1 Introduction

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

The syntax of \texttt{\bm} is:

\texttt{\bm{⟨math expression⟩}}

So $\alpha \not= \bm{\alpha}$ produces $\alpha \not= \alpha$.

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

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

Defines \texttt{⟨cmd⟩} to be the bold form of the math expression. The ⟨math version⟩ defaults to ‘bold’ (i.e., \texttt{\boldmath}).

For relatively simple expressions, the resulting definitions are very efficient, for instance after:

\texttt{\DeclareBoldMathCommand[bold]{\balpha}{\alpha}}

\texttt{\balpha} is a single ‘mathchardef’ token producing a bold alpha, and so is just as fast to execute as \texttt{\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, \texttt{\bmdefine} is provided that is equivalent to: \texttt{\DeclareBoldMathCommand[bold]}.

If there is a ‘heavy’ math version defined (usually accessed by a user-command \texttt{\heavymath}) then a similar command \texttt{\hm} is defined which accesses 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 \texttt{\DeclareBoldMathCommand}. Again an

\footnote{This file has version number v1.2f, last revised 2023/12/19.}

\footnote{Development of this package was commissioned by Y&Y.
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 \hmdefine was \hmdefine{\alpha}{\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’ 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 \TeX 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 \textit).

Before loading the \bm package you may define \bmmax and \hmmax to be suit-
able 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.

\begin{verbatim}
$1 \ g \ \bm(g)$$
$2 \ \text{mathrm}(g \ \bm(g))$$
$3 \ \{g\} \ \bm\{g\}$$
$4 \ \text{mathrm}\{g\} \ \bm\{g\}$$
$5 \ \text{mathrm}(g) \ \bm\{\text{mathrm}(g)\}$$
\end{verbatim}

produces the following:

1gg 2gg 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 g is obtained.

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

3.2 Delimiters

\TeX can treat character tokens in two\footnote{Well more than two really.} 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 ⟨⟩, 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 \overbrace{abc}, not \overbrace{abc}). If you do not include all the arguments you will typically get the error message: Runaway argument?

However commands defined in terms of the \TeX accent and radical primitives may be used without their arguments. So \bm{\hat{a}} produces ā, a bold accent over a non-bold a (compare ā) whereas \hat{a} makes both the a and the accent bold, ā. Similarly, although the \LaTeX command \sqrt must be used with its arguments, \sqrt{abc} may be used as in \sqrt{abc} to produce \sqrt{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} \quad \bm{\sqrt{xyz}} \quad \bm{\sqrt{\mbox{\unboldmath$xyz$}}}

\sqrt{xyz} \quad \sqrt{xyz} \quad \sqrt{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, \texttt{\bm} will use ‘poor man’s bold’, which will overprint 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 ‘mathptm plus’ font set there are suitable fonts for bold and heavy math setting, and so \texttt{\bm} and \texttt{\hm} work well. Similarly in the basic Lucida New Math font set there are no bold math fonts, so \texttt{\bm} will use ‘poor man’s bold’. However, if the Lucida Expert set is used, then \texttt{\bm} will detect, and use, the bold math fonts that are available.

As discussed above, one may set \texttt{\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:

\begin{verbatim}
\DeclareSymbolFont{extras}{OMS}{xyz}{m}{n}
\SetSymbolFont{extras}{bold}{OMS}{xyz}{bx}{n}
\end{verbatim}

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

\begin{verbatim}
\DeclareSymbolFont{boldextras}{OMS}{xyz}{bx}{n}
\end{verbatim}

Then \texttt{\bm} (or \texttt{\hm}) will use this font directly, rather than then accessing the ‘extras’ symbol font via \texttt{\boldmath}.

3.5 Strange failures

In order to get the correct spacing, \texttt{\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 \texttt{\bm} you should always be able to surround it with an extra set of braces \texttt{\bm{\cmd}} rather than \texttt{\bm{\cmd}}. \texttt{\bm} will not then attempt to set the correct spacing, so you may need to set it explicitly, for instance, for a relation, \texttt{\bm{\mathrel{\cmd}}}.

3.6 AMS package amsbsy

The \texttt{\bm} command shares some functionality with the \texttt{\boldsymbol} command from the AMS \LaTeX{} collection. To aid in moving documents between these two packages, this package defines \texttt{\boldsymbol} and \texttt{\heavysymbol} as alternative names for \texttt{\bm} and \texttt{\hm}.
4 Package Options

4.1 Logging level

As described above, the \texttt{bm} package has to interrogate the font setup to try to find matching bold fonts for each font used in the normal math version. This can fail in various ways as there may be no bold font or a bold font may be found but no room is available to allocate it. The options \texttt{warn}, \texttt{info} and \texttt{silent} control whether messages that \texttt{bm} produces are sent to the terminal, or just to the log file (the default) or suppressed.

4.2 Poor Man’s Bold

As discussed above, by default, if no real bold font is available, \texttt{bm} will use “poor man’s bold”. That is, over-printing the character with slight offsets. Since version 1.2e, the package now warns if a font is set up to use this over-printing and the package option \texttt{nopbm} is available which prevents its use in which case \texttt{\bm} will use the non-bold for characters from the affected font.

5 Implementation

Options to use or not use poor man’s bold (over-printing) and level of warning messages.

\begin{verbatim}
\DeclareOption{nopbm}{\let\bm@pmb@\@firstofone}
\DeclareOption{warn}{\def\bm@info{\PackageWarningNoLine{bm}}}
\DeclareOption{info}{\def\bm@info#1{\PackageInfo{bm}{#1\@gobble}}}
\DeclareOption{silent}{\let\bm@info\@gobble}
\ExecuteOptions{info}
\ProcessOptions\relax
\end{verbatim}

The commands \texttt{\bm} and \texttt{\hm} work by defining a number of additional symbol fonts corresponding to the standard ones ‘operators’, ‘letters’, ‘symbols’, and ‘largesymbols’. The names for these symbols fonts are produced by prefixing the usual name with ‘bold’ or ‘heavy’.

