

Data and the State

PUBPOL 2130 / INFO 3130



**Graphs, flows, and
arms**

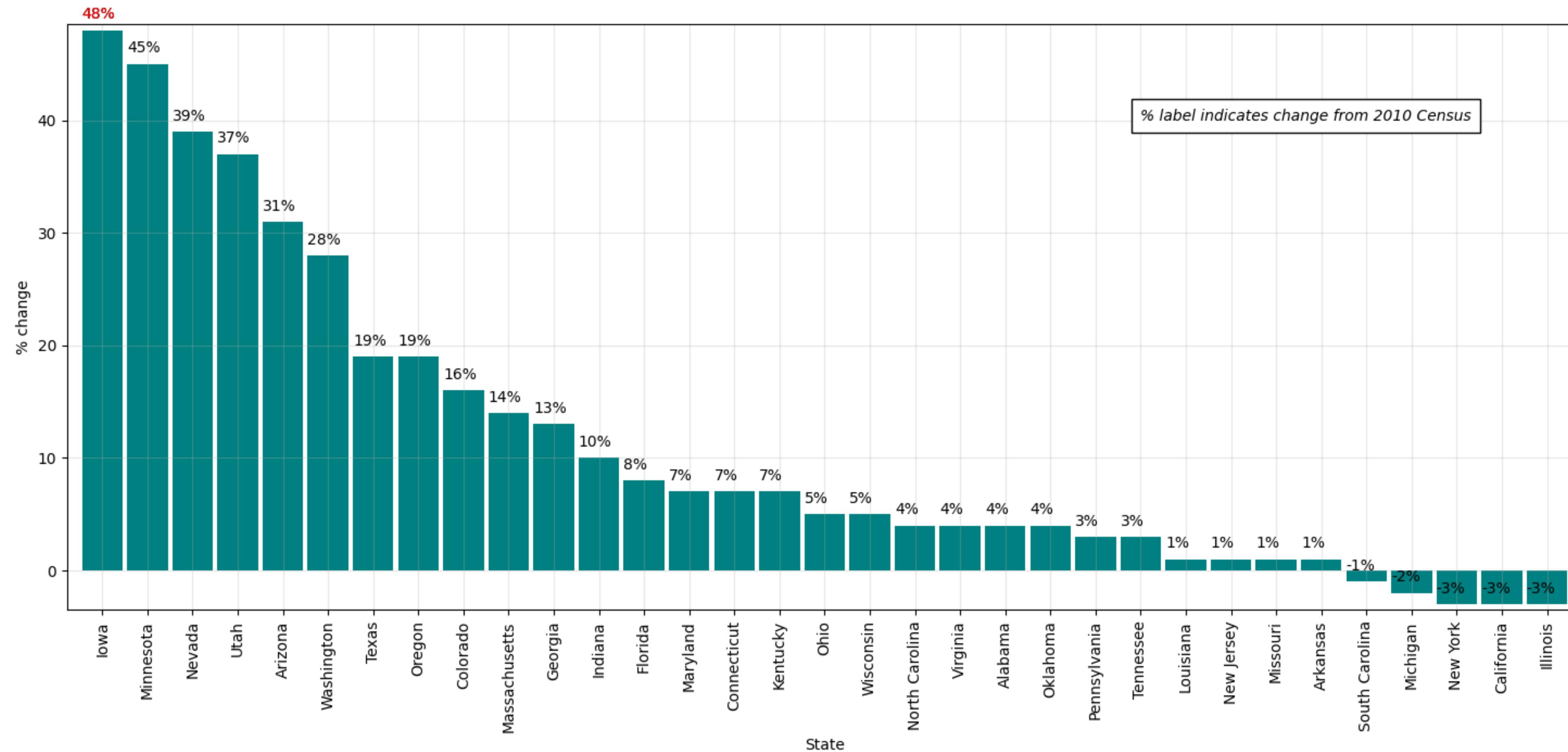
Lecture 8, Thursday Feb 18

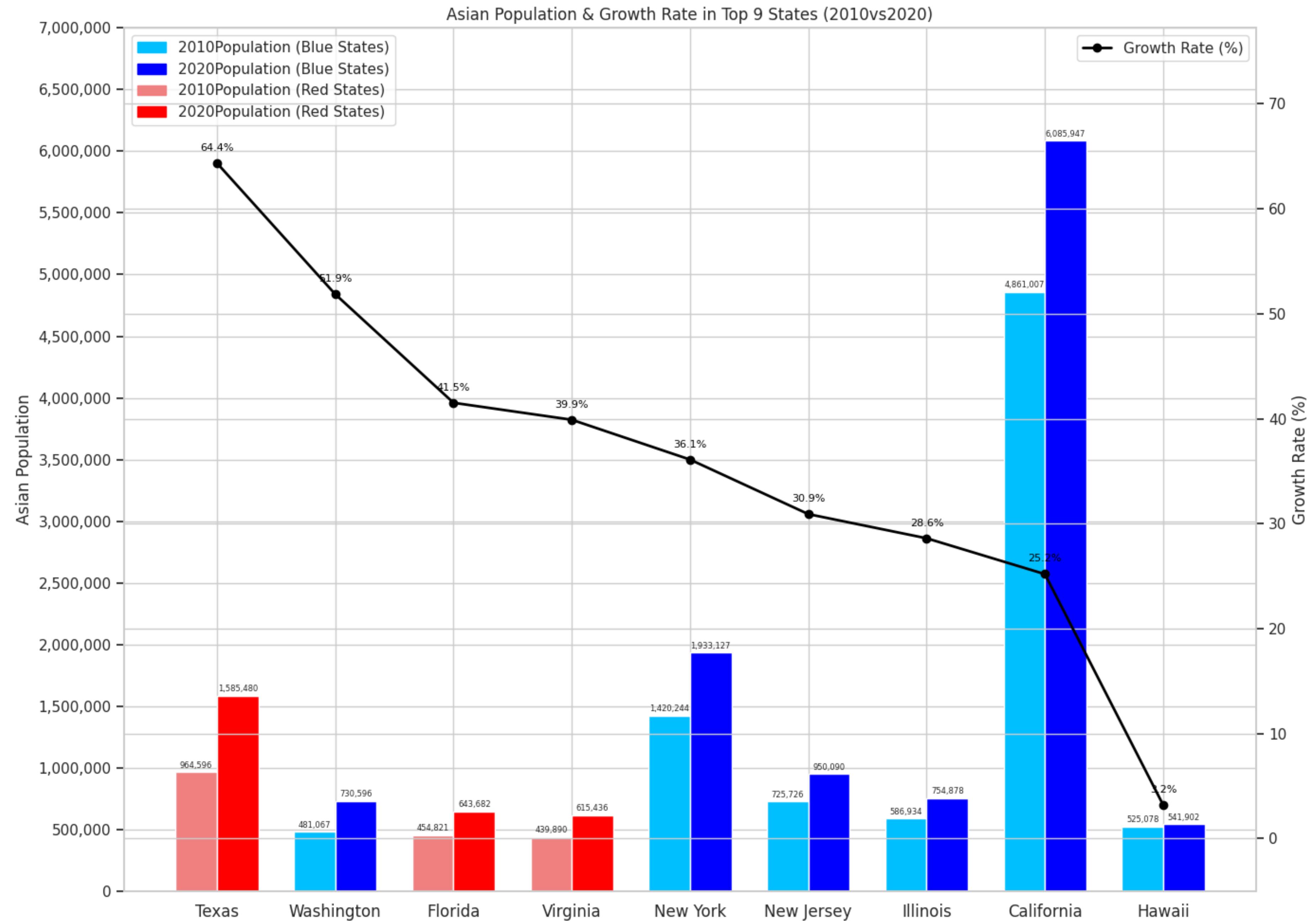
Announcements

- Fill out poll asap, please! tinyurl.com/2130-poll
- Exam info — mostly graded, will get back Tuesday.
- We'll be offering regular Python learner sessions with Jennah on **Tuesdays** from 5:30-7pm in Malott. You can sign up so she knows people are coming, but you can also just show up.
- This week we'll have a special Python session **today (Thursday)** from 5:30-7pm. Come for installations, debugging, practice, and skill-building. All levels welcome, especially beginners!

