ISA 401: Business Intelligence & Data Visualization

09: Tidy Data in R

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Automated Scheduler for Office Hours

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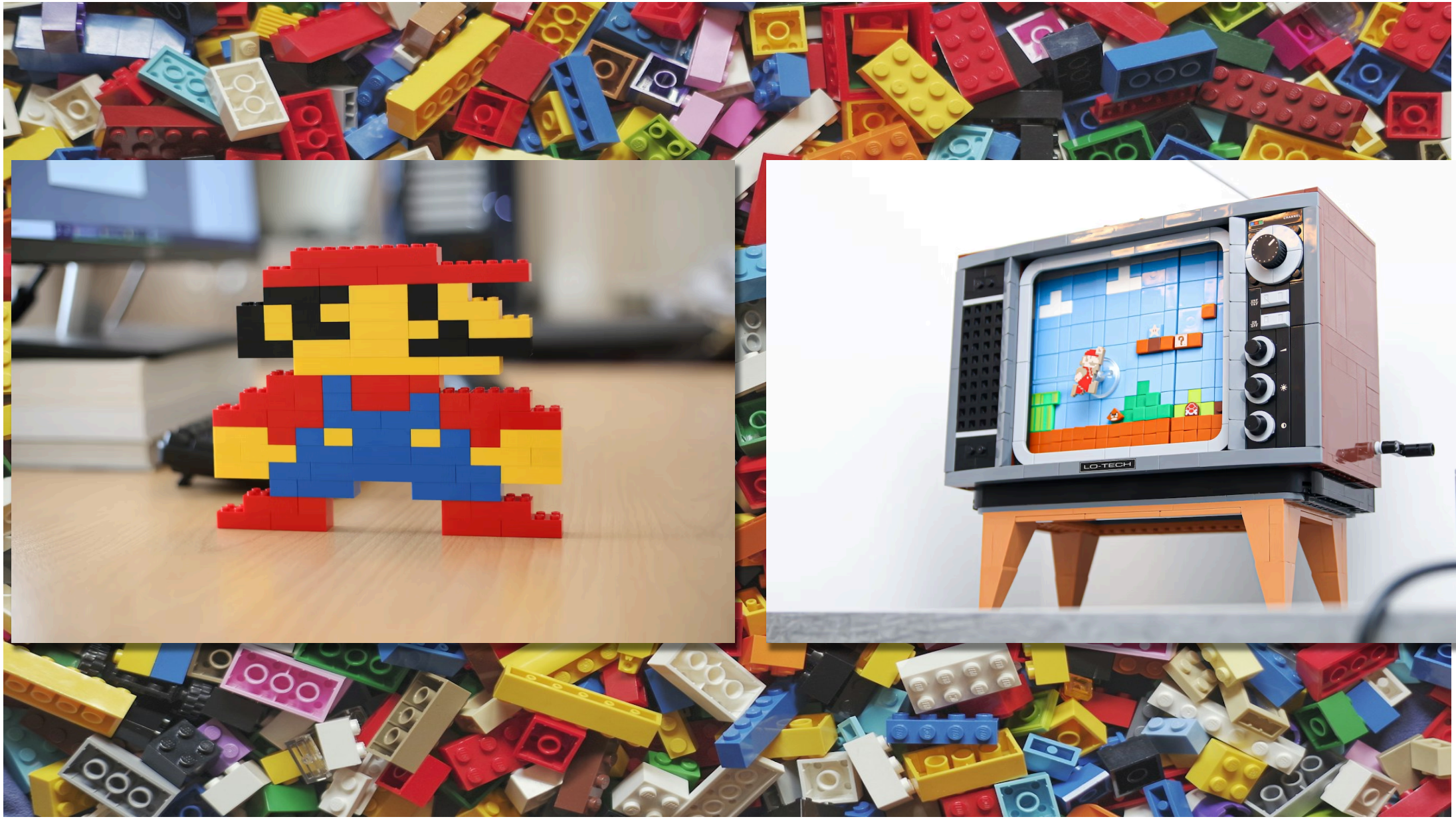
Quick Refresher from Last Class

