MONASH University

MONASH BUSINESS SCHOOL

ETC4500/ETC5450
Advanced R programming

Week 3: R package development

Outline

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System setup

```
install.packages(c("devtools", "roxygen2", "testthat", "knitr"))
```

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```

R build toolchain

- Windows:

  `https://cran.r-project.org/bin/windows/Rtools/`
- macOS: `xcode-select --install`
- Linux: `sudo apt install r-base-dev`

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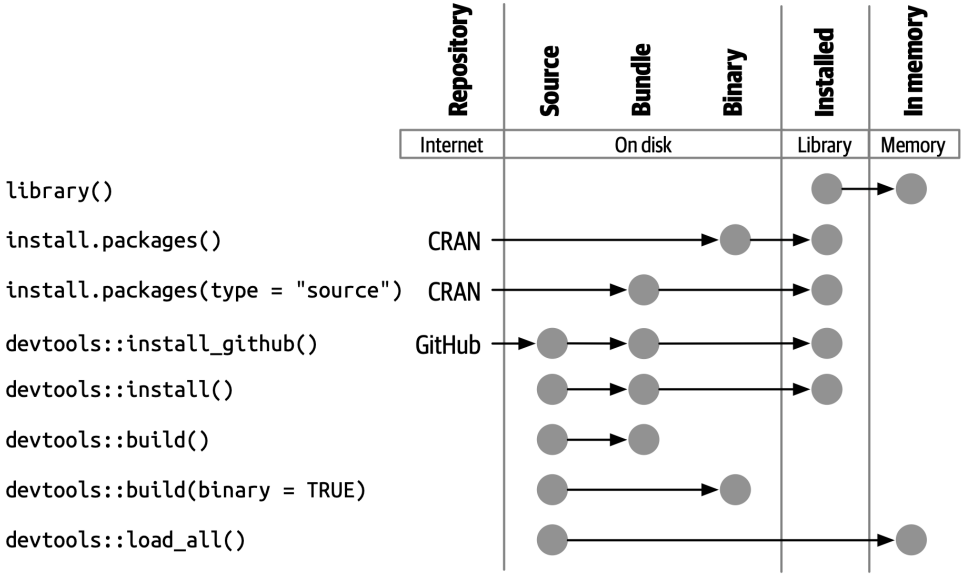
Verify

```
library(devtools)
dev_sitrep()
```

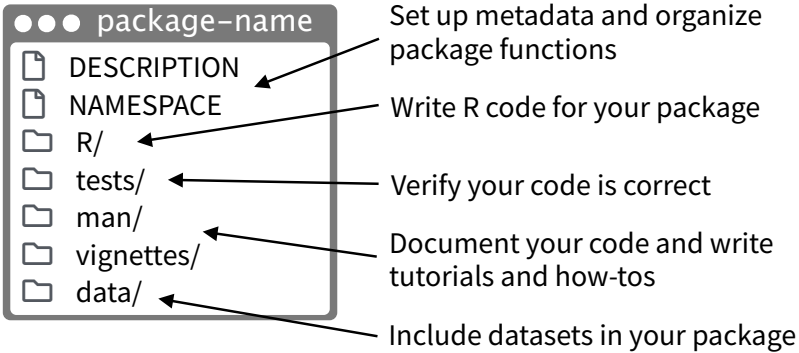
Package states

- **source**: the original files
- **bundled**: some processing, and compressed to a single `.tar.gz` file (e.g., to upload to CRAN)
- **binary**: what you usually download from CRAN
- **installed**: decompressed binary file stored in package library
- **in-memory**: loaded into R session using `library()`

Package states



Package structure



There are multiple packages useful to package development, including **usethis** which handily automates many of the more repetitive tasks. Install and load **devtools,** which wraps together several of these packages to access everything in one step.

Package name

- Only letters, numbers and periods.
- Must start with a letter.
- It cannot end with a period.
- No hyphens or underscores.
- Use the `available::available()` function to try ideas.

Package code is different

- The `DESCRIPTION` file is the principal way to declare dependencies; we don't do this via `library(somepackage)`.
- Be explicit about which functions are user-facing and which are internal helpers. By default, functions are not exported.