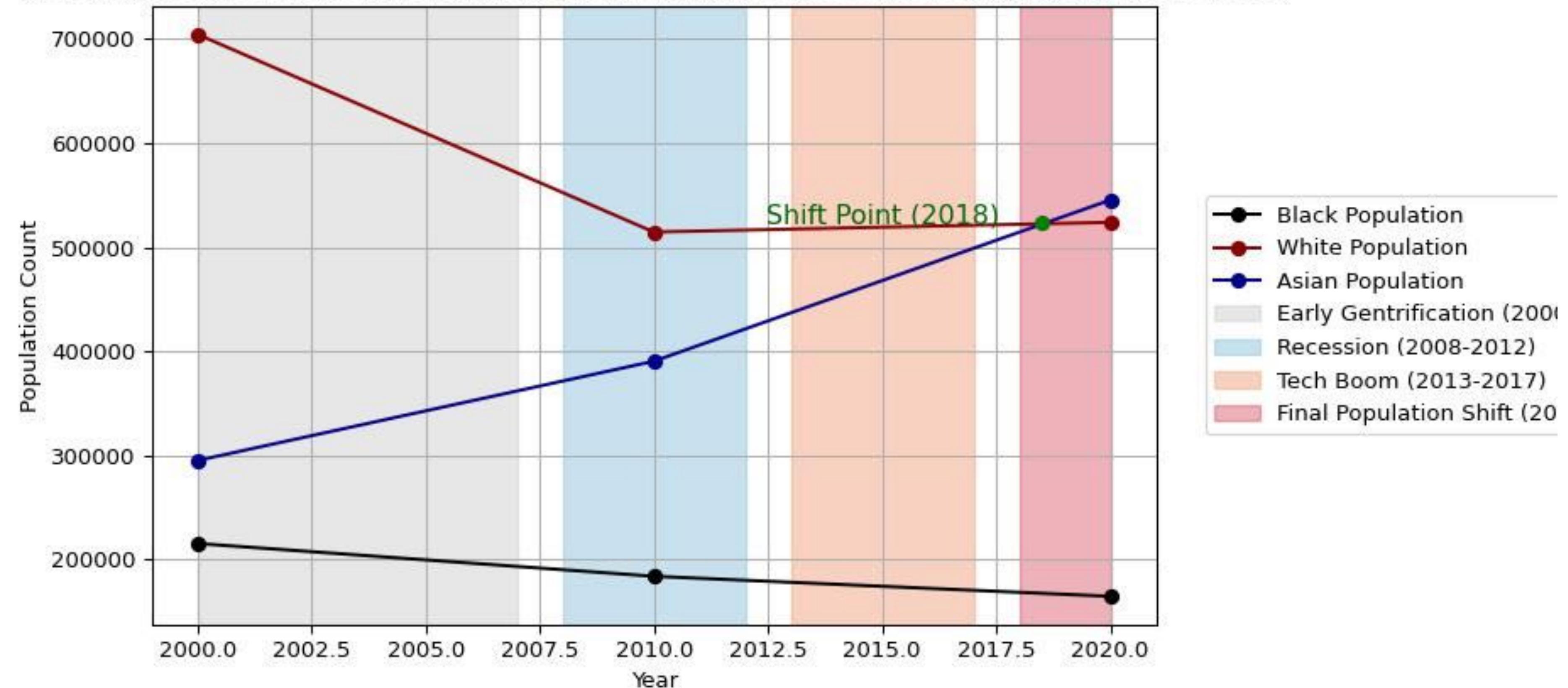
some of your work from HW2

Percent Change of Black Population (Population > 3,000,000), 2010 to 2020 Census

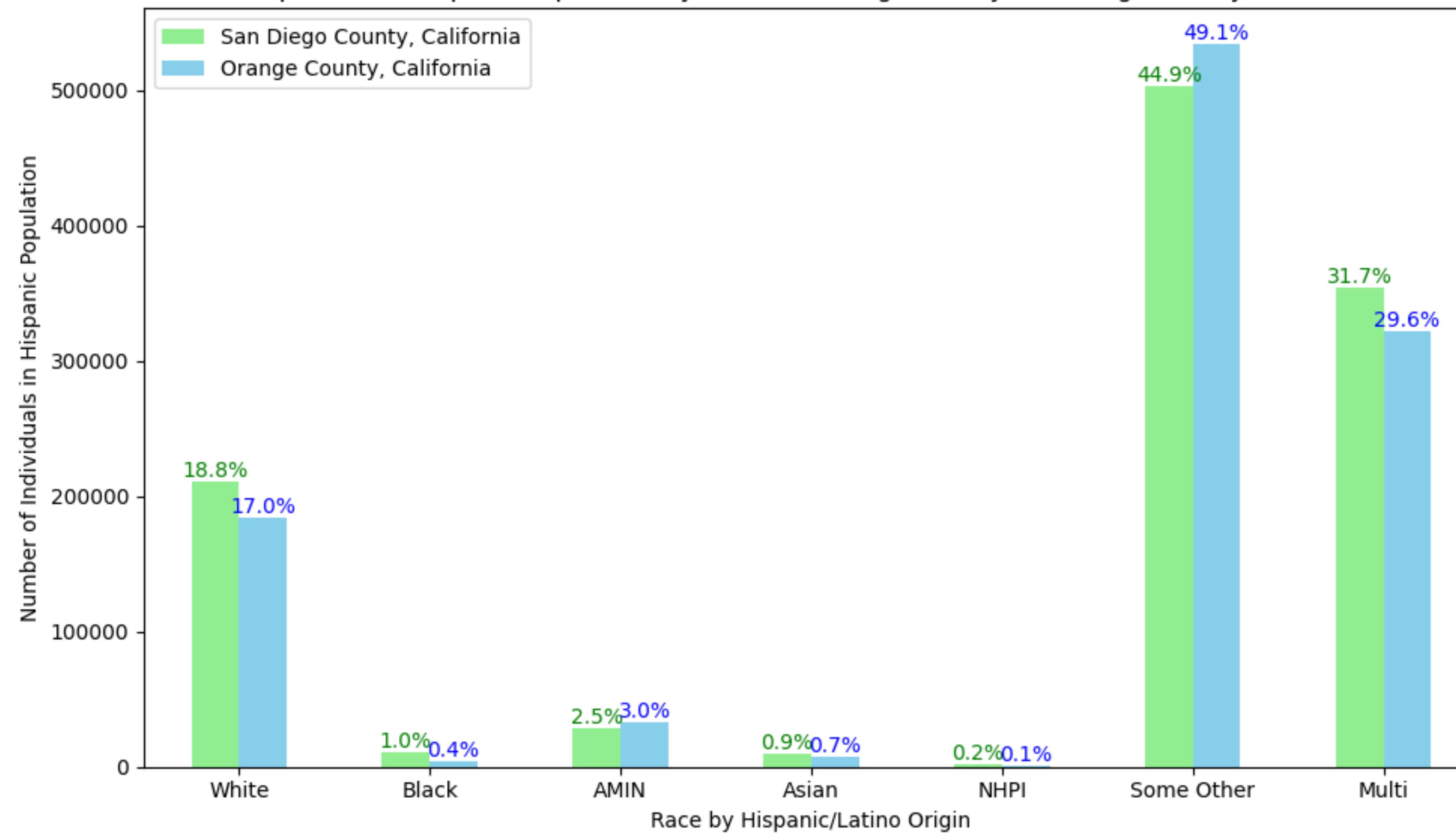




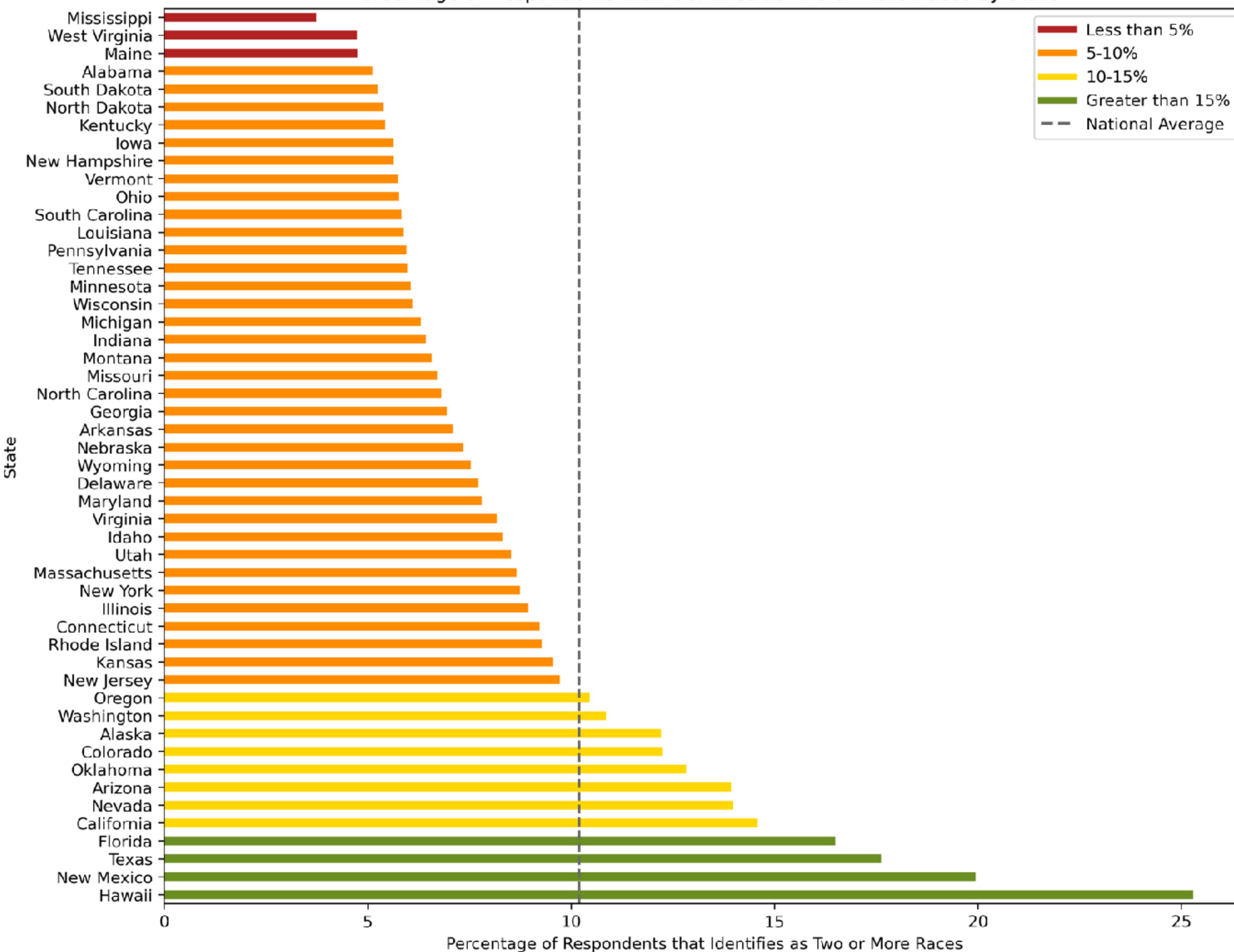
Historical Events and Racial Population Change in Alameda County (Oakland, CA) (2000-2020)



Comparison of Hispanic Population by Race: San Diego County vs. Orange County in California

