$\leqq$	`\leqq`	$\geqq$	`\geqq`
$\leqslant$	`\leqslant`	$\geqslant$	`\geqslant`
$\eqslantless$	`\eqslantless`	$\eqslantgtr$	`\eqslantgtr`
$\lesssim$	`\lesssim`	$\gtrsim$	`\gtrsim`
$\lessapprox$	`\lessapprox`	$\gtrapprox$	`\gtrapprox`
$\approxeq$	`\approxeq`		
$\lessdot$	`\lessdot`	$\gtrdot$	`\gtrdot`
$\lll$	`\lll, \llless`	$\ggg$	`\ggg, \gggtr`
$\lessgtr$	`\lessgtr`	$\gtrless$	`\gtrless`
$\lesseqgtr$	`\lesseqgtr`	$\gtreqless$	`\gtreqless`
$\lesseqqgtr$	`\lesseqqgtr`	$\gtreqqless$	`\gtreqqless`

≐	\doteqdot, \Doteq	≖	\eqcirc
≒	\fallingdotseq	≓	\risingdotseq
≜	\circeq	≜	\triangleq
∽	\backsim	∼	\thicksim
⋍	\backsimeq	≈	\thickapprox
⊆	\subseteqq	⊇	\supseteqq
⋐	\Subset	⋑	\Supset
⊏	\sqsubset	⊐	\sqsupset
≼	\preccurlyeq	≽	\succcurlyeq
⋞	\curlyeqprec	⋟	\curlyeqsucc
≾	\precsim	≿	\succsim
⪷	\precapprox	⪸	\succapprox
◁	\vartriangleleft	▷	\vartriangleright
⊴	\trianglelefteq	⊵	\trianglerighteq
◀	\blacktriangleleft	▶	\blacktriangleright
⊨	\vDash	⊩	\Vdash
⊪	\Vvdash		
⌣	\smallsmile	⌢	\smallfrown
∣	\shortmid	∥	\shortparallel
≏	\bumpeq	≎	\Bumpeq
∴	\therefore	∵	\because
≬	\between	⋔	\pitchfork
∝	\varpropto	϶	\backepsilon

5. Negated relations.

Several negated relation symbols already appear, in identical form, on the basic *MathTimeProfessional* fonts, so in addition to their standard AMS names, their names from the basic font package also appear, in brackets. It should be noted, however, that ≁ (\notsim) from the basic fonts is definitely different from ≁ (\nsim) from the font supplement.

(It might also be mentioned that the final four symbols, \nsqsubset, \nsqsubseteq, \nsqsupset, and \nsqsupseteq, don't actually exist on the AMS fonts.)

≮ \nless [\notless]   ≯ \ngtr [\notgr]

≰ \nleq [\notleq]   ≱ \ngeq [\notgeq]

≰ \nleqslant   ≱ \ngeqslant

≦̸ \nleqq   ≧̸ \ngeqq

⪇ \lneq   ⪈ \gneq

≨ \lneqq   ≩ \gneqq

⪇ \lvertneqq   ⪈ \gvertneqq

⪉ \lnsim   ⪊ \gnsim

⪅ \lnapprox   ⪆ \gnapprox

⊀ \nprec [\notprec]   ⊁ \nsucc   [\notsucc]

⋠ \npreceq   ⋡ \nsucceq
   [\notpreceq]   [\notsucceq]

⪵ \precneqq   ⪶ \succneqq

⋨ \precnsim   ⋩ \succnsim

⪹ \precnapprox   ⪺ \succnapprox

≁ \nsim   ≇ \ncong

∤ \nshortmid   ∦ \nshortparallel

∤ \nmid   ∦ \nparallel

⊬ \nvdash   ⊭ \nvDash

⊮ \nVdash   ⊯ \nVDash

⋪ \ntriangleleft   ⋫ \ntriangleright

⊈ \nsubseteq   ⊉ \nsupseteq
    [\notsubseteq]   [\notsupseteq]

⊈ \nsubseteqq   ⊉ \nsupseteqq

⊊ \subsetneq   ⊋ \supsetneq

⊊ \varsubsetneq   ⊋ \varsupsetneq

⊊ \subsetneqq   ⊋ \supsetneqq

⊊ \varsubsetneqq   ⊋ \varsupsetneqq

⋢ \nsqsubset   ⋣ \nsqsupset

⋢ \nsqsubseteq   ⋣ \nsqsupseteq
    [\notsqsubseteq]   [\notsqsupseteq]

6. Arrows.

In the list below, it should be noted that $\rightleftharpoons$ (\rightleftharpoons) is actually taken from the *MathTimeProfessional* basic fonts, while $\rightsquigarrow$ (\leadsto) appears in the LaTeX symbol font (it is also more common than $\rightsquigarrow$).

\rarrowhead, \larrowhead, and \midshaft (which are not given names in the AMS fonts) may be used to construct longer dashed arrows. For example

       \mathrel{\midshaft\midshaft\midshaft\rarrowhead}

can be used to produce the arrow in the formula $A \dashrightarrow B$.

