

Welcome to the Tidyverse



Your Turn

Form groups of 2-4 people. Introduce yourself to your group members. Tell them:

1. Who you are
2. What you do with data
3. How long you have been using R



HELLO
my name is

Garrett



@StatGarrett

O'REILLY®



Hands-On Programming with R

WRITE YOUR OWN FUNCTIONS AND SIMULATIONS

Garrett Grolemund
Foreword by Hadley Wickham

O'REILLY®



R for Data Science

VISUALIZE, MODEL, TRANSFORM, TIDY, AND IMPORT DATA

Hadley Wickham &
Garrett Grolemund

The R Series

R Markdown

The Definitive Guide



Yihui Xie
J. J. Allaire
Garrett Grolemund

CRC Press
Taylor & Francis Group
A CHAPMAN & HALL BOOK

Pop Quiz

What does **IMRAD** stand for? Poll your neighbors.

Introduction

What hypothesis was tested and why?

Methods

How was the study done?

Results

What answer was discovered?

And Discussion

What does the answer imply?



Which words do you associate
with **math**?

hypotheses

messy

best guess

discover

axioms

logical

certain

prove

Which words do you associate with **Science**?

hypotheses

messy

best guess

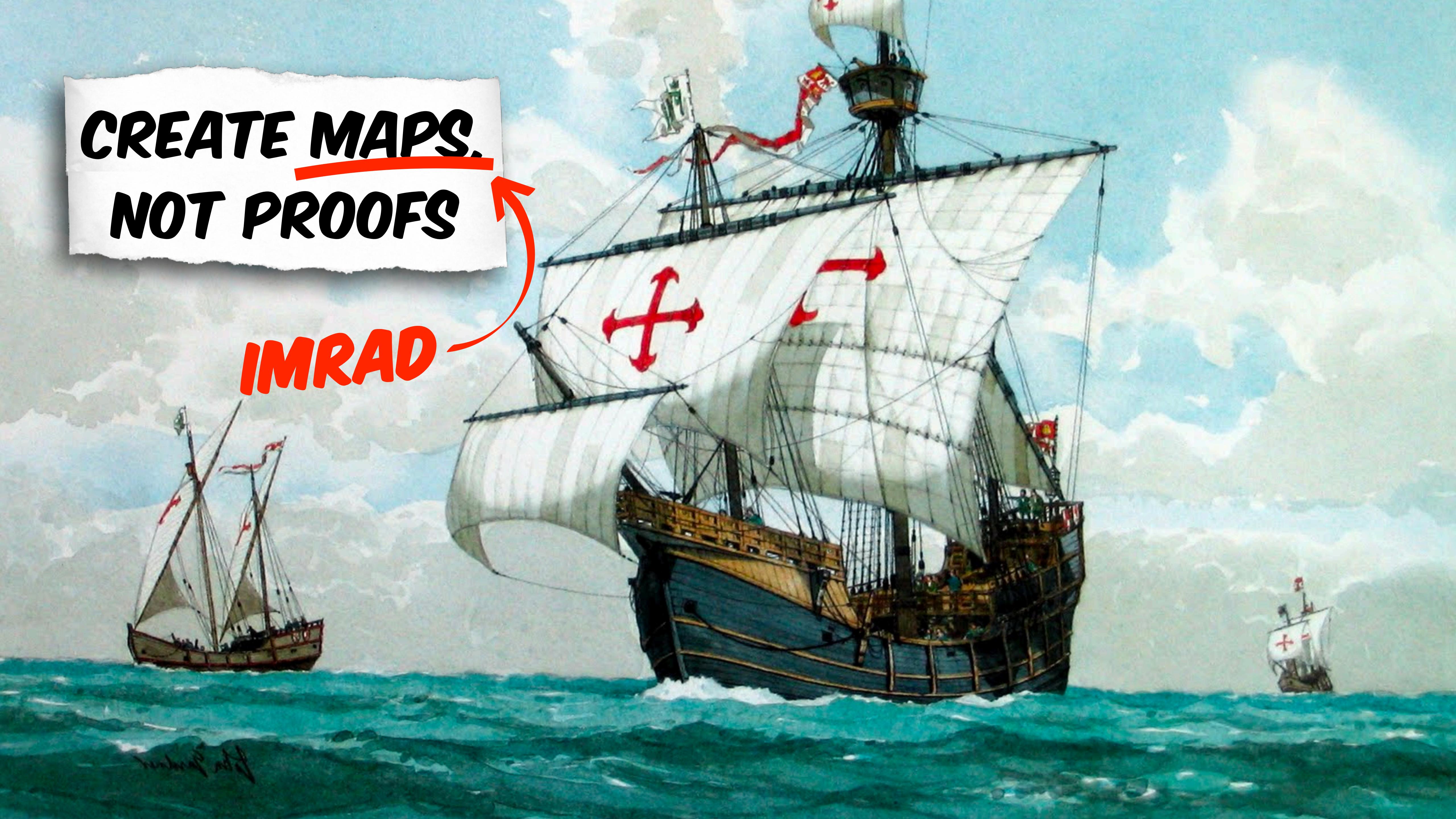
discover

axioms

logical

certain

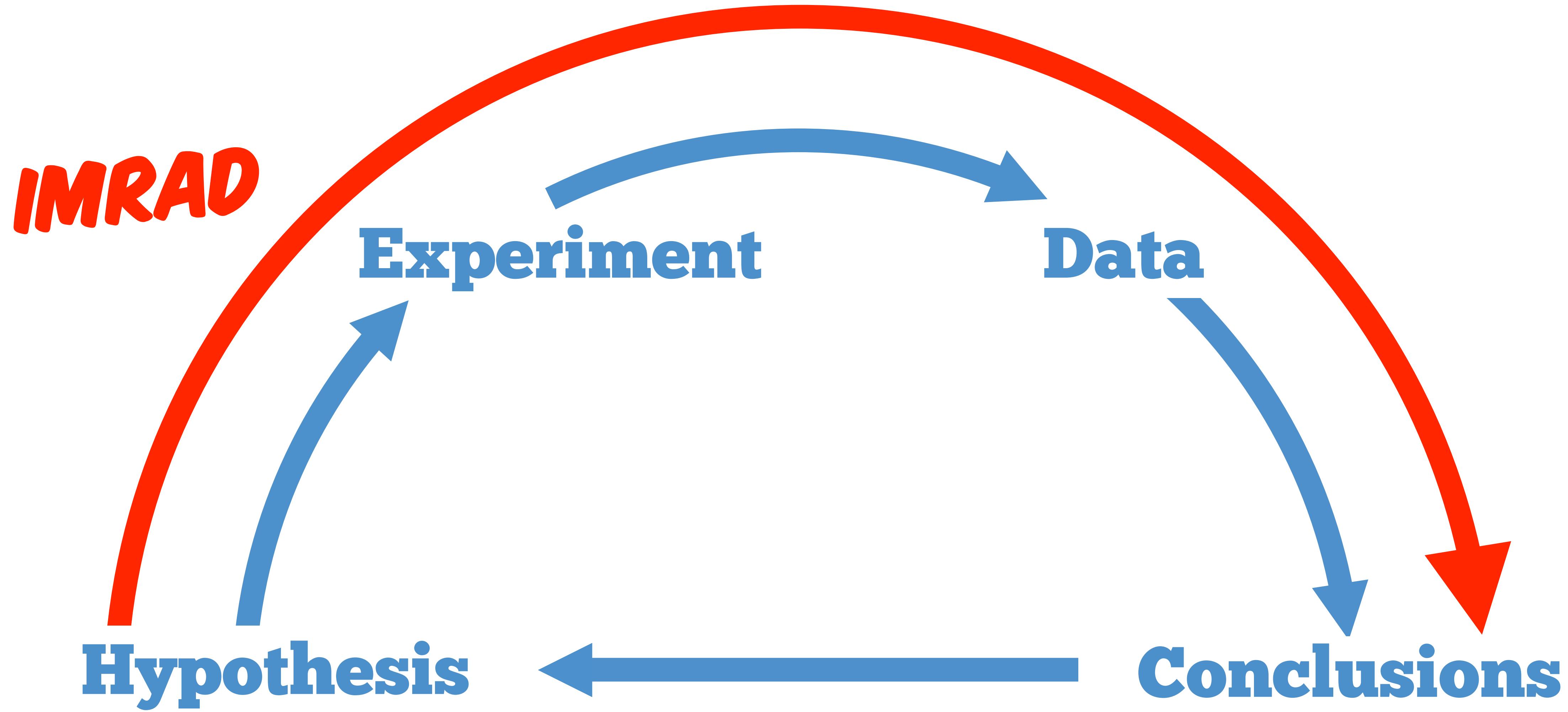
prove



**CREATE MAPS.
NOT PROOFS**

IMRAD

(Experimental) Science



Pop Quiz

What is **data science**? Poll your neighbors.

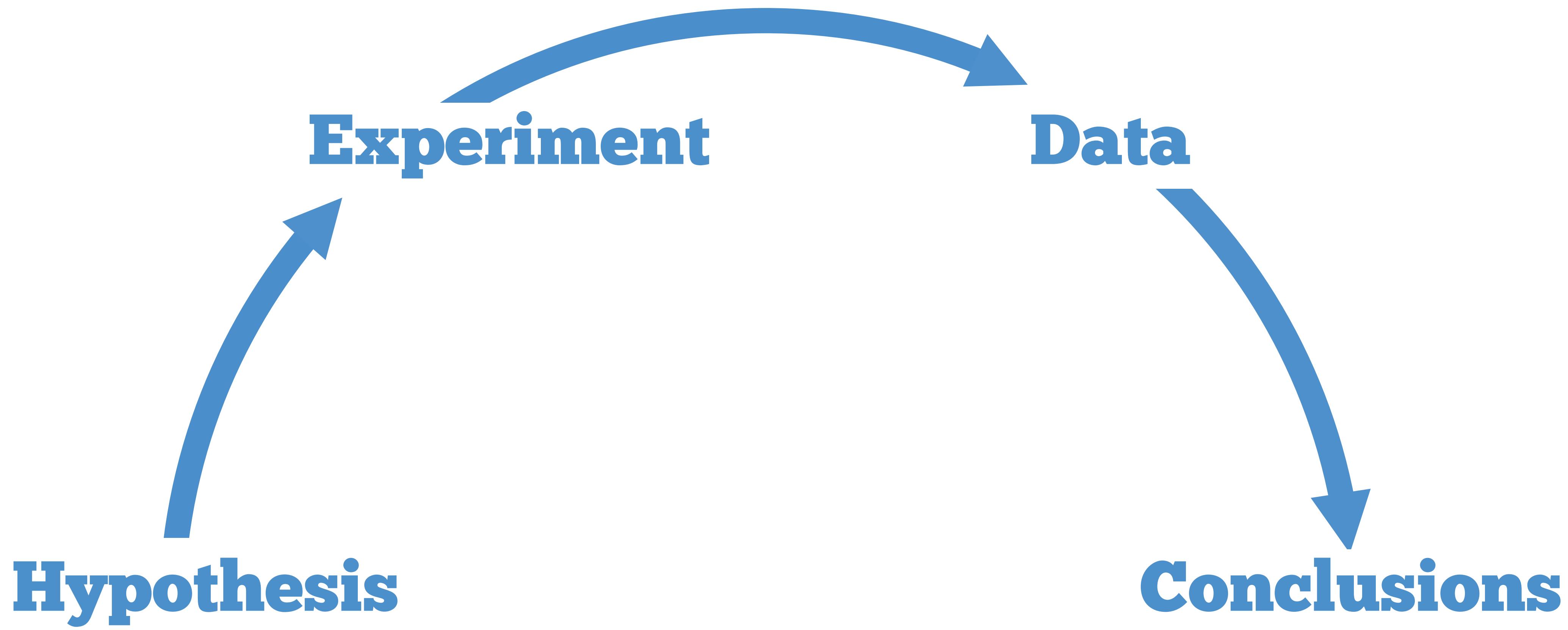


Pop Quiz

What is **data science**? Poll your neighbors.