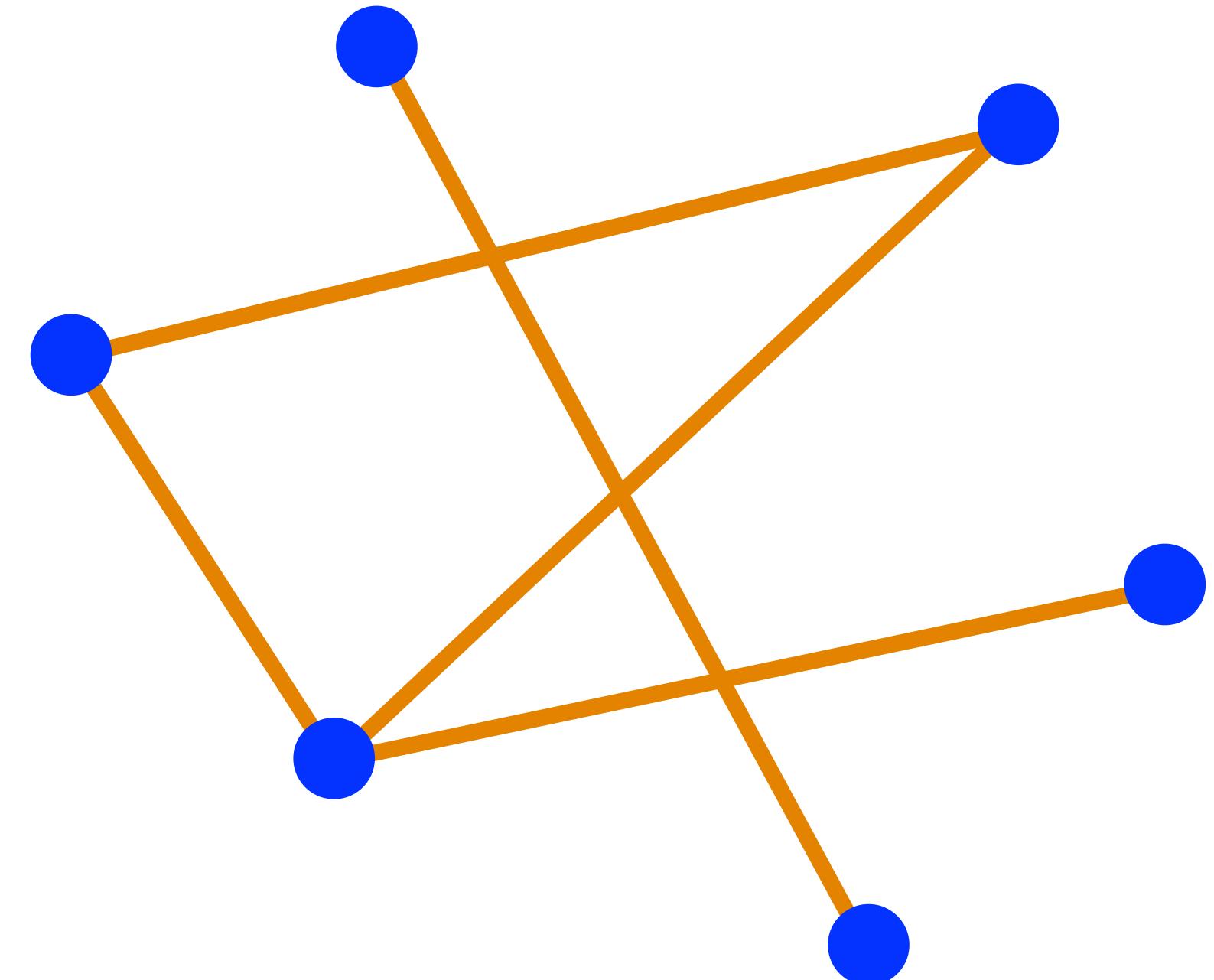


Percentage of Respondents that Identifies as Two or More Races by State



graphs and flows

Graphs



A graph starts with a collection of **nodes**
(also known as **vertices**)

Some of them are connected by **edges**

This is just a general abstract object (and associated data structure) that is useful to represent relationships between pairs of entities

