Data Wrangling

Lab 3

“Data scientists, according to interviews and expert estimates, spend from **50 percent to 80 percent of their time** mired in the mundane labor of collecting and preparing data, before it can be explored for useful information.”

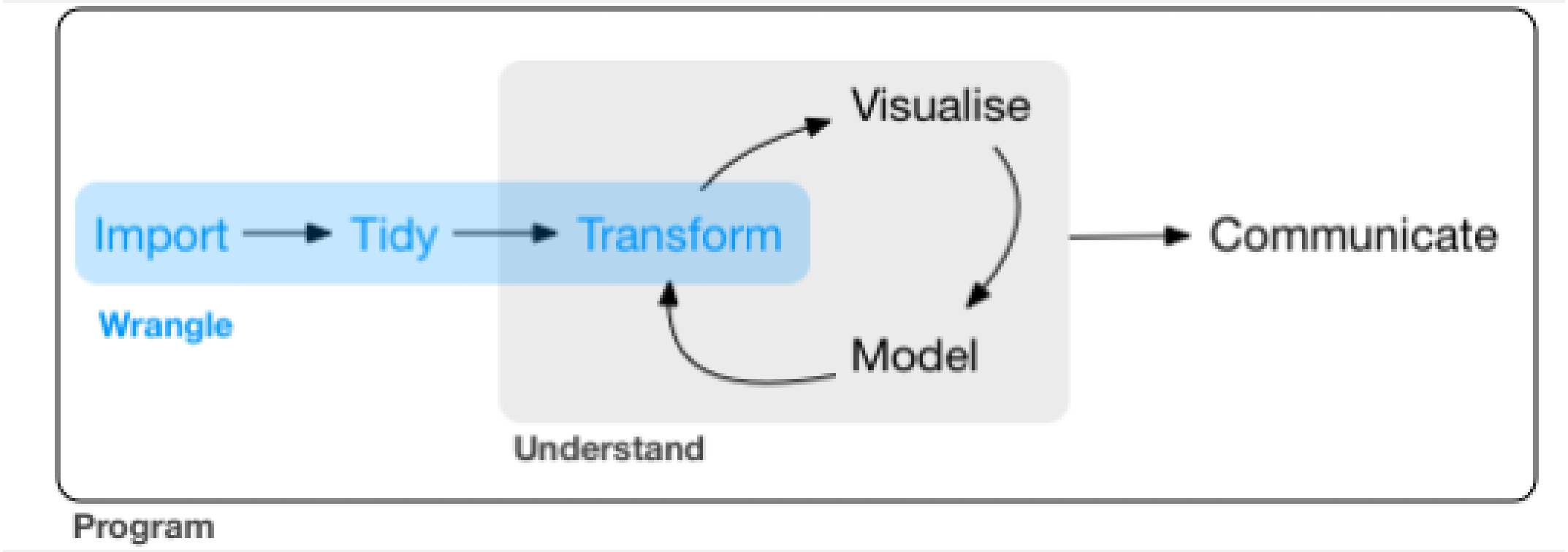
- *New York Times* 2016

Agenda

- Common problems in data wrangling – table contents and formatting
- Long, wide, and unusual data formats
- Thoughts on the tidyverse, tidy data
- Computer memory and “big” data

- Indexing, logical indexing in base R
- Factor/categorical variables

The data analysis pipeline



Hadley Wickham's R for Data Science (mostly tidyverse)

Any issues with this data frame?

	ARREST_KEY	ARREST_DATE	PD_CD	PD_DESC	KY_CD	OFNS_DESC	ARREST_BORO	AGE_GROUP
1	238013474	12/18/2021	157	RAPE 1	104	RAPE	Q	18-24
2	236943583	11/25/2021	263	ARSON 2,3,4	114	ARSON	K	25-44
3	234938876	10/14/2021	594	OBSCENITY 1	116	SEX CRIMES	K	25-44
4	234788259	10/11/2021	263	ARSON 2,3,4	114	ARSON	B	18-24
5	234188790	09/28/2021	578		*NA*		B	25-44
6	234117071	09/27/2021	157	RAPE 1	104	RAPE	K	25-44
7	233755503	09/18/2021	579		*NA*		Q	18-24
8	233740512	09/18/2021	157	RAPE 1	104	RAPE	B	25-44
9	233697123	09/17/2021	157	RAPE 1	104	RAPE	Q	25-44
10	233381184	09/10/2021	578		*NA*		Q	25-44
11	231852329	08/05/2021	157	RAPE 1	104	RAPE	M	25-44
12	231107433	07/20/2021	155	RAPE 2	104	RAPE	Q	45-64

