

Package ‘teal.data’

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Type Package

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Description Provides a 'teal_data' class as a unified data model for 'teal' applications focusing on reproducibility and relational data.

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<https://github.com/insightsengineering/teal.data/>

BugReports <https://github.com/insightsengineering/teal.data/issues>

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cdisc_data	<i>Data input for teal app</i>
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Description

Function is a wrapper around [teal_data\(\)](#) and guesses join_keys for given datasets whose names match ADAM datasets names.

Usage

```
cdisc_data(
  ...,
  join_keys = teal.data::default_cdisc_join_keys[names(rlang::list2(...))],
  code = character(0)
)
```

Arguments

...	any number of objects (presumably data objects) provided as name = value pairs.
join_keys	(join_keys or single join_key_set) optional object with datasets column names used for joining. If empty then it would be automatically derived basing on intersection of datasets primary keys. For ADAM datasets it would be automatically derived.
code	(character, language) optional code to reproduce the datasets provided in ... Note this code is not executed and the teal_data may not be reproducible Use verify() to verify code reproducibility.

Details

This function checks if there were keys added to all data sets.

Value

A teal_data object.

Examples

```
data <- cdisc_data(
  join_keys = join_keys(
    join_key("ADSL", "ADTTE", c("STUDYID" = "STUDYID", "USUBJID" = "USUBJID"))
  )
)

data <- within(data, {
  ADSL <- example_cdisc_data("ADSL")
  ADTTE <- example_cdisc_data("ADTTE")
})
```

col_labels	<i>Variable labels</i>
------------	------------------------

Description

Get or set variable labels in a `data.frame`.

Usage

```
col_labels(x, fill = FALSE)

col_labels(x) <- value

col_relabel(x, ...)
```

Arguments

<code>x</code>	(<code>data.frame</code> or <code>DataFrame</code>) data object
<code>fill</code>	(<code>logical(1)</code>) specifying what to return if variable has no label
<code>value</code>	(character) vector of variable labels of length equal to number of columns in <code>x</code> ; if named, names must match variable names in <code>x</code> and will be used as key to set labels; use <code>NA</code> to remove label from variable
<code>...</code>	name-value pairs, where name corresponds to a variable name in <code>x</code> and value is the new variable label; use <code>NA</code> to remove label from variable

Details

Variable labels can be stored as a `label` attribute set on individual variables. These functions get or set this attribute, either on all (`col_labels`) or some variables (`col_relabel`).

Value

For `col_labels`, named character vector of variable labels, the names being the corresponding variable names. If the `label` attribute is missing, the vector elements will be the variable names themselves if `fill = TRUE` and `NA` if `fill = FALSE`.

For `col_labels<-` and `col_relabel`, copy of `x` with variable labels modified.

Source

These functions were taken from `formatters` package, to reduce the complexity of the dependency tree and rewritten.

Examples

```
x <- iris
col_labels(x)
col_labels(x) <- paste("label for", names(iris))
col_labels(x)
y <- col_relabel(x, Sepal.Length = "Sepal Length of iris flower")
col_labels(y)
```

default_cdisc_join_keys

List containing default joining keys for CDISC datasets

Description

These represent primary and foreign keys for joining CDISC datasets.

Usage

```
default_cdisc_join_keys
```

Format

An object of class join_keys (inherits from list) of length 19.

Source

internal. See data-raw/cdisc_datasets.yaml and data-raw/data.R for details.

See Also

[join_keys\(\)](#)

Examples

```
default_cdisc_join_keys
default_cdisc_join_keys[c("ADSL", "ADAE")] # Subset for ADSL and ADAE
```

example_cdisc_data	<i>Generate sample CDISC datasets</i>
--------------------	---------------------------------------

Description

Retrieves example CDISC datasets for use in examples and testing.

Usage

```
example_cdisc_data(
  dataname = c("ADSL", "ADAE", "ADLB", "ADCM", "ADEX", "ADRS", "ADTR", "ADTTE", "ADVS")
)
```

Arguments

dataname (character(1)) name of a CDISC dataset.

