

# CS 171: Visualization

Hanspeter Pfister  
[pfister@seas.harvard.edu](mailto:pfister@seas.harvard.edu)

# To convey information through visual representations



## CNN ElectionCenter2008

★ ★ RESULTS FROM CNN ★ ★

Electoral votes: Obama 365 ✓ | McCain 173  
(270 to win)

■ Obama ■ McCain ■ Still voting ■ Processing



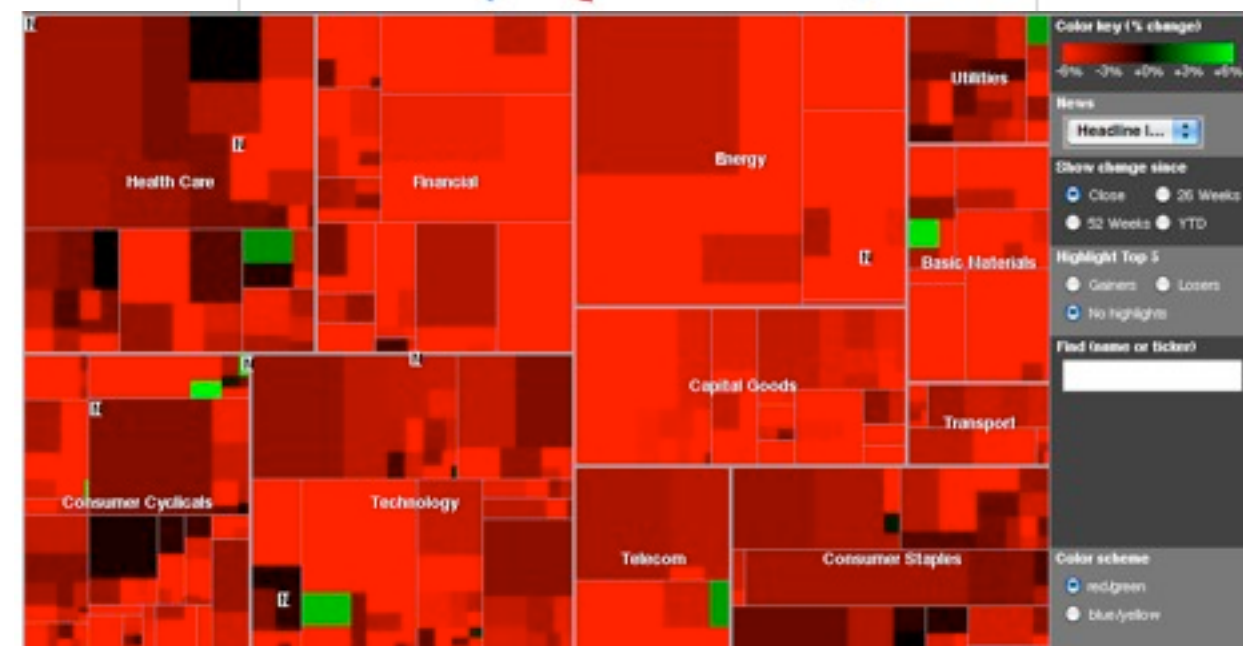
Budget Shortfalls
Share of General Fund
Revenues

Budget shortfalls for 2009 fiscal year, per capita



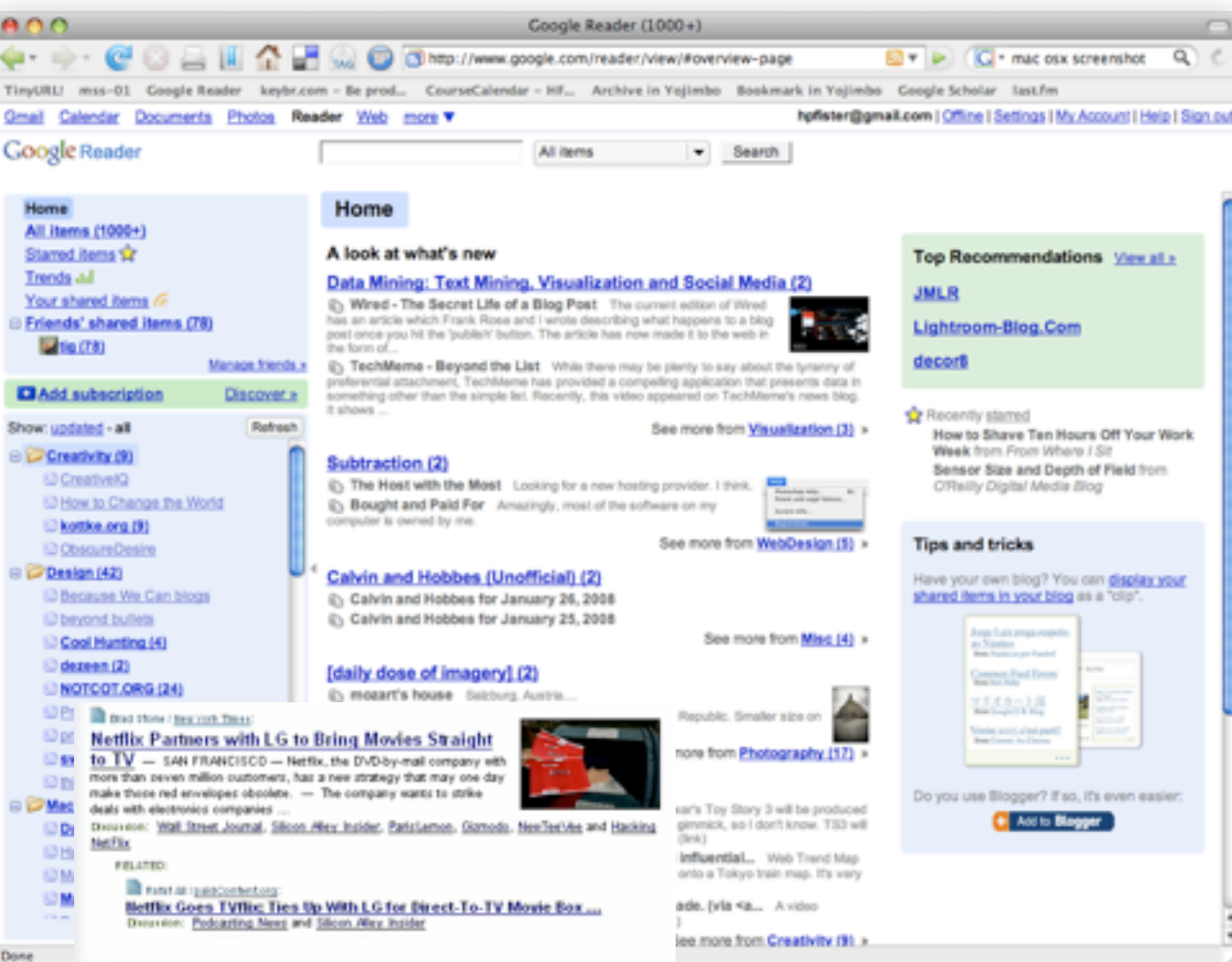
No known budget gap

Note: The map data includes gaps that states had before the 2009 fiscal year budgets were adopted and additional midyear gaps. Exact amounts of midyear budget gaps in Illinois and Wisconsin are unavailable.