Science with non-trivial data?

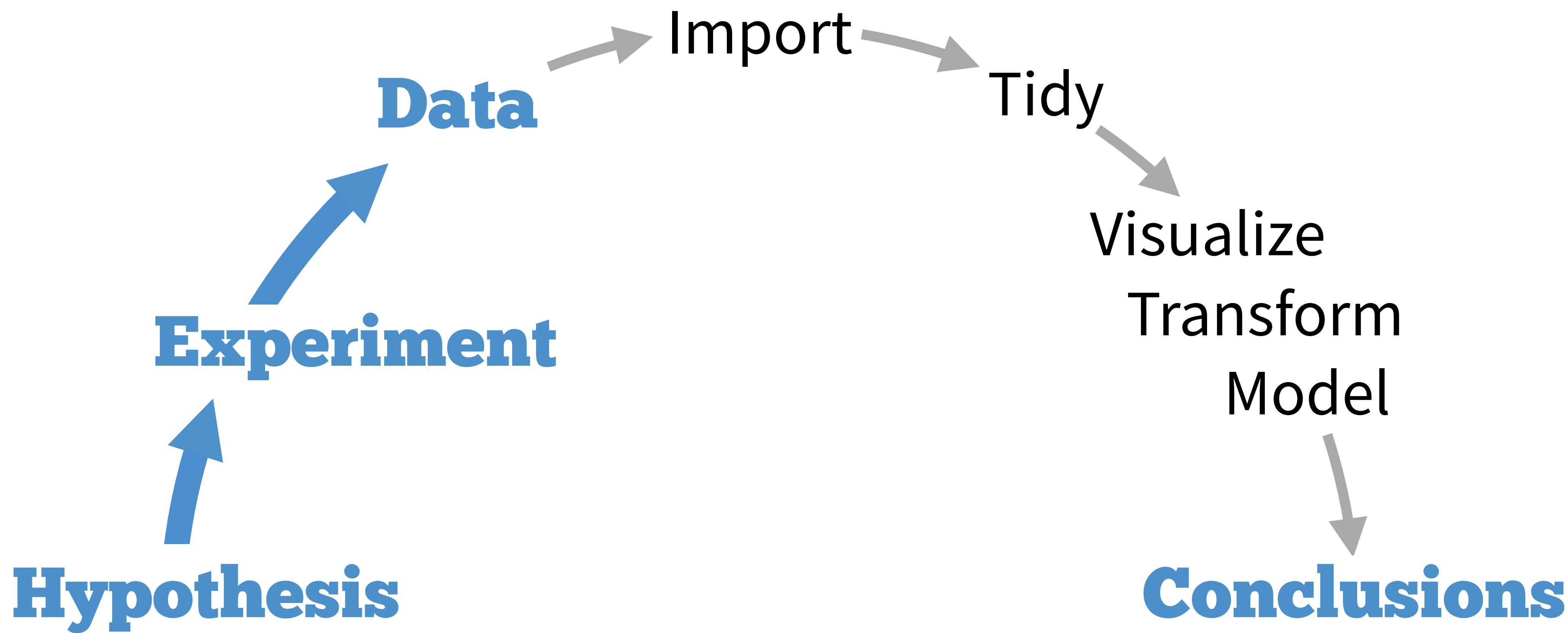
Data Science



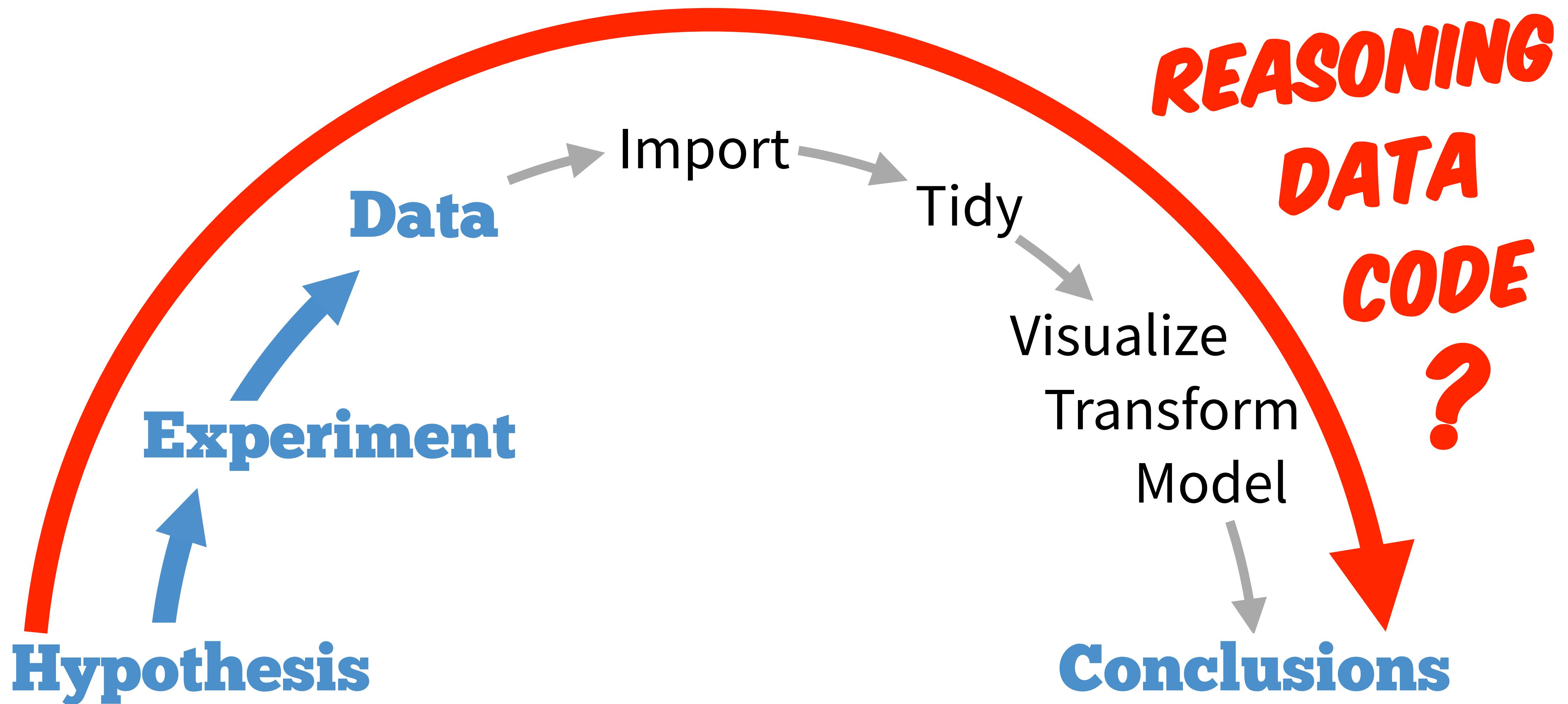
Data Science



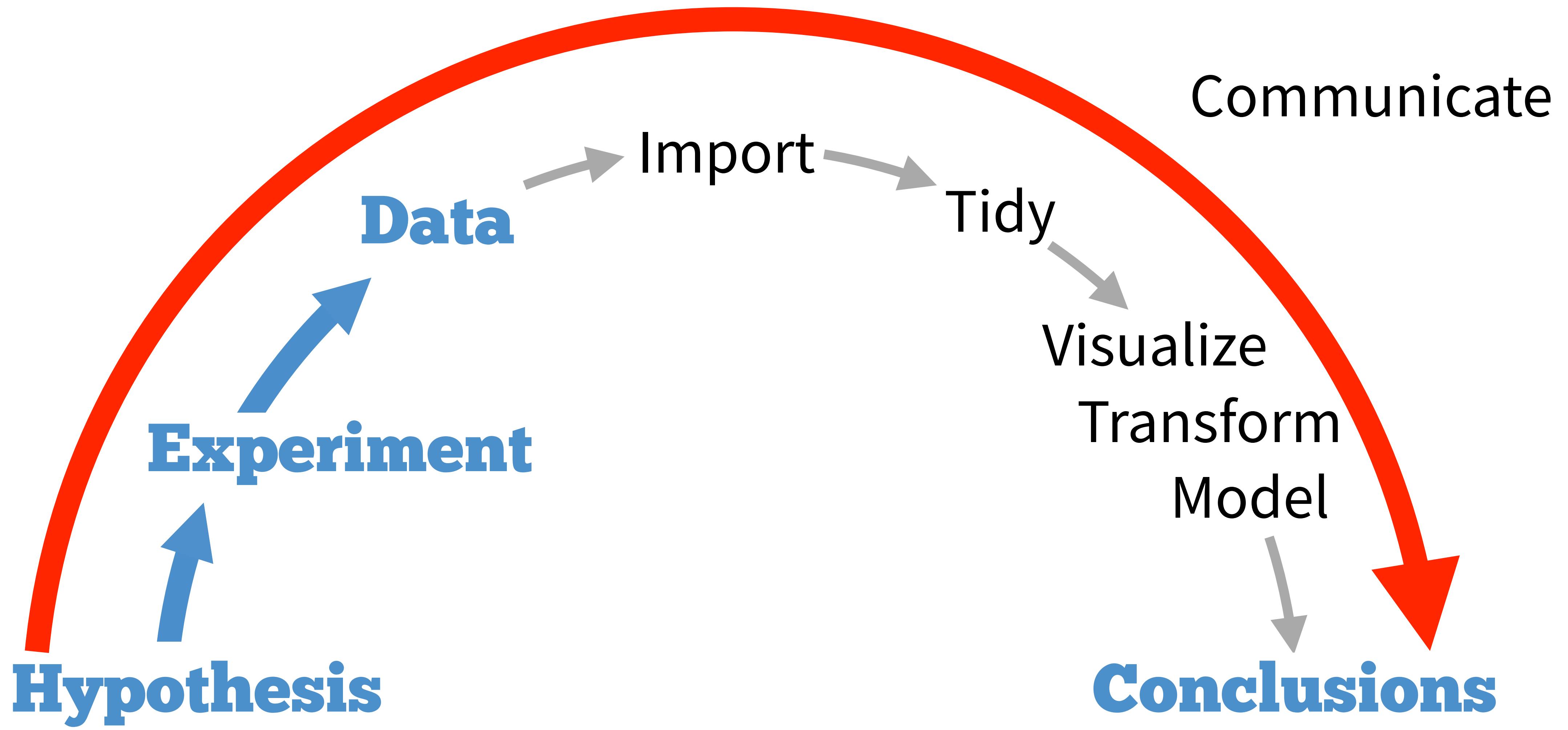
Data Science



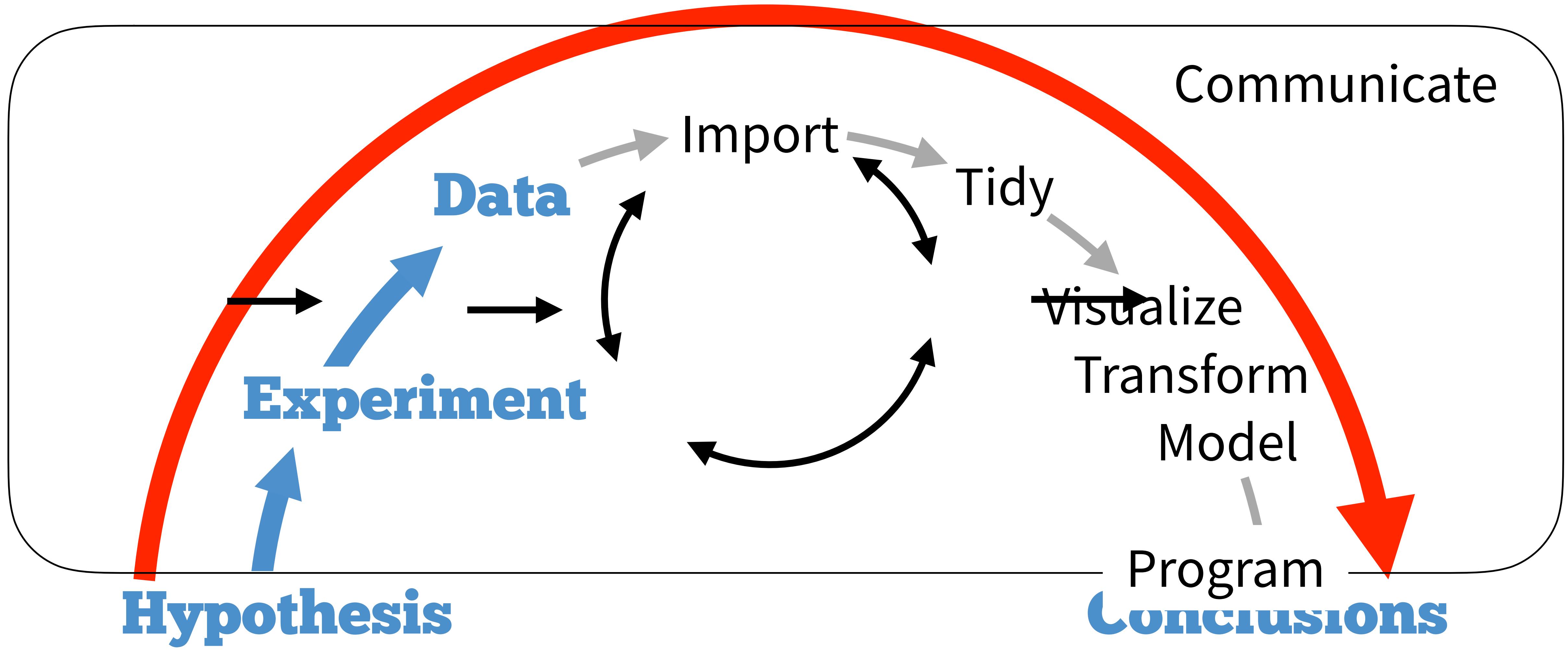
Data Science



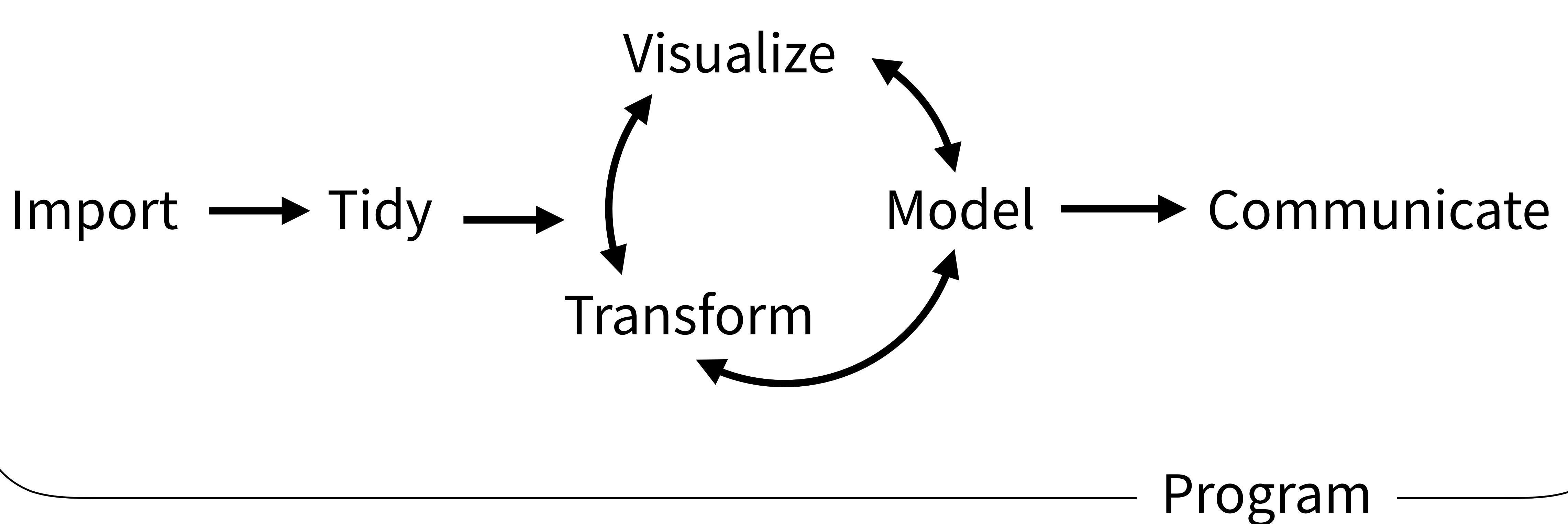
Data Science



Data Science



(Applied) Data Science



Outline

Introduction and
Visualize Data

8:00 - 9:45

Morning Break

9:45 - 10:15

Transform Data

10:15 - 12:00

Lunch

12:00 - 1:30

Model Data

1:30 - 3:15

Afternoon Break

3:15 - 3:45

Reproducible
Reporting

3:45 - 5:30

R and RStudio



Your Turn

Go here and log in for the class materials

<https://rstudio.cloud/project/385945>



Demo

<https://rstudio.cloud/project/385945>



A language



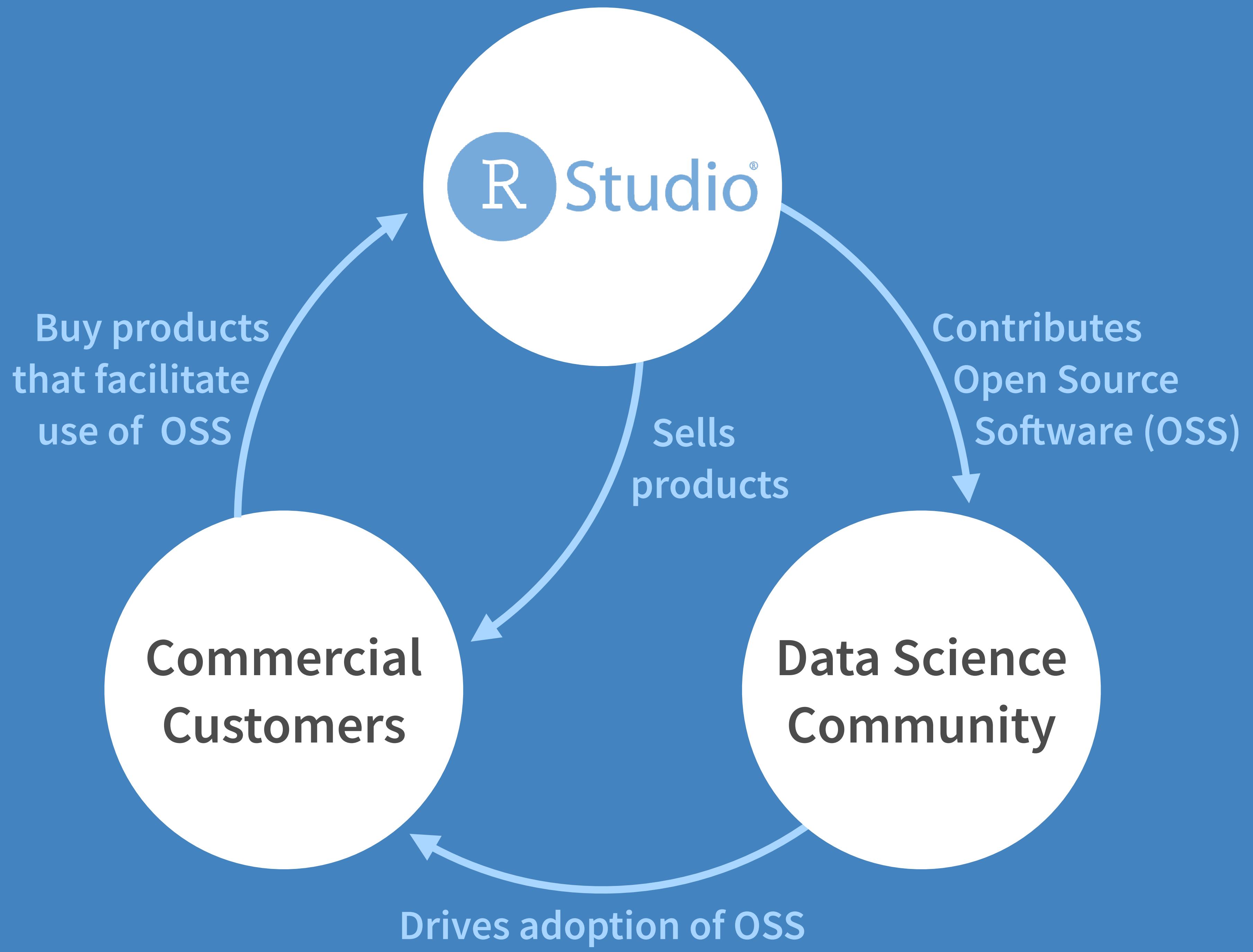
<https://rstudio.cloud/project/385945>

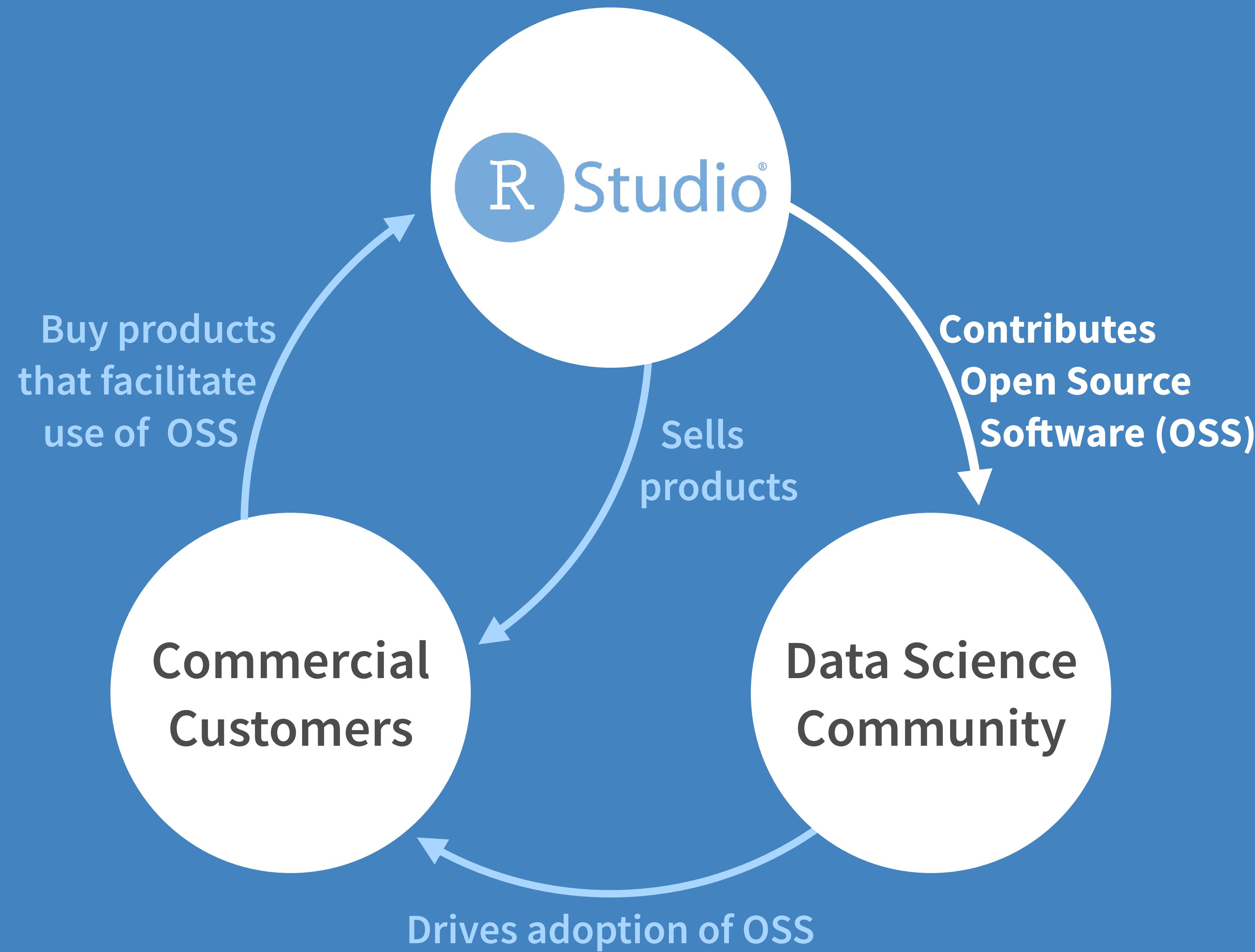


A language



Writing software





R the language

Values - 1, "Florida", "2010-01-25"

R the language

Values - 1, "Florida", "2010-01-25"

Objects - x <- 22/7

A name
without quotes

< followed by -
(it looks like an arrow)

A value,
object, or
function result

