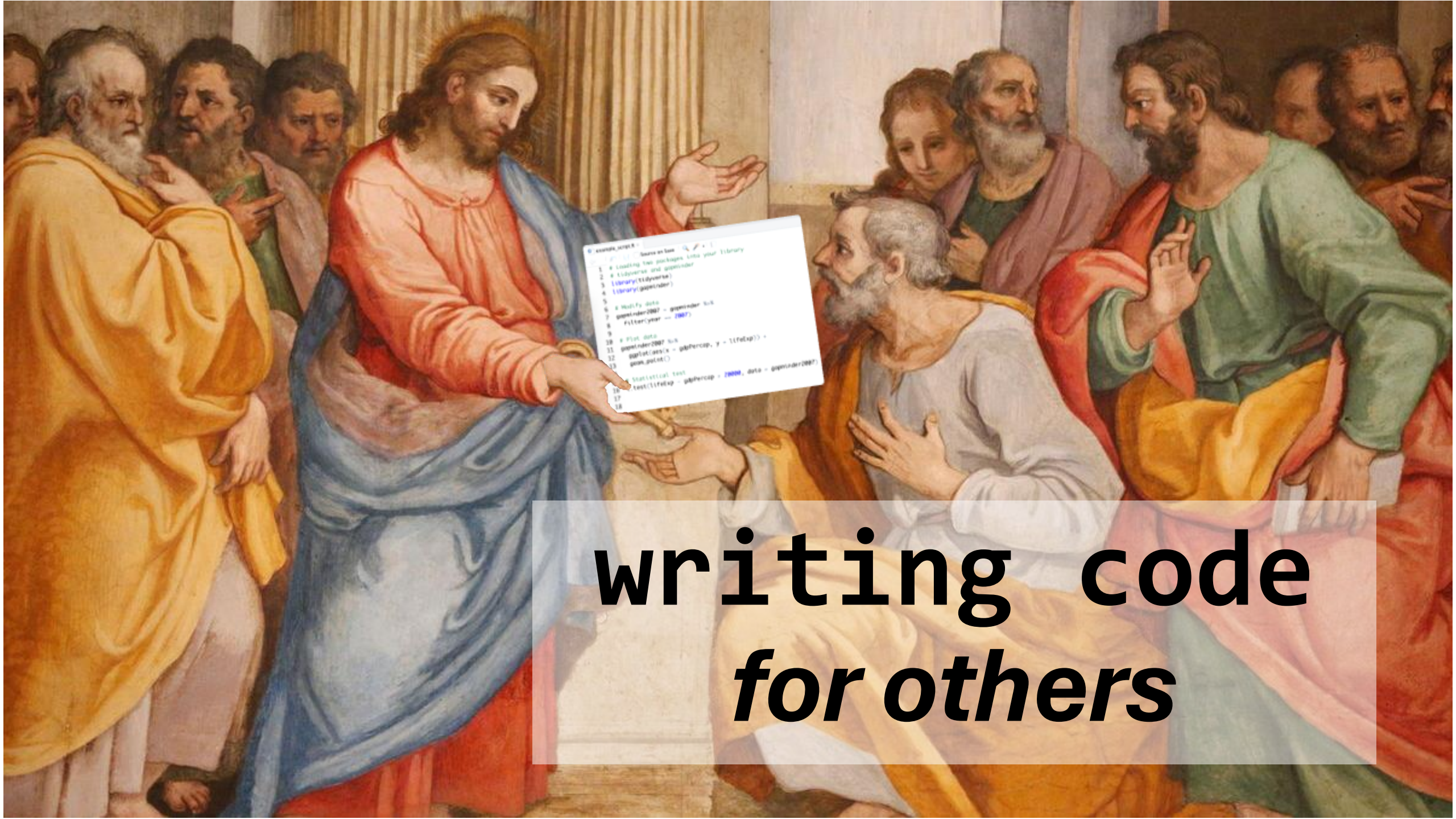
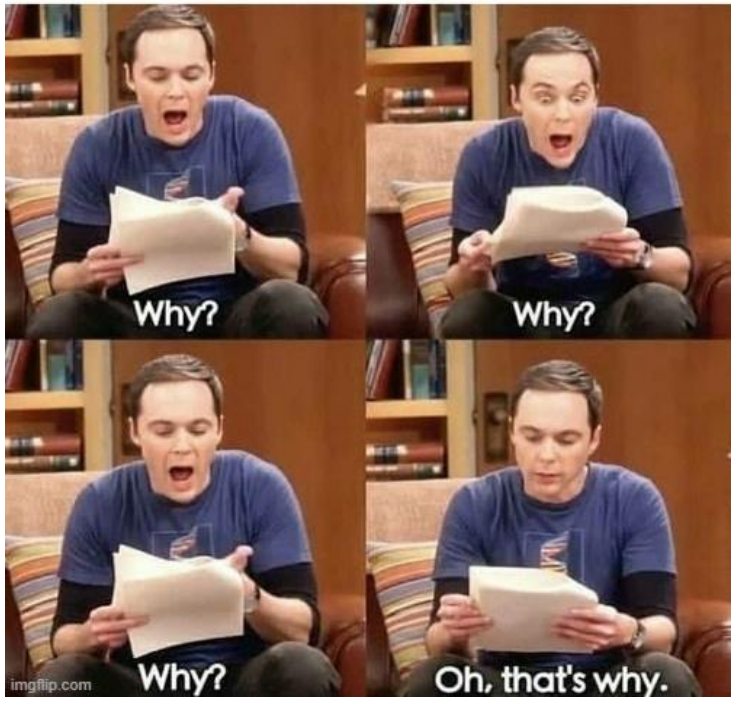

