

Package ‘teal’

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Type Package

Title Exploratory Web Apps for Analyzing Clinical Trials Data

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Description A 'shiny' based interactive exploration framework for analyzing clinical trials data. 'teal' currently provides a dynamic filtering facility and different data viewers. 'teal' 'shiny' applications are built using standard 'shiny' modules.

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URL <https://insightsengineering.github.io/teal/>,
<https://github.com/insightsengineering/teal/>

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

Depends R (>= 4.1), shiny (>= 1.8.1), teal.data (>= 0.7.0), teal.slice (>= 0.6.0)

Imports checkmate (>= 2.1.0), cli, htmltools, jsonlite, lifecycle (>= 0.2.0), logger (>= 0.2.0), methods, rlang (>= 1.0.0), shinyjs, stats, teal.code (>= 0.6.1), teal.logger (>= 0.3.2), teal.reporter (>= 0.4.0), teal.widgets (>= 0.4.3), tools, utils

Suggests bslib, ggplot2 (>= 3.4.0), knitr (>= 1.42), mirai (>= 1.1.1), MultiAssayExperiment, R6, renv (>= 1.0.11), rmarkdown (>= 2.23), roxy.shinylive, rvest (>= 1.0.0), shinytest2, shinyvalidate, testthat (>= 3.2.0), withr (>= 2.1.0), yaml (>= 1.1.0)

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Config/Needs/verdepcheck rstudio/shiny, insightsengineering/teal.data, insightsengineering/teal.slice, mllg/checkmate, jeroen/jsonlite, r-lib/lifecycle, daroczig/logger, shikokuchuo/mirai, r-lib/cli, shikokuchuo/nanonext, rstudio/renv, r-lib/rlang, daattali/shinyjs, insightsengineering/teal.code, insightsengineering/teal.logger,

```

insightsengineering/teal.reporter,
insightsengineering/teal.widgets, rstudio/bslib, yihui/knitr,
bioc::MultiAssayExperiment, r-lib/R6, rstudio/rmarkdown,
tidyverse/rvest, rstudio/shinytest2, rstudio/shinyvalidate,
r-lib/testthat, r-lib/withr, yaml=vubio/r-yaml,
rstudio/htmltools, bioc::matrixStats,
insightsengineering/roxy.shinylive

```

Config/Needs/website insightsengineering/nesttemplate

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Collate "TealAppDriver.R" "checkmate.R" "dummy_functions.R"
 "include_css_js.R" "modules.R" "init.R"
 "landing_popup_module.R" "module_bookmark_manager.R"
 "module_data_summary.R" "module_filter_data.R"
 "module_filter_manager.R" "module_init_data.R"
 "module_nested_tabs.R" "module_session_info.R"
 "module_snapshot_manager.R" "module_teal.R"
 "module_teal_data.R" "module_teal_lockfile.R"
 "module_teal_with_splash.R" "module_transform_data.R"
 "reporter_previewer_module.R" "show_rcode_modal.R" "tdata.R"
 "teal.R" "teal_data_module.R" "teal_data_module-eval_code.R"
 "teal_data_module-within.R" "teal_data_utils.R"
 "teal_modifiers.R" "teal_reporter.R" "teal_slices-store.R"
 "teal_slices.R" "teal_transform_module.R" "utils.R"
 "validate_inputs.R" "validations.R" "zzz.R"

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Contents

add_landing_modal	3
build_app_title	4
example_module	5
init	6
landing_popup_module	8
make_teal_transform_server	9
module_session_info	10
module_teal	11
module_teal_with_splash	12
module_transform_data	13
reporter_previewer_module	14
report_card_template	15
show_rcode_modal	15
tdata	16
TealReportCard	17
teal_data_module	18
teal_modules	20
teal_transform_module	27
validate_has_data	30
validate_has_elements	31
validate_has_variable	32
validate_in	33
validate_inputs	34
validate_no_intersection	36
validate_n_levels	38
validate_one_row_per_id	39
Index	41

add_landing_modal	<i>Add a Landing Popup to teal Application</i>
-------------------	--

Description

Adds a landing popup to the teal app. This popup will be shown when the app starts. The dialog must be closed by the app user to proceed to the main application.

Usage

```
add_landing_modal(
  x,
  title = NULL,
  content = NULL,
  footer = modalButton("Accept"),
  ...
)
```

Arguments

x	(teal_app) A teal_app object created using the init function.
title	An optional title for the dialog.
content	(character(1), shiny.tag or shiny.tag.list) with the content of the popup.
footer	UI for footer. Use NULL for no footer.
...	Additional arguments to <code>shiny::modalDialog()</code> .

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
app <- init(
  data = teal_data(IRIS = iris, MTCARS = mtcars),
  modules = modules(example_module())
) |>
add_landing_modal(
  title = "Welcome",
  content = "This is a landing popup.",
  buttons = modalButton("Accept")
)

if (interactive()) {
  shinyApp(app$ui, app$server)
}
```

build_app_title	<i>Build app title with favicon</i>
-----------------	-------------------------------------

Description

A helper function to create the browser title along with a logo.

Usage

```
build_app_title(
  title = "teal app",
  favicon =
    "https://raw.githubusercontent.com/insightsengineering/hex-stickers/main/PNG/nest.png"
)
```

Arguments

title (character) The browser title for the teal app.

favicon (character) The path for the icon for the title. The image/icon path can be remote or the static path accessible by shiny, like the `www/`

Value

A shiny.tag containing the element that adds the title and logo to the shiny app.

example_module	<i>An example teal module</i>
----------------	-------------------------------

Description

[Experimental]

Usage

```
example_module(
  label = "example teal module",
  datanames = "all",
  transformers = list(),
  decorators = list()
)
```

Arguments

label (character(1)) Label shown in the navigation item for the module or module group. For `modules()` defaults to "root". See Details.

datanames (character) Names of the datasets relevant to the item. There are 2 reserved values that have specific behaviors:

- The keyword "all" includes all datasets available in the data passed to the teal application.
- NULL hides the sidebar panel completely.
- If transformers are specified, their datanames are automatically added to this datanames argument.

transformators (list of `teal_transform_module`) that will be applied to transform module's data input. To learn more check `vignette("transform-input-data", package = "teal")`.

decorators **[Experimental]** (list of `teal_transform_module`) optional, decorator for object included in the module.

Details

This module creates an object called `object` that can be modified with decorators. The object is determined by what's selected in Choose a dataset input in UI. The object can be anything that can be handled by `renderPrint()`. See the `vignette("transform-module-output", package = "teal")` or [teal_transform_module](#) to read more about decorators.

Value

A teal module which can be included in the modules argument to `init()`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
app <- init(
  data = teal_data(IRIS = iris, MTCARS = mtcars),
  modules = example_module()
)
if (interactive()) {
  shinyApp(app$ui, app$server)
}
```

init

Create the server and UI function for the shiny app

Description

[Stable]

End-users: This is the most important function for you to start a teal app that is composed of teal modules.

