Package ‘microbenchmark’

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Title Accurate Timing Functions

Description Provides infrastructure to accurately measure and compare the execution time of R expressions.

URL https://github.com/joshuaulrich/microbenchmark/

BugReports https://github.com/joshuaulrich/microbenchmark/issues/

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Imports graphics, stats

Suggests ggplot2, multcomp, RUnit

SystemRequirements On a Unix-alike, one of the C functions
mach_absolute_time (macOS), clock_gettime or gethrtime. If none of these is found, the obsolescent POSIX function gettimeofday will be tried.

ByteCompile yes

LazyData yes

Version 1.4-7

RoxygenNote 6.1.0

NeedsCompilation yes

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**Description**

Uses ggplot2 to produce a more legible graph of microbenchmark timings

**Usage**

```r
autoplot.microbenchmark(object, ..., log = TRUE, y_max = 1.05 * max(object$time))
```

**Arguments**

- `object`: A microbenchmark object
- `...`: Ignored
- `log`: If TRUE the time axis will be on log scale.
- `y_max`: The upper limit of the y axis (defaults to 5 percent more than the maximum value)

**Value**

A ggplot2 plot

**Author(s)**

Ari Friedman, Olaf Mersmann

**Examples**

```r
if (requireNamespace("ggplot2")) {
  tm <- microbenchmark(rchisq(100, 0),
                        rchisq(100, 1),
                        rchisq(100, 2),
                        rchisq(100, 3),
                        rchisq(100, 5), times=1000L)
  ggplot2::autoplot(tm)
}
```
Description

Boxplot of microbenchmark timings.

Usage

## S3 method for class 'microbenchmark'
boxplot(x, unit = "t", log = TRUE, xlab, ylab,
        horizontal = FALSE, ...)

Arguments

x
A microbenchmark object.
unit
Unit in which the results be plotted.
log
Should times be plotted on log scale?
xlab
X axis label.
ylab
Y axis label.
horizontal
Switch X and Y axes.
...
Passed on to boxplot.formula.

Author(s)

Olaf Mersmann

get_nanotime

Return the current value of the platform timer.

Description

The current value of the most accurate timer of the platform is returned. This can be used as a time
stamp for logging or similar purposes. Please note that there is no common reference, that is, the
timer value cannot be converted to a date and time value.

Usage

get_nanotime()

Author(s)

Olaf Mersmann
**Description**

`microbenchmark` serves as a more accurate replacement of the often seen `system.time(replicate(1000, expr))` expression. It tries hard to accurately measure only the time it takes to evaluate `expr`. To achieve this, the sub-millisecond (supposedly nanosecond) accurate timing functions most modern operating systems provide are used. Additionally all evaluations of the expressions are done in C code to minimize any overhead.

**Usage**

`microbenchmark(..., list = NULL, times = 100L, unit, check = NULL, control = list(), setup = NULL)`

**Arguments**

- `...` Expressions to benchmark.
- `list` List of unevaluated expression to benchmark.
- `times` Number of times to evaluate the expression.
- `unit` Default unit used in `summary` and `print`.
- `check` A function to check if the expressions are equal. By default `NULL` which omits the check. In addition to a function, a string can be supplied. The string ‘equal’ will compare all values using `all.equal`, ‘equivalent’ will compare all values using `all.equal` and `check.attributes = FALSE`, and ‘identical’ will compare all values using `identical`.
- `control` List of control arguments. See Details.
- `setup` An unevaluated expression to be run (untimed) before each benchmark expression.

**Details**

This function is only meant for micro-benchmarking small pieces of source code and to compare their relative performance characteristics. You should generally avoid benchmarking larger chunks of your code using this function. Instead, try using the R profiler to detect hot spots and consider rewriting them in C/C++ or FORTRAN.

The `control` list can contain the following entries:

- `order` the order in which the expressions are evaluated. “random” (the default) randomizes the execution order, “inorder” executes each expression in order and “block” executes all repetitions of each expression as one block.
- `warmup` the number of warm-up iterations performed before the actual benchmark. These are used to estimate the timing overhead as well as spinning up the processor from any sleep or idle states it might be in. The default value is 2.
Value

Object of class ‘microbenchmark’, a data frame with columns expr and time. expr contains the de-
parsed expression as passed to microbenchmark or the name of the argument if the expression was
passed as a named argument. time is the measured execution time of the expression in nanoseconds.
The order of the observations in the data frame is the order in which they were executed.

Note

Depending on the underlying operating system, different methods are used for timing. On Win-

dows the QueryPerformanceCounter interface is used to measure the time passed. For Linux the
clock_gettime API is used and on Solaris the gethrtime function. Finally on MacOS X the,
undocumented, mach_absolute_time function is used to avoid a dependency on the CoreServices
Framework.