writing code
for others

Some disclamers

- My credentials
- Reproducibility { rant time }
- Note: this talk
  - will be (mostly) **R**-based
  - inspired by a couple of talks from this lady ⇢
- Advertisement time: join the EMC coding café

POV: you look at code you wrote last year



But enough about me…

You need to repeat an operation a few times (3-10). Chose a character:

- ❑ Copy-paste athlete
- ❑ For loop master
- ❑ Apply family mobster
- ❑ Vector-ciraptor

code **7217 1669**

How confident are you writing a function:

- ❑ A what now?
- ❑ I can try if you really need me to
- ❑ `def`initely
- ❑ My functions write their own functions, b*tch

The *holy trinity* of code quality

stability

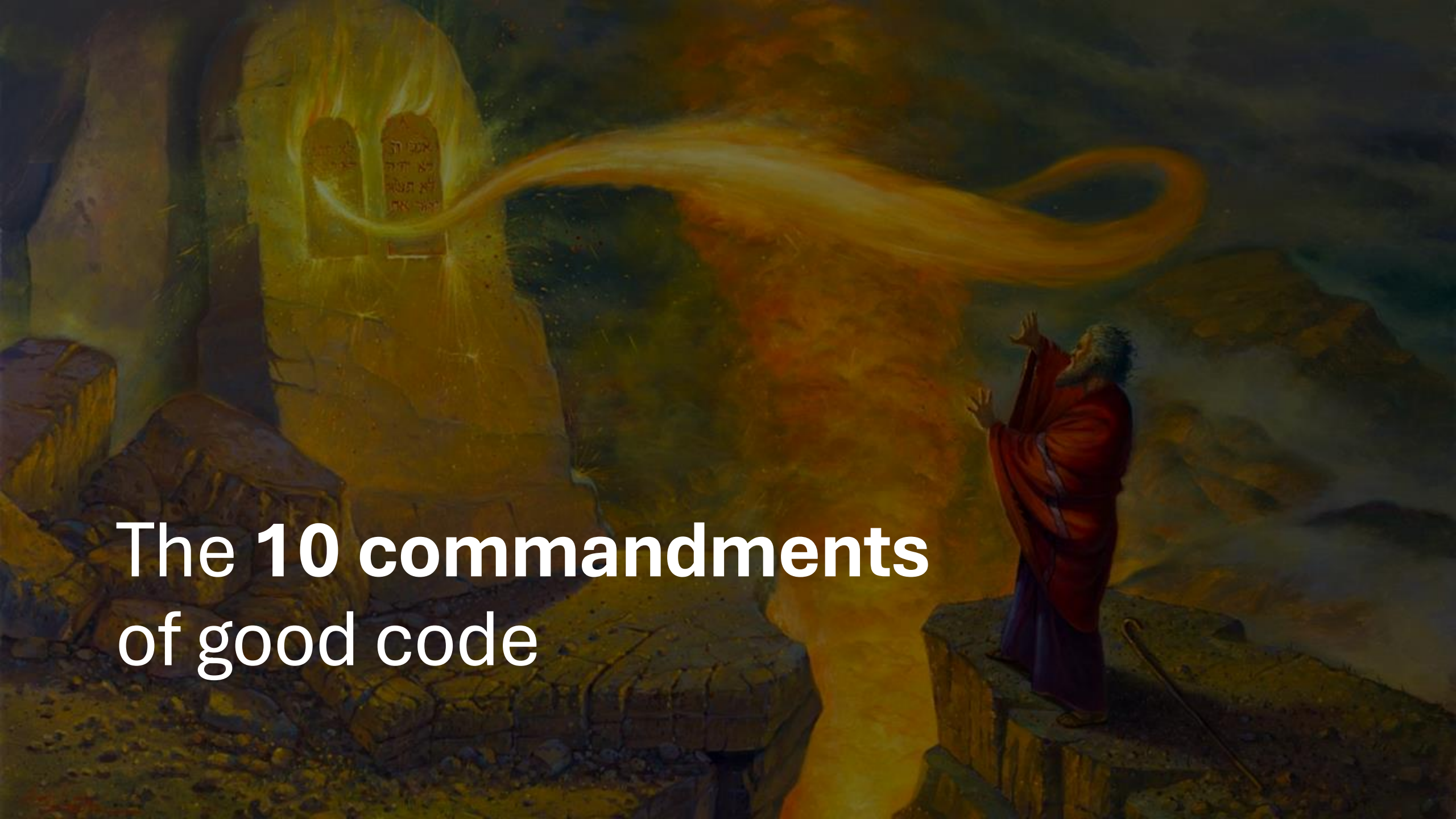
aka **reproducible**

flexibility

aka **cheap to modify**

readability

aka **easy to understand**



The **10 commandments** of good code

1 DO NOT REPEAT YOURSELF (DRY)

Don't do this

```r
# Welcome to my script

## [some code]

# Please input the path to save some output
write.csv(some_output, 'your/user/path/output1.csv')

## [some more code]

write.csv(some_other_output, 'your/user/path/output10.csv')
```

a. use **variables**

```r
# Welcome to my script
# Please input the path where to save the output
user_path <- 'your/user/path'

## [some code]

write.csv(some_output, file.path(user_path, 'output1.csv'))

## [some more code]

write.csv(some_other_output, file.path(user_path, 'output10.csv'))
```

readability **flexibility** **stability**

