Package ‘reticulate’

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Type Package

Title Interface to 'Python'

Version 1.24

Description Interface to 'Python' modules, classes, and functions. When calling into 'Python', R data types are automatically converted to their equivalent 'Python' types. When values are returned from 'Python' to R they are converted back to R types. Compatible with all versions of 'Python' >= 2.7.

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BugReports https://github.com/rstudio/reticulate/issues

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**Description**

Reshape (reindex) a multi-dimensional array, using row-major (C-style) reshaping semantics by default.

**Usage**

```r
array_reshape(x, dim, order = c("C", "F"))
```

**Arguments**

- **x**: An array
- **dim**: The new dimensions to be set on the array.
- **order**: The order in which elements of `x` should be read during the rearrangement. "C" means elements should be read in row-major order, with the last index changing fastest; "F" means elements should be read in column-major order, with the first index changing fastest.

**Details**

This function differs from e.g. `dim(x) <- dim` in a very important way: by default, `array_reshape()` will fill the new dimensions in row-major (C-style) ordering, while `dim<-()` will fill new dimensions in column-major (Fortran-style) ordering. This is done to be consistent with libraries like NumPy, Keras, and TensorFlow, which default to this sort of ordering when reshaping arrays. See the examples for why this difference may be important.
Examples

## Not run:
# let's construct a 2x2 array from a vector of 4 elements
x <- 1:4

# rearrange will fill the array row-wise
array_reshape(x, c(2, 2))
# [,1] [,2]
# [1,] 1 2
# [2,] 3 4
# setting the dimensions 'fills' the array col-wise
dim(x) <- c(2, 2)
x
# [,1] [,2]
# [1,] 1 3
# [2,] 2 4

## End(Not run)

as.character.python.builtin.bytes

Convert Python bytes to an R character vector

Description

Convert Python bytes to an R character vector

Usage

## S3 method for class 'python.builtin.bytes'
as.character(x, encoding = "utf-8", errors = "strict", ...)

Arguments

x
encoding
errors
...
Description

Tools for managing Python conda environments.

Usage

conda_list(conda = "auto")

conda_create(
    envname = NULL,
    packages = NULL,
    ...,
    forge = TRUE,
    channel = character(),
    environment = NULL,
    conda = "auto",
    python_version = minconda_python_version()
)

conda_clone(envname, ..., clone = "base", conda = "auto")

conda_export(
    envname,
    file = if (json) "environment.json" else "environment.yml",
    json = FALSE,
    ...
)

conda_remove(envname, packages = NULL, conda = "auto")

conda_install(
    envname = NULL,
    packages,
    forge = TRUE,
    channel = character(),
    pip = FALSE,
    pip_options = character(),
    pip_ignore_installed = FALSE,
    conda = "auto",
    python_version = NULL,
    ...
)
conda_tools

conda_binary(conda = "auto")
conda_exe(conda = "auto")
conda_version(conda = "auto")
conda_update(conda = "auto")
conda_python(envname = NULL, conda = "auto", all = FALSE)

Arguments

conda
The path to a conda executable. Use "auto" to allow reticulate to automatically find an appropriate conda binary. See Finding Conda and conda_binary() for more details.

envname
The name of, or path to, a conda environment.

packages
A character vector, indicating package names which should be installed or removed. Use python=<version> to request the installation of a specific version of Python.

forge
Boolean; include the conda-forge repository?

channel
An optional character vector of conda channels to include. When specified, the forge argument is ignored. If you need to specify multiple channels, including the conda forge, you can use c("conda-forge", <other channels>).

evironment
The path to an environment definition, generated via (for example) conda_export(), or via conda env export. When provided, the conda environment will be created using this environment definition, and other arguments will be ignored.

python_version
The version of Python to be installed. Set this if you’d like to change the version of Python associated with a particular conda environment.

clone
The name of the conda environment to be cloned.

file
The path where the conda environment definition will be written.

json
Boolean; should the environment definition be written as JSON? By default, conda exports environments as YAML.

pip
Boolean; use pip for package installation? By default, packages are installed from the active conda channels.

pip_options
An optional character vector of additional command line arguments to be passed to pip. Only relevant when pip = TRUE.

pip_ignore_installed
Ignore already-installed versions when using pip? (defaults to FALSE). Set this to TRUE so that specific package versions can be installed even if they are downgrades. The FALSE option is useful for situations where you don’t want a pip install to attempt an overwrite of a conda binary package (e.g. SciPy on Windows which is very difficult to install via pip due to compilation requirements).

all
Boolean; report all instances of Python found?
configure_environment

Value

conda_list() returns an R data.frame, with name giving the name of the associated environment, and python giving the path to the Python binary associated with that environment.

conda_create() returns the path to the Python binary associated with the newly-created conda environment.

conda_clone() returns the path to Python within the newly-created conda environment.

conda_export() returns the path to the exported environment definition, invisibly.

Finding Conda

Most of reticulate’s conda APIs accept a conda parameter, used to control the conda binary used in their operation. When conda = "auto", reticulate will attempt to automatically find a conda installation. The following locations are searched, in order:

1. The location specified by the reticulate.conda_binary R option,
2. The location specified by the RETICULATE_CONDA environment variable,
3. The miniconda_path() location (if it exists),
4. The program PATH,
5. A set of pre-defined locations where conda is typically installed.

To force reticulate to use a particular conda binary, we recommend setting:

```r
options(reticulate.conda_binary = "/path/to/conda")
```

This can be useful if your conda installation lives in a location that reticulate is unable to automatically discover.

configure_environment Configure a Python Environment

Description

Configure a Python environment, satisfying the Python dependencies of any loaded R packages.