R the language

Values - 1, "Florida", "2010-01-25"

Objects - x <- c(22/7, 0.99, 3)

To put multiple values in an object,
combine the values with c()

R the language

Values - 1, "Florida", "2010-01-25"

Objects - x <- c(22/7, 0.99, 3)

Functions - round(x, digits = 3)

A name
without
quotes

followed by
() to run the
function

Arguments:
values, objects, or
function results

Warm Up

Which of these are numbers?

1

"1"

"one"

one

Warm Up

Which of these are numbers?

1

"1"

"one"

one

number

Warm Up

Which of these will work? Suppose `one <- 1.`

`log(1)` `log("1")` `log("one")` `log(one)`

Warm Up

Which of these will work? Suppose `one <- 1.`

`log(1)`

`log("1")`

`log("one")`

`log(one)`

Warm Up

Which of these are character strings?

1

"1"

"one"

one

Warm Up

Which of these are character strings?

1

"1"

"one"

one

words

Warm Up

Which of these are objects?

1

"1"

"one"

one

Warm Up

Which of these are numbers? Which are words?
Which is an object? How can you tell?

1

"1"

"one"

one

object

R Markdown

(Let's start!)

Your Turn

Go to **01-Introduction.**

Open **01-RMarkdown-Exercises.Rmd**. Read through the file and do everything it tells you to do.



