The \texttt{xfp} package
Floating Point Unit

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This package provides a \LaTeX{}2\epsilon document-level interface to the \LaTeX{}3 floating point unit (part of \texttt{expl3}). 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: $x < y$, $x \leq y$, $x > y$, $x \neq y$ 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 $\sin(d)$, $\cos(d)$, $\tan(d)$, $\cot(d)$, $\sec(d)$, $\csc(d)$ 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 $\arcsind(x)$, $\arccosd(x)$, $\arctand(x)$, $\arccotd(x)$, $\arcsecd(x)$, $\arccscd(x)$ 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, $n$ (number of places, 0 by default) and $t$ (behavior on a tie, \texttt{NaN} by default):
  - $\texttt{\fpeval{trunc}(x,n)}$ rounds towards zero,
  - $\texttt{\fpeval{floor}(x,n)}$ 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 $t < 0$.

- Random numbers: $\text{rand}()$, $\text{randint}(m, n)$.
- Constants: $\pi$, $\text{deg}$ (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{} can now compute: $\frac{\sin (3.5)}{2} + 2 \cdot 10^{-3} = \text{fpeval}{\sin(3.5)/2 + 2e-3}$.

\interval The expandable command $\text{\textbackslash interval}$ takes as its argument an integer expression and produces a result using the normal rules of mathematics. The operations recognised are $+,-,\ast$ 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 $\text{\textbackslash def}$ 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 $\text{\textbackslash interval}{1 + 2 + 3}$.

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