Introduction to R for Biologists

Tidyverse ecosystem & making data tidy with tidyr

Developed by Rachael Cox

*Several slides have been contributed by or modified from slides by Dr. Claus Wilke

Day 1 Outline

1. How to get set up using R
2. How and why to use RStudio & R Markdown (.Rmd)
3. Basics of programming
   - Data types
   - Functions
   - Troubleshooting
4. Intro to the Tidyverse
   - Tidy vs untidy data
   - Tidyverse-specific functions

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1. How to get set up using R
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   - Tidy vs untidy data
   - Tidyverse-specific functions

Especially in biology, we work with many different types of data which we collect, analyze, and communicate

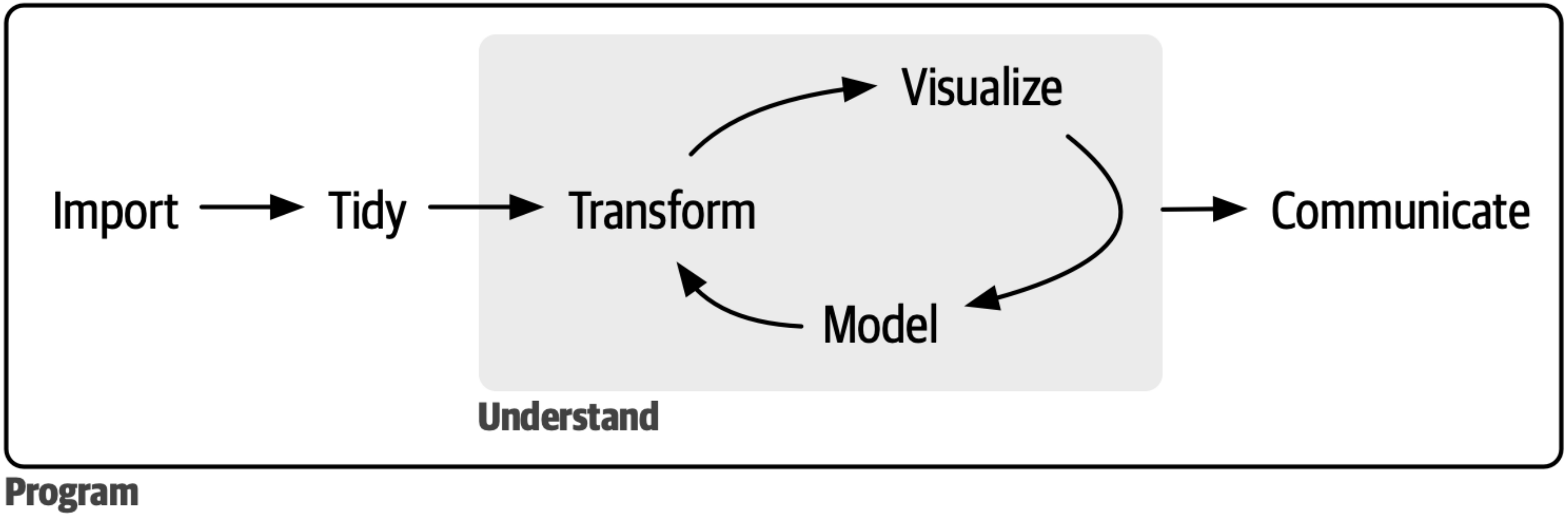


Figure 1, R for Data Science https://r4ds.hadley.nz/

In R, the collection of programs that make up the Tidyverse make this process easier and more reproducible

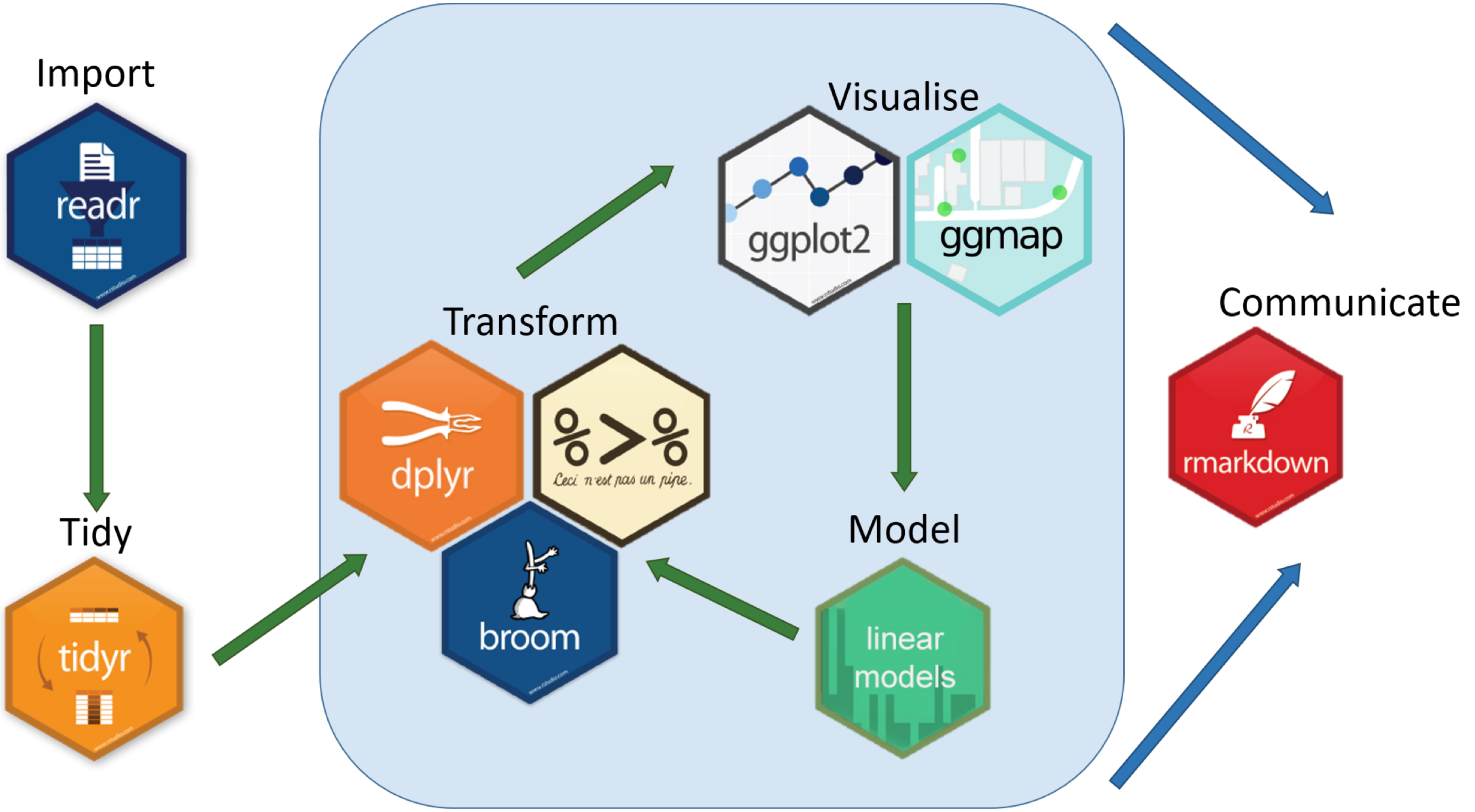
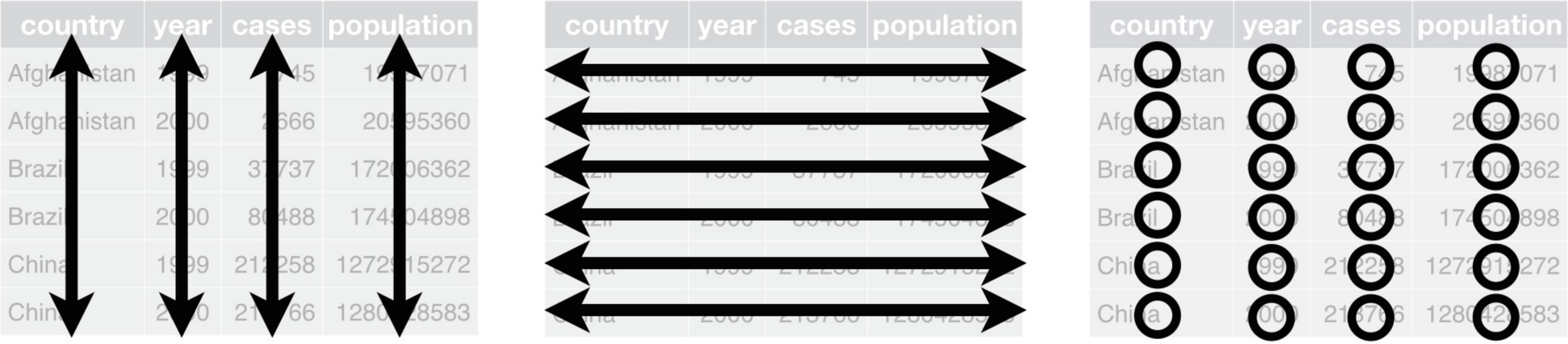