- ✅ Describe what is an API
- ✅ Download data using APIs

Learning Objectives for Today's Class

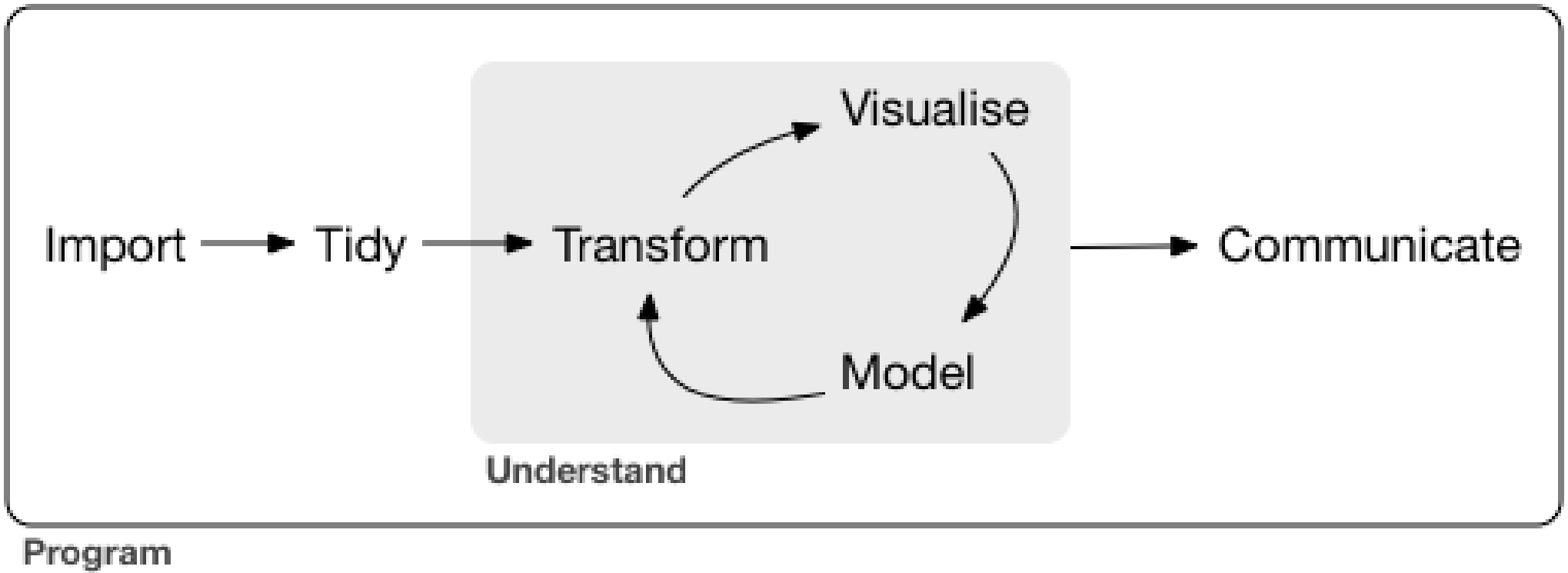
- Define tidy data
- Perform pivot and rectangling operations in 

Tidy Data 🧹



Sources: All three images are obtained from Upsplash

The R for Data Science Workflow



Source: Image is from Wickham, H. Grolemnund, G. (2017). "R for Data Science", O'Reily. https://r4ds.had.co.nz/introduction.html

The Rationale for Tidy Data

- The **tidy framework** provides a **consistent way to organize your data** in R.
- Getting your data into this format requires some **upfront work, but that work pays off in the long term.**
- Once you have tidy data and the tidy tools provided by packages in the `tidyverse`, you will spend **much less time munging data from one representation to another, allowing you to spend more time on the analytic questions at hand.**