Usage

```r
configure_environment(package = NULL, force = FALSE)
```

Arguments

- **package**  The name of a package to configure. When NULL, reticulate will instead look at all loaded packages and discover their associated Python requirements.
- **force**  Boolean; force configuration of the Python environment? Note that configure_environment() is a no-op within non-interactive R sessions. Use this if you require automatic environment configuration, e.g. when testing a package on a continuous integration service.
Details

Normally, this function should only be used by package authors, who want to ensure that their package dependencies are installed in the active Python environment. For example:

```r
.onLoad <- function(libname, pkgname) {
  reticulate::configure_environment(pkgname)
}
```

If the Python session has not yet been initialized, or if the user is not using the default Miniconda Python installation, no action will be taken. Otherwise, reticulate will take this as a signal to install any required Python dependencies into the user’s Python environment.

If you’d like to disable reticulate’s auto-configure behavior altogether, you can set the environment variable:

```
RETICULATE_AUTOCONFIGURE = FALSE
```

e.g. in your ~/.Renviron or similar.

Note that, in the case where the Python session has not yet been initialized, reticulate will automatically ensure your required Python dependencies are installed after the Python session is initialized (when appropriate).

---

dict Create Python dictionary

Description

Create a Python dictionary object, including a dictionary whose keys are other Python objects rather than character vectors.

Usage

- `dict(..., convert = FALSE)`
- `py_dict(keys, values, convert = FALSE)`

Arguments

- `...` Name/value pairs for dictionary (or a single named list to be converted to a dictionary).
- `convert` TRUE to automatically convert Python objects to their R equivalent. If you pass FALSE you can do manual conversion using the `py_to_r()` function.
- `keys` Keys to dictionary (can be Python objects)
- `values` Values for dictionary
Value

A Python dictionary

Note

The returned dictionary will not automatically convert its elements from Python to R. You can do manual conversion with the `py_to_r()` function or pass `convert = TRUE` to request automatic conversion.

Description

This provides a reticulate engine for knitr, suitable for usage when attempting to render Python chunks. Using this engine allows for shared state between Python chunks in a document – that is, variables defined by one Python chunk can be used by later Python chunks.

Usage

`eng_python(options)`

Arguments

`options` Chunk options, as provided by knitr during chunk execution.

Details

The engine can be activated by setting (for example)

```
knitr::knit_engines$set(python = reticulate::eng_python)
```

Typically, this will be set within a document’s setup chunk, or by the environment requesting that Python chunks be processed by this engine. Note that knitr (since version 1.18) will use the reticulate engine by default when executing Python chunks within an R Markdown document.
**import**

*Import a Python module*

**Description**

Import the specified Python module, making it available for use from R.

**Usage**

```r
import(module, as = NULL, convert = TRUE, delay_load = FALSE)

import_main(convert = TRUE)

import_builtins(convert = TRUE)

import_from_path(module, path = ".", convert = TRUE, delay_load = FALSE)
```

**Arguments**

- `module` The name of the Python module.
- `as` An alias for module name (affects names of R classes). Note that this is an advanced parameter that should generally only be used in package development (since it affects the S3 name of the imported class and can therefore interfere with S3 method dispatching).
- `convert` Boolean; should Python objects be automatically converted to their R equivalent? If set to FALSE, you can still manually convert Python objects to R via the `py_to_r()` function.
- `delay_load` Boolean; delay loading the module until it is first used? When FALSE, the module will be loaded immediately. See **Delay Load** for advanced usages.
- `path` The path from which the module should be imported.

**Value**

An R object wrapping a Python module. Module attributes can be accessed via the `$` operator, or via `py_get_attr()`.

**Python Built-ins**

Python’s built-in functions (e.g. `len()`) can be accessed via Python’s built-in module. Because the name of this module has changed between Python 2 and Python 3, we provide the function `import_builtins()` to abstract over that name change.
Delay Load

The delay_load parameter accepts a variety of inputs. If you just need to ensure your module is lazy-loaded (e.g. because you are a package author and want to avoid initializing Python before the user has explicitly requested it), then passing TRUE is normally the right choice.

You can also provide a list of named functions, which act as callbacks to be run when the module is later loaded. For example:

```r
delay_load = list(
    # run before the module is loaded
    before_load = function() { ... }

    # run immediately after the module is loaded
    on_load = function() { ... }

    # run if an error occurs during module import
    on_error = function(error) { ... }
)
```

Alternatively, if you supply only a single function, that will be treated as an on_load handler.

Import from Path

import_from_path() can be used in you need to import a module from an arbitrary filesystem path. This is most commonly used when importing modules bundled with an R package – for example:

```r
path <- system.file("python", package = <package>)
reticulate::import_from_path(<module>, path = path, delay_load = TRUE)
```

Examples

```r
## Not run:
main <- import_main()
sys <- import("sys")

## End(Not run)
```

Description

Download the Miniconda installer, and use it to install Miniconda.
install_miniconda(path = miniconda_path(), update = TRUE, force = FALSE)

Arguments

path The location where Miniconda is (or should be) installed. Note that the Miniconda installer does not support paths containing spaces. See miniconda_path for more details on the default path used by reticulate.

update Boolean; update to the latest version of Miniconda after installation?

force Boolean; force re-installation if Miniconda is already installed at the requested path?

Details

For arm64 builds of R on macOS, install_miniconda() will use binaries from miniforge instead.

Note

If you encounter binary incompatibilities between R and Miniconda, a scripted build and installation of Python from sources can be performed by install_python()

See Also

Other miniconda-tools: miniconda_uninstall(), miniconda_update()

install_python

Install Python

Description

Download and install Python, using the pyenv. and pyenv-win projects.