**Why?**

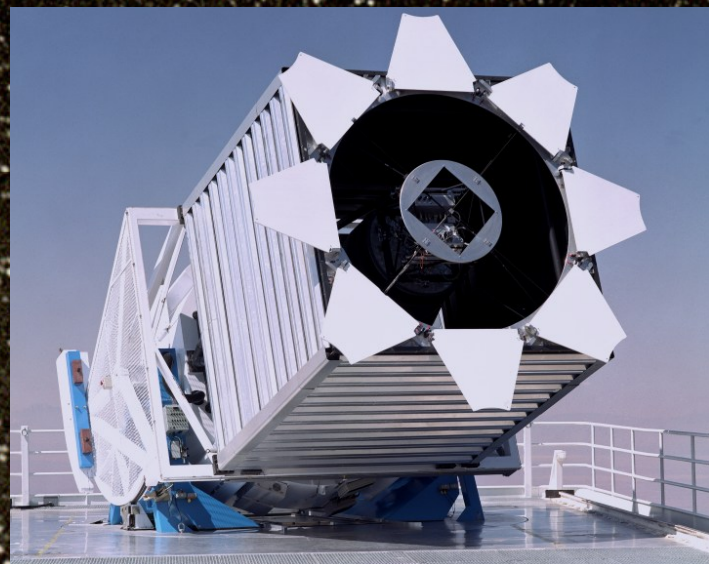
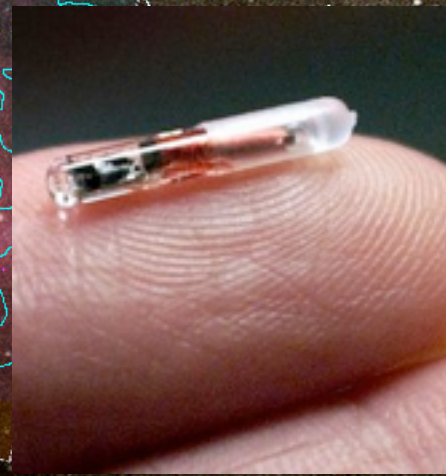
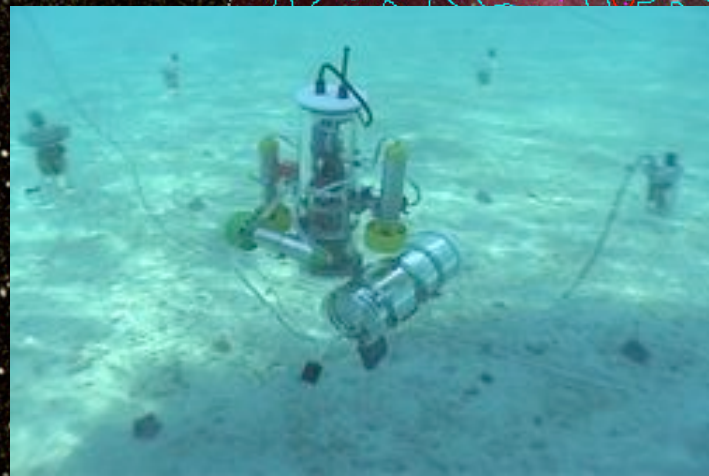
# Information Explosion