R Markdown

An authoring format for Data Science.

The screenshot shows the RStudio interface with an R Markdown file open. The code editor pane contains the following R Markdown code:

```
1 ---  
2 title: "R Notebook"  
3 output: html_notebook  
4 ---  
5  
6 Text written in **markdown**  
7  
8 ```{r}  
9 # code written in R  
10 (x <- rnorm(7))  
11 ...  
12  
13 Text written in _markdown_  
14  
15 ```{r}  
16 # code written in R  
17 hist(x)  
18 ...  
18:4 (Top Level) ⇩  
Console
```

The preview pane shows the rendered content:

Code goes in a chunk

Click to run code in chunk

Code result

The console pane shows the output of the R code:

```
[1] -1.2  1.0 -0.5  0.9 -0.6 -1.1 -1.5
```

12
13 Text written in _markdown_
14
15 ```{r}
16 # code written in R
16:20 C Chunk 2 ⇩ R Markdown ⇩

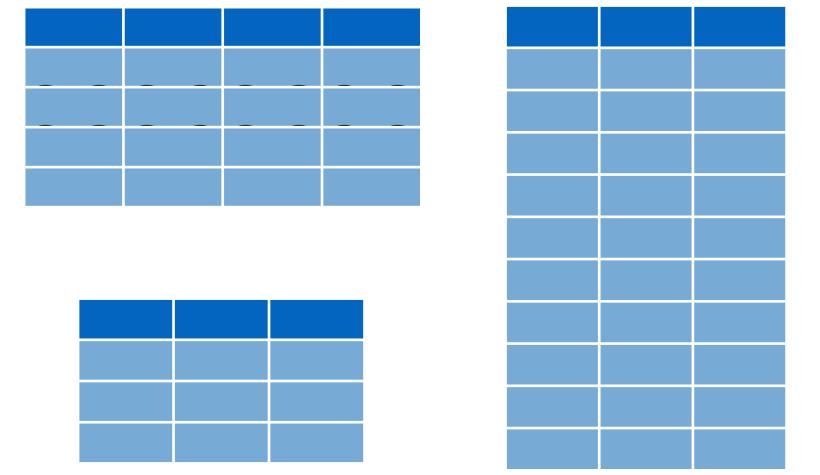
R Packages



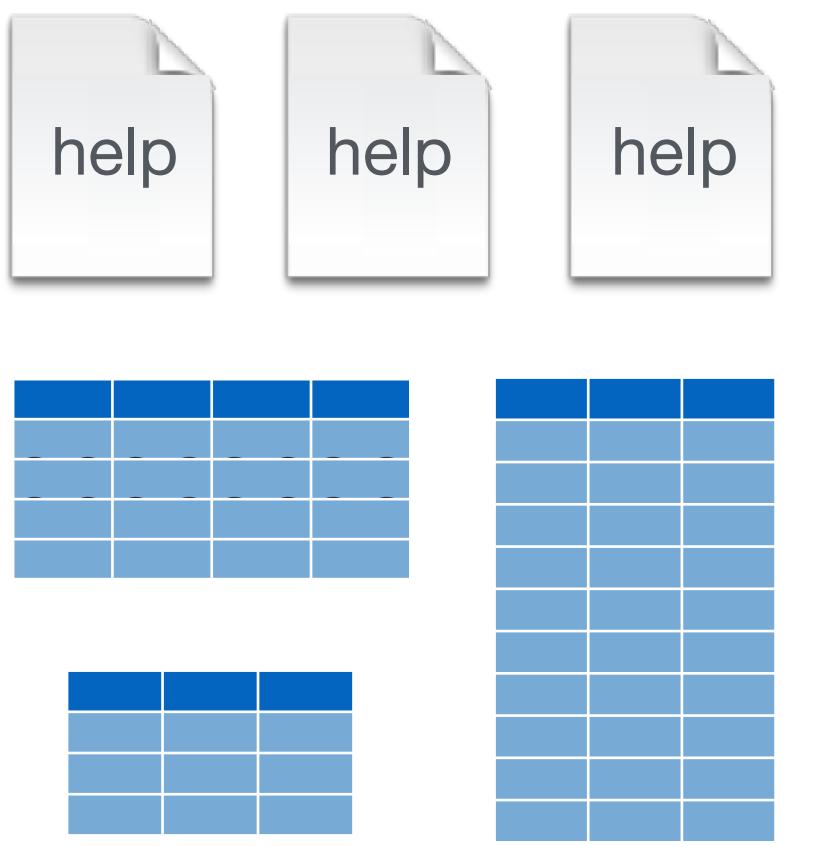
Your Turn

(If you know) explain to your group what an R package is.

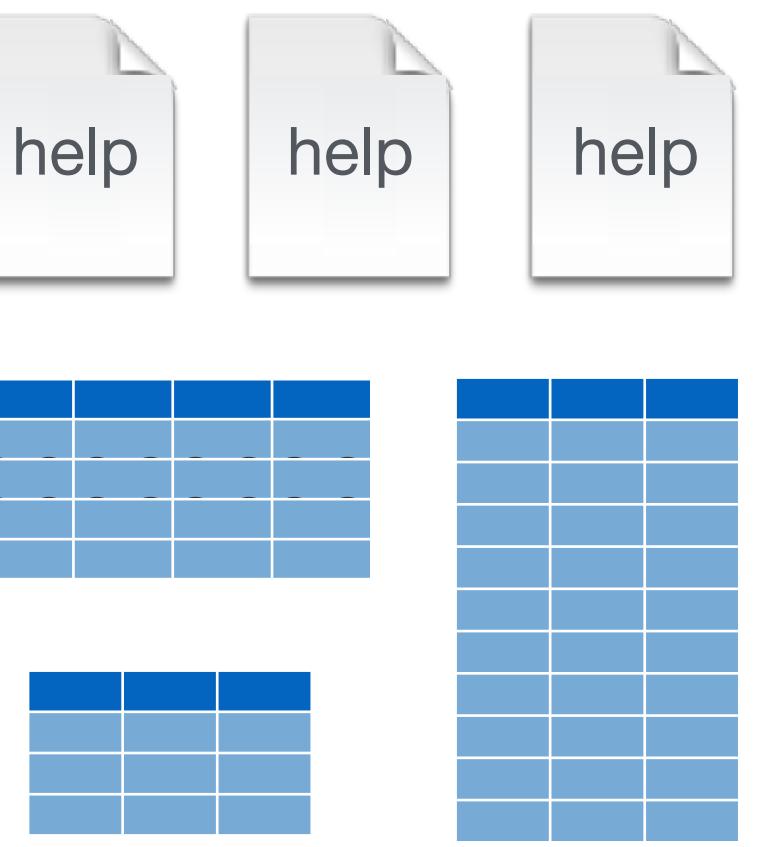




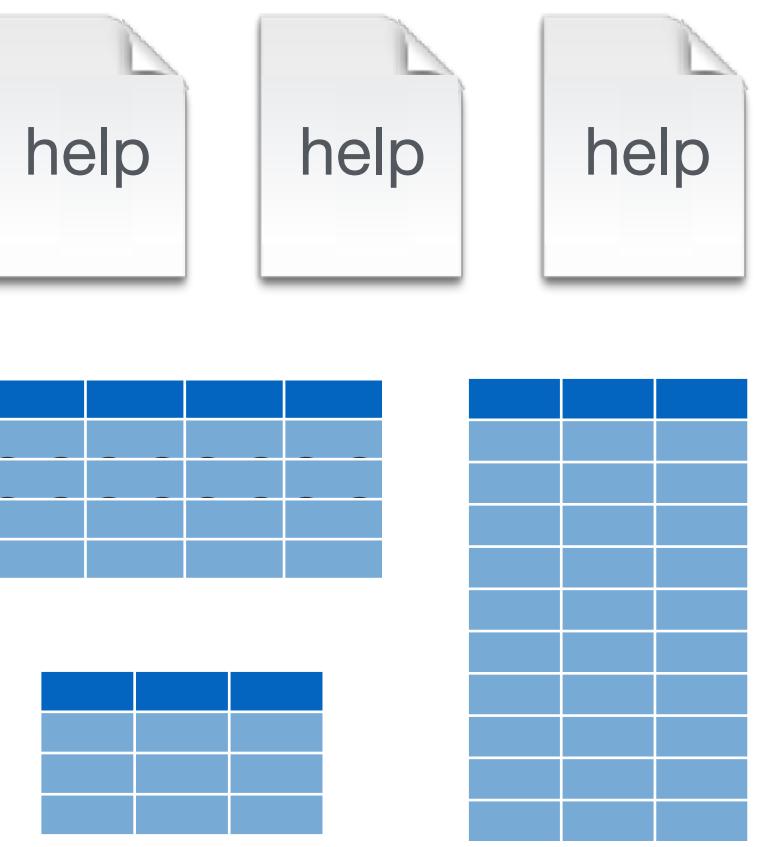
function1()
function2()
function3()
function4()