Usage

install_python(version, list = FALSE, force = FALSE)

Arguments

version The version of Python to install.

list Boolean; if set, list the set of available Python versions?

force Boolean; force re-installation even if the requested version of Python is already installed?
Details

In general, it is recommended that Python virtual environments are created using the copies of Python installed by `install_python()`. For example:

```r
library(reticulate)
version <- "3.8.7"
install_python(version = version)
virtualenv_create("my-environment", python_version = version)
use_virtualenv("my-environment")
```

---

iterate

*Traverse a Python iterator or generator*

Description

Traverse a Python iterator or generator

Usage

```
iterate(it, f = base::identity, simplify = TRUE)
iter_next(it, completed = NULL)
as_iterator(x)
```

Arguments

- `it`: Python iterator or generator
- `f`: Function to apply to each item. By default applies the `identity` function which just reflects back the value of the item.
- `simplify`: Should the result be simplified to a vector if possible?
- `completed`: Sentinel value to return from `iter_next()` if the iteration completes (defaults to `NULL` but can be any R value you specify).
- `x`: Python iterator or iterable

Details

Simplification is only attempted all elements are length 1 vectors of type "character", "complex", "double", "integer", or "logical".

Value

For `iterate()`, a list or vector containing the results of calling `f` on each item in `x` (invisibly); for `iter_next()`, the next value in the iteration (or the sentinel `completed` value if the iteration is complete).
**miniconda_path**  
*Path to Miniconda*

**Description**

The path to the Miniconda installation to use. By default, an OS-specific path is used. If you’d like to instead set your own path, you can set the RETICULATE_MINICONDA_PATH environment variable.

**Usage**

```r
miniconda_path()
```

**miniconda_uninstall**  
*Remove Miniconda*

**Description**

Uninstall Miniconda.

**Usage**

```r
miniconda_uninstall(path = miniconda_path())
```

**Arguments**

- `path` The path in which Miniconda is installed.

**See Also**

Other miniconda-tools: `install_miniconda()`, `miniconda_update()`

**miniconda_update**  
*Update Miniconda*

**Description**

Update Miniconda to the latest version.

**Usage**

```r
miniconda_update(path = miniconda_path())
```
np_array

Arguments

    path
    The location where Miniconda is (or should be) installed. Note that the Miniconda installer does not support paths containing spaces. See miniconda_path for more details on the default path used by reticulate.

See Also

Other miniconda-tools: install_miniconda(), miniconda_uninstall()

---

np_array  NumPy array

Description

Create NumPy arrays and convert the data type and in-memory ordering of existing NumPy arrays.

Usage

np_array(data, dtype = NULL, order = "C")

Arguments

    data
    Vector or existing NumPy array providing data for the array
    dtype
    Numpy data type (e.g. "float32", "float64", etc.)
    order
    Memory ordering for array. "C" means C order, "F" means Fortran order.

Value

A NumPy array object.

---

py  Interact with the Python Main Module

Description

The py object provides a means for interacting with the Python main session directly from R. Python objects accessed through py are automatically converted into R objects, and can be used with any other R functions as needed.

Usage

py

Format

An R object acting as an interface to the Python main module.
**PyClass**  
*Create a python class*

**Description**
Create a python class

**Usage**
```
PyClass(classname, defs = list(), inherit = NULL)
```

**Arguments**
- **classname**: Name of the class. The class name is useful for S3 method dispatch.
- **defs**: A named list of class definitions - functions, attributes, etc.
- **inherit**: A list of Python class objects. Usually these objects have the `python.builtin.type` S3 class.

**Examples**
```r
## Not run:
Hi <- PyClass("Hi", list(
    name = NULL,
    `__init__` = function(self, name) {
        self$name <- name
        NULL
    },
    say_hi = function(self) {
        paste0("Hi ", self$name)
    }
))

a <- Hi("World")
## End(Not run)
```

**py_available**  
*Check if Python is available on this system*

**Description**
Check if Python is available on this system
Usage

py_available(initialize = FALSE)

py_numpy_available(initialize = FALSE)

Arguments

initialize TRUE to attempt to initialize Python bindings if they aren’t yet available (defaults to FALSE).

Value

Logical indicating whether Python is initialized.

Note

The py_numpy_available function is a superset of the py_available function (it calls py_available first before checking for NumPy).

<table>
<thead>
<tr>
<th>py_bool</th>
<th>Python Truthiness</th>
</tr>
</thead>
</table>

Description

Equivalent to bool(x) in Python, or not not x.

Usage

py_bool(x)

Arguments

x, A python object.

Details

If the Python object defines a __bool__ method, then that is invoked. Otherwise, if the object defines a __len__ method, then TRUE is returned if the length is nonzero. If neither __len__ nor __bool__ are defined, then the Python object is considered TRUE. If x

Value

An R scalar logical: TRUE or FALSE. If x is a null pointer or Python is not initialized, FALSE is returned.
py_capture_output  
*Capture and return Python output*

**Description**
Capture and return Python output

**Usage**

```
py_capture_output(expr, type = c("stdout", "stderr"))
```

**Arguments**

- `expr`: Expression to capture stdout for
- `type`: Streams to capture (defaults to both stdout and stderr)

**Value**
Character vector with output

---

py_config  
*Python configuration*

**Description**
Retrieve information about the version of Python currently being used by reticulate.

**Usage**

```
py_config()
```

**Details**
If Python has not yet been initialized, then calling `py_config()` will force the initialization of Python. See `py_discover_config()` for more details.