# The Industrial Revolution of Data

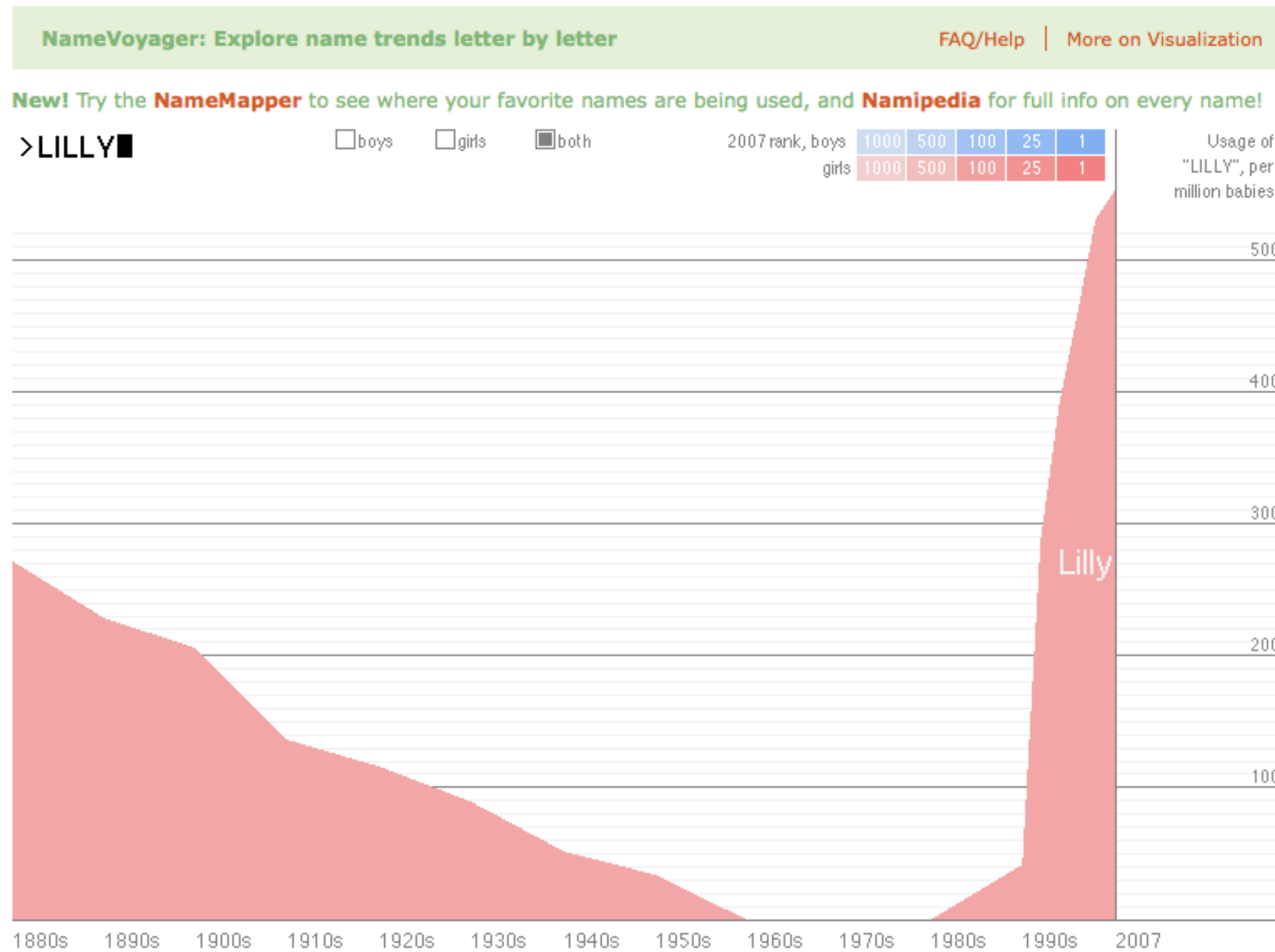
Joe Hellerstein, UC Berkeley





Microsoft Excel - sd_evac_bgs3.dbf															
Type a question for help															
Type a question for help															
Reply with Changes... End Review...															
A1															
ObjectID															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ObjectID	ST	CNT	STCOI	TRACT	B	FIPS	POP2000	POP2005	POP00_SQMI	POP05_SQMI	WHITE	BLACK	AMERI_ES	ASIAN
2	25044	06	073	06073	003207	3	060730032073	2033	2160	3835.8	4075.5	1244	133	13	213
3	25306	06	073	06073	008324	1	060730083241	1856	1803	1874.7	1821.2	1616	12	10	140
4	25307	06	073	06073	008324	2	060730083242	424	445	6057.1	6357.1	394	1	1	19
5	25308	06	073	06073	008324	3	060730083243	660	688	6600.0	6880.0	590	4	0	48
6	25309	06	073	06073	008324	4	060730083244	1908	1994	3028.6	3165.1	1712	15	2	102
7	25310	06	073	06073	008324	5	060730083245	554	556	7914.3	7942.9	511	11	0	18
8	25311	06	073	06073	008324	6	060730083246	568	613	7100.0	7662.5	518	7	0	28
9	25312	06	073	06073	008324	7	060730083247	812	833	5075.0	5206.3	724	7	2	42
10	25313	06	073	06073	008327	1	060730083271	2836	3321	1524.7	1785.5	2414	12	1	292
11	25314	06	073	06073	008327	2	060730083272	2179	2614	3961.8	4752.7	1769	8	4	316
12	25315	06	073	06073	008328	1	060730083281	2291	2707	836.1	988.0	1930	11	3	267
13	25316	06	073	06073	008329	1	060730083291	4334	4919	4422.4	5019.4	3589	35	10	471
14	25317	06	073	06073	008330	1	060730083301	5429	5958	9201.7	10098.3	4341	13	3	888
15	25318	06	073	06073	008331	1	060730083311	2554	2676	6902.7	7232.4	2100	21	1	324
16	25319	06	073	06073	008332	1	060730083321	3412	4226	4805.6	5952.1	2659	11	0	593
17	25322	06	073	06073	008335	1	060730083351	1124	2113	8028.6	15092.9	806	17	3	237
18	25323	06	073	06073	008335	2	060730083352	3966	7484	1129.9	2132.2	2340	41	5	1347
19	25324	06	073	06073	008336	1	060730083361	975	1071	8863.6	9736.4	685	14	1	228
20	25325	06	073	06073	008336	2	060730083362	1565	1512	7452.4	7200.0	1221	31	6	209
21	25327	06	073	06073	008337	2	060730083372	1014	1011	7242.9	7221.4	608	22	5	306
22	25487	06	073	06073	009504	1	060730095041	784	780	2613.3	2600.0	694	8	0	52
23	25765	06	073	06073	013410	1	060730134101	1228	1327	160.7	173.7	897	67	9	67
24	25766	06	073	06073	013410	2	060730134102	1133	1218	1691.0	1817.9	866	43	3	89
25	25767	06	073	06073	013410	3	060730134103	1131	1481	4039.3	5289.3	908	29	1	102
26	25770	06	073	06073	013411	3	060730134113	836	746	3344.0	2984.0	651	26	2	74
27	25798	06	073	06073	013504	1	060730135041	862	848	5746.7	5653.3	473	125	3	134
28	25800	06	073	06073	013504	2	060730135042	1235	1404	2655.2	2825.0	852	120	12	141

# Analyze



M. Wattenberg, 2005

# Reveal Patterns

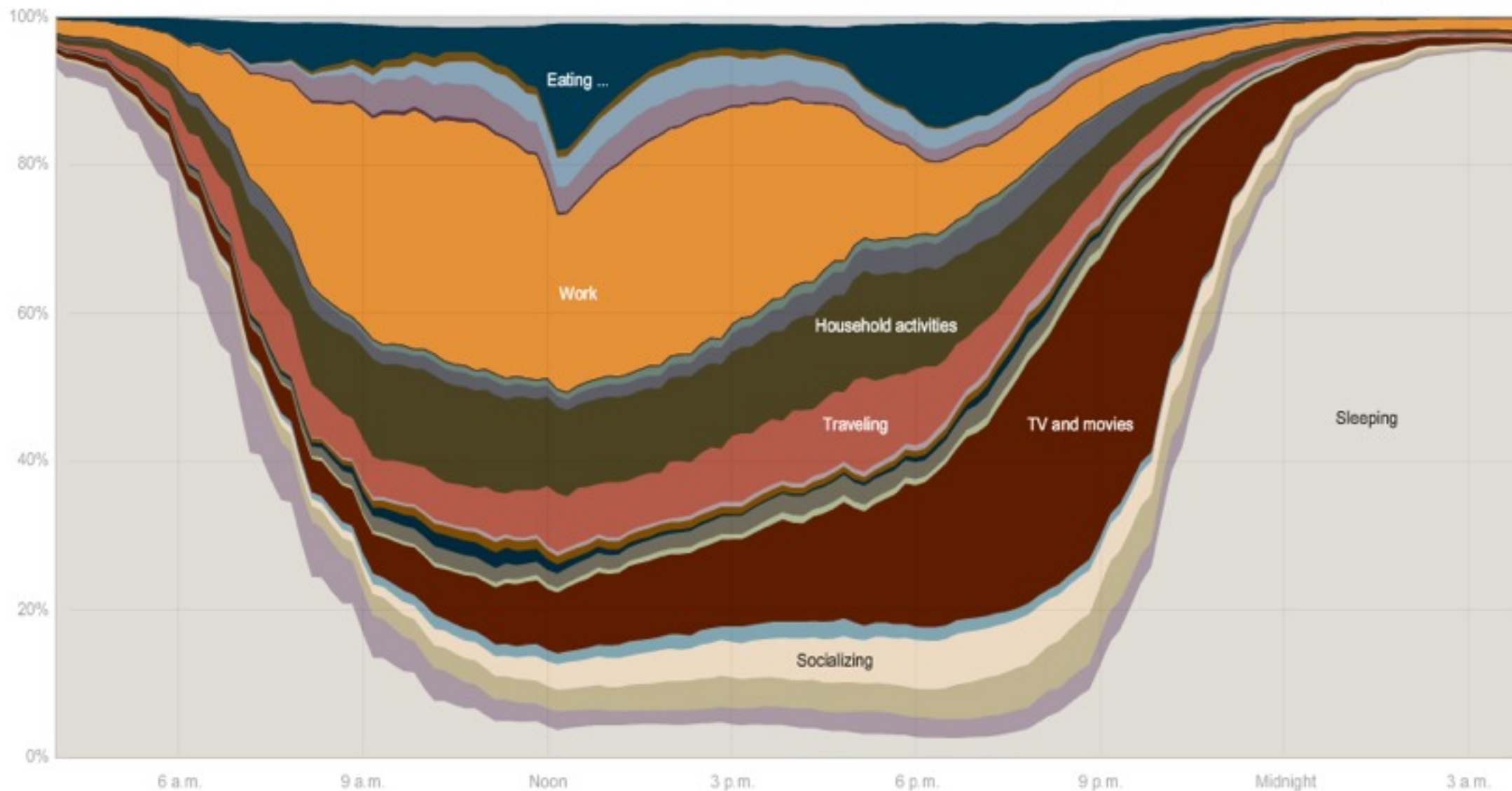
## How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2008. [Related article](#)

