

The **xfp** package

Floating Point Unit

The L^AT_EX Project*

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This package provides a L^AT_EX 2_ε document-level interface to the L^AT_EX 3 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 T_EX 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` $\text{sign } x$, 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: $\max(x_1, x_2, \dots)$, $\min(x_1, x_2, \dots)$, $\text{abs}(x)$.
- Rounding functions, controlled by two optional values, n (number of places, 0 by default) and t (behavior on a tie, `NaN` by default):
 - `trunc`(x, n) rounds towards zero,
 - `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, \dots, 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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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.

E		I	
<code>\edef</code> <i>1, 2</i>	<code>\inteval</code> <i>2</i>
F		N	
<code>\fpeval</code> <i>1</i>	<code>\number</code> <i>2</i>