**Value**
Information about the version of Python in use, as an R list with class "py_config".
**py_del_attr**  
*Delete an attribute of a Python object*

**Description**
Delete an attribute of a Python object.

**Usage**
```python
def py_del_attr(x, name):
```

**Arguments**
- `x`  
  A Python object.
- `name`  
  The attribute name.

---

**py_del_item**  
*Delete / remove an item from a Python object*

**Description**
Delete an item associated with a Python object, as through its `__delitem__` method.

**Usage**
```python
def py_del_item(x, name):
```

**Arguments**
- `x`  
  A Python object.
- `name`  
  The item name.

**Value**
The (mutated) object `x`, invisibly.

**See Also**
Other item-related APIs: `py_get_item()`, `py_set_item()`
**py_discover_config**  
*Discover the version of Python to use with reticulate.*

**Description**

This function enables callers to check which versions of Python will be discovered on a system as well as which one will be chosen for use with reticulate.

**Usage**

```r
py_discover_config(required_module = NULL, use_environment = NULL)
```

**Arguments**

- `required_module`
  
  A optional module name that must be available in order for a version of Python to be used.

- `use_environment`
  
  An optional virtual/conda environment name to prefer in the search.

**Value**

Python configuration object.

---

**py_ellipsis**  
*The builtin constant Ellipsis*

**Description**

The builtin constant Ellipsis

**Usage**

```r
py_ellipsis()
```
Evaluate a Python Expression

Description

Evaluate a single Python expression, in a way analogous to the Python `eval()` built-in function.

Usage

`py_eval(code, convert = TRUE)`

Arguments

- `code`: A single Python expression.
- `convert`: Boolean; automatically convert Python objects to R?

Value

The result produced by evaluating `code`, converted to an R object when `convert` is set to TRUE.

Caveats

`py_eval()` only supports evaluation of 'simple' Python expressions. Other expressions (e.g. assignments) will fail; e.g.

```r
> py_eval("x = 1")
Error in py_eval_impl(code, convert) :
  SyntaxError: invalid syntax (reticulate_eval, line 1)
```

and this mirrors what one would see in a regular Python interpreter:

```python
>>> eval("x = 1")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "<string>", line 1
x = 1
^  
  SyntaxError: invalid syntax
```

The `py_run_string()` method can be used if the evaluation of arbitrary Python code is required.
**py_exe**

*Python executable*

**Description**

Get the path to the Python executable that reticulate has been configured to use. If Python has already been initialized, then reticulate will choose the currently-active copy of Python.

**Usage**

`py_exe()`

**Details**

This can occasionally be useful if you’d like to interact with Python (or its modules) via a subprocess; for example you might choose to install a package with `pip`:

```r
system2(py_exe(), c("-m", "pip", "install", "numpy"))
```

...and so you can also have greater control over how these modules are invoked.

**Value**

The path to the Python executable reticulate has been configured to use.

---

**py_func**

*Wrap an R function in a Python function with the same signature.*

**Description**

This function could wrap an R function in a Python function with the same signature. Note that the signature of the R function must not contain esoteric Python-incompatible constructs.

**Usage**

`py_func(f)`

**Arguments**

- `f`: An R function

**Value**

A Python function that calls the R function `f` with the same signature.
Custom Scaffolding of R Wrappers for Python Functions

Description

This function can be used to generate an R wrapper for a specified Python function while allowing to inject custom code for critical parts of the wrapper generation, such as process the any part of the docs obtained from `py_function_docs()` and append additional roxygen fields. The result from execution of `python_function` is assigned to a variable called `python_function_result` that can also be processed by `postprocess_fn` before writing the closing curly braces for the generated wrapper function.

Usage

```r
py_function_custom_scaffold(
  python_function,
  r_function = NULL,
  additional_roxygen_fields = NULL,
  process_docs_fn = function(docs) docs,
  process_param_fn = function(param, docs) param,
  process_param_doc_fn = function(param_doc, docs) param_doc,
  postprocess_fn = function() { },
  file_name = NULL
)
```

Arguments

- `python_function`  
  Fully qualified name of Python function or class constructor (e.g. `tf$layers$average_pooling1d`)
- `r_function`  
  Name of R function to generate (defaults to name of Python function if not specified)
- `additional_roxygen_fields`  
  A list of additional roxygen fields to write to the roxygen docs, e.g. `list(export = "", rdname = "generated-wrappers")`.
- `process_docs_fn`  
  A function to process docs obtained from `reticulate::py_function_docs(python_function)`.
- `process_param_fn`  
  A function to process each parameter needed for `python_function` before executing `python_function`.
- `process_param_doc_fn`  
  A function to process the roxygen docstring for each parameter.
- `postprocess_fn`  
  A function to inject any custom code in the form of a string before writing the closing curly braces for the generated wrapper function.
- `file_name`  
  The file name to write the generated wrapper function to. If `NULL`, the generated wrapper will only be printed out in the console.
Examples

```r
# Not run:
library(tensorflow)
library(stringr)

# Example of a `process_param_fn` to cast parameters with default values that contain "L" to integers
process_int_param_fn <- function(param, docs) {
  # Extract the list of parameters that have integer values as default
  int_params <- gsub(" = [-]?[0-9]+L",
                       "",
                       str_extract_all(docs$signature, "[A-z]+ = [-]?[0-9]+L")[[1]])
  # Explicitly cast parameter in the list obtained above to integer
  if (param %in% int_params) {
    param <- paste0("as.integer(" , param , ")")
  }
  param
}

# Note that since the default value of parameter `k` is `1L`. It is wrapped by `as.integer()` to ensure it’s casted to integer before sending it to `tf$nn$top_k` for execution. We then print out the python function result.
py_function_custom_scaffold("tf$nn$top_k",
r_function = "top_k",
process_param_fn = process_int_param_fn,
postprocess_fn = function() { "print(python_function_result)" })
```

## End(Not run)

---

**py_get_attr**  
*Get an attribute of a Python object*

**Description**  
Get an attribute of a Python object

**Usage**  
`py_get_attr(x, name, silent = FALSE)`

**Arguments**

- `x`  
  Python object

- `name`  
  Attribute name

- `silent`  
  TRUE to return NULL if the attribute doesn’t exist (default is FALSE which will raise an error)
**py_get_item**

**Value**

Attribute of Python object

---

**Description**

Retrieve an item from a Python object, similar to how `x[name]` might be used in Python code to access an item indexed by key on an object `x`. The object’s `__getitem__` method will be called.

