```
> workshop(
    topic   = “R Introduction for Data Science”,
    trainer = “Muhammad Aswan Syahputra”,
    when    = “2019-05-20”,
    where   = “Telkom University, Bandung”
  )
>  ...
```

- Sensory Scientist @ Sensolution.ID
- Using R for 4+ years, keen on Data Carpentry
- Initiator of Komunitas R Indonesia
- Pkgs: sensehubr, nusandata, bandungjuara, prakiraan, etc
- Shinyapps: sensehub, thermostats, aquastats, bcrp, bandungjuara, etc

aswansyahputra

# Know your neighbour!

- Who are you?
- What you do with data?
- How would you describe your experience with R?

# Our goal

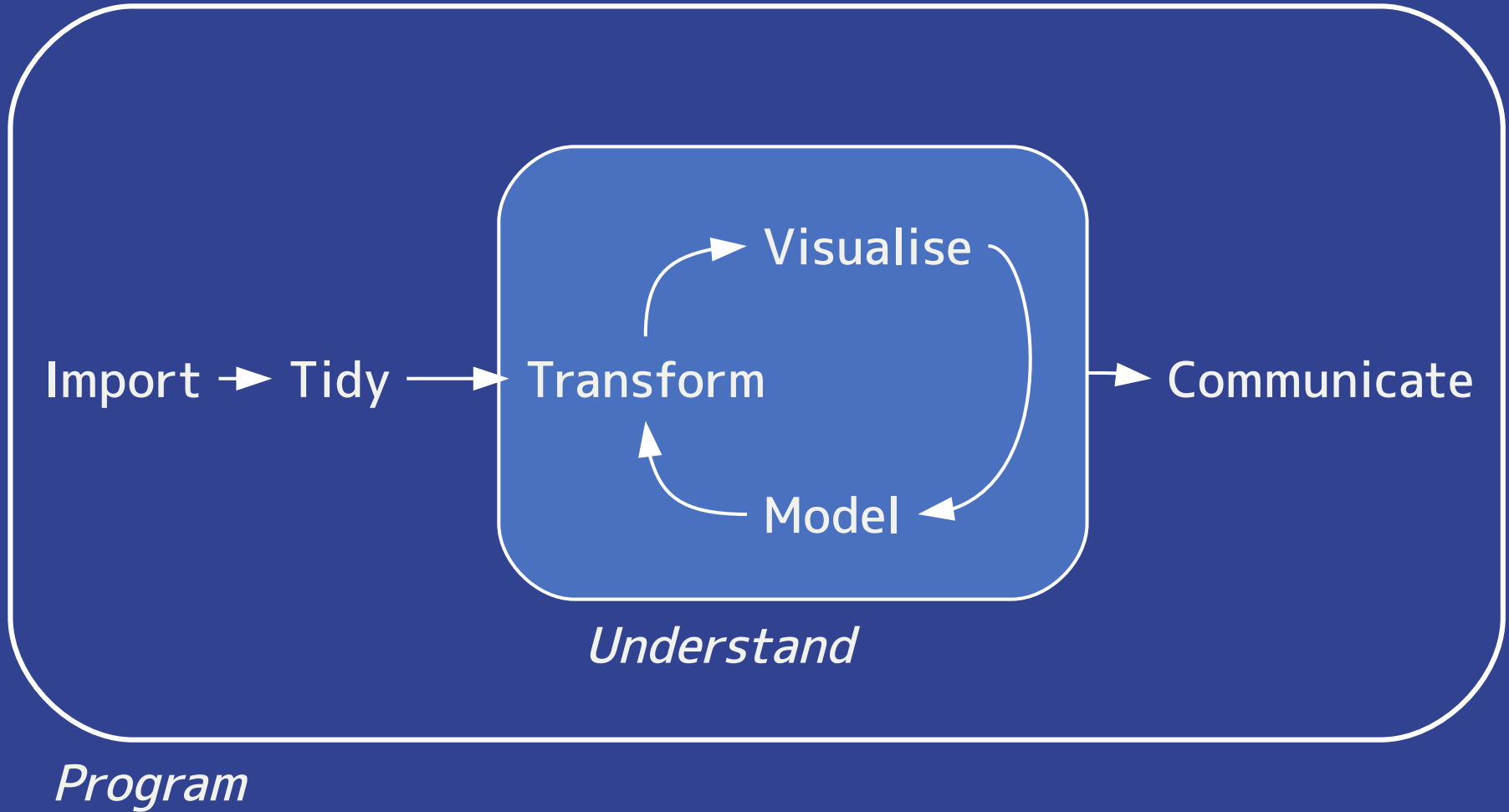

Artwork by @allison_horst

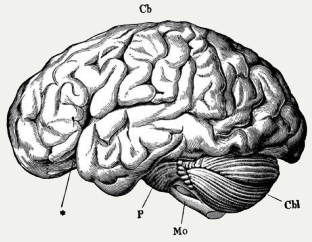

HELLO
My name is
ANDIKA


HELLO
My name is
ALYA


HELLO
My name is
WILLIAM

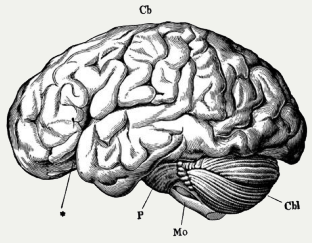

HELLO
My name is
ISHLA


Import
Tidy
Transform
Visualise
Model
Communicate
Understand
Program



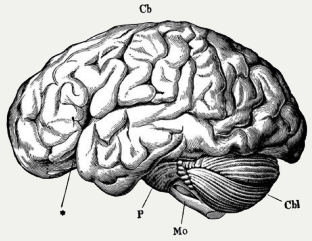

Human thought → Machine Language

Source: https://github.com/rstudio-education/arm-workshop-rsc2019




Human thought → Machine Language

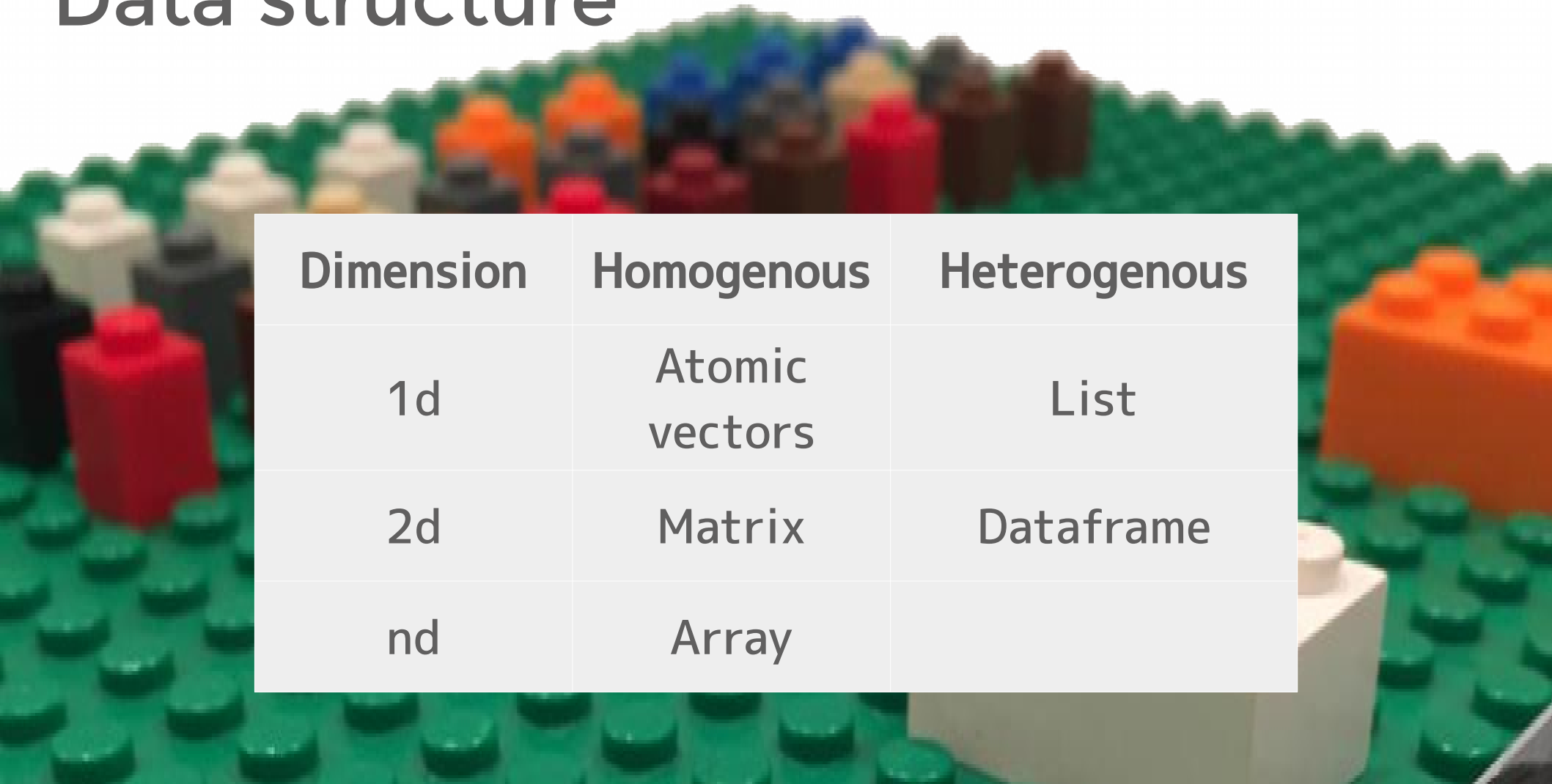
Source: https://github.com/rstudio-education/arm-workshop-rsc2019




Human thought → Machine Language

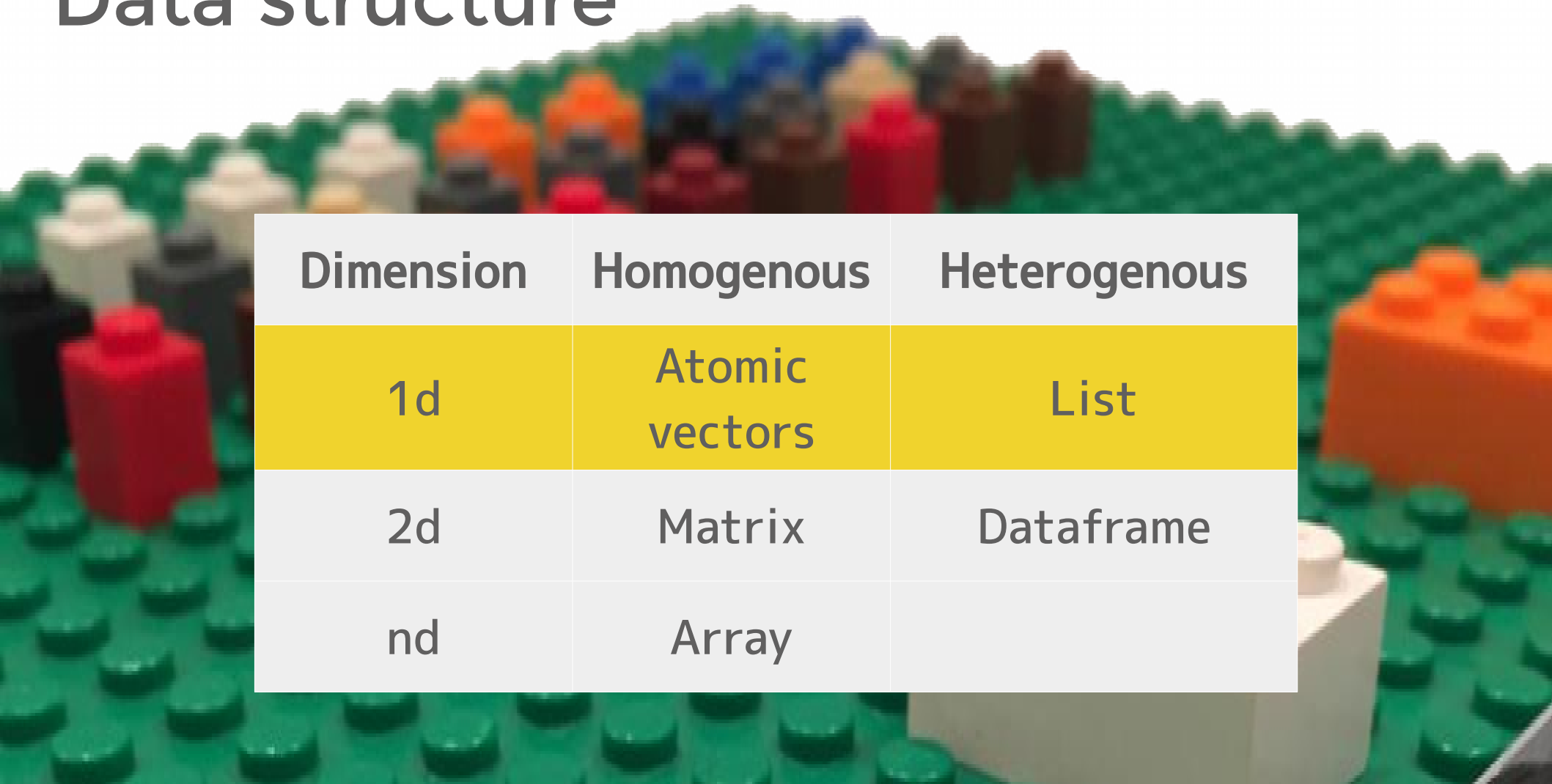
Source: https://github.com/rstudio-education/arm-workshop-rsc2019

# Data structure

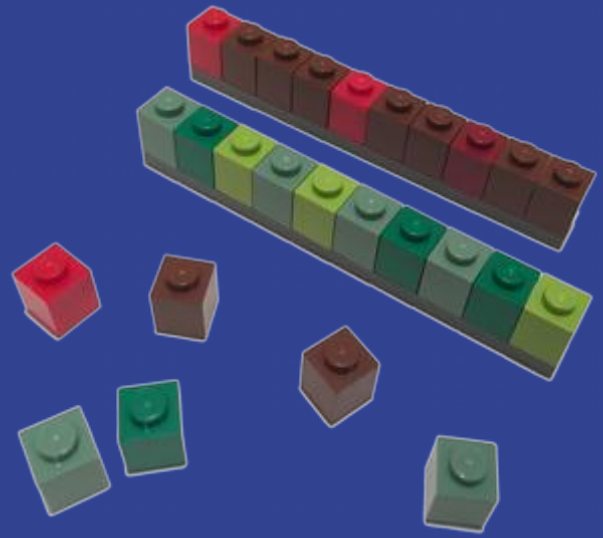


| Dimension | Homogenous | Heterogenous |
|---|---|---|
| 1d | Atomic vectors | List |
| 2d | Matrix | Dataframe |
| nd | Array | |

# Data structure

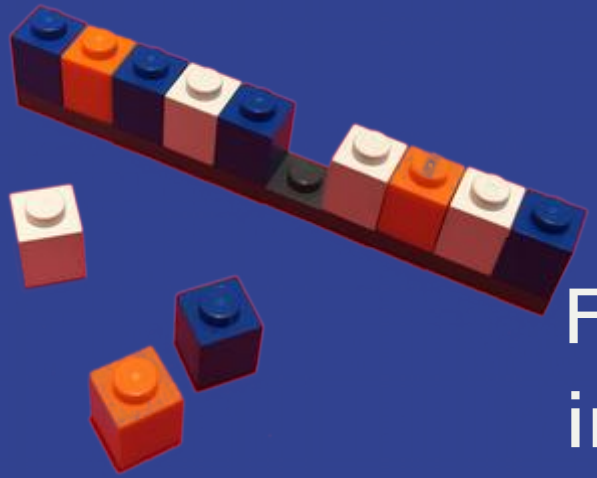


| Dimension | Homogenous | Heterogenous |
|---|---|---|
| 1d | Atomic vectors | List |
| 2d | Matrix | Dataframe |
| nd | Array | |



