Communicating with Data – Welcome!

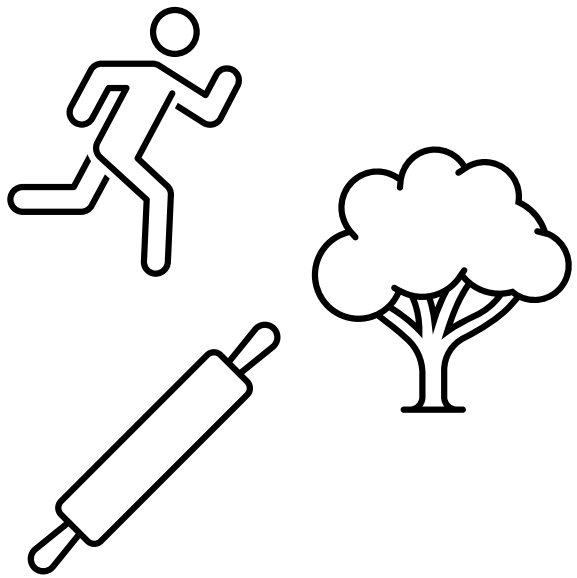
Dr. Ab Mosca (they/them)

Slides based off slides courtesy of Jordan Crouser (https://jcrouser.github.io/)

Plan for Today

- Intros
- About this course
- How is visualization useful?
- What is data?
- Structure of this course

Who Am I?



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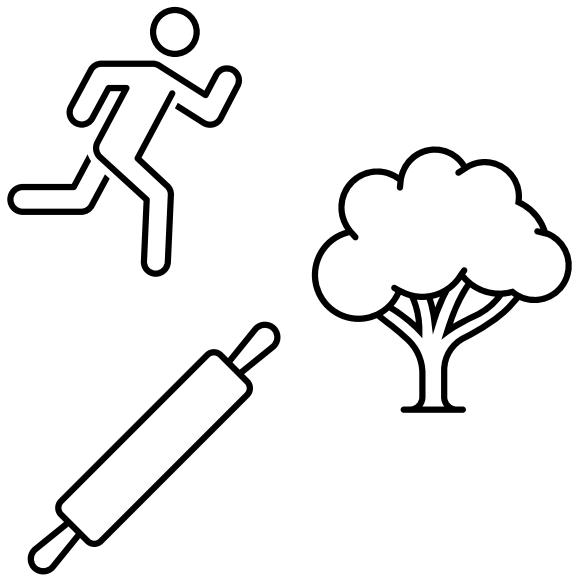

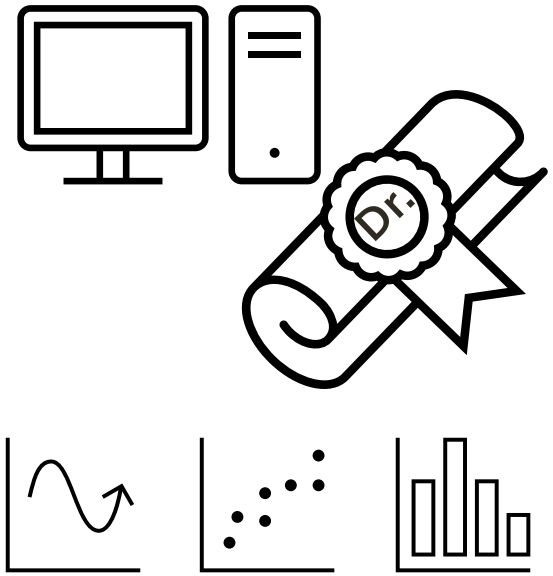

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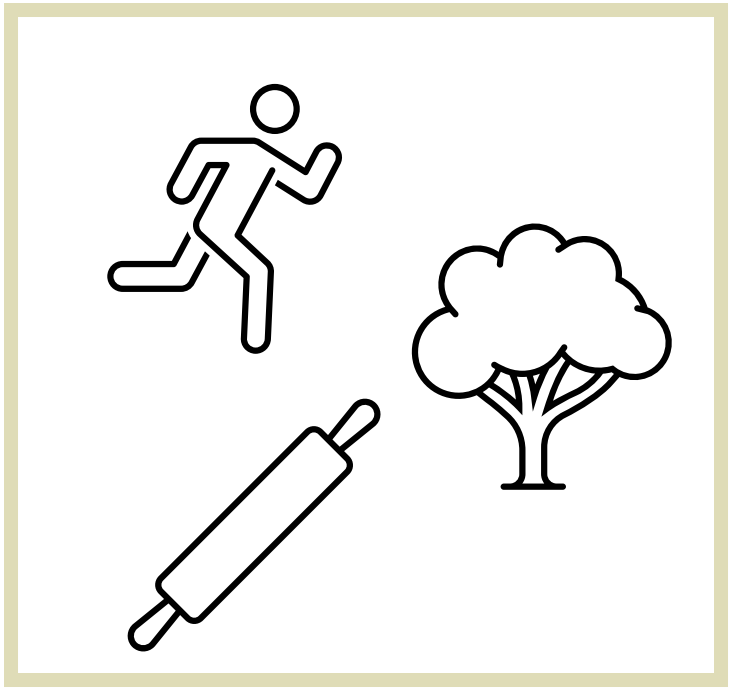