1 DRY level: beginner

Don't do this

```r
# e.g. fitting linear models
fit1 <- lm(out1 ~ exp1 + cov1, data = data)
# [some more code]

fit2 <- lm(out1 ~ exp2 + cov1, data = data)
# [some more code]

fit3 <- lm(out1 ~ exp3 + cov1, data = data)
# [some more code]
```

b. use a **for loop**

```r
fits <- list()

for (exp in c('exp1','exp2','exp3')) {
  # Construct formula as a string
  my_formula <- paste('out1 ~', exp, '+ cov1')
  # Save linear model output inside a list
  fits[[paste0('fit_', exp)]] <- lm(as.formula(my_formula), data=data)
}
# Access model information (e.g. coefficients)
coef(fits$fit_exp1) # or fits[['fit_exp1']] or fits[1] or fits [[1]]
```

readability

flexibility

stability

1 DRY level: intermediate

Don't do this

```r
# e.g. fitting linear models
fit1 <- lm(out1 ~ exp1 + cov1, data = data)
# [some more code]

fit2 <- lm(out1 ~ exp2 + cov1, data = data)
# [some more code]

fit3 <- lm(out1 ~ exp3 + cov1, data = data)
# [some more code]
```

Unlock **vectorization**! →

c. use a **function**

```r
fit_model <- function(exp) {
  # Construct formula as a string
  my_formula <- paste('out1 ~', exp, '+ cov1')
  # Fit the linear model
  fit <- lm(as.formula(my_formula), data=data)
  # [some more code]
  return(fit)
}
```

```r
# Fit the model with each exposure
fits <- lapply(c('exp1','exp2','exp3'), fit_model)
```

```r
fits <- list()
for (exp in c('exp1','exp2','exp3')) {
  fits[[paste0('fit_', exp)]] <- fit_model(exp)
}
```