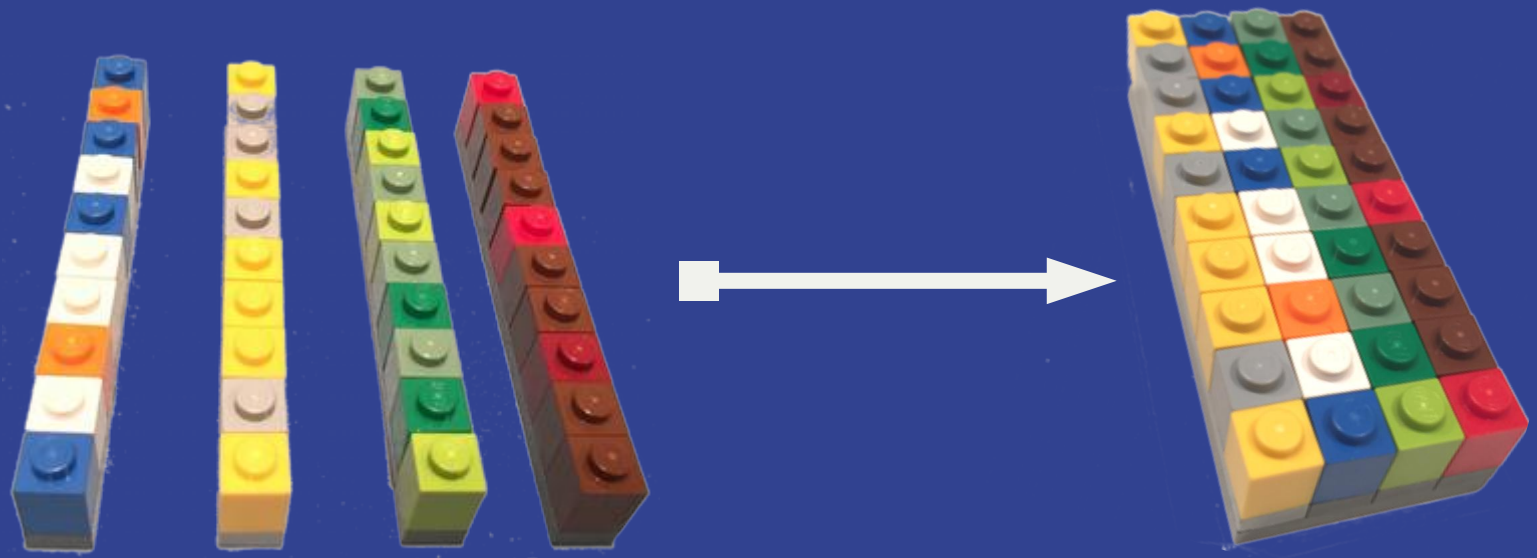
Integer, Double, Character

Logical



Factor (basically integer with class)

Artwork by @JennyBryan



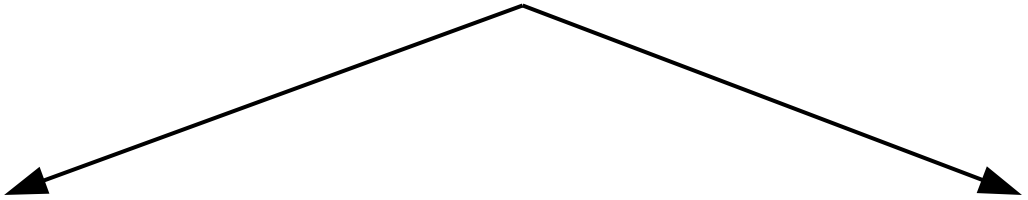
Vectors of same length

Dataframe

Artwork by @JennyBryan

# How do we process the data?

```
function(arg1, arg2, arg3,  ... )
```

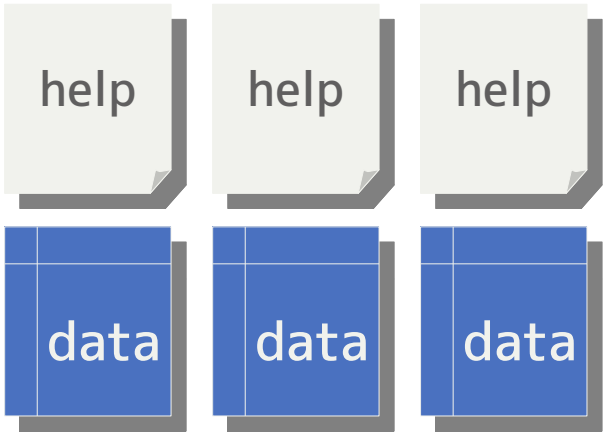


```
change_the_env( ... )
```

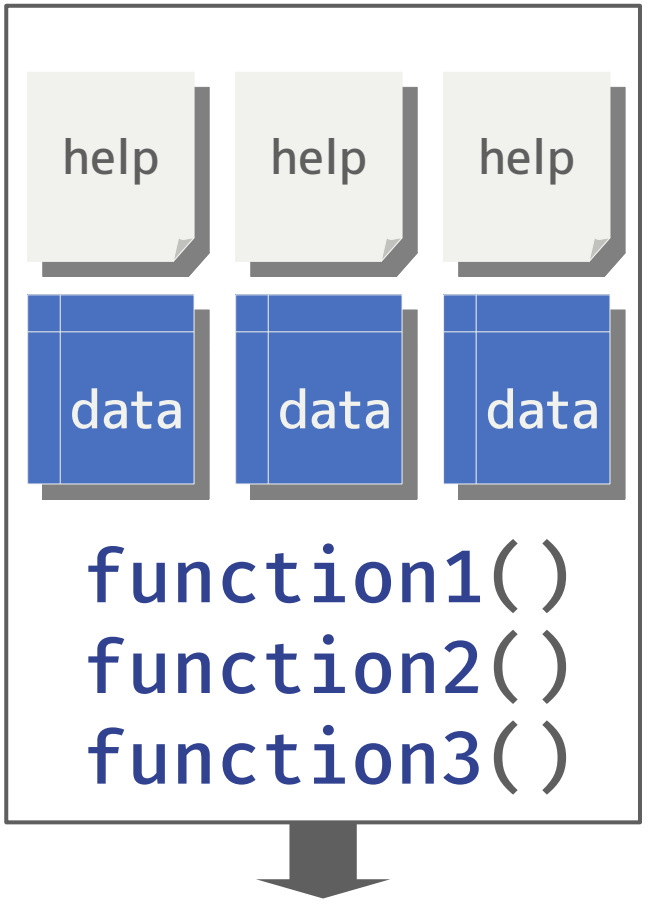
```
calculate_value( ... )
```

assign. <- , =, ->

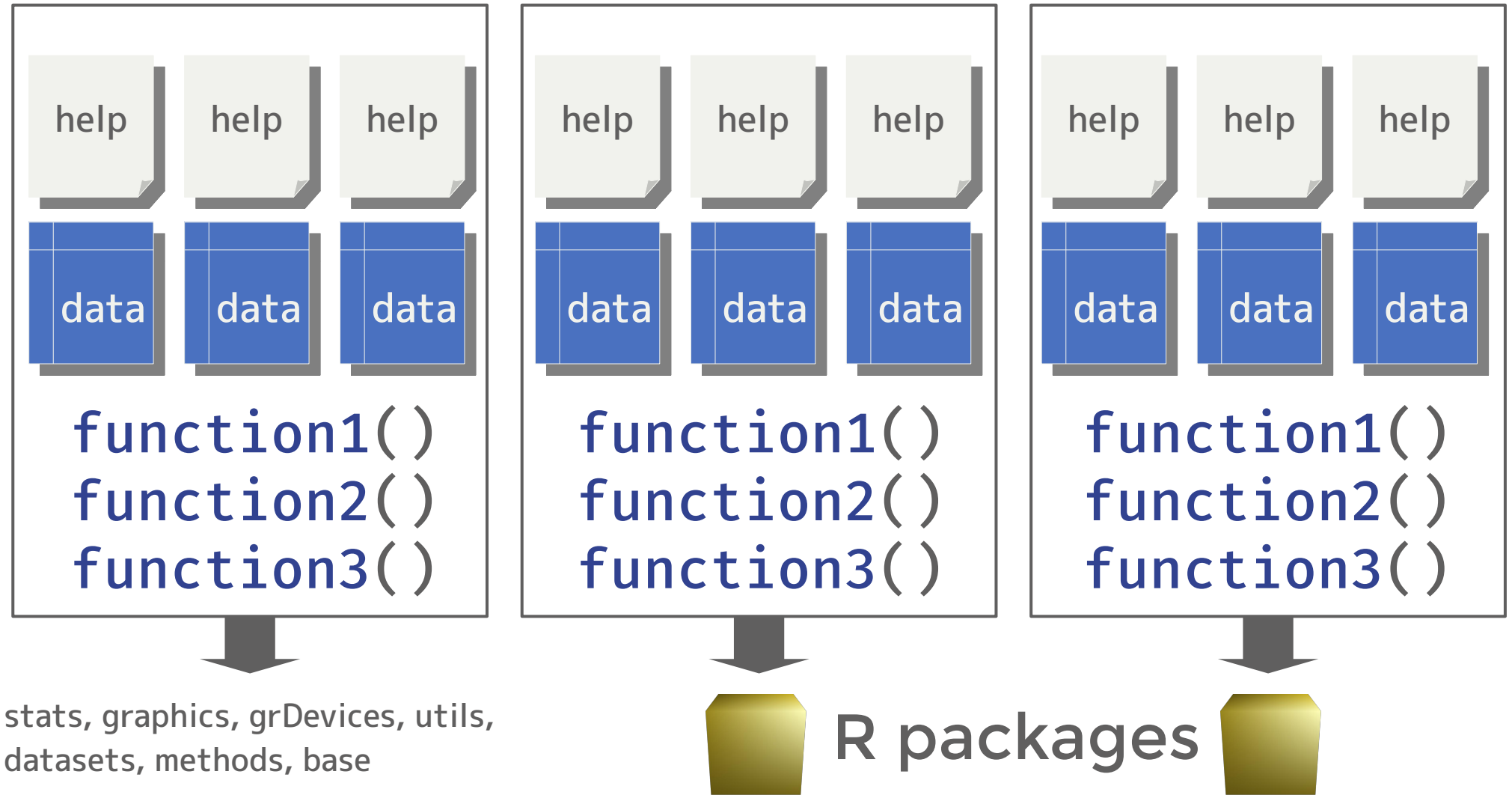
- arguments are contexts of a function
- arguments are matched by name, or
- arguments are matched by position, **be careful!**




```
function1()
function2()
function3()
```




stats, graphics, grDevices, utils,
datasets, methods, base


help
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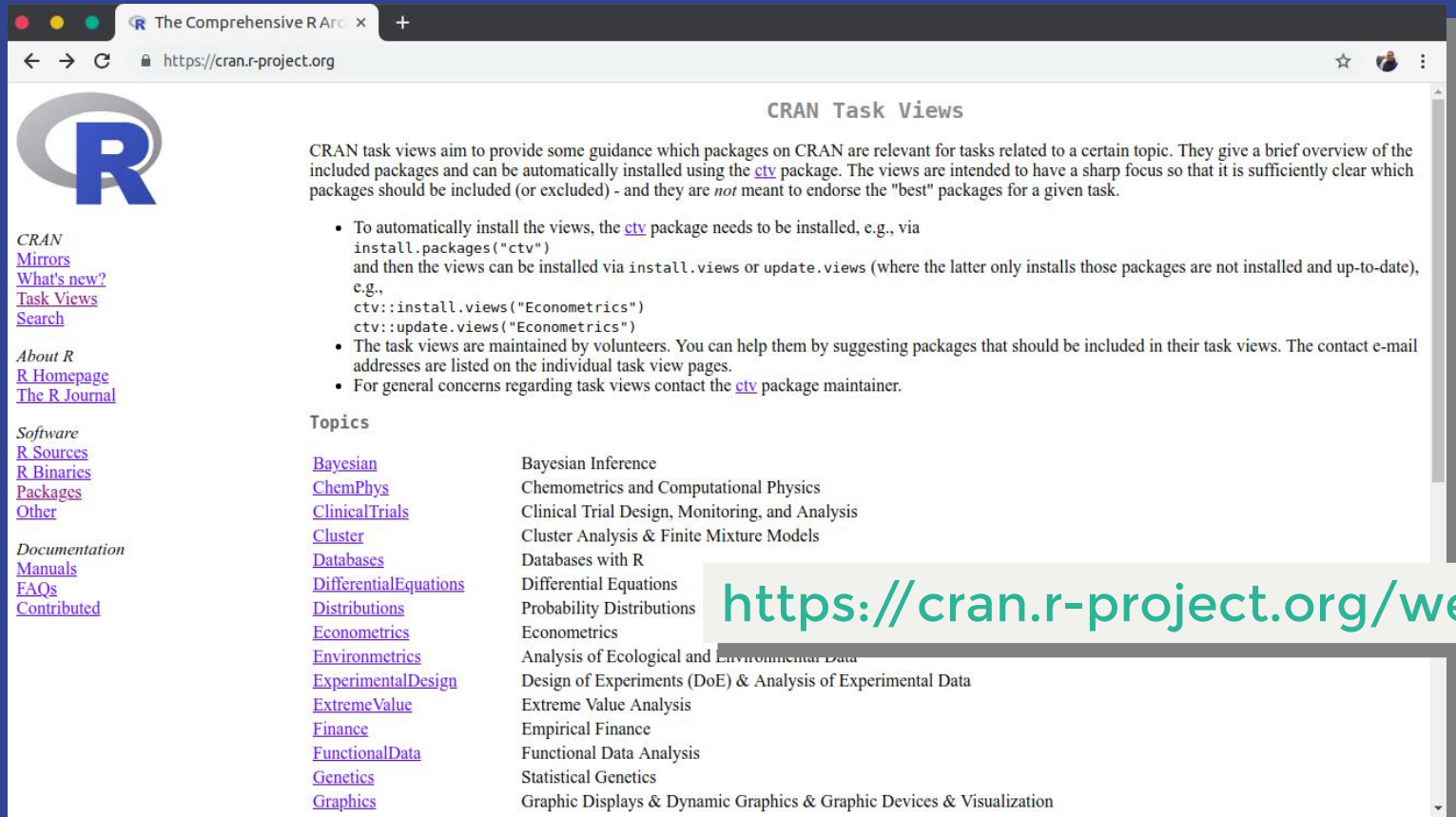
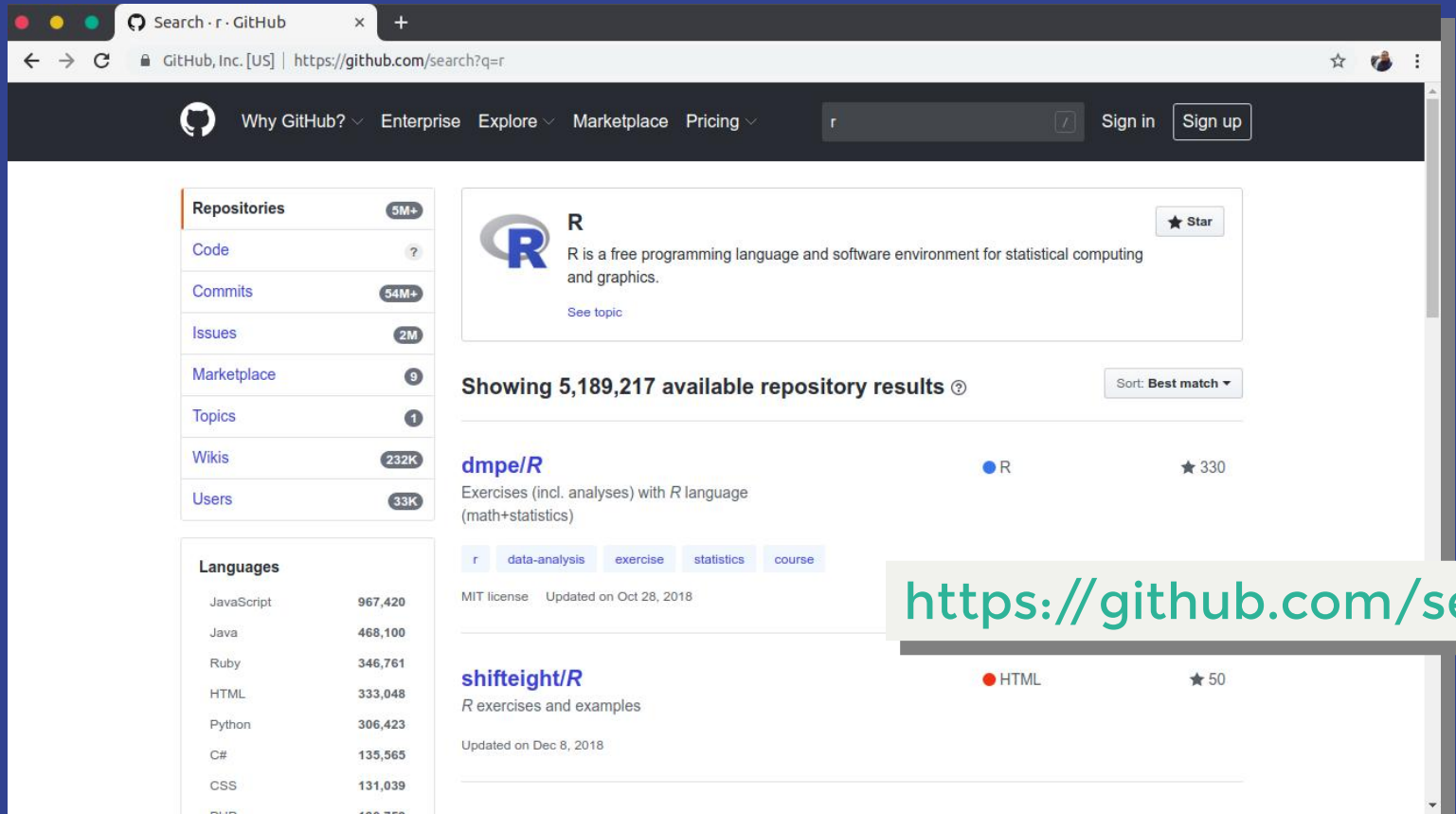
function1()
function2()
function3()
stats, graphics, grDevices, utils,
datasets, methods, base
R packages

