Package ‘cppdoubles’

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Title Fast Relative Comparisons of Floating Point Numbers in 'C++'

Version 0.2.0

Description Compare double-precision floating point vectors using relative differences. All equality operations are calculated using 'cpp11'.

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BugReports https://github.com/NicChr/cppdoubles/issues

Depends R (>= 3.5.0)

Suggests bench, testthat (>= 3.0.0)

LinkingTo cpp11

Config/testthat/edition 3

Encoding UTF-8

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NeedsCompilation yes

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R topics documented:

`all_equal` *Are all values of x nearly equal (within a tolerance) to all values of y?*

Description

A memory-efficient alternative to `all.equal.numeric()`.

Usage

```
all_equal(
  x,
  y,
  tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps)),
  na.rm = FALSE
)
```

Arguments

`x`	A double vector.
`y`	A double vector.
`tol`	A double vector of tolerances.
`na.rm`	Should `NA` values be ignored? Default is `FALSE`.

Details

`all_equal` compares each pair of double-precision floating point numbers in the same way as `double_equal`. If any numbers differ, the algorithm breaks immediately, which can offer significant speed when there are differences at the start of a vector. All arguments are recycled except `na.rm`.

Value

A logical vector of length 1.

The result should match `all(double_equal(x, y))`, including the way `NA` values are handled.

Examples

```
library(cppdoubles)
library(bench)
x <- seq(0, 1, 0.2)
y <- sqrt(x)^2

all_equal(x, y)

# Comparison to all.equal
z <- runif(10^4, 1, 100)
ones <- rep(1, length(z))
mark(base = isTRUE(all.equal(z, z)),
```

```
              cppdoubles = all_equal(z, z),
              iterations = 100)
mark(base = isTRUE(all.equal(z, ones)),
              cppdoubles = all_equal(z, ones),
              iterations = 100)
```

`rel_diff` *Absolute and relative difference*

Description

Calculate absolute differences with `abs_diff()` and relative differences with `rel_diff()`

Usage

```
rel_diff(x, y)

abs_diff(x, y)
```

Arguments

x	A double vector.
y	A double vector.

Value

A numeric vector.

`%~==%` *Relative comparison of double-precision floating point numbers*

Description

Fast and efficient methods for comparing floating point numbers using relative differences.

Usage

```
x %~==% y

x %~>=% y

x %~>% y

x %~<=% y
```

```
x %~<% y

double_equal(
  x,
  y,
  tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps))
)

double_gte(
  x,
  y,
  tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps))
)

double_gt(
  x,
  y,
  tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps))
)

double_lte(
  x,
  y,
  tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps))
)

double_lt(
  x,
  y,
  tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps))
)
```

Arguments

`x`	A double vector.
`y`	A double vector.
`tol`	A double vector of tolerances.

Details

When either `x[i]` or `y[i]` contain a number very close to zero, absolute differences are used, otherwise relative differences are used.

The output of `double_equal()` is commutative, which means the order of arguments don't matter whereas this is not the case for `all.equal.numeric()`.

The calculation is done in C++ and is quite efficient. Recycling follows the usual R rules and is done without allocating additional memory.

Value

A logical vector.

Examples

```
library(cppdoubles)

### Basic usage ###

# Standard equality operator
sqrt(2)^2 == 2

# approximate equality operator
sqrt(2)^2 %~==% 2

sqrt(2)^2 %~>=% 2
sqrt(2)^2 %~<=% 2
sqrt(2)^2 %~>% 2
sqrt(2)^2 %~<% 2

# Alternatively
double_equal(2, sqrt(2)^2)
double_gte(2, sqrt(2)^2)
double_lte(2, sqrt(2)^2)
double_gt(2, sqrt(2)^2)
double_lt(2, sqrt(2)^2)

rel_diff(1, 1 + 2e-10)
double_equal(1, 1 + 2e-10, tol = sqrt(.Machine$double.eps))
double_equal(1, 1 + 2e-10, tol = 1e-10)

# Optionally set a threshold for all comparison
options(cppdoubles.tolerance = 1e-10)
double_equal(1, 1 + 2e-10)

# Floating point errors magnified example

x1 <- 1.1 * 100 * 10^200
x2 <- 110 * 10^200

abs_diff(x1, x2) # Large absolute difference
rel_diff(x1, x2) # Very small relative difference as expected

double_equal(x1, x2)

# all.equal is not commutative but double_equal is
all.equal(10^-8, 2 * 10^-8)
all.equal(2 * 10^-8, 10^-8)

double_equal(10^-8, 2 * 10^-8)
double_equal(2 * 10^-8, 10^-8)
```

```
# All comparisons are vectorised and recycled

double_equal(sqrt(1:10),
             sqrt(1:5),
             tol = c(-Inf, 1e-10, Inf))

# One can check for whole numbers like so
whole_number <- function(x, tol = getOption("cppdoubles.tolerance", sqrt(.Machine$double.eps))){
  double_equal(x, round(x))
}
whole_number(seq(-5, 5, 0.25))
```

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