The \texttt{xfp} package
Floating Point Unit

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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 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: $x < y$, $x \leq y$, $x > y$, $x \neq y$ etc.
- Boolean logic: sign $\text{sign} x$, negation $!x$, conjunction $x \& y$, disjunction $x \mid\mid y$, 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 $\text{sind} x$, $\text{cossd} x$, $\text{tand} x$, $\text{cotsd} x$, $\text{secd} x$, $\text{cscd} x$ expecting their arguments in degrees.
- Inverse trigonometric functions: $\text{asin} x$, $\text{acos} x$, $\text{atan} x$, $\text{acot} x$, $\text{asec} x$, $\text{acsc} x$ giving a result in radians, and $\text{asind} x$, $\text{acosd} x$, $\text{atand} x$, $\text{acotd} x$, $\text{asecd} x$, $\text{acscd} x$ giving a result in degrees.
- Extrema: $\text{max}(x_1, x_2, \ldots)$, $\text{min}(x_1, x_2, \ldots)$, $\text{abs}(x)$.
- Rounding functions, controlled by two optional values, $n$ (number of places, 0 by default) and $t$ (behavior on a tie, NaN by default):
- \text{trunc}(x, n) \text{ rounds towards zero,}
- \text{floor}(x, n) \text{ rounds towards } -\infty,
- \text{ceil}(x, n) \text{ rounds towards } +\infty,
- \text{round}(x, n, t) \text{ rounds to the closest value, with ties rounded to an even value}
  \text{ by default, towards zero if } t = 0, \text{ towards } +\infty \text{ if } t > 0 \text{ and towards } -\infty \text{ if } t < 0.

• Random numbers: \text{rand()}, \text{randint}(m, n).
• Constants: \text{pi}, \text{deg} (one degree in radians).
• Dimensions, automatically expressed in points, e.g., \text{pc} is 12.
• Automatic conversion (no need for \text{number}) of integer, dimension, and skip variables 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.

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

\textbf{\texttt{\textbackslash interval}} \textbullet The expandable command \texttt{\textbackslash interval} 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 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.

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

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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.

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  \texttt{\edef} & \texttt{\textbackslash interval} & 1, 2 & 2 \\
  \textbf{F} & \textbf{N} \\
  \texttt{\fpeval} & \texttt{\number} & 1 & 2
\end{tabular}