# CRAN Task Views



# GitHub


Search · r · GitHub
GitHub, Inc. [US] | https://github.com/search?q=r
Why GitHub?
Enterprise
Explore
Marketplace
Pricing
r
Sign in
Sign up
Repositories 5M+
Code
Commits 54M+
Issues 2M
Marketplace 9
Topics 1
Wikis 232K
Users 33K
Languages
JavaScript 967,420
Java 468,100
Ruby 346,761
HTML 333,048
Python 306,423
C# 135,565
CSS 131,039
R
R is a free programming language and software environment for statistical computing and graphics.
See topic
Star
Showing 5,189,217 available repository results
Sort: Best match
dmpe/R
Exercises (incl. analyses) with R language (math+statistics)
R
330
r
data-analysis
exercise
statistics
course
MIT license
Updated on Oct 28, 2018
shifteight/R
R exercises and examples
HTML
50
Updated on Dec 8, 2018
https://github.com/search?q=r

## Installing package, only once

```
install.packages("pkg") # from CRAN/local
remotes::install_github("user/pkg") # from GitHub
remotes::install_bioc("repo") # from Bioconductor
```

## Loading package, once in every session

```
library(pkg)
pacman::p_load(pkg) # load or install if not
available
```

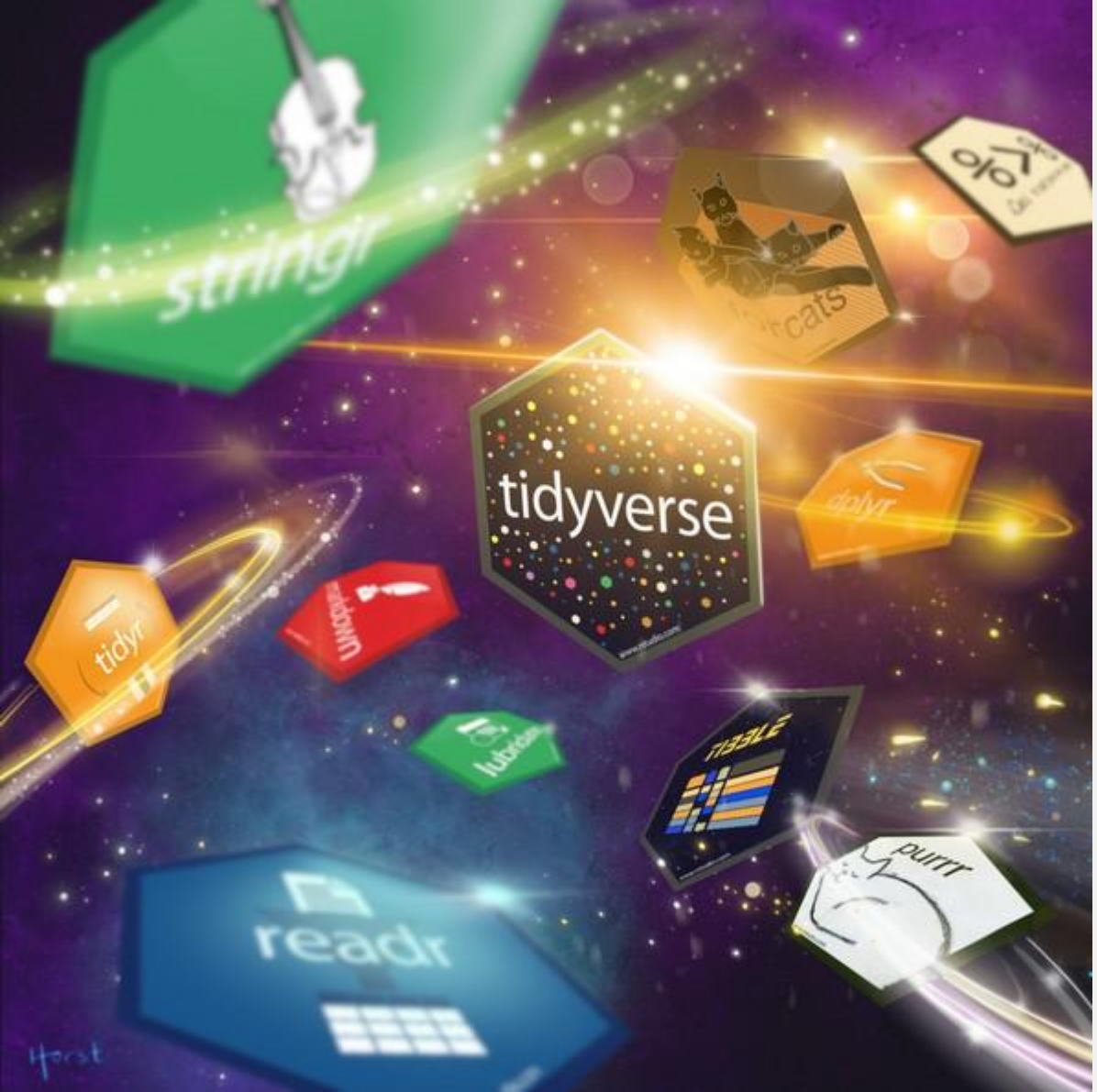
A lot of R packages

# to use! :D

A lot of R packages

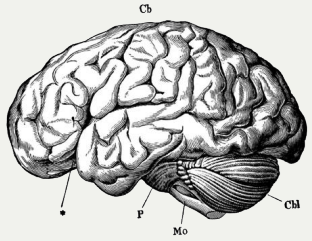
# to use! :(


tidyverse
www.rstudio.com




The tidyverse is an opinionated **collection of R packages** designed for **data science.** All packages **share** an underlying **design** philosophy, **grammar**, and **data structures**.

Artwork by @allison_horst

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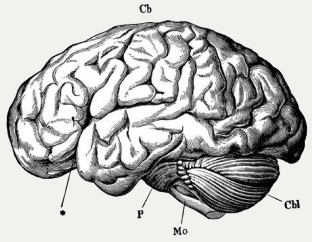



Human thought → Machine Language

Source: https://github.com/rstudio-education/arm-workshop-rsc2019

# R Syntax Comparison

## Dollar sign

```
goal(data$x, data$y)
```

- A.k.a base syntax
- Subsetting data by using '[ ]'

## Formula

```
goal(y~x, data=data)
```

Mostly used in modeling and statistical test

## Tidyverse

```
data %>% goal(x, y)
```

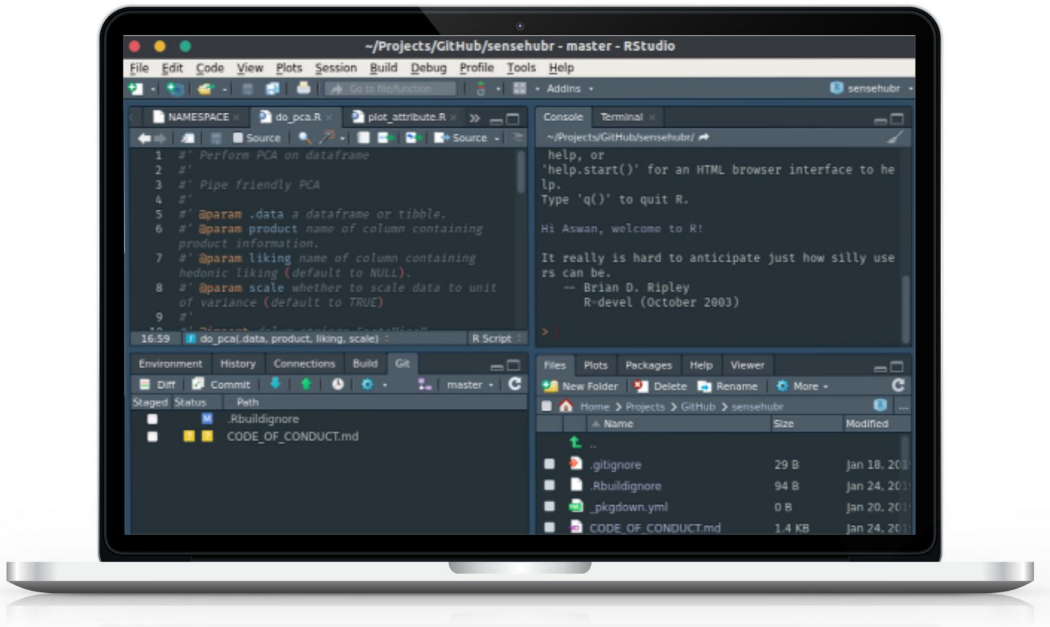
- Expecting data as the first argumen
- Plotting using '+' flavour

Cheatsheet: https://github.com/rstudio/cheatsheets/raw/master/syntax.pdf

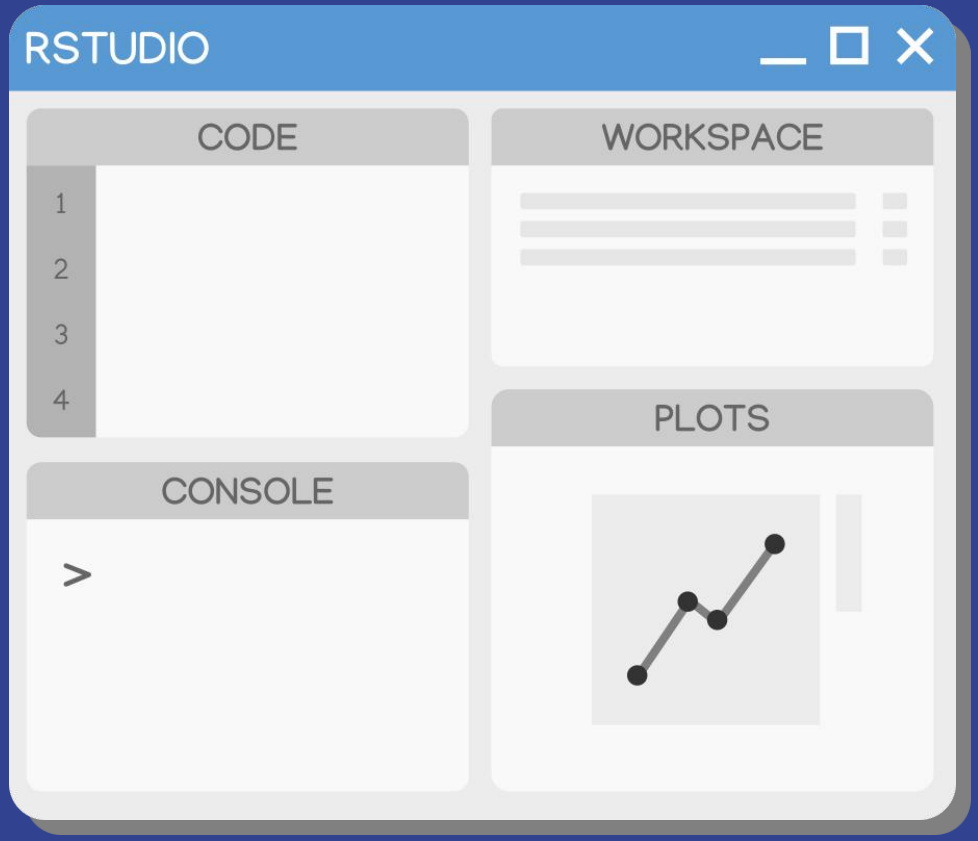
# RStudio®

**Main features:**

- Console
- Syntax-highlighting editor
- Tools for plotting, history, debugging and workspace management