### Everyone

Sleeping, eating, working and watching television take up about two-thirds of the average day.

Everyone	Employed	White	Age 15-24	H.S. grads	No children
Men	Unemployed	Black	Age 25-64	Bachelor's	One child
Women	Not in lab...	Hispanic	Age 65+	Advanced	Two+ children



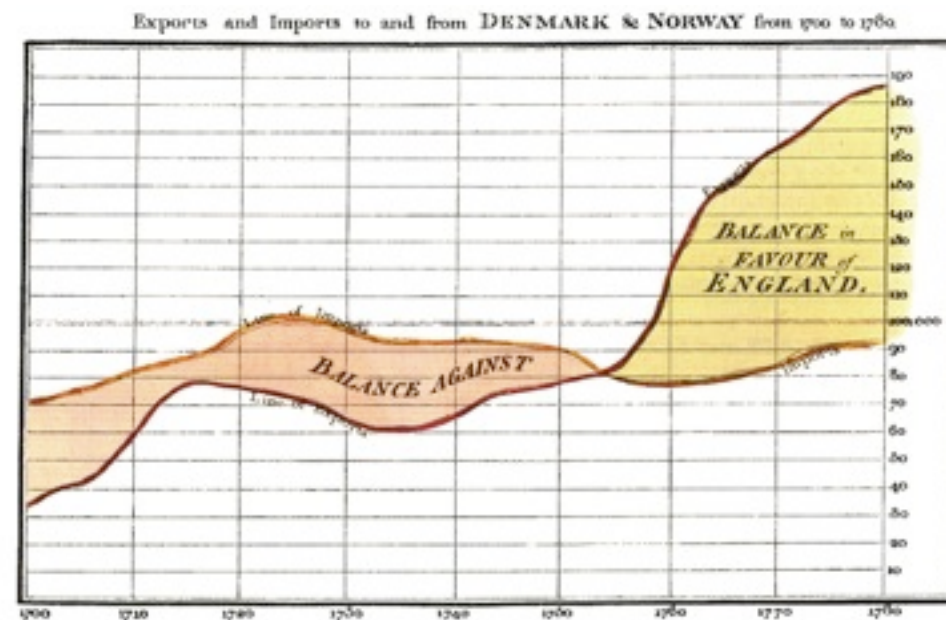


# Tell Stories



# “It is things that make us smart.”

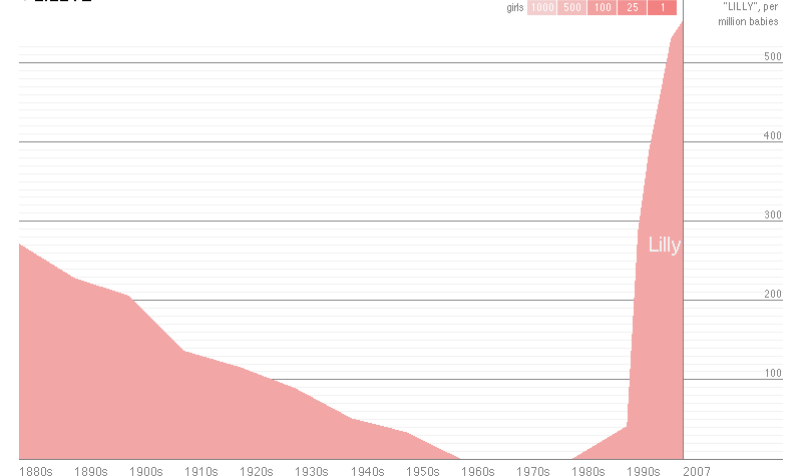
Donald Norman



NameVoyager: Explore name trends letter by letter [FAQ/Help](#) | [More on Visualization](#)

New! Try the **NameMapper** to see where your favorite names are being used, and **Namipedia** for full info on every name!

>LILLY■ ☐ boys ☐ girls ☒ both 2007rank, boys 1000 500 100 25 1 girls 1000 500 100 25 1