Image from: https://teachdatascience.com/tidyverse/

Tidy data

“Tidy datasets are all alike but every messy dataset is messy in its own way” — Hadley Wickham

Tidy data



country	year	cases	population
Afghanistan	1999	745	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174504898
China	1999	212258	1272915272
China	2000	213766	1280428583

Three rules:

1. Each variable has its own column
2. Each observation has its own row
3. Each value has its own cell

Example: Contingency table

	survived	died
drug	15	3
placebo	4	12

not tidy

Example: Contingency table

	survived	died
drug	15	3
placebo	4	12

← Y variable, outcome

not tidy

↑

X variable, treatment

tidy

X treatment	Y outcome	count
drug	survived	15
drug	died	3
placebo	survived	4
placebo	died	12

Example: Contingency table, extended

	survived	died
drug	15	3
placebo	4	12

not tidy

tidy

patient	treatment	outcome
1	drug	survived
2	drug	died
3	drug	survived
4	placebo	died
	⋮	

`tidyr` library provides functions for transforming tables

	survived	died
drug	15	3
placebo	4	12

`pivot_longer()`

patient	treatment	outcome
1	drug	survived
2	drug	died
3	drug	survived
4	placebo	died
	⋮	

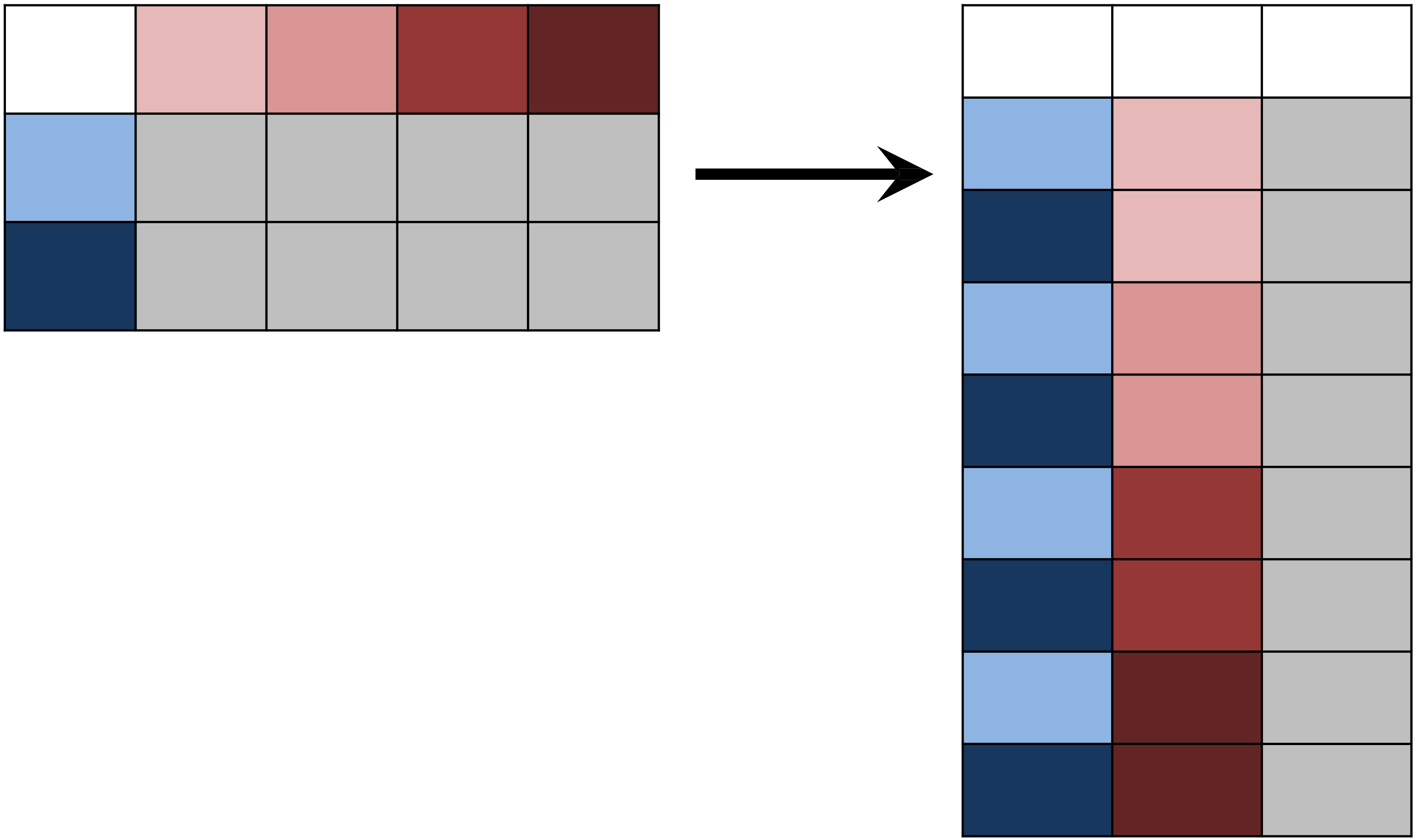
`pivot_wider()`

Making data sets longer or wider

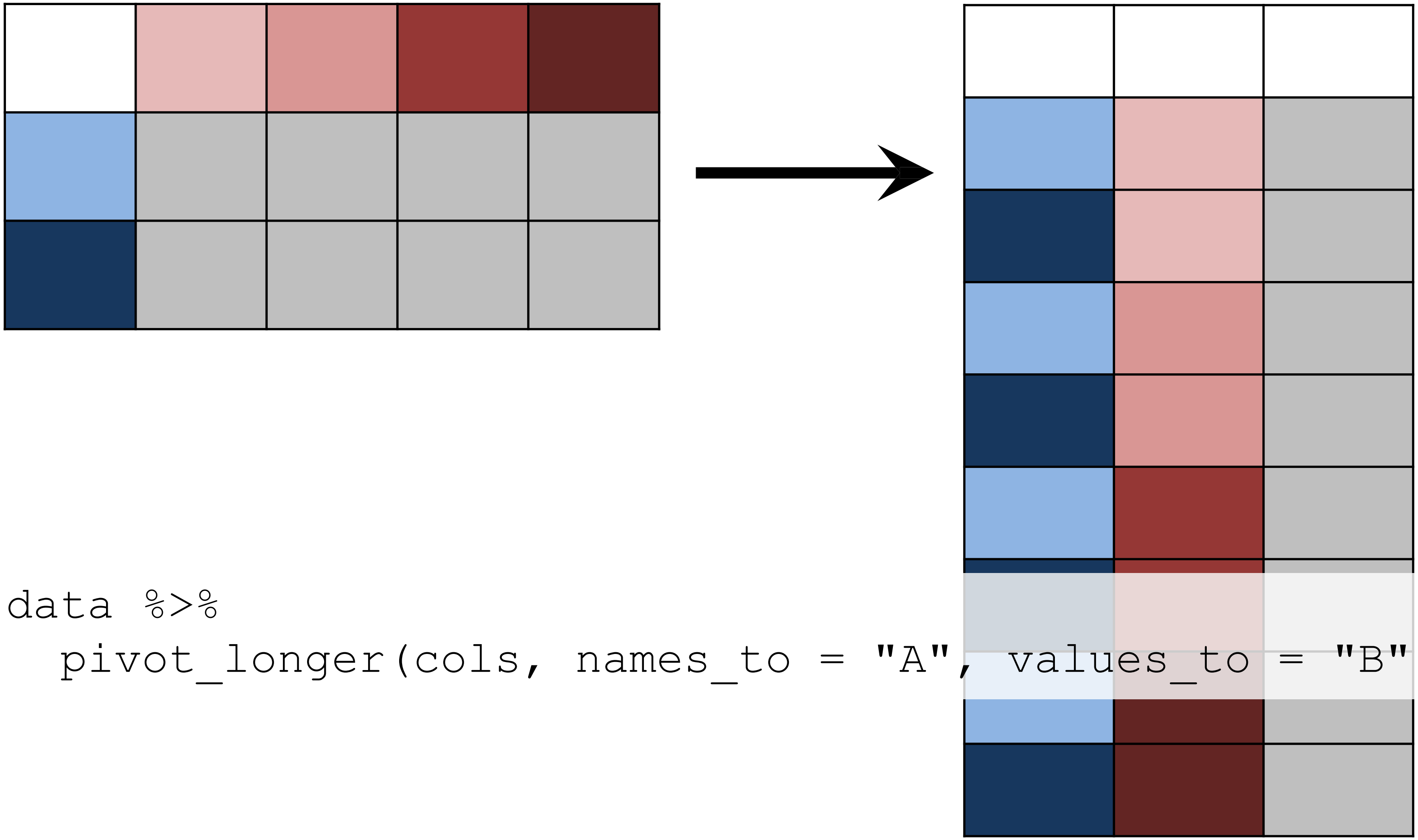
We'll be discussing two functions:

- `pivot_longer()` — make a wide table long
- `pivot_wider()` — make a long table wide

pivot_longer()