Usage

```
init(
  data,
  modules,
  filter = teal_slices(),
  title = lifecycle::deprecated(),
  header = lifecycle::deprecated(),
```

```

    footer = lifecycle::deprecated(),
    id = lifecycle::deprecated()
  )

```

Arguments

data	(teal_data or teal_data_module) For constructing the data object, refer to teal.data::teal_data() and teal_data_module() .
modules	(list or teal_modules or teal_module) Nested list of teal_modules or teal_module objects or a single teal_modules or teal_module object. These are the specific output modules which will be displayed in the teal application. See modules() and module() for more details.
filter	(teal_slices) Optionally, specifies the initial filter using teal_slices() .
title	(shiny.tag or character(1)) [Deprecated] Optionally, the browser window title. Defaults to a title "teal app" with the icon of NEST. Can be created using the build_app_title() or by passing a valid shiny.tag which is a head tag with title and link tag. This parameter is no longer supported. Use modify_title() on the teal app object instead.
header	(shiny.tag or character(1)) [Deprecated] Optionally, the header of the app. This parameter is no longer supported. Use modify_header() on the teal app object instead.
footer	(shiny.tag or character(1)) [Deprecated] Optionally, the footer of the app. This parameter is no longer supported. Use modify_footer() on the teal app object instead.
id	[Deprecated] (character) Optionally, a string specifying the shiny module id in cases it is used as a shiny module rather than a standalone shiny app. This parameter is no longer supported. Use ui_teal() and srv_teal() instead.

Value

Named list containing server and UI functions.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```

app <- init(
  data = within(
    teal_data(),
    {
      new_iris <- transform(iris, id = seq_len(nrow(iris)))
      new_mtcars <- transform(mtcars, id = seq_len(nrow(mtcars)))
    }
  ),
  modules = modules(
    module(

```

```

    label = "data source",
    server = function(input, output, session, data) {},
    ui = function(id, ...) tags$div(p("information about data source")),
    datanames = "all"
  ),
  example_module(label = "example teal module"),
  module(
    "Iris Sepal.Length histogram",
    server = function(input, output, session, data) {
      output$hist <- renderPlot(
        hist(data()[["new_iris"]]$Sepal.Length)
      )
    },
    ui = function(id, ...) {
      ns <- NS(id)
      plotOutput(ns("hist"))
    },
    datanames = "new_iris"
  )
),
filter = teal_slices(
  teal_slice(dataname = "new_iris", varname = "Species"),
  teal_slice(dataname = "new_iris", varname = "Sepal.Length"),
  teal_slice(dataname = "new_mtcars", varname = "cyl"),
  exclude_varnames = list(new_iris = c("Sepal.Width", "Petal.Width")),
  module_specific = TRUE,
  mapping = list(
    `example teal module` = "new_iris Species",
    `Iris Sepal.Length histogram` = "new_iris Species",
    global_filters = "new_mtcars cyl"
  )
)
)
if (interactive()) {
  shinyApp(app$ui, app$server)
}

```

landing_popup_module *Landing popup module*

Description

[Deprecated] Creates a landing welcome popup for teal applications.

This module is used to display a popup dialog when the application starts. The dialog blocks access to the application and must be closed with a button before the application can be viewed. This function is deprecated, please use `add_landing_modal()` on the teal app object instead.

Usage

```
landing_popup_module(
  label = "Landing Popup",
  title = NULL,
  content = NULL,
  buttons = modalButton("Accept")
)
```

Arguments

label	(character(1)) Label of the module.
title	(character(1)) Text to be displayed as popup title.
content	(character(1), shiny.tag or shiny.tag.list) with the content of the popup. Passed to ... of shiny::modalDialog. See examples.
buttons	(shiny.tag or shiny.tag.list) Typically a modalButton or actionButton. See examples.

Value

A teal_module (extended with teal_landing_module class) to be used in teal applications.

```
make_teal_transform_server
```

Make teal_transform_module's server

Description

A factory function to simplify creation of a [teal_transform_module](#)'s server. Specified expr is wrapped in a shiny module function and output can be passed to the server argument in [teal_transform_module\(\)](#) call. Such a server function can be linked with ui and values from the inputs can be used in the expression. Object names specified in the expression will be substituted with the value of the respective input (matched by the name) - for example in expression(graph <- graph + ggtitle(title)) object title will be replaced with the value of input\$title.

Usage

```
make_teal_transform_server(expr)
```

Arguments

expr	(language) An R call which will be evaluated within teal.data::teal_data environment.
------	---

Value

function(id, data) returning shiny module

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
trim_iris <- teal_transform_module(
  label = "Simplified interactive transformator for iris",
  datanames = "iris",
  ui = function(id) {
    ns <- NS(id)
    numericInput(ns("n_rows"), "Subset n rows", value = 6, min = 1, max = 150, step = 1)
  },
  server = make_teal_transform_server(expression(iris <- head(iris, n_rows)))
)

app <- init(
  data = teal_data(iris = iris),
  modules = example_module(transformators = trim_iris)
)
if (interactive()) {
  shinyApp(app$ui, app$server)
}
```

module_session_info	teal user session info module
---------------------	-------------------------------

Description

Module to display the user session info popup and to download a lockfile. Module is included when running `init()` but skipped when using `module_teal`. Please be aware that session info contains R session information, so multiple module's calls will share the same information.

Usage

```
ui_session_info(id)

srv_session_info(id)
```

Arguments

`id` (character(1)) shiny module instance id.

