Intro to Tidyverse!

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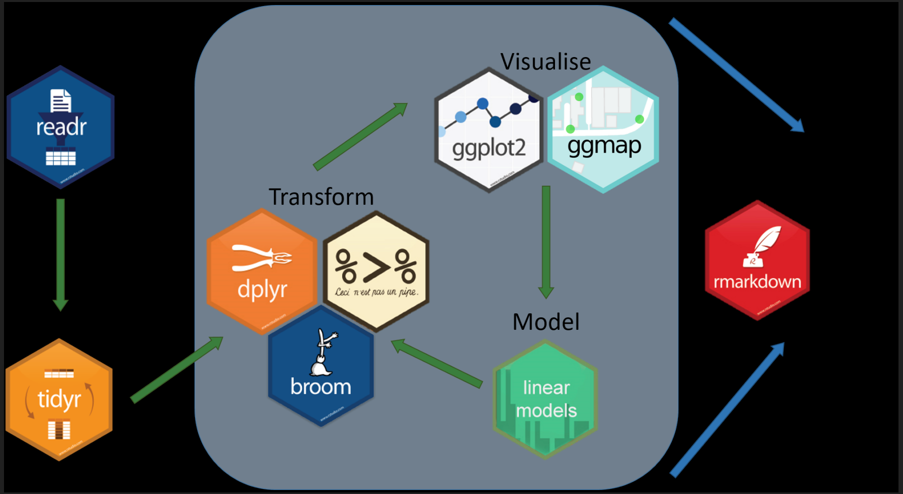
Intro

- **Familiar w/ R and ggplot? Introduce yourself briefly!**
  - Who you are | Name, affiliation
  - Do you have the same version of
    - R (4.1+), RStudio & Tidyverse?
    - NO? Installation time!

Need help? Raise your hand! ✋ **OR ask on chat!** 💬

Today!

- **Workshop**
  - Intro to Tidyverse



Welcome to *tidyverse*

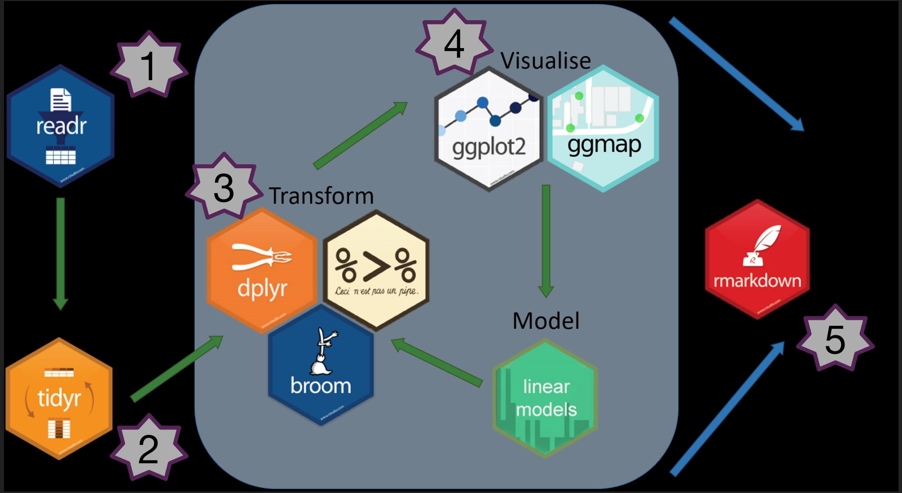
P1: Getting Started w/ readr

P2: Reshaping data w/ tidyr

P3: Data wrangling w/ dplyr

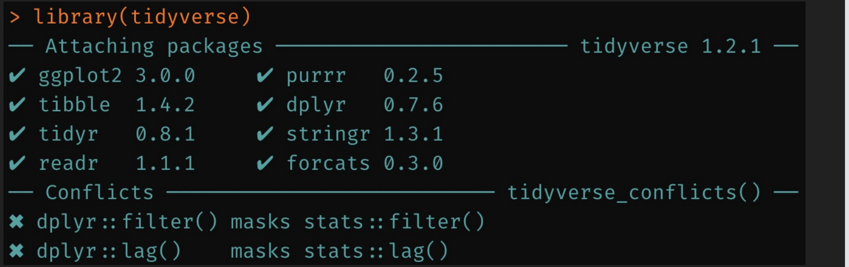
P4: DataViz w/ ggplot

P5: Wrap-up w/ RMarkdown

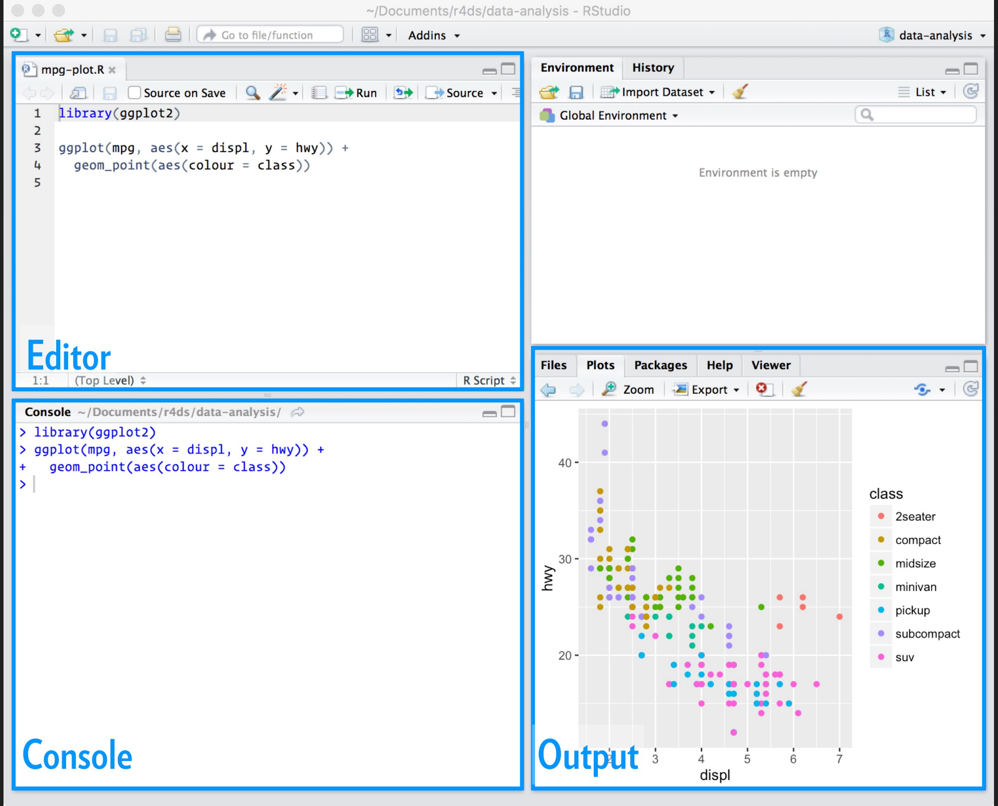


Part 1: Getting Started: Environment

- ✓ Installing RStudio, R
- ✓ Installing tidyverse



```
> library(tidyverse)
── Attaching packages ──────────────────────── tidyverse 1.2.1 ──
✔ ggplot2 3.0.0     ✔ purrr   0.2.5
✔ tibble  1.4.2     ✔ dplyr   0.7.6
✔ tidyr   0.8.1     ✔ stringr 1.3.1
✔ readr   1.1.1     ✔ forcats 0.3.0
── Conflicts ─────────────────────── tidyverse_conflicts() ──
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag()    masks stats::lag()
```