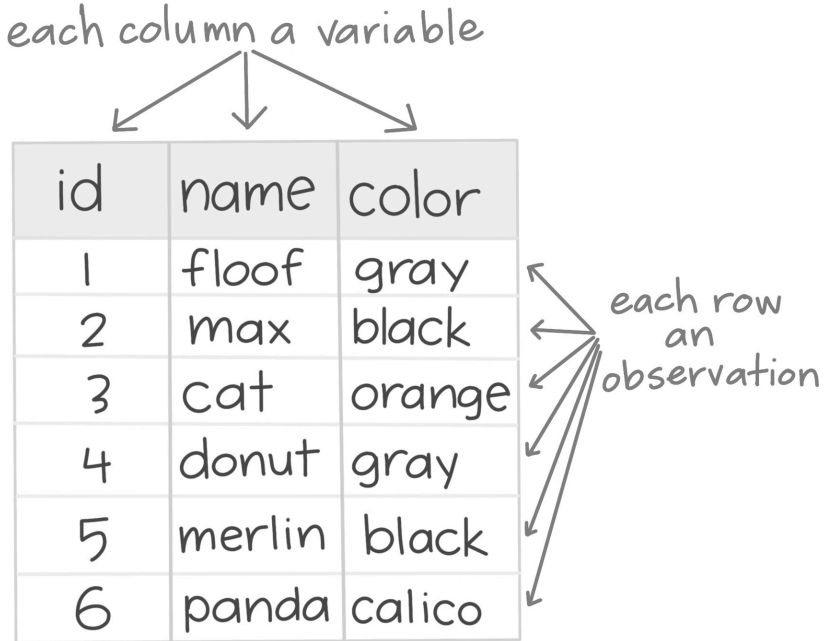
Source: Slide is based on Wickham, H. Grolemnund, G. (2017). "R for Data Science", O'Reily. https://r4ds.had.co.nz/tidy-data.html.

"TIDY DATA is a standard way of mapping the meaning of a dataset to its structure."

–HADLEY WICKHAM

In tidy data:

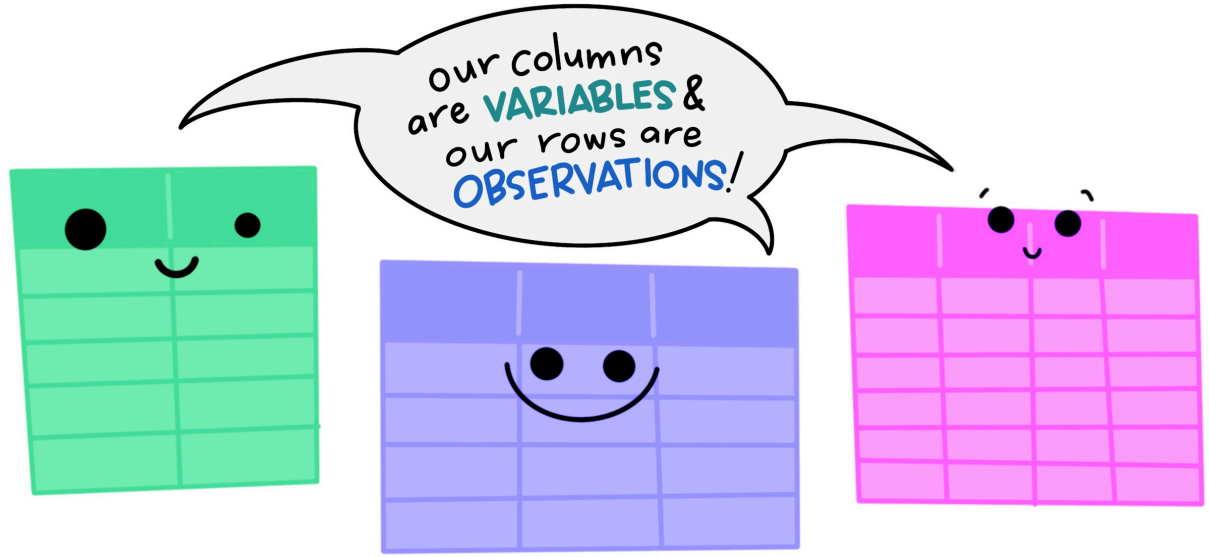
- each variable forms a column
- each observation forms a row
- each cell is a single measurement



Wickham, H. (2014). Tidy Data. Journal of Statistical Software *59* (10). DOI: 10.18637/jss.v059.i10