readability **flexibility** **stability**

1 DRY level: advanced

Don't do this

```
# e.g. fitting linear models
fit1 <- lm(out1 ~ exp1 + cov1, data = data)
# [some more code]

fit2 <- lm(out1 ~ exp2 + cov1, data = data)
# [some more code]

fit3 <- lm(out1 ~ exp3 + cov1, data = data)
# [some more code]

fit4 <- lm(out2 ~ exp1 + cov1, data = data)
# [some more code]

fit5 <- lm(out2 ~ exp2 + cov1, data = data)
# [some more code]
```

d. add ***arguments*** to your **function**

```
fit_model <- function(exp, out) {
  my_formula <- paste(out, '~', exp, '+ cov1')
  fit <- lm(as.formula(my_formula), data=data)
}

fits <- list()
for (out in c('out1','out2')) {
  for (exp in c('exp1','exp2','exp3')) {
    fits[[paste0('fit_', out, exp)]] <- fit_model(exp, out)
  }
}
```

readability **flexibility** **stability**

1 DRY level: brat

Don't do this

```r
# e.g. fitting linear models
fit1 <- lm(out1 ~ exp1 + cov1, data = data)
# [some more code]

fit2 <- lm(out1 ~ exp2 + cov1, data = data)
# [some more code]

fit3 <- lm(out1 ~ exp3 + cov1, data = data)
# [some more code]

fit4 <- lm(out2 ~ exp1 + cov1, data = data)
# [some more code]

fit5 <- lm(out2 ~ exp2 + cov1, data = data)
# [some more code]
```

```r
fit_model <- function(exp, out, cov = '+ cov1') {
  my_formula <- paste(out, '~', exp, cov)
  fit <- lm(as.formula(my_formula), data=data)
  print(summary(fit))
  NULL
}

# Define all possible combinations of arguments
exps <- c('exp1','exp2','exp3')
outs <- c('out1','out2')
covs <- c('+ cov1', '+ cov1 + cov2')

all_models <- expand.grid(exp = exps, out = outs, cov = covs)

# Apply the model
do.call(mapply, c(fit_model, all_models))
# OR
# use purrr::pmap()
```

readability **flexibility** **stability**

2 # comment. your. code.

Explain yourself, what seems obvious now may become confusing once you forgot the context (…for me: *pretty darn soon*)

3 Don't expect *anyone* to read the comments

"there are only two hard things in Computer Science: cache invalidation and **naming things**."

Good code should *"read like English"*

- ⇢ Pick the right **names** your functions and variables
- ⇢ (in R) use **piping** (`%>%` , `|>`)

The code should explain ***what***, the comment should explain ***why***

readability | **flexibility** | **stability**

4 Use “chapters” and “paragraphs”

Avoid very *long scripts* (with 500+ lines)

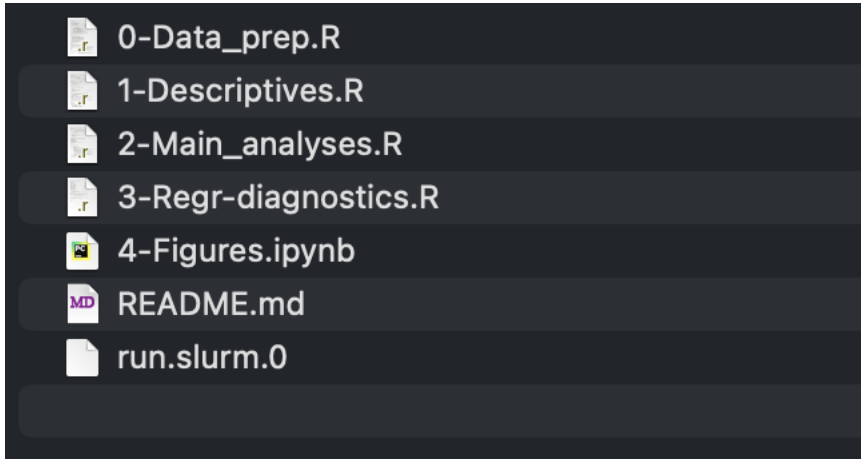
- Divide your pipeline into “chapter” **files**
- … *number* them (when it makes sense)
- *Tip*: access variables or functions defined inside other files:

```
source(“0-functions.R”)
```

```
from definitions.backend import *
```

Divide your script into **sections** using

```
# [section title] ------------------------
```



A **few small functions** > one *monster* function

readability | flexibility | stability

5 **You have to break it** (before you can fix it)

Repeat after me: errors should **never** pass silently .

