

Package ‘nanotime’

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Type Package

Title Nanosecond-Resolution Time for R

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Author Dirk Eddelbuettel and Leonardo Silvestri

Maintainer Dirk Eddelbuettel <edd@debian.org>

Description Full 64-bit resolution date and time support with resolution up to nanosecond granularity is provided, with easy transition to and from the standard 'POSIXct' type.

Imports methods, bit64, RcppCCTZ (>= 0.2.3), zoo

Suggests RUnit, data.table, xts

License GPL (>= 2)

RoxygenNote 6.0.1

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R topics documented:

nanotime-class 1

Index 7

nanotime-class *Nanosecond resolution datetime functionality*

Description

Functions to operate on nanosecond time resolution using integer64 bit representation. Conversion functions for several standard R types are provided, and more will be added as needed. as.integer64 conversion helper returning the underlying integer64 representation

Usage

```
nanotime(x, ...)  
  
## S4 method for signature 'character'  
nanotime(x, format = "", tz = "")  
  
nanotime.matrix(x)  
  
## S4 method for signature 'POSIXct'  
nanotime(x)  
  
## S4 method for signature 'POSIXlt'  
nanotime(x)  
  
## S4 method for signature 'Date'  
nanotime(x)  
  
## S4 method for signature 'nanotime'  
print(x, format = "", tz = "", ...)  
  
## S4 method for signature 'nanotime'  
show(object)  
  
## S3 method for class 'nanotime'  
format(x, format = "", tz = "", ...)  
  
## S3 method for class 'nanotime'  
index2char(x, ...)  
  
## S3 method for class 'nanotime'  
as.POSIXct(x, tz = "", ...)  
  
## S3 method for class 'nanotime'  
as.POSIXlt(x, tz = "", ...)  
  
## S3 method for class 'nanotime'  
as.Date(x, ...)  
  
## S3 method for class 'nanotime'  
as.data.frame(x, ...)  
  
## S3 method for class 'nanotime'  
as.integer64(x, ...)  
  
as.integer64(x, ...)  
  
## S4 method for signature 'nanotime,character'  
e1 - e2
```

```
## S4 method for signature 'nanotime,nanotime'  
e1 - e2  
  
## S4 method for signature 'nanotime,integer64'  
e1 - e2  
  
## S4 method for signature 'nanotime,numeric'  
e1 - e2  
  
## S4 method for signature 'ANY,nanotime'  
e1 - e2  
  
## S4 method for signature 'nanotime,ANY'  
e1 - e2  
  
## S4 method for signature 'nanotime,ANY'  
e1 + e2  
  
## S4 method for signature 'nanotime,integer64'  
e1 + e2  
  
## S4 method for signature 'nanotime,numeric'  
e1 + e2  
  
## S4 method for signature 'ANY,nanotime'  
e1 + e2  
  
## S4 method for signature 'integer64,nanotime'  
e1 + e2  
  
## S4 method for signature 'numeric,nanotime'  
e1 + e2  
  
## S4 method for signature 'nanotime,nanotime'  
e1 + e2  
  
## S4 method for signature 'nanotime,ANY'  
Arith(e1, e2)  
  
## S4 method for signature 'ANY,nanotime'  
Arith(e1, e2)  
  
## S4 method for signature 'nanotime,ANY'  
Compare(e1, e2)  
  
## S4 method for signature 'nanotime,nanotime'  
Compare(e1, e2)
```

```
## S4 method for signature 'nanotime,ANY'  
Logic(e1, e2)  
  
## S4 method for signature 'ANY,nanotime'  
Logic(e1, e2)  
  
## S4 method for signature 'nanotime'  
Math(x)  
  
## S4 method for signature 'nanotime'  
Math2(x, digits)  
  
## S4 method for signature 'nanotime'  
Summary(x, ..., na.rm = FALSE)  
  
## S4 method for signature 'nanotime'  
min(x, ..., na.rm = FALSE)  
  
## S4 method for signature 'nanotime'  
max(x, ..., na.rm = FALSE)  
  
## S4 method for signature 'nanotime'  
range(x, ..., na.rm = FALSE)  
  
## S4 method for signature 'nanotime'  
Complex(z)  
  
## S4 method for signature 'nanotime'  
x[i, j, ..., drop = FALSE]  
  
## S4 replacement method for signature 'nanotime'  
x[i, j, ...] <- value  
  
## S3 method for class 'nanotime'  
c(...)  
  
## S4 replacement method for signature 'nanotime'  
names(x) <- value  
  
## S4 method for signature 'nanotime'  
is.na(x)
```

Arguments

x	The object which want to convert to class nanotime
...	further arguments passed to or from methods.
format	A character string. Can also be set via options("nanotimeFormat") and uses

	‘%Y-%m-%dT%H:%M:%E9S%Ez’ as a default and fallback
tz	Required for as.POSIXct and as.POSIXlt, can be set via options("nanotimeTz") and uses ‘UTC’ as a default and fallback
object	argument for method show
e1	Operand of class nanotime
e2	Operand of class nanotime
digits	Required for Math2 signature but ignored here
na.rm	a logical indicating whether missing values should be removed.
z	Required for Complex signature but ignored here
i	index specifying elements to extract or replace.
j	Required for [signature but ignored here
drop	Required for [signature but ignored here
value	argument for nanotime-class

Details

Notice that the conversion from POSIXct explicitly sets the last three digits to zero. Nanosecond time stored in a 64-bit integer has nineteen digits precision where doubles (which are used internally for POSIXct as well) only have sixteen digits. So rather than showing three more (essentially *random*) digits it is constructed such that these three additional digits are zeros.