For maximum flexibility we get the font definitions by looking in the corresponding math versions, i.e., into \texttt{\mv@bold} and if defined into \texttt{\mv@heavy}.

\begin{verbatim}
\bm@table \bm@boldtable \bm@heavytable
\end{verbatim}

The table, \texttt{\bm@table}, (which is locally \texttt{\let} to either the bold or heavy version) defines, for each \texttt{\langle math group \rangle} ((\texttt{\langle fam \rangle})), the ‘offset’ to the bold version of the specified symbol font. If there is no bold symbol font defined, the offset will be set to zero if there is a bold font assigned to this slot in the bold math version, or -1 if the font in the bold math version is the same as the one in the normal math version. In this case a ‘poor man’s bold’ system of overprinting is used to achieve boldness where this is possible.

The settings are made at the time this package is read, and so it is best to load this package late, after any font loading packages have been loaded. Symbol fonts loaded after this package will get the offset of zero, so they will still be made bold by \texttt{\bm} as long as an appropriate font is declared for the bold math version.
\bm@boldtable and \bm@heavytable are set up using very similar code, which is temporarily defined to \bm, to save wasting a csname. Similarly \bm@pmb... (which will be defined later) are used as scratch macros. (This csname saving no longer used, setup command is \bm@setup, not \bm.)

The general plan. Run through the fonts allocated to the normal math version. Ignore ⟨math alphabet⟩ allocations\(^2\) but for each math symbol font, look in the math version specified by #1 (bold or heavy). If the font there is different, then allocate a new symbol font in the normal math version to access that bold font and place the numerical difference between the allocations of the bold and normal font into the table being built (\bm@boldtable, if #1 is bold). If the symbol allocation is already greater than \bmmax do not allocate a new symbol font, but rather set the offset in the table to zero. \bm will detect this, and use \boldmath on its argument in this case, so the bold font will be accessed but more slowly than using a direct access to a bold font allocated into the normal math version. If the font allocated in the bold math version is the same as the font in the normal math version, set the offset to −1, which is a flag value that causes \bm to use ‘poor man’s bold’ overprinting three copies of the symbol, offset slightly to give an appearance of boldness.

Fonts containing delimiters and math accents must be allocated into the normal math version if they are to be used with \bm. (In these cases \bm will produce the normal weight symbol, rather than using \boldmath or poor man’s bold.)

\def\bm@setup#1#2{\%

This code can not work inside a group, as that would affect any symbol font allocations, so instead use some scratch macros to save and restore the definitions of commands we need to change locally.

\let\bm@install@mathalphabet\install@mathalphabet
\let\bm@getanddefine@fonts\getanddefine@fonts
\let\bm@or\or
\edef\bm@general{\f@encoding/\f@family/\f@series/\f@shape/\f@size}\%

#2 specifies the maximum number of fonts to allocate (either \bmmax or \hmmax). First check against \count18 that there are that many slots left, and if not reduce accordingly. Put the resulting value in \@tempcnta.

\@tempcnta#2\%
\count@-\count18\%
\advance\count@-\@tempcnta\%
\advance\count@15\relax
\ifnum\count@<\z@\%
\advance\@tempcnta\count@\%
\fi
\%

Make \or non-expandable, so we can build an \ifcase bit-by-bit in a sequence of \edefs.

\let\or\relax
\%

Initialise the table (to \@gobble to remove the first \or).

\expandafter\let\csname bm=@#1table\endcsname\@gobble

Helper macro that adds the next entry to the table being built.

\def\bm@define##1{\%
\expandafter\xdef\csname bm@#1table\endcsname{\%

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Each symbol font is recorded in the math version list by a sequence such as:
\getanddefine@fonts \symsymbols \OMS/cmsy/m/n
Where the first argument is a chardef token carrying the number allocated (to
symbols, in this example), and the second argument is a csname whose name
denotes the font used. So locally redefine \getanddefine@fonts to compare #2
with the name in the appropriate slot in the bold math version.
\def\getanddefine@fonts##1##2{%
  \def\@tempa{##2}%
  \ifx\@tempa\@tempb####1##1####2####3\@nil{\def\@tempb{####2}}%
  \expandafter\expandafter\expandafter
  \@tempb\csname mv@#1\endcsname\@nil

Now \@tempa and \@tempb contain the names of the fonts allocated to this
slot in the two math versions.
\ifx\@tempa\@tempb
  If they are the same, set this offset to −1, as a flag to use poor man’s bold.
  \bm@define\m@ne
  \bm@info{No #1 for \string##2%
    \ifx\bm@pmb@\@firstofone\else, using \string\pmb\fi}%
  \else
  Else make a new name by adjoining #1 to the name of the symbol font, eg,
  \symboldsymbols to match \symsymbols. If that font has already been allo-
cated, or if \@tempcnta is positive so we can allocate a new slot for this font, then
the table will be set with the offset between the two fonts. Otherwise set the offset
to zero (so \boldmath will be used to access the font).
  \edef\@tempa{sym#1\expandafter\@gobblefour\string##1}%
  \ifnum\@tempcnta<%
    \expandafter\ifx\csname\@tempa\endcsname\relax
      \@ne
    \else
      \m@ne
    \fi
    \expandafter\expandafter\expandafter
    \@tempb\csname mv@#1\endcsname\@nil
  \else
    \bm@define\z@
  \fi