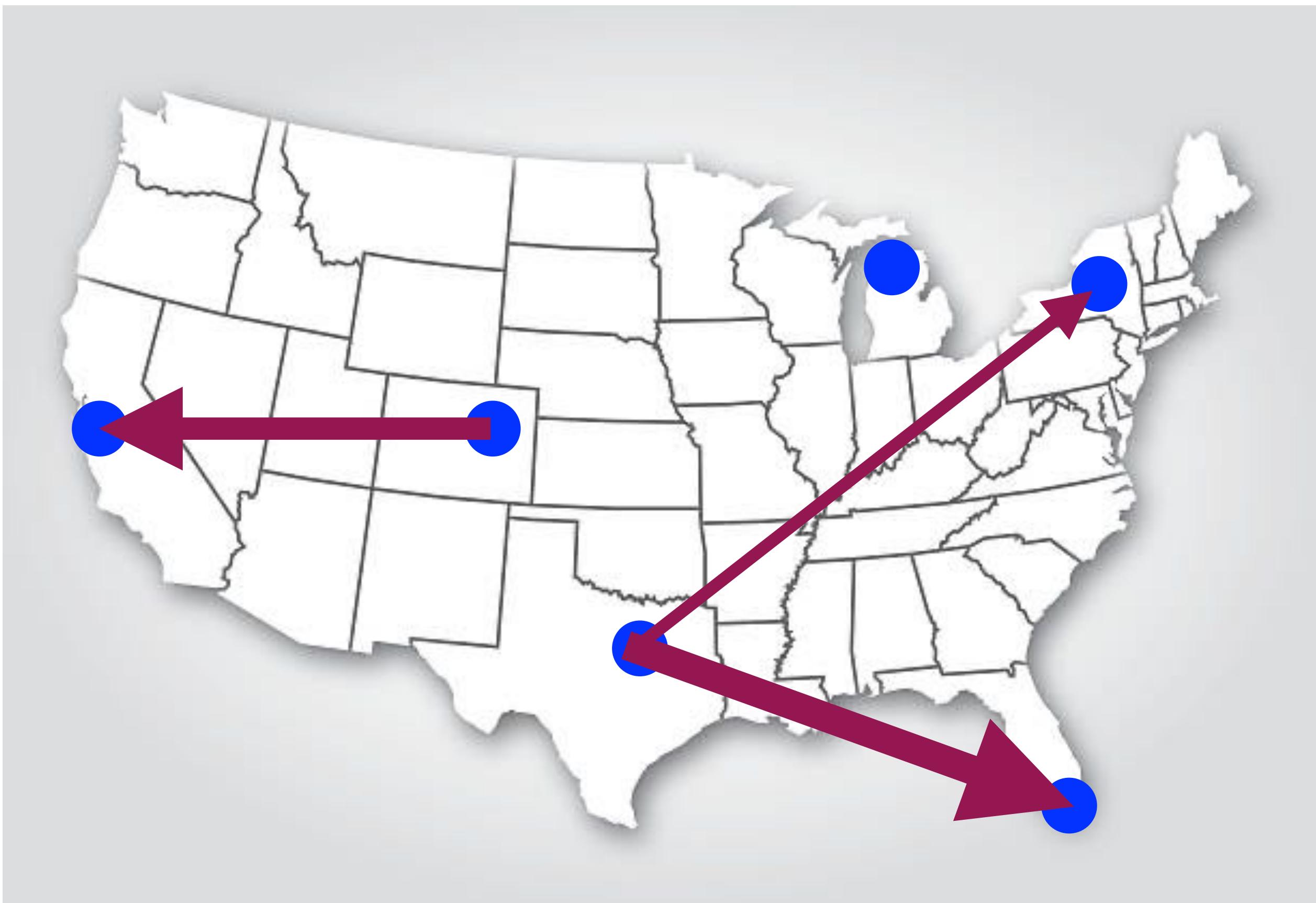
A **tree** is an important special case: it's just a graph with no cycles

Examples:

Family tree

Shipping patterns

Infectious disease

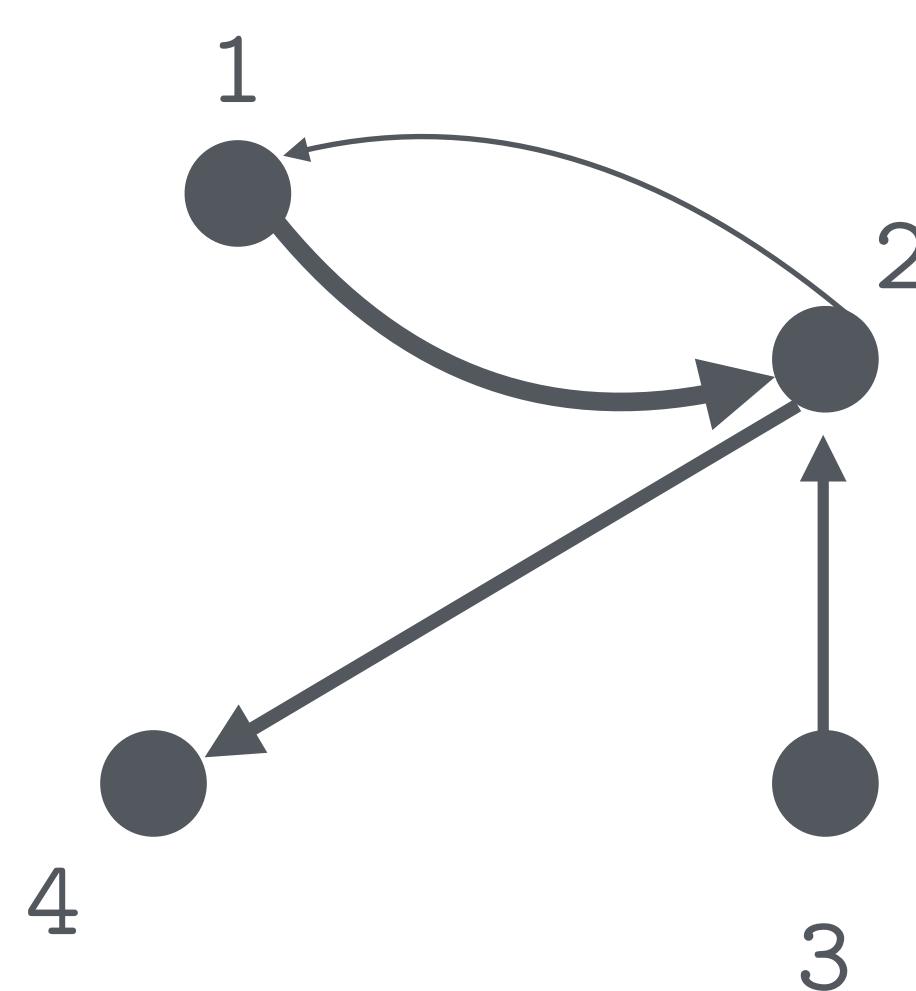
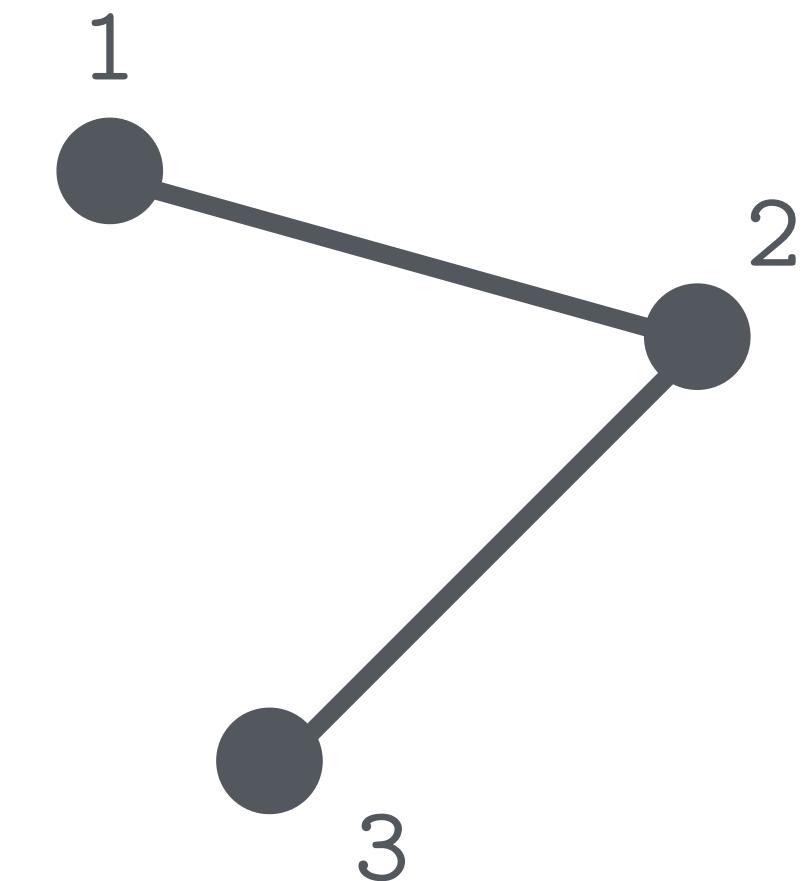


If we pair a map with a graph by specifying locations for nodes, then we can use **directed** and **weighted** edges to represent flows from point to point