# Visualization

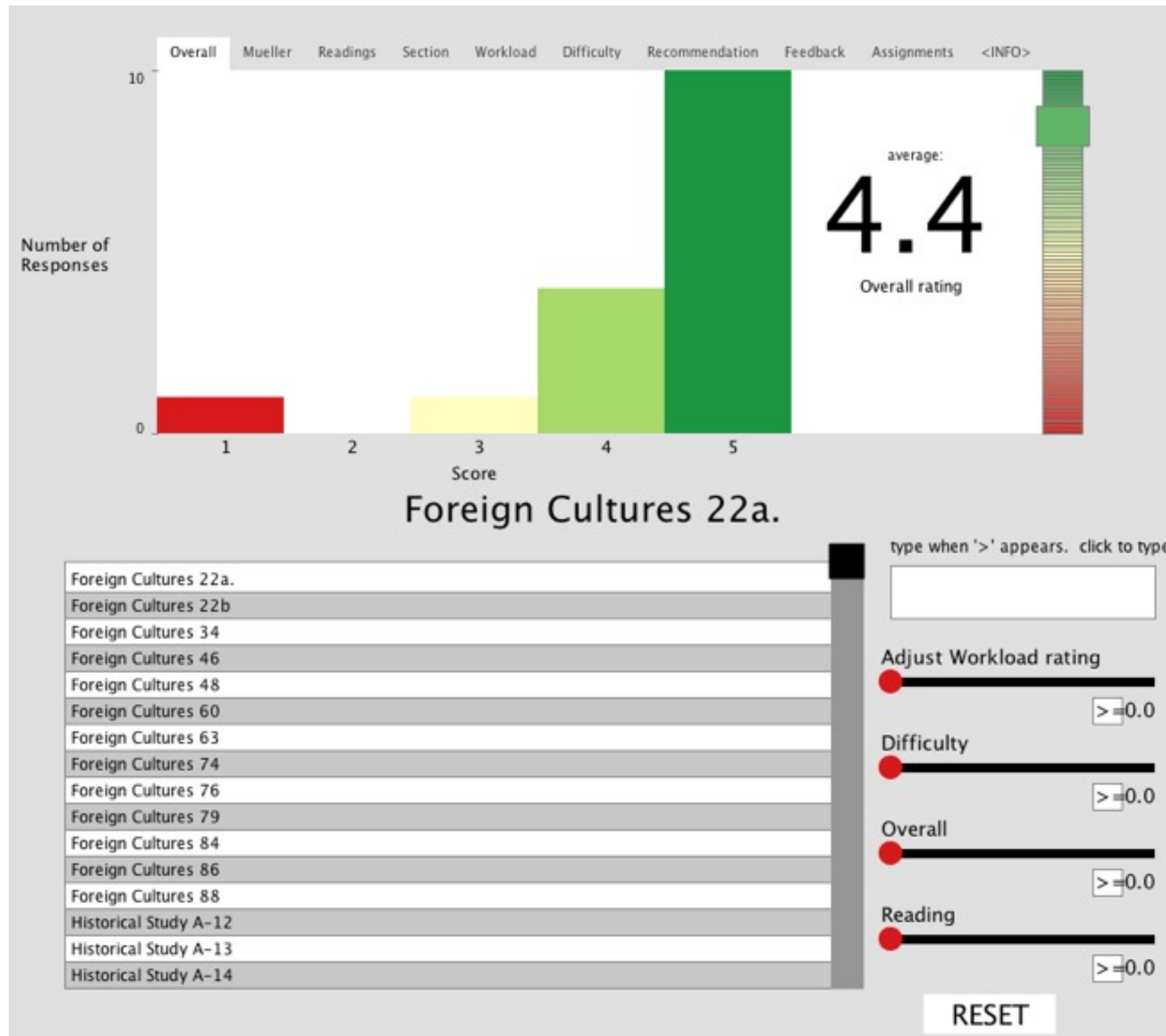
- Helps us think
- Reduces load on working memory
- Offloads cognition
- Uses the power of human perception

# CS 171 Goals

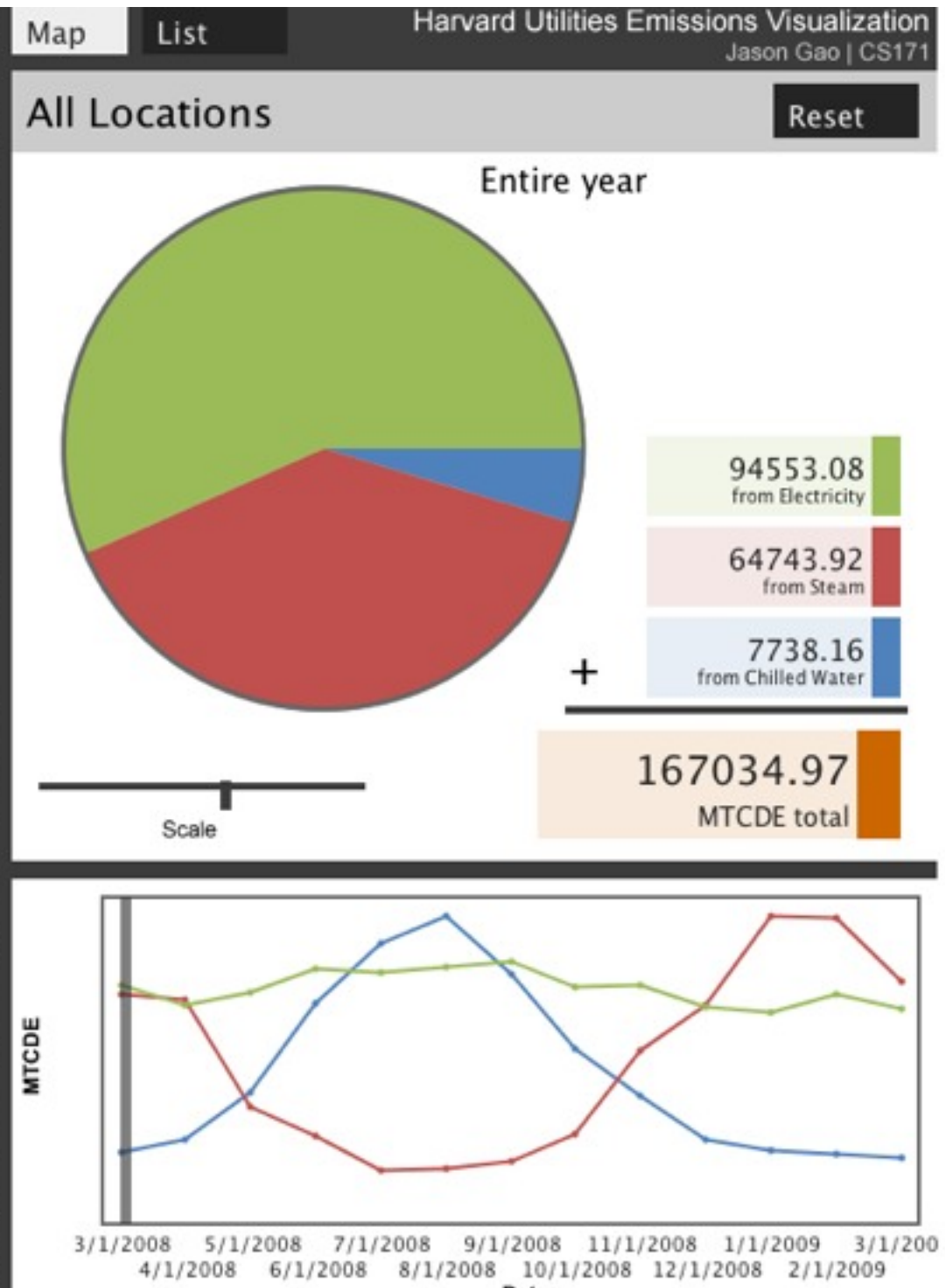