If the font is not yet allocated, allocate it now, using an internal hack into
\DeclareMathSymbolFont.
However before allocating it look in the bold math version to see if it is the
same, and if so use that. For example with Mathtime the ‘operators’ font in the
‘heavy’ math version is different from that in ‘normal’, but it is the same as the
font in ‘bold’ (Times bold). So rather than allocate \symheavyoperators just set
it equal to \symboldoperators.
\expandafter\expandafter\expandafter
\@tempb\csname endcsname\relax
\begingroup
\escapechar\m@ne
\edef\@tempb{\endgroup
  \noexpand\split@name
  \expandafter\string\@tempb}%
  \@tempb/\@nil
\expandafter\ifx \csname symbold\expandafter\@gobblefour\string##1\endcsname \relax

If no font has been allocated for \texttt{bm} yet, then allocate it now.
\expandafter\new@mathgroup\csname\@tempa\endcsname
\expandafter\new@symbolfont\csname\@tempa\endcsname
\f@encoding\f@family\f@series\f@shape

Reduce by one the number of fonts we can still allocate.
\advance\@tempcnta\m@ne

\else
Else do a similar look into the bold mathgroup. Use \texttt{bm@expand} as a scratch macro to save on string space.
\def\bm@expand####1##1####2####3\@nil{\def\bm@expand{####2}}% 
\expandafter\expandafter\expandafter 
\bm@expand\csname mv@bold\endcsname\@nil
\ifx\bm@expand\@tempb
If the font just found (in heavy) is the same as the font in bold use the slot (in normal) previously allocated for the bold font. (That clear?)
\expandafter\let\csname\@tempa\expandafter\endcsname\csname symbold\expandafter\@gobblefour\string##1\endcsname
\else
Otherwise allocate a new slot for it.
\expandafter\new@mathgroup\csname\@tempa\endcsname
\expandafter\new@symbolfont\csname\@tempa\endcsname
\f@encoding\f@family\f@series\f@shape
\advance\@tempcnta\m@ne
\fi
\fi
\else
If the font has been allocated already, use the existing allocation.
\bm@info
{Symbol font \texttt{\@tempa} space already defined.\MessageBreak Not overwriting it}%
\fi

Whether the font has just been allocated, or whether it was previously allocated, compute the offset and add it to the table.
\count@\csname\@tempa\endcsname
\advance\count@-##1%
\bm@define{\the\count@}\relax%
\fi%

The math version list also contains information about math alphabet commands, but we want to ignore those here, so …
Having set up the local definitions, execute the list for the normal math version.

\mv@normal

So now the offsets are all entered into the table, separated by \or. Finish off the definition by making this an \ifcase. Add a default value of zero, so that any symbol fonts declared later will also work, as long as a bold version is assigned to the bold math version.

\expandafter\xdef\csname bm@#1table\endcsname{\noexpand\ifcase\@tempcnta\csname bm@#1table\endcsname\noexpand\else\z@\noexpand\fi}%

Put things back as they were.

\expandafter\split@name\bm@general\@nil
\let\install@mathalphabet\bm@install@mathalphabet
\let\getanddefine@fonts\bm@getanddefine@fonts
\let\or\bm@or

To save declaring too many symbol fonts, do not auto-declare any more than \bmmax bold symbol fonts into the normal math version. Any bold fonts not so allocated will be accessed via \boldmath which is slower and doesn’t work for delimiters and accents. It may be set in the preamble with \newcommand but use \chardef here for a slight efficiency gain.

If this is set to a higher value before this package is loaded, keep that value.

\ifx\bmmax\@undefined\chardef\bmmax=4\fi

If there is no bold math version, it is very easy to set up the table since there is no need to use all the tricky code above. Also, at the end of the package redefine the internal macro that \bm uses to call \boldmath, to use poor man’s bold instead.

\ifx\mv@bold\@undefined\def\bm@boldtable{\m@ne}\AtEndOfPackage{\def\bm@gr@up#1#2{\bm@install@mathalphabet{#2}}\else\bm@setup{bold}\bmmax\mathbf As the bold font has been defined as a symbol font, make \mathbf access that rather than have it allocate a new math group for the same font. (Just in case there were no free slots wrap this in an extra test.)

\@ifundefined{symboldoperators}{}{\DeclareSymbolFontAlphabet{mathbf}{boldoperators}}

\fi
\texttt{\textbackslash hmax} Same for heavy, but default to three this time (enough for mathtime plus, as no heavy operators font).

\begin{verbatim}
111 \ifx\hmax@undefined
112 \chardef\hmax=3
113 \fi

Similarly if there is a heavy math version, set up \texttt{\textbackslash bm@heavy\textbackslash table}. (If there is no heavy math version, do nothing here, as \texttt{\textbackslash h}m will be set to \texttt{\textbackslash bm} later, once that is defined.)

\begin{verbatim}
114 \ifx\mv@heavy@undefined
115 \else
116 \texttt{\textbackslash bm@setup\{heavy\}\textbackslash hmax}
117 \fi
\end{verbatim}

\texttt{\textbackslash bm@general} \texttt{\textbackslash bm} is pretty much \texttt{\textbackslash bmdefine\textbackslash bm@command} followed by executing \texttt{\textbackslash bm@command}. It would in principle be possible to execute the emboldened tokens directly, rather than building up a macro first, but (as I learned the hard way) it’s difficult to do this in the midst of all these nested \texttt{\textbackslash if} constructs. First extract the central bit of code for \texttt{\textbackslash h}m \texttt{\textbackslash bm \textbackslash bmdefine} and \texttt{\textbackslash bmdefine}. Note that in the case of the inline versions they take an argument and brace it, rather than relying on \texttt{\textbackslash bm@general} to pick up the argument. This makes the code robust with respect to premature expansion.