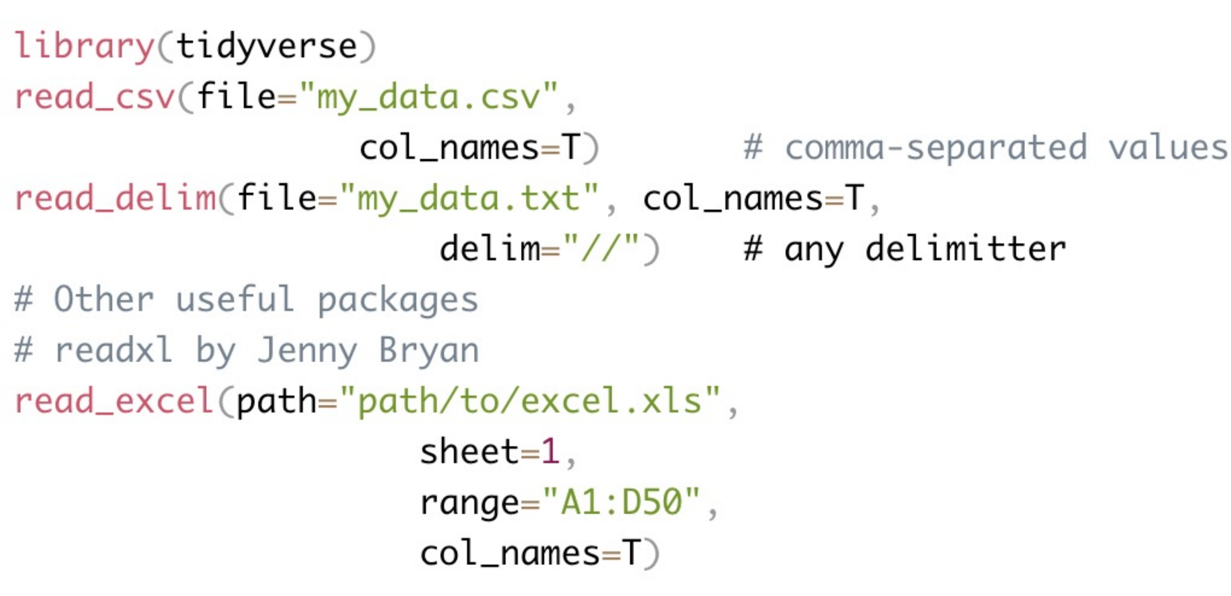
```
library(ggplot2)

ggplot(mpg, aes(x = displ, y = hwy)) +
  geom_point(aes(colour = class))
```

```
> library(ggplot2)
> ggplot(mpg, aes(x = displ, y = hwy)) +
+   geom_point(aes(colour = class))
>
```

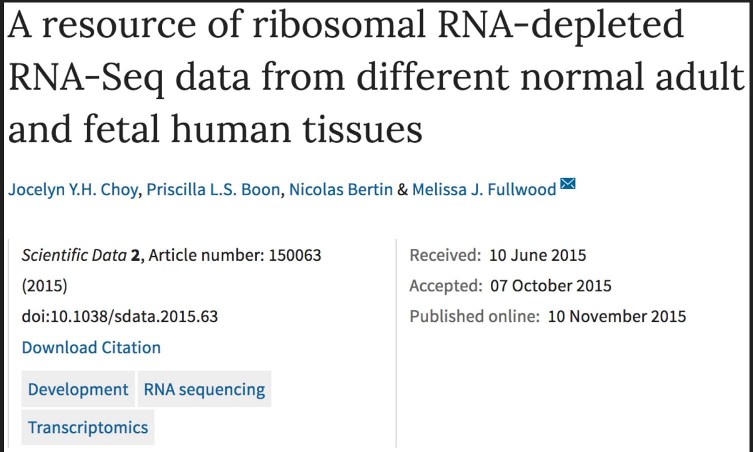
Getting Started: Data, your data

1. Import your data



```
library(tidyverse)
read_csv(file="my_data.csv",
                 col_names=T)       # comma-separated values
read_delim(file="my_data.txt", col_names=T,
                     delim="//")   # any delimitter
# Other useful packages
# readxl by Jenny Bryan
read_excel(path="path/to/excel.xls",
                    sheet=1,
                    range="A1:D50",
                    col_names=T)
```

Getting Started: Today’s Dataset



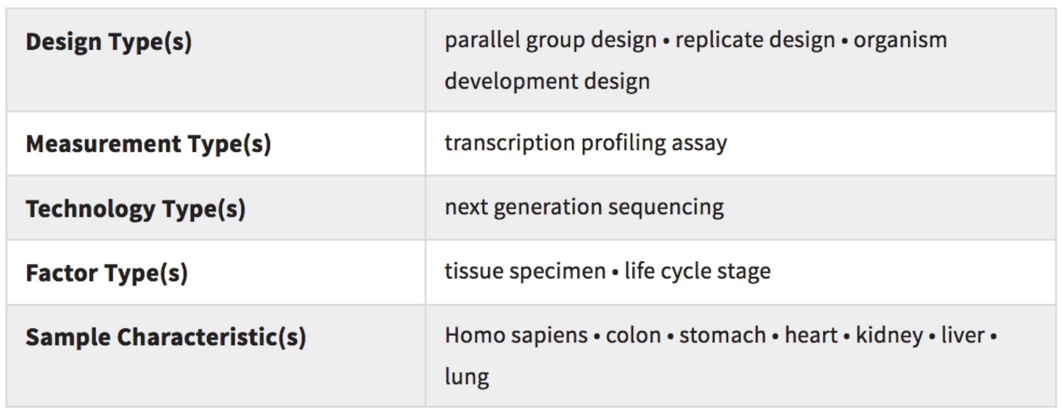
A resource of ribosomal RNA-depleted RNA-Seq data from different normal adult and fetal human tissues

Jocelyn Y.H. Choy, Priscilla L.S. Boon, Nicolas Bertin & Melissa J. Fullwood

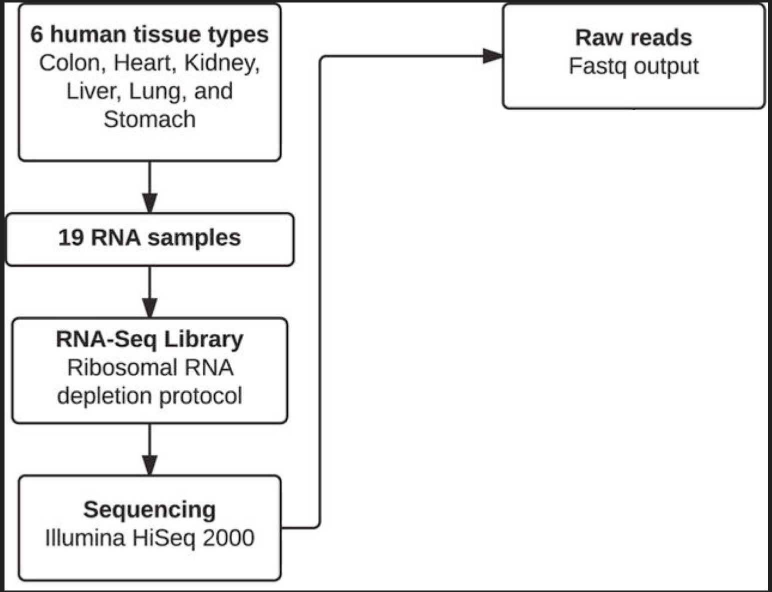
Scientific Data **2**, Article number: 150063 (2015)
doi:10.1038/sdata.2015.63
Download Citation

Development RNA sequencing
Transcriptomics

Received: 10 June 2015
Accepted: 07 October 2015
Published online: 10 November 2015



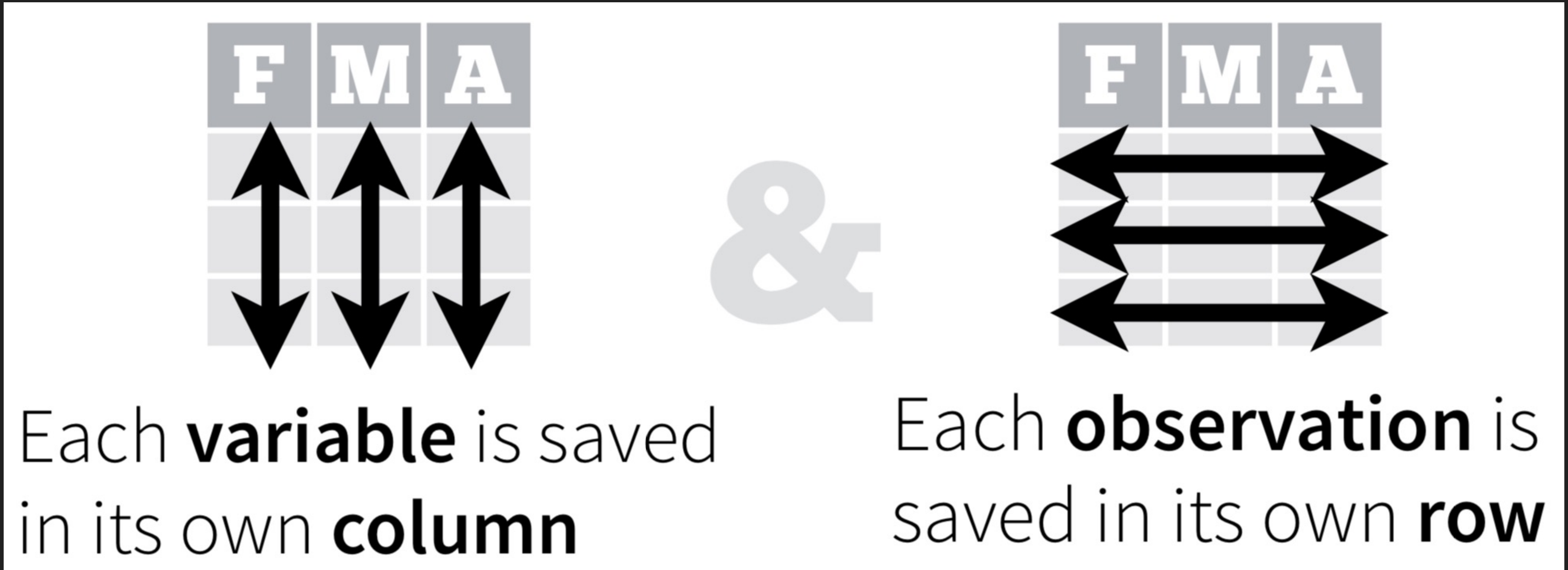
Design Type(s)	parallel group design • replicate design • organism development design
Measurement Type(s)	transcription profiling assay
Technology Type(s)	next generation sequencing
Factor Type(s)	tissue specimen • life cycle stage
Sample Characteristic(s)	Homo sapiens • colon • stomach • heart • kidney • liver • lung