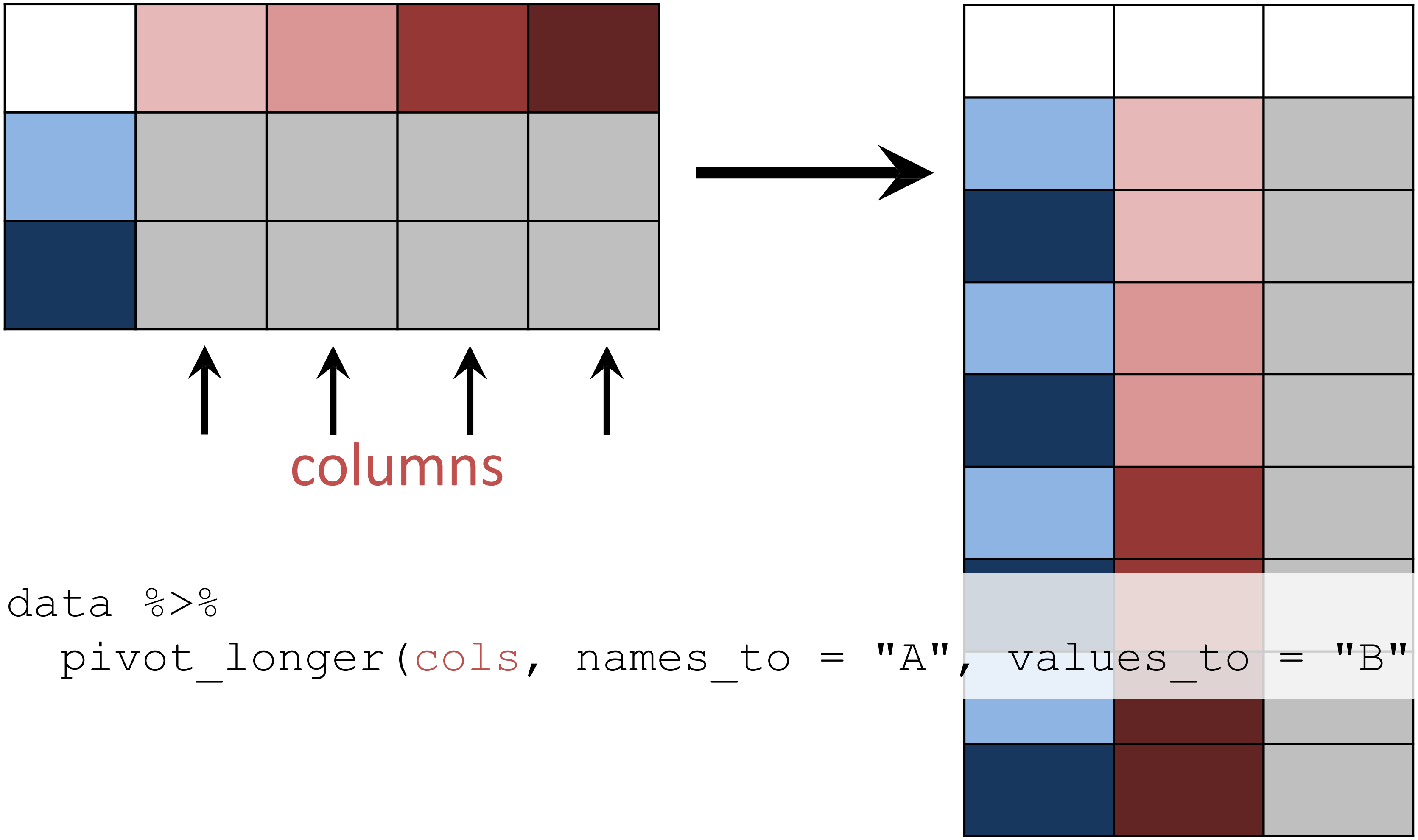


pivot_longer()



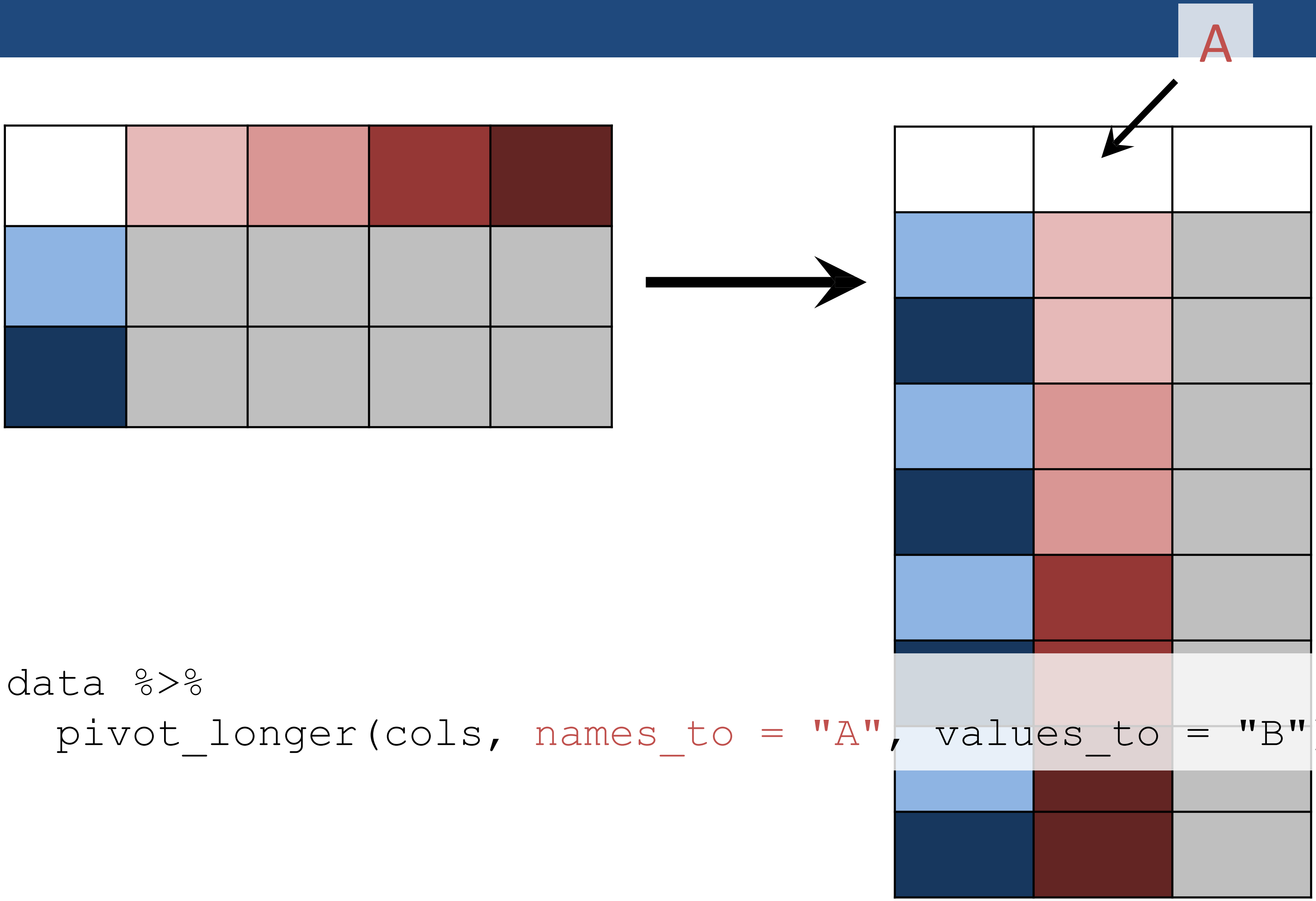
```
data %>%
  pivot_longer(cols, names_to = "A", values_to = "B")
```

pivot_longer()