\begin{verbatim}
118 \begingroup
119 \catcode’\textbackslash ‘=\active
120 \catcode’\_=\active
121 \@firstofone\endgroup
122 \def\bm@general#1#2#3#4#5{%
123 \begingroup
First locally disable \texttt{\textbackslash bm} and \texttt{\textbackslash h}m, as they would mess things up terribly, and the original Spivak versions used the syntax \texttt{\textbackslash bmdefine\textbackslash balpha\{\textbackslash bm\/alpha\}.

\begin{verbatim}
124 \let\bm\@firstofone
125 \let\h@firstofone

Now initialise the commands used to save the tokens constructed.

\begin{verbatim}
126 \global\let\bm@command\@empty
127 \let\@let@token\@empty
\end{verbatim}

As we want to expand the macros to look at their definition turn off protection. Otherwise the \texttt{\textbackslash protect} will be carried over and apply to the wrong token, eg \texttt{\textbackslash protect\{\textbackslash textbackslash protect\textbackslash empty\}.

\begin{verbatim}
128 \let\protect\@empty
129 \let\@typeset@protect\@empty
\end{verbatim}

Set up either bold or heavy.

\begin{verbatim}
130 \def\bm@mathchoice{\bm@m@thchoice\textbackslash choice\#1}%
131 \def\bm@group{\bm@gr@up\textbackslash choice\#1}%
132 \let\bm@table#2%
\end{verbatim}

Make sure \texttt{\textbackslash left} and \texttt{\textbackslash right} are really non expandable, and not \texttt{\textbackslash ifx} equal to anything else.

\begin{verbatim}
133 \let\left\holdinginserts
\end{verbatim}

These three save on the number of \texttt{\textbackslash ifx} tests below.

\begin{verbatim}
134 \let\right\left
135 \let\mskip\mkern
136 \let\hskip\kern
\end{verbatim}

10
Definition of \prime locally modified so as not to use \futurelet in the look ahead, but to make the \prime available at the top level to be made bold, or heavy or whatever. \prime is locally active for this definition.

\let\bm@prime\copy
\let\relax
\def\'{\bm@prime\prime\relax}%

For optional argument commands. This expandable version of \@ifnextchar is not 100% safe, but works for \sqrt unless you put something really strange in the arguments.

\def\@ifnextchar##1##2##3##4{% 
  \if##1##4% 
    \expandafter\@firstoftwo 
  \else 
    \expandafter\@secondoftwo 
  \fi 
  {##2##4}{##3{##4}}}%
\let\kernel@ifnextchar\@ifnextchar

For Vladimir Volovich…

\def\GenericWarning##1##2{% 
  \unvcopy{\GenericWarning{##1}{##2}}}%
\def\GenericError##1##2##3##4{% 
  \unvcopy{\GenericError{##1}{##2}{##3}{##4}}}%

For AMS definitions.

\let\DN@\copy
\let\FN@\copy
\let\nolimits@\copy
\let\next@\copy
\global\let\bm@first\@empty

For AMS version of \sqrt: don’t expand, just wrap it in a brace group so that it can be made bold in a safe but slow way. Do the same for internal accent command.

Code for AMS accent allows bm to be used (just) with accent but stops the nested accents stacking correctly, this can be corrected by using an extra brace group as usual. \bm{\hat{\hat{F}}}

\ifx\uproot@\undefined\else 
  \def\root##1\of##2{{\root##1\of{##2}}}%
\fi 

\def\mathaccentV##1{\mathaccent"\accentclass@}%

For breqn definitions.

\let\@ifnext\@ifnextchar
\let\measure#1\has\copy
\let\rel@break\copy
\let\bin@break\copy
\let\after@open\copy
\let\after@close\copy

Make sure things like \pounds take the ‘math branch’ even in \bmdefine (which is not executed in math mode).

\let\ifmmode\iftrue
We have to ensure that the math alphabets have definitions that correspond the “bold” math version we are going to switch to. As these definitions are globally assigned when a math version is changed it is likely that right now we have those of the normal math version active. Argument #3 holds either \mv@bold or \mv@heavy and we execute that after redefining \install@mathalphabet and \getanddefine@fonts suitably. The definitions are reverted back to their original the moment the scanning is done.

\let\install@mathalphabet\def\let\getanddefine@fonts\@gobbletwo
168 #3%

The last redefinition just makes \mathit type commands re-insert themselves (more or less) as if they are allowed to expand they die horribly if the expansions are put into \mathchoice and so executed more than once.

171 \def\select@group##1##2##3##4{{% 172 \protect##1{##4}}}%
173 \def\use@mathgroup##1##2##3{{% 174 \protect\use@mathgroup##1{##2}{##3}}}%

So now start looking at the argument.

175 \bm@expand#5\bm@end
176 \endgroup

Finally outside the group either execute \bm@command (for \bm) or save its definition (for \bmdefine).

177 #4}

End of the \@firstofone above, and the scope of the active ’.

178 }

\bm Set up the bold (rather than heavy) version, and run \bm@command right at the end, to execute the emboldened argument. The argument is grabbed by the top level function, and explicitly braced, so that \bm works even if the braces are omitted round its argument in a ‘moving argument’.