**Usage**

```r
py_get_item(x, key, silent = FALSE)
```

**Arguments**

- **x**: A Python object.
- **key**: The key used for item lookup.
- **silent**: Boolean; when TRUE, attempts to access missing items will return NULL rather than throw an error.

**See Also**

Other item-related APIs: `py_del_item()`, `py_set_item()`

---

**py_has_attr**

**Check if a Python object has an attribute**

**Description**

Check whether a Python object `x` has an attribute `name`.

**Usage**

```r
py_has_attr(x, name)
```

**Arguments**

- **x**: A python object.
- **name**: The attribute to be accessed.

**Value**

TRUE if the object has the attribute `name`, and FALSE otherwise.
**py_help**

*Documentation for Python Objects*

**Description**

Documentation for Python Objects

**Usage**

`py_help(object)`

**Arguments**

- **object**: Object to print documentation for

**py_id**

*Unique identifier for Python object*

**Description**

Get a globally unique identifier for a Python object.

**Usage**

`py_id(object)`

**Arguments**

- **object**: Python object

**Value**

Unique identifier (as integer) or NULL

**Note**

In the current implementation of CPython this is the memory address of the object.
Install Python packages into a virtual environment or Conda environment.

Usage

```r
py_install(
  packages,
  envname = NULL,
  method = c("auto", "virtualenv", "conda"),
  conda = "auto",
  python_version = NULL,
  pip = FALSE,
  ...,
  pip_ignore_installed = ignore_installed,
  ignore_installed = FALSE
)
```

Arguments

- **packages**: A vector of Python packages to install.
- **envname**: The name, or full path, of the environment in which Python packages are to be installed. When NULL (the default), the active environment as set by the RETICULATE_PYTHON_ENV variable will be used; if that is unset, then the r-reticulate environment will be used.
- **method**: Installation method. By default, "auto" automatically finds a method that will work in the local environment. Change the default to force a specific installation method. Note that the "virtualenv" method is not available on Windows.
- **conda**: The path to a conda executable. Use "auto" to allow reticulate to automatically find an appropriate conda binary. See Finding Conda and conda_binary() for more details.
- **python_version**: The requested Python version. Ignored when attempting to install with a Python virtual environment.
- **pip**: Boolean; use pip for package installation? This is only relevant when Conda environments are used, as otherwise packages will be installed from the Conda repositories.
- **...**: Additional arguments passed to conda_install() or virtualenv_install().
- **pip_ignore_installed, ignore_installed**: Boolean; whether pip should ignore previously installed versions of the requested packages. Setting this to TRUE causes pip to install the latest versions of all dependencies into the requested environment. This ensure that no dependencies are satisfied by a package that exists either in the site library or was previously installed from a different—potentially incompatible—distribution channel.
(ignore_installed is an alias for pip_ignore_installed, pip_ignore_installed takes precedence).

Details

On Linux and OS X the "virtualenv" method will be used by default ("conda" will be used if virtualenv isn’t available). On Windows, the "conda" method is always used.

See Also

conda_install(), for installing packages into conda environments. virtualenv_install(), for installing packages into virtual environments.

\---

\section*{py_is_null_xptr} \textit{Check if a Python object is a null externalptr}

\section*{Description}

Check if a Python object is a null externalptr

\section*{Usage}

\begin{verbatim}
py_is_null_xptr(x)
py_validate_xptr(x)
\end{verbatim}

\section*{Arguments}

\begin{itemize}
  \item \texttt{x} \hspace{1cm} Python object
\end{itemize}

\section*{Details}

When Python objects are serialized within a persisted R environment (e.g. .RData file) they are deserialized into null externalptr objects (since the Python session they were originally connected to no longer exists). This function allows you to safely check whether whether a Python object is a null externalptr.

The \texttt{py_validate} function is a convenience function which calls \texttt{py_is_null_xptr} and throws an error in the case that the xptr is NULL.

\section*{Value}

Logical indicating whether the object is a null externalptr
**Description**

Create a Python iterator from an R function

**Usage**

\[\text{py\_iterator}(\text{fn, completed = NULL})\]

**Arguments**

- **fn**: R function with no arguments.
- **completed**: Special sentinel return value which indicates that iteration is complete (defaults to NULL)

**Details**

Python generators are functions that implement the Python iterator protocol. In Python, values are returned using the `yield` keyword. In R, values are simply returned from the function.

In Python, the `yield` keyword enables successive iterations to use the state of previous iterations. In R, this can be done by returning a function that mutates its enclosing environment via the `<<-` operator. For example:

```r
sequence_generator <- function(start) {
  value <- start
  function() {
    value <<- value + 1
    value
  }
}
```

Then create an iterator using `py_iterator()`:

\[g <- \text{py\_iterator}(\text{sequence\_generator}(10))\]

**Value**

Python iterator which calls the R function for each iteration.

**Ending Iteration**

In Python, returning from a function without calling `yield` indicates the end of the iteration. In R however, `return` is used to yield values, so the end of iteration is indicated by a special return value (NULL by default, however this can be changed using the `completed` parameter). For example:
sequence_generator <- function(start) {
  value <- start
  function() {
    value <<- value + 1
    if (value < 100)
      value
    else
      NULL
  }
}

### Threading

Some Python APIs use generators to parallelize operations by calling the generator on a background thread and then consuming its results on the foreground thread. The `py_iterator()` function creates threadsafe iterators by ensuring that the R function is always called on the main thread (to be compatible with R’s single-threaded runtime) even if the generator is run on a background thread.