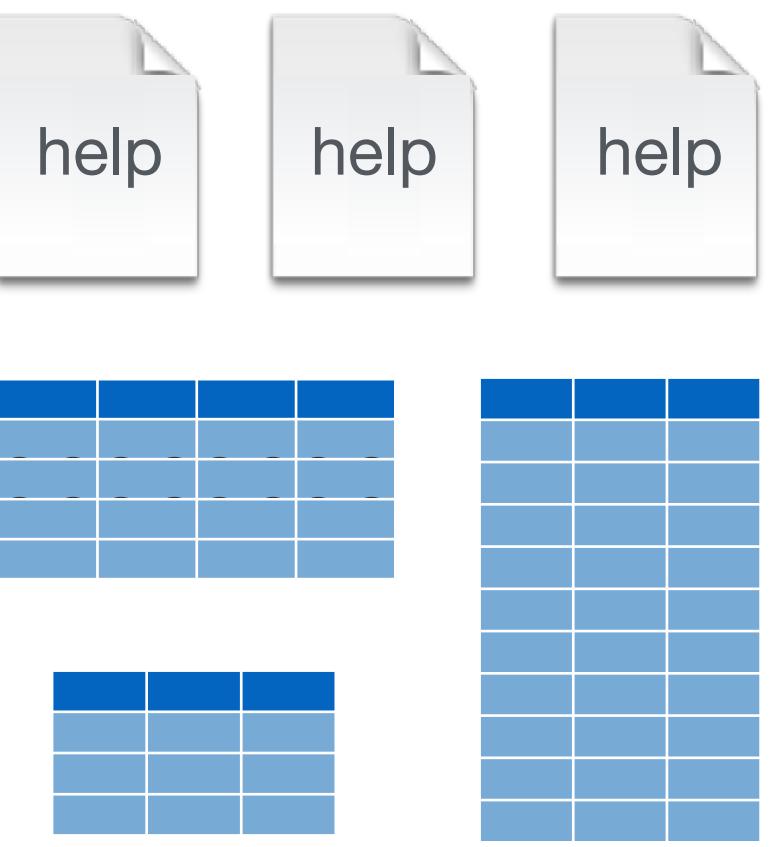
function1()
function2()
function3()
function4()



function5()
function6()
function7()
function8()

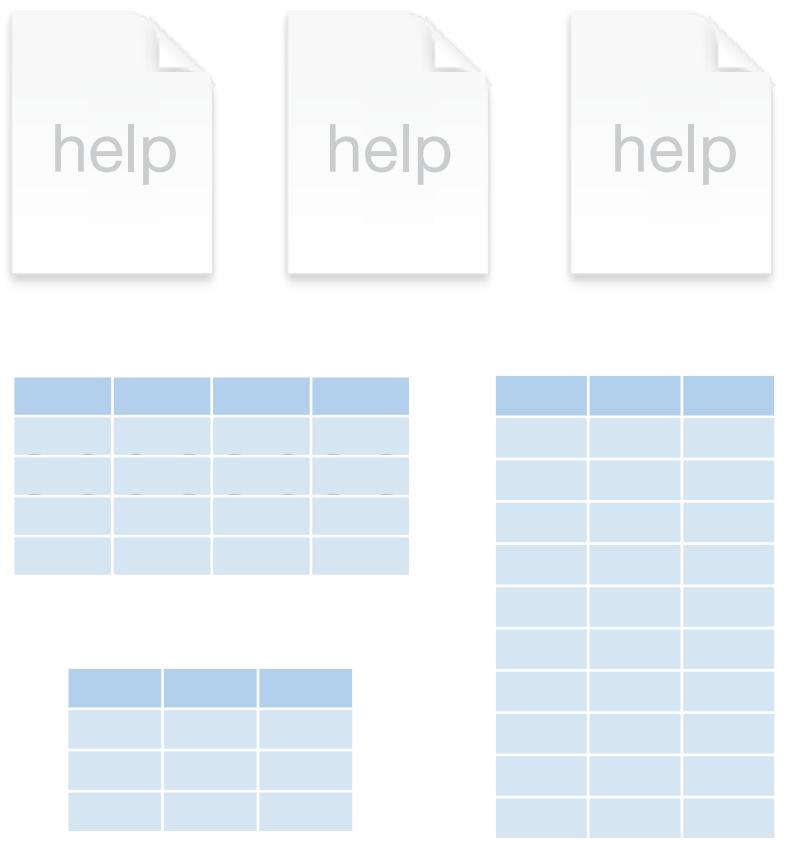


function9()
functionA()
functionB()
functionC()

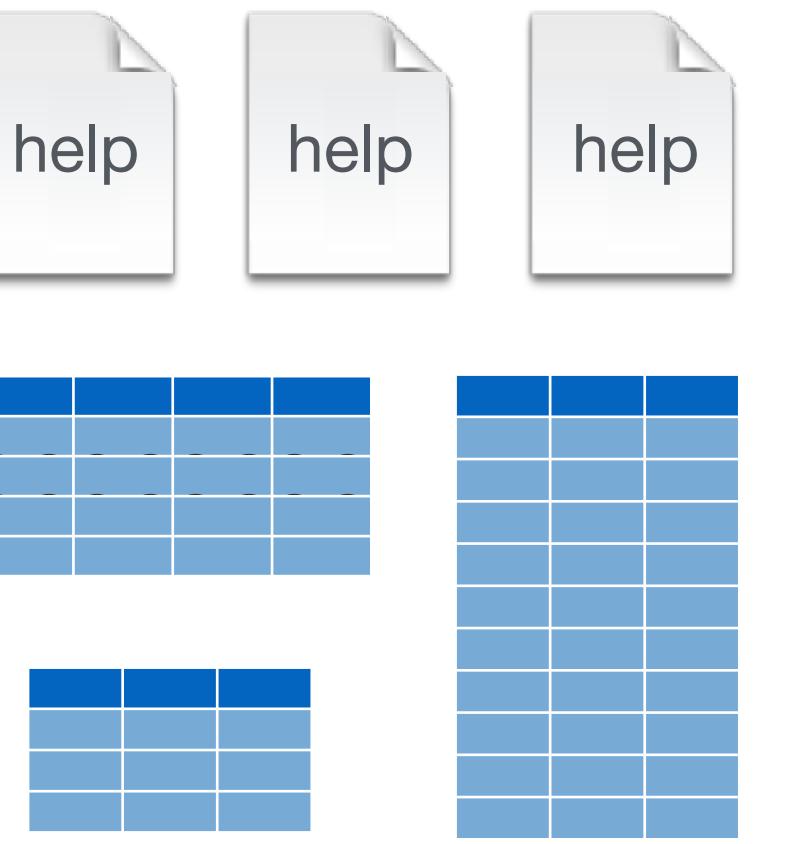


functionD()
functionE()
functionF()
functionG()

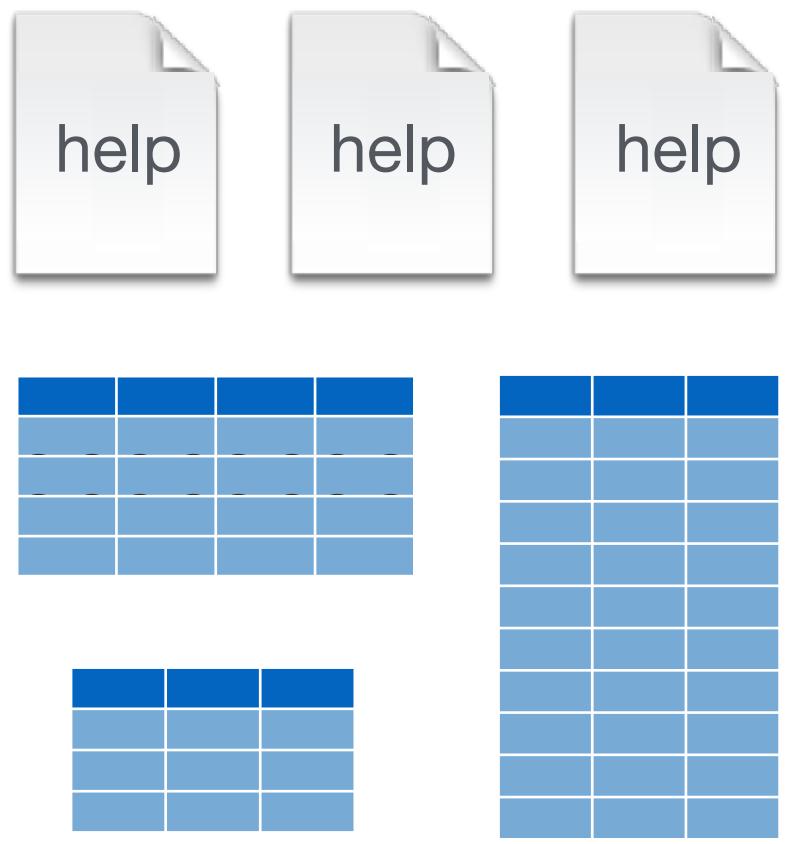
Base R



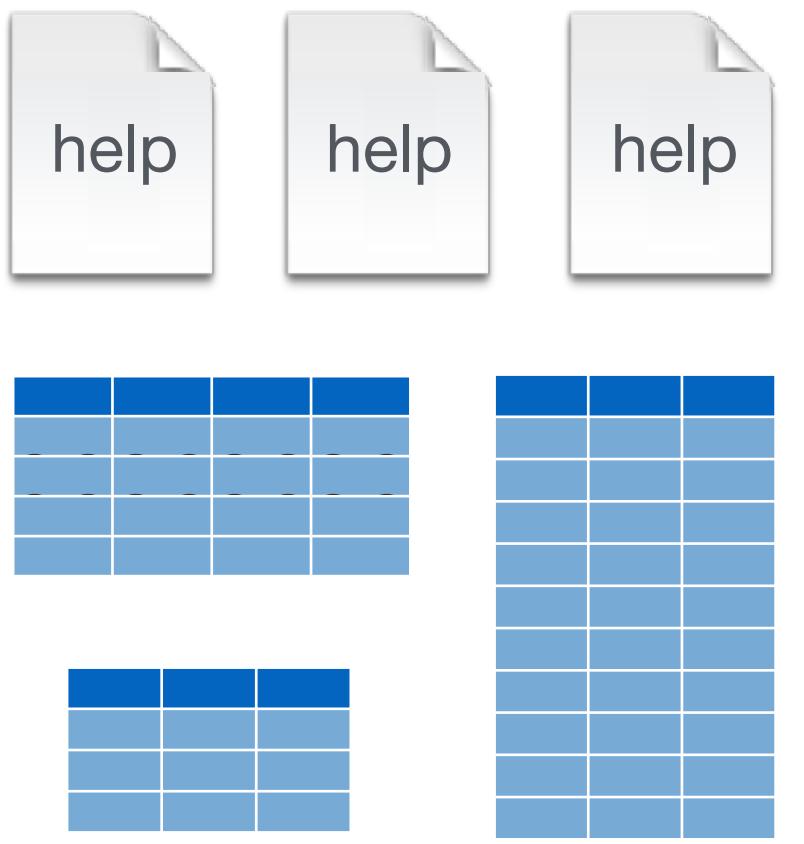
function1()
function2()
function3()
function4()



function5()
function6()
function7()
function8()