179 \DeclareRobustCommand\bm{% 180 \bm@general\boldmath\bm@boldtable\mv@bold\bm@command}
181 \protected@edef\bm#1{\bm{#1}}

\DeclareBoldMathCommand\DeclareBoldMathCommand{⟨mathversion⟩}{⟨command⟩}{⟨math expression⟩}

\bm@declare looks like \bm except at the end the specified command is globally defined to be \bm@command. The ⟨mathversion⟩ defaults to ‘bold’.

182 \def\DeclareBoldMathCommand{⟨@testopt⟩\bm@declare{bold}}
183 \def\bm@declare[#1]{% 184 \expandafter\bm@general
185 \csname #1math\expandafter\endcsname
186 \csname bm@#1table\expandafter\endcsname
187 \csname mv@#1\endcsname
188 \{\bm@define#2\}}

\bmdefine \bmdefine Shorthand for \DeclareBoldMathCommand[bold].\bm is empty within the definition, so that either \bmdefine\balpha{\bm\alpha} or \bmdefine\balpha{\alpha}
may be used. (The former just for compatibility with the original version for plain 
\TeX.)

189 \def\bmdefine{\DeclareBoldMathCommand[bold]}

\hm Same again for \hm.

\hmdefine

190 \ifx\mv@heavy\@undefined
If there is no heavy math version defined, let \hm be defined as \bm. Currently
there is no warning given, perhaps there should be, or even an error?

191 \let\hm\bm
192 \let\heavymath\boldmath
193 \let\bm@heavytable\bm@boldtable
194 \else
Otherwise define \hm and \hmdefine in direct analogy with the above.

195 \DeclareRobustCommand\hm{%
196 \bm@general\heavymath\bm@heavytable\mv@heavy\bm@command}
197 \protected@edef\hm#1{\hm{#1}}
198 \def\hmdefine{\DeclareBoldMathCommand[heavy]}
199 \fi

\bm@end Normally speaking \outer declarations should be avoided at all costs. (\LaTeX
redefines all of plain \TeX’s allocation macros to be non-outer.) However this is
one place where it seems like a good idea. If a command taking an argument is put
in \bm without its argument, then the \@@end terminating token would be taken
as the argument, and so the rest of the paragraph would be gobbled up and the
\LaTeX would die horribly. So make the internal terminating token \outer. (The
actual test for termination is made against \@@end not \bm@end as this macro will
be expanded by the look-ahead system.)

200 \outer\def\bm@end{\@@end}

\bm@expand \afterassignment \bm@exp@nd 
\bm@exp@nd \afterassignment \bm@test
\bm@test Normally we will grab the non-expandable token as a macro argument but better
check it is not \{ first. Save the previous token so we can check later if it was \left,
in which case use the delcode rather than the mathcode if the current token is a
character.

203 \def\bm@test{%
204 \let\bm@previous\@let@token
205 \futurelet\@let@token\bm@test@}

---

3The need for this was noticed while testing \sqrt. The definition of \root inherited from
plain \TeX has an anomalous space token, that is normally harmless (just wastes memory), but
which killed earlier versions of this package.
\texttt{\textbackslash bm@test@} If looking at a single token, switch to \texttt{\textbackslash bm@test@token}, else if looking at a \{ \} group, grab the whole group with \texttt{\textbackslash bm@group}. A \texttt{\textbackslash bgroup} token will take the wrong branch here (currently not trapped).

\begin{verbatim}
206 \def\bm@test@{%
207 \ifx\@let@token\bgroup
208 \expandafter\bm@group
209 \else
210 \expandafter\bm@test@token
211 \fi}
\end{verbatim}

\texttt{\textbackslash bm@group} If faced with a group when we are in math mode, put it in a \texttt{\textbackslash boldsymbol}-like construct and then recurse on \texttt{\textbackslash bm@expand}. Otherwise just use \texttt{\textbackslash bfseries\textbackslash boldmath}. The actual test is deferred till ‘run time’. Here and elsewhere could deal with the inner list with an inner call to \texttt{\textbackslash bm}, but that doesn’t seem to gain very much, and complicates the code quite a bit.

\texttt{\textbackslash bm@gr@up} #1 is either \texttt{\textbackslash boldmath} or \texttt{\textbackslash heavymath}. Need to add an extra set of explicit braces around #2 as otherwise the math style commands applied in \texttt{\textbackslash mathchoice} might only apply to the first half of an \texttt{\textbackslash over} construction.

\begin{verbatim}
212 \def\bm@gr@up#1#2{%
213 \bm@add{{\bm@gr@@p#1{{#2}}}}}
\end{verbatim}

\texttt{\textbackslash bm@gr@@p} #1 is either \texttt{\textbackslash boldmath} or \texttt{\textbackslash heavymath}.

\begin{verbatim}
214 \def\bm@gr@@p#1#2{%
215 \ifmmode
216 \bm@mchoice#1{#2}{#2}{#2}{#2} \else
217 \bfseries#1#2 \fi}
\end{verbatim}

\texttt{\textbackslash bm@test@token} If not facing a \{ \} group then test to see what we have. Basic idea: Trap \texttt{\textbackslash mathchar}def tokens, character tokens, and calls to \texttt{\textbackslash mathchar}, \texttt{\textbackslash mathaccent}, etc, and change the \texttt{math-group} (fam) to point at the bold version. Other things just copy straight over to the command being built. (Anything inside a \texttt{\textbackslash mathop} or similar will end up being made bold as the \texttt{\textbackslash mathop} will be copied over, but its argument will be made bold by the group code above.)