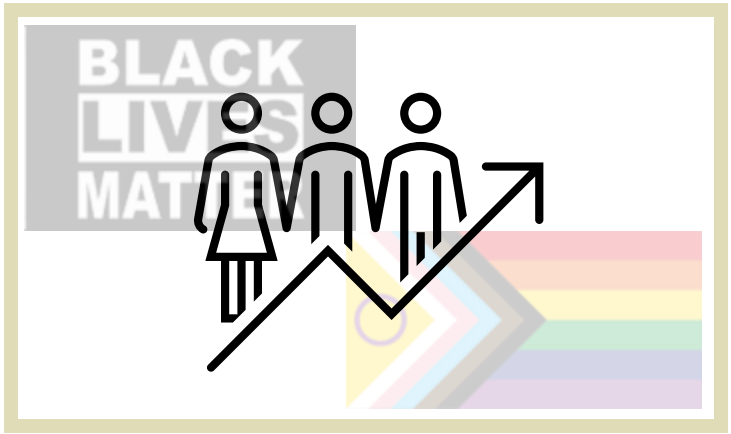

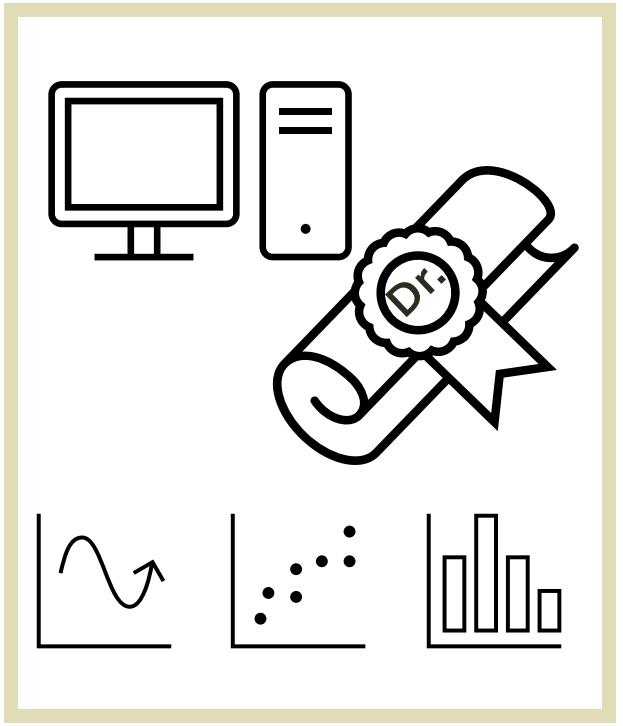

Who Are You?

- Form groups of 3
- Introduce yourselves (name, pronouns)
- Share:
  - A highlight of your summer break
- Find 1 thing that your entire group has in common (favorite color? hometown? left-handed? Be creative!)
- After about 5 minutes we will go around, introduce ourselves, and share what each group has in common

Who Are You?

- Form **new groups** of 3 (move around!)
- Introduce yourselves (name, pronouns)
- Share:
  - Would you rather live in an estate that can have anything you want but you can never leave OR live in a camper van and have to move every day?
- After about 5 minutes we will go around, introduce ourselves, and share our would you rather answers

Who Are You?

- Form **new new groups** of 3 (move around!)
- Introduce yourselves (name, pronouns)
- Share:
  - Would you rather have the ability to teleport (only yourself, no items) OR have instant deliveries?
- After about 5 minutes we will go around, introduce ourselves, and share our would you rather answers

- Name tags!

About this course

Communicating with data

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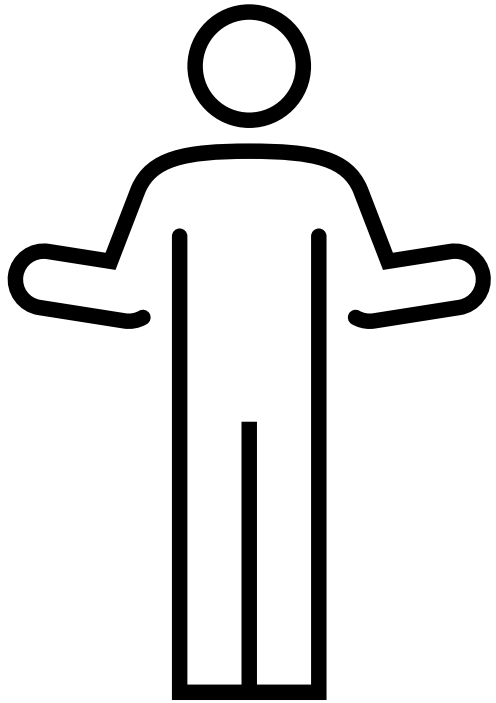
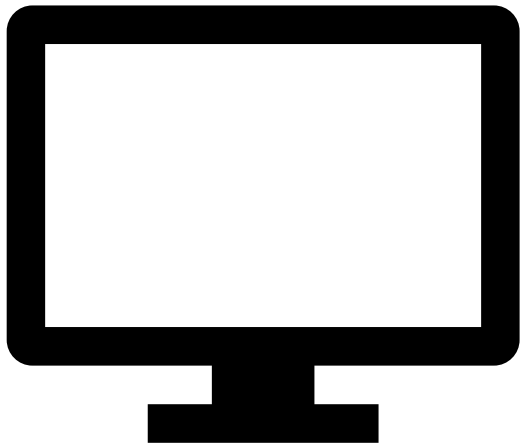
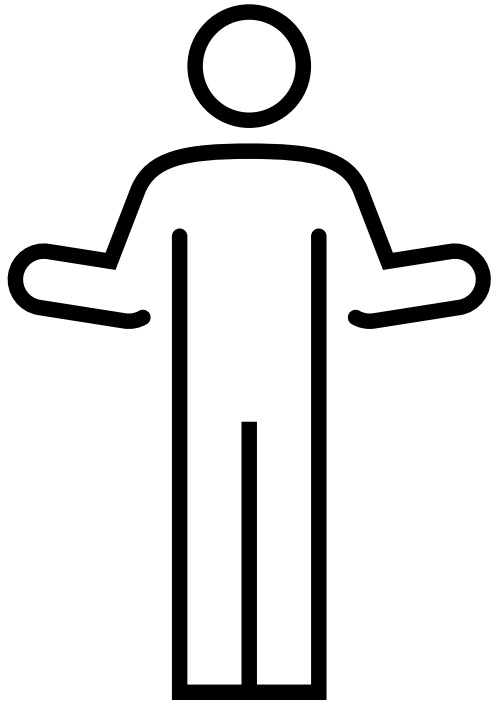


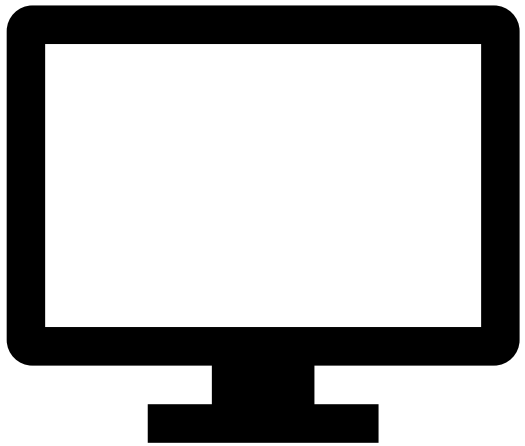


About this course

Communicating with data

What are the strengths of each wrt data and communication?