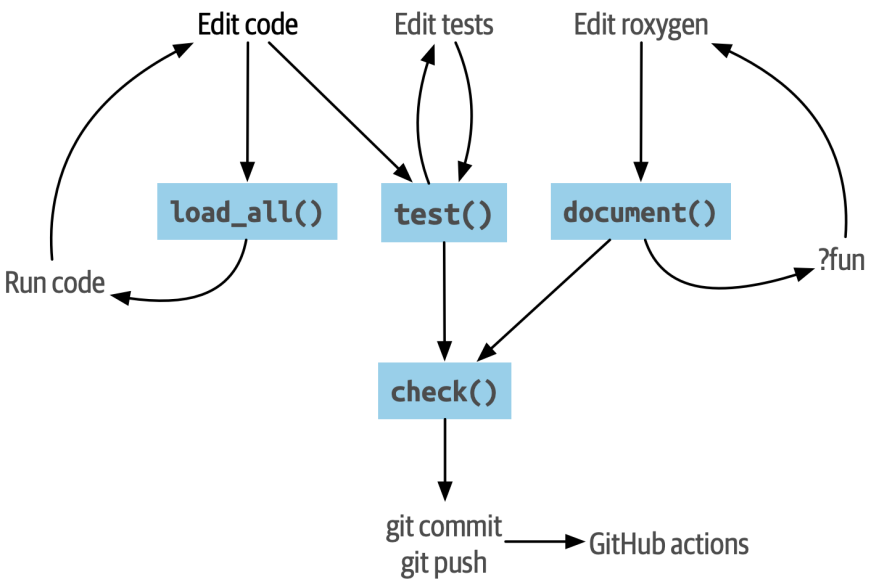
Exercise: Start on a package

We will create a package that doubles numbers.

1. Create a new folder with package name and setup project file.
2. Create package skeleton

```
create_package()
```

Workflow


Edit code
Edit tests
Edit roxygen
load_all()
test()
document()
Run code
?fun
check()
git commit
git push
GitHub actions

Workflow shortcuts

- `install()` : Ctrl-Shift-B
- `load_all()` : Ctrl-Shift-L
- `document()` : Ctrl-Shift-D
- `check()` : Ctrl-Shift-E
- `test()` : Ctrl-Shift-T

Outline

DESCRIPTION file

```
Package: doubler
Title: This package doubles numbers
Version: 0.0.0.9000
Authors@R:
    person("Rob", "Hyndman", , "Rob.Hyndman@monash.edu", role = c("aut", "cre"))
Description: Whether the input is real, complex or character, this will double it.
License: GPL (>= 3)
Encoding: UTF-8
Roxygen: list(markdown = TRUE)
RoxygenNote: 7.3.1
Suggests:
    testthat (>= 3.0.0)
Config/testthat/edition: 3
```

DESCRIPTION file

- **Title**: one line description. Plain text, title case, no more than 65 characters.
- **Description**: Several sentences, one paragraph. 80 characters per line, 4 space indentation. Don't include the package name in the Title or Description. Do not start with "This package does…"
- **Author**: Use `Authors@R` with `person()` for each author.
- **Version**. `Major.Minor.Patch.9000`. The `9000` is a placeholder for development versions.
- **License**: `GPL-3` or `MIT` are common.

DESCRIPTION file

- **Depends**: packages that are attached with your package. (Not needed for most packages.)
- **Imports**: packages that are used in your package. (Refer to functions using `pkg::fun()`.)
- **Suggests**: packages that are used in your package, but not required. (E.g., in tests or examples.)
- **LazyData**: `true` prevents users having to use `data()`.

DESCRIPTION file

Functions to help with the DESCRIPTION file:

- `use_github()` or `use_github_links()`: set the GitHub repository, URL and BugReports.
- `use_mit_license()`: set the license to MIT.
- `use_gpl3_license()`: set the license to GPL-3.
- `use_package()`: Add package to Imports or Suggests.
- `use_data()`: Add data to your package.
- `use_tidy_description()`: Clean up the DESCRIPTION file.

NAMESPACE file

- Generated by `roxygen2`, so don't edit by hand.
- `export()`: export a function (including S3 and S4 generics).
- `S3method()`: export an S3 method.
- `importFrom()`: import selected object from another namespace (including S4 generics).
- `import()`: import all objects from another package's namespace.
- `useDynLib()`: registers routines from a DLL (this is specific to packages with compiled code).