Key tools for navigating datasets

	ARREST_KEY	ARREST_DATE	PD_CD	PD_DESC	KY_CD	OFNS_DESC	ARREST_BORO	AGE_GROUP
1	238013474	12/18/2021	157	RAPE 1	104	RAPE	Q	18-24
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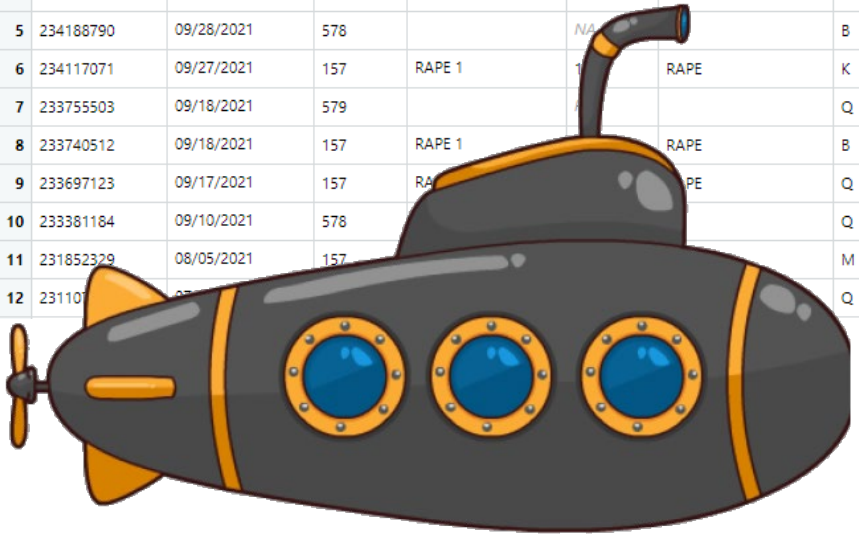
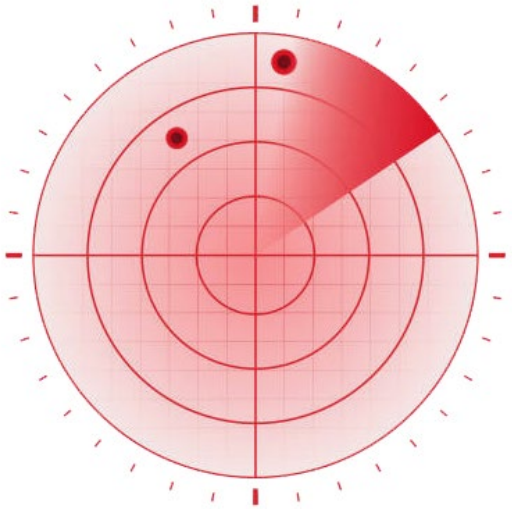
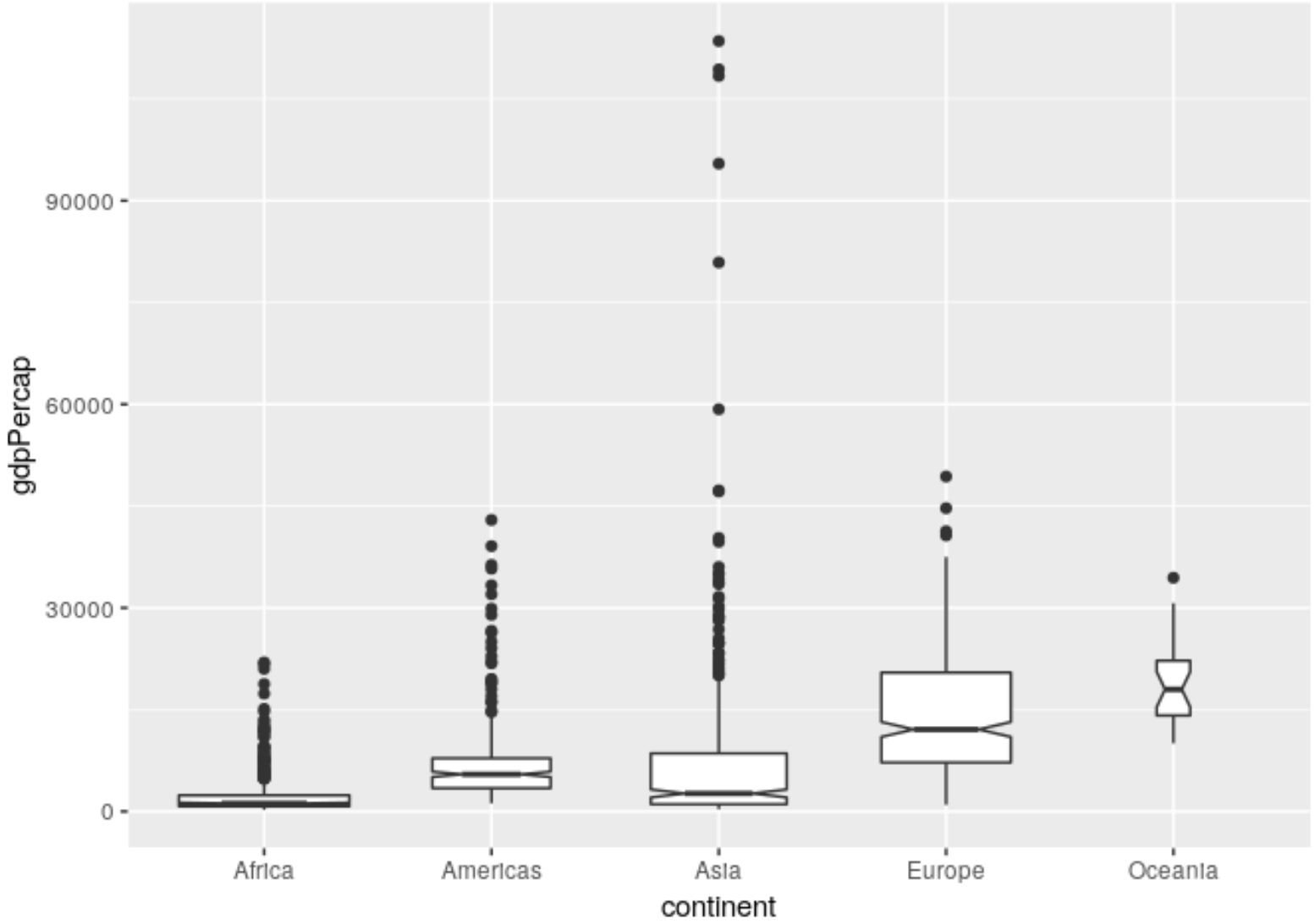
11	231852329	08/05/2021	157				M	25-44
12	23110						Q	45-64