Value

NULL invisibly

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
ui <- fluidPage(
  ui_session_info("session_info")
)

server <- function(input, output, session) {
  srv_session_info("session_info")
}

if (interactive()) {
  shinyApp(ui, server)
}
```

module_teal	teal <i>main module</i>
-------------	-------------------------

Description

[Stable] Module to create a teal app as a Shiny Module.

Usage

```
ui_teal(id, modules)

srv_teal(id, data, modules, filter = teal_slices())
```

Arguments

id	(character(1)) shiny module instance id.
modules	(teal_modules) teal_modules object. These are the specific output modules which will be displayed in the teal application. See modules() and module() for more details.
data	(teal_data, teal_data_module, or reactive returning teal_data) The data which application will depend on.
filter	(teal_slices) Optionally, specifies the initial filter using teal_slices() .

Details

This module can be used instead of [init\(\)](#) in custom Shiny applications. Unlike [init\(\)](#), it doesn't automatically include [module_session_info](#).

Module is responsible for creating the main shiny app layout and initializing all the necessary components. This module establishes reactive connection between the input data and every other

component in the app. Reactive change of the data passed as an argument, reloads the app and possibly keeps all input settings the same so the user can continue where one left off.

data flow in teal application:

This module supports multiple data inputs but eventually, they are all converted to reactive returning `teal_data` in this module. On this reactive `teal_data` object several actions are performed:

- data loading in [module_init_data](#)
- data filtering in [module_filter_data](#)
- data transformation in [module_transform_data](#)

Fallback on failure:

`teal` is designed in such way that app will never crash if the error is introduced in any custom shiny module provided by app developer (e.g. [teal_data_module\(\)](#), [teal_transform_module\(\)](#)). If any module returns a failing object, the app will halt the evaluation and display a warning message. App user should always have a chance to fix the improper input and continue without restarting the session.

Value

NULL invisibly

`module_teal_with_splash`

UI and server modules of teal

Description

[Deprecated] Please use [module_teal](#) instead.

Usage

```
ui_teal_with_splash(
  id,
  data,
  modules,
  title = build_app_title(),
  header = tags$p(),
  footer = tags$p()
)

srv_teal_with_splash(id, data, modules, filter = teal_slices())
```

Arguments

id	(character(1)) shiny module instance id.
data	(teal_data, teal_data_module, or reactive returning teal_data) The data which application will depend on.
modules	(teal_modules) teal_modules object. These are the specific output modules which will be displayed in the teal application. See modules() and module() for more details.
title	(shiny.tag or character(1)) [Deprecated] Optionally, the browser window title. Defaults to a title "teal app" with the icon of NEST. Can be created using the build_app_title() or by passing a valid shiny.tag which is a head tag with title and link tag. This parameter is no longer supported. Use modify_title() on the teal app object instead.
header	(shiny.tag or character(1)) [Deprecated] Optionally, the header of the app. This parameter is no longer supported. Use modify_header() on the teal app object instead.
footer	(shiny.tag or character(1)) [Deprecated] Optionally, the footer of the app. This parameter is no longer supported. Use modify_footer() on the teal app object instead.
filter	(teal_slices) Optionally, specifies the initial filter using teal_slices() .

Value

Returns a reactive expression containing a teal_data object when data is loaded or NULL when it is not.

module_transform_data *Module to transform reactive teal_data*

Description

Module calls [teal_transform_module\(\)](#) in sequence so that reactive teal_data output from one module is handed over to the following module's input.

Usage

```
ui_transform_teal_data(id, transformers, class = "well")

srv_transform_teal_data(
  id,
  data,
  transformers,
  modules = NULL,
  is_transform_failed = reactiveValues()
)
```

Arguments

<code>id</code>	(character(1)) shiny module instance id.
<code>transformators</code>	(list of teal_transform_module) that will be applied to transform module's data input. To learn more check vignette("transform-input-data", package = "teal").
<code>class</code>	(character(1)) CSS class to be added in the div wrapper tag.
<code>data</code>	(reactive returning teal_data)
<code>modules</code>	(teal_modules or teal_module) For datanames validation purpose
<code>is_transform_failed</code>	(reactiveValues) contains logical flags named after each transformator. Help to determine if any previous transformator failed, so that following transformators can be disabled and display a generic failure message.

Value

reactive teal_data

reporter_previewer_module

Create a teal module for previewing a report

Description**[Experimental]**

This function wraps `teal.reporter::reporter_previewer_ui()` and `teal.reporter::reporter_previewer_srv()` into a teal_module to be used in teal applications.

If you are creating a teal application using `init()` then this module will be added to your application automatically if any of your teal_modules support report generation.

Usage

```
reporter_previewer_module(label = "Report previewer", server_args = list())
```

Arguments

<code>label</code>	(character(1)) Label shown in the navigation item for the module or module group. For modules() defaults to "root". See Details.
<code>server_args</code>	(named list) Arguments passed to <code>teal.reporter::reporter_previewer_srv()</code> .

Value

teal_module (extended with teal_module_previewer class) containing the teal.reporter pre-viewer functionality.

report_card_template	<i>Template function for TealReportCard creation and customization</i>
----------------------	--

Description

This function generates a report card with a title, an optional description, and the option to append the filter state list.

Usage

```
report_card_template(
  title,
  label,
  description = NULL,
  with_filter,
  filter_panel_api
)
```

Arguments

title	(character(1)) title of the card (unless overwritten by label)
label	(character(1)) label provided by the user when adding the card
description	(character(1)) optional, additional description
with_filter	(logical(1)) flag indicating to add filter state
filter_panel_api	(FilterPanelAPI) object with API that allows the generation of the filter state in the report

Value

(TealReportCard) populated with a title, description and filter state.

show_rcode_modal	<i>Show R code modal</i>
------------------	--------------------------

Description**[Deprecated]**

Use the `shiny::showModal()` function to show the R code inside.

Usage

```
show_rcode_modal(title = NULL, rcode, session = getDefaultReactiveDomain())
```

Arguments

title	(character(1)) Title of the modal, displayed in the first comment of the R code.
rcode	(character) vector with R code to show inside the modal.
session	(ShinySession) optional shiny session object, defaults to <code>shiny::getDefaultReactiveDomain()</code> .

References

`shiny::showModal()`

tdata	<i>Create a tdata object</i>
-------	------------------------------

Description**[Superseded]**

Recent changes in teal cause modules to fail because modules expect a tdata object to be passed to the data argument but instead they receive a teal_data object, which is additionally wrapped in a reactive expression in the server functions. In order to easily adapt such modules without a proper refactor, use this function to downgrade the data argument.

Usage

```
new_tdata(...)

tdata2env(...)

get_code_tdata(...)