6 human tissue types Colon, Heart, Kidney, Liver, Lung, and Stomach
19 RNA samples
RNA-Seq Library Ribosomal RNA depletion protocol
Sequencing Illumina HiSeq 2000
Raw reads Fastq output

https://www.nature.com/articles/sdata201563

Back to RStudio

Part 2: Reshaping data w/ *tidyr*

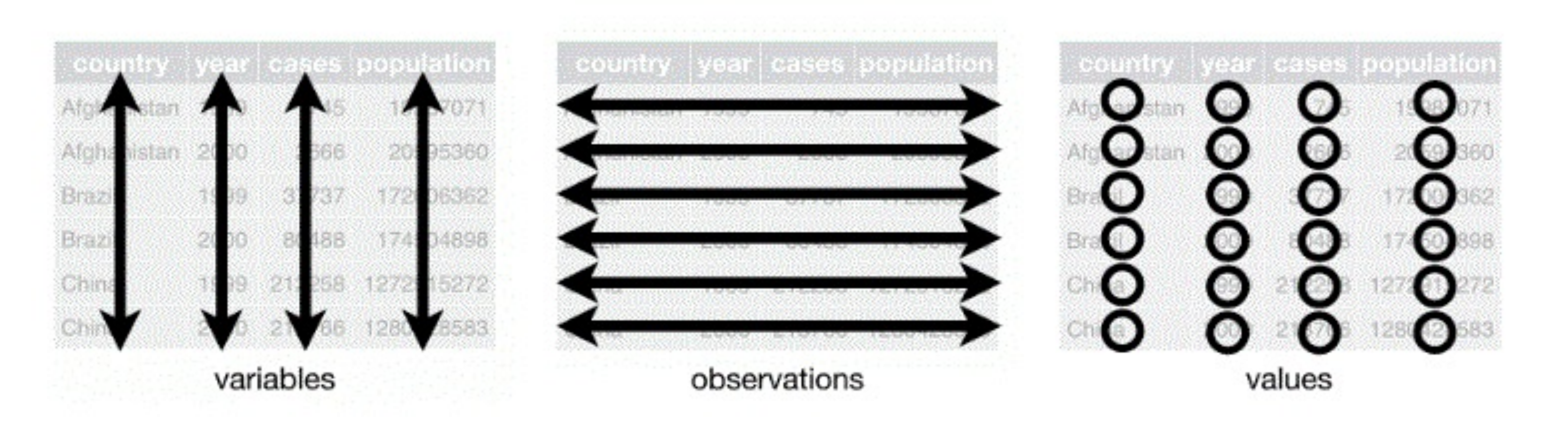


Each **variable** is saved in its own **column**

Each **observation** is saved in its own **row**

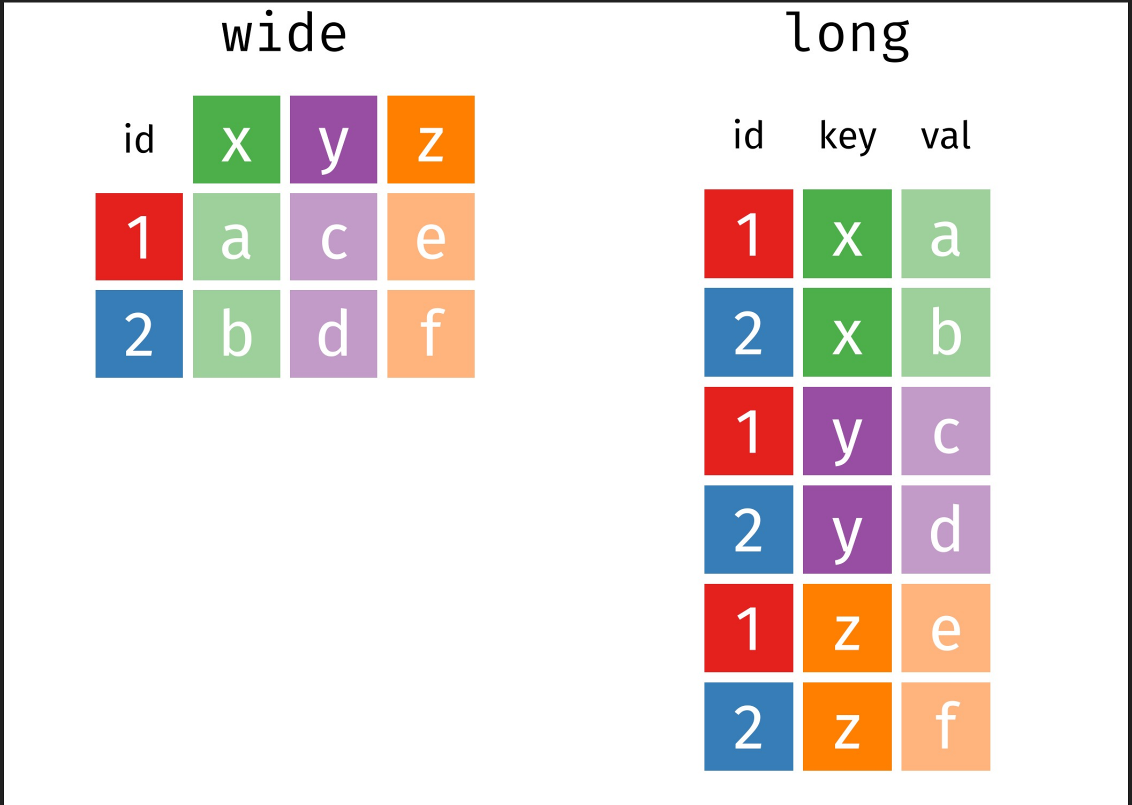
Tidy Data … In a ‘Tidy’ dataset, …

Part 2: What is tidy data?



- Each variable in the data set is placed in its own column.
- Each observation is placed in its own row.
- Each value is placed in its own cell.