\begin{verbatim}
220 \def\bm@test@token#1{%
221 \let\bm@next\@empty
222 \ifx#1\@@end
223 \bm@mathchoice
224 \else\ifx#1\mathchoice
225 \let\bm@next\bm@mathchoice
226 \else\ifx#1\mathchar
227 \afterassignment\bm@mathchar\count@
228 \else\ifx#1\mathaccent
229 \fi\fi\fi\fi
230 \else\ifx#1\mathchar
231 \afterassignment\bm@mathchar\count@
232 \else\ifx#1\mathaccent
233 \afterassignment\bm@mathchoice
234 \let\bm@next\bm@mathchoice
235 \else\ifx#1\mathchar
236 \afterassignment\bm@mathchar\count@
237 \else\ifx#1\mathaccent
238 \fi\fi\fi\fi
239 \fi}
\end{verbatim}

Stop here. Note that it is vital that the terminating token is non-expandable and defined, rather than the usual \LaTeXX terminators \texttt{\textbackslash @nil} and \texttt{\textbackslash @}. (Worse still would be a ‘quark’ like \texttt{docstrip’s \textbackslash qStop}.)

\begin{verbatim}
222 \ifx#1\@@end
224 \else\ifx#1\mathchar
226 \afterassignment\bm@mathchar\count@
227 \else\ifx#1\mathaccent
228 \afterassignment\bm@mathchoice
229 \let\bm@next\bm@mathchoice
231 \else\ifx#1\mathchar
233 \afterassignment\bm@mathchar\count@
234 \else\ifx#1\mathaccent
236 \fi\fi\fi\fi
239 \fi}
\end{verbatim}

\texttt{\textbackslash bm@mathchoice} uses macro arguments, so need to make the tail recursion explicit here. All the other cases recurse by way of \texttt{\afterassignment} which means all the trailing \texttt{\textbackslash fi} are eaten while making the assignment.

\begin{verbatim}
223 \else\ifx#1\mathchar
224 \let\bm@next\bm@mathchoice
226 \afterassignment\bm@mathchar\count@
227 \else\ifx#1\mathaccent
228 \afterassignment\bm@mathchoice
229 \let\bm@next\bm@mathchoice
231 \else\ifx#1\mathchar
233 \afterassignment\bm@mathchar\count@
234 \else\ifx#1\mathaccent
236 \fi\fi\fi\fi
239 \fi}
\end{verbatim}

The main point: Find these expressions, and change the mathgroup.

\begin{verbatim}
225 \else\ifx#1\mathchar
226 \afterassignment\bm@mathchar\count@
227 \else\ifx#1\mathaccent
228 \afterassignment\bm@mathchoice
229 \let\bm@next\bm@mathchoice
231 \else\ifx#1\mathchar
233 \afterassignment\bm@mathchar\count@
234 \else\ifx#1\mathaccent
236 \fi\fi\fi\fi
239 \fi}
\end{verbatim}
Need to trap spaces, otherwise digits will get turned to bold mathchars.

\texttt{vcopy} is a flag to copy the next group unchanged to the result command.

Other command, look if it’s a mathchardef token (otherwise just add it).
Character token. If it is of catcode 11 or 12, get its mathcode. If that is "8000 replace the token by its active version, and then let bm expansion look again at the character. Being really active this time, it will expand away (probably).
If the previous token was \texttt{\textbackslash left} or \texttt{\textbackslash right}, get the delcode instead of the mathcode.

Here we need to check for LuaTeX merging mathchar values with Umathchar.

And final possibility: a character token of catcode other than 11 or 12.
\texttt{\bmdefine} End code for \texttt{\bmdefine}. Define the given command name to the robust form of the accumulated code.

If \texttt{\bmcommand} is equal to \texttt{@gtempa} then it is a macro whose expansion is a single call to \texttt{\mathchar}, so that can be optimised with \texttt{\mathchardef}.

```latex
\begin{verbatim}
def\bmdefine#1{\begingroup
  \ifx\bmcommand@\@gtempa
    \def\mathchar{\global\mathchardef#1}\bmcommand
  \else
    \Rather than simply \texttt{\let}\bmcommand\bmcommand, make the defined command robust.\texttt{\bmfirst} is normally empty, but might be something like \texttt{\DOTSI} which needs to be lifted to the top level, in front of any \texttt{\protect} because of the lookahead mechanism used in the \texttt{amsmath} package.
  \toks@\expandafter{\bmcommand}
  \xdef#1{\bmfirst\noexpand\bmprotect\noexpand#1{\the\toks@}}
  \fi
\endgroup}
\end{verbatim}
```

\texttt{\bmprotect} Commands defined by \texttt{\bmdefine} re-insert themselves if protection is enabled.

```latex
\begin{verbatim}
def\bmprotect#1{\ifx\protect@\@typeset@protect
  \expandafter\@firstofone
\else
  \protect#1\expandafter\@gobble
\fi}
\end{verbatim}
```

\texttt{\bm@choice} \texttt{\boldsymbol}, more or less. \#1 is either \texttt{\boldmath} or \texttt{\heavymath}.

```latex
\begin{verbatim}
def\bm@choice#1#2#3#4#5{\mathchoice{\hbox{#1$\displaystyle\m@th#2$}}{\hbox{#1$\textstyle\m@th#3$}}{\hbox{#1$\scriptstyle\m@th#4$}}{\hbox{#1$\scriptscriptstyle\m@th#5$}}}
\end{verbatim}
```

\texttt{\bm@mathchoice} Action if you find a \texttt{\mathchoice}. Add the bold version to \texttt{\bmcommand} then recurse. \#1 is either \texttt{\boldmath} or \texttt{\heavymath}.

```latex
\begin{verbatim}
def\bm@mathchoice#1#2#3#4#5{\bm@add{\bm@choice#1{#2}{#3}{#4}{#5}}}
\end{verbatim}
```

