

The **xfp** package

Floating Point Unit

The L^AT_EX3 Project*

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This package provides a L^AT_EX 2_ε document-level interface to the L^AT_EX3 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 will produce 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 .
- Trigonometry: $\sin x$, $\cos x$, $\tan x$, $\cot x$, $\sec x$, $\csc x$ expecting their arguments in radians, and $\text{sind } x$, $\text{cosd } x$, $\text{tand } x$, $\text{cotd } x$, $\text{secd } x$, $\text{cscd } x$ 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: $\max(x, y, \dots)$, $\min(x, y, \dots)$, $\text{abs}(x)$.
- Rounding functions ($n = 0$ by default, $t = \text{NaN}$ 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 $t < 0$.
- Random numbers: $\text{rand}()$, $\text{randint}(m, n)$ (requires pdfT_EX or LuaT_EX).
- Constants: **pi**, **deg** (one degree in radians).

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- 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, expressing dimensions in points and ignoring the stretch and shrink components of skips.

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}` \$.

`\interval` ★

The expandable command `\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 T_EX 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 $\interval{1 + 2 + 3}$ \$.

Index

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>\interval</code> <i>2</i>
F		N	
<code>\fpeval</code> <i>1</i>	<code>\number</code> <i>2</i>