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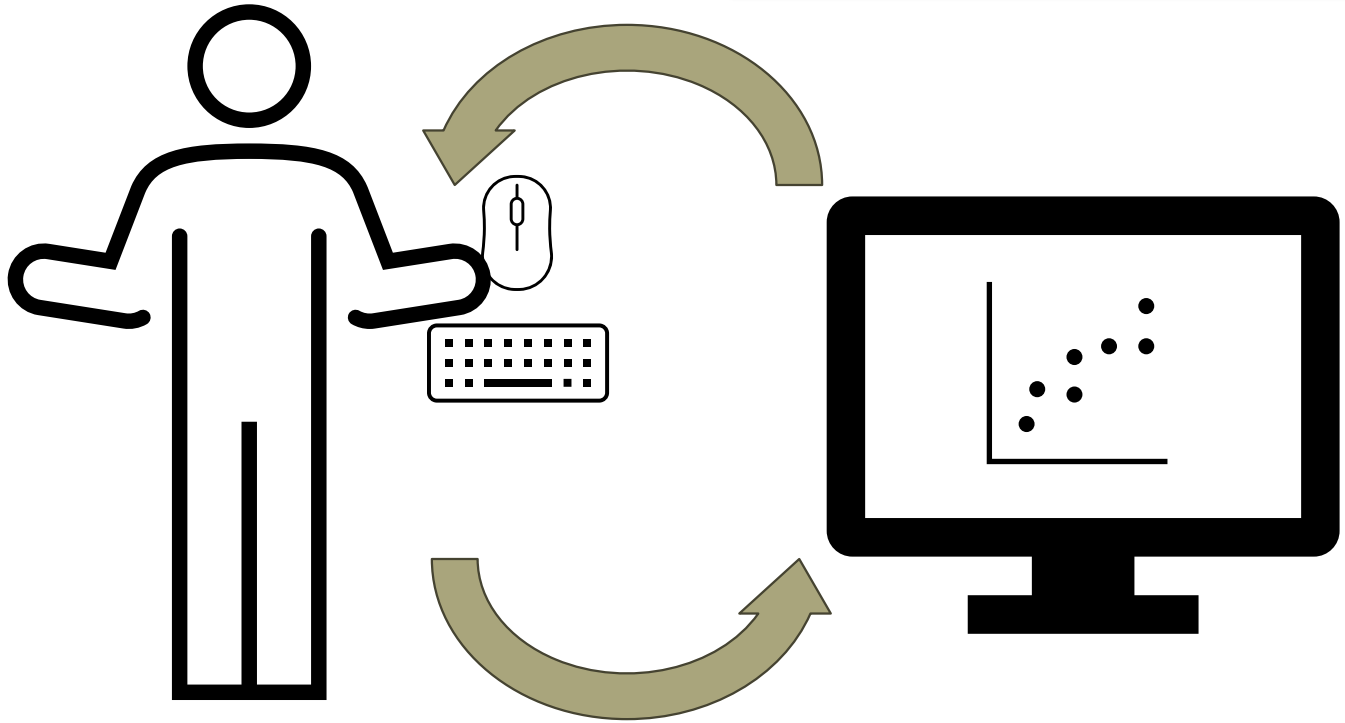