\texttt{\bm@register} Combined code for setting up \texttt{\bm@r@gister} with the correct register type.

```latex
\begin{verbatim}
def\bm@r@gister#1#2{\def\@tempa{#1\the#2}
  \afterassignment\bm@r@gister#2}
\end{verbatim}
```

\texttt{\bm@r@gister} \texttt{\m@kern} itself would transfer to \texttt{\bmcommand} without any special test, but any explicit dimension following would be converted to \texttt{\mathchar}. So trap this and grab the muskip as a muskip. This is used in \texttt{\iint}. \texttt{\penalty} was needed for the AMS version of \texttt{\colon}, and so do most of the others as well.

```latex
\begin{verbatim}
def\bm@r@gister{\bm@xadd{\@tempa\space}}
\end{verbatim}
```
\textbf{\texttt{\bm@mathchar}} Change the family (math group) of a mathcode and then use the modified code with \texttt{\bm@mathchar}. If there is no suitable bold font in the current math version, use the original unmodified mathcode, but switch to \texttt{\boldmath} (if there is a bold font there) or use ‘poor man’s bold’. Note that these other possibilities are only possible here, not for the otherwise similar code for \texttt{\delimiter} or \texttt{\mathaccent}, as those commands must work with fonts from the same math version.

Finally recurse down the list.

\begin{verbatim}
def\bm@mathchar{%
@tempcntb\count@
\let@tempa\bm@group
\bm@changefam{}%
\ifnum\count@>\@tempcntb
\ifx\bm@command\@empty
\xdef\@gtempa{\mathchar\the\count@ space}%
\fi
\bm@xadd{\mathchar\the\count@ space}%
\else
\begingroup
\divide\count@"1000
\let\bm@expand\relax
\bm@xadd\bm@class
\@tempa will be \bm@group (which applies \boldmath and \mathchoice) unless it was changed by \bm@changefam to \bm@pmb (which applies a ‘poor man’s bold’ construction in a \mathchoice).
\edef\@tempb{%
\noexpand\@tempa{\mathchar\the\count@ space}}%
\@tempb
\fi}
\endgroup
\@tempa will be \bm@group (which applies \boldmath and \mathchoice) unless it was changed by \bm@changefam to \bm@pmb (which applies a ‘poor man’s bold’ construction in a \mathchoice).
edef\@tempb{%
\noexpand\@tempb{\mathchar\the\count@ space}}%
\@tempb
\fi}
\end{verbatim}

\textbf{\texttt{\bm@umathchar}} Version of \texttt{\bm@mathchar} for \texttt{\Umathchar}, this is easier as no need to take apart the number, the match class and fam are provided as distinct arguments.

\begin{verbatim}
def\bm@umathchar#1#2#3{%
@tempcnta#2\relax
\count@\bm@table
\ifnum\count@="z@
\bmogr@up\boldmath{\Umathchar#1 #2 #3 }%
\else
\ifnum\count@="m@one
\else
\advance\@tempcnta\count@
\fi
\fi}
\end{verbatim}
Add a poor man’s bold construction to the list being built.
\def\bm@pmb#1{\bm@add{\bm@pmb@{#1}}}

\bm@pmb@ \pmb variant. (See \TeX{}book, or AMS amsbsy package.) This one takes a bit more care to use smaller offsets in subscripts.
\ifx\bm@pmb@\@firstofone\else\def\bm@pmb@#1{{\setbox\tw@\hbox{$\m@th\mkern.4mu$}\mathchoice\bm@pmb@@\displaystyle\@empty{#1}\bm@pmb@@\textstyle\@empty{#1}\bm@pmb@@\scriptstyle\defaultscriptratio{#1}\bm@pmb@@\scriptscriptstyle\defaultscriptscriptratio{#1}}}\fi

\bm@pmb@@ Helper macro. Box \#3 and set it three times in the style \#1, offset by an amount reduced by the ratio specified in \#2.
\def\bm@pmb@@#1#2#3{{\setbox\z@\hbox{$\m@th#1#3$}\dimen@#2\wd\tw@\rlap{\copy\z@}\kern\dimen@\raise1.5\dimen@\rlap{\copy\z@}\kern\dimen@\box\z@}}

\bm@class Convert a numeric math class back to a math class command. \texttt{\textbullet{}mathord} is omitted in class 0 and 7 to save space and so things work out right in constructions such as \texttt{x^a} where \texttt{x^\textbullet{}mathord{a}} would not work.
\def\bm@class{\ifcase\count@\or\mathop\or\mathbin\or\mathrel\or\mathopen\or\mathclose\or\mathpunct\fi}

\bm@add A version of \texttt{\g@addto@macro} that internally uses a \texttt{begingroup} rather than a brace group\textsuperscript{4}, to save creating a mathord.
As need to redefine it anyway, save some tokens by making it specific to \texttt{\bm@command}, and to execute \texttt{\bm@expand} to continue the loop.
\def\bm@add#1{%
\textsuperscript{4}This bug is fixed in the \LaTeX{} kernel of 1996/12/01

18
\begingroup
\toks@\expandafter{\bm@command#1}%
\xdef\bm@command{\the\toks@}%
\endgroup
\bm@expand

\bm@xadd An \xdef version of \bm@add.
\def\bm@xadd#1{% 
\begingroup 
\toks@\expandafter{\bm@command}% 
\xdef\bm@command{\the\toks@#1}% 
\endgroup 
\bm@expand
}

\bm@mathaccent \mathaccent version of \bm@mathchar.
\def\bm@mathaccent{% 
\def\bm@mathchar{ 
\bm@changefam{} 
}

The next four lines were added in v1.0e. Without them \bm\{\hat{A}\} makes the accent bold using \bm but the group \{A\} is made bold via a \mathchoice construction as for any other group, as \bm does not attempt to parse inside brace groups. While that produces something acceptable for lower case letters, it produces \(\hat{A}\) which is not too good. The braces may simply be omitted: \bm\{\hat A\} would work, producing \(\hat A\), however I did not want to document such a restriction, so now modify bm so that such brace groups are handled gracefully.

