The \texttt{xfp} package
Floating Point Unit

The \LaTeX{} Project\footnote{E-mail: latex-team@latex-project.org}

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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{}\texttt{2e} document-level interface to the \LaTeX{}\texttt{3} floating point unit (part of \texttt{expl3}). It also provides a parallel integer expression interface for convenience.

\begin{verbatim}
\fpeval
\end{verbatim}

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 $x \ast y$, division $x/y$, square root $\sqrt{x}$, and parentheses.
- Comparison operators: $x < y$, $x \leq y$, $x > ? y$, $x ! = y$ etc.
- Boolean logic: sign sign $x$, negation $! x$, conjunction $x \&\& y$, disjunction $x || y$, ternary operator $x ? y : z$.
- Exponentials: exp $x$, ln $x$, $x^y$.
- Integer factorial: fact $x$.
- Trigonometry: sin $x$, cos $x$, tan $x$, cot $x$, sec $x$, csc $x$ expecting their arguments in radians, and sind $x$, cosd $x$, tand $x$, cotd $x$, secd $x$, cscd $x$ expecting their arguments in degrees.
- Inverse trigonometric functions: asin $x$, acos $x$, atan $x$, acot $x$, asec $x$, acsc $x$ giving a result in radians, and asind $x$, acosd $x$, atand $x$, acotd $x$, asecd $x$, acscd $x$ giving a result in degrees.
- Extrema: max($x_1, x_2, \ldots$), min($x_1, x_2, \ldots$), abs($x$).
- Rounding functions, controlled by two optional values, \textit{n} (number of places, 0 by default) and \textit{t} (behavior on a tie, NaN by default):
- \text{trunc}(x, n)\) rounds towards zero,
- \text{floor}(x, n)\) rounds towards \(-\infty\),
- \text{ceil}(x, n)\) rounds towards \(+\infty\),
- \text{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 \(t < 0\).

- \text{Random numbers: \texttt{rand()}, randint}(m, n).
- \text{Constants: \texttt{pi, deg} (one degree in radians).}
- \text{Dimensions, automatically expressed in points, \textit{e.g.}, \texttt{pc} is 12.}

- \text{Automatic conversion (no need for \texttt{\number}) of integer, dimension, and skip variables to floating points numbers, expressing dimensions in points and ignoring the stretch and shrink components of skips.}

- \text{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.

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

\text{\texttt{\inteval} \star} \ \text{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 \texttt{+}, \texttt{-}, \texttt{*} and \texttt{/} plus parentheses. Division occurs with rounding, and ties are rounded away from zero. 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.}

An example of use could be the following.

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

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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{center}
\begin{tabular}{lll}
E & \texttt{\edef} & 1, 2 \\
I & \texttt{\inteval} & 2 \\
F & \texttt{\fpeval} & 1 \\
N & \texttt{\number} & 2
\end{tabular}
\end{center}