Outline

Documenting the package

```
use_package_doc()
```

Documenting functions

- Add roxygen2 comments to your `.R` files
  - RStudio menu: `Code > Insert roxygen skeleton` (while cursor is within function)
  - Or use Github Copilot (in RStudio or VS-Code)
  - Or write them by hand
- Then use `document()` to generate the `Rd` files and the `NAMESPACE` file. (Or press `Ctrl+Shift+D` in RStudio.)
- Preview documentation with `?function`

Documenting functions

```
#' Title
#'
#' Description
#' More description
#'
#' @param x Description of x
#' @inheritParams fun
#' @returns Description of return value
#' @examples
#' @importFrom pkg fun
#' @import pkg
#' @rdname fun
#' @aliases fun
#' @seealso fun
#' @references Some reference
#' @author Your name
#' @export
```

Documenting data

- Put raw data in `data-raw/`
- Code to wrangle data and create objects in `data-raw/`
- `use_data(object)` to add rda to `data/`

```
#' Title
#'
#' Description
#' More description
#'
#' @source Where did you get the data?
#' @format Class, dimensions, or other details
#' @keywords datasets
#' @examples
"object"
```

README.Rmd

1. Describe the high-level purpose of the package.
2. A simple example illustrating package.
3. Installation instructions
4. An overview of the main components of the package.

- Like a short vignette
- Displayed on the Github repository and the front page of the pkgdown site.
- Create with `usethis::use_readme_rmd()`
- Build with `devtools::build_readme()`

Vignettes

- A long-form guide to your package, or an extended example.
  - `usethis::use_vignette("my-vignette")`
  - Creates a `vignettes/` directory.
  - Adds the necessary dependencies to `DESCRIPTION`
  - Drafts a vignette, `vignettes/my-vignette.Rmd`.
  - Adds some patterns to `.gitignore`

Vignettes YAML

```
---
title: "Vignette Title"
author: Your name
output: rmarkdown::html_vignette
vignette: >
  %\VignetteIndexEntry{Vignette Title}
  %\VignetteEngine{knitr::rmarkdown}
  %\VignetteEncoding{UTF-8}
---
```

Vignettes initial code chunks

````
```{r, include = FALSE}
knitr::opts_chunk$set(
  collapse = TRUE,
  comment = "#>"
)
```
````

````
```{r setup}
library(yourpackage)
```
````

- Any package used in a vignette must be included in Suggests if not already in Imports.

NEWS

- List changes in each release that users might care about.
- Use `usethis::use_news_md()` to create a `NEWS.md` file.

```
# foofy (development version)

* Better error message when grooving an invalid grobble (#206).

# foofy 1.0.0

## Major changes

* Can now work with all grooveable grobbles!

## Minor improvements and bug fixes

* Printing scrobbles no longer errors (@githubusername, #100).

* Wibbles are now 55% less jibbly (#200).
```

Outline

testthat v3

- `usethis::use_testthat()`
  - Create a `tests/testthat/` directory.
  - Add `testthat` to the Suggests field in DESCRIPTION and specify `testthat 3e` in the `Config/testthat/edition` field.
  - Create a file `tests/testthat.R` that runs all your tests when `check()` runs.
- Every exported function should have tests.
- `usethis::use_test("some_tests.R")` creates a test file for a function or group of functions.
- Each R file should match a test file.

testthat v3

- Test files live in `tests/testthat/` and are named `test-*.R`.
- Each test file should test one function or a small group of related functions.
- Useful testing functions:
  - `expect_equal()`, `expect_identical()`, `expect_true()`, `expect_false()`
  - `expect_error()`, `expect_warning()`, `expect_message()`
- `test()` runs all tests.

What to test

- Focus on testing the exported functions.
- Strive to test each behaviour in one and only one test.
- Avoid testing simple code that you're confident will work.
- Always write a test when you discover a bug.
- The test-first philosophy: always start by writing the tests, and then write the code that makes them pass.
- Use `devtools::test_coverage()` to see which parts of your package are tested.

Outline

pkgdown websites

- `usethis::use_pkgdown()`
  - Creates `_pkgdown.yml` to configure site.
  - Updates `.Rbuildignore`
  - Adds `docs` to `.gitignore`
- `pkgdown::build_site()` to build the site.
- `usethis::use_pkgdown_github_pages()` to publish the site via GitHub Actions and GitHub Pages.
- Make a hex sticker with the `hexSticker` package.
- Add it using `usethis::use_logo()`.

Outline

Github Actions

- Some development tasks can be executed automatically on Github with a trigger (e.g., a push)
- Run `R CMD check`:

```
usethis::use_github_action("check_standard")
```

- Compute test coverage:

```
usethis::use_github_action("test-coverage")
```

- Build and deploy pkgdown site:

```
usethis::use_github_action("pkgdown")
```

- The `.github/workflows/` directory contains action files.
- See `https://github.com/r-lib/actions/` for more examples.

Outline

Exercise

- If you haven't finished Assignment 1, do it now.
- If you have finished Assignment 1, create an R package that includes `remaining_customers` as the only function. Add unit tests, a readme file, and a pkgdown website.