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

get_metadata(...)

as_tdata(...)
```

Arguments

... ignored

Value

nothing

TealReportCard	TealReportCard
----------------	----------------

Description

[Experimental] Child class of `teal.reporter::ReportCard` that is used for teal specific applications. In addition to the parent methods, it supports rendering teal specific elements such as the source code, the encodings panel content and the filter panel content as part of the meta data.

Super class

`teal.reporter::ReportCard` -> TealReportCard

Methods

Public methods:

- `TealReportCard$append_src()`
- `TealReportCard$append_fs()`
- `TealReportCard$append_encodings()`
- `TealReportCard$clone()`

Method `append_src()`: Appends the source code to the content meta data of this TealReportCard.

Usage:

```
TealReportCard$append_src(src, ...)
```

Arguments:

`src` (character(1)) code as text.

`...` any rmarkdown R chunk parameter and its value. But `eval` parameter is always set to FALSE.

Returns: Object of class TealReportCard, invisibly.

Examples:

```
card <- TealReportCard$new()$append_src(
  "plot(iris)"
)
card$get_content()[[1]]$get_content()
```

Method `append_fs()`: Appends the filter state list to the content and metadata of this TealReportCard. If the filter state list has an attribute named `formatted`, it appends it to the card otherwise it uses the default `yaml::as.yaml` to format the list. If the filter state list is empty, nothing is appended to the content.

Usage:

```
TealReportCard$append_fs(fs)
```

Arguments:

`fs` (teal_slices) object returned from `teal_slices()` function.

Returns: self, invisibly.

Method `append_encodings()`: Appends the encodings list to the content and metadata of this `TealReportCard`.

Usage:

```
TealReportCard$append_encodings(encodings)
```

Arguments:

`encodings` (list) list of encodings selections of the teal app.

Returns: self, invisibly.

Examples:

```
card <- TealReportCard$new()$append_encodings(list(variable1 = "X"))
card$get_content()[[1]]$get_content()
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
TealReportCard$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

Examples

```
## -----
## Method `TealReportCard$append_src`
## -----

card <- TealReportCard$new()$append_src(
  "plot(iris)"
)
card$get_content()[[1]]$get_content()

## -----
## Method `TealReportCard$append_encodings`
## -----

card <- TealReportCard$new()$append_encodings(list(variable1 = "X"))
card$get_content()[[1]]$get_content()
```

teal_data_module

Data module for teal applications

Description

[Experimental]

Create a `teal_data_module` object and evaluate code on it with history tracking.

Usage

```
teal_data_module(ui, server, label = "data module", once = TRUE)

## S4 method for signature 'teal_data_module,character'
eval_code(object, code)

## S3 method for class 'teal_data_module'
within(data, expr, ...)
```

Arguments

ui	(function(id)) shiny module UI function; must only take id argument
server	(function(id)) shiny module server function; must only take id argument; must return reactive expression containing teal_data object
label	(character(1)) Label of the module.
once	(logical(1)) If TRUE, the data module will be shown only once and will disappear after successful data loading. App user will no longer be able to interact with this module anymore. If FALSE, the data module can be reused multiple times. App user will be able to interact and change the data output from the module multiple times.
object	(teal_data_module)
code	(character, language or expression) code to evaluate. It is possible to preserve original formatting of the code by providing a character or an expression being a result of <code>parse(keep.source = TRUE)</code> .
data	(teal_data_module) object
expr	(expression) to evaluate. Must be inline code. See within()
...	See Details.

Details

`teal_data_module` creates a shiny module to interactively supply or modify data in a teal application. The module allows for running any code (creation *and* some modification) after the app starts or reloads. The body of the server function will be run in the app rather than in the global environment. This means it will be run every time the app starts, so use sparingly.

Pass this module instead of a `teal_data` object in a call to `init()`. Note that the server function must always return a `teal_data` object wrapped in a reactive expression.

See vignette `vignette("data-as-shiny-module", package = "teal")` for more details.

`eval_code` evaluates given code in the environment of the `teal_data` object created by the `teal_data_module`. The code is added to the `@code` slot of the `teal_data`.

`within` is a convenience function for evaluating inline code inside the environment of a `teal_data_module`. It accepts only inline expressions (both simple and compound) and allows for injecting values into `expr` through the `...` argument: as `name:value` pairs are passed to `...`, `name` in `expr` will be replaced with `value`.

Value

`teal_data_module` returns a list of class `teal_data_module` containing two elements, `ui` and `server` provided via arguments.

`eval_code` returns a `teal_data_module` object with a delayed evaluation of code when the module is run.

`within` returns a `teal_data_module` object with a delayed evaluation of `expr` when the module is run.

See Also

[teal.data::teal_data](#), [teal.code::qenv\(\)](#)

Examples

```
tdm <- teal_data_module(
  ui = function(id) {
    ns <- NS(id)
    actionButton(ns("submit"), label = "Load data")
  },
  server = function(id) {
    moduleServer(id, function(input, output, session) {
      eventReactive(input$submit, {
        data <- within(
          teal_data(),
          {
            dataset1 <- iris
            dataset2 <- mtcars
          }
        )

        data
      })
    })
  }
)

eval_code(tdm, "dataset1 <- subset(dataset1, Species == 'virginica')")

within(tdm, dataset1 <- subset(dataset1, Species == "virginica"))

# use additional parameter for expression value substitution.
valid_species <- "versicolor"
within(tdm, dataset1 <- subset(dataset1, Species %in% species), species = valid_species)
```

Description

[Stable] Create a nested tab structure to embed modules in a teal application.