Details

This function returns a dummy dataset and should only be used within `teal.data`. Note that the datasets are not created and maintained in `teal.data`, they are retrieved from [random.cdisc.data](#) package.

Value

A CDISC dataset as a `data.frame`.

get_code,teal_data-method	<i>Get code from teal_data object</i>
---------------------------	---------------------------------------

Description

Retrieve code from `teal_data` object.

Usage

```
## S4 method for signature 'teal_data'
get_code(
  object,
  deparse = TRUE,
  names = NULL,
  datanames = lifecycle::deprecated(),
  ...
)
```

Arguments

object	(teal_data)
deparse	(logical) flag specifying whether to return code as character (deparse = TRUE) or as expression (deparse = FALSE).
names	(character) Successor of datanames. Vector of dataset names to return the code for. For more details see the "Extracting dataset-specific code" section.
datanames	[Deprecated] (character) vector of dataset names to return the code for. For more details see the "Extracting dataset-specific code" section. Use names instead.
...	Parameters passed to internal methods. Currently, the only supported parameter is check_names (logical(1)) flag, which is TRUE by default. Function warns about missing objects, if they do not exist in code but are passed in datanames. To remove the warning, set check_names = FALSE.

Details

Retrieve code stored in @code, which (in principle) can be used to recreate all objects found in the environment (@.xData). Use names to limit the code to one or more of the datasets enumerated in the environment.

Value

Either a character string or an expression. If names is used to request a specific dataset, only code that *creates* that dataset (not code that uses it) is returned. Otherwise, all contents of @code.

Extracting dataset-specific code

When names is specified, the code returned will be limited to the lines needed to *create* the requested datasets. The code stored in the @code slot is analyzed statically to determine which lines the datasets of interest depend upon. The analysis works well when objects are created with standard infix assignment operators (see ?assignOps) but it can fail in some situations.

Consider the following examples:

Case 1: Usual assignments.

```
data <- teal_data() |>
  within({
    foo <- function(x) {
      x + 1
    }
    x <- 0
    y <- foo(x)
  })
get_code(data, names = "y")
```

x has no dependencies, so get_code(data, names = "x") will return only the second call.
y depends on x and foo, so get_code(data, names = "y") will contain all three calls.

Case 2: Some objects are created by a function's side effects.

```
data <- teal_data() |>
  within({
    foo <- function() {
      x <- x + 1
    }
    x <- 0
    foo()
    y <- x
  })
get_code(data, names = "y")
```

Here, `y` depends on `x` but `x` is modified by `foo` as a side effect (not by reassignment) and so `get_code(data, names = "y")` will not return the `foo()` call.

To overcome this limitation, code dependencies can be specified manually. Lines where side effects occur can be flagged by adding `"# @linksto <object name>"` at the end.

Note that `within` evaluates code passed to `expr` as is and comments are ignored. In order to include comments in code one must use the `eval_code` function instead.

```
data <- teal_data() |>
  eval_code("
    foo <- function() {
      x <- x + 1
    }
    x <- 0
    foo() # @linksto x
    y <- x
  ")
get_code(data, names = "y")
```

Now the `foo()` call will be properly included in the code required to recreate `y`.

Note that two functions that create objects as side effects, `assign` and `data`, are handled automatically.

Here are known cases where manual tagging is necessary:

- non-standard assignment operators, *e.g.* `%<>%`
- objects used as conditions in `if` statements: `if (<condition>)`
- objects used to iterate over in `for` loops: `for(i in <sequence>)`
- creating and evaluating language objects, *e.g.* `eval(<call>)`

Examples

```
tdata1 <- teal_data()
tdata1 <- within(tdata1, {
  a <- 1
  b <- a^5
  c <- list(x = 2)
})
get_code(tdata1)
```

```

get_code(tdata1, names = "a")
get_code(tdata1, names = "b")

tdata2 <- teal_data(x1 = iris, code = "x1 <- iris")
get_code(tdata2)
get_code(verify(tdata2))

```

join_key

Create a relationship between a pair of datasets

Description

Create a relationship between two datasets, `dataset_1` and `dataset_2`. By default, this function establishes a directed relationship with `dataset_1` as the parent. If `dataset_2` is not specified, the function creates a primary key for `dataset_1`.