Graphs in Python

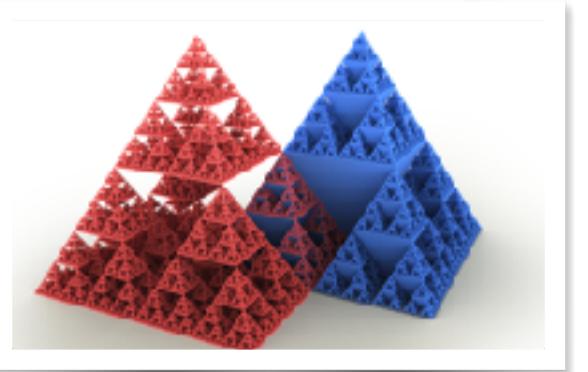
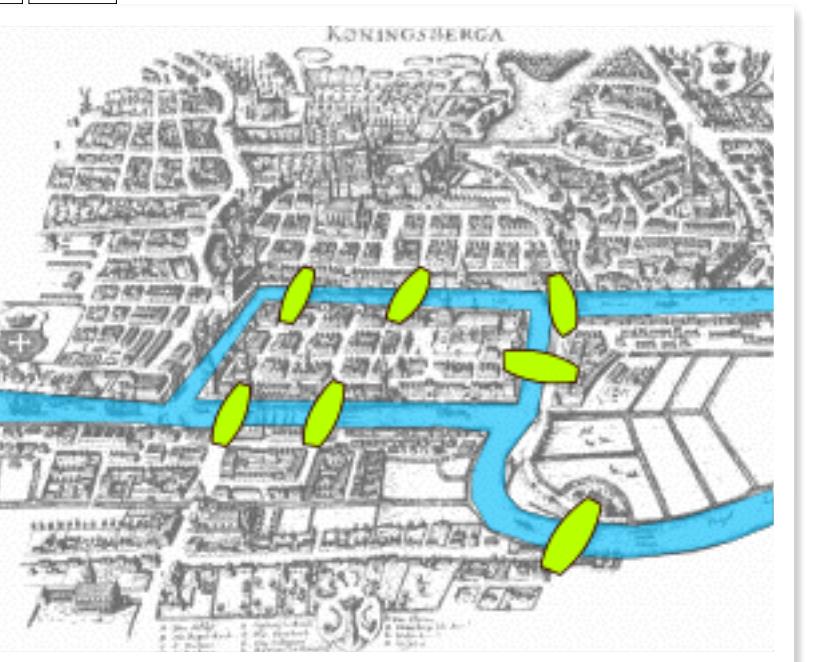
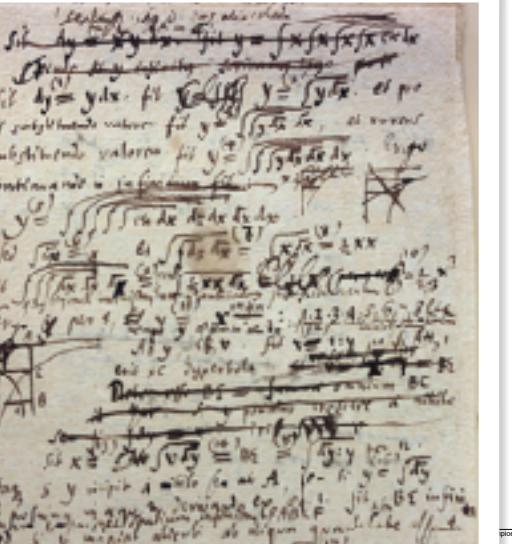
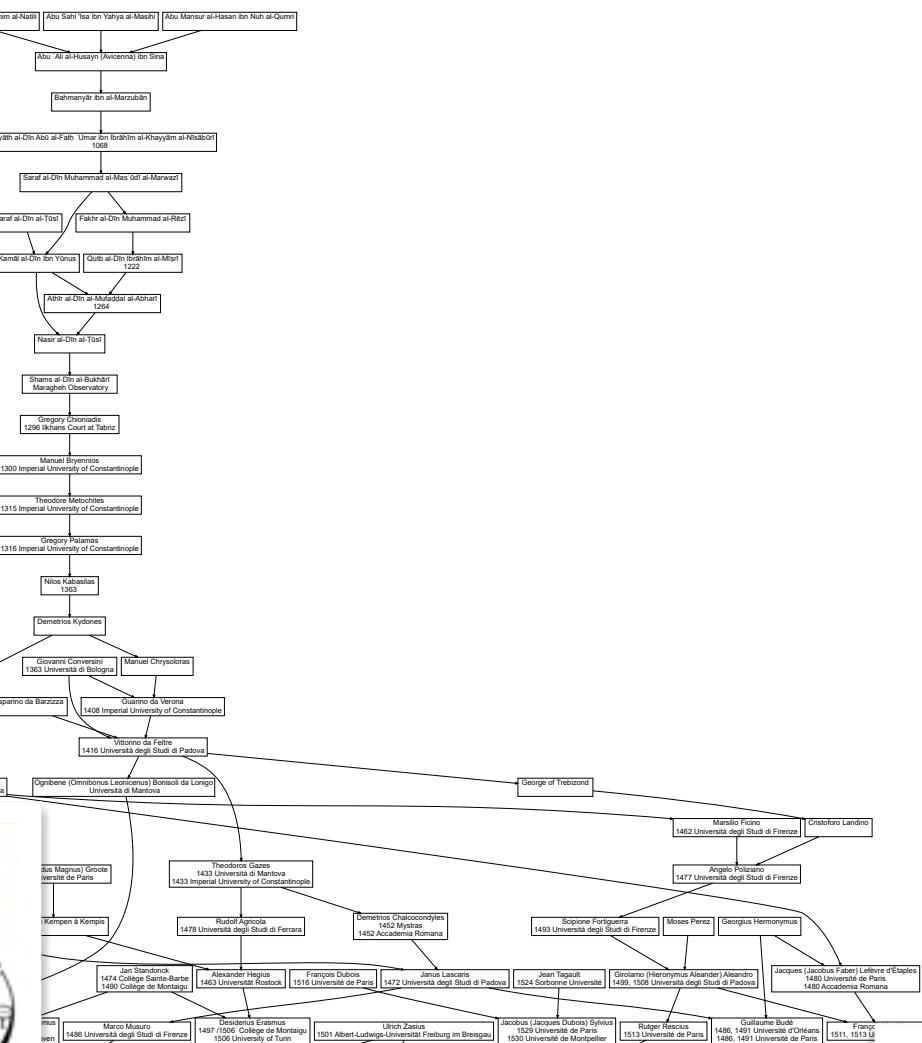
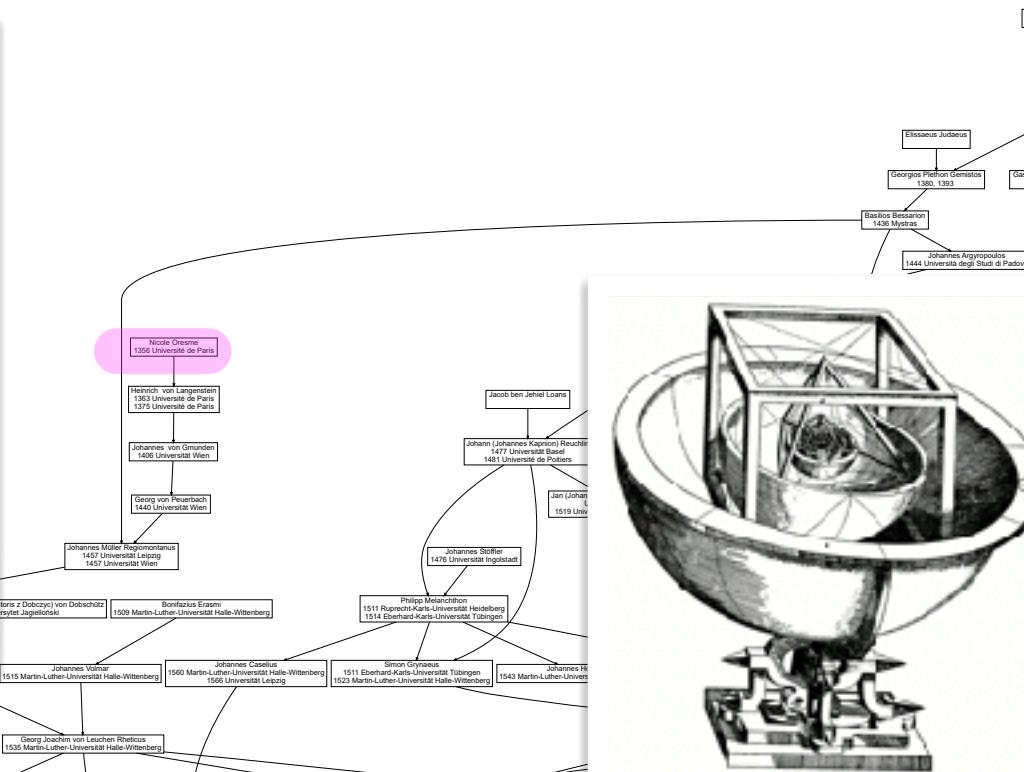
- The most common Python library for graphs is called NetworkX
- Graphs are built out of a basic Python structure called a dictionary, which is a collection of pairs
- The lingo for dictionaries is “key:value pairs”, so here the starting endpoint for an edge is the key and the stopping endpoint, plus any edge attributes, is the value

```
{  
    1: {2: {}},  
    2: {1: {}, 3: {}},  
    3: {2: {}}  
}
```