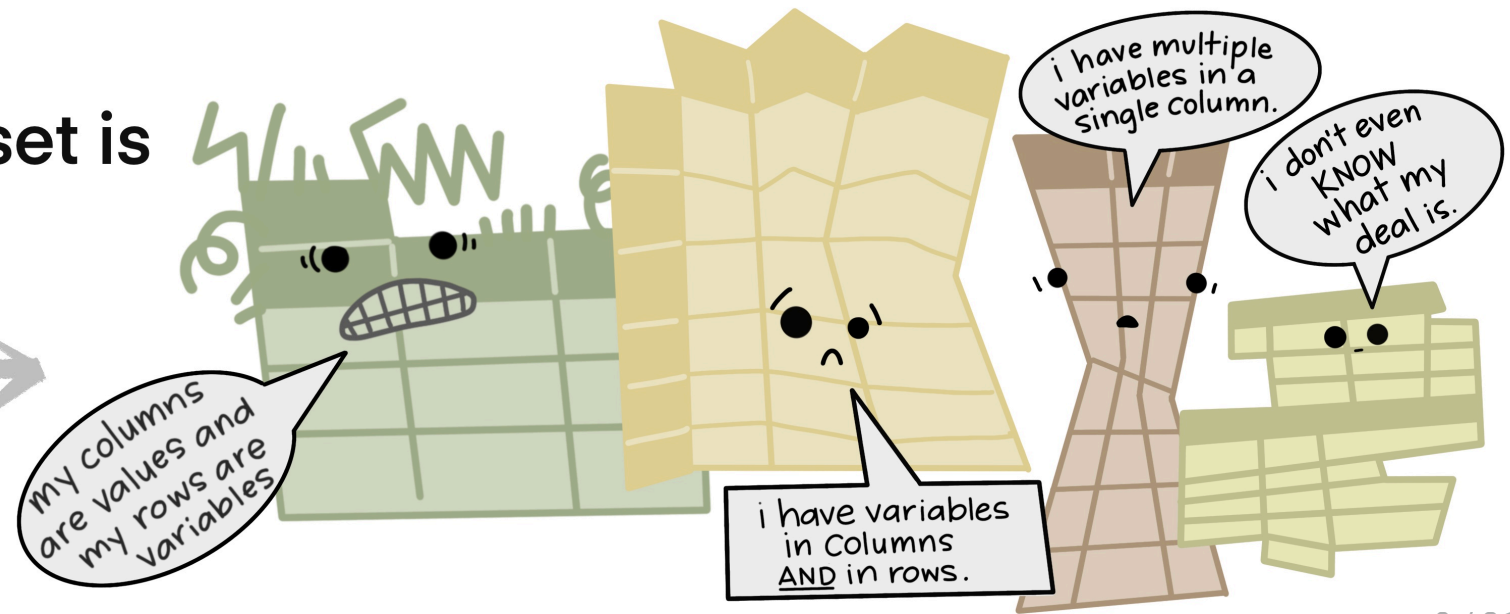
Source: Illustration is from the Openscapes blog Tidy Data for reproducibility, efficiency, and collaboration by Julia Lowndes and Allison Horst

The standard structure of tidy data means that "tidy datasets are all alike..."



"...but every messy dataset is messy in its own way."

–HADLEY WICKHAM



Source: Illustration is from the Openscapes blog Tidy Data for reproducibility, efficiency, and collaboration by Julia Lowndes and Allison Horst

tidy data ≠ clean data

The `movies` data is tidy but not clean.

```
movies <- tibble::as_tibble(jsonlite::read_json(
  "https://vega.github.io/vega-editor/app/data/movies.json",
  simplifyVector = TRUE))

movies |>
  dplyr::relocate(Release_Date, US_DVD_Sales) |> # move cols to front
  dplyr::slice(37:39, 268:269) |> # filter specific row numbers
  print(width = 80) # print nicely
```

```
## # A tibble: 5 × 16
##   Release_Date US_DVD_Sales Title     US_Gross Worldwide_Gross Production_Budget
##   <chr>               <int> <chr>        <int>           <dbl>             <int>
## 1 9-Mar-94               NA Four Wed… 52700832       242895809           4500000
## 2 18-Oct-06              NA 51 Birch…    84689            84689            350000
## 3 1963-01-01             NA 55 Days … 10000000         10000000          17000000
## 4 <NA>                   NA Drei            0                0           7200000
## 5 16-Jan-98              NA The Dress    16556            16556           2650000
## # ℹ 10 more variables: MPAA_Rating <chr>, Running_Time_min <int>,
## #   Distributor <chr>, Source <chr>, Major_Genre <chr>, Creative_Type <chr>,
## #   Director <chr>, Rotten_Tomatoes_Rating <int>, IMDB_Rating <dbl>,
## #   IMDB_Votes <int>
```

Non-graded Activity: Tidy or Not?