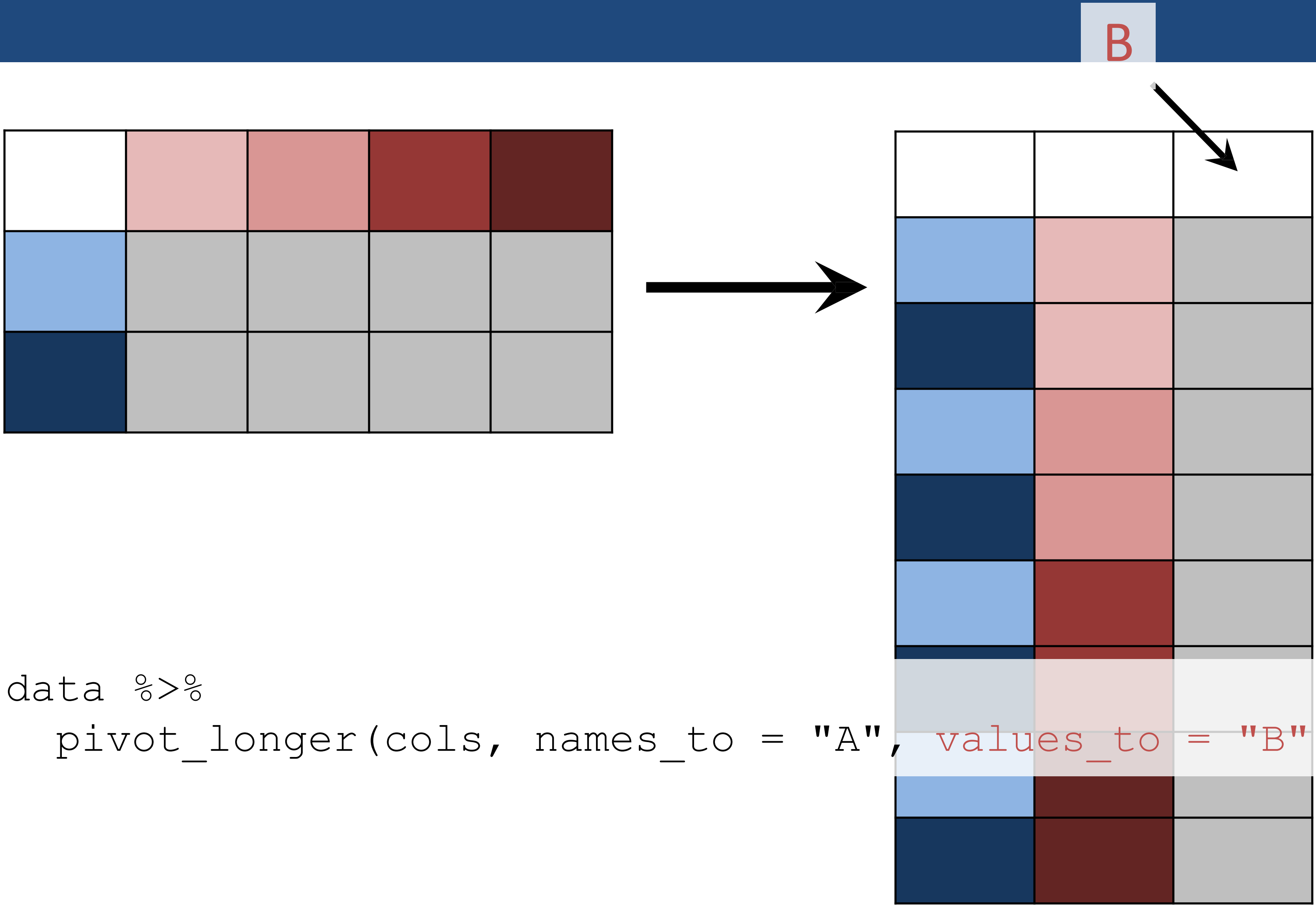
```
data %>%
  pivot_longer(cols, names_to = "A", values_to = "B")
```

pivot_longer()



```
data %>%
  pivot_longer(cols, names_to = "A", values_to = "B")
```

pivot_longer()



```
data %>%
  pivot_longer(cols, names_to = "A", values_to = "B")
```

Example: Untidy dataset

```
> head(sitka_wide)
  tree treat t152 t174 t201 t227 t258
1    1 ozone 4.51 4.98 5.41 5.90 6.15
2    2 ozone 4.24 4.20 4.68 4.92 4.96
3    3 ozone 3.98 4.36 4.79 4.99 5.03
4    4 ozone 4.36 4.77 5.10 5.30 5.36
5    5 ozone 4.34 4.95 5.42 5.97 6.28
6    6 ozone 4.59 5.08 5.36 5.76 6.00
```

Is this data tidy? Why or why not?

Example: Tidying dataset using pivot_longer()

```
> head(sitka_wide)
  tree treat t152 t174 t201 t227 t258
1    1 ozone 4.51 4.98 5.41 5.90 6.15
2    2 ozone 4.24 4.20 4.68 4.92 4.96
3    3 ozone 3.98 4.36 4.79 4.99 5.03
4    4 ozone 4.36 4.77 5.10 5.30 5.36
5    5 ozone 4.34 4.95 5.42 5.97 6.28
6    6 ozone 4.59 5.08 5.36 5.76 6.00
```

Data Frame object

```
sitka_wide %>%
  pivot_longer(
    t152:t258, names_to = "time", values_to = "size”
  )
```