Usage

```
join_key(dataset_1, dataset_2 = dataset_1, keys, directed = TRUE)
```

Arguments

<code>dataset_1, dataset_2</code>	(character(1)) Dataset names. When <code>dataset_2</code> is omitted, a primary key for <code>dataset_1</code> is created.
<code>keys</code>	(optionally named character) Column mapping between the datasets, where <code>names(keys)</code> maps columns in <code>dataset_1</code> corresponding to columns of <code>dataset_2</code> given by the elements of <code>keys</code> . • If unnamed, the same column names are used for both datasets. • If any element of the <code>keys</code> vector is empty with a non-empty name, then the name is used for both datasets.
<code>directed</code>	(logical(1)) Flag that indicates whether it should create a parent-child relationship between the datasets. • TRUE (default) <code>dataset_1</code> is the parent of <code>dataset_2</code>; • FALSE when the relationship is undirected.

Value

object of class `join_key_set` to be passed into `join_keys` function.

See Also

[join_keys\(\)](#), [parents\(\)](#)

Examples

```
join_key("d1", "d2", c("A"))
join_key("d1", "d2", c("A" = "B"))
join_key("d1", "d2", c("A" = "B", "C"))
```

join_keys

Manage relationships between datasets using join_keys

Description

Facilitates the creation and retrieval of relationships between datasets. `join_keys` class extends `list` and contains keys connecting pairs of datasets. Each element of the list contains keys for specific dataset. Each dataset can have a relationship with itself (primary key) and with other datasets.

Note that `join_keys` list is symmetrical and assumes a default direction, that is: when keys are set between `ds1` and `ds2`, it defines `ds1` as the parent in a parent-child relationship and the mapping is automatically mirrored between `ds2` and `ds1`.

Usage

```
## Constructor, getter and setter
join_keys(...)

## Default S3 method:
join_keys(...)

## S3 method for class 'join_keys'
join_keys(...)

## S3 method for class 'teal_data'
join_keys(...)

## S3 method for class 'join_keys'
x[i, j]

## S3 replacement method for class 'join_keys'
x[i, j, directed = TRUE] <- value

## S3 method for class 'join_keys'
c(...)

## S3 method for class 'join_key_set'
c(...)

join_keys(x) <- value
```

```
## S3 replacement method for class 'join_keys'
join_keys(x) <- value

## S3 replacement method for class 'teal_data'
join_keys(x) <- value

## S3 method for class 'join_keys'
format(x, ...)

## S3 method for class 'join_keys'
print(x, ...)
```

Arguments

...	optional, • either teal_data or join_keys object to extract join_keys • or any number of join_key_set objects to create join_keys • or nothing to create an empty join_keys
x	(join_keys) empty object to set the new relationship pairs. x is typically an object of join_keys class. When called with the join_keys(x) or join_keys(x) <- value then it can also take a supported class (teal_data, join_keys)
i, j	indices specifying elements to extract or replace. Index should be a character vector, but it can also take numeric, logical, NULL or missing.
directed	(logical(1)) Flag that indicates whether it should create a parent-child relationship between the datasets. • TRUE (default) dataset_1 is the parent of dataset_2; • FALSE when the relationship is undirected.
value	For x[i, j, directed = TRUE] <- value (named/unnamed character) Column mapping between datasets. For join_keys(x) <- value: (join_key_set or list of join_key_set) relationship pairs to add to join_keys list.

Value

join_keys object.

Methods (by class)

- join_keys(): Returns an empty join_keys object when called without arguments.
- join_keys(join_keys): Returns itself.
- join_keys(teal_data): Returns the join_keys object contained in teal_data object.
- join_keys(...): Creates a new object with one or more join_key_set parameters.