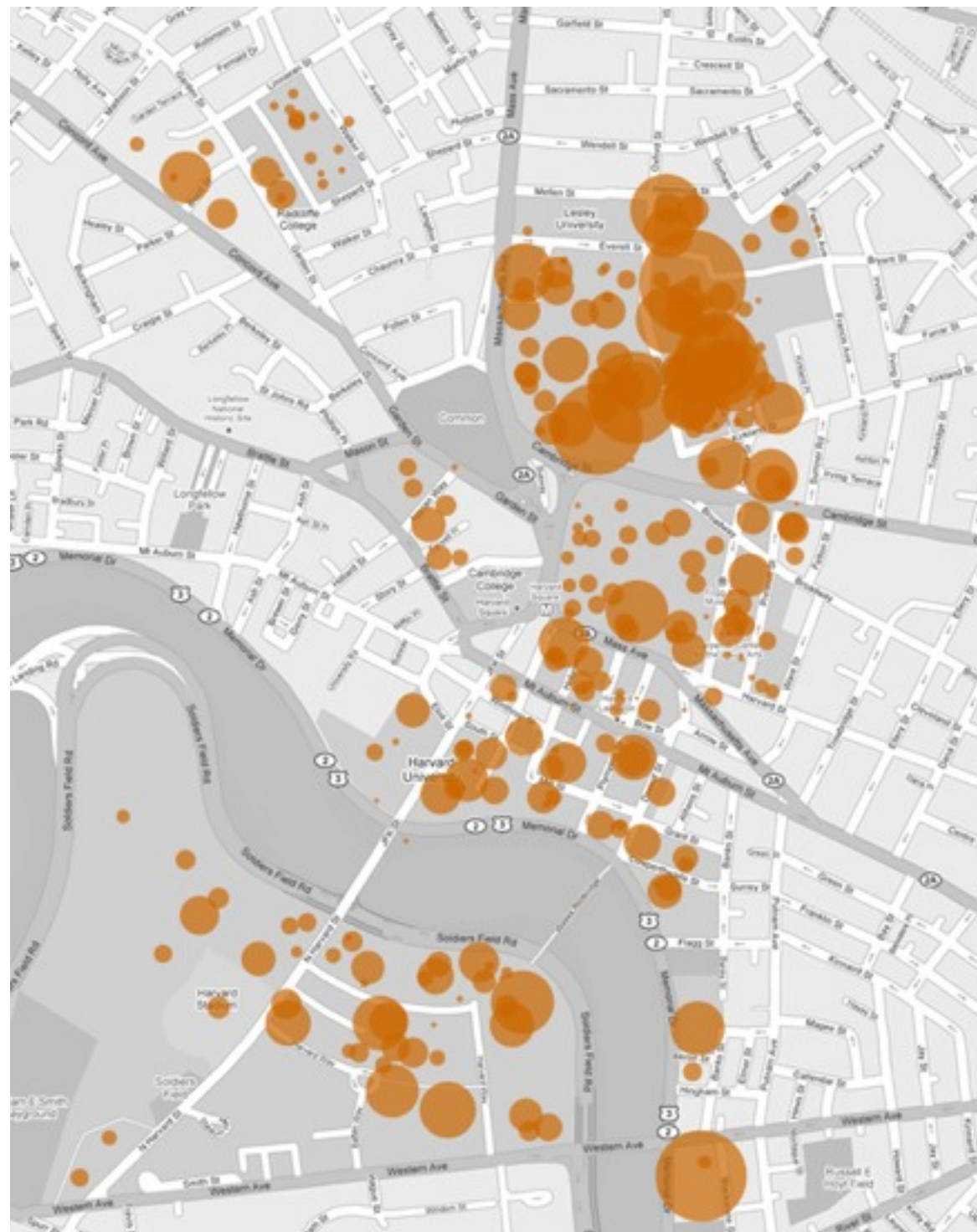
- Principles of effective visualizations
- Gathering data (Python)
- Implementing interactive visualizations (Processing)
- Programming homework and a final project



