Abstract

The skmath package provides improved and new math commands for superior typesetting with less effort.

1 Introduction

This package intends to provide helpful (re-)definitions of commands related to typesetting mathematics, and specifically typesetting them in a more intuitive, less verbose and more beautiful way. It was originally not intended for use by the public, and as such there may be incompatibilities with other packages of which I am not aware, but I figured it could be useful to other people as well.

2 Usage

2.1 Options

As of version v0.5, the package provides two key-value options.

- **commonsets true,false** *(false)*
  Optionally define \( \mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R} \) and \( \mathbb{C} \) as blackboard variants of the respective letters, to represent the common sets of numbers.

- **notation iso,english,german,legacy** *(legacy)*
  This option controls the style of a few typographic elements that differ between countries and standards (such as the style of integrals, derivatives and greek letters).

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*Available on [http://www.ctan.org/pkg/skmath](http://www.ctan.org/pkg/skmath).*

†Development version available on [https://github.com/urdh/skmath](https://github.com/urdh/skmath).
2.2 New commands

The package defines a number of new commands that aid in typesetting certain mathematical formulae.

\[ \mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C} \]

These commands are only available if the commonsets option is given. They typeset the set of natural, integer, rational, real and complex numbers respectively.

**Example:**
\begin{equation*}
\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}.
\end{equation*}

\[ \ii, \jj \]

These commands typeset the imaginary unit (either \( i \) as used in mathematics or \( j \) as used in electrotechnology). While normal use of the package simply results in italic characters, setting the notation option to iso will set these upright.

\[ \ee \]

This command typesets Euler’s number \( e = \sum_{n=0}^{\infty} \frac{1}{n!} \). The style is affected by the notation option in the same way as \texttt{\exp}.

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The commands \texttt{\norm} and \texttt{\abs}, quite expectedly, typeset the norm and absolute value of an expression, respectively. They have one mandatory argument (the expression), and different norms can be achieved by appending a subscript after the argument of \texttt{\norm}.

Example:

\[
\left\| \mathbf{x} \right\|_p = \left( \sum_{i=1}^n |x_i|^p \right)^{1/p}
\]

\begin{equation*}
\norm{\vec{x}}_p = \left( \sum_{i=1}^n \abs{x_i}^p \right)^{\frac{1}{p}}
\end{equation*}

There is also a command \texttt{\d}, with one mandatory argument, that typesets the differential part of an integral.

Example:

\[
\int_{\mathbb{R}} \frac{\sin(x)}{x} \, dx
\]

\begin{equation*}
\int_{\mathbb{R}} \! \frac{\sin(x)}{x} \, \text{d}x
\end{equation*}

This macro typesets a partial derivative. The starred variant typesets derivatives as subscripts, i.e. \(f_{xx,y}\), while the unstarred variant typesets full fractions:

\[
\pd^* \{\text{function}\}\{\text{var}, \text{var}, \ldots\}
\]

\[
\pd \{\text{function}\}\{\text{var}, \text{var}, \ldots\}
\]
Example:
\[
\frac{\partial^{m+n} f}{\partial x^m \partial y^n}
\]
\begin{equation*}
\pd{f}{x^m, y^n}
\end{equation*}

As the example shows, the comma-separated list of variables also supports superscripts to denote the number of derivatives, and the sum of the variables is automatically calculated.

\td{\langle function \rangle}{\langle var \rangle}

This macro typesets a total derivative. Unlike \pd, this macro does not have a starred variant, and only typesets full fractions:

Example:
\[
\frac{d^m f}{d x^m}
\]
\begin{equation*}
\td{f}{x^m}
\end{equation*}

\E{\langle expression \rangle}

The command \E typesets the expectation of a random variable.

Example:
\[
\E[\hat{\mu}] = \mu
\]
\begin{equation*}
\E[\hat{\mu}] = \mu
\end{equation*}

\P{\langle expression \rangle}{\text{given} \langle expression \rangle}

The \P command typesets a probability. The \text{given} command can be used to typeset conditional probabilities, within \P.

\begin{equation*}
\P{\text{given} \langle expression \rangle}
\end{equation*}
Example:

\[
P(A \mid B) = \frac{P(B \mid A)P(A)}{P(B)}
\]

\begin{equation*}
\var{A \mid\text{given}\ B} = \frac{\P{B \mid\text{given}\ A}\P{A}}{\P{B}}
\end{equation*}

\var{\langle\text{expression}\rangle}
\cov{\langle\text{expression}\rangle}{\langle\text{expression}\rangle}

The commands \texttt{\var} and \texttt{\cov} typeset the variance and covariance of an expression.