Functions

- `x[names]`: Returns a subset of the `join_keys` object for given names, including parent names and symmetric mirror keys between names in the result.
- `x[i, j]`: Returns join keys between datasets `i` and `j`, including implicit keys inferred from their relationship with a parent.
- `x[i, j] <- value`: Assignment of a key to pair (`i`, `j`).
- `x[i] <- value`: This (without `j` parameter) **is not** a supported operation for `join_keys`.
- `join_keys(x)[i, j] <- value`: Assignment to `join_keys` object stored in `x`, such as a `teal_data` object or `join_keys` object itself.
- `join_keys(x) <- value`: Assignment of the `join_keys` in object with `value`. `value` needs to be an object of class `join_keys` or `join_key_set`.

See Also

[join_key\(\)](#) for creating `join_keys_set`, [parents\(\)](#) for parent operations, [teal_data\(\)](#) for `teal_data` constructor *and* [default_cdisc_join_keys](#) for default CDISC keys.

Examples

```
# Creating a new join keys ----

jk <- join_keys(
  join_key("ds1", "ds1", "pk1"),
  join_key("ds2", "ds2", "pk2"),
  join_key("ds3", "ds3", "pk3"),
  join_key("ds1", "ds2", c(pk1 = "pk2")),
  join_key("ds1", "ds3", c(pk1 = "pk3"))
)

jk

# Getter for join_keys ---

jk["ds1", "ds2"]

# Subsetting join_keys ----

jk["ds1"]
jk[1:2]
jk[c("ds1", "ds2")]

# Setting a new primary key ---

jk["ds4", "ds4"] <- "pk4"
jk["ds5", "ds5"] <- "pk5"

# Setting a single relationship pair ---
```

```

jk["ds1", "ds4"] <- c("pk1" = "pk4")

# Removing a key ---

jk["ds5", "ds5"] <- NULL
# Merging multiple `join_keys` objects ---

jk_merged <- c(
  jk,
  join_keys(
    join_key("ds4", keys = c("pk4", "pk4_2")),
    join_key("ds3", "ds4", c(pk3 = "pk4_2"))
  )
)
# note: merge can be performed with both join_keys and join_key_set

jk_merged <- c(
  jk_merged,
  join_key("ds5", keys = "pk5"),
  join_key("ds1", "ds5", c(pk1 = "pk5"))
)
# Assigning keys via join_keys(x)[i, j] <- value ----

obj <- join_keys()
# or
obj <- teal_data()

join_keys(obj)["ds1", "ds1"] <- "pk1"
join_keys(obj)["ds2", "ds2"] <- "pk2"
join_keys(obj)["ds3", "ds3"] <- "pk3"
join_keys(obj)["ds1", "ds2"] <- c(pk1 = "pk2")
join_keys(obj)["ds1", "ds3"] <- c(pk1 = "pk3")

identical(jk, join_keys(obj))
# Setter for join_keys within teal_data ----

td <- teal_data()
join_keys(td) <- jk

join_keys(td)["ds1", "ds2"] <- "new_key"
join_keys(td) <- c(join_keys(td), join_keys(join_key("ds3", "ds2", "key3")))
join_keys(td)

```

names.teal_data

Names of data sets in teal_data object

Description

Functions to get the names of a teal_data object. The names are obtained from the objects listed in the qenv environment.

Usage

```
## S3 method for class 'teal_data'
names(x)
```

Arguments

x A (teal_data) object to access or modify.

Details

Objects named with a . (dot) prefix will be ignored and not returned. To get the names of all objects, use `ls(x, all.names = TRUE)`, however, it will not group the names by the `join_keys` topological structure.

In order to rename objects in the `teal_data` object, use base R functions (see examples).

Value

A character vector of names.

Examples

```
td <- teal_data(iris = iris)
td <- within(td, mtcars <- mtcars)
names(td)

# hidden objects with dot-prefix
td <- within(td, .CO2 <- CO2)
names(td) # '.CO2' will not be returned

# rename objects
td <- teal_data(iris = iris)
td <- within(td, {
  new_iris <- iris
  rm(iris)
})
names(td) # only 'new_iris' will be returned
```

names<-join_keys *The names of a join_keys object*

Description

The names of a `join_keys` object

Usage

```
## S3 replacement method for class 'join_keys'
names(x) <- value
```

Arguments

`x` an R object.
`value` a character vector of up to the same length as `x`, or NULL.

parents	<i>Get and set parents in join_keys object</i>
---------	--

Description

`parents()` facilitates the creation of dependencies between datasets by assigning a parent-child relationship.