Usage

```
module(
  label = "module",
  server = function(id, data, ...) moduleServer(id, function(input, output, session)
    NULL),
  ui = function(id, ...) tags$p(paste0("This module has no UI (id: ", id, " )")),
  filters,
  datanames = "all",
  server_args = NULL,
  ui_args = NULL,
  transformers = list()
)

modules(..., label = "root")

## S3 method for class 'teal_module'
format(
  x,
  is_last = FALSE,
  parent_prefix = "",
  what = c("datasets", "properties", "ui_args", "server_args", "decorators",
    "transformers"),
  ...
)

## S3 method for class 'teal_modules'
format(x, is_root = TRUE, is_last = FALSE, parent_prefix = "", ...)

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

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

Arguments

- | | |
|--------|---|
| label | (character(1)) Label shown in the navigation item for the module or module group. For <code>modules()</code> defaults to "root". See Details. |
| server | (function) shiny module with following arguments: <ul style="list-style-type: none"> • id - teal will set proper shiny namespace for this module (see <code>shiny::moduleServer()</code>). • input, output, session - (optional; not recommended) When provided, then <code>shiny::callModule()</code> will be used to call a module. From shiny 1.5.0, the recommended way is to use <code>shiny::moduleServer()</code> instead which doesn't require these arguments. |

	• <code>data</code> (optional) If the server function includes a <code>data</code> argument, it will receive a reactive expression containing the <code>teal_data</code> object. • <code>datasets</code> (optional) When provided, the module will be called with <code>FilteredData</code> object as the value of this argument. (See <code>teal.slice::FilteredData</code>). • <code>reporter</code> (optional) When provided, the module will be called with <code>Reporter</code> object as the value of this argument. (See <code>teal.reporter::Reporter</code>). • <code>filter_panel_api</code> (optional) When provided, the module will be called with <code>FilterPanelAPI</code> object as the value of this argument. (See <code>teal.slice::FilterPanelAPI</code>). • ... (optional) When provided, <code>server_args</code> elements will be passed to the module named argument or to the ...
<code>ui</code>	(function) shiny UI module function with following arguments: • <code>id</code> - teal will set proper shiny namespace for this module. • ... (optional) When provided, <code>ui_args</code> elements will be passed to the module named argument or to the ...
<code>filters</code>	(character) Deprecated. Use <code>datanames</code> instead.
<code>datanames</code>	(character) Names of the datasets relevant to the item. There are 2 reserved values that have specific behaviors: • The keyword "all" includes all datasets available in the data passed to the teal application. • NULL hides the sidebar panel completely. • If transformers are specified, their <code>datanames</code> are automatically added to this <code>datanames</code> argument.
<code>server_args</code>	(named list) with additional arguments passed on to the server function.
<code>ui_args</code>	(named list) with additional arguments passed on to the UI function.
<code>transformators</code>	(list of <code>teal_transform_module</code>) that will be applied to transform module's data input. To learn more check <code>vignette("transform-input-data", package = "teal")</code> .
...	• For <code>modules()</code>: (<code>teal_module</code> or <code>teal_modules</code>) Objects to wrap into a tab. • For <code>format()</code> and <code>print()</code>: Arguments passed to other methods.
<code>x</code>	(<code>teal_module</code> or <code>teal_modules</code>) Object to format/print.
<code>is_last</code>	(<code>logical(1)</code>) Whether this is the last item in its parent's children list. Affects the tree branch character used (L- vs -)
<code>parent_prefix</code>	(<code>character(1)</code>) The prefix inherited from parent nodes, used to maintain the tree structure in nested levels
<code>what</code>	(character) Specifies which metadata to display. Possible values: "datasets", "properties", "ui_args", "server_args", "transformators"
<code>is_root</code>	(<code>logical(1)</code>) Whether this is the root node of the tree. Only used in <code>format.teal_modules()</code> . Determines whether to show "TEAL ROOT" header

Details

`module()` creates an instance of a `teal_module` that can be placed in a teal application. `modules()` shapes the structure of a the application by organizing `teal_module` within the navigation panel. It wraps `teal_module` and `teal_modules` objects in a `teal_modules` object, which results in a nested structure corresponding to the nested tabs in the final application.

Note that for `modules()` `label` comes after `...`, so it must be passed as a named argument, otherwise it will be captured by `...`.

The labels "global_filters" and "Report previewer" are reserved because they are used by the mapping argument of `teal_slices()` and the report previewer module `reporter_previewer_module()`, respectively.

Value

`module()` returns an object of class `teal_module`.

`modules()` returns a `teal_modules` object which contains following fields:

- `label`: taken from the `label` argument.
- `children`: a list containing objects passed in `...`. List elements are named after their `label` attribute converted to a valid shiny id.

Restricting datasets used by teal_module:

The `datanames` argument controls which datasets are used by the module's server. These datasets, passed via server's `data` argument, are the only ones shown in the module's tab.

When `datanames` is set to "all", all datasets in the `data` object are treated as relevant. However, this may include unnecessary datasets, such as:

- Proxy variables for column modifications
- Temporary datasets used to create final ones
- Connection objects

Datasets which name is prefixed in `teal_data` by the dot (.) are not displayed in the teal application. Please see the "*Hidden datasets*" section in 'vignette("including-data-in-teal-applications").

`datanames` with transformers

When transformers are specified, their `datanames` are added to the module's `datanames`, which changes the behavior as follows:

- If `module(datanames)` is NULL and the transformers have defined `datanames`, the sidebar will appear showing the transformers' datasets, instead of being hidden.
- If `module(datanames)` is set to specific values and any transformer has `datanames = "all"`, the module may receive extra datasets that could be unnecessary

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```

library(shiny)

module_1 <- module(
  label = "a module",
  server = function(id, data) {
    moduleServer(
      id,
      module = function(input, output, session) {
        output$data <- renderDataTable(data()[["iris"]])
      }
    )
  },
  ui = function(id) {
    ns <- NS(id)
    tagList(dataTableOutput(ns("data")))
  },
  datanames = "all"
)

module_2 <- module(
  label = "another module",
  server = function(id) {
    moduleServer(
      id,
      module = function(input, output, session) {
        output$text <- renderText("Another Module")
      }
    )
  },
  ui = function(id) {
    ns <- NS(id)
    tagList(textOutput(ns("text")))
  },
  datanames = NULL
)

modules <- modules(
  label = "modules",
  modules(
    label = "nested modules",
    module_1
  ),
  module_2
)

app <- init(
  data = teal_data(iris = iris),
  modules = modules
)

if (interactive()) {

```

```

    shinyApp(app$ui, app$server)
  }
  mod <- module(
    label = "My Custom Module",
    server = function(id, data, ...) {},
    ui = function(id, ...) {},
    datanames = c("ADSL", "ADTTE"),
    transformers = list(),
    ui_args = list(a = 1, b = "b"),
    server_args = list(x = 5, y = list(p = 1))
  )
  cat(format(mod))
  custom_module <- function(
    label = "label", ui_args = NULL, server_args = NULL,
    datanames = "all", transformers = list(), bk = FALSE) {
    ans <- module(
      label,
      server = function(id, data, ...) {},
      ui = function(id, ...) {
      },
      datanames = datanames,
      transformers = transformers,
      ui_args = ui_args,
      server_args = server_args
    )
    attr(ans, "teal_bookmarkable") <- bk
    ans
  }

  dummy_transformator <- teal_transform_module(
    label = "Dummy Transform",
    ui = function(id) div("(does nothing)"),
    server = function(id, data) {
      moduleServer(id, function(input, output, session) data)
    }
  )

  plot_transformator <- teal_transform_module(
    label = "Plot Settings",
    ui = function(id) div("(does nothing)"),
    server = function(id, data) {
      moduleServer(id, function(input, output, session) data)
    }
  )

  static_decorator <- teal_transform_module(
    label = "Static decorator",
    server = function(id, data) {
      moduleServer(id, function(input, output, session) {
        reactive({
          req(data())
          within(data(), {
            plot <- plot +