$\dashrightarrow$	\dashrightarrow, \dasharrow	$\dashleftarrow$	\dashleftarrow
$\leftarrowhead$	\larrowhead	$\rightarrowhead$	\rarrowhead
$-$	\midshaft		
$\leftleftarrows$	\leftleftarrows	$\rightrightarrows$	\rightrightarrows
$\leftrightarrows$	\leftrightarrows	$\rightleftarrows$	\rightleftarrows
$\Lleftarrow$	\Lleftarrow	$\Rrightarrow$	\Rrightarrow
$\twoheadleftarrow$	\twoheadleftarrow	$\twoheadrightarrow$	\twoheadrightarrow
$\leftarrowtail$	\leftarrowtail	$\rightarrowtail$	\rightarrowtail
$\looparrowleft$	\looparrowleft	$\looparrowright$	\looparrowright
$\leftrightharpoons$	\leftrightharpoons	$\rightleftharpoons$	\rightleftharpoons
$\curvearrowleft$	\curvearrowleft	$\curvearrowright$	\curvearrowright
$\circlearrowleft$	\circlearrowleft	$\circlearrowright$	\circlearrowright
$\Lsh$	\Lsh	$\Rsh$	\Rsh
$\upuparrows$	\upuparrows	$\downdownarrows$	\downdownarrows
$\upharpoonleft$	\upharpoonleft	$\upharpoonright$	\upharpoonright, \restriction
$\downharpoonleft$	\downharpoonleft	$\downharpoonright$	\downharpoonright
$\rightsquigarrow$	\rightsquigarrow	$\leftrightsquigarrow$	\leftrightsquigarrow
$\leadsto$	\leadsto	$\multimap$	\multimap

7. Negated arrows.

$\nleftarrow$	\nleftarrow	$\nrightarrow$	\nrightarrow
$\nLeftarrow$	\nLeftarrow	$\nRightarrow$	\nRightarrow
$\nleftrightarrow$	\nleftrightarrow	$\nLeftrightarrow$	\nLeftrightarrow

III. Bold and Heavy Symbols

You can access the bold versions of the new symbols with

```
\loadbsya
```

and the heavy versions with

```
\loadhsya
```

1. If you have the lines

```
\loadbm
\loadsya
\loadbsya
```

in your file, then

```
$\boldmath .  .  . $
```

may be applied even when the formula contains extra symbols from the sup-
plementary package. For example, $\boldmath x<y\leqq z$ produces the
formula $x < y \leqq z$

2. For individual symbols, instead of introducing a whole slew of new names,
like '\bmboxplus', the single command \bma may be used before any of
the additional symbols in Supplement A to produce the bold version. Thus,
\bma\boxplus yields ⊞. Similarly, \hma\boxdot yields ⊡.

Just as there aren't heavy versions of letters, the "alphabetical" symbols Ⓡ
and Ⓢ don't have heavy versions, so \hma\circledR or \hma\circledS
will simply give a "slug" ▮.

IV. Emergency Loading

Normally, a font of symbols for use in math mode must be available in 3
different sizes, and TEX regards these 3 fonts as comprising a font 'family'.

Family 0 always contains the fonts for the normal roman letters that will be
used for operator names, as in $\sin x^{\cos x^{\tan x}}$.

Family 1 always contains the fonts for the italic letters that are used for variables, as in x^{y^z} (together with some other stray symbols).

Family 2 always contains the fonts for most of the standard symbols, like $\pm$, $\times$, $\div$, for formulas like $(a \pm b)^{(a \times b)^{(a \div b)}}$.

Family 3 always contains the fonts for the basic operators that occur in two sizes, like

$$\int \!\!\! \int \Sigma \sum$$

and delimiters that occur in various sizes, like

$$(((\Big(\qquad \Big\rangle \Big\rangle \rangle \rangle$$

(This family usually uses the same font three times, instead of using three individual fonts.)

There is no particular order required for families after these basic four, but the next family usually contains the fonts for the bold letters that appear in formulas like $\mathbf{x^{y^z}}$.

When you `\loadbm` three new families are created, corresponding to bold versions of families 1, 2, and 3, and `\loadhm` creates further families.

In addition, `\loadhrb` creates a family, as do `\loadbbb`, `\loadhrbd`, and `\loadbbbd` (though presumably you will only be using one of these at a time).

And then `\loadsya` creates a family, as do `\loadbsya` and `\loadhsya`.

Moreover, other macro packages may create other families. For example, if you are using the 'typewriter font' for math, with formulas like $\mathtt{x^{y^z}}$, another family has been created.

It doesn't matter in what order all these new families are invoked, or just which family—after 0, 1, 2, 3—contains which symbols, because the macro packages take care of all these details for you. But there is one problem: TEX only allows a total of 16 familes, 0, . . . ,15.

This means that eventually you may just run out!—when you try to load the appropriate fonts, you will get an error message that there is no room for another \fam.*

There is currently no general agreement about how this problem should be handled (even though it will become crucial when STIX starts creating gazillions of new symbols), but for now, *MathTimeProfessional* offers a partial solution if you encounter this problem at the stage where you would like to \loadsya, \loadbsya, or \loadhsya.

If these commands do not work, you can instead use an "emergency load",

        \Eloadsya,   etc.

This will load the appropriate fonts in different sizes, without creating a new family; TEX will process the new symbols in a slightly slower way (the difference will probably be unnoticeable), but everything will work just as before.**

There is only one precaution: Don't mix a \loadsya with an \Eloadbsya [or an \Eloadsya with a \loadbsya], or the new \boldmath and \bma won't work right. The same precaution is required for the heavy fonts.

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*In fact, this document has that problem, so the holey roman bold and black board bold fonts had to be used as text fonts; subscripts and superscripts would not have been positioned properly on a letter like $\mathbb{T}$, where the subscript should be tucked in closer to the stem.

**For the curious, this can be made to work because none of these symbols have an "italic correction"—subscripts are not tucked in below superscripts—so the symbols can basically be treated as text fonts.