Usage

```
parents(x)

## S3 method for class 'join_keys'
parents(x)

## S3 method for class 'teal_data'
parents(x)

parents(x) <- value

## S3 replacement method for class 'join_keys'
parents(x) <- value

## S3 replacement method for class 'teal_data'
parents(x) <- value

parent(x, dataset_name)
```

Arguments

`x` (join_keys or teal_data) object that contains "parents" information to retrieve or manipulate.
`value` (named list) of character vectors.
`dataset_name` (character(1)) Name of dataset to query on their parent.

Details

Each element is defined by a list element, where `list("child" = "parent")`.

Value

a list of character representing the parents.
 For `parent(x, dataset_name)` returns NULL if parent does not exist.

Methods (by class)

- `parents(join_keys)`: Retrieves parents of `join_keys` object.
- `parents(teal_data)`: Retrieves parents of `join_keys` inside `teal_data` object.

Functions

- `parents(x) <- value`: Assignment of parents in `join_keys` object.
- `parents(join_keys) <- value`: Assignment of parents of `join_keys` object.
- `parents(teal_data) <- value`: Assignment of parents of `join_keys` inside `teal_data` object.
- `parent()`: Getter for individual parent.

See Also

[join_keys\(\)](#)

Examples

```
# Get parents of join_keys ---

jk <- default_cdisc_join_keys["ADEX"]
parents(jk)
# Get parents of join_keys inside teal_data object ---

td <- teal_data(
  ADSL = rADSL,
  ADTTE = rADTTE,
  ADRS = rADRS,
  join_keys = default_cdisc_join_keys[c("ADSL", "ADTTE", "ADRS")]
)
parents(td)
# Assignment of parents ---

jk <- join_keys(
  join_key("ds1", "ds2", "id"),
  join_key("ds5", "ds6", "id"),
  join_key("ds7", "ds6", "id")
)

parents(jk) <- list(ds2 = "ds1")

# Setting individual parent-child relationship

parents(jk)["ds6"] <- "ds5"
parents(jk)["ds7"] <- "ds6"
# Assignment of parents of join_keys inside teal_data object ---

parents(td) <- list("ADTTE" = "ADSL") # replace existing
parents(td)["ADRS"] <- "ADSL" # add new parent
# Get individual parent ---
```

```
parent(jk, "ds2")
parent(td, "ADTTE")
```

random_cdisc_data	<i>Simulated CDISC Data for Examples</i>
-------------------	--

Description

This package contains random datasets that are used for testing purposes in the `teal.data` package:

- rADSL: Random subject-level analysis dataset
- rADAE: Random adverse events analysis dataset
- rADCM: Random concomitant medications analysis dataset
- rADEX: Random response analysis dataset
- rADLB: Random laboratory data analysis dataset
- rADRS: Random response analysis dataset
- rADTR: Random tumor response analysis dataset
- rADTTE: Random time to event analysis dataset
- rADVS: Random vital signs analysis dataset

Usage

rADSL

rADAE

rADCM

rADEX

rADLB

rADRS

rADTR

rADTTE

rADVS

Format

- rADSL: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 400 rows and 55 columns.
- rADAE: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 1934 rows and 92 columns.
- rADCM: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 3685 rows and 83 columns.
- rADEX: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 6400 rows and 79 columns.
- rADLB: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 8400 rows and 102 columns.
- rADRS: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 3200 rows and 65 columns.
- rADTR: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 2800 rows and 76 columns.
- rADTTE: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 2000 rows and 67 columns.
- rADVS: An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 16800 rows and 87 columns.

Source

- rADSL: [random.cdisc.data::cadsl](#)
- rADAE: [random.cdisc.data::cadae](#)
- rADCM: [random.cdisc.data::cadcm](#)
- rADEX: [random.cdisc.data::cadex](#)
- rADLB: [random.cdisc.data::cadlb](#)
- rADRS: [random.cdisc.data::cadrs](#)
- rADTR: [random.cdisc.data::cadtr](#)
- rADTTE: [random.cdisc.data::cadtte](#)
- rADVS: [random.cdisc.data::cadvs](#)

show,teal_data-method *Show teal_data object*

Description

Prints teal_data object.