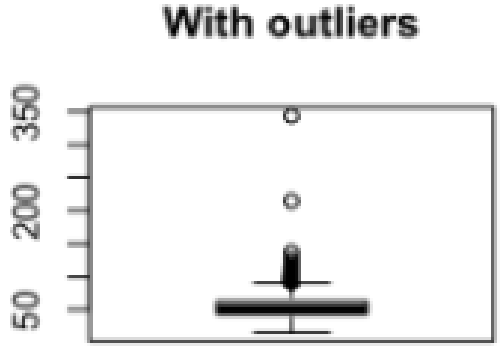


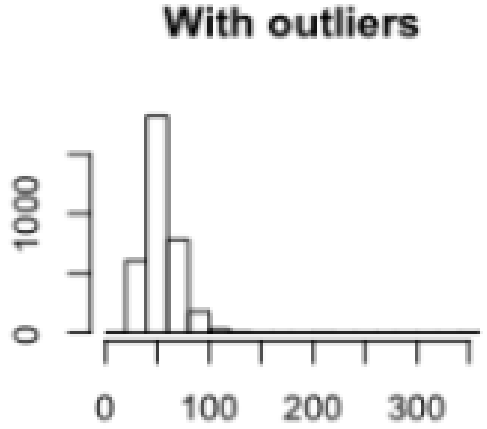
1. Plotting “on-the-fly”
2. Logical queries
3. Error messages

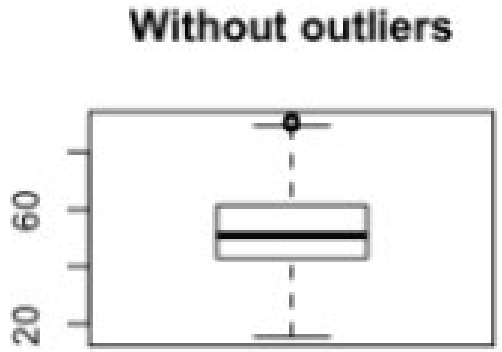
Anything wrong with this plot?