---

**py_last_error**

*Get or clear the last Python error encountered*

#### Description

Get or clear the last Python error encountered

#### Usage

```r
py_last_error()
```

```r
py_clear_last_error()
```

#### Value

For `py_last_error()`, a list with the type, value, and traceback for the last Python error encountered (can be `NULL` if no error has yet been encountered).

---

**py_len**

*Length of Python object*

#### Description

Get the length of a Python object. This is equivalent to calling the Python builtin `len()` function on the object.

#### Usage

```r
py_len(x, default = NULL)
```
Arguments

x  A Python object.

default The default length value to return, in the case that the associated Python object has no __len__ method. When NULL (the default), an error is emitted instead.

Details

Not all Python objects have a defined length. For objects without a defined length, calling py_len() will throw an error. If you’d like to instead infer a default length in such cases, you can set the default argument to e.g. 1L, to treat Python objects without a __len__ method as having length one.

Value

The length of the object, as a numeric value.

---

**py_list_attributes**  List all attributes of a Python object

**Description**

List all attributes of a Python object

**Usage**

py_list_attributes(x)

**Arguments**

x  Python object

**Value**

Character vector of attributes
py_list_packages

List installed Python packages

Description

List the Python packages that are installed in the requested Python environment.

Usage

```r
py_list_packages(
  envname = NULL,
  type = c("auto", "virtualenv", "conda"),
  python = NULL
)
```

Arguments

- `envname`: The name of, or path to, a Python virtual environment. Ignored when `python` is non-NULL.
- `type`: The virtual environment type. Useful if you have both virtual environments and Conda environments of the same name on your system, and you need to disambiguate them.
- `python`: The path to a Python executable.

Details

When `envname` is NULL, reticulate will use the "default" version of Python, as reported by `py_exe()`. This implies that you can call `py_list_packages()` without arguments in order to list the installed Python packages in the version of Python currently used by reticulate.

Value

An R data.frame, with columns:

- `package`: The package name.
- `version`: The package version.
- `requirement`: The package requirement.
- `channel`: (Conda only) The channel associated with this package.
**py_main_thread_func**

Create a Python function that will always be called on the main thread

**Description**

This function is helpful when you need to provide a callback to a Python library which may invoke the callback on a background thread. As R functions must run on the main thread, wrapping the R function with `py_main_thread_func()` will ensure that R code is only executed on the main thread.

**Usage**

```r
description

py_main_thread_func(f)
```

**Arguments**

- **f**
  - An R function with arbitrary arguments

**Value**

A Python function that delegates to the passed R function, which is guaranteed to always be called on the main thread.

**py_module_available**

Check if a Python module is available on this system.

**Description**

Note that this function will also attempt to initialize Python before checking if the requested module is available.

**Usage**

```r
description

py_module_available(module)
```

**Arguments**

- **module**
  - The name of the module.

**Value**

TRUE if the module is available and can be loaded; FALSE otherwise.
### py_none

**Description**

Get a reference to the Python None object.

**Usage**

```r
py_none()
```

### py_run

**Description**

Execute code within the scope of the `__main__` Python module.

**Usage**

```r
py_run_string(code, local = FALSE, convert = TRUE)
```

```r
py_run_file(file, local = FALSE, convert = TRUE)
```

**Arguments**

- `code`: The Python code to be executed.
- `local`: Boolean; should Python objects be created as part of a local / private dictionary? If FALSE, objects will be created within the scope of the Python main module.
- `convert`: Boolean; should Python objects be automatically converted to their R equivalent? If set to FALSE, you can still manually convert Python objects to R via the `py_to_r()` function.
- `file`: The Python script to be executed.

**Value**

A Python dictionary of objects. When `local` is FALSE, this dictionary captures the state of the Python main module after running the provided code. Otherwise, only the variables defined and used are captured.
### py_save_object

#### Description

Save and load Python objects.

#### Usage

```python
py_save_object(object, filename, pickle = "pickle", ...)  
py_load_object(filename, pickle = "pickle", ...)
```

#### Arguments

- **object**: A Python object.
- **filename**: The output file name. Note that the file extension .pickle is considered the "standard" extension for serialized Python objects as created by the pickle module.
- **pickle**: The "pickle" implementation to use. Defaults to "pickle", but other compatible Python "pickle" implementations (e.g. "cPickle") could be used as well.
- **...**: Optional arguments, to be passed to the pickle module's dump() and load() functions.

#### Details

Python objects are serialized using the pickle module – see [https://docs.python.org/3/library/pickle.html](https://docs.python.org/3/library/pickle.html) for more details.

### py_set_attr

#### Description

Set an attribute of a Python object

#### Usage

```python
py_set_attr(x, name, value)
```

#### Arguments

- **x**: Python object
- **name**: Attribute name
- **value**: Attribute value
py_set_item

Set an item for a Python object

Description
Set an item on a Python object, similar to how \( x[\text{name}] = \text{value} \) might be used in Python code to set an item called \text{name} with value \text{value} on object \( x \). The object’s \_setitem\_ method will be called.

Usage
\[
\text{py_set_item}(x, \text{name}, \text{value})
\]

Arguments
- \( x \): A Python object.
- \( \text{name} \): The item name.
- \( \text{value} \): The item value.

Value
The (mutated) object \( x \), invisibly.

See Also
Other item-related APIs: \text{py_del_item()}, \text{py_get_item()}

py_set_seed

Set Python and NumPy random seeds

Description
Set various random seeds required to ensure reproducible results. The provided seed value will establish a new random seed for Python and NumPy, and will also (by default) disable hash randomization.