```

```

      ggtitle("This is title") +
      xlab("x axis")
    })
  })
}
)

complete_modules <- modules(
  custom_module(
    label = "Data Overview",
    datanames = c("ADSL", "ADAE", "ADVS"),
    ui_args = list(
      view_type = "table",
      page_size = 10,
      filters = c("ARM", "SEX", "RACE"),
      decorators = list(static_decorator)
    ),
    server_args = list(
      cache = TRUE,
      debounce = 1000,
      decorators = list(static_decorator)
    ),
    transformers = list(dummy_transformator),
    bk = TRUE
  ),
  modules(
    label = "Nested 1",
    custom_module(
      label = "Interactive Plots",
      datanames = c("ADSL", "ADVS"),
      ui_args = list(
        plot_type = c("scatter", "box", "line"),
        height = 600,
        width = 800,
        color_scheme = "viridis"
      ),
      server_args = list(
        render_type = "svg",
        cache_plots = TRUE
      ),
      transformers = list(dummy_transformator, plot_transformator),
      bk = TRUE
    ),
    modules(
      label = "Nested 2",
      custom_module(
        label = "Summary Statistics",
        datanames = "ADSL",
        ui_args = list(
          stats = c("mean", "median", "sd", "range"),
          grouping = c("ARM", "SEX")
        )
      )
    )
  )
)

```

```

    ),
    modules(
      label = "Labeled nested modules",
      custom_module(
        label = "Subgroup Analysis",
        datanames = c("ADSL", "ADAE"),
        ui_args = list(
          subgroups = c("AGE", "SEX", "RACE"),
          analysis_type = "stratified"
        ),
        bk = TRUE
      )
    ),
    modules(custom_module(label = "Subgroup Analysis in non-labeled modules"))
  )
),
custom_module("Non-nested module")
)

cat(format(complete_modules))
cat(format(complete_modules, what = c("ui_args", "server_args", "transformators")))
cat(format(complete_modules, what = c("decorators", "transformators")))

```

teal_transform_module *Data module for teal transformations and output customization*

Description

[Experimental]

teal_transform_module provides a shiny module that enables data transformations within a teal application and allows for customization of outputs generated by modules.

Usage

```

teal_transform_module(
  ui = NULL,
  server = function(id, data) data,
  label = "transform module",
  datanames = "all"
)

```

Arguments

ui	(function(id)) shiny module UI function; must only take id argument
server	(function(id, data) or expression) A shiny module server function that takes id and data as arguments, where id is the module id and data is the reactive teal_data input. The server function must return a reactive expression containing a teal_data object. For simplified syntax, use make_teal_transform_server() .

label	(character(1)) Label of the module.
datanames	(character) Specifies the names of datasets relevant to the module. Only filters for the specified datanames will be displayed in the filter panel. The keyword "all" can be used to display filters for all datasets. datanames are automatically appended to the <code>modules()</code> datanames.

Transforming Module Inputs in teal

Data transformations occur after data has been filtered in teal. The transformed data is then passed to the server of `teal_module()` and managed by teal's internal processes. The primary advantage of `teal_transform_module` over custom modules is in its error handling, where all warnings and errors are managed by teal, allowing developers to focus on transformation logic.

For more details, see the vignette: `vignette("transform-input-data", package = "teal")`.

Customizing Module Outputs

`teal_transform_module` also allows developers to modify any object created within `teal.data::teal_data`. This means you can use it to customize not only datasets but also tables, listings, and graphs. Some `teal_modules` permit developers to inject custom shiny modules to enhance displayed outputs. To manage these decorators within your module, use `ui_transform_teal_data()` and `srv_transform_teal_data()`. (For further guidance on managing decorators, refer to `ui_args` and `srv_args` in the vignette documentation.)

See the vignette `vignette("transform-module-output", package = "teal")` for additional examples.

server as a language

The server function in `teal_transform_module` must return a reactive `teal.data::teal_data` object. For simple transformations without complex reactivity, the server function might look like this:

```
function(id, data) {
  moduleServer(id, function(input, output, session) {
    reactive({
      within(
        data(),
        expr = x <- subset(x, col == level),
        level = input$level
      )
    })
  })
}
```

The example above can be simplified using `make_teal_transform_server`, where `level` is automatically matched to the corresponding input parameter:

```
make_teal_transform_server(expr = expression(x <- subset(x, col == level)))
```

Examples in Shinylive**example-1** [Open in Shinylive](#)**Examples**

```

data_transformators <- list(
  teal_transform_module(
    label = "Static transformator for iris",
    datanames = "iris",
    server = function(id, data) {
      moduleServer(id, function(input, output, session) {
        reactive({
          within(data(), {
            iris <- head(iris, 5)
          })
        })
      })
    },
    teal_transform_module(
      label = "Interactive transformator for iris",
      datanames = "iris",
      ui = function(id) {
        ns <- NS(id)
        tags$div(
          numericInput(ns("n_cols"), "Show n columns", value = 5, min = 1, max = 5, step = 1)
        )
      },
      server = function(id, data) {
        moduleServer(id, function(input, output, session) {
          reactive({
            within(data(),
              {
                iris <- iris[, 1:n_cols]
              },
              n_cols = input$n_cols
            )
          })
        })
      }
    )
  )
)

output_decorator <- teal_transform_module(
  server = make_teal_transform_server(
    expression(
      object <- rev(object)
    )
  )
)

app <- init(

```

```

data = teal_data(iris = iris),
modules = example_module(
  transformers = data_transformators,
  decorators = list(output_decorator)
)
)
if (interactive()) {
  shinyApp(app$ui, app$server)
}

```

validate_has_data	<i>Validate that dataset has a minimum number of observations</i>
-------------------	---

Description

[Stable]

Usage

```

validate_has_data(
  x,
  min_nrow = NULL,
  complete = FALSE,
  allow_inf = TRUE,
  msg = NULL
)

```

Arguments

x	(data.frame)
min_nrow	(numeric(1)) Minimum allowed number of rows in x.
complete	(logical(1)) Flag specifying whether to check only complete cases. Defaults to FALSE.
allow_inf	(logical(1)) Flag specifying whether to allow infinite values. Defaults to TRUE.
msg	(character(1)) Additional message to display alongside the default message.