Outliers – what to do?







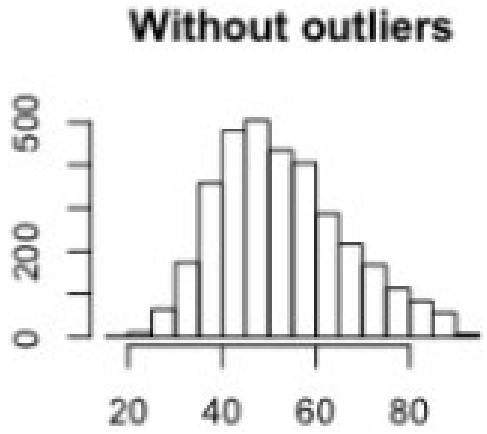


Table formatting

storms

storm	wind	pressure	date
Alberto	110	1007	2000-08-12
Alex	45	1009	1998-07-30
Allison	65	1005	1995-06-04
Ana	40	1013	1997-07-01
Arlene	50	1010	1999-06-13
Arthur	45	1010	1996-06-21

cases

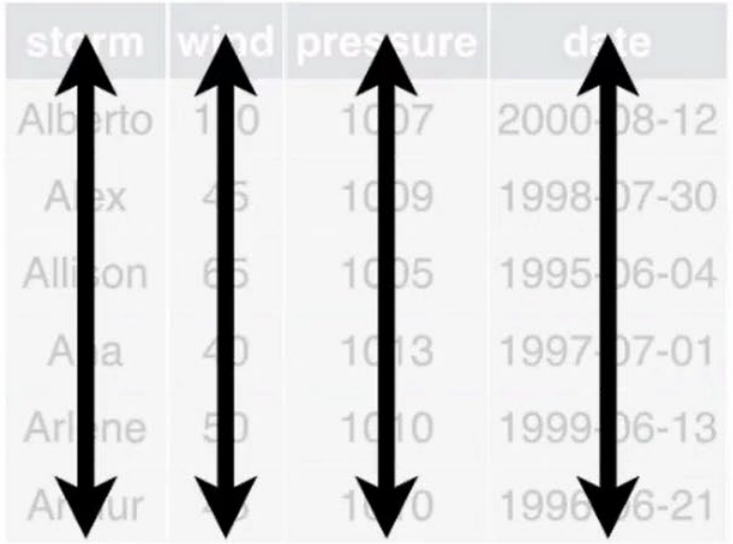
Country	2011	2012	2013
FR	7000	6900	7000
DE	5800	6000	6200
US	15000	14000	13000

pollution

city	particle size	amount ($\mu g/m^3$)
New York	large	23
New York	small	14
London	large	22
London	small	16
Beijing	large	121
Beijing	small	56

Table formatting

storms



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Ana	40	1013	1997-07-01
Arlene	50	1010	1999-06-13
Arthur	45	1010	1996-06-21

- Storm name
- Wind Speed (mph)
- Air Pressure
- Date

cases

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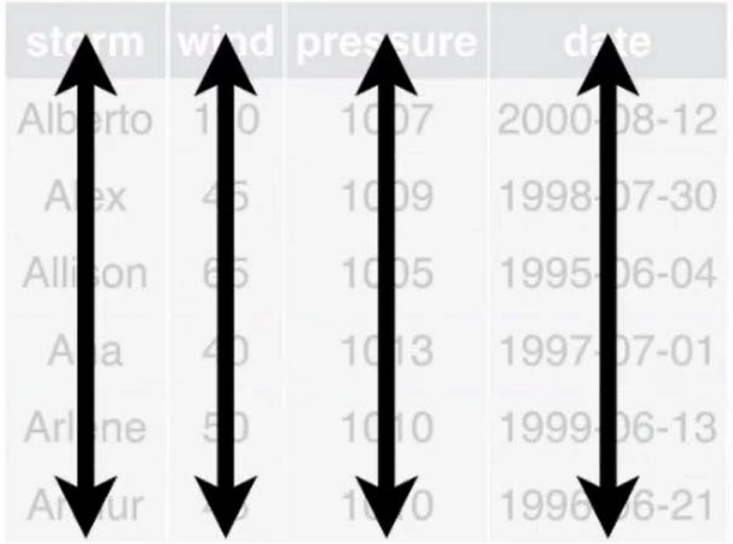
Table formatting