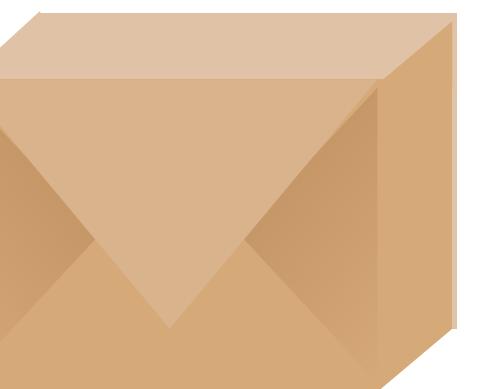


function9()
functionA()
functionB()
functionC()



functionD()
functionE()
functionF()
functionG()

Base R



46

R Packages



The Comprehensive R Archive x Garrett

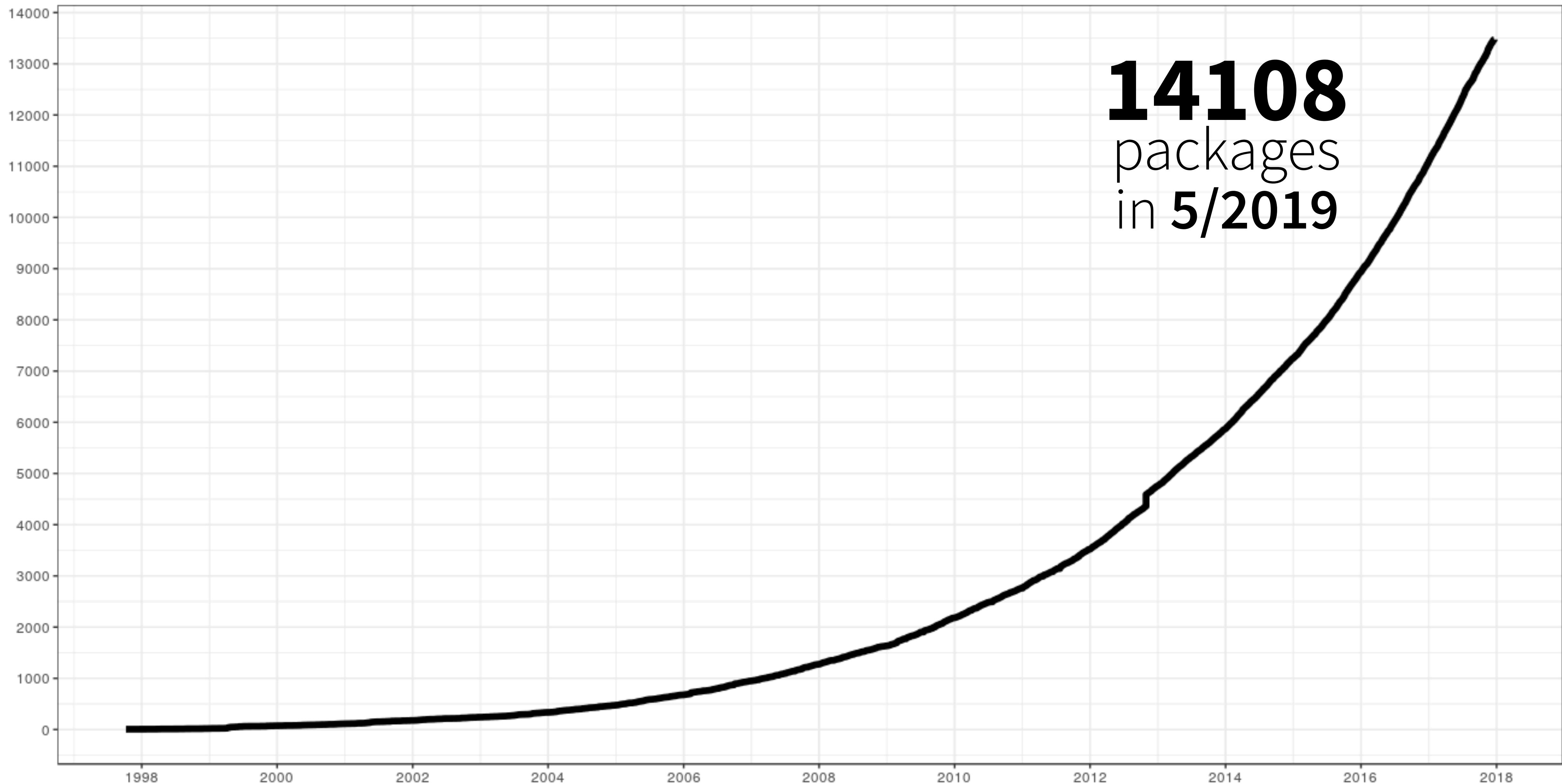
Secure | https://cran.r-project.org

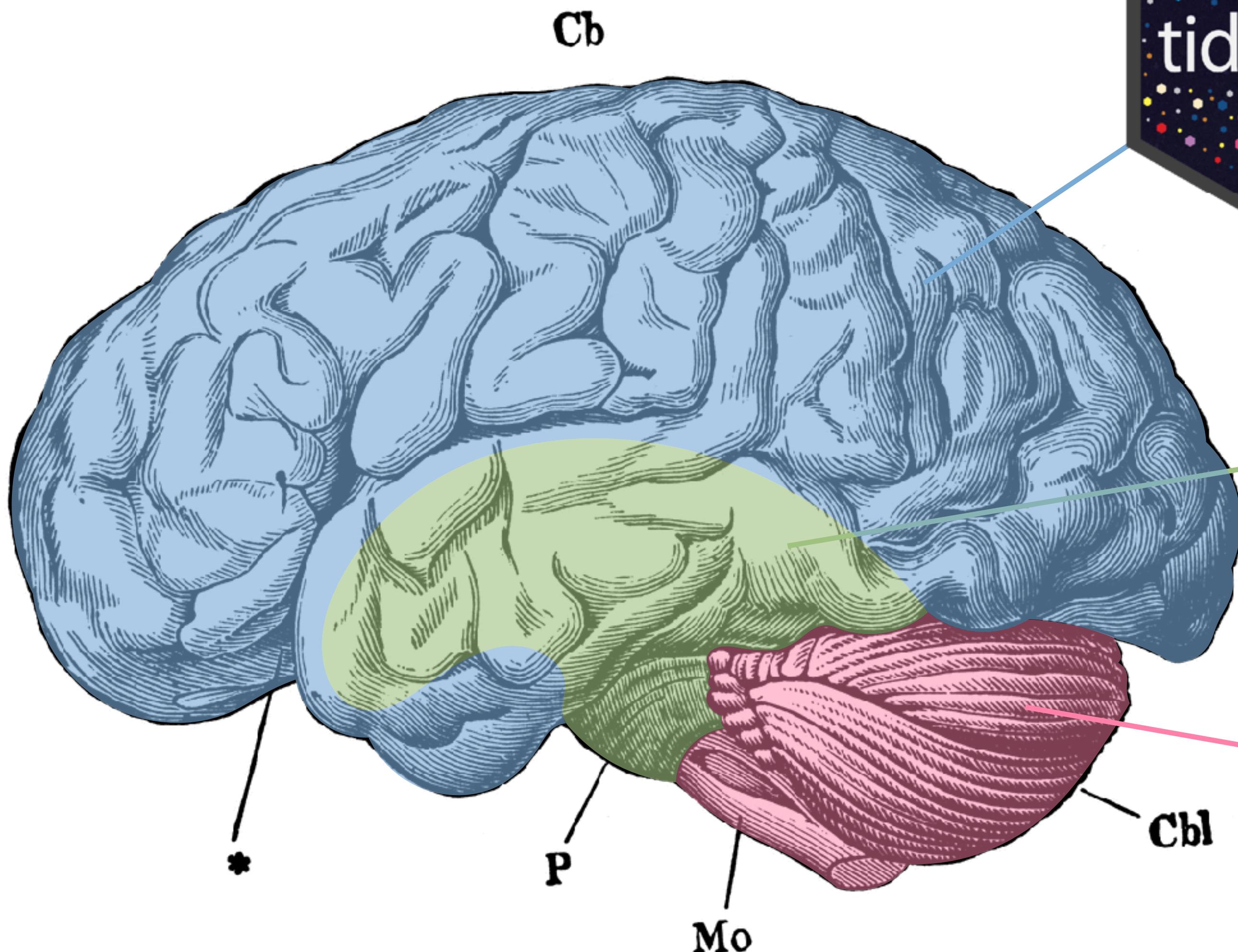
Available CRAN Packages By Name

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A3	Accurate, Adaptable, and Accessible Error Metrics for Predictive Models
abyyR	Access to Abbyy Optical Character Recognition (OCR) API
abc	Tools for Approximate Bayesian Computation (ABC)
ABCAnalysis	Computed ABC Analysis
abc.data	Data Only: Tools for Approximate Bayesian Computation (ABC)
abcdeFBA	ABCDE_FBA: A-Biologist-Can-Do-Everything of Flux Balance Analysis with this package
ABCOptim	Implementation of Artificial Bee Colony (ABC) Optimization
ABCp2	Approximate Bayesian Computational Model for Estimating P2
ABC.RAP	Array Based CpG Region Analysis Pipeline
abcrf	Approximate Bayesian Computation via Random Forests
abctools	Tools for ABC Analyses
abd	The Analysis of Biological Data
abf2	Load Gap-Free Axon ABF2 Files
ABHgenotypeR	Easy Visualization of ABH Genotypes
abind	Combine Multidimensional Arrays
abjutils	Useful Tools for Jurimetric Analysis Used by the Brazilian Jurimetrics Association
abn	Modelling Multivariate Data with Additive Bayesian Networks
abodOutlier	Angle-Based Outlier Detection

