The bm package*†

David Carlisle with support by Frank Mittelbach

1999/07/05

1 Introduction

This package defines commands to access bold math symbols. The basic command is `\bm` which may be used to make the math expression in its argument be typeset using bold fonts.

The syntax of `\bm` is:
`\bm{`⟨*math expression*⟩`}`
So `$\alpha \not= \bm{\alpha}$` produces $\alpha \neq \boldsymbol{\alpha}$.

`\bm` goes to some trouble to preserve the spacing, so that for instance `\bm<` is a bold $\boldsymbol{<}$ but with the correct `\mathrel` spacing that TEX gives to $<$. The calculations that TEX needs to do for `\bm` can be quite involved and so a definition form is provided.

`\DeclareBoldMathCommand[`⟨*math version*⟩`]{`⟨*cmd*⟩`}{`⟨*math expression*⟩`}`

Defines `\cmd` to be the bold form of the math expression. The ⟨*math version*⟩ defaults to 'bold' (i.e., `\boldmath`).

For relatively simple expressions, the resulting definitions are very efficient, for instance after:
`\DeclareBoldMathCommand\balpha{\alpha}`
`\balpha` is a single 'mathchardef' token producing a bold alpha, and so is just as fast to execute as `\alpha`.

The above command is mainly intended for use in packages. For occasional use in LATEX documents, and for compatibility with the plain TEX support for the mathtime fonts, a 'user-level' version, `\bmdefine` is provided that is equivalent to:
`\DeclareBoldMathCommand[bold]`.

If there is a 'heavy' math version defined (usually accessed by a user-command `\heavymath`) then a similar command `\hm` is defined which access these 'ultra bold' fonts. Currently this is probably only useful with the 'mathtime plus' font collection. Definitions of commands that use these fonts may be made by specifying the optional argument 'heavy' to `\DeclareBoldMathCommand`. Again an abbreviation, `\hmdefine`, is provided, equivalent to:
`\DeclareBoldMathCommand[heavy]`.

The command names (but not the implementation) are taken from Michael Spivak's macros to support the mathtime fonts for plain TEX. In those original macros, the syntax for `\bmdefine` was `\bmdefine\balpha{\bm\alpha}` (with a nested `\bm`). This syntax also works with this package.

2 Font allocation

In order to access bold fonts in the simplest and quickest possible manner, the package normally allocates symbol fonts for bold (and possibly heavy) fonts into the 'normal'

*This file has version number v1.0g, last revised 1999/07/05.
†Development of this package was commissioned by Y&Y.

math version. By default it allocates at most four fonts for \bm and at most three fonts for \hm. This means that if the mathtime plus font set is being used, seven additional symbol fonts will be used, in addition to the basic four that LaTeX already declares. The mathtime package also declares an extra symbol font, bringing the total to twelve. The maximum number of symbol *and* math alphabet fonts that can be used in a math version is sixteen. So the above allocation scheme does not leave room for many extra math symbols (such as the AMS symbols) or math alphabets (such as \mathit).

Before loading the bm package you may define \bmmax and \hmmax to be suitable values, for instance you may want to set \newcommand\hmmax{0} if you will not be using \hm much, but you do have a heavy math version defined.

Even if \bmmax is set to zero, \bm will still access the correct bold fonts (by accessing the fonts via \boldmath) but this method is slower, and does not work with delimiters. Delimiters can only be made bold if the bold font has been allocated.

Conversely if you have a non standard font set that makes available extra math delimiters and accents in bold and medium weights you may want to *increase* \bmmax so that fonts are allocated for your font set.

3 Features

In most cases this package should work in a fairly self explanatory way, but there are some things that might not be obvious.

3.1 Interaction with Math Alphabet Commands

As mentioned above, \bm goes to some trouble to try to make a command that is just like its argument, but using a bold font. This does not always produce the effect that you might expect.

```
$1 g \bm{g}$
$2 \mathrm{g \bm{g}}$
$3 {g} \bm{{g}}$
$4 \mathrm{{g} \bm{{g}}}$
$5 \mathrm{g} \bm{\mathrm{g}}$
```

produces the following:

1g 2g$\boldsymbol{g}$ 3gg 4gg 5gg

In math mode ‘g’ is effectively a command that produces the letter ‘g’ from the ‘letters’ alphabet, unless a Math Alphabet command is in effect, in which case the ‘g’ comes from the specified alphabet. \bm{g} makes an equivalent command, but which defaults to a bold letter alphabet. So in the first example \bm{g} is bold math italic, but in the second example the \mathrm applies to both g and \bm{g} in the same way, and so they are both roman.

\bm only inspects the ‘top level’ definition of a command, for more complicated expressions, and anything inside a { } group, \bm forces bold fonts by essentially the same (slow) technique used by the AMS \boldsymbol command (but \bm still takes more care of the spacing). So the third example produces identical output to the first (but TeX takes more time producing it).

In the fourth example the \mathrm{\bm{g}} is essentially equivalent to \mathrm{\mbox{\boldmath$g$}}. Currently math alphabet settings are not passed down to ‘nested’ math lists, and so in this example, the \mathrm has no effect, and a bold math italic $\boldsymbol{g}$ is obtained.