Usage
\[
\text{py_set_seed}(\text{seed}, \text{disable_hash_randomization} = \text{TRUE})
\]

Arguments
- \( \text{seed} \): A single value, interpreted as an integer
- \( \text{disable_hash_randomization} \): Disable hash randomization, which is another common source of variable results. See \url{https://docs.python.org/3.4/using/cmdline.html#envvar-PYTHONHASHSEED}
Details

This function does not set the R random seed, for that you should call `set.seed()`.

---

py_str

An S3 method for getting the string representation of a Python object

Description

An S3 method for getting the string representation of a Python object

Usage

`py_str(object, ...)`

Arguments

- `object`: Python object
- `...`: Unused

Details

The default implementation will call `PyObject_Str` on the object.

Value

Character vector

---

py_suppress_warnings

Suppress Python warnings for an expression

Description

Suppress Python warnings for an expression

Usage

`py_suppress_warnings(expr)`

Arguments

- `expr`: Expression to suppress warnings for

Value

Result of evaluating expression
**py_unicode**  
*Convert to Python Unicode Object*

**Description**
Convert to Python Unicode Object

**Usage**
```
py_unicode(str)
```

**Arguments**
- str: Single element character vector to convert

**Details**
By default R character vectors are converted to Python strings. In Python 3 these values are unicode objects however in Python 2 they are 8-bit string objects. This function enables you to obtain a Python unicode object from an R character vector when running under Python 2 (under Python 3 a standard Python string object is returned).

**py_version**  
*Python version*

**Description**
Get the version of Python currently being used by reticulate.

**Usage**
```
py_version()
```

**Value**
The version of Python currently used, or NULL if Python has not yet been initialized by reticulate.
**r-py-conversion**  
*Convert between Python and R objects*

**Description**

Convert between Python and R objects

**Usage**

```r
r_to_py(x, convert = FALSE)
py_to_r(x)
```

**Arguments**

- `x` A Python object.
- `convert` Boolean; should Python objects be automatically converted to their R equivalent? If set to FALSE, you can still manually convert Python objects to R via the `py_to_r()` function.

**Value**

An R object, as converted from the Python object.

---

**repl_python**  
*Run a Python REPL*

**Description**

This function provides a Python REPL in the R session, which can be used to interactively run Python code. All code executed within the REPL is run within the Python main module, and any generated Python objects will persist in the Python session after the REPL is detached.

**Usage**

```r
repl_python(  
  module = NULL,  
  quiet =getOption("reticulate.repl.quiet", default = FALSE),  
  input = NULL
)
```
Arguments

- **module**: An (optional) Python module to be imported before the REPL is launched.
- **quiet**: Boolean; print a startup banner when launching the REPL? If TRUE, the banner will be suppressed.
- **input**: Python code to be run within the REPL. Setting this can be useful if you’d like to drive the Python REPL programmatically.

Details

When working with R and Python scripts interactively, one can activate the Python REPL with `repl_python()`, run Python code, and later run `exit` to return to the R console.

Magics

A handful of magics are supported in `repl_python()`:

- Lines prefixed with `!` are executed as system commands:
  - `!cmd --arg1 --arg2`: Execute arbitrary system commands

Magics start with a `%` prefix. Supported magics include:

- `%conda ...` executes a conda command in the active conda environment
- `%pip ...` executes pip for the active python.
- `%load, %loadpy, %run` executes a python file.
- `%system, !!` executes a system command and capture output
- `%env`: read current environment variables.
  - `%env name`: read environment variable 'name'.
  - `%env name=val, %env name val`: set environment variable 'name' to 'val'. val elements in `{}` are interpolated using f-strings (required Python >= 3.6).
- `%cd <dir>` change working directory.
  - `%cd -:` change to previous working directory (as set by `%cd`).
  - `%cd -3:` change to 3rd most recent working directory (as set by `%cd`).
  - `%cd -foo/bar:` change to most recent working directory matching "foo/bar" regex (in history of directories set via `%cd`).
- `%pwd`: print current working directory.
- `%dhist`: print working directory history.

Additionally, the output of system commands can be captured in a variable, e.g.:

- `x = !ls`

where x will be a list of strings, consisting of stdout output split in "\n" (stderr is not captured).
Example

```python
# enter the Python REPL, create a dictionary, and exit
repl_python()
dictionary = {'alpha': 1, 'beta': 2}
exit

# access the created dictionary from R
py$dictionary
# $alpha
# [1] 1
#
# $beta
# [1] 2
```

See Also

`py`, for accessing objects created using the Python REPL.

source_python  
Read and evaluate a Python script

Description

Evaluate a Python script within the Python main module, then make all public (non-module) objects within the main Python module available within the specified R environment.

Usage

```r
source_python(file, envir = parent.frame(), convert = TRUE)
```

Arguments

- `file`: The Python script to be executed.
- `envir`: The environment to assign Python objects into (for example, `parent.frame()` or `globalenv()`). Specify `NULL` to not assign Python objects.
- `convert`: Boolean; should Python objects be automatically converted to their R equivalent? If set to `FALSE`, you can still manually convert Python objects to R via the `py_to_r()` function.

Details

To prevent assignment of objects into R, pass `NULL` for the `envir` parameter.
tuples  

Create Python tuple

Description
Create a Python tuple object

Usage
```r
tuple(..., convert = FALSE)
```

Arguments
- `...`: Values for tuple (or a single list to be converted to a tuple).
- `convert`: TRUE to automatically convert Python objects to their R equivalent. If you pass FALSE you can do manual conversion using the `py_to_r()` function.

Value
A Python tuple

Note
The returned tuple will not automatically convert its elements from Python to R. You can do manual conversion with the `py_to_r()` function or pass `convert = TRUE` to request automatic conversion.

use_python  

Use Python

Description
Select the version of Python to be used by reticulate.