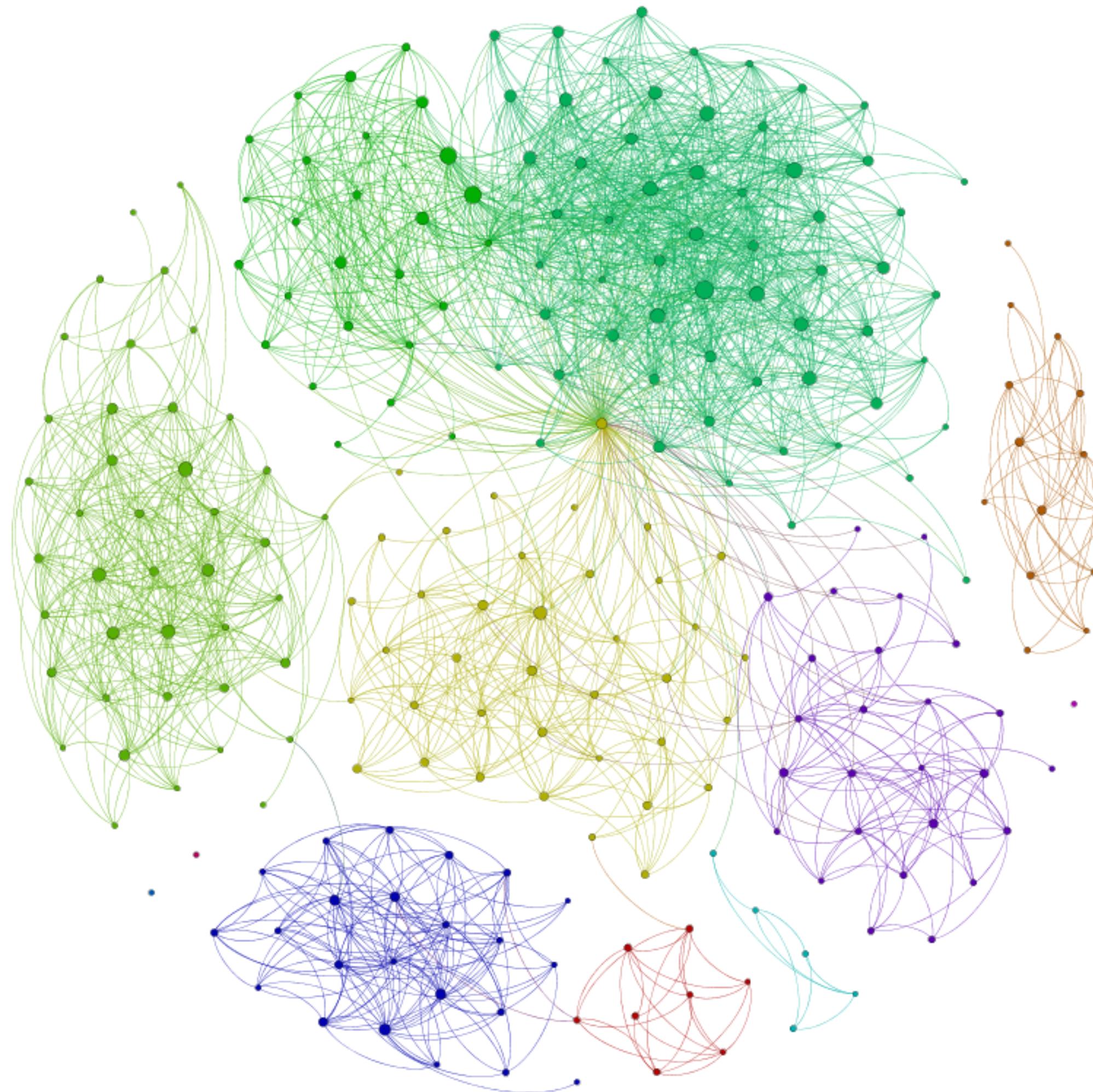
```
{  
    1: {2: {'weight': 3.5}},  
    2: {1: {'weight': 1}, 4: {'weight': 2.6}},  
    3: {2: {'weight': 2.1}}  
}
```

Math family tree



Academic Genealogy of Victor Donnay and Christopher Donnay
The Mathematics Genealogy Project is a service of
North Dakota State University and the American Mathematical Society
<http://www.mathgenealogy.org>