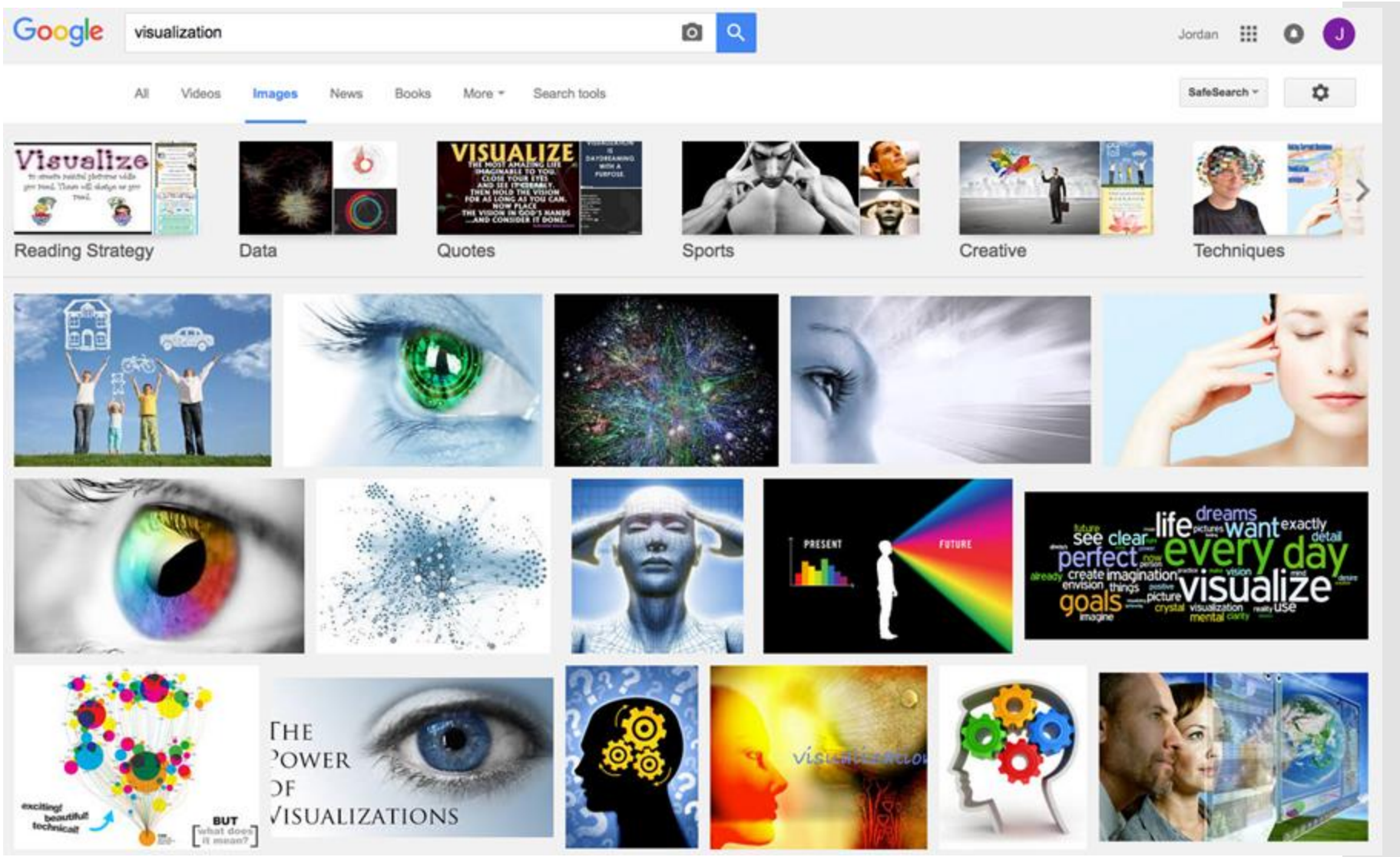
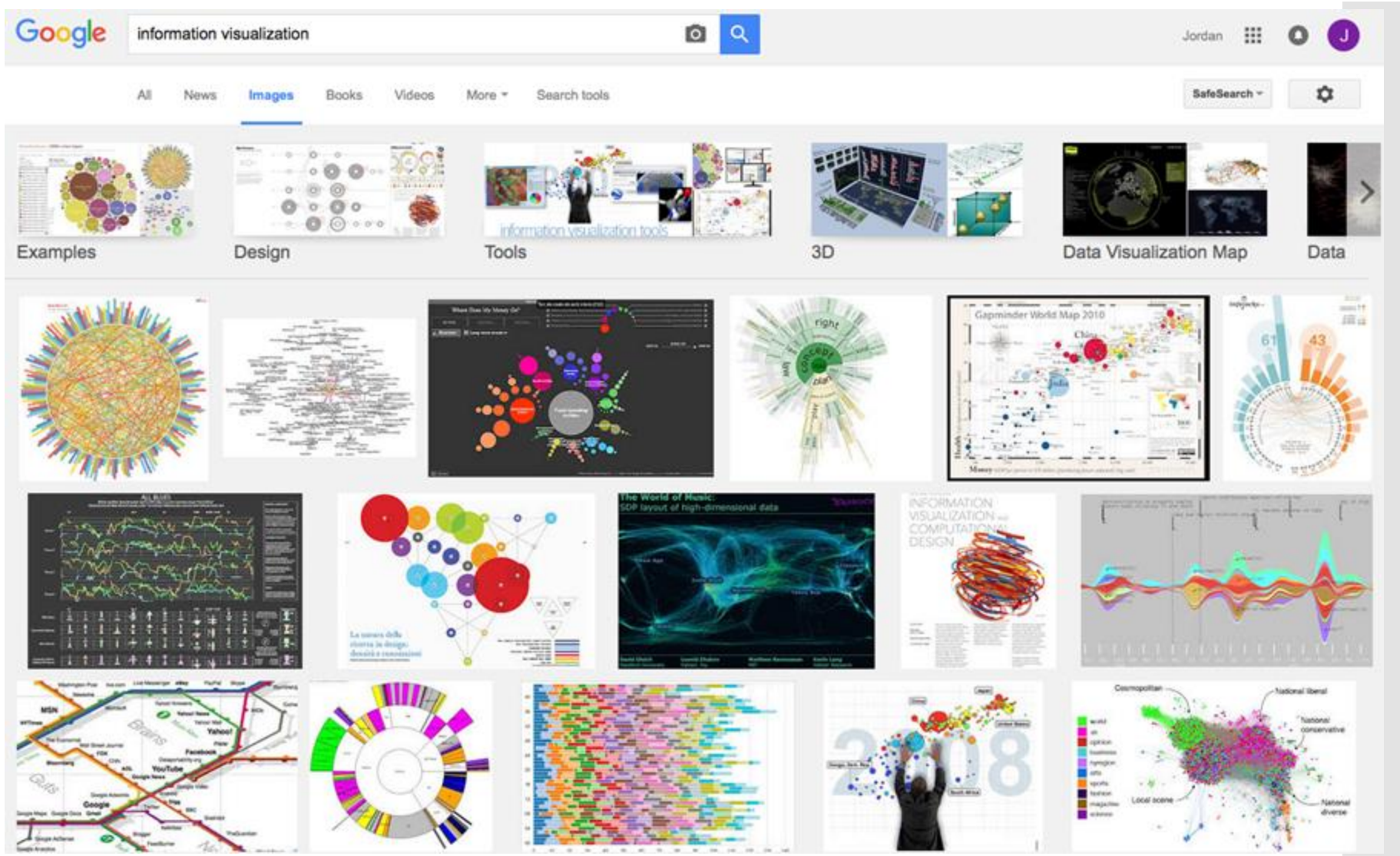