Part 2: In a ‘Tidy’ dataset, …



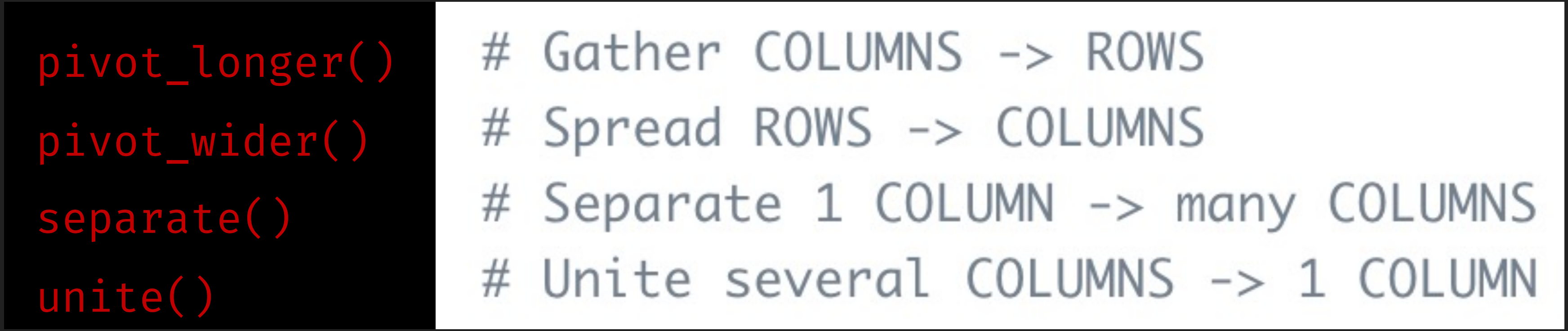
wide

id	x	y	z
1	a	c	e
2	b	d	f

long

id	key	val
1	x	a
2	x	b
1	y	c
2	y	d
1	z	e
2	z	f

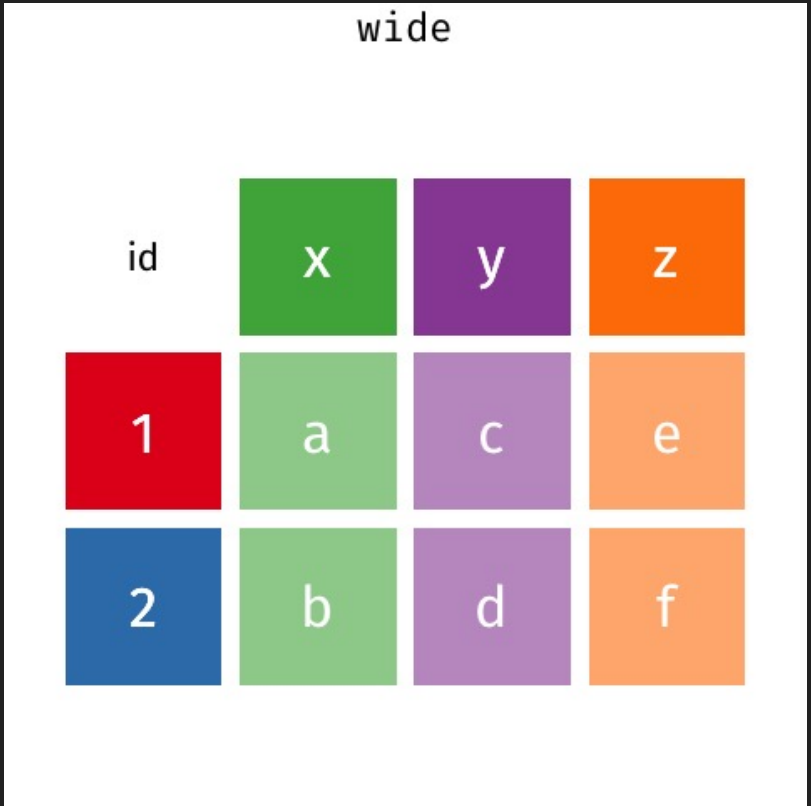
Part 2: Reshaping data w/ *tidyr*



```
pivot_longer()   # Gather COLUMNS -> ROWS
pivot_wider()    # Spread ROWS -> COLUMNS
separate()       # Separate 1 COLUMN -> many COLUMNS
unite()          # Unite several COLUMNS -> 1 COLUMN
```

Part 2: Reshaping data w/ *tidyr*

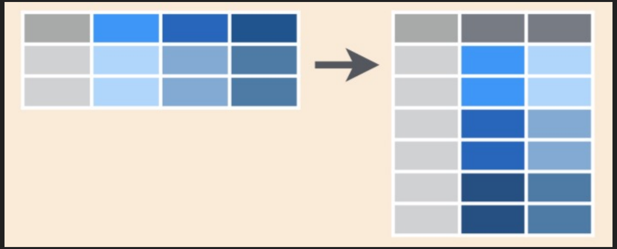
Tidy data



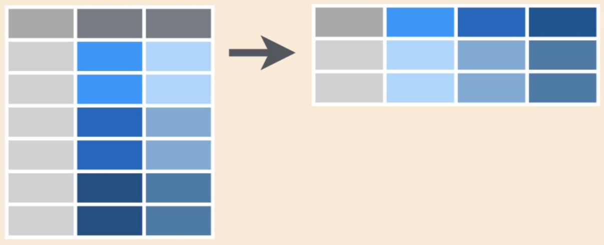
wide

id	x	y	z
1	a	c	e
2	b	d	f

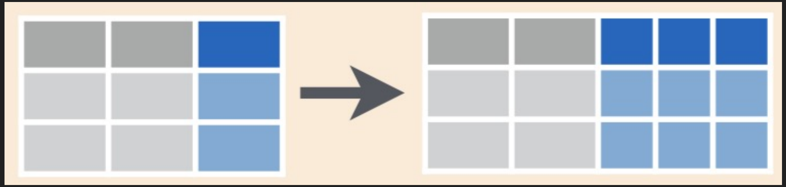
Part 2: Reshaping data w/ *tidyr*



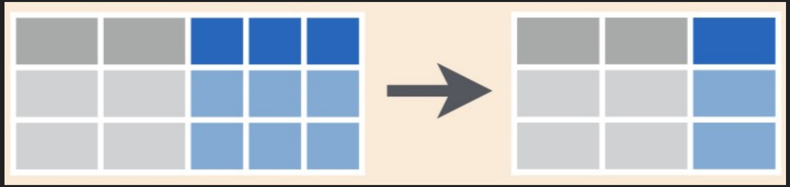
pivot_longer



pivot_wider



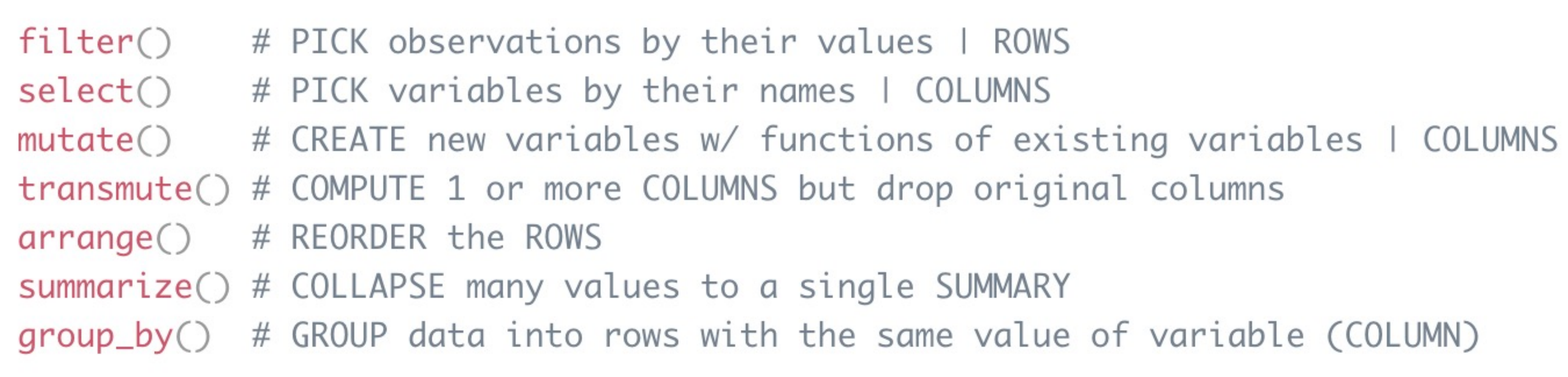
separate



unite

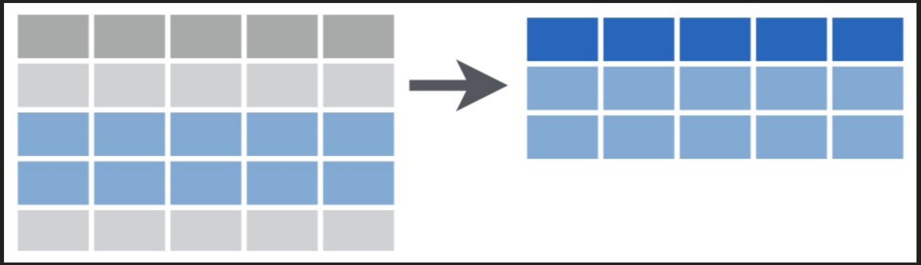
Back to RStudio

Part 3: Wrangling data w/ *dplyr*

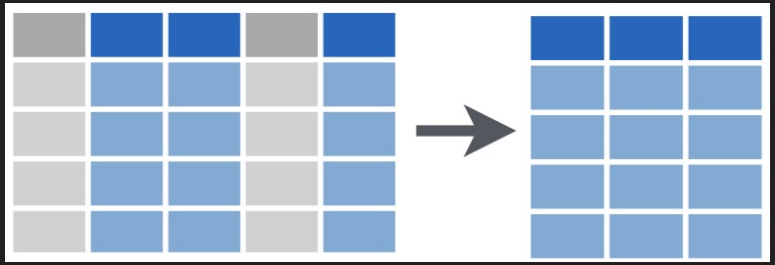


```
filter()    # PICK observations by their values | ROWS
select()    # PICK variables by their names | COLUMNS
mutate()    # CREATE new variables w/ functions of existing variables | COLUMNS
transmute() # COMPUTE 1 or more COLUMNS but drop original columns
arrange()   # REORDER the ROWS
summarize() # COLLAPSE many values to a single SUMMARY
group_by()  # GROUP data into rows with the same value of variable (COLUMN)
```