Value

A nanotime object

Caveats

Working with dates and times is *difficult*. One needs a representation of both *time points* and *time duration*. In R, think of Date or POSIXct objects for the former, and difftime for the later. Here we (currently) only have time points, but they are effectively also durations relative to the epoch of January 1, 1970.

Design

There are two external libraries doing two key components.

We rely on the [bit64](#) package for integer64 types to represent nanoseconds relative to the epoch. This is similar to POSIXct which uses fractional seconds since the epoch—so here we are essentially having the same values, but multiplied by 10 to the power 9 and stored as integers. We need to rely on the external package as we require 64-bit integers whereas R itself only has 32-bit integers. The [bit64](#) package is clever about how it manages to provide such an integer using only the 64-bit double type and very clever (and efficient) transformations.

The other is the CCTZ library in C++, which we access via the [RcppCCTZ](#) package. CCTZ extends the C++11 standard library type chrono type in very useful ways for time zones and localtime. We use its formatting and parsing features.

Output Format

Formatting and character conversion for `nanotime` objects is done by functions from the [RcppCCTZ](#) package relying on code from its embedded CCTZ library. The default format is ISO3339 compliant: `%Y-%m-%dT%H:%M:%E9S%Ez`. It specifies a standard ISO 8601 part for date and time — as well as nine digits of precision for fractional seconds (down to nanoseconds) and on offset (typically zero as we default to UTC). It can be overridden by using `options()` with the key of `nanotimeFormat` and a suitable value. Similarly, `nanotimeTz` can be used to select a different timezone.

Author(s)

Dirk Eddelbuettel

Examples

```
x <- nanotime("1970-01-01T00:00:00.000000001+00:00")
print(x)
x <- x + 1
print(x)
format(x)
x <- x + 10
print(x)
format(x)
format(nanotime(Sys.time()) + 1:3) # three elements each 1 ns apart
```

Index

- + , ANY, nanotime-method (nanotime-class),
1
- + , integer64, nanotime-method
(nanotime-class), 1
- + , nanotime, ANY-method (nanotime-class),
1
- + , nanotime, integer64-method
(nanotime-class), 1
- + , nanotime, nanotime-method
(nanotime-class), 1
- + , nanotime, numeric-method
(nanotime-class), 1
- + , numeric, nanotime-method
(nanotime-class), 1
- , ANY, nanotime-method (nanotime-class),
1
- , nanotime, ANY-method (nanotime-class),
1
- , nanotime, character-method
(nanotime-class), 1
- , nanotime, integer64-method
(nanotime-class), 1
- , nanotime, nanotime-method
(nanotime-class), 1
- , nanotime, numeric-method
(nanotime-class), 1
- [, nanotime-method (nanotime-class), 1
- [<- , nanotime-method (nanotime-class), 1

- Arith, ANY, nanotime-method
(nanotime-class), 1
- Arith, nanotime, ANY-method
(nanotime-class), 1
- as.data.frame.nanotime
(nanotime-class), 1
- as.Date.nanotime (nanotime-class), 1
- as.integer64 (nanotime-class), 1
- as.POSIXct.nanotime (nanotime-class), 1
- as.POSIXlt.nanotime (nanotime-class), 1

- bit64, 5

- c.nanotime (nanotime-class), 1
- Compare, nanotime, ANY-method
(nanotime-class), 1
- Compare, nanotime, nanotime-method
(nanotime-class), 1
- Complex, nanotime-method
(nanotime-class), 1

- format.nanotime (nanotime-class), 1

- index2char.nanotime (nanotime-class), 1
- is.na, nanotime-method (nanotime-class),
1

- Logic, ANY, nanotime-method
(nanotime-class), 1
- Logic, nanotime, ANY-method
(nanotime-class), 1

- Math, nanotime-method (nanotime-class), 1
- Math2, nanotime-method (nanotime-class),
1
- max, nanotime-method (nanotime-class), 1
- min, nanotime-method (nanotime-class), 1

- names<- , nanotime-method
(nanotime-class), 1
- nanotime (nanotime-class), 1
- nanotime, character-method
(nanotime-class), 1
- nanotime, Date-method (nanotime-class), 1
- nanotime, POSIXct-method
(nanotime-class), 1
- nanotime, POSIXlt-method
(nanotime-class), 1
- nanotime-class, 1
- nanotime-package (nanotime-class), 1
- nanotime.matrix (nanotime-class), 1

print, nanotime-method (nanotime-class),
1

range, nanotime-method (nanotime-class),
1

RcppCCTZ, 5, 6

show, nanotime-method (nanotime-class), 1

Summary, nanotime-method
(nanotime-class), 1