What is visualization?



What is visualization?



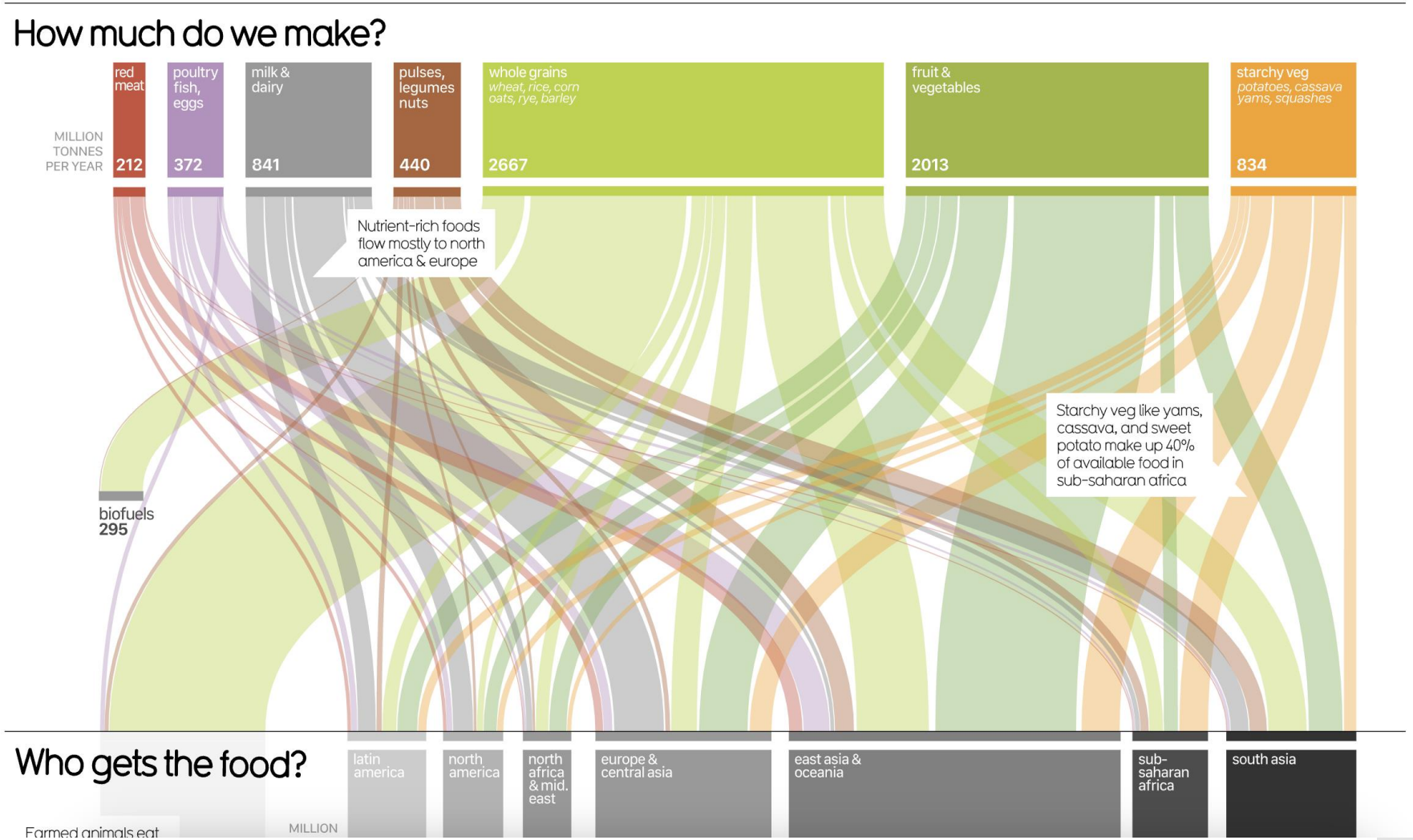
Perhaps a more helpful question:

What are some ways
a “visualization” can be **useful**?

Does it help you spot trends?

More info here: http://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak

Does it help you explore?



https://informationisbeautiful.net/visualizations/global-food-supply-where-does-all-the-worlds-food-go/

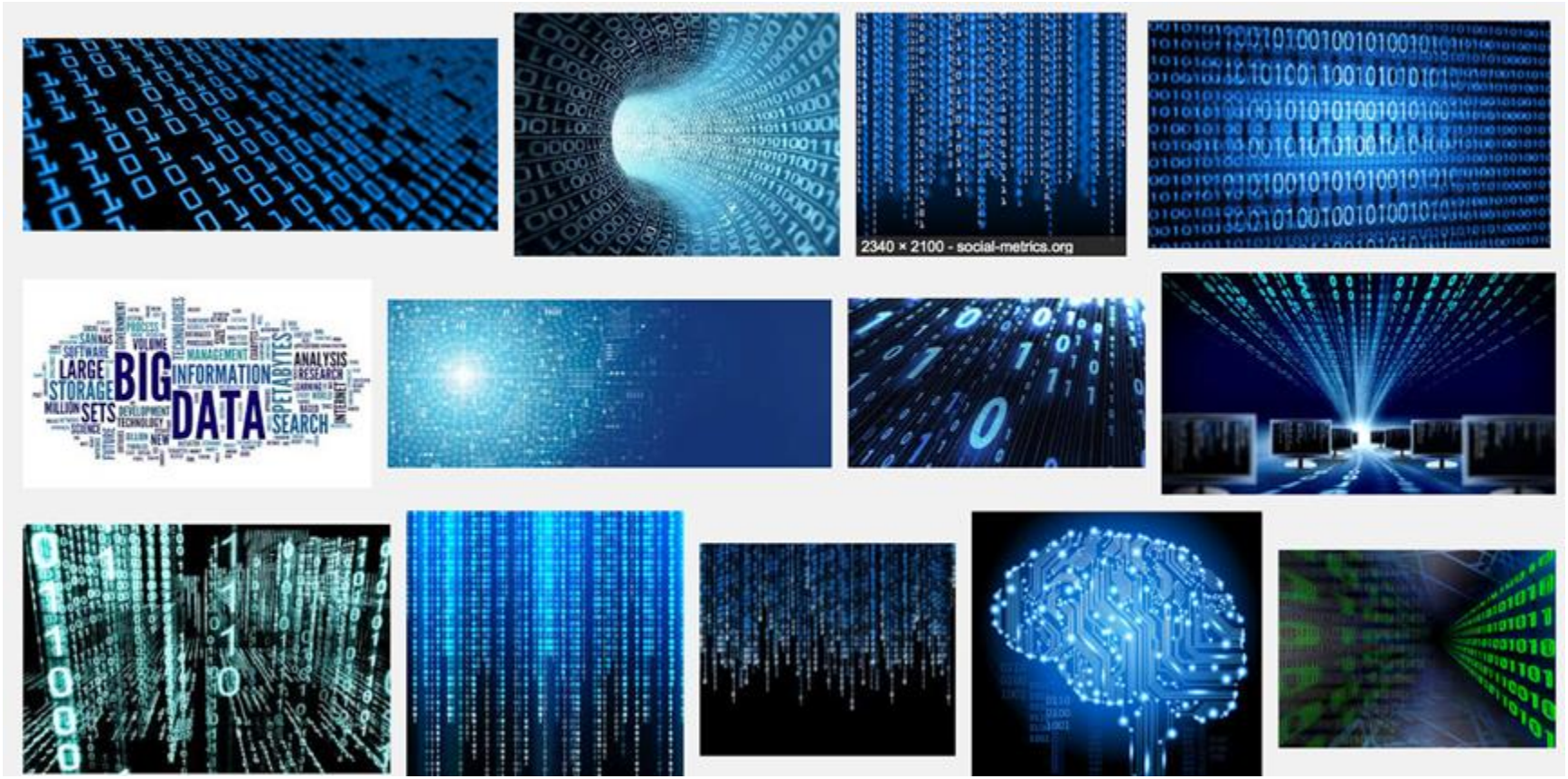
Does it tell a story?