Details

This function is a wrapper for `shiny::validate`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```

library(teal)
ui <- fluidPage(
  sliderInput("len", "Max Length of Sepal",
    min = 4.3, max = 7.9, value = 5
  ),
  plotOutput("plot")
)

server <- function(input, output) {
  output$plot <- renderPlot({
    iris_df <- iris[iris$Sepal.Length <= input$len, ]
    validate_has_data(
      iris_df,
      min_nrow = 10,
      complete = FALSE,
      msg = "Please adjust Max Length of Sepal"
    )

    hist(iris_df$Sepal.Length, breaks = 5)
  })
}
if (interactive()) {
  shinyApp(ui, server)
}

```

validate_has_elements *Validates that vector has length greater than 0*

Description**[Stable]****Usage**

```
validate_has_elements(x, msg)
```

Arguments

x	vector
msg	message to display

Details

This function is a wrapper for `shiny::validate`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```

data <- data.frame(
  id = c(1:10, 11:20, 1:10),
  strata = rep(c("A", "B"), each = 15)
)
ui <- fluidPage(
  selectInput("ref1", "Select strata1 to compare",
    choices = c("A", "B", "C"), selected = "A"
  ),
  selectInput("ref2", "Select strata2 to compare",
    choices = c("A", "B", "C"), selected = "B"
  ),
  verbatimTextOutput("arm_summary")
)

server <- function(input, output) {
  output$arm_summary <- renderText({
    sample_1 <- data$id[data$strata == input$ref1]
    sample_2 <- data$id[data$strata == input$ref2]

    validate_has_elements(sample_1, "No subjects in strata1.")
    validate_has_elements(sample_2, "No subjects in strata2.")

    paste0(
      "Number of samples in: strata1=", length(sample_1),
      " comparions strata2=", length(sample_2)
    )
  })
}
if (interactive()) {
  shinyApp(ui, server)
}

```

validate_has_variable *Validates that dataset contains specific variable*

Description**[Stable]****Usage**

```
validate_has_variable(data, varname, msg)
```

Arguments

data	(data.frame)
varname	(character(1)) name of variable to check for in data
msg	(character(1)) message to display if data does not include varname

Details

This function is a wrapper for `shiny::validate`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
data <- data.frame(
  one = rep("a", length.out = 20),
  two = rep(c("a", "b"), length.out = 20)
)
ui <- fluidPage(
  selectInput(
    "var",
    "Select variable",
    choices = c("one", "two", "three", "four"),
    selected = "one"
  ),
  verbatimTextOutput("summary")
)

server <- function(input, output) {
  output$summary <- renderText({
    validate_has_variable(data, input$var)
    paste0("Selected treatment variables: ", paste(input$var, collapse = ", "))
  })
}
if (interactive()) {
  shinyApp(ui, server)
}
```

 validate_in

Validates that vector includes all expected values

Description

[Stable]

Usage

```
validate_in(x, choices, msg)
```

Arguments

x	Vector of values to test.
choices	Vector to test against.
msg	(character(1)) Error message to display if some elements of x are not elements of choices.

Details

This function is a wrapper for `shiny::validate`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
ui <- fluidPage(
  selectInput(
    "species",
    "Select species",
    choices = c("setosa", "versicolor", "virginica", "unknown species"),
    selected = "setosa",
    multiple = FALSE
  ),
  verbatimTextOutput("summary")
)

server <- function(input, output) {
  output$summary <- renderPrint({
    validate_in(input$species, iris$Species, "Species does not exist.")
    nrow(iris[iris$Species == input$species, ])
  })
}
if (interactive()) {
  shinyApp(ui, server)
}
```

validate_inputs

Send input validation messages to output

Description

Captures messages from `InputValidator` objects and collates them into one message passed to `validate`.

Usage

```
validate_inputs(..., header = "Some inputs require attention")
```

Arguments

<code>...</code>	either any number of <code>InputValidator</code> objects or an optionally named, possibly nested list of <code>InputValidator</code> objects, see Details
<code>header</code>	(<code>character(1)</code>) generic validation message; set to <code>NULL</code> to omit

Details

`shiny::validate` is used to withhold rendering of an output element until certain conditions are met and to print a validation message in place of the output element. `shinyvalidate::InputValidator` allows to validate input elements and to display specific messages in their respective input widgets. `validate_inputs` provides a hybrid solution. Given an `InputValidator` object, messages corresponding to inputs that fail validation are extracted and placed in one validation message that is passed to a `validate/need` call. This way the input validator messages are repeated in the output.

The `...` argument accepts any number of `InputValidator` objects or a nested list of such objects. If validators are passed directly, all their messages are printed together under one (optional) header message specified by `header`. If a list is passed, messages are grouped by validator. The list's names are used as headers for their respective message groups. If neither of the nested list elements is named, a header message is taken from `header`.

Value

Returns `NULL` if the final validation call passes and a `shiny.silent.error` if it fails.

Examples in Shinylive

example-1 [Open in Shinylive](#)

See Also

[shinyvalidate::InputValidator](#), [shiny::validate](#)

Examples

```
library(shiny)
library(shinyvalidate)

ui <- fluidPage(
  selectInput("method", "validation method", c("sequential", "combined", "grouped")),
  sidebarLayout(
    sidebarPanel(
      selectInput("letter", "select a letter:", c(letters[1:3], LETTERS[4:6])),
      selectInput("number", "select a number:", 1:6),
      tags$br(),
      selectInput("color", "select a color:",
        c("black", "indianred2", "springgreen2", "cornflowerblue"),
        multiple = TRUE
      ),
      sliderInput("size", "select point size:",
        min = 0.1, max = 4, value = 0.25
      )
    ),
    mainPanel(plotOutput("plot"))
  )
)

server <- function(input, output) {
```

```

# set up input validation
iv <- InputValidator$new()
iv$add_rule("letter", sv_in_set(LETTERS, "choose a capital letter"))
iv$add_rule("number", function(x) {
  if (as.integer(x) %% 2L == 1L) "choose an even number"
})
iv$enable()
# more input validation
iv_par <- InputValidator$new()
iv_par$add_rule("color", sv_required(message = "choose a color"))
iv_par$add_rule("color", function(x) {
  if (length(x) > 1L) "choose only one color"
})
iv_par$add_rule(
  "size",
  sv_between(
    left = 0.5, right = 3,
    message_fmt = "choose a value between {left} and {right}"
  )
)
iv_par$enable()

output$plot <- renderPlot({
  # validate output
  switch(input[["method"]],
    "sequential" = {
      validate_inputs(iv)
      validate_inputs(iv_par, header = "Set proper graphical parameters")
    },
    "combined" = validate_inputs(iv, iv_par),
    "grouped" = validate_inputs(list(
      "Some inputs require attention" = iv,
      "Set proper graphical parameters" = iv_par
    ))
  )

  plot(faithful$eruptions ~ faithful$waiting,
    las = 1, pch = 16,
    col = input[["color"]], cex = input[["size"]]
  )
})

if (interactive()) {
  shinyApp(ui, server)
}