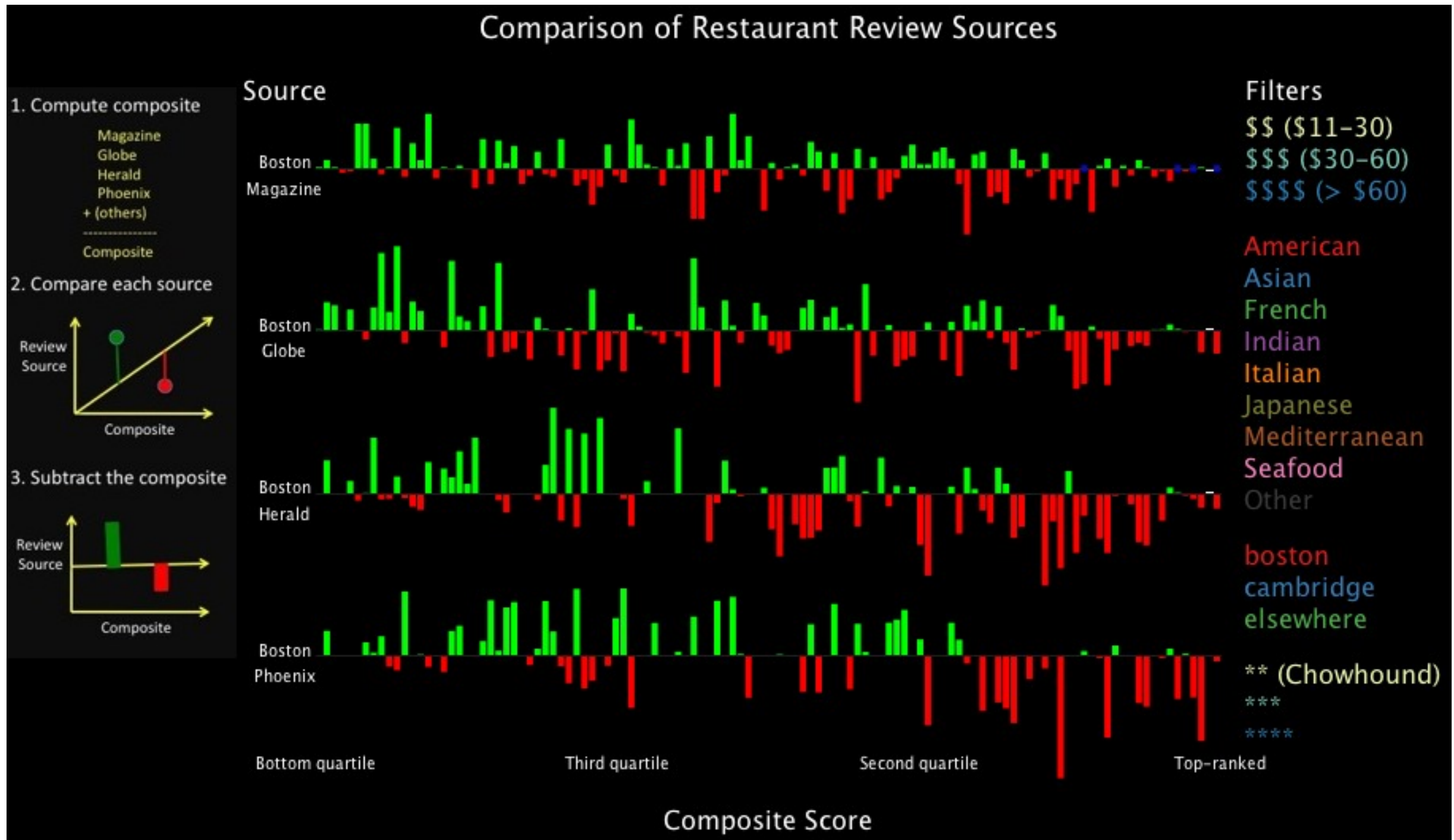
# Samir Paul & Jesse Rader



# Jason Gao



# Naveen Sinha

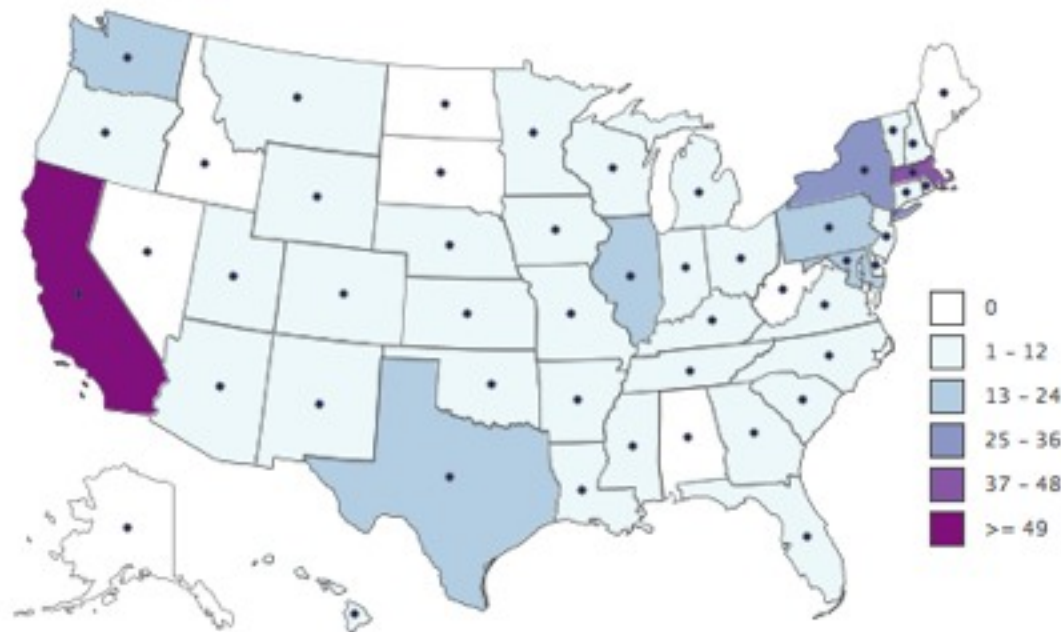




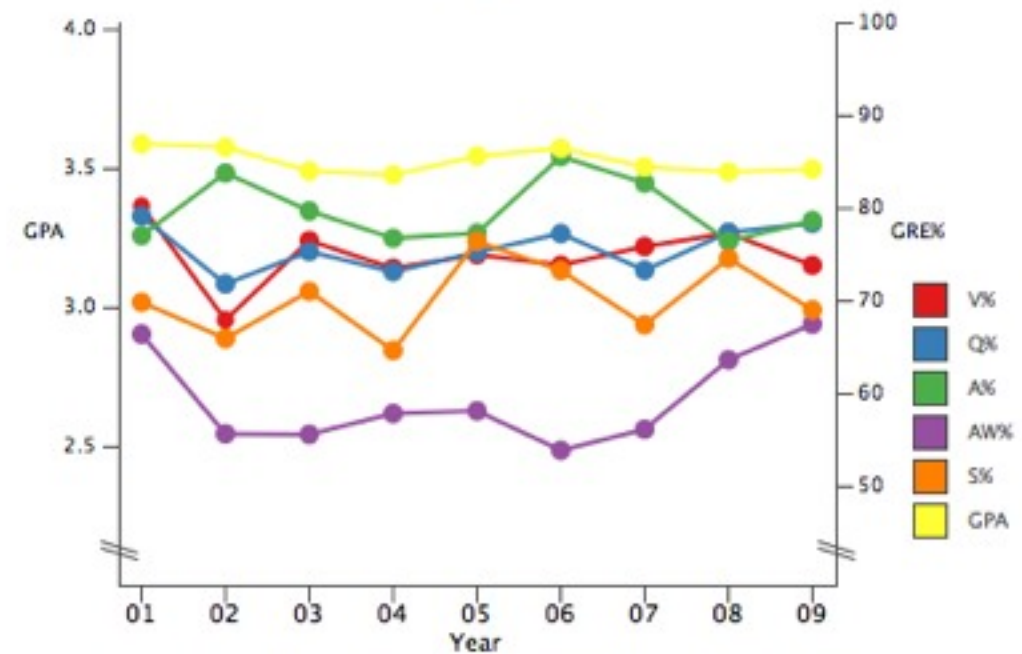
# Karen Hansen

## Trends in Graduate Admissions

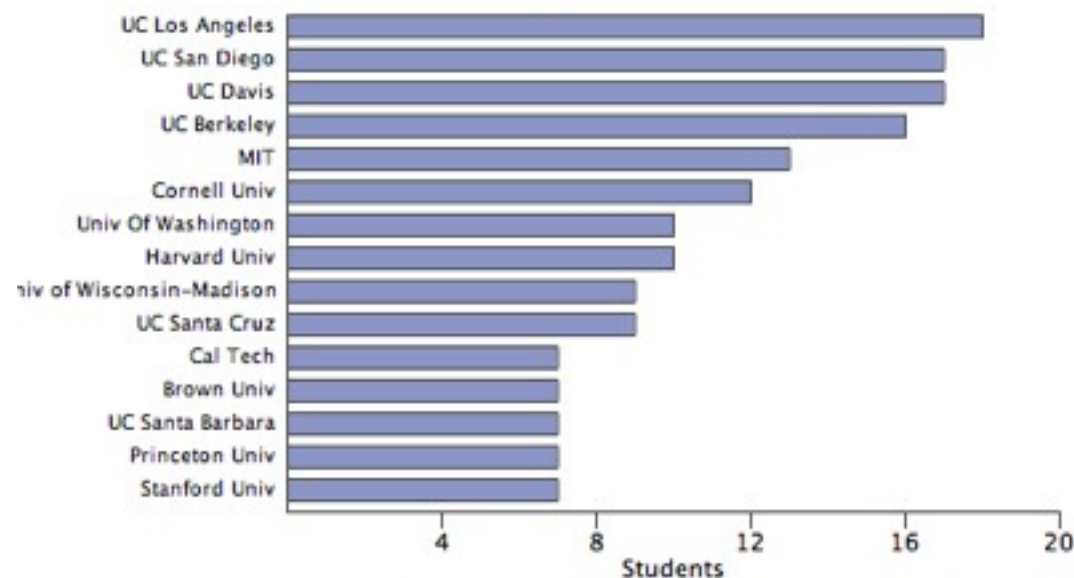
Home State ?