Hans Rosling's 200 Countries, 200 Years, 4 Minutes – The Joy of Stats – BBC Four
https://www.youtube.com/watch?v=jbkSRLYSojo

Visualization (def.)

Visual **representations** of data that reinforce human **cognition**

Wait… what is “data”?



Data: a definition

Data is a set of *variables* that capture various aspects of the world:

Tuition rates, enrollment numbers, public vs. private, etc.

Data: a definition

A dataset also contains a set of *observations* (also called *records)* over these variables. For example:

tuition = $46,288, *enrollment* = 2,563, *private, etc.*

Data: a definition

A dataset also contains a set of *observations* (also called *records)* over these variables. For example:

tuition = $16,115, *enrollment* = 28,635, *public, etc.*

One way to think about this:

VARIABLES

OBSERVATIONS

	Tuition	Enrollment	Public vs. Private	…
Smith College	$46,288	2,563	private	
UMass Amherst	$16,115	28,635	public	
Hampshire College	$48,065	1,400	private	
Mount Holyoke College	$43,886	2,189	private	
Amherst College	$50,562	1,792	private	
⋮				

Another way to think about this

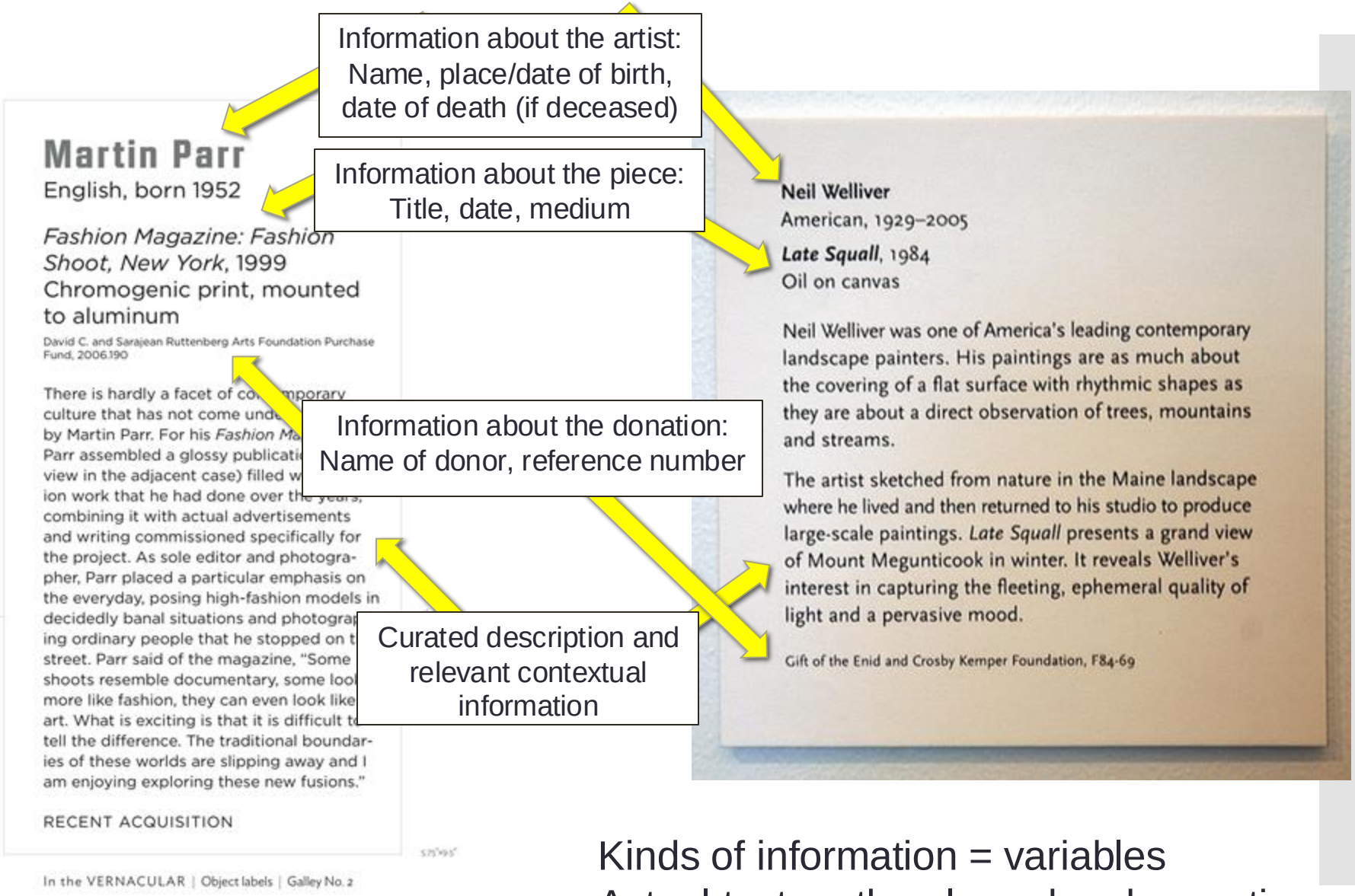
```
class school_obs:
      def __init__(tuition, enrollment,
                   pub_or_priv):
            self.tuition = tuition
            self.enrollment = enrollment
            self.pub_or_priv = pub_or_priv
```