In the face of *ambiguity* (which will probably be there), <u>don't *guess*</u>

⇢ Check your **user input** (…often: classes and types)

```
if (is.numeric(variable)) {
  mean(variable)
} else if (is.factor(variable)) {
  warning("Factor means are not meaningful, how about frequencies.")
  table(variable)
} else {
  stop("You need to input either a numeric variable or a factor.")
}
```

<u>Don't</u> comment & uncomment code, *especially* if you need to do it in multiple places!

⇢ ***Throw*** **errors** and/or ***catch*** them using `tryCatch()`

readability | **flexibility** | **stability**

BUT… beware of **onion functions**

```
get_some_data <- function(config, outfile) {
  if (config_ok(config)) {
    if (can_write(outfile)) {
      if (can_open_network_connection(config)) {
        data <- parse_something_from_network()
        if(makes_sense(data)) {
          data <- beautify(data)
          write_it(data, outfile)
          return(TRUE)
        } else {
          return(FALSE)
        }
      } else {
        stop("Can't access network")
      }
    } else {
      ## uhm. What was this else for again?
    }
  } else {
    ## maybe, some bad news about ... the config?
  }
}
```

6 Flat is better than nested

Less indentation > more indentation.

Not all `if`s need an `else`…

⇢ Use quick `stop()` and `return()` (“*guard clauses*”)

e.g. `stopifnot(is.numeric(x) || is.logical(x))`

Use control-flow *alternatives*:

```
ifelse(age_yrs < 2, "baby",
       ifelse(age_yrs < 13, "kid",
              ifelse(age_yrs < 20, "teen",
                     "adult"
              )
       )
)
```

```
library(dplyr)

tibble(
  age_yrs = c(0, 4, 15, 24, 55),
  age_cat = case_when(
    age_yrs < 2  ~ "baby",
    age_yrs < 13 ~ "kid",
    age_yrs < 20 ~ "teen",
    TRUE         ~ "adult"
  )
)
```

readability | flexibility | stability

7 Code independence

Avoid adding dependencies

(unless you *really* need them)

Packages:

are living things, they **change** all the time

depend on other packages, *which*

Good practice::**contextualize functions!**

```
# Read file
foreign::read.spss(my_spss_file)
```

Don't do this

```
# Upload packages
library('foreign')
library('table1')
library('tidyverse')
library('dplyr')
library('gt')
library('plyr')
library('car')
library('nnet')
library('pscl')
library('broom')
library('xtable')
library('car')
library('MASS')
library('emmeans')
library('mice')
```

readability | flexibility | **stability**

8 Version control (a): use environments

A *programming environment* = “the infrastructure (including the compiler and the tools) where the code can run”