Example:

\[
\var{X} = \E{(X-\mu)^2}
\]
\[
\cov{X}{Y} = \E{XY} - \E{X}\E{Y}
\]

\begin{gather*}
\var{X} = \E{(X-\mu)^2}\\
\cov{X}{Y} = \E{XY} - \E{X}\E{Y}
\end{gather*}

2.3 Improved commands

In addition to adding new commands, this package also redefines already existing commands in a mostly backwards-compatible way to improve their usefulness.
\sin \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}
\arcsin \{\langle\text{expression}\rangle\}
\cos \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}
\arccos \{\langle\text{expression}\rangle\}
\tan \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}
\arctan \{\langle\text{expression}\rangle\}
\cot \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}
\sinh \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}
\cosh \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}
\tanh \[\langle\text{power}\rangle\]\{\langle\text{expression}\rangle\}

The trigonometric functions have been redefined to typeset more easily. They typeset \langle\text{expression}\rangle as an argument of the expression, and (if applicable) \langle\text{power}\rangle as a superscript between the function and its argument, e.g. \(\sin^2(\phi)\). When the argument is empty, no parentheses are emitted: \cos.

\ln \{\langle\text{expression}\rangle\}

The natural logarithm macro \ln has also been redefined to require an argument which is typeset as the argument of the logarithm.

\log \[\langle\text{base}\rangle\]\{\langle\text{expression}\rangle\}

The related macro \log is redefined in a similar way, but also accepts an optional argument denoting the base of the logarithm: \(\log_2(x)\). As with the trigonometric functions, no parentheses are emitted if the mandatory argument is empty: \log.

\exp *\{\langle\text{expression}\rangle\}

The exponential, \exp, is redefined to typeset its argument as a superscript of \(e\) in some display styles, and as an argument of \exp otherwise:

\(e^{\sqrt{2}\exp(x)}\)

Additionally, it is possible to force the \exp mode by using the starred variant.

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The maximum/minimum macros have been redefined in a manner similar to the trigonometric functions. They typeset \( \langle \text{expression} \rangle \) inside curly brackets (the starred version omits the brackets), with the optional \( \langle \text{domain} \rangle \) typeset in a subscript after the operator (e.g. \( \min_{x \in \mathbb{R}^+} f(x) \)). Argument variants are also provided, and the \( \langle \text{expression} \rangle \) is centered underneath the operator if possible:

\[
\arg \min_{x \in \mathbb{R}^+} f(x)
\]

### 2.4 Stylistic changes

Some commands have been redefined in a completely backwards-compatible way to improve the end result of their typesetting.

\( \frac{\langle \text{numerator} \rangle}{\langle \text{denominator} \rangle} \)

The \( \frac{\langle \rangle}{\langle \rangle} \) command has been changed to improve typesetting, allowing displaystyle math in some settings.

\( \bar{\langle \text{expression} \rangle} \)

\( \vec{\langle \text{expression} \rangle} \)

The \( \bar{\langle \rangle} \) command has been changed to cover the entire \( \langle \text{expression} \rangle \) (i.e. \( \pi \)), and \( \vec{\langle \rangle} \) has been changed to match the \( \text{vector sym} \) command provided by isomath.

\( \Re{\langle \text{expression} \rangle} \)

\( \Im{\langle \text{expression} \rangle} \)

These commands typeset the real and imaginary part of a number. Standard use of the package takes definitions roughly from amsmath, while
setting the notation option to \texttt{iso} changes the definitions to match ISO 80000-2.

## 3 Known issues

A list of current issues is available in the Github repository of this package\(^1\), but as of the release of v0.5, there is one known issue.

\#15 The package is incompatible with (at least) blindtext, when including math in the blind text. This is due to the redifinition of \texttt{\sin} (and friends), which is incompatible with the original \texttt{amsmath} definition. This is a feature, not a bug.

If you discover any bugs in this package, please report them to the issue tracker in the skmath Github repository.

\(^1\)\url{https://github.com/urdh/skmath/issues}
4 Installation

The easiest way to install this package is using the package manager provided by your \LaTeX{} installation if such a program is available. Failing that, provided you have obtained the package source (skmath.tex and Makefile) from either CTAN or Github, running `make install` inside the source directory works well. This will extract the documentation and code from skmath.tex, install all files into the TDS tree at TEXMFHOME and run `mktexlsr`.

If you want to extract code and documentation without installing the package, run `make all` instead. If you insist on not using `make`, remember that packages distributed using SkDoC must be extracted using `pdflatex`, not `tex` or `latex`.

5 Changes

**v0.1**
General: Initial version.

**v0.1c**
General: Moved package from docstrip to skdoc.

**v0.1d**
General: Fixed fatal documentation and package errors.

**v0.1e**
General: Added statistics commands.

**v0.1g**
General: Documentation fixes.

**v0.2**
General: Use expl3 functionality throughout the package.

**v0.3**
General: Added \min/\max and friends. Added \pd.

**v0.3a**
General: Added \sinh, \cosh and \tanh.

**v0.3b**
General: Detect empty arguments in trigonometric and logarithmic functions, fix \ln.
\textbf{v0.4}  
General: Added notation option, macros for complex numbers.

\textbf{v0.4a}  
General: Replaced deprecated/removed \texttt{expl3} constructs.

\textbf{v0.4b}  
General: Track \texttt{expl3} changes (thanks to Joseph Wright).

\textbf{v0.5}  
General: Added \texttt{\textbackslash td}.

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Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the page where the implementation of the corresponding entry is discussed. Numbers in roman refer to other mentions of the entry.

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