VARIABLES

OBSERVATIONS

```
smith = school_obs(46288, 2563, “private”)
umass = school_obs(16115, 28635, “public”)
```

Yet another way to think about this



Kinds of information = variables
Actual text on the placard = observations

Data: a definition

Each variable may be either *independent* or *dependent*:

- An *independent variable* is not controlled or affected by another variable (e.g., time in a time-series dataset)
- A *dependent variable* is affected by a variation in one or more associated independent variables (e.g., temperature in a region)

Basic data types

- Nominal
- Ordinal
- Scale / Quantitative
  - Ratio
  - Interval

An unordered set {…}
of non-numeric values

For example:

- Categorical (finite) data
  {apple, orange, pear}
  {red, green, blue}
- Arbitrary (infinite) data
  {“12 Main St. Boston MA”, “45 Wall St. New York NY”, …}
  {“John Smith”, “Jane Doe”, …}

Basic data types

- Nominal
- Ordinal
- Scale / Quantitative
  - Ratio
  - Interval

An ordered set <…>
(also known as a tuple)

For example:

- Numeric: <2, 4, 6, 8>
- Binary: <0, 1>
- Non-numeric:
  <G, PG, PG-13, R>

Basic data types

- Nominal
- Ordinal
- Scale / Quantitative
  - Ratio
  - Interval

A numeric range […]

Ratios

- Distance from “absolute zero”
- Can be compared mathematically using division
- For example: height, weight

Intervals

- Ordered numeric elements that can be mathematically manipulated, but cannot be compared as ratios
- E.g.: date, current time

Converting between basic data types

- Q → O [0, 100] → <F, D, C, B, A>
- O → N <F, D, C, B, A> → {C, B, F, D, A}
- N → O (??)
  - {John, Mike, Bob} → <Bob, John, Mike>
  - {red, green, blue} → <blue, green, red>
- O → Q (??)
  - Hashing?
  - Bob + John = ??

Readings in Information Visualization: Using Vision To Think. Card, Mackinglay, Schneiderman, 1999

Basic operations

- Nominal (N)
  - Equality: = and ≠
  - Frequency: how often does *x* appear?
- Ordinal (O)
  - Relation to other points: >, <, ≥, ≤
  - Distribution: inference on relative frequency
- Quantitative (Q)
  - Other mathematical operations: (+, -, *, /, etc.)
  - Descriptive statistics: *average, standard deviation, etc.*

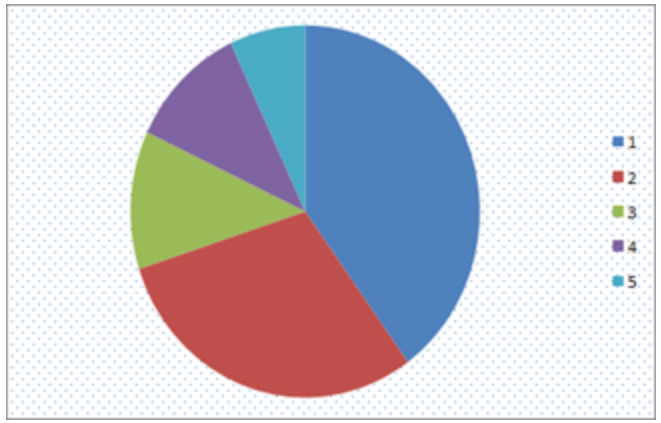
Why is this important?

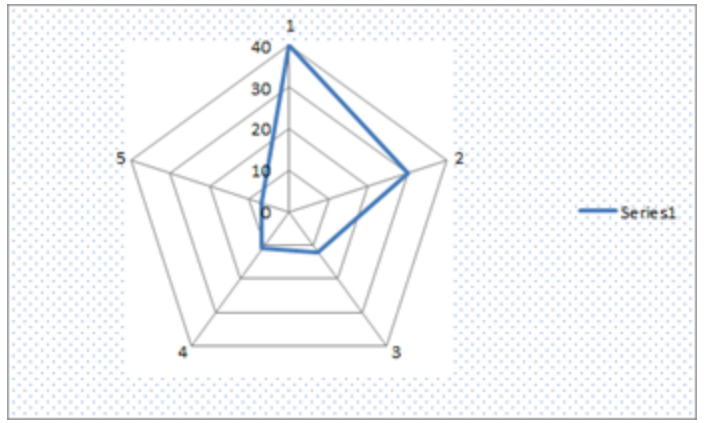
- Data have dimensions
- Visualizations have dimensions, too
- To build visualizations, we need to **map** data dimensions to visual dimensions

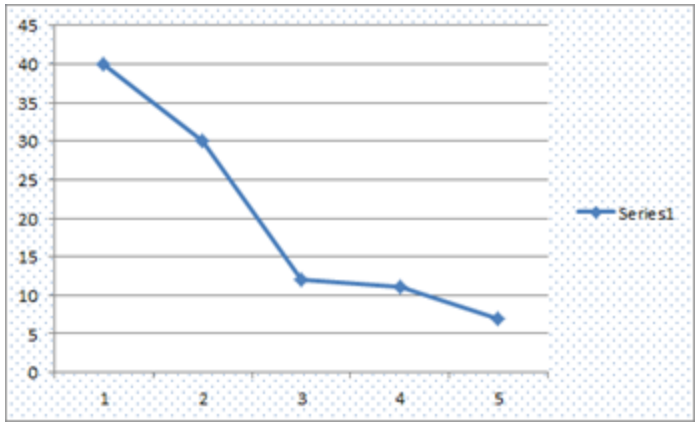
Key question for this course

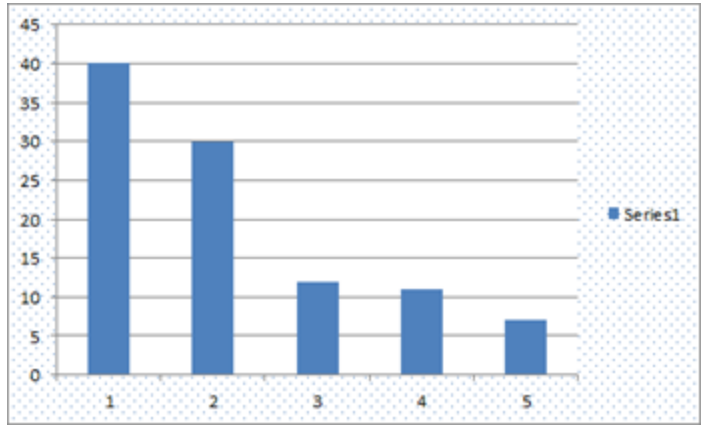
Which **data dimension** should be mapped