Number of R packages ever published on CRAN



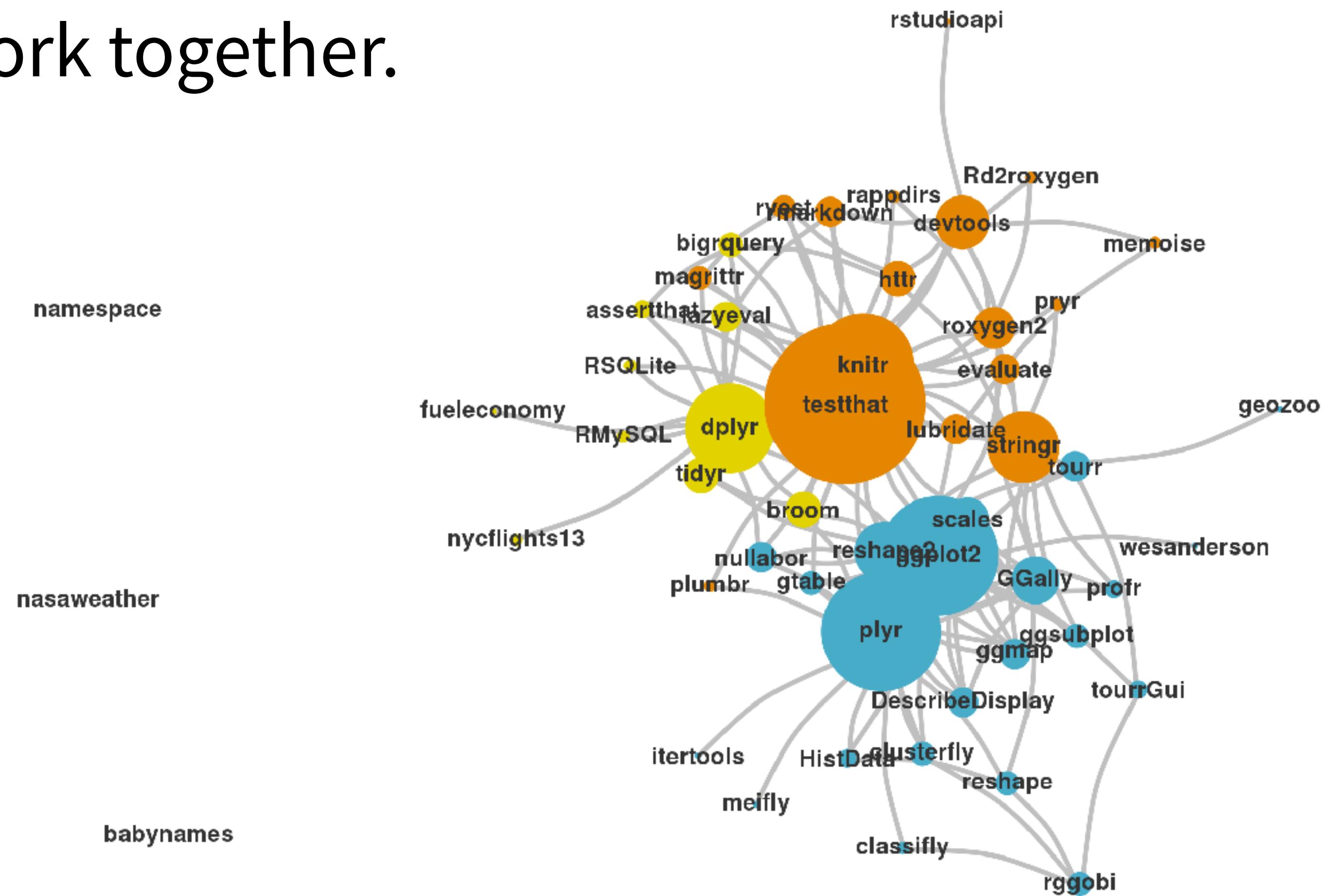


Limbic
System

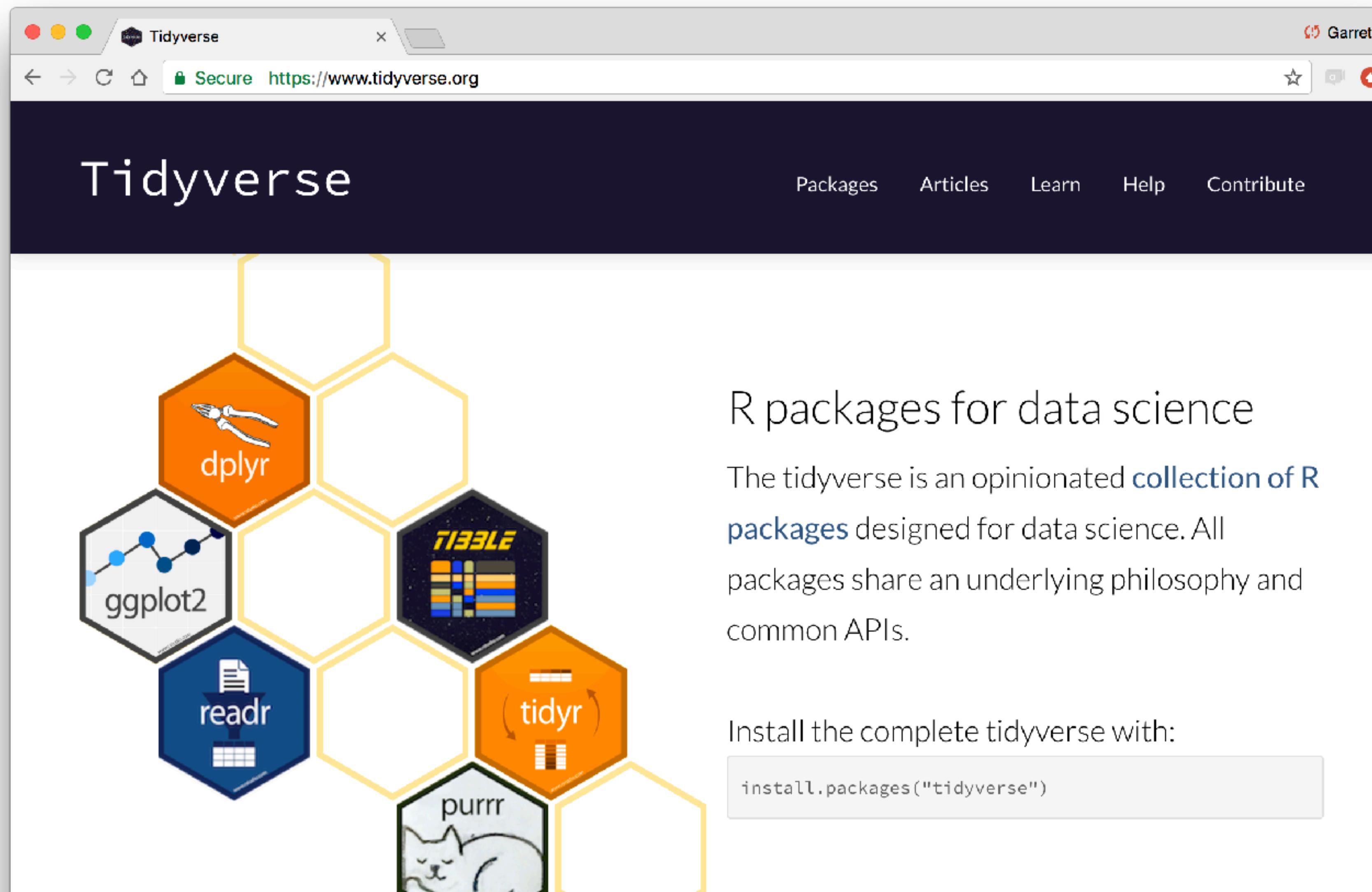
Reptilian
Brain

The Tidyverse

A collection of modern R packages that share common philosophies, embed best practices, and are designed to work together.



tidyverse.org



Using packages

1

```
install.packages("foo")
```

Downloads files to computer

1 x per computer

Quiz

The tidyverse contains the following packages.
How would you install them?

ggplot2

dplyr

tidyr

readr

purrr

tibble

hms

stringr

lubridate

forcats

DBI

haven

httr

jsonlite

readxl

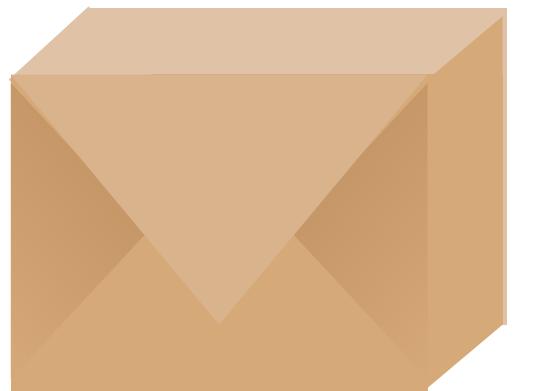
rvest

xml2

modelr

tidyverse

tidyverse



An R package that serves as a short cut for installing and loading the components of the tidyverse.

```
library("tidyverse")
```

```
install.packages("tidyverse")
```

does the equivalent of

```
install.packages("ggplot2")
install.packages("dplyr")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("hms")
install.packages("stringr")
install.packages("lubridate")
install.packages("forcats")
install.packages("DBI")
install.packages("haven")
install.packages("httr")
install.packages("jsonlite")
install.packages("readxl")
install.packages("rvest")
install.packages("xml2")
install.packages("modelr")
install.packages("broom")
```

I've already installed all of
the packages you need

Using packages

1

```
install.packages("foo")
```

Downloads files to computer

1 x per computer

2

```
library("foo")
```

Loads package

1 x per R Session

```
install.packages("tidyverse")
```

does the equivalent of

```
install.packages("ggplot2")
install.packages("dplyr")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("hms")
install.packages("stringr")
install.packages("lubridate")
install.packages("forcats")
install.packages("DBI")
install.packages("haven")
install.packages("httr")
install.packages("jsonlite")
install.packages("readxl")
install.packages("rvest")
install.packages("xml2")
install.packages("modelr")
install.packages("broom")
```

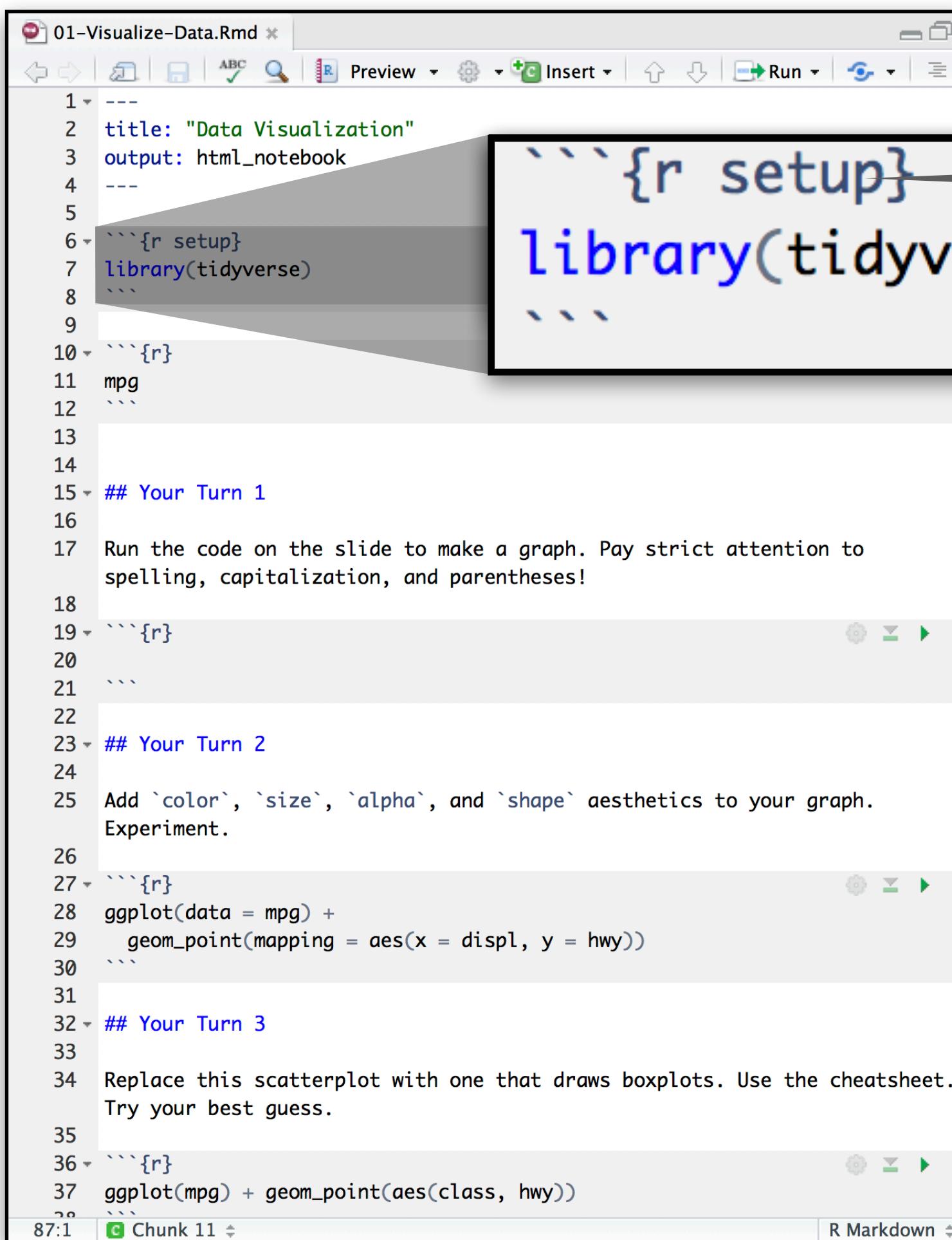
```
library("tidyverse")
```

does the equivalent of

```
library("ggplot2")
library("dplyr")
library("tidyr")
library("readr")
library("purrr")
library("tibble")
```