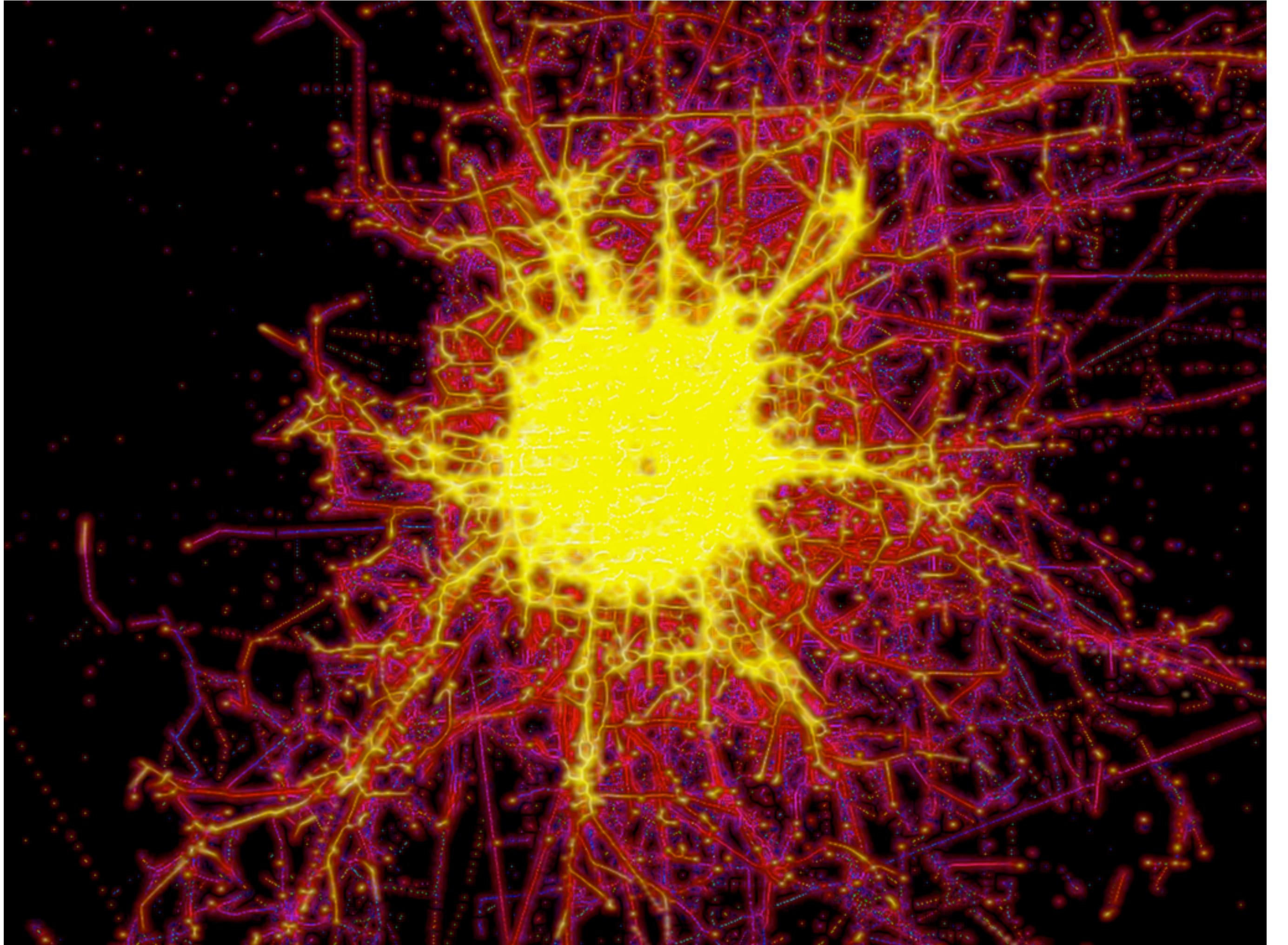
A social network



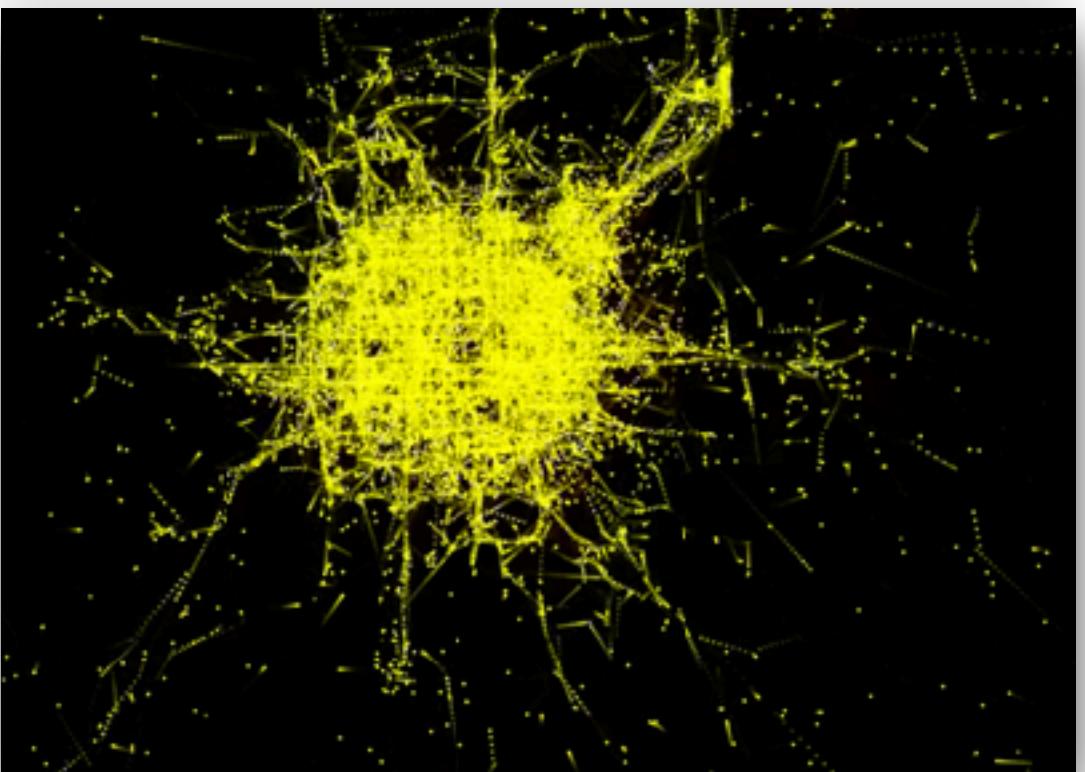
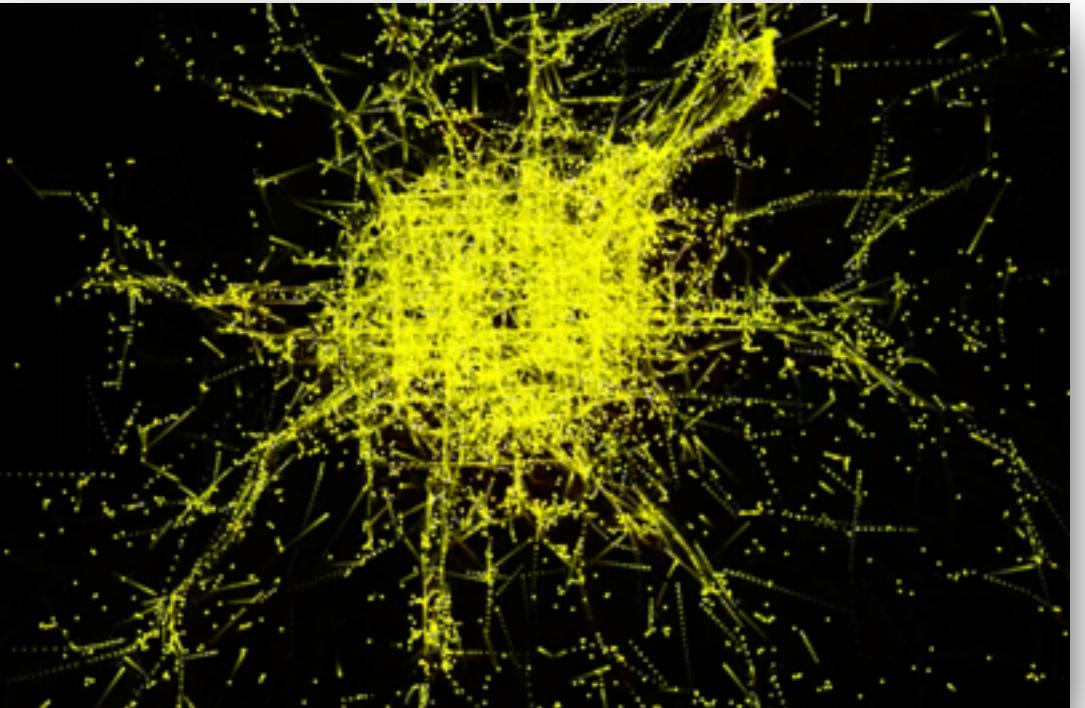
Global shipping routes