05:00

Activity | table1 | table2 | table3 | table4a | table4b

- In the next five panels, there five tables all displaying the number of TB cases documented by the World Health Organization in Afghanistan, Brazil, and China between 1999 and 2000.
- The data contains values associated with four variables (country, year, cases, and population), but each table organizes the values in a different layout.
- **Based on the information in the previous slide, please document which of the table(s) is(are) tidy and if not, which rules are violated.**
- **Discuss your answer with your neighboring colleague.**

> *Note that you have a total of five minutes for this non-graded activity.*

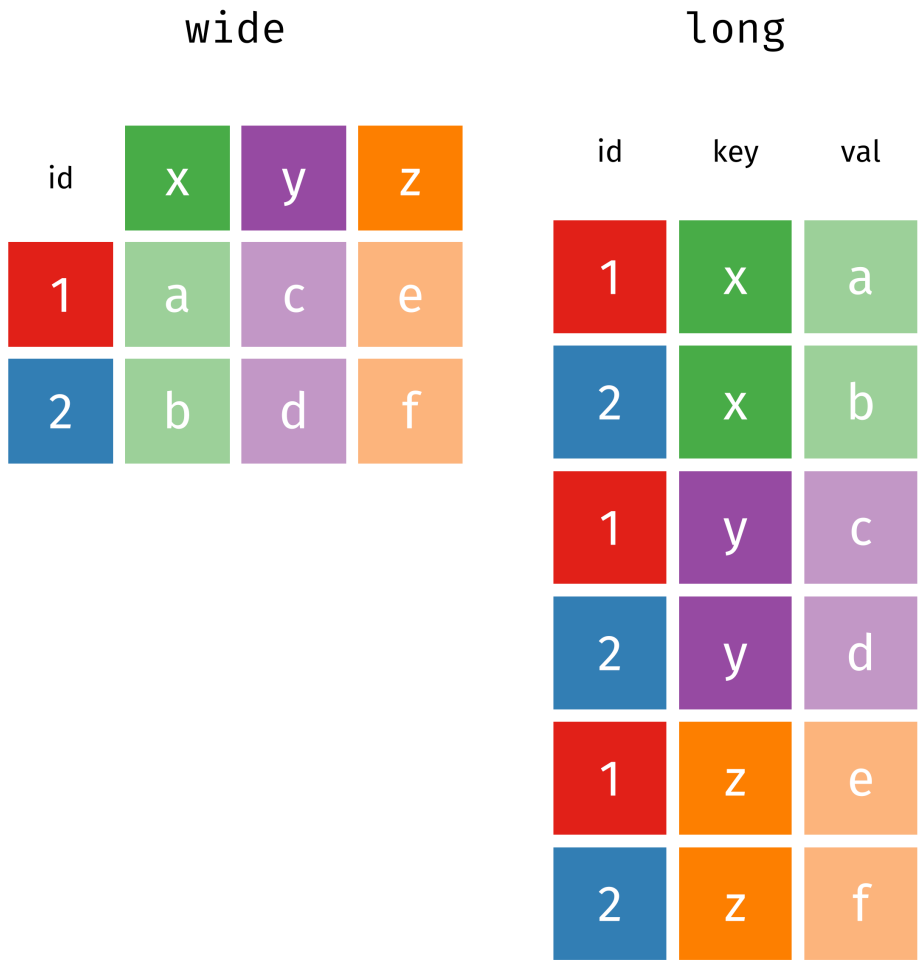
Getting Data into Tidy Format

Key Functions from the `tidyr`

type	`function()`	`function()`
pivoting	pivot_longer()	pivot_wider()
splitting/combining	separate()	unite()
nesting/unnesting	nest()	unnest()
missing	complete()	fill()