It would be possible to locally make mathaccents take an argument during the bm look-ahead, so the brace groups would then vanish during expansion, however I would then need to explicitly skip past \langle\text{filler}\rangle and also make sure that the end of parse token was not gobbled in marginal cases like $\bm\hat$.

So instead do the following which gets rid of \langle\text{filler}\rangle with a redefinition of \relax, and just locally changes \bm@group so that instead of doing a \mathchoice it simply adds \bgroup and \egroup around the tokens, and lets bm modify the tokens of the ‘argument’. This means that \bm\{\hat{A}\} now produces \mathaccent 29790 \bgroup \mathchar 30017 \egroup

The inner math list is a single mathchar, and so \TeX will not box it, and the math accent will correctly position, taking into account the skewchar information.

As the normal bm lookahead is used, it is automatic that the parse will end without trying to go past \bm@end.

One disadvantage is that the group will mean that \bm@previous will not be correctly updated. However that is only used for delimiter checking, so can not matter here.

\def\bm@group##1{\endgroup\bm@xadd{\bgroup}##1\egroup}%
\def\bm@test@token{\endgroup\bm@test@token}%
\let\relax\@empty
\bm@xadd{\mathaccent\the\count@\space}%

\bm@delimiter Change both families (math groups) of a delcode and then use the modified code with \delimiter. Don’t change code ‘0’ as that denotes a null delimiter.
\def\bm@delimiter{% 
  \ifnum\count@>\z@
    \bm@changefam{}\n    \bm@changefam{000}\n  \fi
  \bm@xadd{\delimiter\the\count@\space}}%

\def\bm@radical{%
  \bm@changefam{}\n  \bm@changefam{000}\n  \bm@xadd{\radical\the\count@\space}}%

\def\bm@mchar@{Catcode 12 \mathchar, for \ifx tests.}
\edef\bm@mchar@{\meaning\mathchar}

\def\bm@umchar@{Catcode 12 \Umathchar, for \ifx tests.}
\edef\bm@umchar@{\string\U\expandafter\@gobble\meaning\mathchar}

\def\bm@mchar@test#1"#2"#3"#4"#5\@nil#6{%
  \xdef\meaning@{#1}%
  \ifx\meaning@\bm@mchar@
    \count@"#2\relax
    \bm@mathchar
  \else
    \Test for \Umathchar.
    \ifx\meaning@\bm@umchar@
      \bm@umathchar{"#2}{"#3}{"#4}%
    \else
      \Some other command: copy it straight over. If it is the first thing added, and it is a \relax token, save it in \bm@first for use in \bm@define.
      \ifx\bm@previous\@empty
        \ifx\relax#6%
          \gdef\bm@first{#6}%
        \fi
      \fi
      \ifx#6%
        \gdef\bm@first{}%
      \fi
      \ifx#6%
        \gdef\bm@first{}%
      \fi
  \fi
}\fi

\def\bm@change{Pull out one specified hex digit and pass it to \bm@modify to change. Its one argument is normally empty, but it will be 000 when necessary to access the second math group in a delimiter code.}
\def\bm@change{#1{#6}{#4}%
  \\ifx\bm@previous\@empty
    \\ifx\relax#6%
      \gdef\bm@first{#6}%
    \fi
  \fi
  \\ifx#6%
    \gdef\bm@first{}%
  \fi
  \\ifx#6%
    \gdef\bm@first{}%
  \fi
}\fi

\def\bm@change{#1{% 
  \@tempcnta\count@\n  \divide\@tempcnta"100#1 \n  \multiply\@tempcnta"100\n  \advance\@tempcnta\count@ \n  \divide\@tempcnta"100\n}

20
Having isolated the required math group (fam), look up the offset in the current table.

\@tempcnta \bm@table

If the offset is $-1$, keep \count@ unchanged, but set \@tempa to use poor man’s bold. Otherwise increment \count@ to change the math group specified.

\ifnum \@tempcnta = \m@ne
  \let \@tempa \bm@pmb
\else
  \multiply \@tempcnta "100 #1 \%
  \advance \count@ \@tempcnta
\fi

\bm@prime Support ‘. Earlier versions did not make the prime bold in a’. \bm{a''} will now produce (with the normal encodings)

\mathchar 30049 \bm@prime \mathchar 1584 \relax
\bm@prime \mathchar 1584 \relax

So \bm@prime does essentially the same as the active definition of ‘, which is to start a superscript group then keep adding \prime for each ‘ (or \bm@prime) following. Here modified to grab a \relax delimited argument and use that instead of \prime. \bm@prime is locally \let to ‘ so the \ifx tests in \prime@s don’t need changing.

\def \bm@prime{\bgroup
  \let \bm@prime' \%
  \def \prim@s##1\relax{##1\futurelet \@let@token \pr@m@s}
  \relax\pr@m@s
}

\boldsymbol Finally, to ease conversion of documents between this package and the amsbsy package:

\let \boldsymbol \bm
\let \heavysymbol \hm

\heavysymbol //package}