The \texttt{xfp} package

Floating Point Unit

The \LaTeX{} Project*

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The two functions provided by this package are part of the \LaTeX{} format starting with 2022-06-01 release. This package is therefore no longer needed and only provided to be able to process older documents loading.

This package provides a \LaTeX{}2ε document-level interface to the \LaTeX{}3 floating point unit (part of \texttt{exp3}). It also provides a parallel integer expression interface for convenience.

The expandable command \texttt{\fpeval} takes as its argument a floating point expression and produces a result using the normal rules of mathematics. As this command is expandable it can be used where \TeX{} requires a number and for example within a low-level \texttt{\edef} operation to give a purely numerical result.

Briefly, the floating point expressions may comprise:

- Basic arithmetic: addition \(x + y\), subtraction \(x - y\), multiplication \(x \times y\), division \(x/y\), square root \(\sqrt{x}\), and parentheses.
- Comparison operators: \(x < y\), \(x \leq y\), \(x > y\), \(x! = y\) etc.
- Boolean logic: \(\text{sign}\ x\), negation \(\neg x\), conjunction \(x \& \& y\), disjunction \(x || y\), ternary operator \(x?y:z\).
- Exponentials: \(\exp x\), \(\ln x\), \(x^y\).
- Integer factorial: \(\text{fact } x\).
- Trigonometry: \(\sin x\), \(\cos x\), \(\tan x\), \(\cot x\), \(\sec x\), \(\csc x\) expecting their arguments in radians, and \(\sin x\), \(\cos x\), \(\tan x\), \(\cot x\), \(\sec x\), \(\csc x\) expecting their arguments in degrees.
- Inverse trigonometric functions: \(\arcsin x\), \(\arccos x\), \(\arctan x\), \(\arccot x\), \(\arcsec x\), \(\arccsc x\) giving a result in radians, and \(\text{asin}\ x\), \(\text{acos}\ x\), \(\text{atand}\ x\), \(\text{acotd}\ x\), \(\text{asecd}\ x\), \(\text{acscd}\ x\) giving a result in degrees.
- Extrema: \(\max(x_1, x_2, \ldots)\), \(\min(x_1, x_2, \ldots)\), \(\text{abs}(x)\).
- Rounding functions, controlled by two optional values, \(n\) (number of places, 0 by default) and \(t\) (behavior on a tie, \texttt{NaN} by default):

\footnotesize
\begin{itemize}
\item \texttt{\fpeval}
\end{itemize}

\footnotesize
\begin{itemize}
\item E-mail: latex-team@latex-project.org
\end{itemize}

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- \texttt{trunc}(x, n) rounds towards zero,
- \texttt{floor}(x, n) rounds towards $-\infty$,
- \texttt{ceil}(x, n) rounds towards $+\infty$,
- \texttt{round}(x, n, t) rounds to the closest value, with ties rounded to an even value
  by default, towards zero if $t = 0$, towards $+\infty$ if $t > 0$ and towards $-\infty$ if
  $t < 0$.

- Random numbers: \texttt{rand()}, \texttt{randint}(m, n).
- Constants: \texttt{pi}, \texttt{deg} (one degree in radians).
- Dimensions, automatically expressed in points, \textit{e.g.}, \texttt{pc} is 12.
- Automatic conversion (no need for \texttt{number}) of integer, dimension, and skip vari-
  ables to floating points numbers, expressing dimensions in points and ignoring the
  stretch and shrink components of skips.
- Tuples: $(x_1, \ldots, x_n)$ that can be added together, multiplied or divided by a floating
  point number, and nested.

An example of use could be the following.

\LaTeX{} can now compute: $\frac{\sin (3.5)}{2} + 2 \cdot 10^{-3} = \texttt{fpeval}{\sin(3.5)/2 + 2e-3}$.

\texttt{\inteval} \star The expandable command \texttt{\inteval} takes as its argument an integer expression and
produces a result using the normal rules of mathematics. The operations recognised are
+,-,* and / plus parentheses. Division occurs with \textit{rounding}, and ties are rounded away
from zero. As this command is expandable it can be used where \LaTeX{} requires a number
and for example within a low-level \texttt{\edef} operation to give a purely numerical result.

An example of use could be the following.

\LaTeX{} can now compute: The sum of the numbers is $\texttt{\inteval}{1 + 2 + 3}$.

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The italic numbers denote the pages where the corresponding entry is described, numbers
underlined point to the definition, all others indicate the places where it is used.

\begin{verbatim}
E \edef ........................................ 1, 2 \inteval ........................................ 2
F \fpeval ........................................ 1 \number ........................................ 2
\end{verbatim}