rstudio.com/products/rstudio/download/

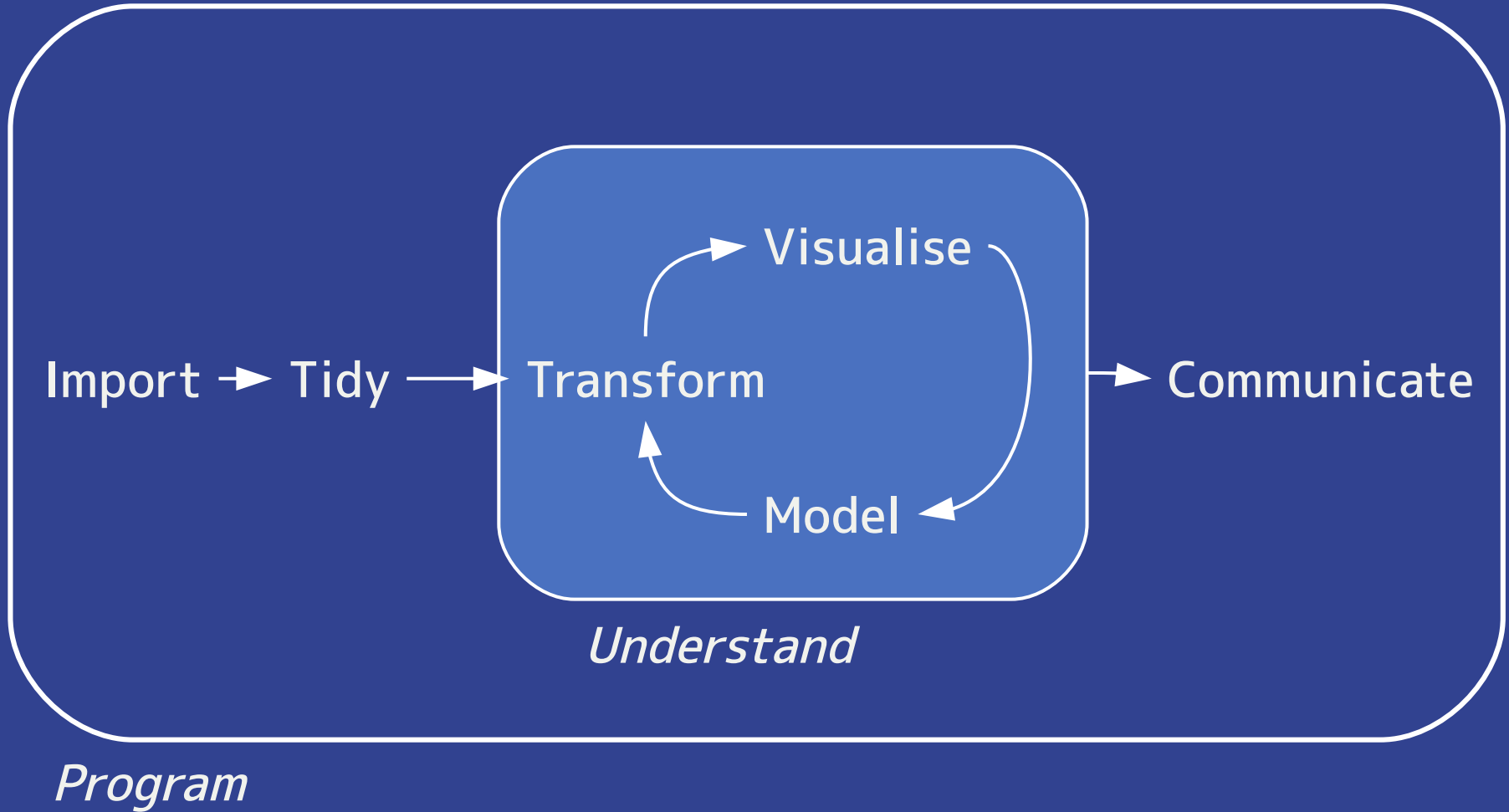


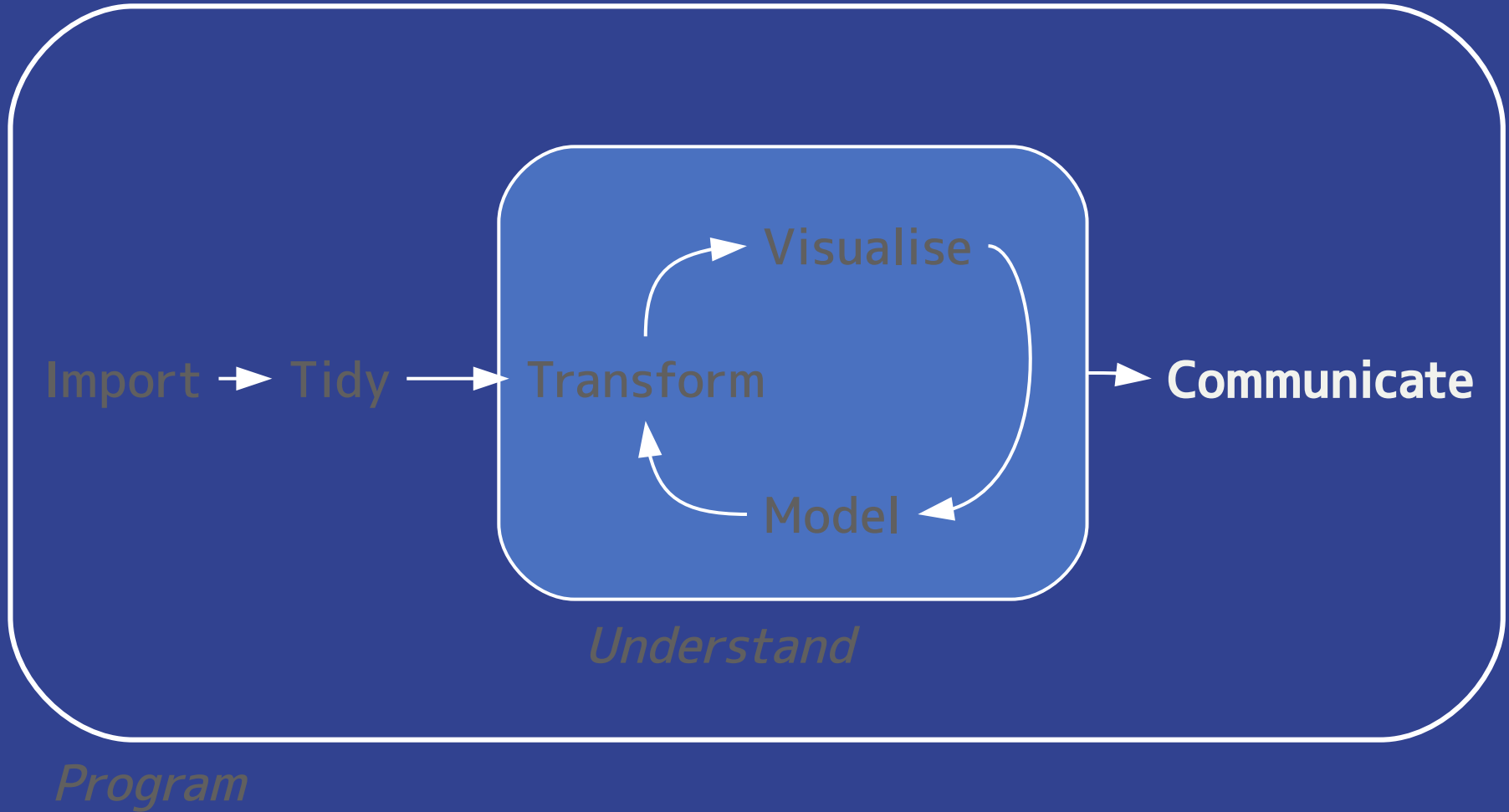

- **Tab**, autocompletion & path navigation
- **Alt + -**, for assignment operator <-
- **Ctrl + Shift + M**, for pipe operator %>%
- **Ctrl + Enter**, run current line code/example on help page
- **Ctrl + Up**, search for code history on console or editor pane
- **Alt + Up/Down**, move code to above or below
- **Alt + Shift + Up/Down**, copy code to above or below
- **Ctrl + D**, delete current line
- **Ctrl + Shift + F10**, restart R session
- **Ctrl + Alt + B**, run code up to current line

Cheatsheet: https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf

# Let's get them!

- Download R at **cran.r-project.org**
- Download RStudio at **rstudio.com**
- Download R packages: **tidyverse**


Import
Tidy
Transform
Visualise
Model
Communicate
Understand
Program


Import
Tidy
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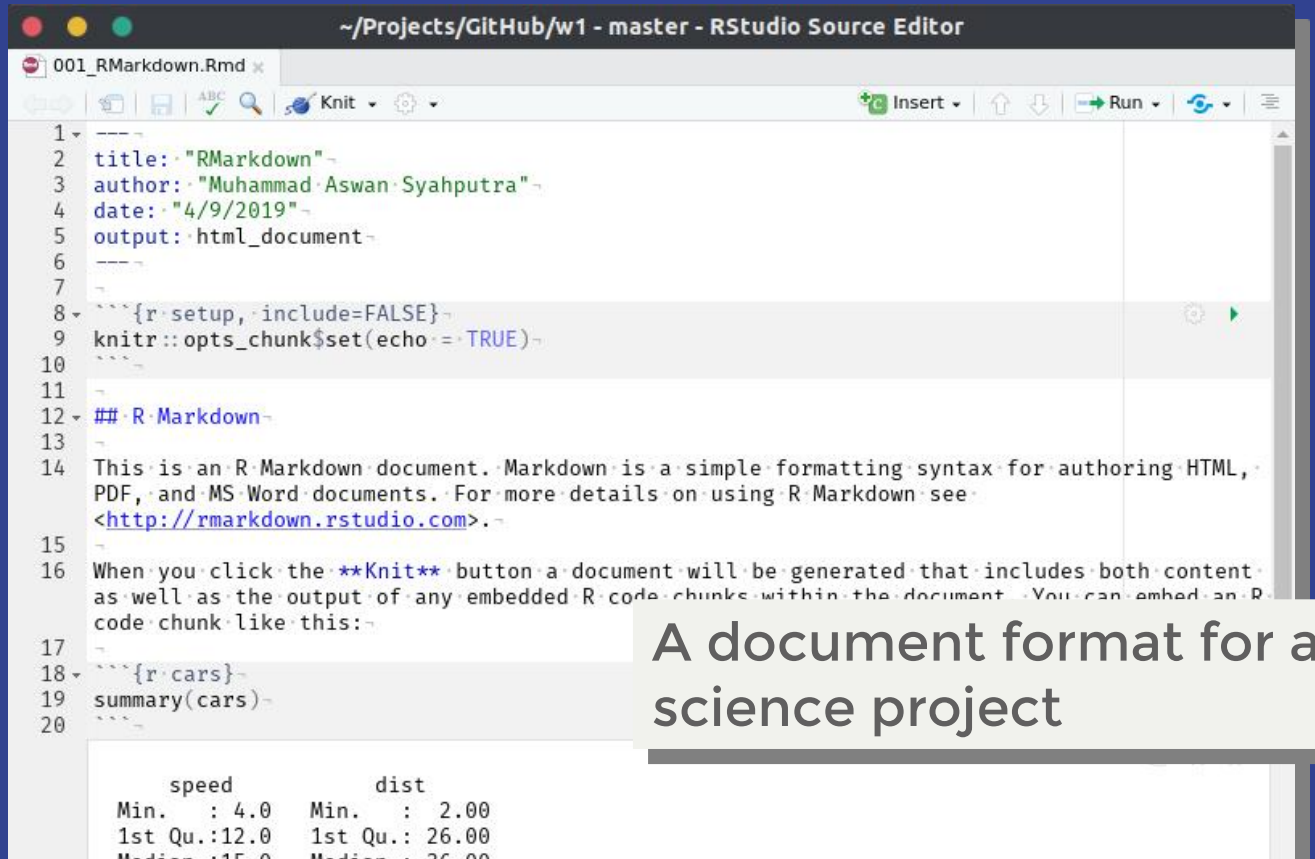
Artwork by @allison_horst

# R Markdown




A document format for authoring data science project

- Use script (R Markdown or R Script), try to avoid console
- Use Projects, not `setwd( ... )` in script
- Set `stringsAsFactor = FALSE`, but not in the .Rprofile
- Ctrl+Shift+F10 and Ctrl+Alt+B to clean up,
  not `rm(list=ls())`
- Learn the handy shortcuts
- Do not save and load .Rdata
- Use version control system: git!

git

Reading: happygitwithr.com

Download: git-scm.com

With great codes,
comes great bugs!

*- (not) Uncle Ben*

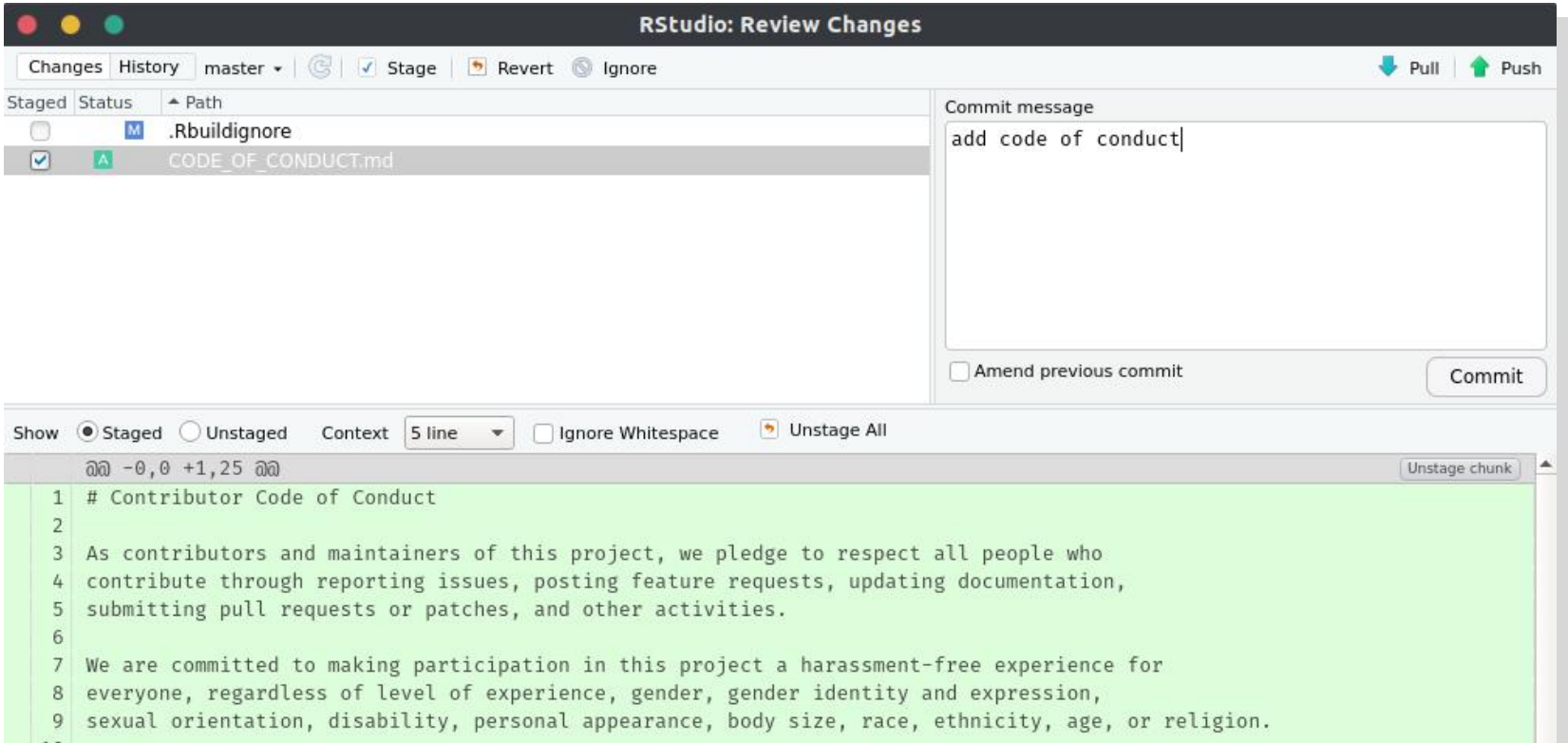
Store and share! Why sharing your work? Motivation here.

- `git clone https://github/user/repo`
- Do some works!
- `git add file.R` or `git add .`
- `git commit -m “what you have done”`
- `git push origin master`
- Repeat: work, git add, git commit, git push

git

- `git init`
- `git remote add origin https://github/user/repo`
- Do some works!
- `git add file.R` or `git add .`
- `git commit -m “what you have done”`
- `git push -u origin master` `#use -u only once`
- Repeat: work, git add, git commit, git push

# It is available in RStudio!



# How to git(Hub)?

- Create account at **github.com**
- Download and install git from **git-scm.com**
- In Rstudio, Tools – Global Options – Git/SVN – Browse git executable:
  - Windows: **C:/Program Files/Git/bin/git.exe**
  - UNIX/UNIX-like: **/usr/bin/git**

# How to set git?

- Open git bash/shell/terminall
- Run:

```
git config --global
user.email
“email@domain.com”

git config --global
user.name “Your Name”
```

# Let's get started!

- Go to **github.com/r-academy/intro**
- Hit 'Fork' button
- Click 'Clone or Download', copy the URL
- In RStudio, File – New Project – Version Control – Git. Paste URL
- In File pane (bottom-right), click vignettes-'001_pendahuluan.Rmd' to open it
- You have **10 minutes** to play with it!

# Working directory

```
> fs::dir_tree()
.
├── 003_kamisdata_Debat-Pilpres1-2019.Rproj
├── Dockerfile
├── R
│   ├── cari.R
│   └── impor.R
├── README.md
├── data
│   └── debat-pilpres1-2019.rda
├── data-raw
│   └── debat_pilpres1_2019.R
├── install.R
└── vignettes
    ├── aswansyahputra-frekuensidansentimen.Rmd
    ├── aswansyahputra-frekuensidansentimen.html
    └── aswansyahputra-frekuensidansentimen_files
> 
```