Similarly the last example is equivalent to $\mbox{\boldmath$\mathrm{g}$}} and so in this case, one obtains a bold roman **g**.

3.2 Delimiters

TEX can treat character tokens in two[1] ways. If there is a preceding `\left` or `\right` it can treat them as a delimiter, otherwise it can treat them as a standard character. For example `\left<\right>` produces $\langle\rangle$, which is totally different from `<>`, which produces $<>$.

TEX can only do this for character tokens. Commands such as `\langle` do not act in this way. This means that `\bm` has to decide whether to treat a character as a delimiter or not. The rule it uses is, it makes a delimiter command for a character if the previous token in the argument was `\left` or `\right`. So `\left\bm{<}` does not work, but `\bm{\left<}` does.

3.3 Command Arguments

Normally if a command takes arguments the full command, including any arguments, should be included in `\bm`.

So `\bm{\overbrace{abc}}` (producing $\bm{\overbrace{abc}}$) not `\bm{\overbrace}{abc}`. If you do not include all the arguments you will typically get the error message:

```
Runaway argument?
! Forbidden control sequence found while scanning use of ...
```

However commands defined in terms of the TEX accent and radical primitives *may* be used without their arguments. So `\bm{\hat}{a}` produces $\bm{\hat}{a}$, a bold accent over a non-bold *a* (compare $\hat{a}$) whereas `\bm{\hat{a}}` makes both the *a* and the accent bold, $\bm{\hat{a}}$. Similarly, although the LATEX command `\sqrt` must be used with its arguments, `\sqrtsign` may be used as in `\bm\sqrtsign{abc}` to produce $\bm\sqrtsign{abc}$ rather than $\sqrt{abc}$ or $\sqrt{abc}$

If you really need to make a command with arguments use bold fonts without making all of the arguments bold, you can explicitly reset the math version in the argument, eg:

```
\sqrt{xyz}   \bm{\sqrt{xyz}}   \bm{\sqrt{\mbox{\unboldmath$xyz$}}}
```

$\sqrt{xyz}$ $\bm{\sqrt{xyz}}$ $\bm{\sqrt{\mbox{\unboldmath$xyz$}}}$

3.4 Bold fonts

This package interrogates the font allocations of the bold and heavy math versions, to determine which bold fonts are available. This means that it is best to load the package *after* any packages that define new symbol fonts, or (like the mathtime package) completely change the symbol font allocations.

If no bold font appears to be available for a particular symbol, `\bm` will use 'poor man's bold' that is, overprinting the same character in slightly offset positions to give an appearance of boldness.

In the standard Computer Modern font set, there is no bold 'large symbols' font. In the 'mathptm' and (standard) mathtime font sets there are no bold math fonts. In the 'mathtime plus' font set there are suitable fonts for bold and heavy math setting, and so `\bm` and `\hm` work well. Similarly in the basic Lucida New Math font set there are no bold math fonts, so `\bm` will use 'poor man's bold. However if the Lucida Expert set is used, Then `\bm` will detect, and use the bold math fonts that are available.

As discussed above, one may set `\bmmax` higher or lower than its default value of four to control the font allocation system. Finer control may be gained by explicitly declaring bold symbol fonts. Suppose you have a symbol font 'xyz' that is available in medium and bold weights, then you would declare this to LATEX via:

```
\DeclareSymbolFont{extras}  {OMS}{xyz}{m}{n}
\SetSymbolFont{extras}{bold}{OMS}{xyz}{bx}{n}
```

At this point the symbols wil be available in the normal math version, and their bold variants in `\boldmath`. If you also declare:

```
\DeclareSymbolFont{boldextras}{OMS}{xyz}{bx}{n}
```

[1] Well more than two really.

That is, declare a symbol font whose name is formed by prefixing ‘bold’ (or ‘heavy’) to an existing symbol font, then `\bm` (or `\hm`) will use this font directly, rather then accessing the ‘extras’ symbol font via `\boldmath`.

3.5 Strange failures

In order to get the correct spacing, `\bm` has to ‘investigate’ the definition of the commands in its argument. It is possible that some strange constructions could ‘confuse’ this investigation. If this happens then LaTeX will almost certainly stop with a strange error. This should not happen with any of the math symbols defined in the base LaTeX or AMS distributions, or any commands defined in terms of those symbols using normal LaTeX math constructs. However if some command does fail to work inside `\bm` you should always be able to surround it with an extra set of braces `\bm{{\cmd}}` rather than `\bm{\cmd}`. `\bm` will not then attempt to set the correct spacing, so you may need to set it explicitly, for instance, for a relation, `\bm{\mathrel{\cmd}}`.

3.6 AMS package amsbsy

The `\bm` command shares some functionailty with the `\boldsymbol` command from the AMS LaTeX collection. To aid in moving documents between these two packages, this package defines `\boldsymbol` and `\heavysymbol` as alternative names for `\bm` and `\hm`.