Before evaluating each expression times times times, the overhead of calling the timing functions and the
C function call overhead are estimated. This estimated overhead is subtracted from each measured
evaluation time. Should the resulting timing be negative, a warning is thrown and the respective
value is replaced by 0. If the timing is zero, a warning is raised. Should all evaluations result in one
of the two error conditions described above, an error is raised.

One platform on which the clock resolution is known to be too low to measure short runtimes with
the required precision is Oracle® Solaris on some SPARC® hardware. Reports of other platforms
with similar problems are welcome. Please contact the package maintainer.

Author(s)

Olaf Mersmann

See Also

print.microbenchmark to display and boxplot.microbenchmark or autoplot.microbenchmark
to plot the results.

Examples

## Measure the time it takes to dispatch a simple function call
## compared to simply evaluating the constant \code{NULL}
f <- function() NULL
res <- microbenchmark(NULL, f(), times=1000L)

## Print results:
print(res)

## Plot results:
boxplot(res)

## Pretty plot:
if (requireNamespace("ggplot2")) {
  ggplot2::autoplot(res)
}

## Example check usage
my_check <- function(values) {
  all(sapply(values[-1], function(x) identical(values[1], x)))
}

f <- function(a, b)
  2 + 2

a <- 2
## Check passes
microbenchmark(2 + 2, 2 + a, f(2, a), f(2, 2), check=my_check)
## Not run:
a <- 3
## Check fails
microbenchmark(2 + 2, 2 + a, f(2, a), f(2, 2), check=my_check)

## End(Not run)
## Example setup usage
set.seed(21)
x <- rnorm(10)
microbenchmark(x, rnorm(10), check=my_check, setup=set.seed(21))
## Will fail without setup
## Not run:
microbenchmark(x, rnorm(10), check=my_check)

## End(Not run)
## using check
a <- 2
microbenchmark(2 + 2, 2 + a, sum(2, a), sum(2, 2), check='identical')
microbenchmark(2 + 2, 2 + a, sum(2, a), sum(2, 2), check='equal')
attr(a, 'abc') <- 123
microbenchmark(2 + 2, 2 + a, sum(2, a), sum(2, 2), check='equivalent')
## check='equal' will fail due to difference in attribute
## Not run:
microbenchmark(2 + 2, 2 + a, sum(2, a), sum(2, 2), check='equal')

## End(Not run)

microtiming_precision <- function(rounds = 100L, warmup = 2^18)

Description

This function is currently experimental. Its main use is to judge the quality of the underlying timer implementation of the operating system. The function measures the overhead of timing a C function call rounds times and returns all non-zero timings observed. This can be used to judge the granularity and resolution of the timing subsystem.

Usage

microtiming_precision(rounds = 100L, warmup = 2^18)
print.microbenchmark

Arguments
rounds       Number of measurements used to estimate the precision.
warmup      Number of iterations used to warm up the CPU.

Value
A vector of observed non-zero timings.

Author(s)
Olaf Mersmann

Description
Print microbenchmark timings.

Usage
## S3 method for class 'microbenchmark'
print(x, unit, order, signif, ...)

Arguments
x      An object of class microbenchmark.
unit   What unit to print the timings in. Default value taken from to option microbenchmark.unit (see example).
order  If present, order results according to this column of the output.
signif If present, limit the number of significant digits shown.
...    Passed to print.data.frame

Note
The available units are nanoseconds ("ns"), microseconds ("us"), milliseconds ("ms"), seconds ("s") and evaluations per seconds ("eps") and relative runtime compared to the best median time ("relative").

If the multcomp package is available a statistical ranking is calculated and displayed in compact letter display from in the cld column.

Author(s)
Olaf Mersmann
See Also

boxplot.microbenchmark and autoplot.microbenchmark for a plot methods.

Examples

```r
a1 <- a2 <- a3 <- a4 <- numeric(0)
res <- microbenchmark(a1 <- c(a1, 1),
a2 <- append(a2, 1),
a3[length(a3) + 1] <- 1,
a4[[length(a4) + 1]] <- 1,
times=100L)
print(res)
## Change default unit to relative runtime
options(microbenchmark.unit="relative")
print(res)
## Change default unit to evaluations per second
options(microbenchmark.unit="eps")
print(res)
```

summary.microbenchmark

Summarize microbenchmark timings.

Description

Summarize microbenchmark timings.

Usage

```r
## S3 method for class 'microbenchmark'
summary(object, unit, ...)
```

Arguments

- `object` An object of class microbenchmark.
- `unit` What unit to print the timings in. If none is given, either the unit attribute of object or the option microbenchmark.unit is used and if neither is set “t” is used.
- `...` Passed to print.data.frame

Value

A data.frame containing the aggregated results.
Note

The available units are nanoseconds ("ns"), microseconds ("us"), milliseconds ("ms"), seconds ("s") and evaluations per seconds ("eps") and relative runtime compared to the best median time ("relative").

See Also

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