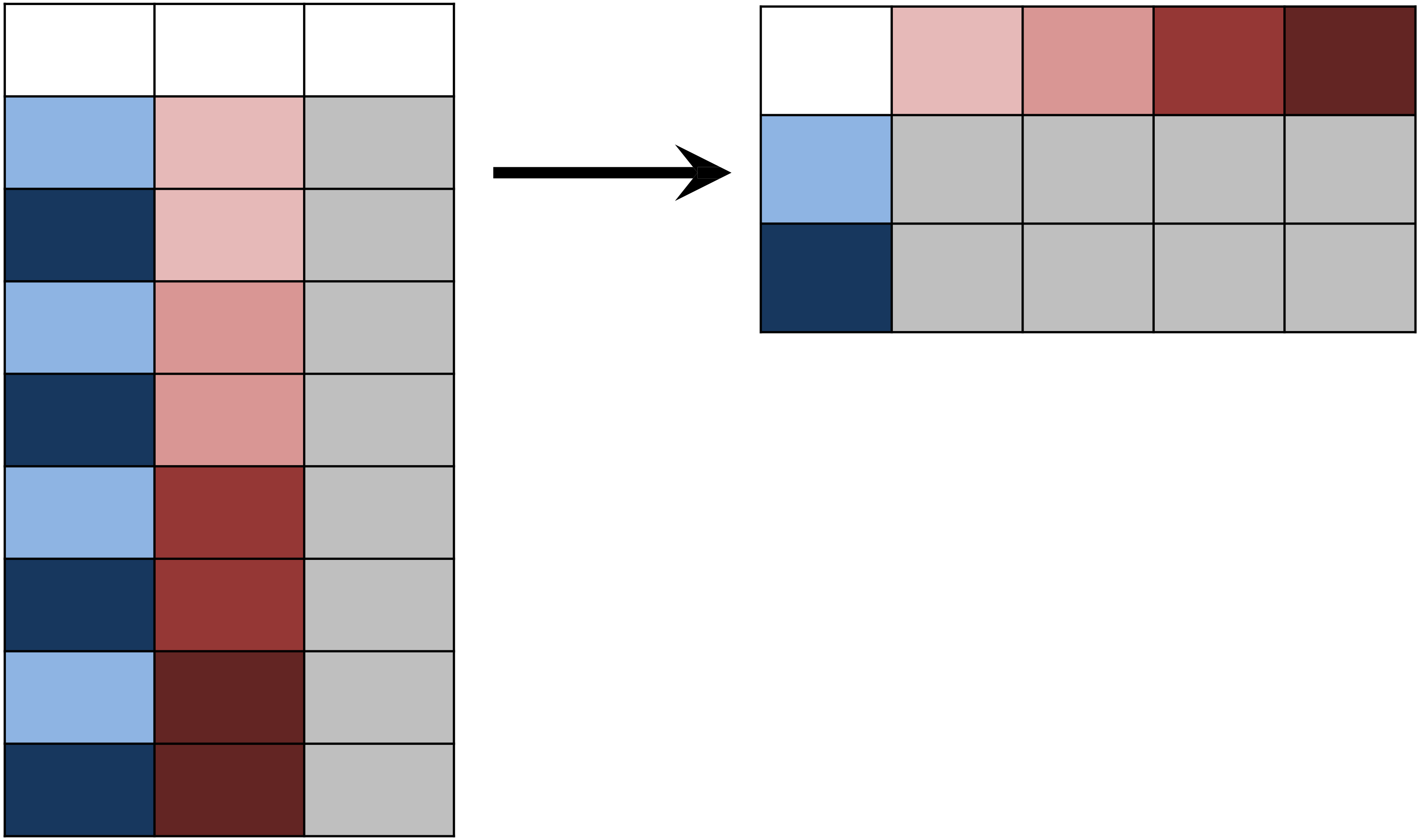
Pipe command (being ”sent to”)

`pivot_longer()` function

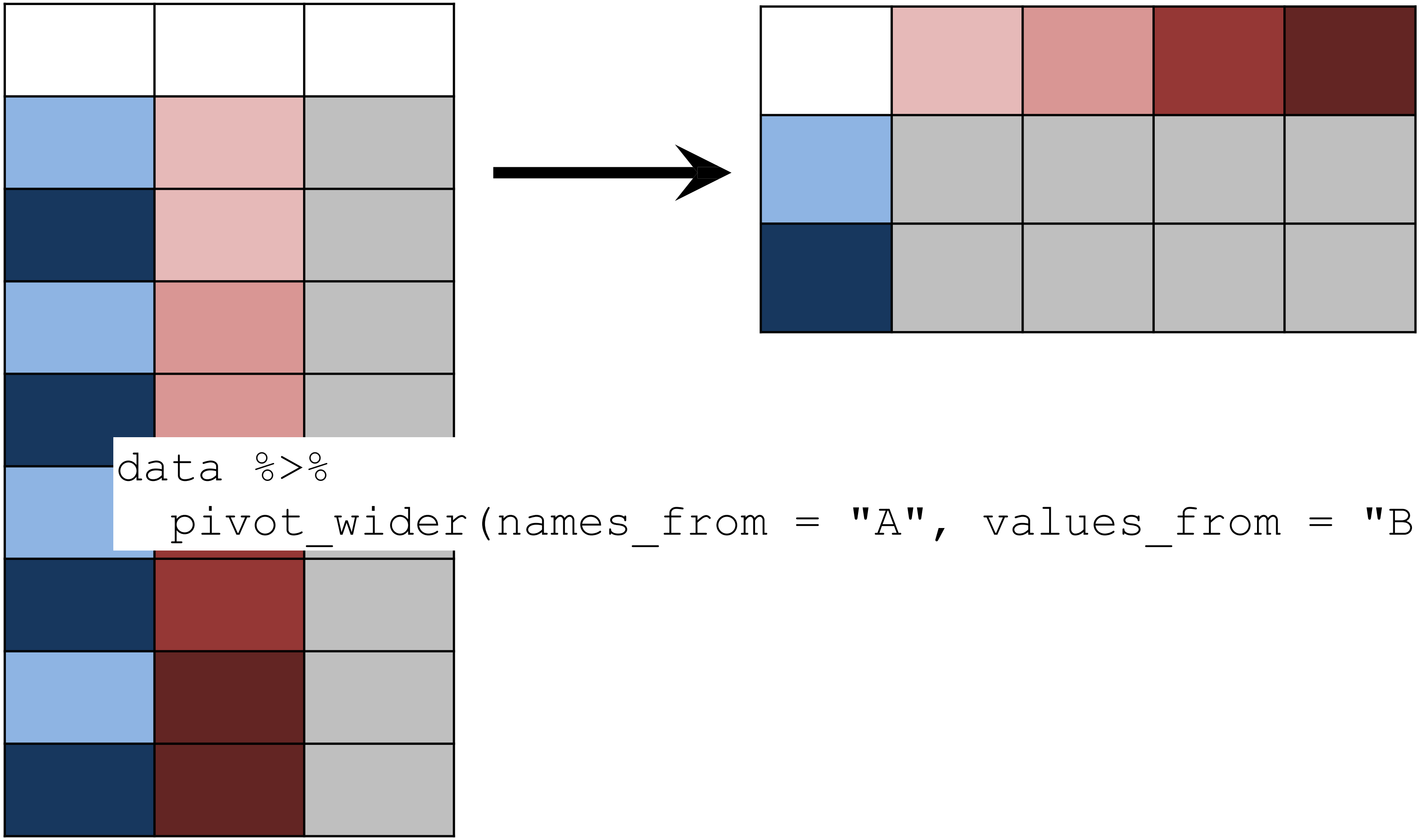
Example: Tidying dataset using pivot_longer()

```
> sitka_wide %>%
  pivot_longer(
    t152:t258, names_to = "time", values_to = "size”
  )
# A tibble: 395 x 4
    tree treat time    size
   <int> <fct> <chr> <dbl>
 1     1 ozone t152   4.51
 2     1 ozone t174   4.98
 3     1 ozone t201   5.41
 4     1 ozone t227   5.9
 5     1 ozone t258   6.15
 6     2 ozone t152   4.24
 7     2 ozone t174   4.2
 8     2 ozone t201   4.68
 9     2 ozone t227   4.92
10     2 ozone t258   4.96
# … with 385 more rows
```