Part 3: Wrangling data w/ *dplyr*

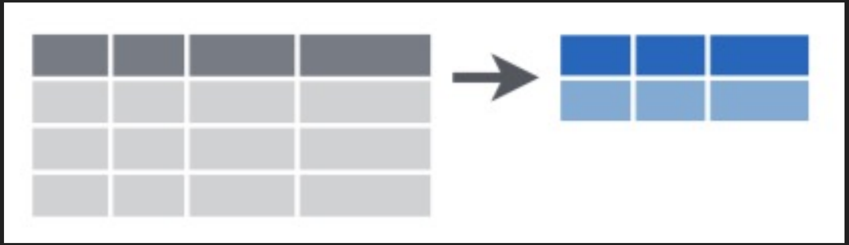


filter

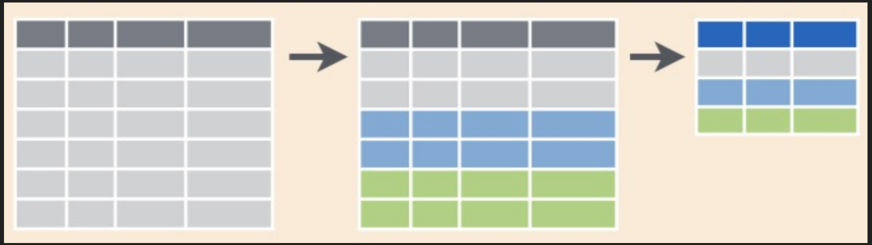


select

Part 3: Wrangling data w/ *dplyr*



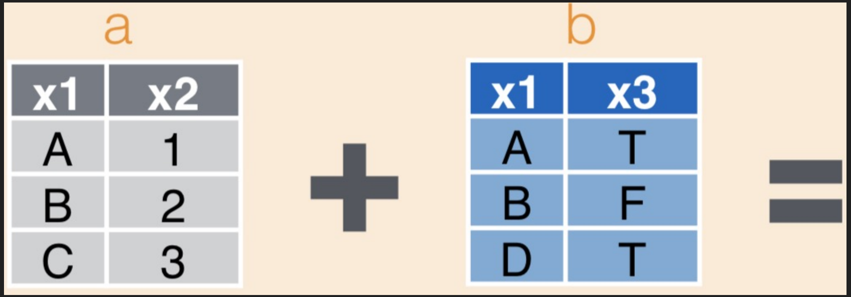
summarise



group_by

Part 3: Wrangling data w/ *dplyr*

Mutating joins



a

x1	x2
A	1
B	2
C	3

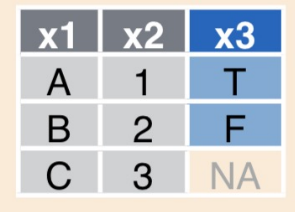
+

b

x1	x3
A	T
B	F
D	T

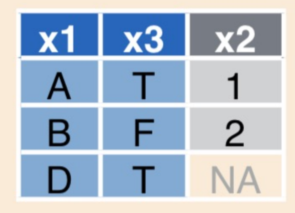
=

left_join()



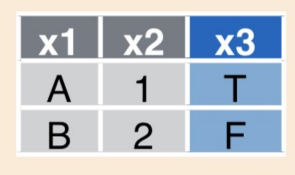
x1	x2	x3
A	1	T
B	2	F
C	3	NA

right_join()



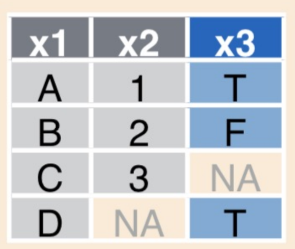
x1	x3	x2
A	T	1
B	F	2
D	T	NA

inner_join()



x1	x2	x3
A	1	T
B	2	F

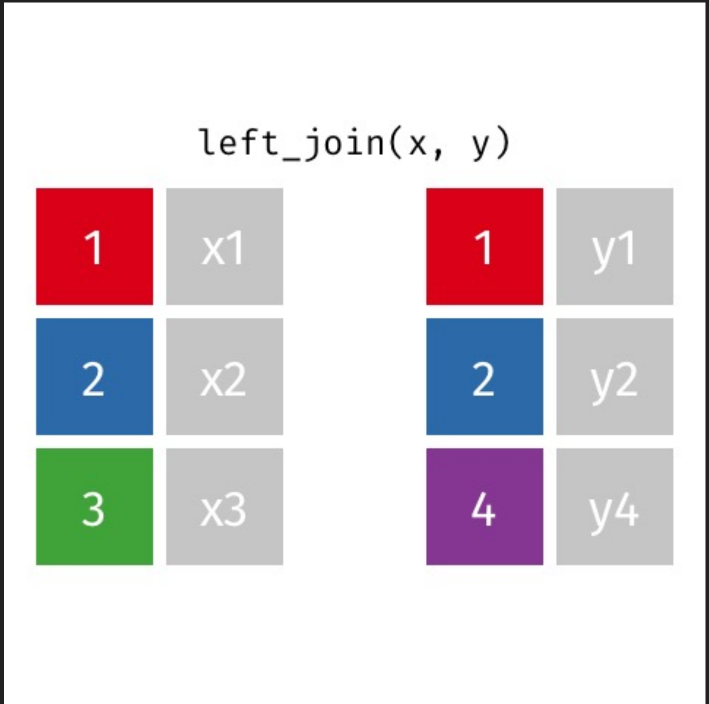
outer_join()