Basically: the **version** of R and the packages

...and, sometimes, the OS

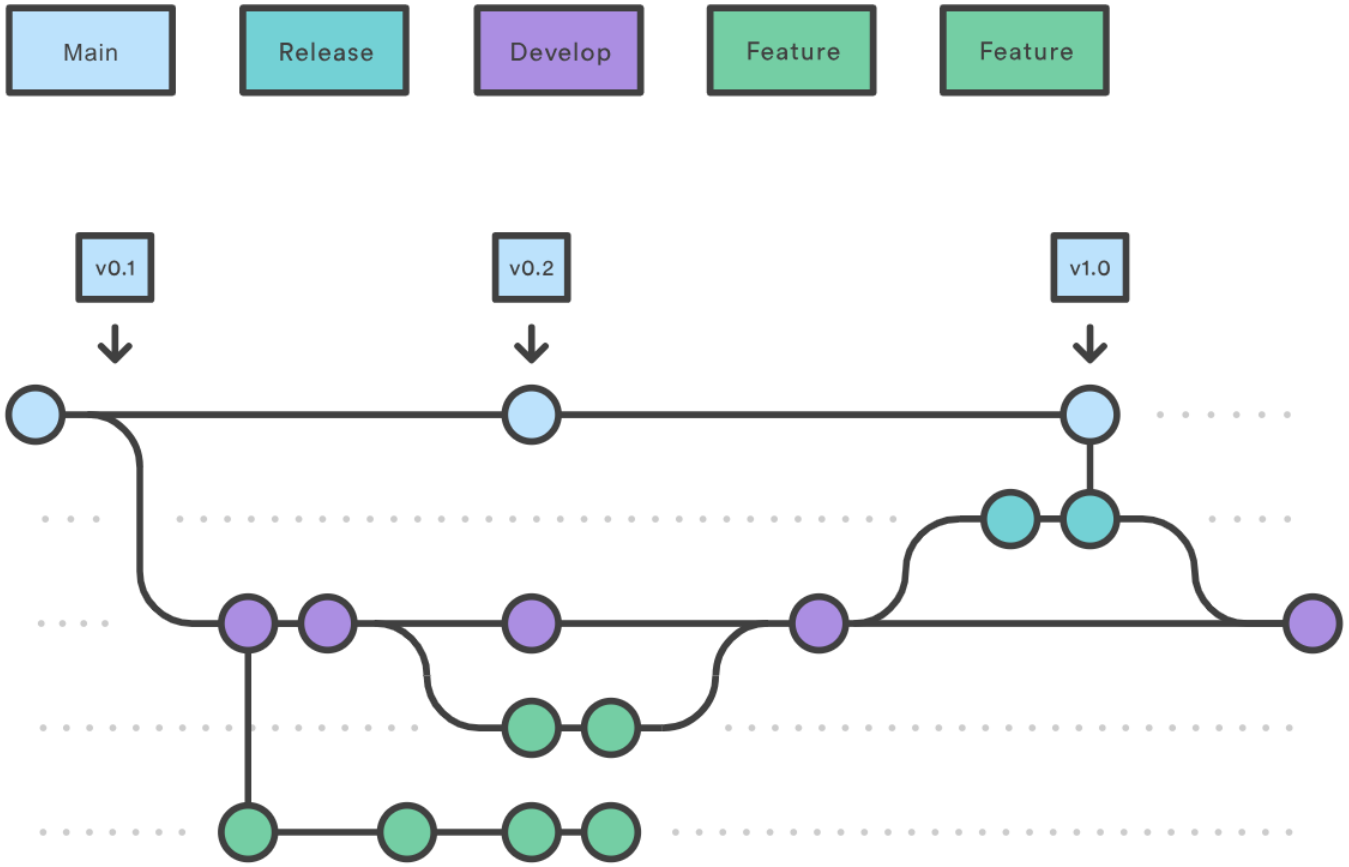
Environment managers: `conda`, `venv`, `pyenv`

From R:

```
# 1. Activate the environment
renv::activate()
# 2. Create a "lockfile": a "snapshot" of the current project
renv::snapshot()
# 3. Reproduce it any place else
renv::restore()
```

readability | flexibility | **stability**

9 Version control (b): use git



[note] Upcoming talk:

Introduction to git and github

PhD meeting
5 Feb 2024,14:00

readability | flexibility | **stability**

8

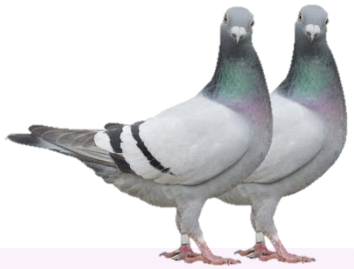
9

Version control (a & b): use projects

I often see scripts starting like this:

```
setwd('path/to/project/folder/')
```

Use a **project** instead…



RStudio makes this very easy! [demo]

Once you create a project, it's <u>much easier</u> to manage your files, your dependencies (with `renv`), track code versions (with `git`) and (eventually) give it somebody else.

readability | flexibility | **stability**

10 *Peer review*, baby 😎

- As an author, **ask *people* to review your code**!
  - ⇢ Best medicine against *code blindness*
  - ⇢ If you can *(and you can)* have at least one co-author review the code

- As a reviewer, ask to see the code : that's the real scientific product

readability | flexibility | **stability**

In summary…

1. **Don't repeat yourself**: use variables, functions and loops
2. **#comment** your code
3. Pick names so you can `read_code_like("English")`
4. Keep your files (and functions) **short** & **organised**
5. Throw and catch **errors**
6. Avoid (a lot of) **indentation**
7. Avoid package **dependencies**
8. Use **environments**
9. Use **git**

   } control those **versions**

10. **Peer review** the code

readability | **flexibility** | **stability**

Bonus: some extra **don’ts**

- ✗ forget to `set.seed()`
- ✗ refer to columns in a data frame using their numbers
- ✗ make functions dependent on global enviroment variables

Thanks for listening!

`(happy_coding_everyone;)`