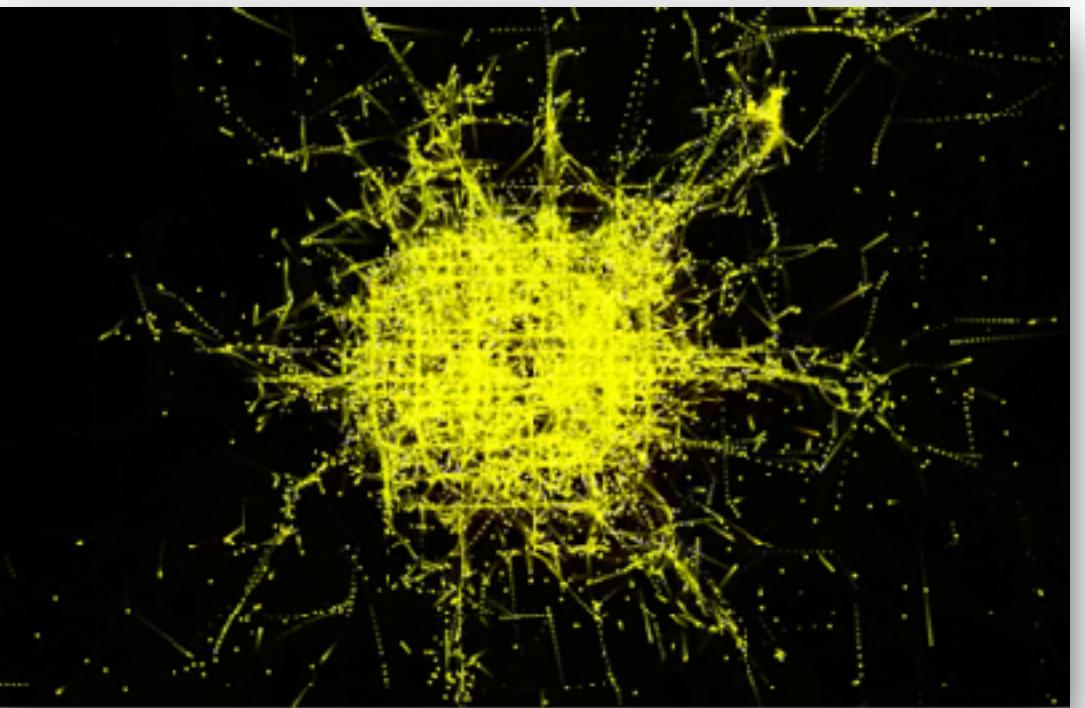
One day of taxis in Beijing



heatmap



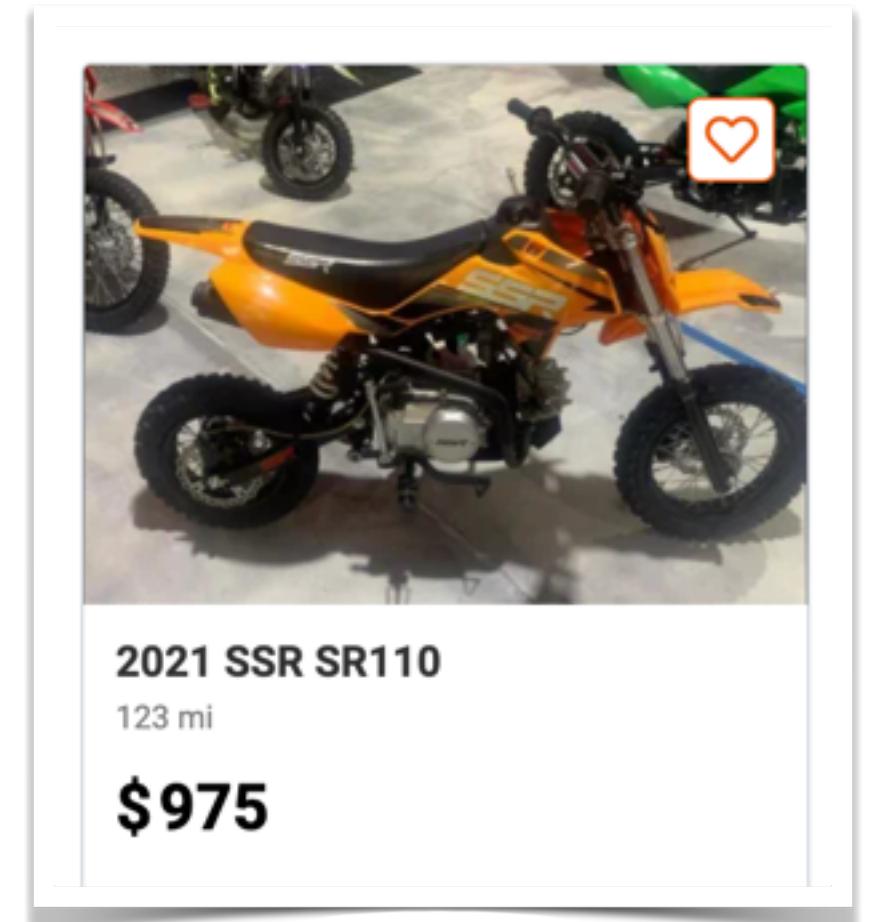
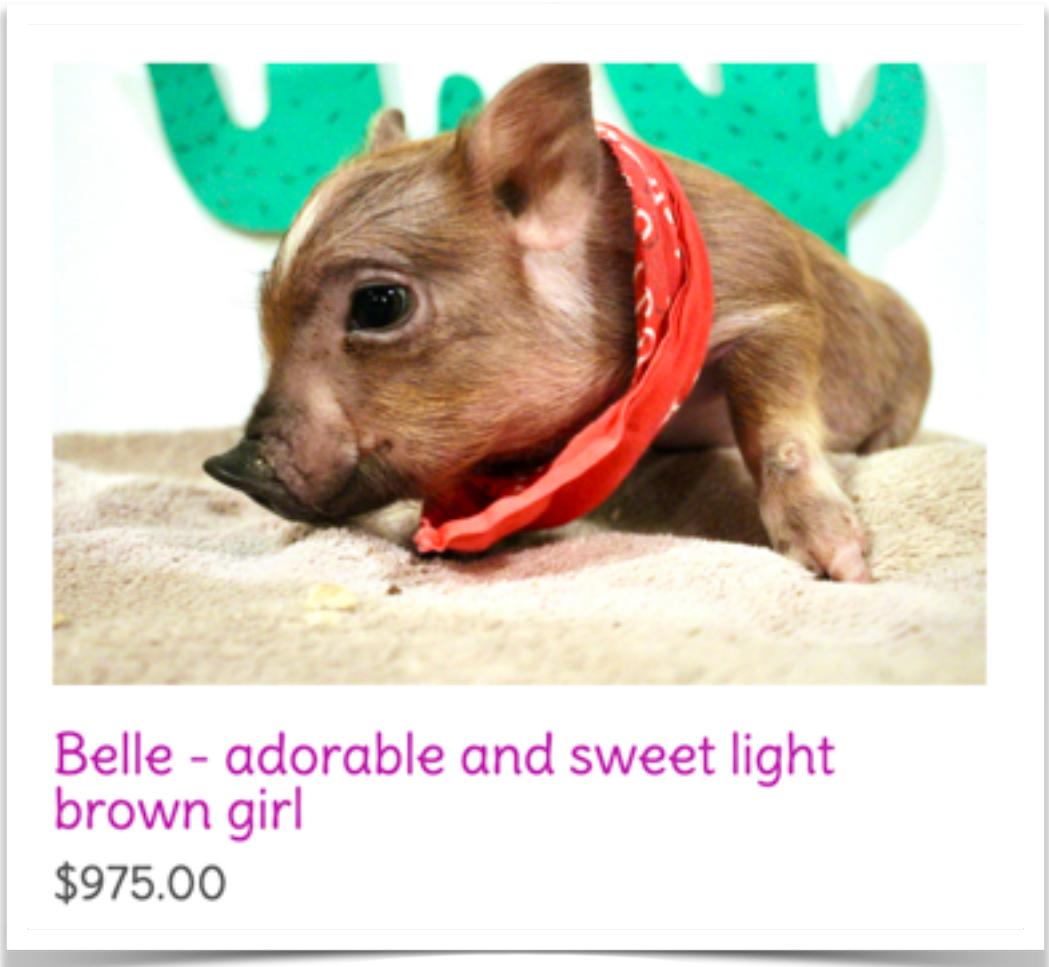
snapshots



commensurating units

Commensurating units

- If you add $\frac{2}{5} + \frac{3}{4}$, it might be hard to see how they will combine
- But a common denominator of 20 makes this $\frac{8}{20} + \frac{15}{20}$, and now they are easier to compare and combine
- Same thing goes for making comparisons across time and place, often needed in public policy terms
- For example, if you want to track incomes across time by employment sector, you might convert all values to 2020 dollars (say) to control for inflation
- In fact, many economists would say this is **what money is** — a constructed way to make goods and services comparable



Weapons flows

- We will examine the flow of major weapons around the world using a large dataset constructed by **SIPRI** – the Stockholm International Peace Research Institute
- They have constructed a commensurating unit called **TIV** or Trend-Indicator Value. It's not quite the same as price, but is intended to quantify military capability through a mix of cost and lethality



Mi-17 Helicopter

7.25 TIV



MTU-183 diesel engine

0.08 TIV



T-34-85

0.95 TIV

Example: Spain sent Turkey 730 TIV in 2003

Dataframe of major weapons transfers

0s

```
arms_df[(arms_df["Weapon designation"] == "Mi-17") & (arms_df["Supplier"] != "Russia") & (arms_df["Supplier"] != "Soviet Union")]
# arms_df[arms_df["status"] == "Second hand"]
```

	Recipient	Supplier	Year of order	Number ordered	.1	Weapon designation	Weapon description	Number delivered	.2	Year(s) of delivery	status	Comments	SIPRI TIV per unit	SIPRI TIV for total order
4	Afghanistan	United Kingdom	2009.0	Nan	2.0	Nan	Mi-17	transport helicopter	2.0	Nan	2010	Second hand	Second-hand Mi-17 version bought by UK for 'Pr...	2.90 5.80
89	Afghanistan	unknown supplier(s)	2007.0	?	6.0	Nan	Mi-17	transport helicopter	6.0	Nan	2008	Second hand	Probably second-hand; financed by UAE	2.90 17.40
91	Afghanistan	Slovakia	2007.0	Nan	3.0	?	Mi-17	transport helicopter	3.0	?	2008	Second hand	Second-hand; aid	2.90 8.70
94	Afghanistan	Czechia	2007.0	Nan	6.0	Nan	Mi-17	transport helicopter	6.0	Nan	2007; 2008	Second hand but modernized	Second-hand but modernized before delivery; ai...	4.79 28.71
153	African Union**	unknown supplier(s)	2004.0	Nan	15.0	Nan	Mi-17	transport helicopter	15.0	?	2005	Second hand	Leased from and operated by civilian company f...	2.90 43.50
							Second-	

FlowmapBlue will make interactive flowmap

