The xfp package
Floating Point Unit

The LaTeX Project*

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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 LaTeX2ε document-level interface to the LaTeX3 floating point unit (part of expl3). It also provides a parallel integer expression interface for convenience.

\texttt{fpeval} \texttt{*} 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: $x < y$, $x \leq y$, $x > y$, $x ! = y$ etc.

- Boolean logic: sign $\text{sign} x$, negation $\neg x$, 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 $\text{sind} x$, $\text{cosd} x$, $\text{tand} x$, $\text{cotd} x$, $\text{secd} x$, $\text{cscd} x$ 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: $\max(x_1, x_2, \ldots)$, $\min(x_1, x_2, \ldots)$, $\text{abs}(x)$.

- Rounding functions, controlled by two optional values, $n$ (number of places, 0 by default) and $t$ (behavior on a tie, NaN by default):

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– $\text{trunc}(x, n)$ 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: $\text{rand}()$, $\text{randint}(m, n)$.
• Constants: pi, deg (one degree in radians).
• Dimensions, automatically expressed in points, e.g., pc is 12.
• Automatic conversion (no need for \texttt{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: $\frac{\sin (3.5)}{2} + 2 \cdot 10^{-3} = \fpeval{\sin(3.5)/2 + 2e-3}$.

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

\texttt{\inteval} \quad The expandable command \texttt{\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 \texttt{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{} 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.

\begin{verbatim}
| E                      | I                      |
|\edef                    | 1, 2                   |
|\inteval                | 2                      |

| F                      | N                      |
|\fpeval                 | 1                      |
|\number                 | 2                      |
\end{verbatim}