x1	x2	x3
A	1	T
B	2	F
C	3	NA
D	NA	T

Part 3: Wrangling data w/ *dplyr*

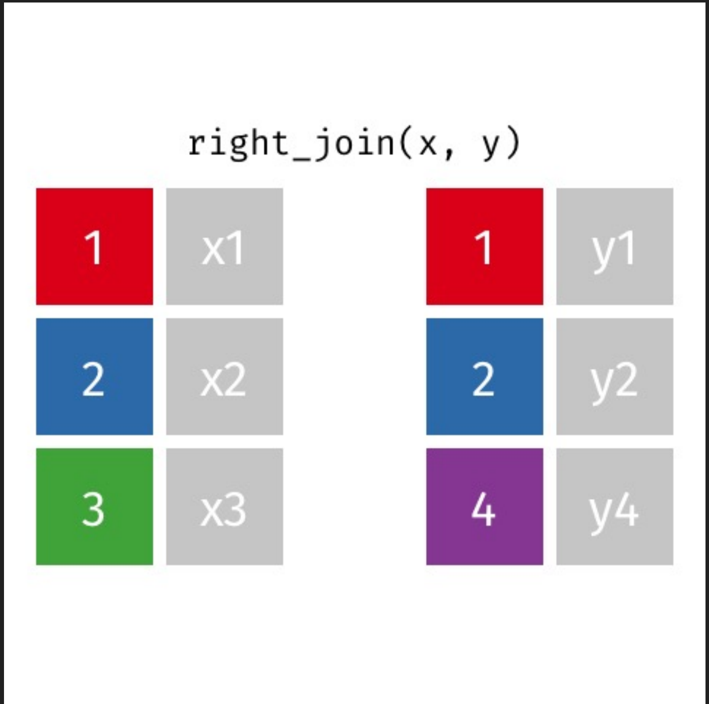
Mutating joins



gadenbuie/tidyexplain

Part 3: Wrangling data w/ *dplyr*

Mutating joins



```
right_join(x, y)
```

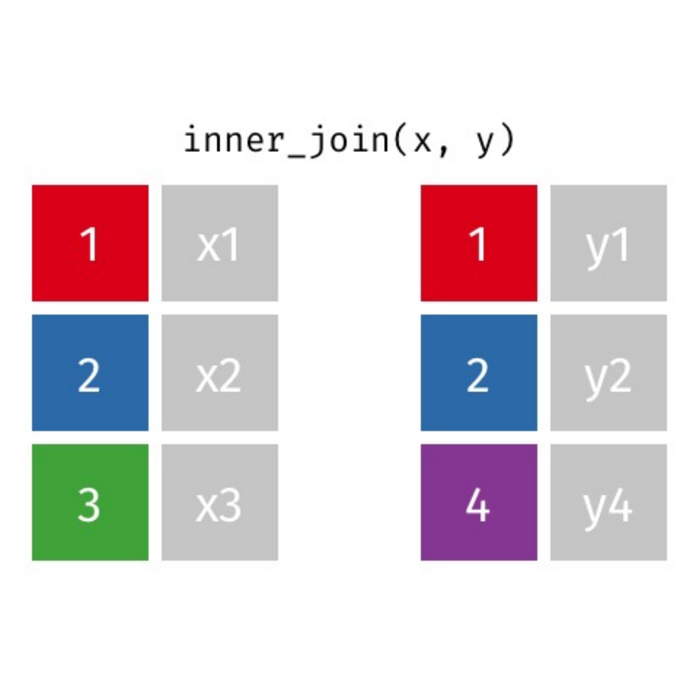
1	x1
2	x2
3	x3

1	y1
2	y2
4	y4

gadenbuie/tidyexplain

Part 3: Wrangling data w/ *dplyr*

Mutating joins



```
inner_join(x, y)
```

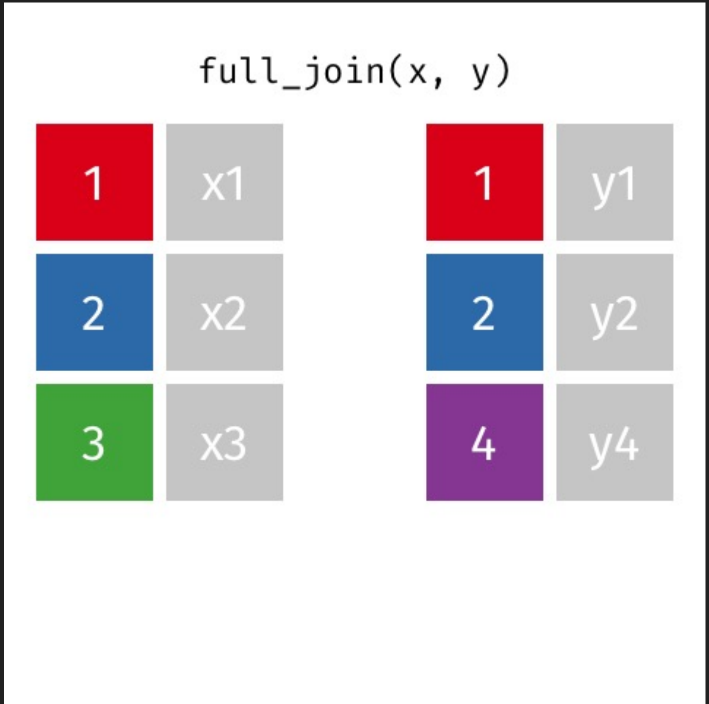
1	x1
2	x2
3	x3

1	y1
2	y2
4	y4

gadenbuie/tidyexplain

Part 3: Wrangling data w/ *dplyr*

Mutating joins



```
full_join(x, y)
```

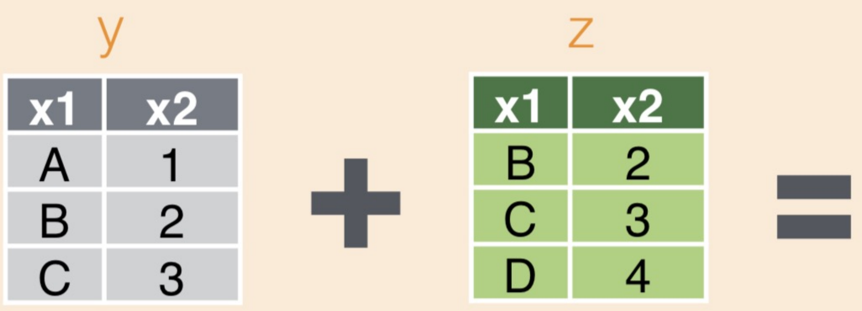
1	x1
2	x2
3	x3

1	y1
2	y2
4	y4

gadenbuie/tidyexplain

Part 3: Wrangling data w/ *dplyr*

Set operations



y

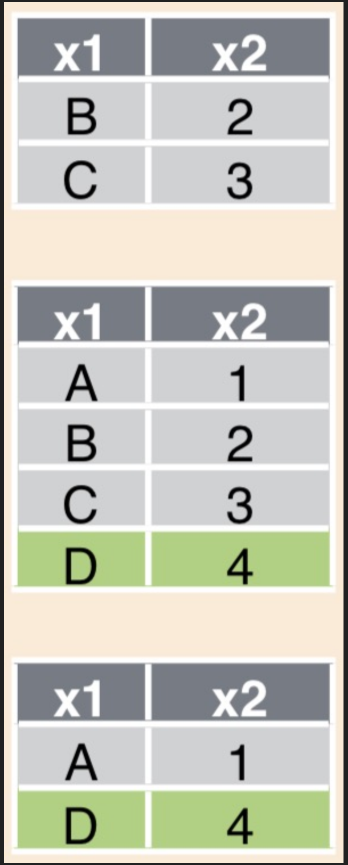
x1	x2
A	1
B	2
C	3

+

z

x1	x2
B	2
C	3
D	4

=



intersect()

x1	x2
B	2
C	3

union()

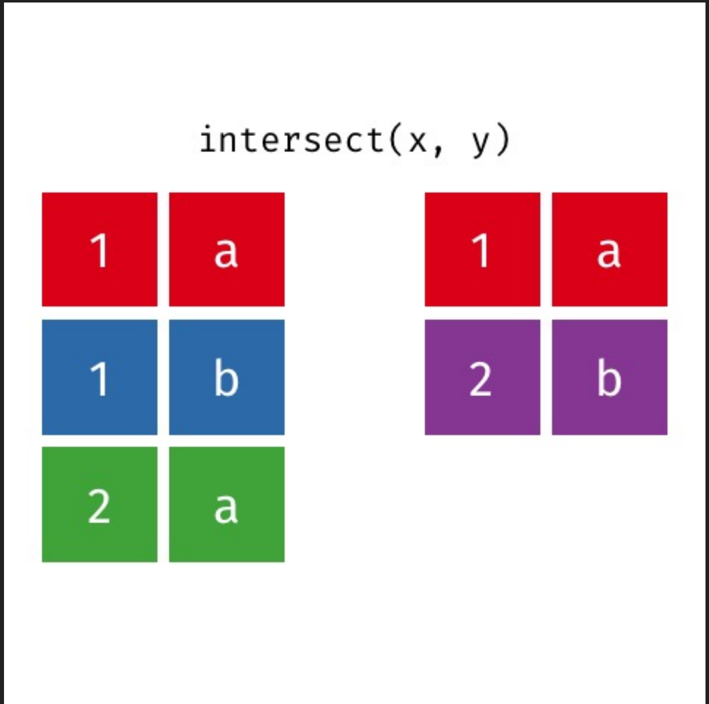
x1	x2
A	1
B	2
C	3
D	4

setdiff()

