The **xfp** package
Floating Point Unit

The **LATEX** Project

Released 2022-06-22

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.

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 $x \times y$, 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 $\text{sign} x$, negation $\! x$, conjunction $x \& y$, disjunction $x \| y$, ternary operator $x ? y : z$.
- Exponentials: $\exp x$, $\ln x$, $x^y$.
- Integer factorial: $\text{fact} x$.
- Trigonometry: $\sin x$, $\cos x$, $\tan x$, $\cot x$, $\sec x$, $\csc x$ expecting their arguments in radians, and $\text{sind} x$, $\text{cosd} x$, $\tand x$, $\cotd x$, $\secd x$, $\cscd x$ expecting their arguments in degrees.
- Inverse trigonometric functions: $\sin^{-1} x$, $\cos^{-1} x$, $\tan^{-1} x$, $\cot^{-1} x$, $\sec^{-1} x$, $\csc^{-1} x$ giving a result in radians, and $\text{asind} x$, $\text{acosd} x$, $\text{atand} x$, $\text{acotd} x$, $\text{secd} x$, $\text{cscd} x$ 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):

*E-mail: latex-team@latex-project.org*
– \text{trunc}(x, n) \text{ rounds towards zero,}
– \text{floor}(x, n) \text{ rounds towards } -\infty,
– \text{ceil}(x, n) \text{ rounds towards } +\infty,
– \text{round}(x, n, t) \text{ rounds to the closest value, with ties rounded to an even value}
  \text{by default, towards zero if } t = 0, \text{ towards } +\infty \text{ if } t > 0 \text{ and towards } -\infty \text{ if } t < 0.

- Random numbers: \text{rand(), randint}(m, n).
- Constants: \text{pi, deg} \text{ (one degree in radians).}
- Dimensions, automatically expressed in points, \text{e.g., pc is 12}.
- Automatic conversion \text{(no need for } \text{number}) \text{ of integer, dimension, and skip}
  \text{variables to floating points numbers, expressing dimensions in points and ignoring the}
  \text{stretch and shrink components of skips.}
- Tuples: \((x_1, \ldots, x_n)\) \text{ that can be added together, multiplied or divided by a floating}
  \text{point number, and nested.}

An example of use could be the following.

\LaTeX{} \text{can now compute: } \frac{\sin (3.5)}{2} + 2\cdot 10^{-3} = \text{\fpeval{sin(3.5)/2 + 2e-3}} \text{.}

The expandable command \text{\inteval} \text{ takes as its argument an integer expression and}
\text{produces a result using the normal rules of mathematics. The operations recognised are}
\text{+,-,* and / plus parentheses. Division occurs with rounding, and ties are rounded away}
\text{from zero. As this command is expandable it can be used where \TeX{} requires a number}
\text{and for example within a low-level } \\text{\edef} \text{ operation to give a purely numerical result.}

An example of use could be the following.

\LaTeX{} \text{can now compute: The sum of the numbers is } \inteval{1 + 2 + 3} \text{.}

\inteval \star \hspace{1cm} \text{The expandable command } \text{\inteval} \text{ takes as its argument an integer expression and}
\text{produces a result using the normal rules of mathematics. The operations recognised are}
\text{+,-,* and / plus parentheses. Division occurs with rounding, and ties are rounded away}
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An example of use could be the following.

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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.

\text{\edef \hspace{1cm}} \text{I}
\text{................................. 1, 2} \inteval \text{................................. 2}

\text{\fpeval \hspace{1cm}} \text{N}
\text{................................. 1} \\text{\number} \text{................................. 2}

2