Source: Slide is based on Earo Wang's STAT 220 Slides

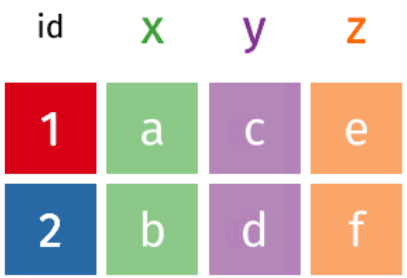
Wide Vs Long Data



Source: Image is from Garrick Aden-Buie's excellent tidyexplain GitHub Repository

`pviot_()` to Transform Wide from/to Long

wide



Source: Image is from Garrick Aden-Buie's excellent tidyexplain GitHub Repository

The `pivot_longer()` Function

```
pivot_longer(wide,
       cols = x:z,
  names_to = "key",
 values_to = "val")
```

returns

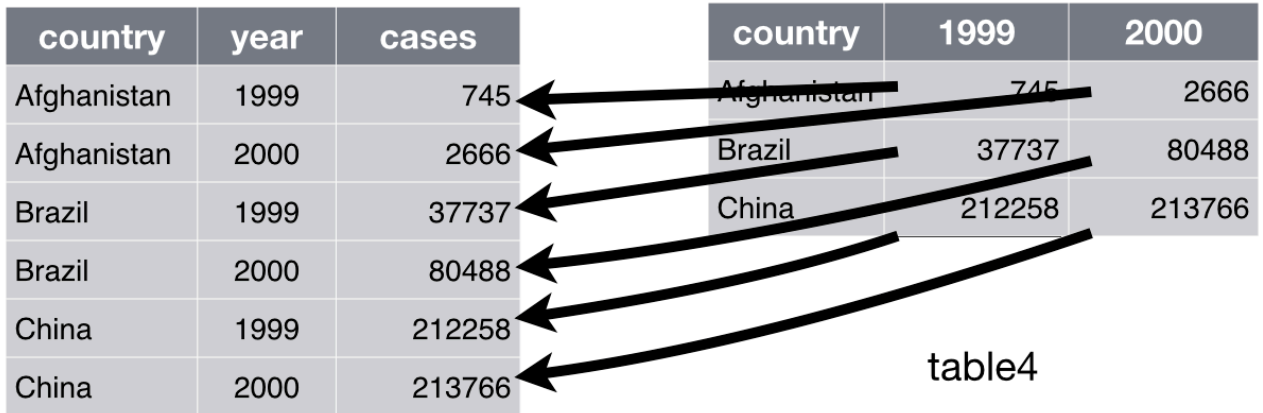
Source: Image is from Garrick Aden-Buie's excellent tidyexplain GitHub Repository

`pivot_longer()` for table4a [1]

To tidy a dataset like this, we need to pivot the **offending columns into a new pair of variables**.
To describe that operation we need **three parameters:**

- The set of columns whose names are values, not variables. In this example, those are the columns `1999` and `2000`.
- The name of the variable to move the column names to. Here it is `year`.
- The name of the variable to move the column values to. Here it's `cases`.

`pivot_longer()` for table4a [2]



Pivoting table4a into a longer, tidy form

`pivot_longer()` for table4a [3]

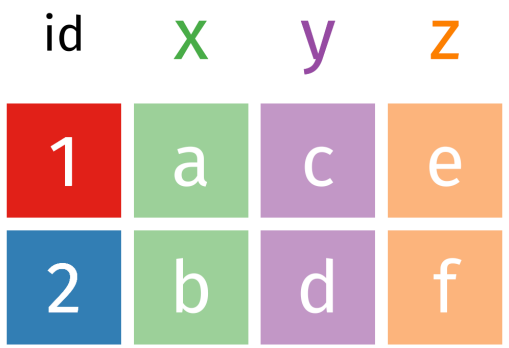
```
tidyr::pivot_longer(table4a, c(`1999`, `2000`), names_to = "year", values_to = "cases")
```

```
## # A tibble: 6 × 3
##   country     year   cases
##   <chr>       <chr>  <dbl>
## 1 Afghanistan 1999     745
## 2 Afghanistan 2000    2666
## 3 Brazil      1999   37737
## 4 Brazil      2000   80488
## 5 China       1999  212258
## 6 China       2000  213766
```

The `pivot_wider()` Function

```
pivot_wider(long,
  names_from = key,
 values_from = val)
```

returns



Source: Image is from Garrick Aden-Buie's excellent tidyexplain GitHub Repository

`pivot_wider()` for table2 [1]