storms



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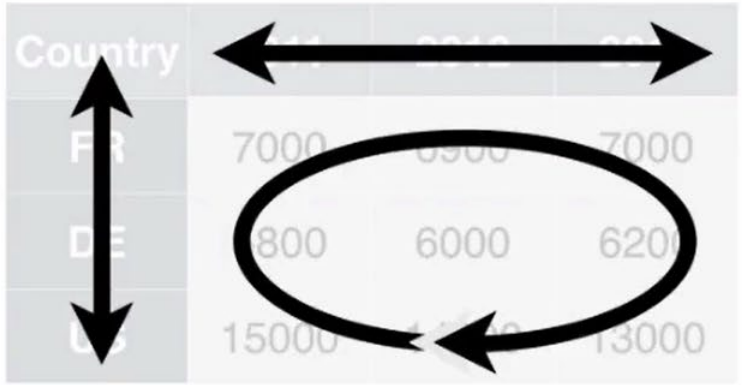
- Wind Speed (mph)
- Air Pressure
- Date

cases



- Country
- Year
- Count

pollution

city	particle size	amount ($\mu g/m^3$)
New York	large	23
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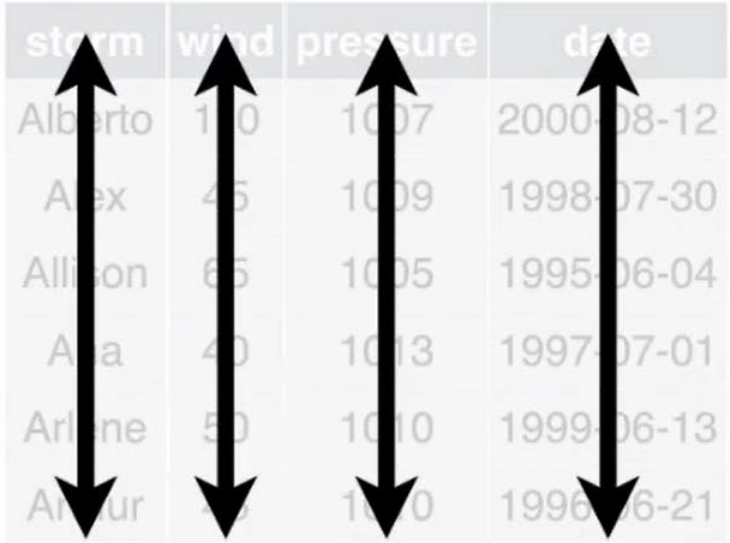
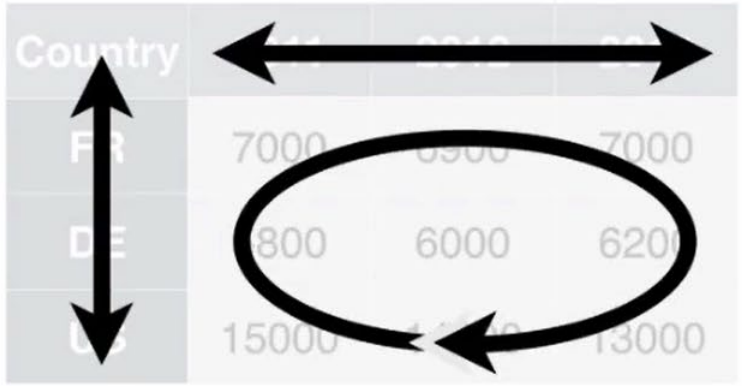
Table formatting

storms



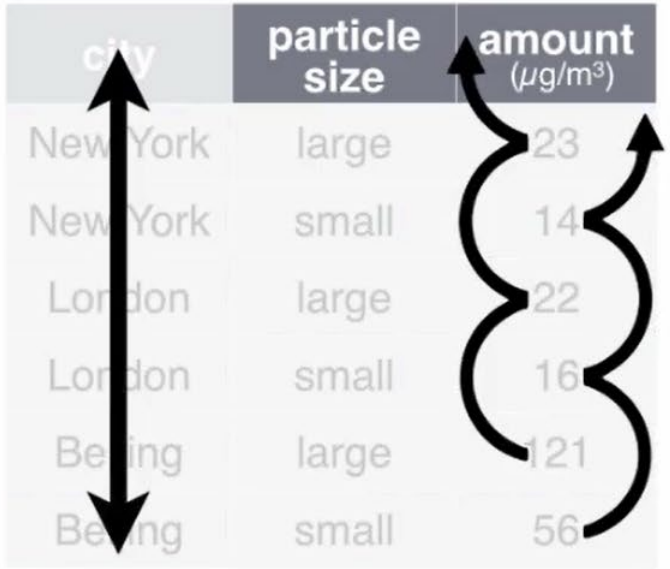
- Storm name
- Wind Speed (mph)
- Air Pressure
- Date