Usage
```r
use_python(python, required = NULL)
use_python_version(version, required = NULL)
use_virtualenv(virtualenv = NULL, required = NULL)
use_condaenv(condaenv = NULL, conda = "auto", required = NULL)
use_miniconda(condaenv = NULL, required = NULL)
```
**use_python**

**Arguments**

- **python**: The path to a Python binary.
- **required**: Is the requested copy of Python required? If TRUE, an error will be emitted if the requested copy of Python does not exist. Otherwise, the request is taken as a hint only, and scanning for other versions will still proceed.
- **version**: The version of Python to use. reticulate will search for versions of Python as installed by the `install_python()` helper function.
- **virtualenv**: Either the name of, or the path to, a Python virtual environment.
- **condaenv**: The name of the Conda environment to use.
- **conda**: The path to a conda executable. By default, reticulate will check the PATH, as well as other standard locations for Anaconda installations.

**Details**

The reticulate package initializes its Python bindings lazily – that is, it does not initialize its Python bindings until an API that explicitly requires Python to be loaded is called. This allows users and package authors to request particular versions of Python by calling `use_python()` or one of the other helper functions documented in this help file.

**RETICULATE_PYTHON**

The RETICULATE_PYTHON environment variable can also be used to control which copy of Python reticulate chooses to bind to. It should be set to the path to a Python interpreter, and that interpreter can either be:

- A standalone system interpreter,
- Part of a virtual environment,
- Part of a Conda environment.

When set, this will override any other requests to use a particular copy of Python. Setting this in ~/.Renviron (or optionally, a project .Renviron) can be a useful way of forcing reticulate to use a particular version of Python.

**Caveats**

Note that the requests for a particular version of Python via `use_python()` and friends only persist for the active session; they must be re-run in each new R session as appropriate.

If `use_python()` (or one of the other `use_*()` functions) are called multiple times, the most recently-requested version of Python will be used. Note that any request to `use_python()` will always be overridden by the RETICULATE_PYTHON environment variable, if set.

The `py_config()` function will also provide a short note describing why reticulate chose to select the version of Python that was ultimately activated.
virtualenv-tools  Interface to Python Virtual Environments

Description

R functions for managing Python virtual environments.

Usage

```r
virtualenv_create(
  envname = NULL,
  python = NULL,
  ..., 
  version = NULL,
  packages = "numpy",
  module = getOption("reticulate.virtualenv.module"),
  system_site_packages = getOption("reticulate.virtualenv.system_site_packages",
    default = FALSE),
  pip_version = getOption("reticulate.virtualenv.pip_version", default = NULL),
  setuptools_version = getOption("reticulate.virtualenv.setuptools_version", default = NULL),
  extra = getOption("reticulate.virtualenv.extra", default = NULL)
)

virtualenv_install(
  envname = NULL,
  packages,
  ignore_installed = FALSE,
  pip_options = character(),
  ...
)

virtualenv_remove(envname = NULL, packages = NULL, confirm = interactive())

virtualenv_list()

virtualenv_root()

virtualenv_python(envname = NULL)

virtualenv_exists(envname = NULL)
```

Arguments

| envname      | The name of, or path to, a Python virtual environment. If this name contains any slashes, the name will be interpreted as a path; if the name does not contain slashes, it will be treated as a virtual environment within virtualenv_root(). |
When NULL, the virtual environment as specified by the RETICULATE_PYTHON_ENV environment variable will be used instead. To refer to a virtual environment in the current working directory, you can prefix the path with ./<name>.

python
The path to a Python interpreter, to be used with the created virtual environment. When NULL, the Python interpreter associated with the current session will be used.

... Optional arguments; currently ignored and reserved for future expansion.

version
The version of Python to be used with the newly-created virtual environment. Python installations as installed via install_python() will be used.

packages
A set of Python packages to install (via pip install) into the virtual environment, after it has been created. By default, the "numpy" package will be installed, and the pip, setuptools and wheel packages will be updated. Set this to FALSE to avoid installing any packages after the virtual environment has been created.

module
The Python module to be used when creating the virtual environment – typically, virtualenv or venv. When NULL (the default), venv will be used if available with Python >= 3.6; otherwise, the virtualenv module will be used.

system_site_packages
Boolean; create new virtual environments with the --system-site-packages flag, thereby allowing those virtual environments to access the system’s site packages? Defaults to FALSE.

pip_version
The version of pip to be installed in the virtual environment. Relevant only when module == "virtualenv". Set this to FALSE to disable installation of pip altogether.

setuptools_version
The version of setuptools to be installed in the virtual environment. Relevant only when module == "virtualenv". Set this to FALSE to disable installation of setuptools altogether.

extra
An optional set of extra command line arguments to be passed. Arguments should be quoted via shQuote() when necessary.

ignore_installed
Boolean; ignore previously-installed versions of the requested packages? (This should normally be TRUE, so that pre-installed packages available in the site libraries are ignored and hence packages are installed into the virtual environment.)

pip_options
An optional character vector of additional command line arguments to be passed to pip.

confirm
Boolean; confirm before removing packages or virtual environments?

Details
Virtual environments are by default located at ~/.virtualenvs (accessed with the virtualenv_root() function). You can change the default location by defining the WORKON_HOME environment variable.
with.python.builtin.object

Evaluate an expression within a context.

Description

The `with` method for objects of type `python.builtin.object` implements the context manager protocol used by the Python `with` statement. The passed object must implement the `context manager` (`__enter__` and `__exit__`) methods.

Usage

```r
## S3 method for class 'python.builtin.object'
with(data, expr, as = NULL, ...)
```

Arguments

- `data` : Context to enter and exit
- `expr` : Expression to evaluate within the context
- `as` : Name of variable to assign context to for the duration of the expression’s evaluation (optional).
- `...` : Unused
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