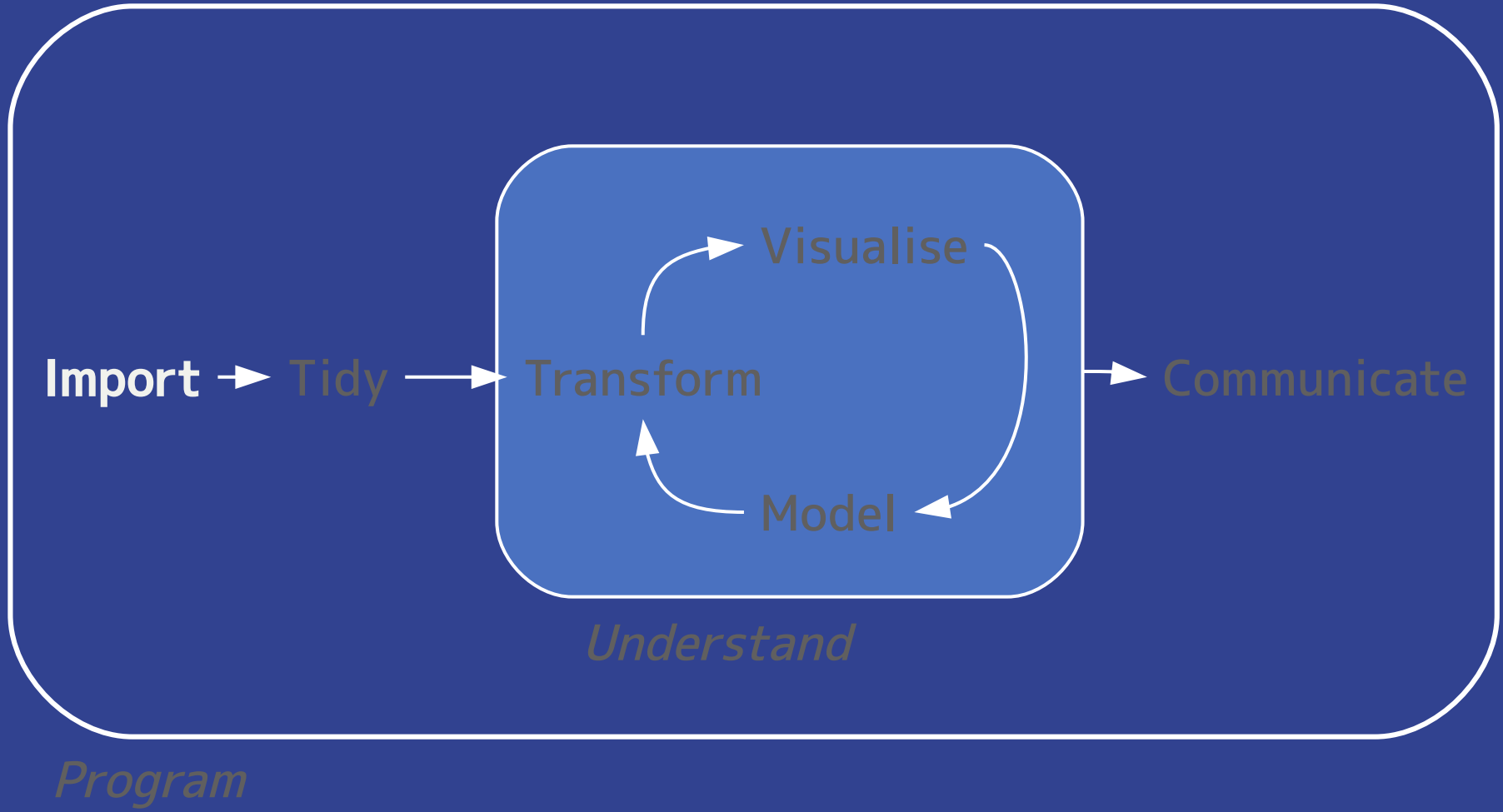
**3 principles for naming files:**

- Machine readable
- Human readable
- Default ordering

More info:
speakerdeck.com/jennybc/how-to-name-files

# How to use git?

- In Environment Pane, hit ‘Git’ tab
- Click commit, a window pane will appear
- Select all files (Ctrl + A), click ‘Stage’
- Fill commit message, the click ‘Commit’
- Hit ‘Push’ Button, done!
- You may check you GitHub now!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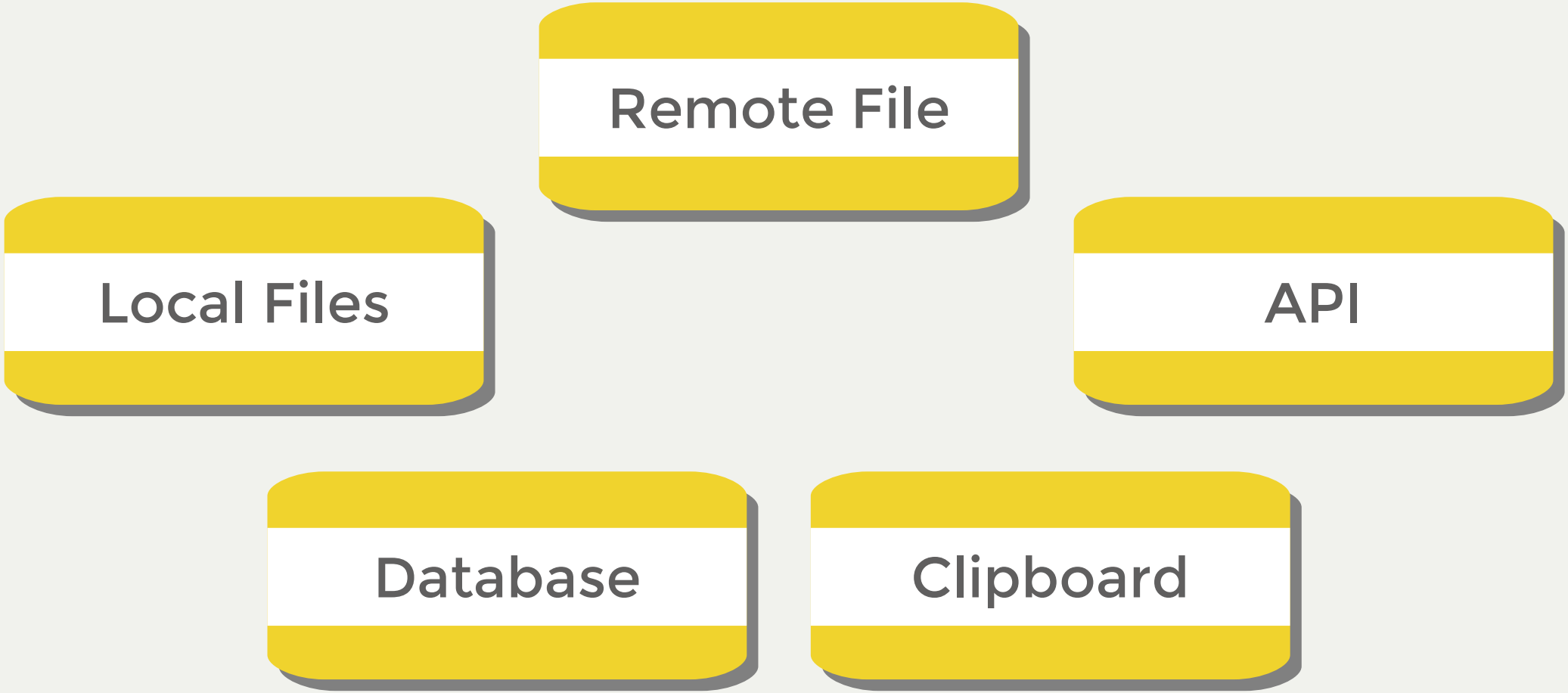
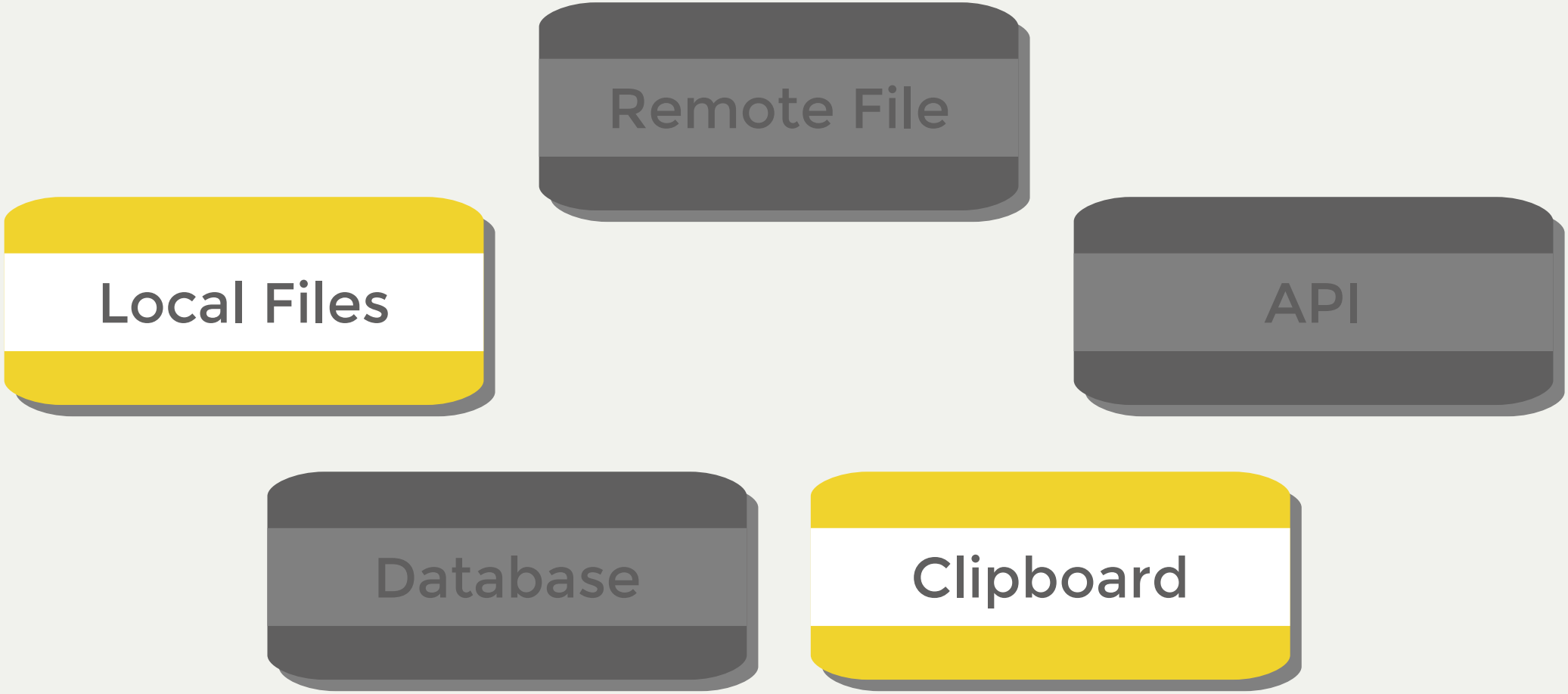

Remote File
Local Files
API
Database
Clipboard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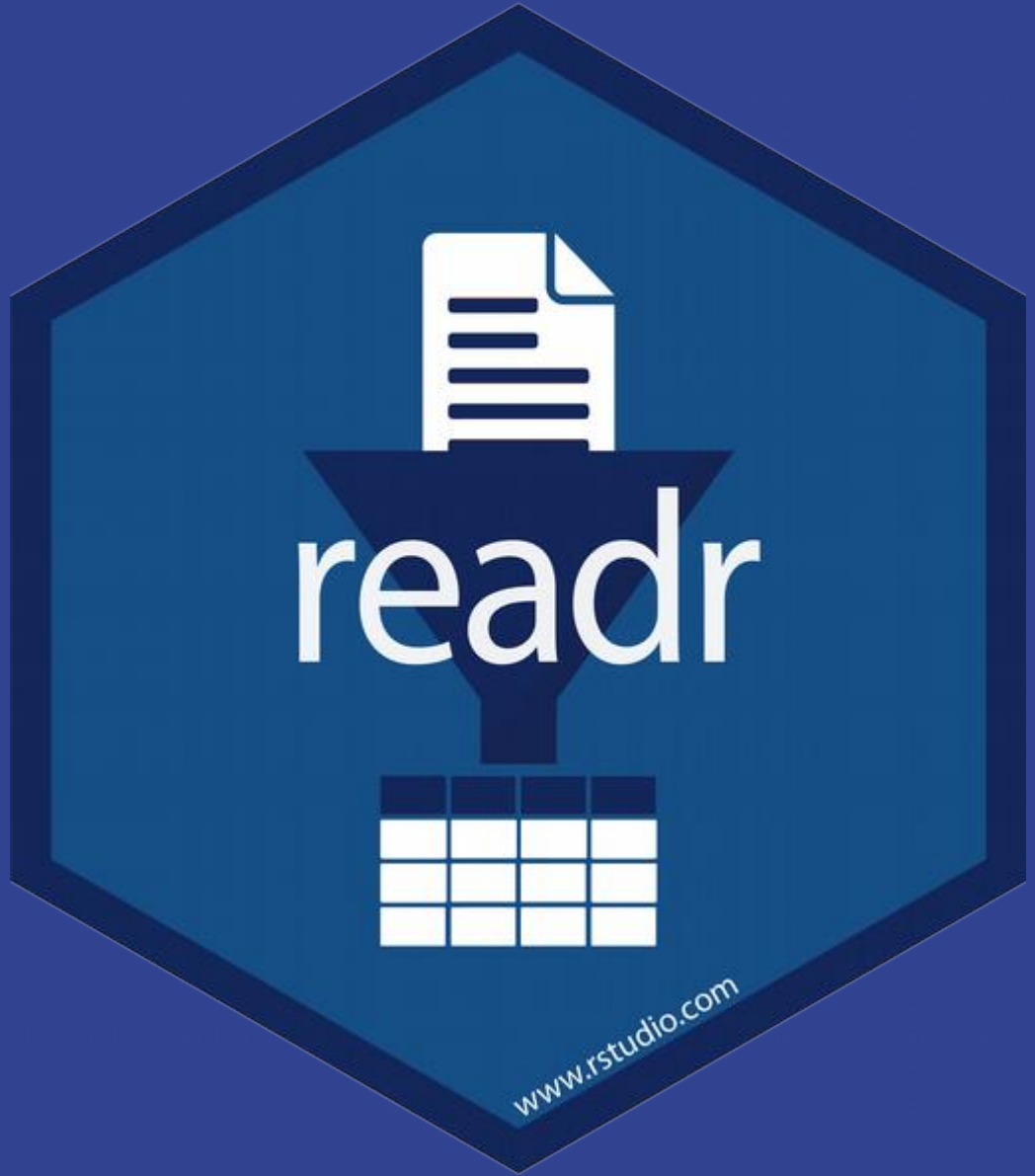

readr
www.rstudio.com


DATA
PASTA

- `read_csv()`: comma separated (CSV) files
- `read_tsv()`: tab separated files
- `read_delim()`: general delimited files
- `read_fwf()`: fixed width files
- `read_table()`: tabular files where columns are separated by white-space.
- `read_log()`: web log files

# readr

**Brisbane area**
Partly cloudy. Light winds.

3:30 pm, UV Index predicted to reach 11 [Extreme]

**Brisbane area**
Partly cloudy. Medium (50%) chance of showers, most likely in the late morning and afternoon. Light winds becoming easterly 15 to 20 km/h in the late afternoon then becoming light in the evening.

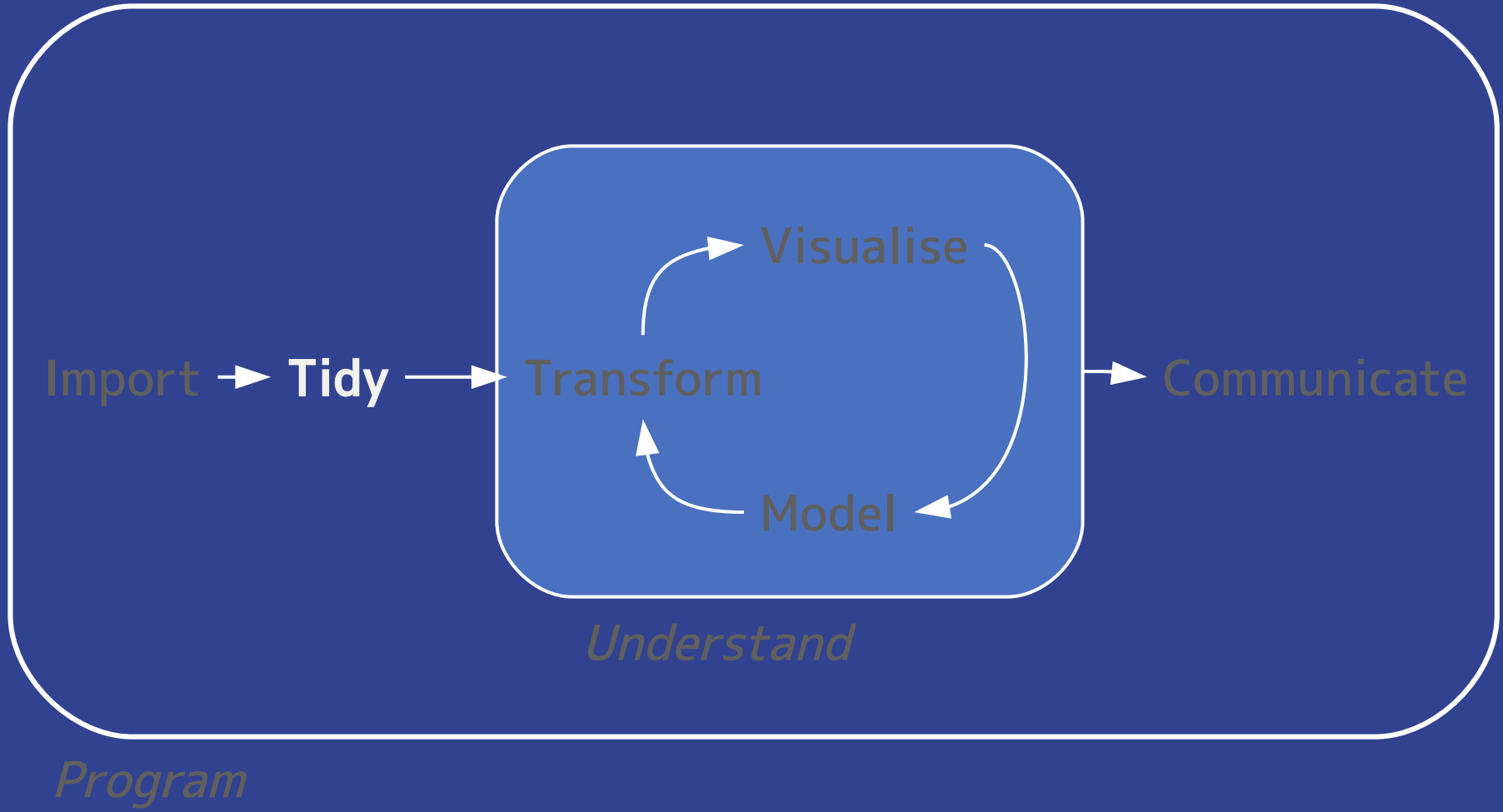
3:30 pm, UV Index predicted to reach 11 [Extreme]

**Brisbane area**
Partly cloudy. Light winds.

**7 day Town Forecasts**

| Location | Min | Max |
|---|---|---|
| Brisbane | 23 | 30 |
| Brisbane Airport | 22 | 29 |
| Beaudesert | 21 | 30 |
| Chermside | 22 | 30 |
| Gatton | 21 | 30 |
| Ipswich | 21 | 31 |
| Logan Central | 22 | 30 |
| Manly | 23 | 28 |
| Mount Gravatt | 22 | 29 |
| Oxley | 22 | 31 |
| Redcliffe | 23 | 28 |

# datapasta


Import
Tidy
Transform
Visualise
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Understand
Program

Tidy datasets are all alike,
but every messy dataset
is messy in its own way!