pivot_wider()

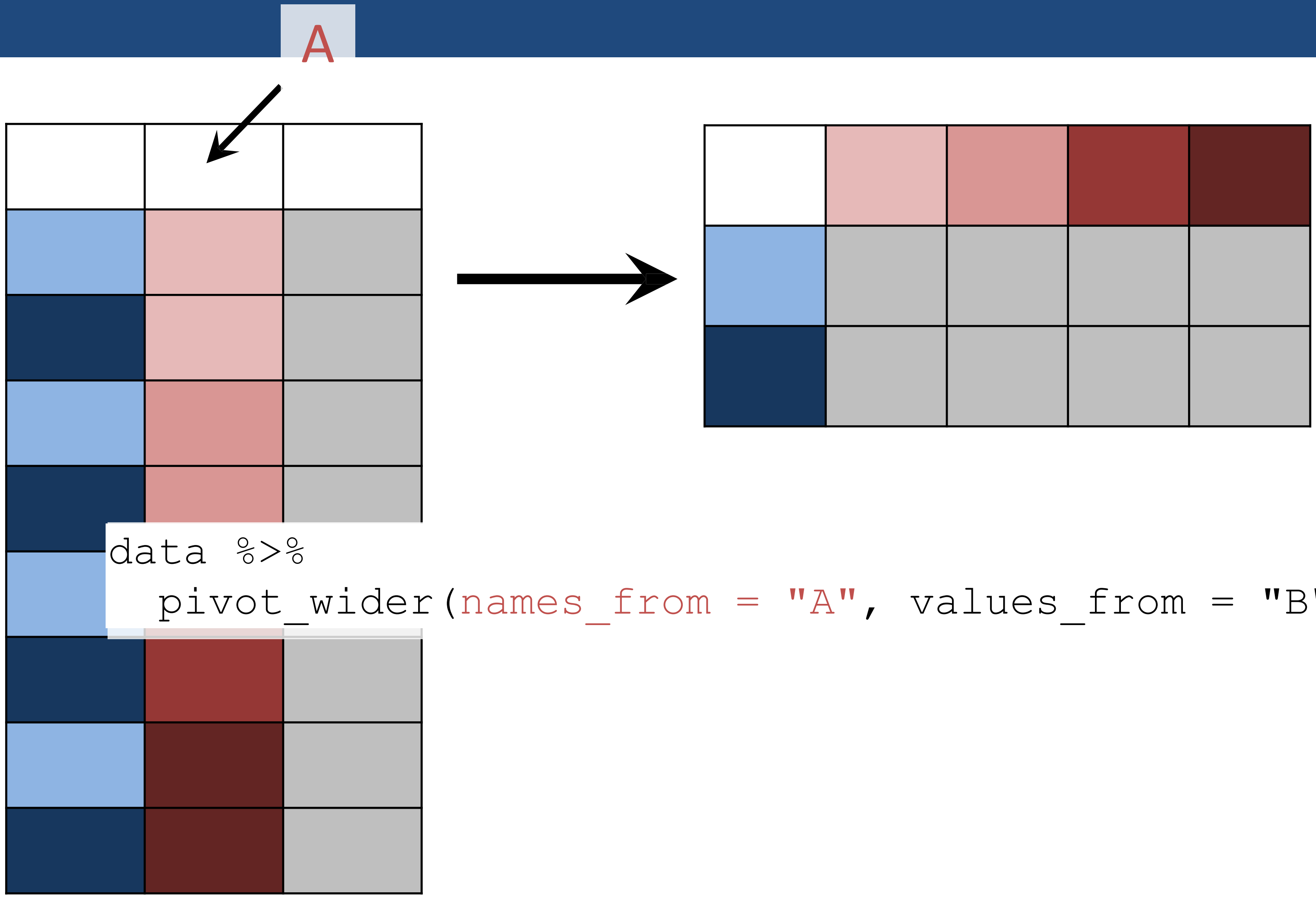


pivot_wider()