```

validate_no_intersection

Validates no intersection between two vectors

Description**[Stable]****Usage**

```
validate_no_intersection(x, y, msg)
```

Arguments

x	vector
y	vector
msg	(character(1)) message to display if x and y intersect

Details

This function is a wrapper for `shiny::validate`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
data <- data.frame(
  id = c(1:10, 11:20, 1:10),
  strata = rep(c("A", "B", "C"), each = 10)
)

ui <- fluidPage(
  selectInput("ref1", "Select strata1 to compare",
    choices = c("A", "B", "C"),
    selected = "A"
  ),
  selectInput("ref2", "Select strata2 to compare",
    choices = c("A", "B", "C"),
    selected = "B"
  ),
  verbatimTextOutput("summary")
)

server <- function(input, output) {
  output$summary <- renderText({
    sample_1 <- data$id[data$strata == input$ref1]
    sample_2 <- data$id[data$strata == input$ref2]

    validate_no_intersection(
      sample_1, sample_2,
      "subjects within strata1 and strata2 cannot overlap"
    )
    paste0(
      "Number of subject in: reference treatment=", length(sample_1),
```

```

      " comparisons treatment=", length(sample_2)
    )
  })
}
if (interactive()) {
  shinyApp(ui, server)
}

```

validate_n_levels

Validate that variables has expected number of levels

Description

[Stable]

Usage

```
validate_n_levels(x, min_levels = 1, max_levels = 12, var_name)
```

Arguments

x	variable name. If x is not a factor, the unique values are treated as levels.
min_levels	cutoff for minimum number of levels of x
max_levels	cutoff for maximum number of levels of x
var_name	name of variable being validated for use in validation message

Details

If the number of levels of x is less than min_levels or greater than max_levels the validation will fail. This function is a wrapper for shiny::validate.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```

data <- data.frame(
  one = rep("a", length.out = 20),
  two = rep(c("a", "b"), length.out = 20),
  three = rep(c("a", "b", "c"), length.out = 20),
  four = rep(c("a", "b", "c", "d"), length.out = 20),
  stringsAsFactors = TRUE
)
ui <- fluidPage(
  selectInput(
    "var",

```

```

      "Select variable",
      choices = c("one", "two", "three", "four"),
      selected = "one"
    ),
    verbatimTextOutput("summary")
  )

server <- function(input, output) {
  output$summary <- renderText({
    validate_n_levels(data[[input$var]], min_levels = 2, max_levels = 15, var_name = input$var)
    paste0(
      "Levels of selected treatment variable: ",
      paste(levels(data[[input$var]]),
            collapse = ", ")
    )
  })
}
if (interactive()) {
  shinyApp(ui, server)
}

```

 validate_one_row_per_id

Validate that dataset has unique rows for key variables

Description

[Stable]

Usage

```
validate_one_row_per_id(x, key = c("USUBJID", "STUDYID"))
```

Arguments

x	(data.frame)
key	(character) Vector of ID variables from x that identify unique records.

Details

This function is a wrapper for `shiny::validate`.

Examples in Shinylive

example-1 [Open in Shinylive](#)

Examples

```
iris$id <- rep(1:50, times = 3)
ui <- fluidPage(
  selectInput(
    inputId = "species",
    label = "Select species",
    choices = c("setosa", "versicolor", "virginica"),
    selected = "setosa",
    multiple = TRUE
  ),
  plotOutput("plot")
)
server <- function(input, output) {
  output$plot <- renderPlot({
    iris_f <- iris[iris$Species %in% input$species, ]
    validate_one_row_per_id(iris_f, key = c("id"))

    hist(iris_f$Sepal.Length, breaks = 5)
  })
}
if (interactive()) {
  shinyApp(ui, server)
}
```

Index

`add_landing_modal`, 3
`as_tdata`(`tdata`), 16

`build_app_title`, 4

`eval_code`(`teal_data_module`), 18
`eval_code`, `teal_data_module`, `character-method`
 (`teal_data_module`), 18
`eval_code`, `teal_data_module`, `expression-method`
 (`teal_data_module`), 18
`eval_code`, `teal_data_module`, `language-method`
 (`teal_data_module`), 18
`example_module`, 5

`format.teal_module`(`teal_modules`), 20
`format.teal_modules`(`teal_modules`), 20

`get_code_tdata`(`tdata`), 16
`get_metadata`(`tdata`), 16

`init`, 6
`init()`, 6, 10, 11, 14, 19

`join_keys.tdata`(`tdata`), 16

`landing_popup_module`, 8

`make_teal_transform_server`, 9
`make_teal_transform_server()`, 27
`module`(`teal_modules`), 20
`module()`, 7, 11, 13
`module_filter_data`, 12
`module_init_data`, 12
`module_session_info`, 10, 11
`module_teal`, 10, 11, 12
`module_teal_with_splash`, 12
`module_transform_data`, 12, 13
`modules`(`teal_modules`), 20
`modules()`, 7, 11, 13, 28

`new_tdata`(`tdata`), 16

`print.teal_module`(`teal_modules`), 20
`print.teal_modules`(`teal_modules`), 20

`report_card_template`, 15
`reporter_previewer_module`, 14
`reporter_previewer_module()`, 23

`shiny::callModule()`, 21
`shiny::getDefaultReactiveDomain()`, 16
`shiny::modalDialog()`, 4
`shiny::moduleServer()`, 21
`shiny::showModal()`, 15, 16
`shiny::validate`, 35
`shinyvalidate::InputValidator`, 35
`show_rcode_modal`, 15
`srv_session_info`(`module_session_info`),
 10
`srv_teal`(`module_teal`), 11
`srv_teal()`, 7
`srv_teal_with_splash`
 (`module_teal_with_splash`), 12
`srv_transform_teal_data`
 (`module_transform_data`), 13
`srv_transform_teal_data()`, 28

`tdata`, 16
`tdata2env`(`tdata`), 16
`teal.code::qenv()`, 20
`teal.data::teal_data`, 9, 20, 28
`teal.data::teal_data()`, 7
`teal.reporter::ReportCard`, 17
`teal.reporter::Reporter`, 22
`teal.reporter::reporter_previewer_srv()`,
 14
`teal.reporter::reporter_previewer_ui()`,
 14

`teal.slice::FilteredData`, 22
`teal.slice::FilterPanelAPI`, 22
`teal_data_module`, 18
`teal_data_module()`, 7, 12

teal_module(teal_modules), 20
teal_module(), 28
teal_modules, 20, 28
teal_slices(), 7, 11, 13, 17, 23
teal_transform_module, 6, 9, 27
teal_transform_module(), 9, 12, 13
TealReportCard, 17

ui_session_info(module_session_info),
 10
ui_teal(module_teal), 11
ui_teal(), 7
ui_teal_with_splash
 (module_teal_with_splash), 12
ui_transform_teal_data
 (module_transform_data), 13
ui_transform_teal_data(), 28

validate_has_data, 30
validate_has_elements, 31
validate_has_variable, 32
validate_in, 33
validate_inputs, 34
validate_n_levels, 38
validate_no_intersection, 36
validate_one_row_per_id, 39

within(teal_data_module), 18
within(), 19