to which **visual dimension?**

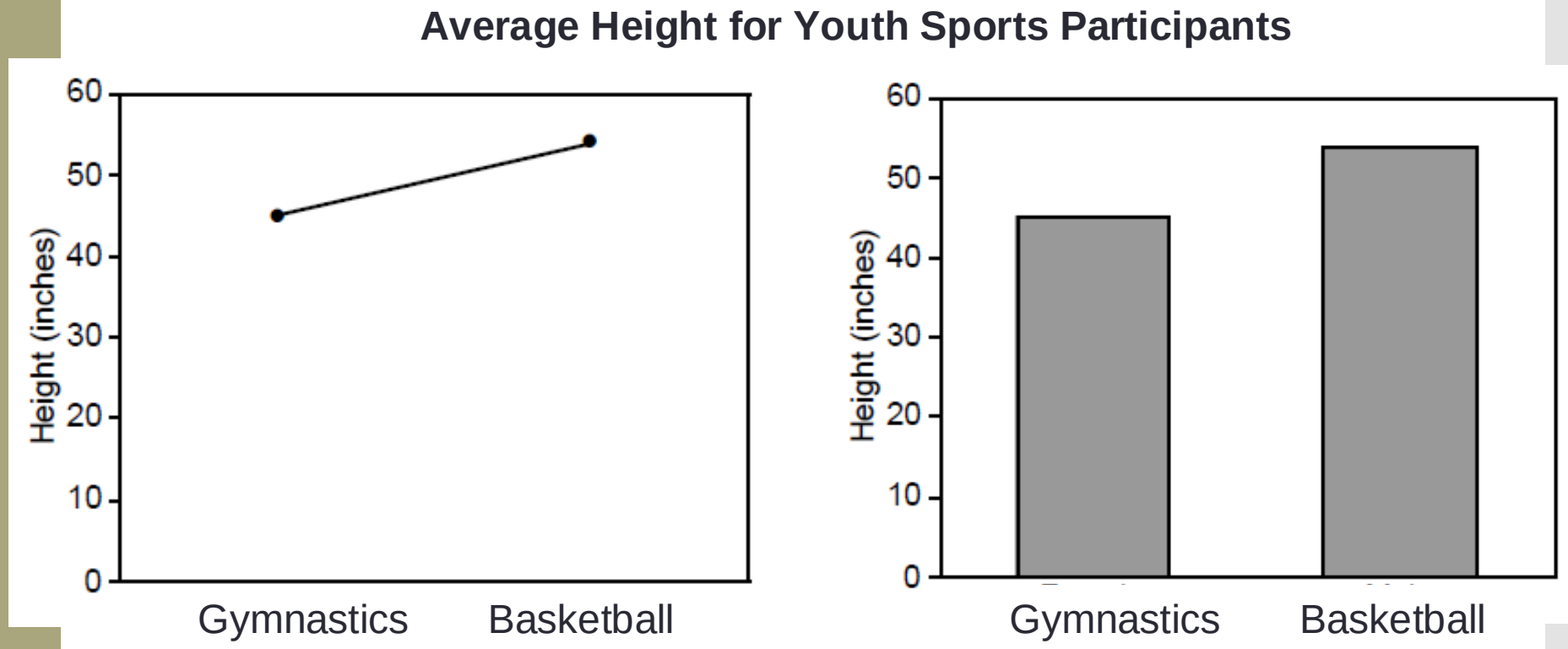








Answer: it depends



What we'll cover in this class

- Visua ization Fundamenta s (next c ass)
- Perception
- Design Princip es
- Co or Theory
- Dea ing with Mu tip e Variab es
- Text Data
- Storyte ing with Data
- Data Driven Journa ism
- Animation and Movement
- nteractive Visua ization

General information

- Course website:
  - https://amosca01.github.io/SDS-CS109/

Structure of this course

- Disclaimer:

  this class is an experiment in **constructionism**
  (the idea that people learn most effectively
  when they're building personally-meaningful things)

- Our job as instructors:

Preparing for labs

- Our labs will be run using Tableau, a drag-and-drop visualization tool suite
- Tableau for Teaching has donated license keys (good for one year) for everyone enrolled in this course
- Instructions for getting a license will be posted to shortly

Course project

- Goals:
  - Learn how to break big, unwieldy questions down into clear, manageable problems
  - Figure out if/how the techniques we cover in class apply to your specific problems
  - **Use visualization to address them**
- Several (graded) milestones along the way
- Demos and discussion on the final day of class

gain real experience | solve real problems
build real relationships

What you'll get

By the end of this course, you will:

- Know how to use visualization to **communicate ideas**
- Know the **foundational methods** and tools available
- Be familiar with **ongoing research** in visualization
- Have (marketable!) experience developing useful visualizations to solve **real problems**

What I expect from you

- You like challenging problems, and you're excited about "figuring stuff out"
- You're willing to get comfortable asking questions
- You're interested in the perspectives of people with very different backgrounds from your own
- You turn things in on time, show up to class, or let me know in advance*

What you can expect from me

- I'm flexible w.r.t. the topics we cover:
  - This course is a collaboration
  - If there's something you want to learn that's not on the agenda, speak up!
  - If I'm doing something that doesn't work for you (Font too small on presentations? Speaking too quickly? Using a marker or color you can't see?), please let me know!

I'm here to help you succeed, and I believe you all have the ability to succeed

Questions?