*- Hadley Wickham*

# A Tidy dataset

| | Name | Gender | Age |
|---|---|---|---|
| 1 | Phil | Male | 54 |
| 2 | May | Female | 46 |
| 3 | Mack | NA | 31 |

# A variable has its own column

| | Var. 1 | Var. 2 | Var. 3 |
|---|---|---|---|
| Obs. 1 | A | B | C |
| Obs. 2 | D | E | F |
| Obs. 3 | G | H | I |

# An observation has its own row

| | Var. 1 | Var. 2 | Var. 3 |
|---|---|---|---|
| Obs. 1 | A | B | C |
| Obs. 2 | D | E | F |
| Obs. 3 | G | H | I |

# An value has its own cell

| | Var. 1 | Var. 2 | Var. 3 |
|---|---|---|---|
| Obs. 1 | A | B | C |
| Obs. 2 | D | E | F |
| Obs. 3 | G | H | I |

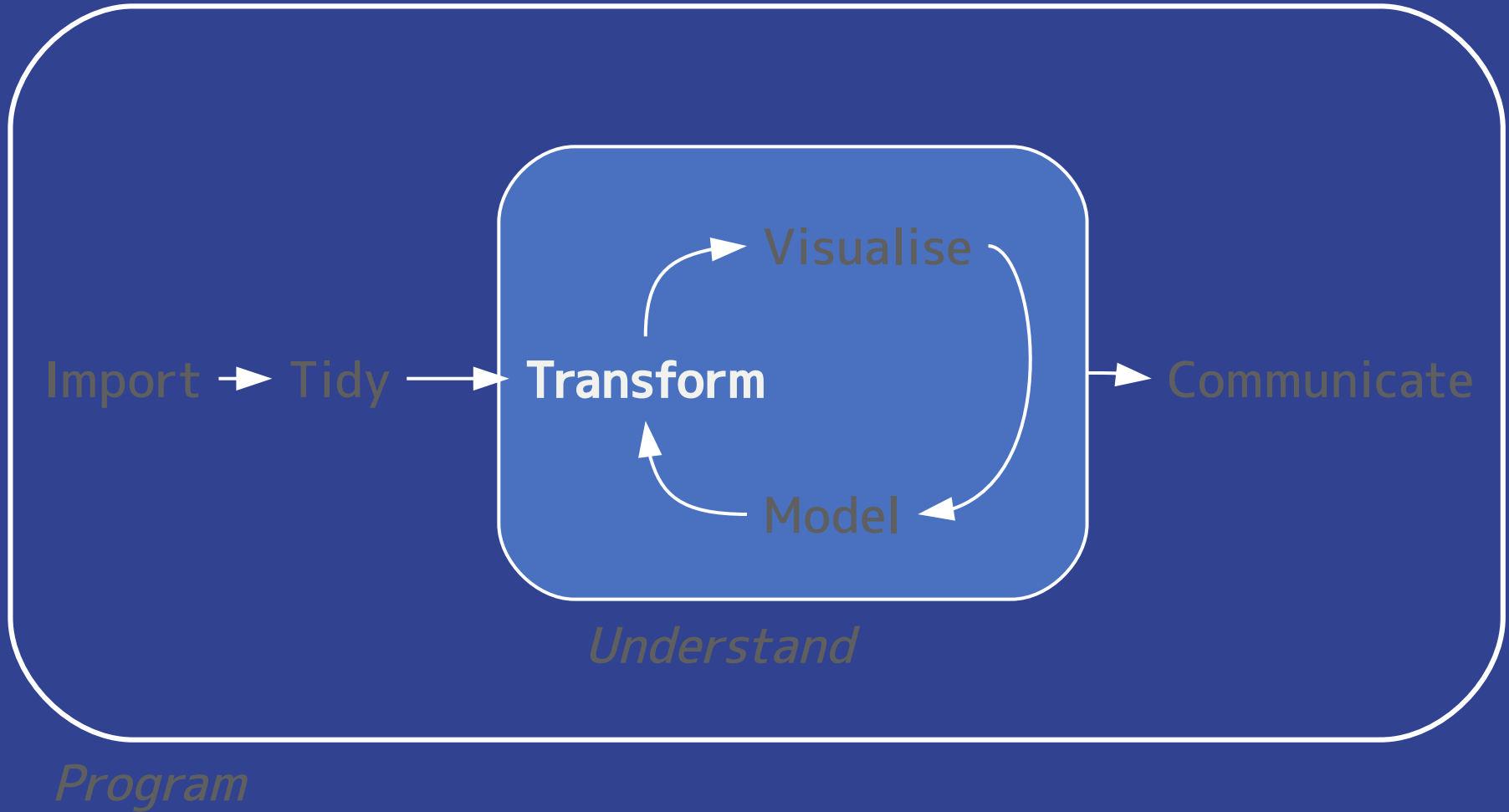

work by @allison_horst

# Not only tidy, but also tame

- Use syntactical names for column names
- Use consistent case: snake_case, camelCase, caterpillar.case
- Cast column type accordingly: <chr>, <dbl>, <lgl>, <date>, etc
- Treat <fct> carefully!
- Preferably turn implicit missing observation into explicit NA value

# Let's do practice!

- Open '002_impor-tidy-data.Rmd'
- You have **15 minutes** to play with it
- Do not forget to push your works into GitHub!


Import
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# dplyr : go wrangling


Artwork by @allison_horst

## dplyr basic functions:

- `filter()` selects rows based on their values
- `mutate()` creates new variables
- `select()` picks columns by name
- `summarise()` calculates summary statistics
- `arrange()` sorts the rows

## tidyr basic functions:

- `gather()` wide-format >> long-format
- `spread()` long-format >> wide-format
- `fill()` fills value based on previous entry
- `complete()` turns implicit missing values into explicit

## Operators:

- ! (not)
- | (or)
- & (and)
- ==, !=
- <, <=, >, >=
- %in%
- is.na()

# How can I chain?


1. diputar
2. dijilat
3. dicelupin
4. dimakan :D

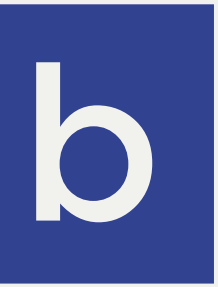

1. putar(apa)
2. jilat(apa, berapa_kali)
3. celup(apa, ke)
4. makan(apa, output)

a

```
> oreo_putar ← putar(apa = “oreo”)
> oreo_jilat ← jilat(apa = oreo_putar,
                     berapa_kali = 2)
> oreo_celup ← celup(apa = oreo_jilat,
                     ke = “susu”)
> makan(apa = oreo_celup,
        output = “kenyang.perut”)
```

a

```
> oreo_putar ← putar(apa = “oreo”)
> oreo_jilat ← jilat(apa = oreo_putar,
                     berapa_kali = 2)
> oreo_celup ← celup(apa = oreo_jilat,
                     ke = “susu”)
> makan(apa = oreo_celup,
        output = “kenyang.perut”)
```



```
> makan(
    celup(
      jilat(
        putar(apa = “oreo”),
        berapa_kali = 2
        ),
      ke = “susu”
    ),
    output = “kenyang.perut”
  )
```

```r
function(arg1, arg2, arg3, ... )
```

```r
arg1 %>%
  function(arg2, arg3, ... )
```

---

```r
function(arg1, arg2, arg3, ... )
```

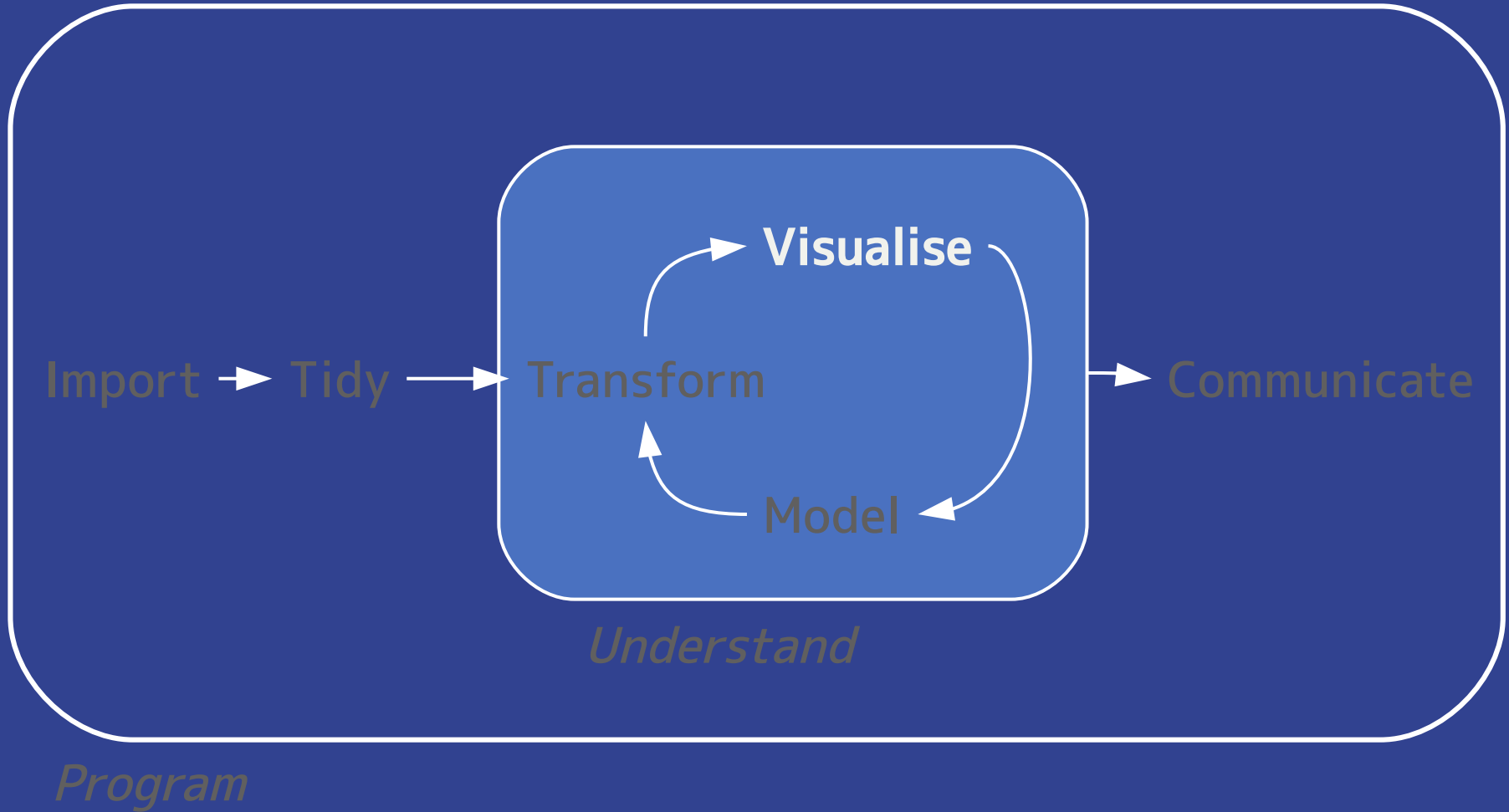
```r
arg2 %>%
  function(arg1, arg2=.,arg3, ... )
```

# magrittr

```
> putar(apa = “oreo”) %>%
    jilat(berapa_kali = 2) %>%
    celup(ke = “susu”) %>%
    makan(output = “kenyang.perut”)
```

# Let's do practice!

- Open '003_transformasi.Rmd'
- You have **30 minutes** to play with it
- Do not forget to push your works into GitHub!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Program

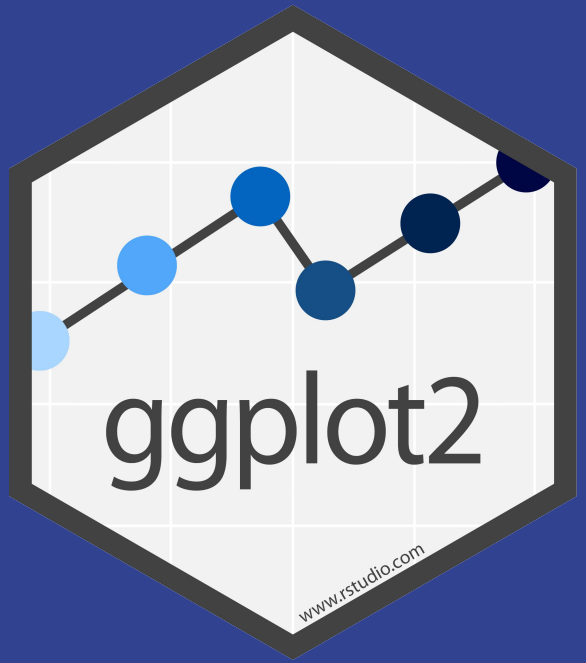

Artwork by @allison_horst

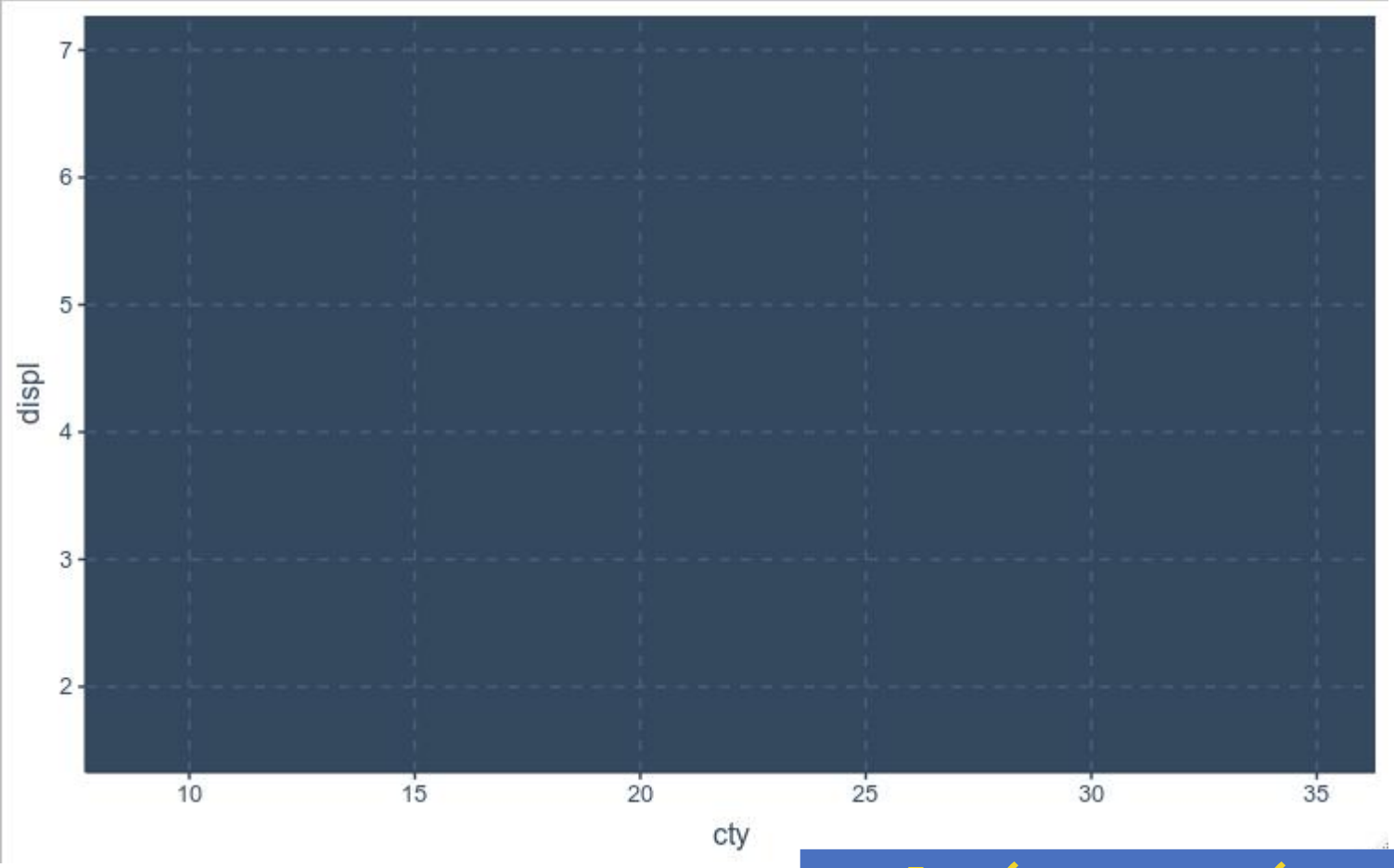
```
ggplot(data) +
   geom_X(mapping=aes(…)) +
    …

ggplot(data, mapping=aes( … )) +
   geom_X( ) +
    …
```