- `pivot_wider()` is the opposite of `pivot_longer()`.
- You use it when an observation is scattered across multiple rows.
- For example, take table2: an observation is a country in a year, but each observation is spread across two rows.

```
head(table2, n = 3)
```

```
## # A tibble: 3 × 4
##   country      year type           count
##   <chr>       <dbl> <chr>          <dbl>
## 1 Afghanistan  1999 cases            745
## 2 Afghanistan  1999 population 19987071
## 3 Afghanistan  2000 cases           2666
```

`pivot_wider()` for table2 [2]

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

table2

Source: Slide is based on Wickham, H. Grolemnund, G. (2017). "R for Data Science", O'Reily. https://r4ds.had.co.nz/tidy-data.html.

`pivot_wider()` for table2 [3]

```
tidyr::pivot_wider(table2, names_from = type, values_from = count)
```

```
## # A tibble: 6 × 4
##   country      year  cases population
##   <chr>       <dbl>  <dbl>      <dbl>
## 1 Afghanistan  1999    745   19987071
## 2 Afghanistan  2000   2666   20595360
## 3 Brazil       1999  37737  172006362
## 4 Brazil       2000  80488  174504898
## 5 China        1999 212258 1272915272
## 6 China        2000 213766 1280428583
```

`separate()` for table3 [1]

```
## # A tibble: 6 × 3
##   country      year rate
##   <chr>       <dbl> <chr>
## 1 Afghanistan  1999 745/19987071
## 2 Afghanistan  2000 2666/20595360
## 3 Brazil       1999 37737/172006362
## 4 Brazil       2000 80488/174504898
## 5 China        1999 212258/1272915272
## 6 China        2000 213766/1280428583
```

`table3` has a different problem:

- we have one column (`rate`) that contains two variables (`cases` and `population`).
- To fix this problem, we'll need the `separate()` function.

`separate()` for table3 [2]

country	year	rate
Afghanistan	1999	**745** / 19987071
Afghanistan	2000	**2666** / 20595360
Brazil	1999	**37737** / 172006362
Brazil	2000	**80488** / 174504898
China	1999	**212258** / 1272915272
China	2000	**213766** / 1280428583

table3

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

Source: Slide is based on Wickham, H. Grolemnund, G. (2017). "R for Data Science", O'Reily. https://r4ds.had.co.nz/tidy-data.html.

`separate()` for table3 [3]

```
tidyr::separate(table3, rate, into = c("cases", "population"), convert = TRUE)
```

```
## # A tibble: 6 × 4
##   country      year  cases population
##   <chr>       <dbl>  <int>      <int>
## 1 Afghanistan  1999    745   19987071
## 2 Afghanistan  2000   2666   20595360
## 3 Brazil       1999  37737  172006362
## 4 Brazil       2000  80488  174504898
## 5 China        1999 212258 1272915272
## 6 China        2000 213766 1280428583
```

Non-graded Class Activity

05:00

Activity | Your Solution

> *In this five minute non-graded activity, please do the following*

- Go to https://usafacts.org/visualizations/coronavirus-covid-19-spread-map/
- Download the data for `Deaths` by clicking on the tab to the right of the page.
- **Tidy this data based on the information you have learned in today's class.**