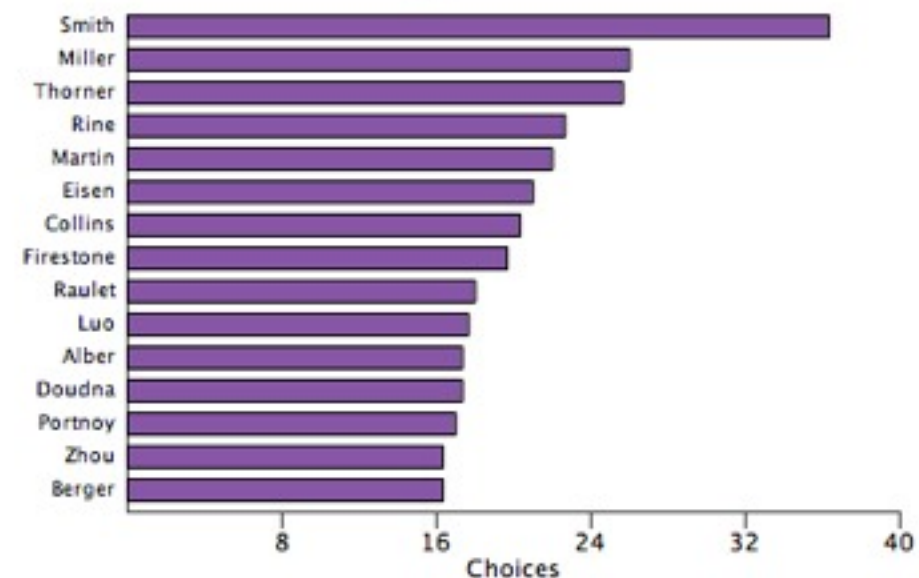
GPA and GRE Score Averages ?



Top Undergraduate Universities ?

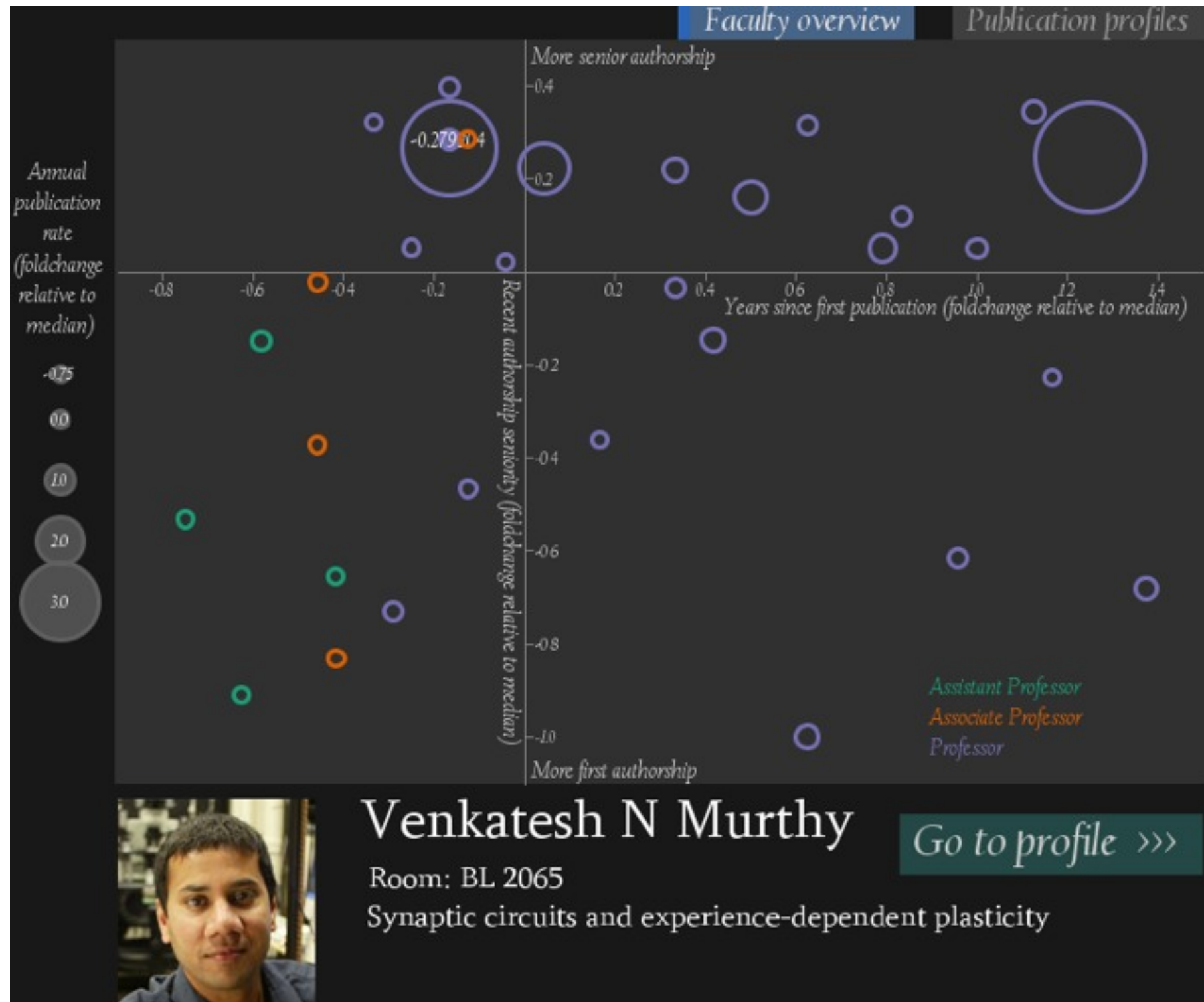


Top Faculty Choices ?





# Xiao He



# David Jacopille

Visualizing the **The New York Times**

February 13, 1999

Article count: 187  
Total words: 91648  
Avg words in an article: 490.1  
Avg sentence count: 27.9  
Avg. syllable length: 1.7  
Avg sentence word count: 18.72  
Avg. emotional words / 1000 words: 7.58  
Avg. positive words / 1000 words: 3.17  
Avg. negative words / 1000 words: 3.86



+ -



1999

article count

total words

words/article

syllables/word

words/sentence

sentence count

emotional words

positive words

negative words

cs171.org

- Scraping Data
- Data and Image Models
- Visualization Process
- Visual Perception
- Color Encoding
- Cognitive Principles
- Interaction Techniques
- Statistical Graphs
- Maps & Google Earth
- Trees and Networks
- Higher-dimensional Data
- Text Visualization
- Images and Video
- Life Science Visualization
- Social Visualization
- Visualization & The Arts