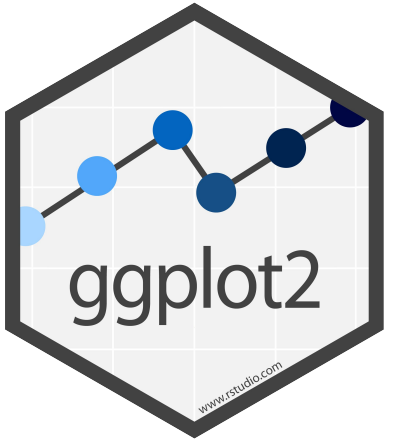
---

```
data %>%
   ggplot(mapping=aes( … )) +
   geom_X( ) +
    …
```

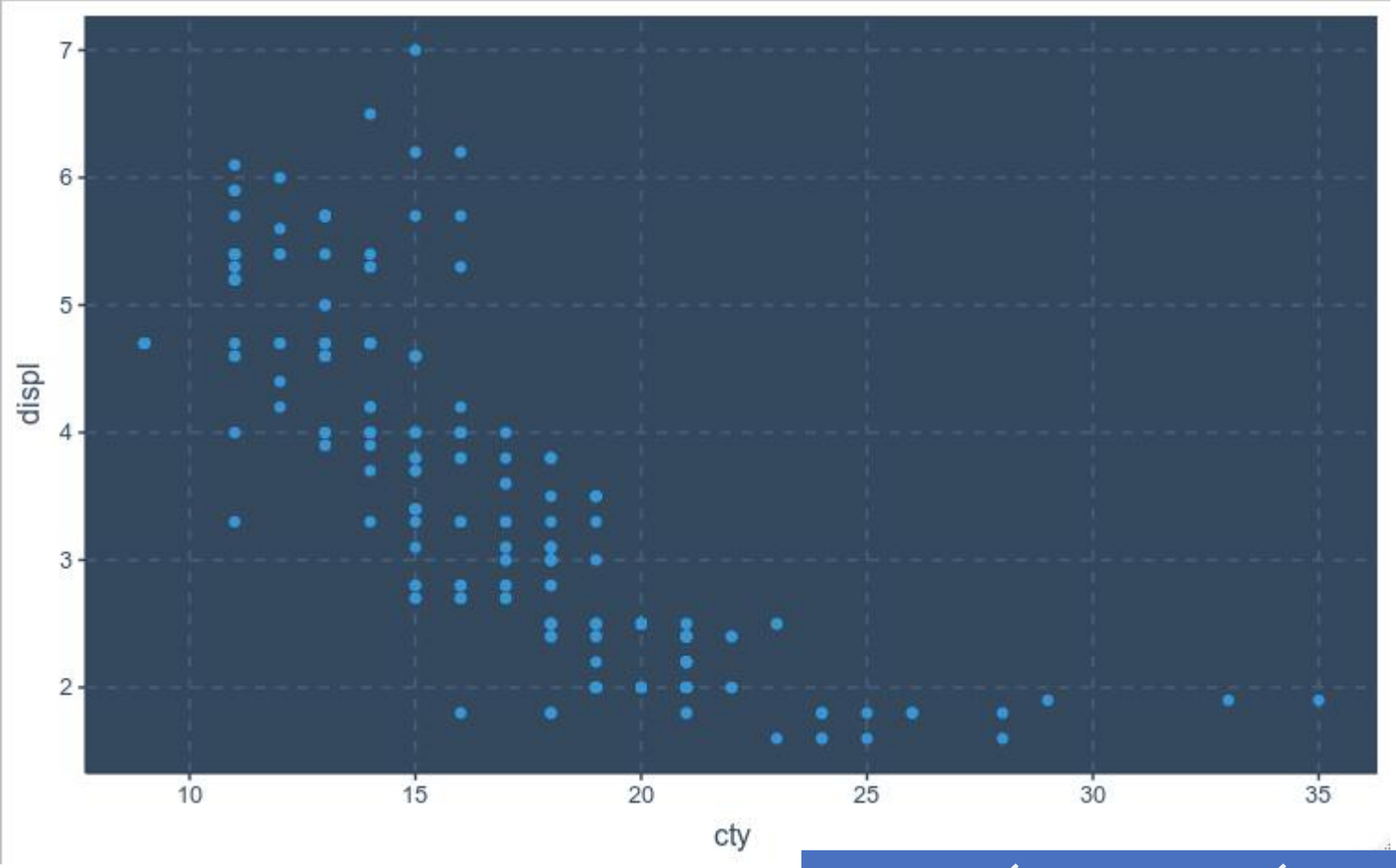
# ggplot2

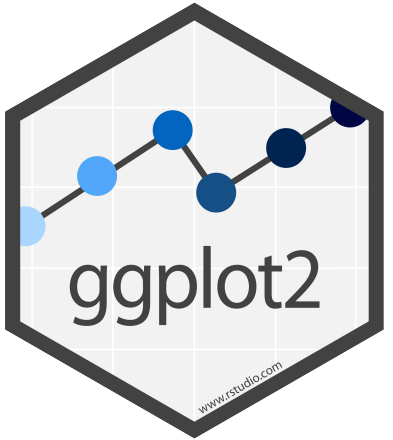




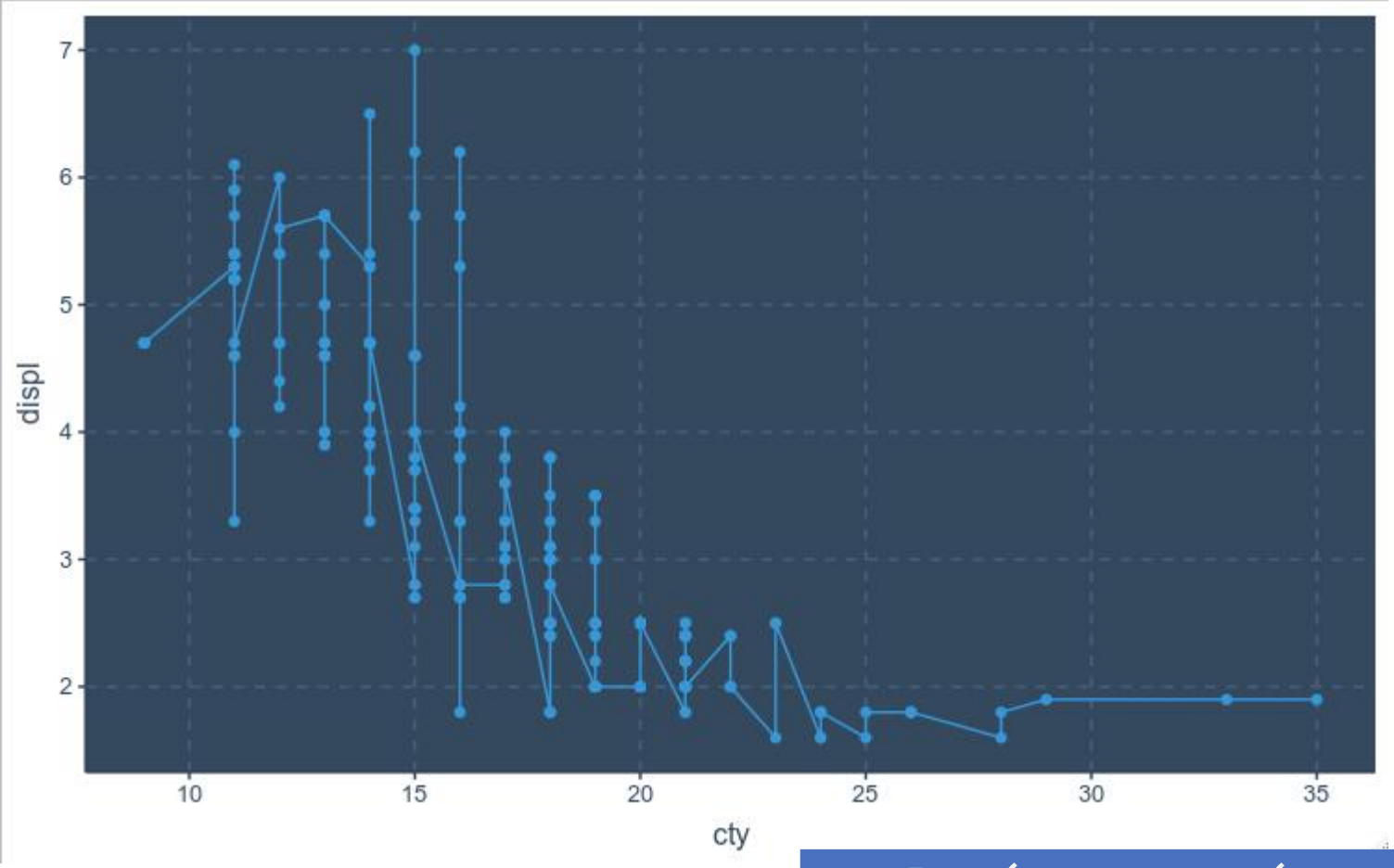



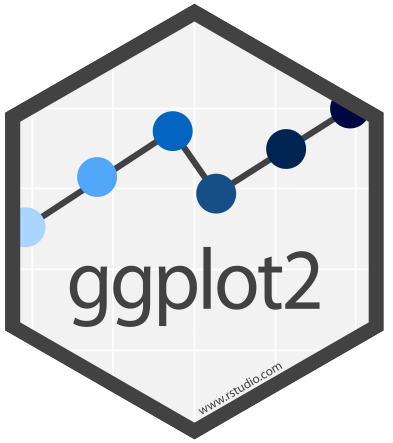

```
ggplot(mpg, aes(x = cty, y = displ))
```



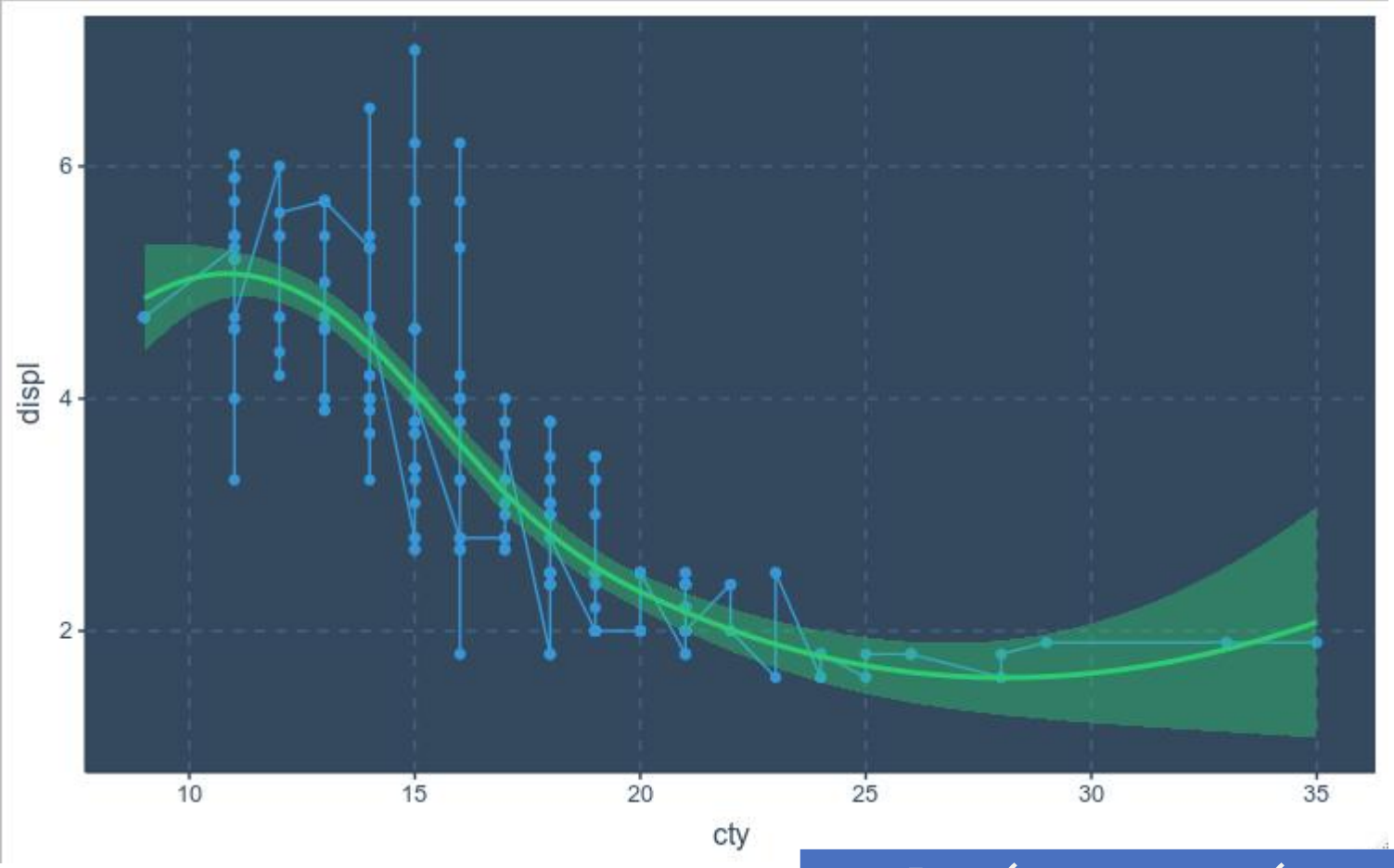



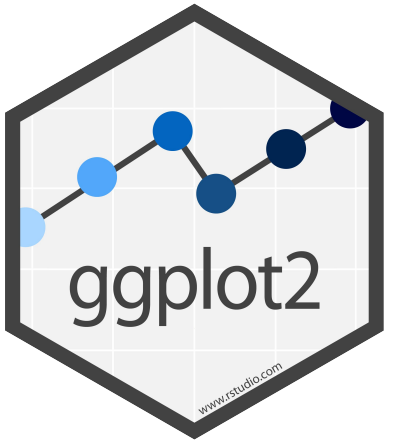

```
ggplot(mpg, aes(x = cty, y = displ)) +
  geom_point()
```




```
ggplot(mpg, aes(x = cty, y = displ)) +
  geom_point() +
  geom_line()
```

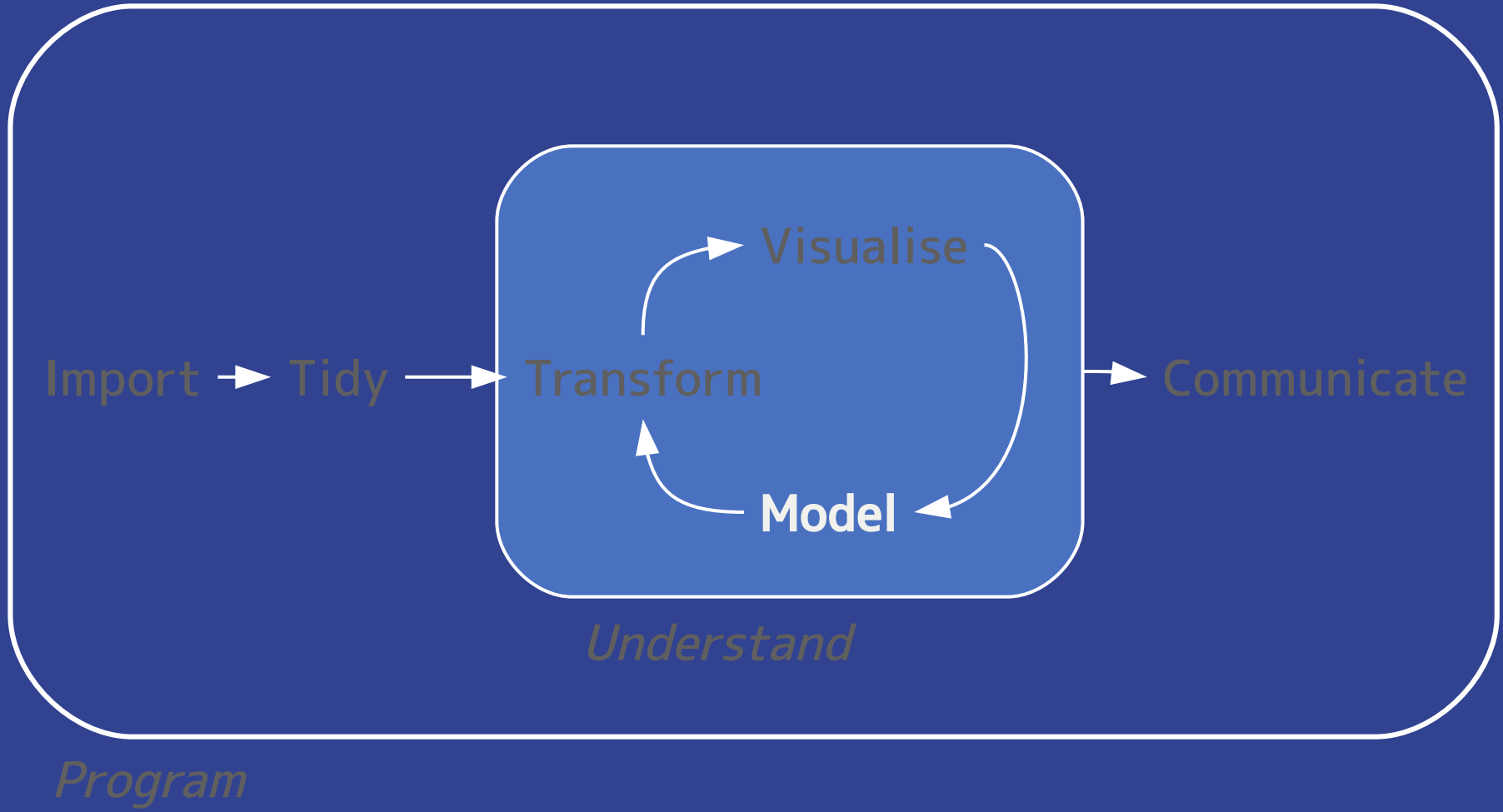



```
ggplot(mpg, aes(x = cty, y = displ)) +
  geom_point() +
  geom_line() +
  geom_smooth()
```