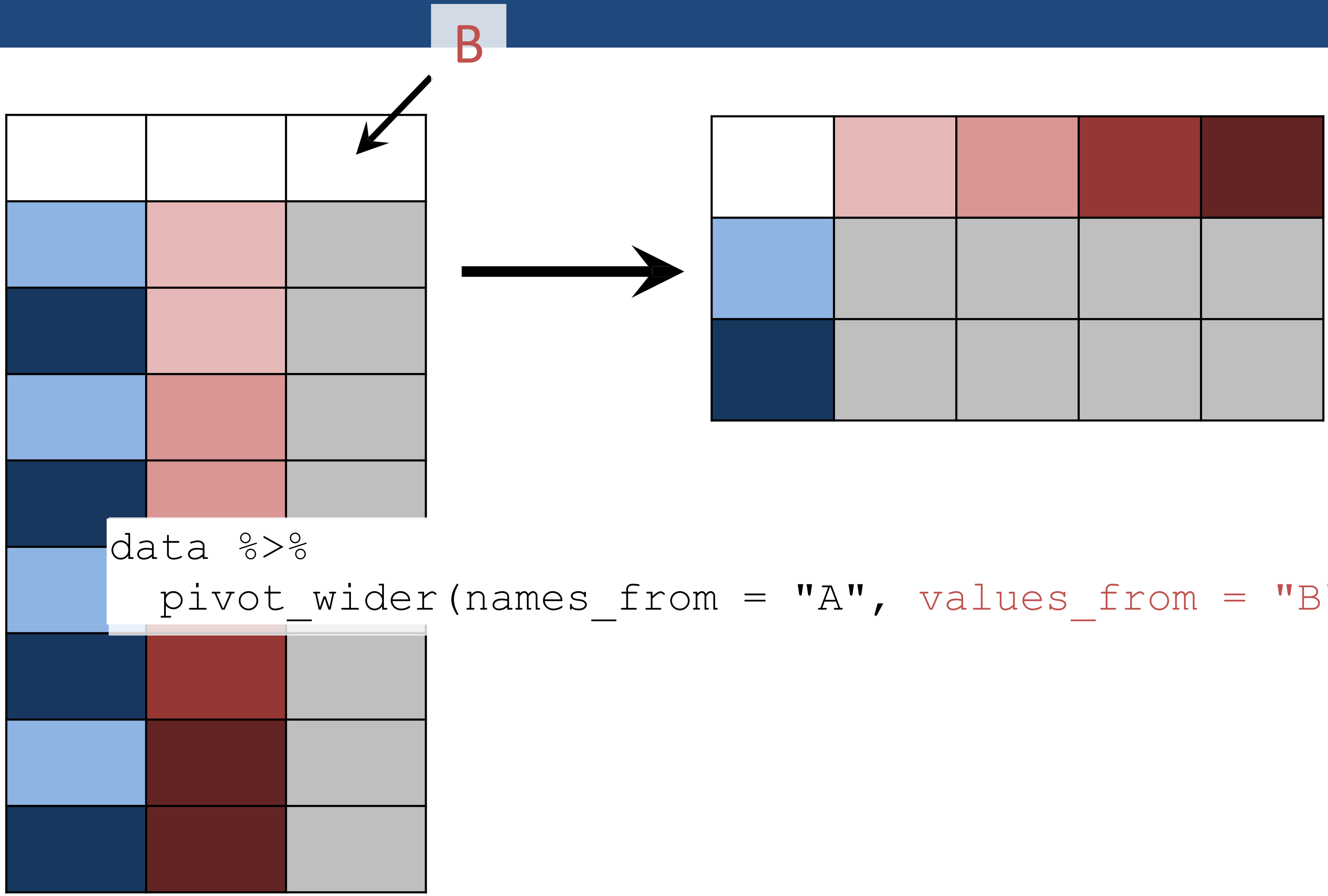
```
data %>%
  pivot_wider(names_from = "A", values_from = "B")
```

pivot_wider()



```
data %>%
  pivot_wider(names_from = "A", values_from = "B")
```

pivot_wider()



```
data %>%
  pivot_wider(names_from = "A", values_from = "B")
```

Example: Let’s turn the sitka data into a wide table

```
> head(sitka)
  size Time tree treat
1 4.51  152    1 ozone
2 4.98  174    1 ozone
3 5.41  201    1 ozone
4 5.90  227    1 ozone
5 6.15  258    1 ozone
6 4.24  152    2 ozone
```

```
sitka %>%
  pivot_wider(names_from="Time", values_from="size")
```

Example: Let’s turn the Sitka data into a wide table

```
> sitka %>%
  pivot_wider(names_from="Time", values_from="size")

# A tibble: 79 x 7
    tree treat `152` `174` `201` `227` `258`
   <int> <fct> <dbl> <dbl> <dbl> <dbl> <dbl>
 1     1 ozone  4.51  4.98  5.41  5.9   6.15
 2     2 ozone  4.24  4.2   4.68  4.92  4.96
 3     3 ozone  3.98  4.36  4.79  4.99  5.03
 4     4 ozone  4.36  4.77  5.1   5.3   5.36
 5     5 ozone  4.34  4.95  5.42  5.97  6.28
 6     6 ozone  4.59  5.08  5.36  5.76  6
 7     7 ozone  4.41  4.56  4.95  5.23  5.33
 8     8 ozone  4.24  4.64  4.95  5.38  5.48
 9     9 ozone  4.82  5.17  5.76  6.12  6.24
10    10 ozone  3.84  4.17  4.67  4.67  4.8
# … with 69 more rows
```

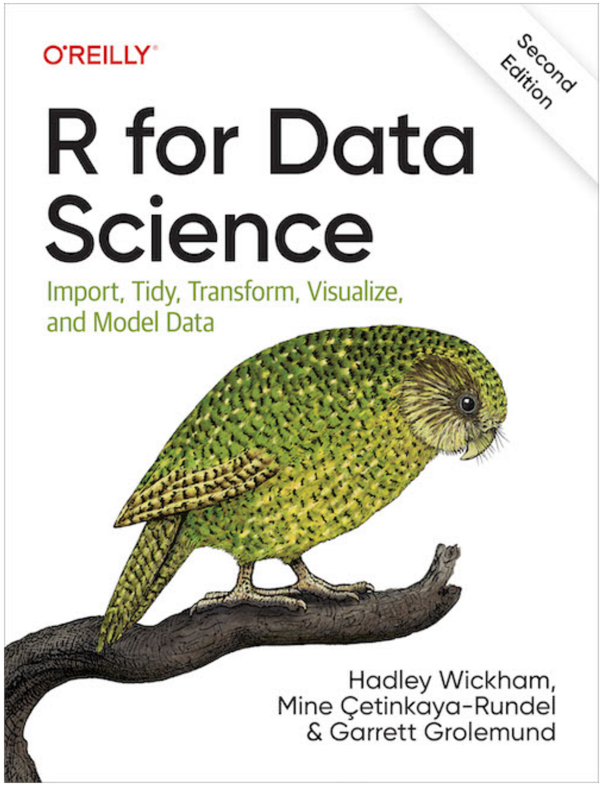
Working with tidy data in R: tidyverse

Fundamental actions on data tables:

- make new columns — `mutate()`
- combine tables, adding columns — `left_join()`
- combine tables, adding rows — `bind_rows()`
- choose rows — `filter()`
- choose columns — `select()`
- arrange rows — `arrange()`
- calculate summary statistics — `summarize()`
- work on groups of data — `group_by()`

Resources for more information on tidyverse and data sciences in R

Highly recommend “R for Data Science” (2e)


O'REILLY
Second Edition
R for Data Science
Import, Tidy, Transform, Visualize, and Model Data
Hadley Wickham, Mine Çetinkaya-Rundel & Garrett Grolemund

https://r4ds.hadley.nz/

Quick guides for tidyverse functions:
https://posit.co/resources/cheatsheets/