x1	x2
A	1
D	4

Part 3: Wrangling data w/ *dplyr*

Set operations



```
intersect(x, y)
```

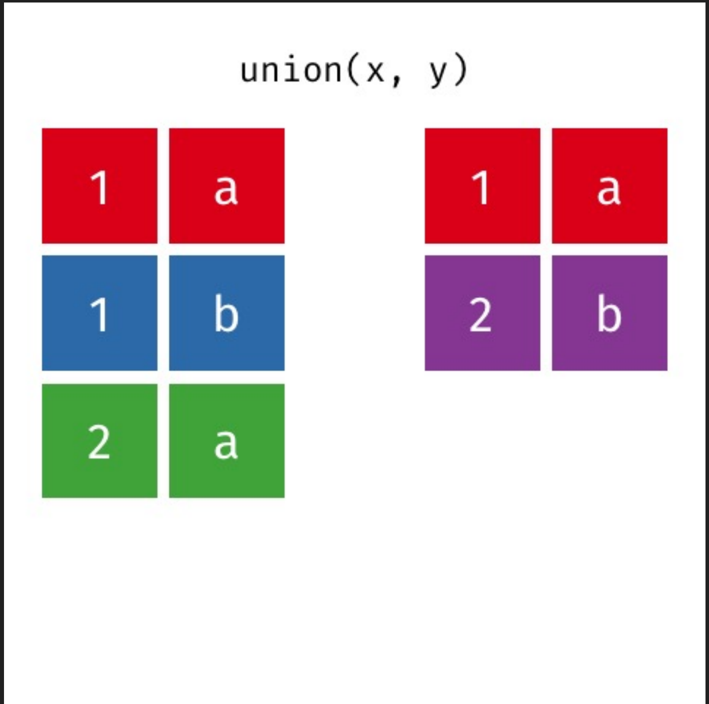
1	a
1	b
2	a

1	a
2	b

gadenbuie/tidyexplain

Part 3: Wrangling data w/ *dplyr*

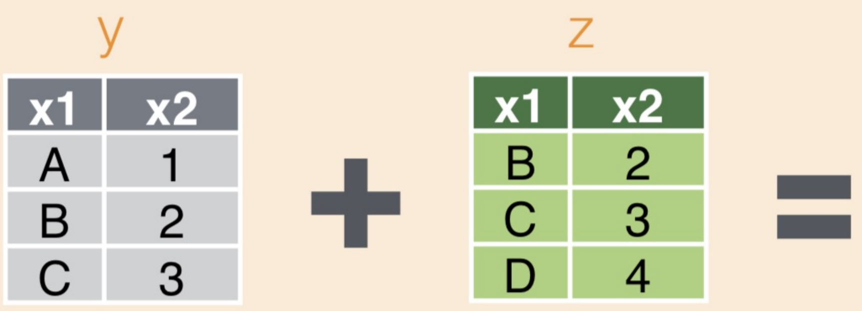
Set operations



gadenbuie/tidyexplain

Part 3: Wrangling data w/ *dplyr*

Binding



y

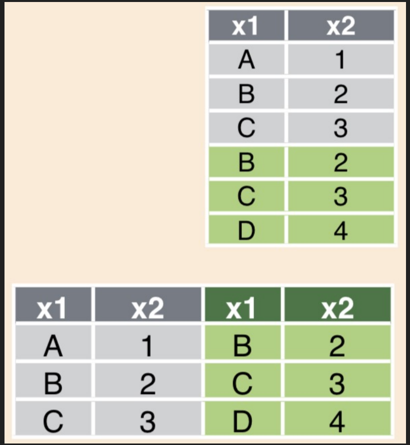
x1	x2
A	1
B	2
C	3

+

z

x1	x2
B	2
C	3
D	4

=



bind_rows()

x1	x2
A	1
B	2
C	3
B	2
C	3
D	4

bind_cols()

x1	x2	x1	x2
A	1	B	2
B	2	C	3
C	3	D	4

Back to RStudio

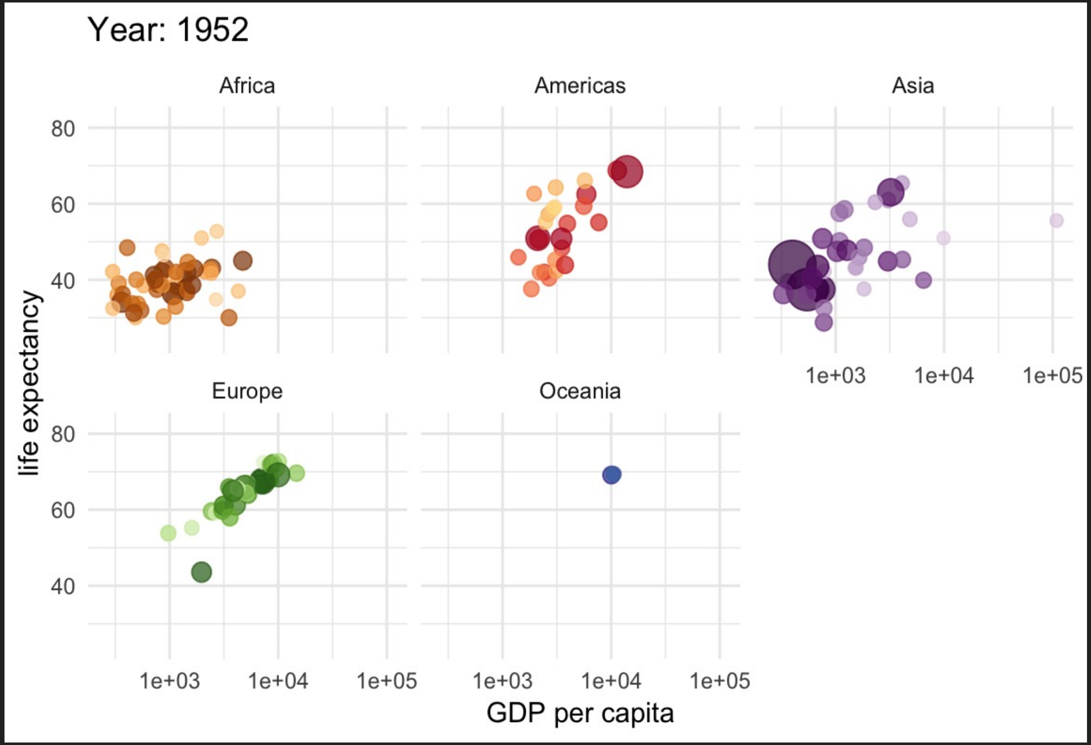
Part 4: Visualizing tidy data w/ ggplot2

Geometry of graphics

- **data**: Must be a data frame
- **aes**thetics: How your data are represented visually
  - x, y, color, size, shape, etc.
- **geom**etry: Geometries of plotted objects
  - points, lines, boxplot, polygons, etc.
- and *other customizations*

Part 4: Visualizing tidy data w/ ggplot2

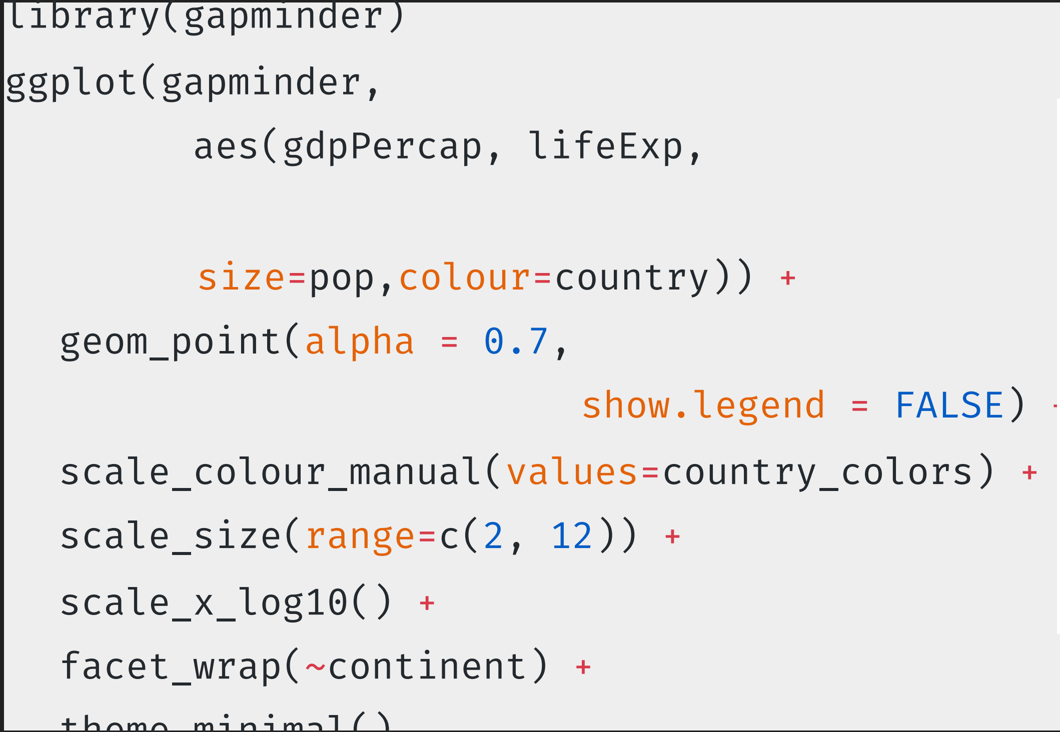
gganimate: aha!



thomasp85/
gganimate

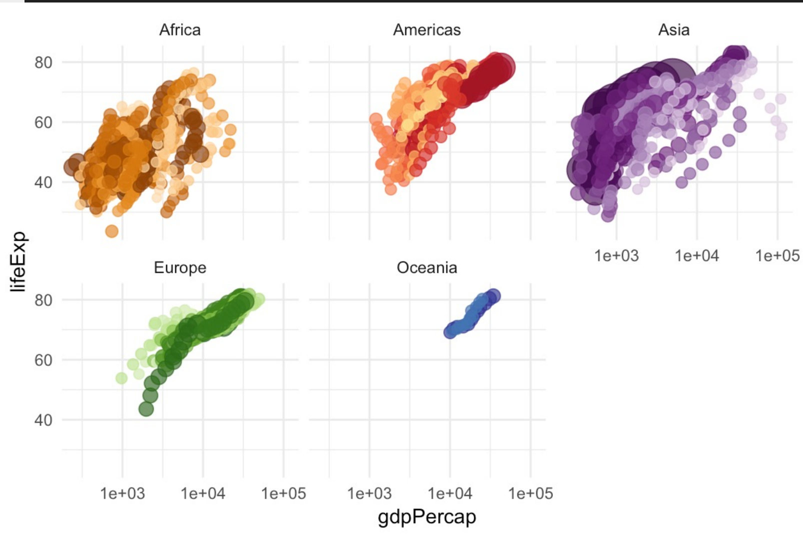
Part 4: Visualizing tidy data w/ ggplot2