# Let’s do practice!

- Open ‘004_visualisasi.Rmd’
- You have **15 minutes** to play with it
- Do not forget to push your works into GitHub!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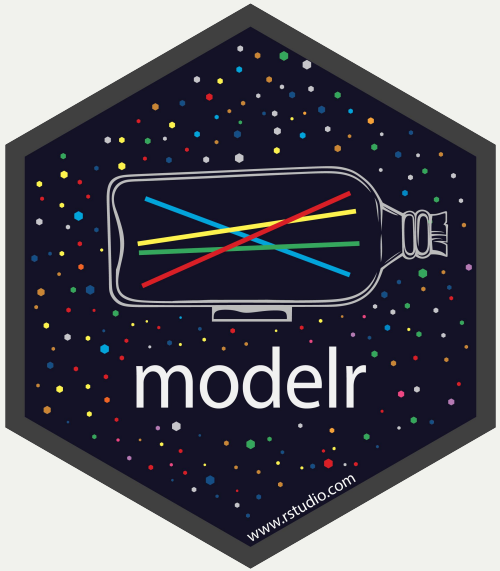
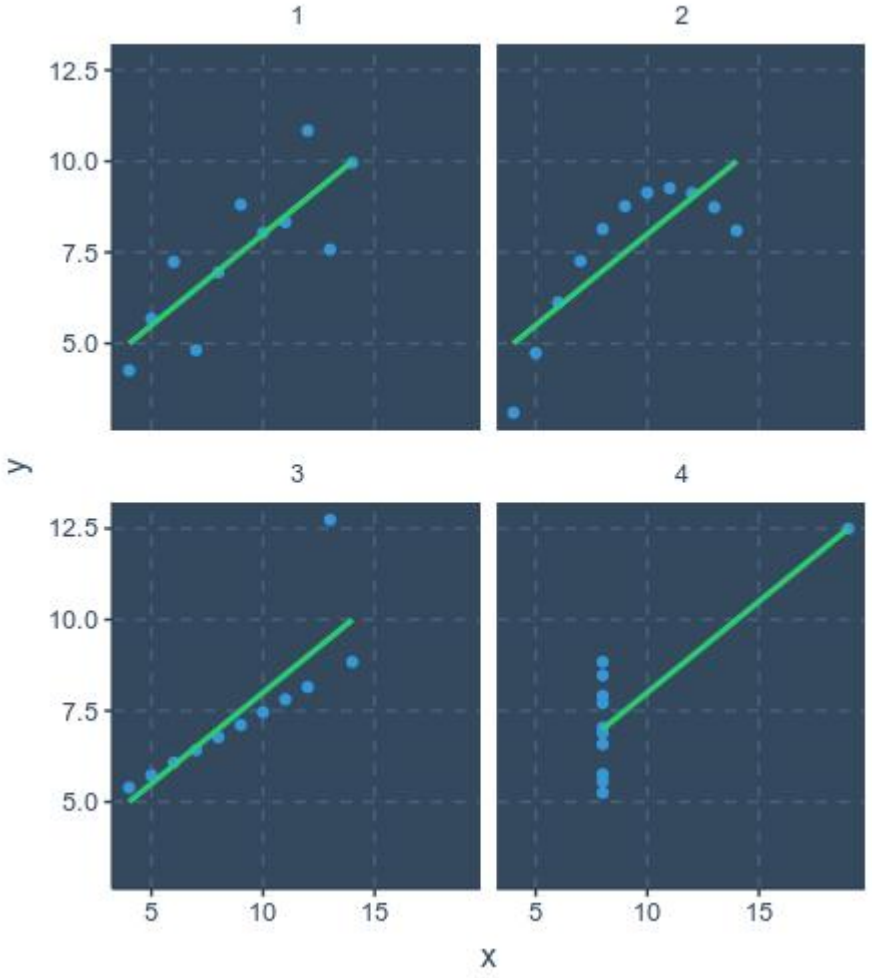



A low dimensional description of a higher dimensional data set


Source: https://github.com/rstudio-education/arm-workshop-rsc2019



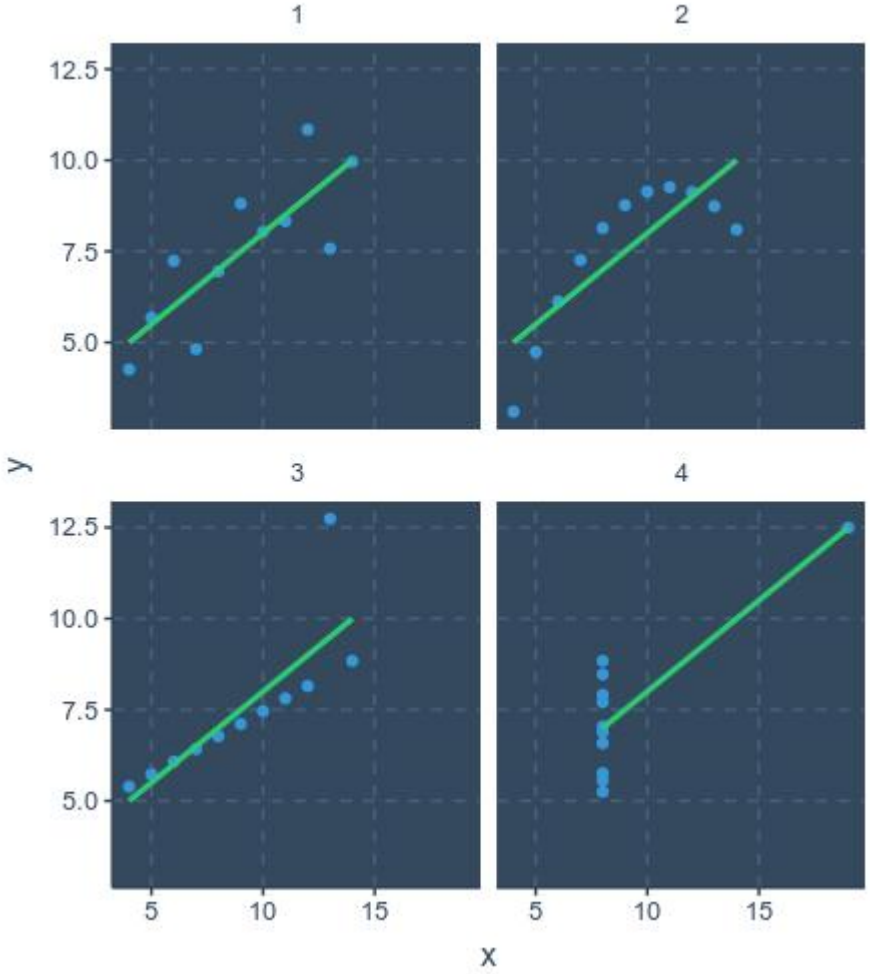

Outcome ~ Predictor/Explanatory

To predict

To explain

All models are wrong, but some are useful – George Box

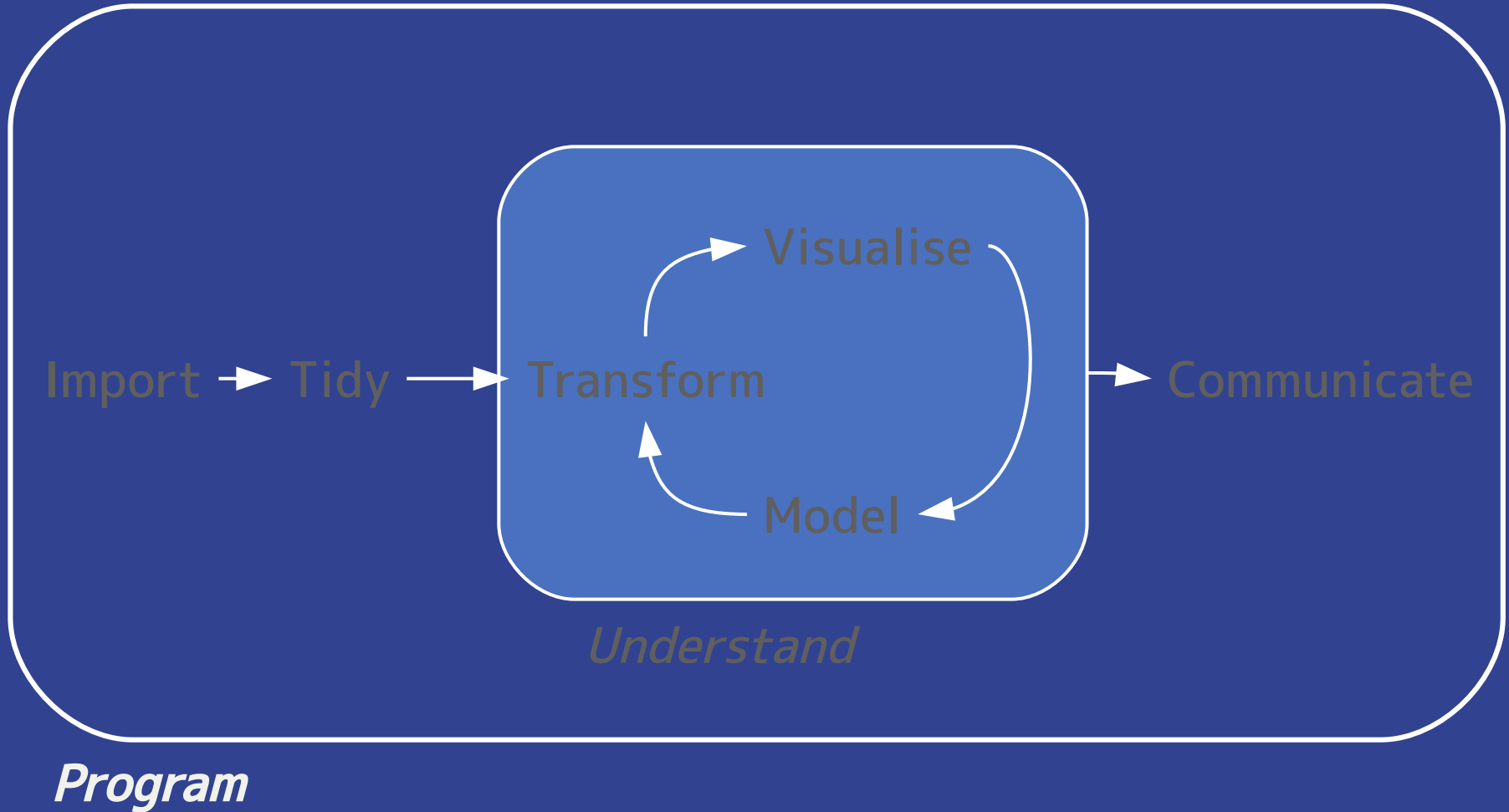
# Anscombe's Quartet




| | | |
|---|---|---|
| Mean of x | 9 | exact |
| Sample variance of x | 11 | exact |
| Mean of y | 7.50 | to 2 decimal places |
| Sample variance of y | 4.125 | ±0.003 |
| Correlation between x and y | 0.816 | to 3 decimal places |
| Linear regression line | y = 3.00 + 0.500x | to 2 and 3 decimal places, respectively |
| $R^2$ | 0.67 | to 3 decimal places |

# Let's do practice!

- Open '005_model.Rmd'
- You have **40 minutes** to play with it
- Do not forget to push your works into GitHub!


Import
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```
x ← something
for (i in seq_along(x) {
  function(x[[i]])
}
```

```
x ← something
*apply(x, function)
```

```
x ← something
map_*(x, function)
```

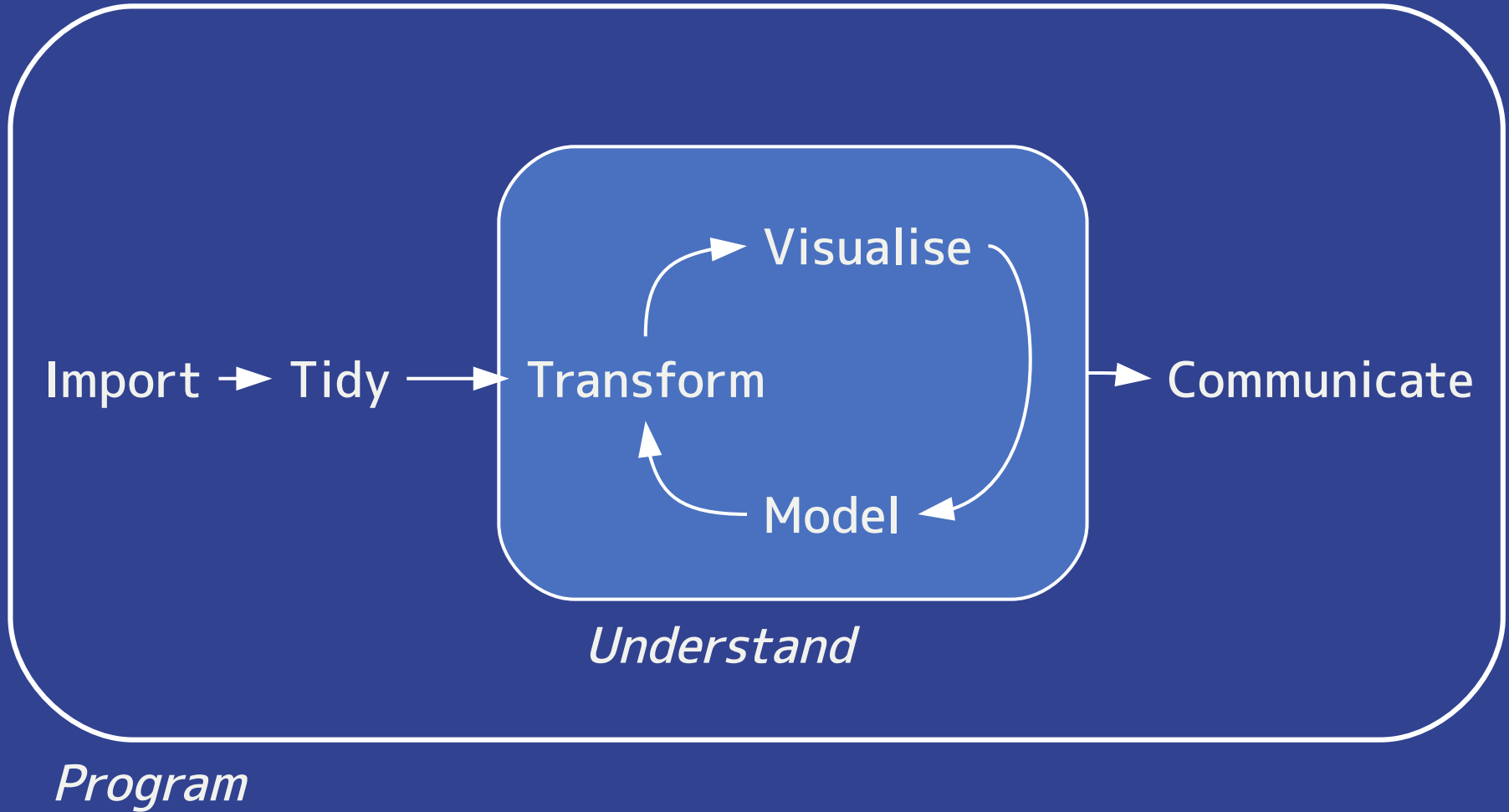
# purrr

# Let's do practice!

- Open '006_iterasi.Rmd'
- You have **20 minutes** to play with it
- Do not forget to push your works into GitHub!

# Congrats!


Artwork by @allison_horst


Import
Tidy
Transform
Visualise
Model
Communicate
Understand
Program

```
> contact_me(
    name       = “Muhammad Aswan Syahputra”,
    email      = aswansyahputra@sensolution.id
    phone      = +62 822 3465 3816
    twitter    = @aswansyahputra_
  )
>  ...
```