Recap

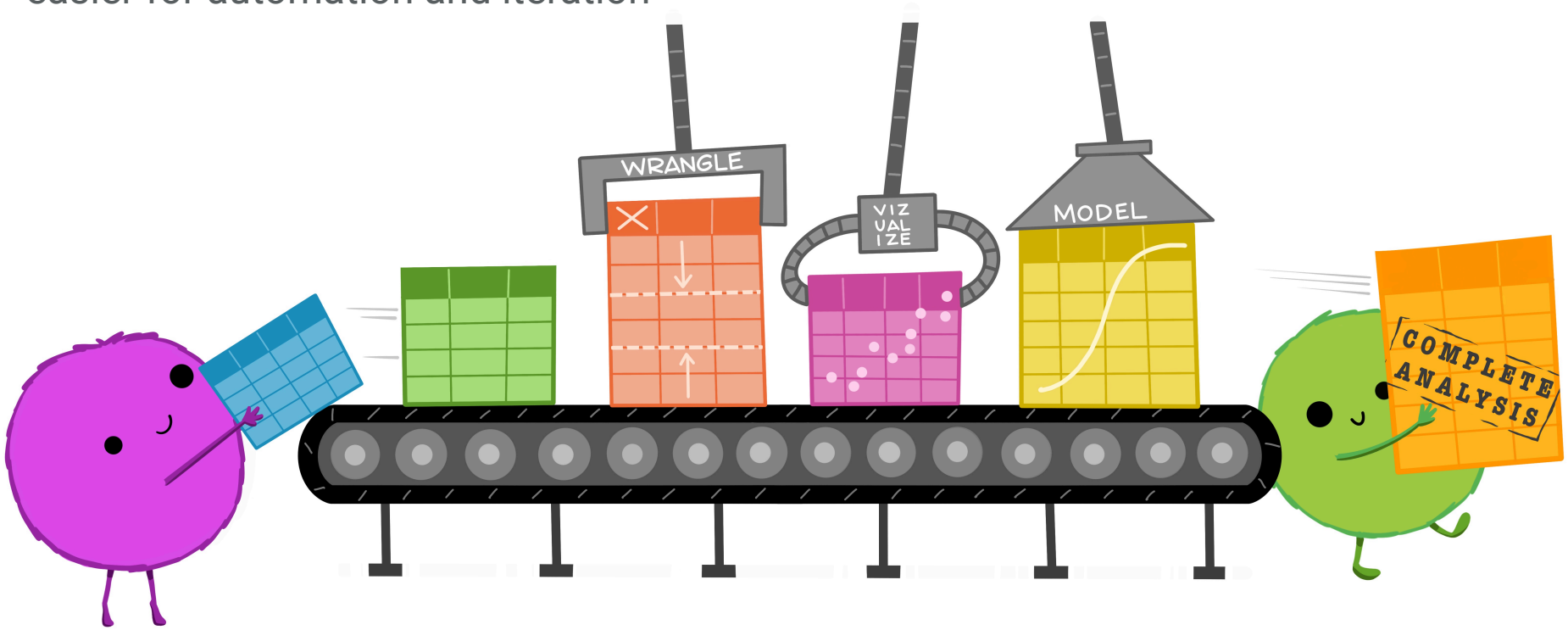
Summary of Main Points

By now, you should be able to do the following:

- Define tidy data
- Perform pivot and rectangling operations in 

Advantages of Tidy Data

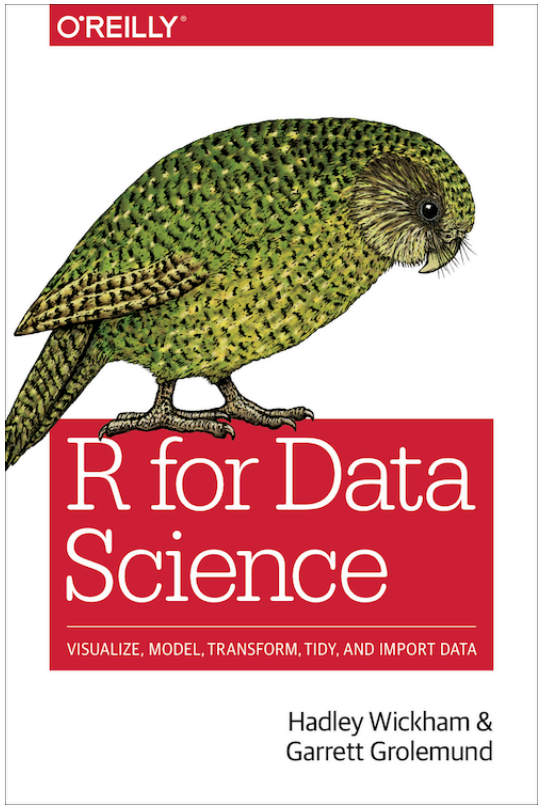
- one set of consistent tools for different datasets
- easier for automation and iteration



Source: Illustration is from the Openscapes blog Tidy Data for reproducibility, efficiency, and collaboration by Julia Lowndes and Allison Horst

Things to Do Prior to Next Class

Please go through the following two supplementary readings and complete assignment 06: tidy data.



- Tidy data
- {tidyr} cheatsheet