Usage

```
## S4 method for signature 'teal_data'
show(object)
```

Arguments

object (teal_data)

Value

Input teal_data object.

Examples

```
teal_data()
teal_data(x = iris, code = "x = iris")
verify(teal_data(x = iris, code = "x = iris"))
```

teal_data	<i>Comprehensive data integration function for teal applications</i>
-----------	--

Description

Initializes a data for teal application.

Usage

```
teal_data(..., join_keys = teal.data::join_keys(), code = character(0))

## S3 method for class 'teal_data'
x[names]
```

Arguments

<code>...</code>	any number of objects (presumably data objects) provided as <code>name = value</code> pairs.
<code>join_keys</code>	(<code>join_keys</code> or single <code>join_key_set</code>) optional object with datasets column names used for joining. If empty then no joins between pairs of objects.
<code>code</code>	(character, language) optional code to reproduce the datasets provided in <code>...</code> . Note this code is not executed and the <code>teal_data</code> may not be reproducible. Use <code>verify()</code> to verify code reproducibility.
<code>x</code>	(<code>teal_data</code>)
<code>names</code>	(character) names of objects included in <code>teal_subset</code> to subset

Details

A `teal_data` is meant to be used for reproducibility purposes. The class inherits from `teal.code::qenv` and we encourage to get familiar with **teal.code** first. `teal_data` has following characteristics:

- It inherits from the environment and methods such as `$`, `get()`, `ls()`, `as.list()`, `parent.env()` work out of the box.
- `teal_data` is a locked environment, and data modification is only possible through the `teal.code::eval_code()` and `within.qenv()` functions.
- It stores metadata about the code used to create the data (see `get_code()`).
- It supports slicing (see `teal.code::subset-qenv`)
- Is immutable which means that each code evaluation does not modify the original `teal_data` environment directly.
- It maintains information about relationships between datasets (see `join_keys()`).

Value

A `teal_data` object.

Subsetting

`x[names]` subsets objects in `teal_data` environment and limit the code to the necessary needed to build limited objects.

See Also

`teal.code::eval_code`, `get_code()`, `join_keys()`, `names.teal_data()`

Examples

```
teal_data(x1 = iris, x2 = mtcars)

# Subsetting
data <- teal_data()
data <- eval_code(data, "a <- 1;b<-2")
```

```

data["a"]
data[c("a", "b")]

join_keys(data) <- join_keys(join_key("a", "b", "x"))
join_keys(data["a"]) # should show empty keys
join_keys(data["b"])
join_keys(data)["a"] # should show empty keys
join_keys(data)["b"]

```

verify

Verify code reproducibility

Description

Checks whether code in `teal_data` object reproduces the stored objects.

Usage

```
verify(x)
```

Arguments

`x` `teal_data` object

Details

If objects created by code in the `@code` slot of `x` are `all_equal` to the contents of the environment (`@.xData` slot), the function updates the `@verified` slot to `TRUE` in the returned `teal_data` object. Once verified, the slot will always be set to `TRUE`. If the `@code` fails to recreate objects in `teal_data`'s environment, an error is raised.

Value

Input `teal_data` object or error.

Examples

```

tdata1 <- teal_data()
tdata1 <- within(tdata1, {
  a <- 1
  b <- a^5
  c <- list(x = 2)
})
verify(tdata1)

tdata2 <- teal_data(x1 = iris, code = "x1 <- iris")
verify(tdata2)
verify(tdata2)@verified

```

```
tdata2@verified

tdata3 <- teal_data()
tdata3 <- within(tdata3, {
  stop("error")
})
try(verify(tdata3)) # fails

a <- 1
b <- a + 2
c <- list(x = 2)
d <- 5
tdata4 <- teal_data(
  a = a, b = b, c = c, d = d,
  code = "a <- 1
          b <- a
          c <- list(x = 2)
          e <- 1"
)
tdata4
## Not run:
verify(tdata4) # fails

## End(Not run)
```

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