cases



- Country
- Year
- Count

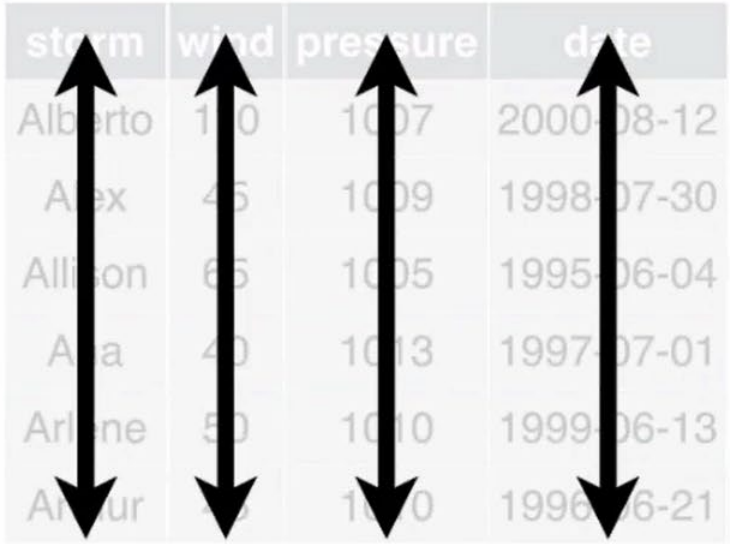
pollution



- City
- Amount of large particles
- Amount of small particles

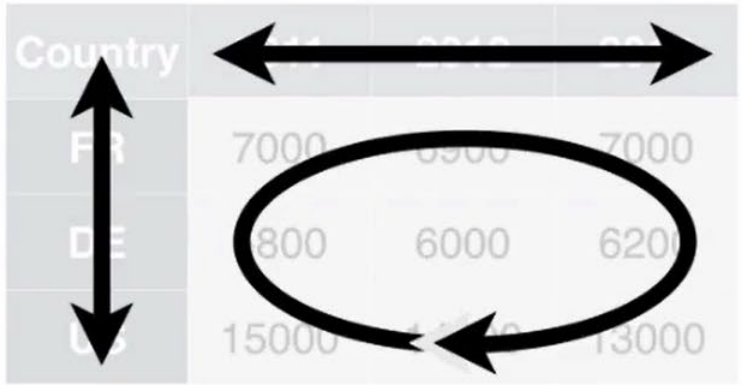
Table formatting

storms



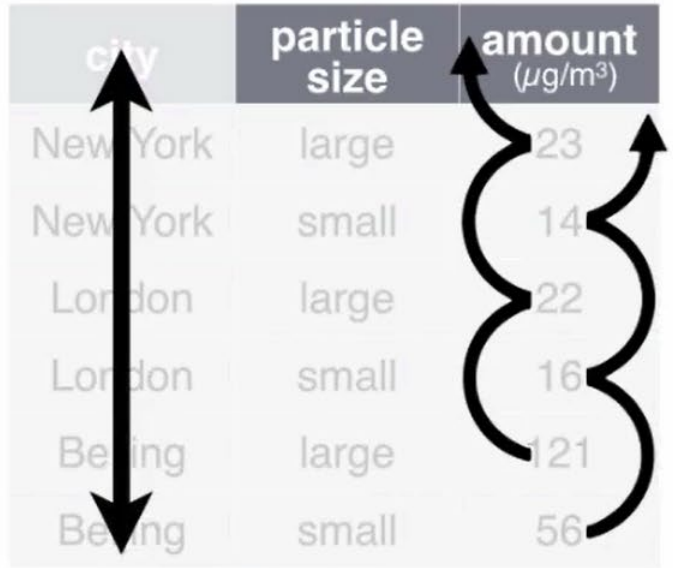
```
storms$storm
storms$wind
storms$pressure
storms$date
```

cases



```
cases$country
names(cases)[-1]
unlist(cases[1:3, 2:4])
```

pollution




```
pollution$city[1,3,5]
pollution$amount[1,3,5]
pollution$amount[2,4,6]
```