Setup

The setup chunk is always run once before anything else



A screenshot of RStudio showing an R Markdown file titled "01-Visualize-Data.Rmd". The code editor displays the following R code:

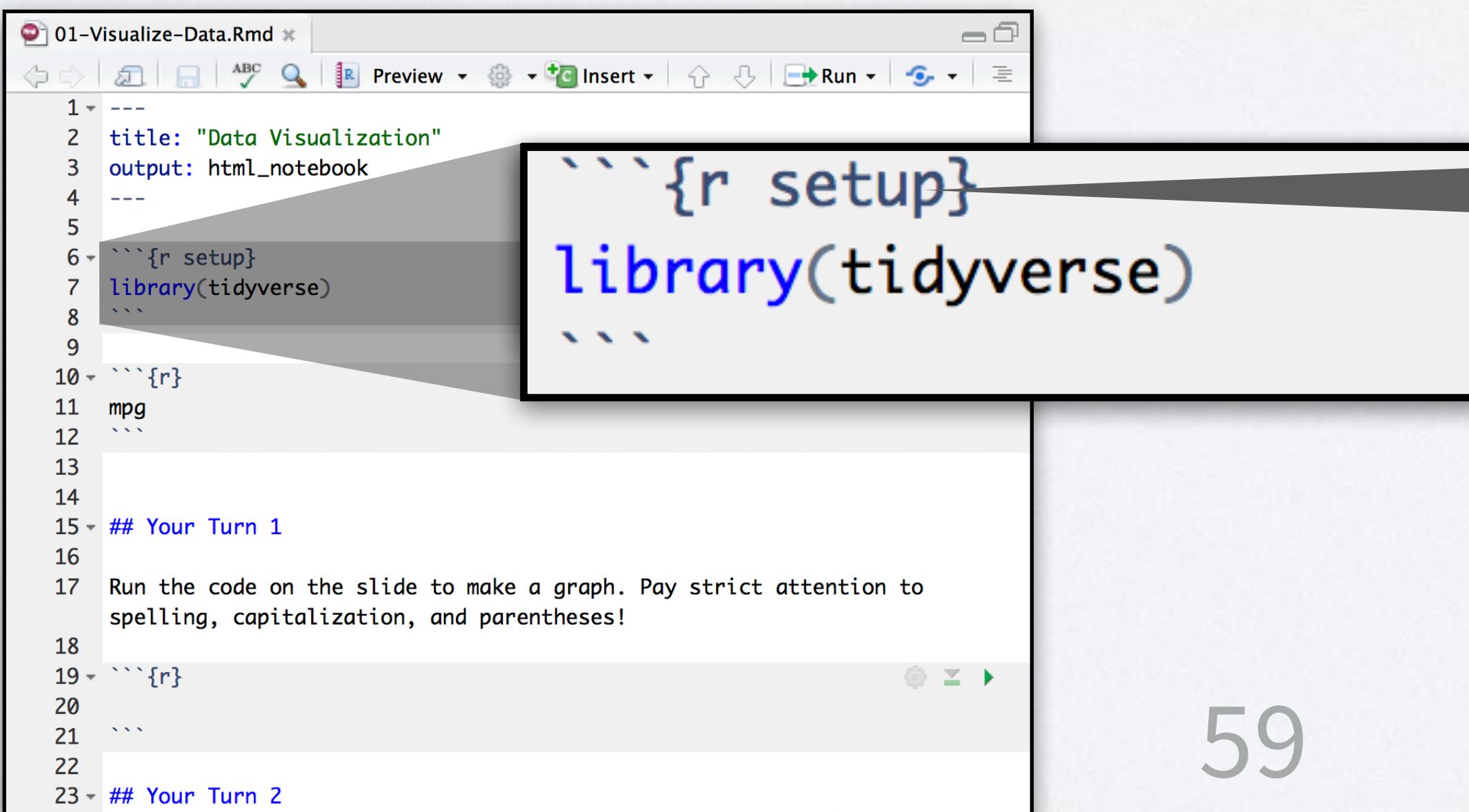
```
1 ---  
2 title: "Data Visualization"  
3 output: html_notebook  
4 ---  
5  
6 ```{r setup}  
7 library(tidyverse)  
8 ```  
9  
10 ```{r}  
11 mpg  
12  
13  
14  
15 ## Your Turn 1  
16  
17 Run the code on the slide to make a graph. Pay strict attention to  
spelling, capitalization, and parentheses!  
18  
19 ```{r}  
20  
21  
22  
23 ## Your Turn 2  
24  
25 Add `color`, `size`, `alpha`, and `shape` aesthetics to your graph.  
Experiment.  
26  
27 ```{r}  
28 ggplot(data = mpg) +  
29   geom_point(mapping = aes(x = displ, y = hwy))  
30  
31  
32 ## Your Turn 3  
33  
34 Replace this scatterplot with one that draws boxplots. Use the cheatsheet.  
Try your best guess.  
35  
36 ```{r}  
37 ggplot(mpg) + geom_point(aes(class, hwy))  
38  
39
```

The code editor highlights the first code chunk with a black border. A callout bubble points from this highlighted chunk to a text box containing the following explanatory text:

chunk labels are optional,
the setup label is special

Your Turn

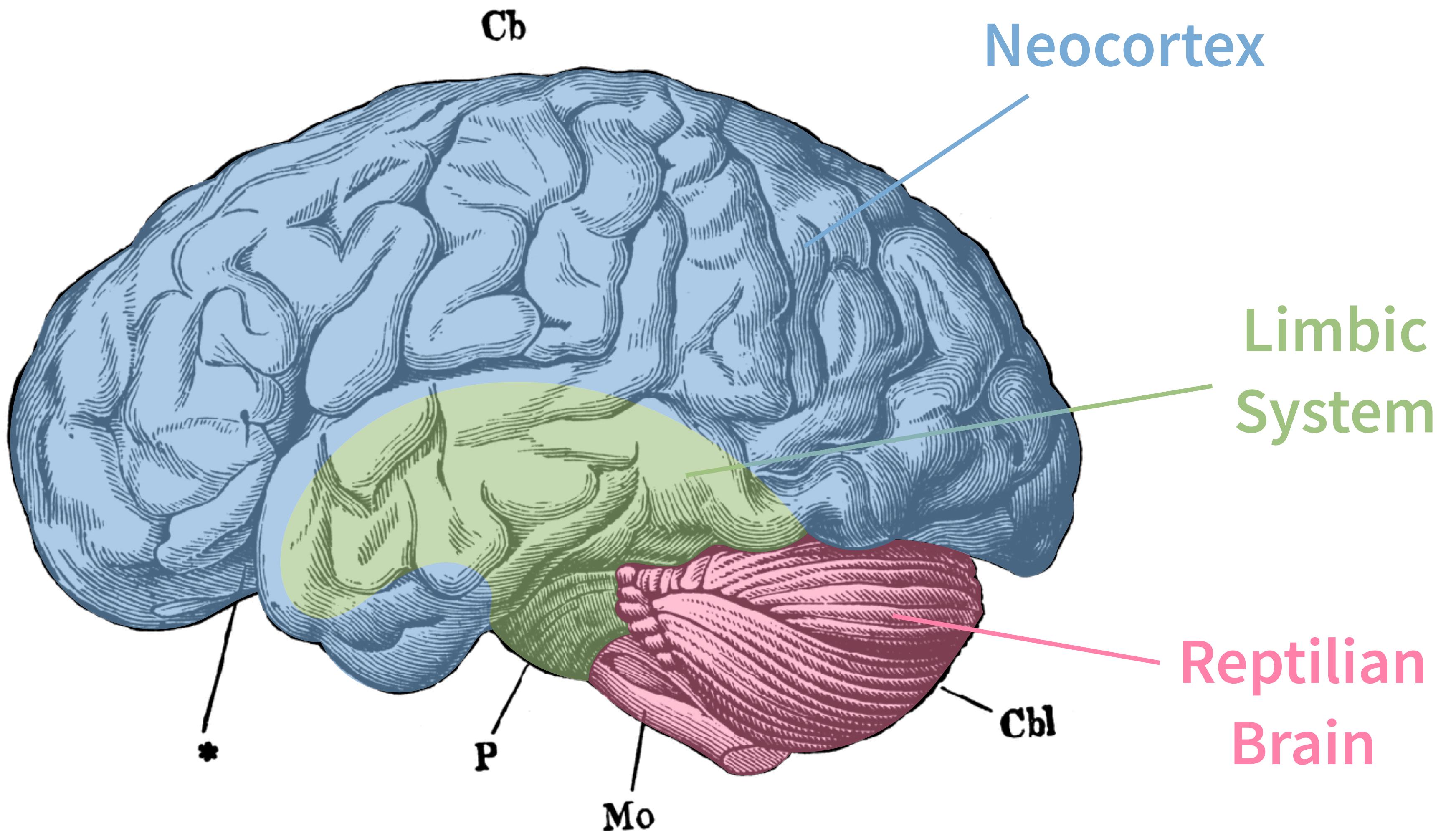
Add a setup chunk to the top of **01-RMarkdown-Exercises.Rmd**. Use it to load the tidyverse package, then uncomment and run the ggplot2 chunk at the bottom of your file.



```
1 ---  
2 title: "Data Visualization"  
3 output: html_notebook  
4 ---  
5  
6 ```{r setup}  
7 library(tidyverse)  
8 ```  
9  
10 ```{r}  
11 mpg  
12 ```  
13  
14  
15 ## Your Turn 1  
16  
17 Run the code on the slide to make a graph. Pay strict attention to  
spelling, capitalization, and parentheses!  
18  
19 ```{r}  
20 ```  
21  
22  
23 ## Your Turn 2
```

chunk labels are optional,
the setup label is special







Your Turn 0

Navigate up to the **02-Visualize** folder.

Open 02-Visualize-Exercises.Rmd

Add a setup chunk that loads the
tidyverse packages.

