The xfp package
Floating Point Unit

The LaTeX Project*

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This package provides a LaTeX 2_ε document-level interface to the LaTeX3 floating point unit (part of expl3). It also provides a parallel integer expression interface for convenience.

`\fpeval` ⋆

The expandable command `\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 `\edef` operation to give a purely numerical result.

Briefly, the floating point expressions may comprise:

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

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  - ceil(x, n) rounds towards $+\infty$,
  - 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: *rand*(), *randint*(m, n).
- Constants: `pi`, `deg` (one degree in radians).
- Dimensions, automatically expressed in points, *e.g.*, `pc` is 12.
- Automatic conversion (no need for `\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}
= \fpeval{sin(3.5)/2 + 2e-3} $.
```

`\inteval` ⋆

The expandable command `\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 *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 `\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 $\inteval{1 + 2 + 3}$.
```

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