Three principles of tidy data

storms

storm	wind	pressure	date
Alberto	110	1007	2000-08-12
Alex	45	1009	1998-07-30
Allison	65	1005	1995-06-04
Ana	40	1013	1997-07-01
Arlene	50	1010	1999-06-13
Arthur	45	1010	1996-06-21

1. Each **variable** is saved in its own **column**
2. Each **observation** is saved in its own **row**
3. Each “type” of observation is stored in a **single table** (e.g. storms)

Enter the tidyverse

R packages for data science

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

Install the complete tidyverse with:

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

Consider [criticisms of tidyverse]

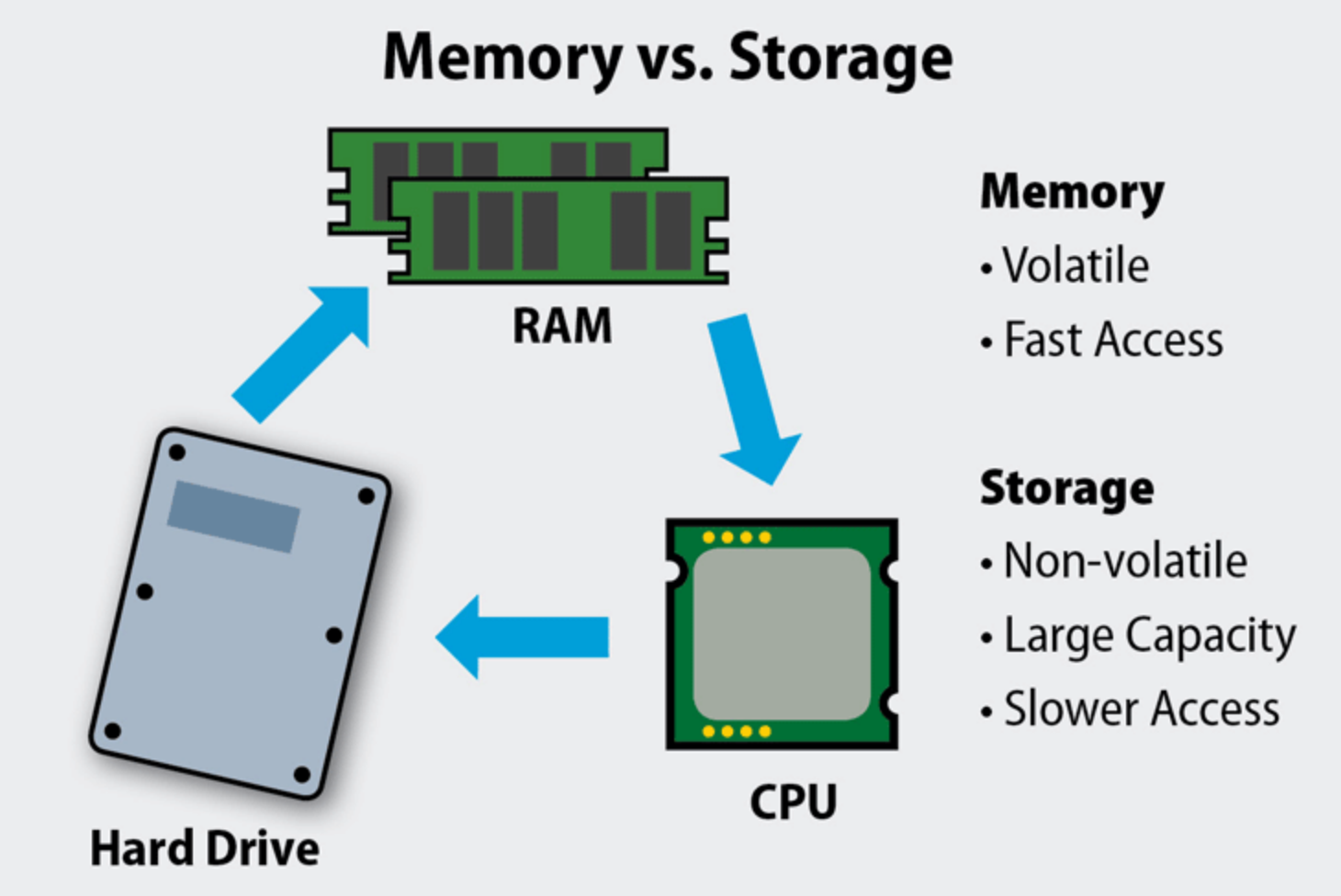
Tidyverse and beyond resources

RStudio cheat sheets including tidyverse packages

Good overview of data wrangling using tidyverse

Hadley Wickham's R for Data Science

Computer memory and working with data



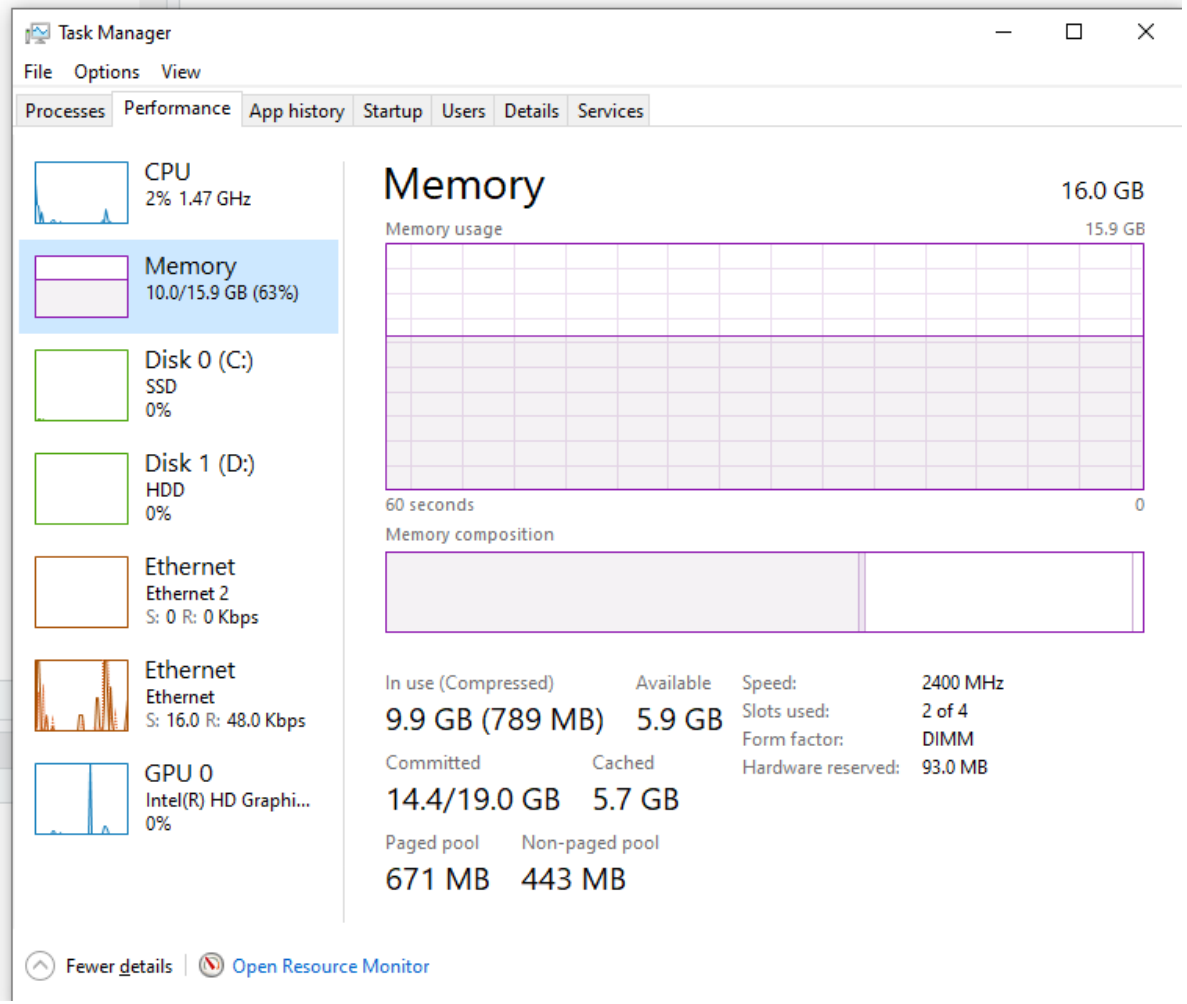
“Medium” data:
< 2 GB

“Large” data:
2-10 GB

“Big” data:
10+ GB

Computer memory

arrests	155507 obs. of 15 variables
pricey	39416 obs. of 10 variables
tb	121149 obs. of 5 variables



Rstudio with
~300,000 rows of data

Google Chrome with
10 tabs open