gapminder: static plot



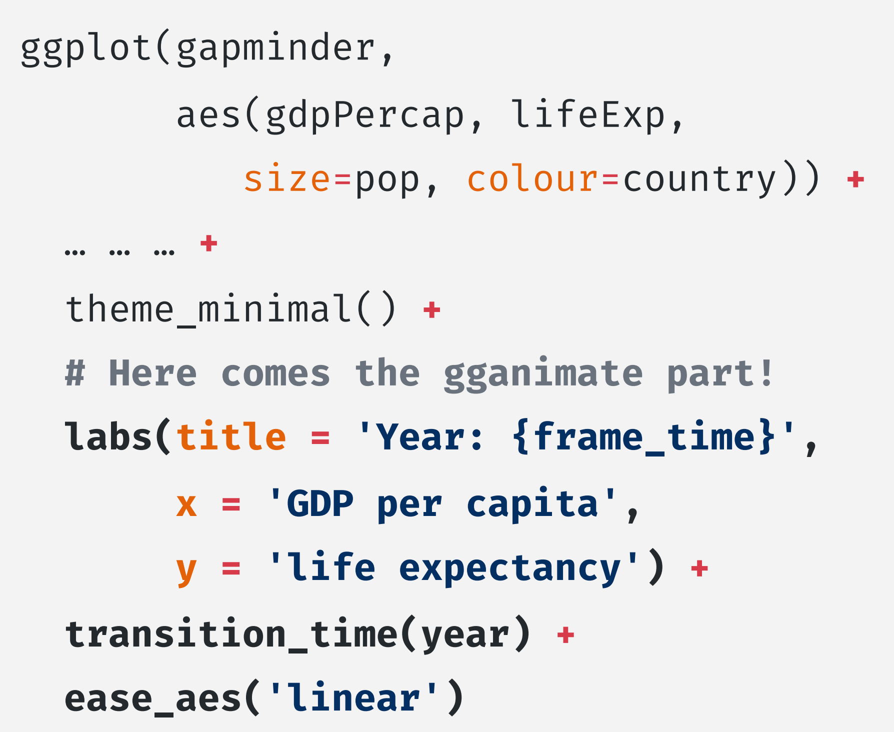
```
library(gapminder)
ggplot(gapminder,
        aes(gdpPercap, lifeExp,

        size=pop,colour=country)) +
  geom_point(alpha = 0.7,
                          show.legend = FALSE) +
  scale_colour_manual(values=country_colors) +
  scale_size(range=c(2, 12)) +
  scale_x_log10() +
  facet_wrap(~continent) +
  theme_minimal()
```

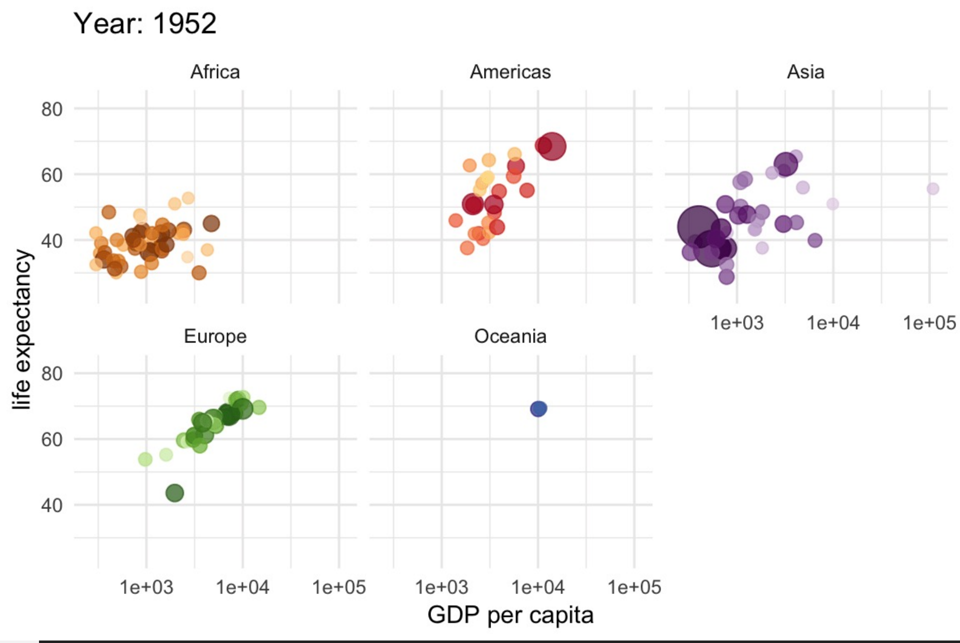


Part 4: Visualizing tidy data w/ ggplot2

gapminder: dynamic plot



```
ggplot(gapminder,
       aes(gdpPercap, lifeExp,
          size=pop, colour=country)) +
  … … … +
  theme_minimal() +
  # Here comes the gganimate part!
  labs(title = 'Year: {frame_time}',
       x = 'GDP per capita',
       y = 'life expectancy') +
  transition_time(year) +
  ease_aes('linear')
```



Part 5: Export & Wrap-up

ggsave — Save your plots

write_delim — Save your data

Back to RStudio

Tidyverse Recap

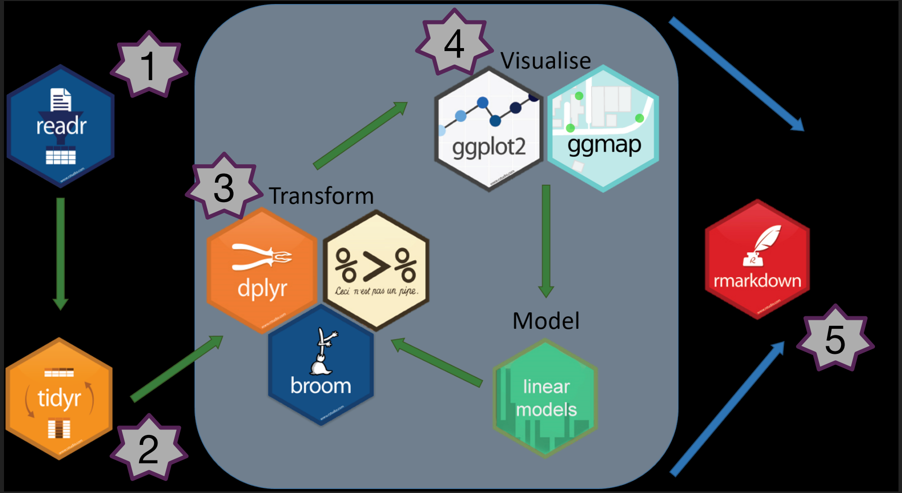
P1: Getting Started w/ readr ✓

P2: Reshaping data w/ tidyr ✓

P3: Data wrangling w/ dplyr ✓

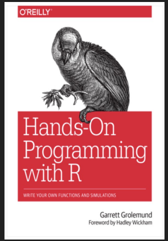
P4: DataViz w/ ggplot ✓

P5: Wrap-up w/ RMarkdown ✓

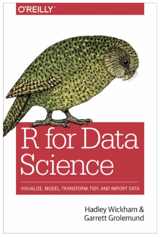


Resources

- Hands-On Programming with R: *Grolemund* #HOPR
  - https://rstudio-education.github.io/hopr/

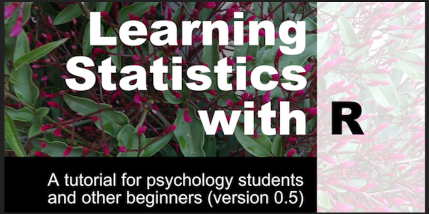

O'REILLY
Hands-On Programming with R
WRITE YOUR OWN FUNCTIONS AND SIMULATIONS
Garrett Grolemund
Foreword by Hadley Wickham

- R for Data Science: *Wickham & Grolemund* #R4DS
  - https://r4ds.had.co.nz


O'REILLY
R for Data Science
VISUALIZE, MODEL, TRANSFORM, TIDY, AND IMPORT DATA
Hadley Wickham & Garrett Grolemund

- R Programming for Data Science: Peng
  - https://leanpub.com/rprogramming

- Learning Statistics with R: Navarro
  - https://learningstatisticswithr.com/book


Learning Statistics with R
A tutorial for psychology students and other beginners (version 0.5)

More Resources

- **R-Ladies EL material:** github.com/rladies-eastlansing
- **#TidyTuesday** challenges
- **gganimate:** thomasp85/gganimate
- **tidyexplain:** gadenbuie/tidyexplain
- **Distill (theme for RMarkdown)**: https://rstudio.github.io/distill
- Google & https://stackoverflow.com/ are your best friends!

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