

Interaction

Maneesh Agrawala

CS 448B: Visualization
Fall 2021

1

Stephen Curry's 3-Point Record in Context: Off the Charts

By GREGOR AUCH and KEVIN DUEAUX APRIL 16, 2016
This chart contains 752 lines – one for each N.B.A. player who finished in the top 20 in 3-point attempts made in each season since 1980. **Sitting atop it** is the Golden State Warriors' Stephen Curry, who finished the regular season with a record 402 3-pointers.

The record is an outlier that defies most comparisons, but here is one: It is the equivalent of hitting 103 home runs in a Major League Baseball season.

The colors show a clear progression toward more 3-pointers. In the 1979-80 N.B.A. season, the first to feature the 3-pointer, **making just 21** was good enough to put a player among the league's top 20. On Feb. 27, Curry made **12 3-pointers** in a single game. On Feb. 27,

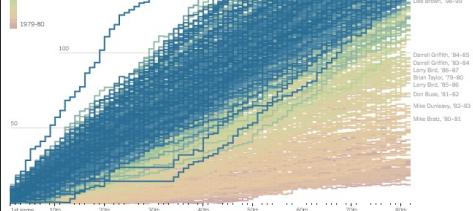
How can he do that? He's taller, and the best three-point shooters in history are consider. Over the past 30 years, the number of 3-point field goals has trended steadily upward. If we project that trend into the future, 402 becomes a perfectly natural number of 3-point field goals for an N.B.A. player to make.

In the mid-2030s.

Cumulative three-point field goals made over the course of a season

Find a player

2015-16
1979-80

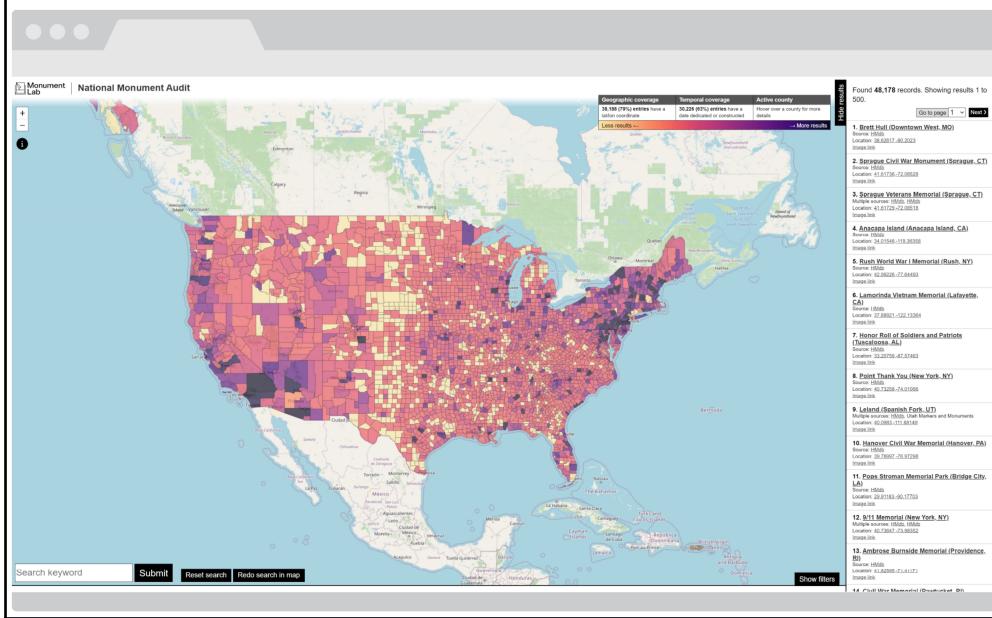


2

SEARCH THE DATA

Monument Study Set Search Interface

This search interface allows you to explore the 48,178 data records that make up the *National Monument Audit* "study set." We retrieved and analyzed data records from 42 data sources created and maintained by federal, state, local, tribal, institutional, and affinity organizations. These data sources were included because they provided publicly accessible digital records about a wide range of cultural and natural objects. A large part of the work of the Audit was accessing, converting, parsing, and mapping that data into a single, normalized dataset and identifying records representing monuments. The study set does not include every monument in the United States.



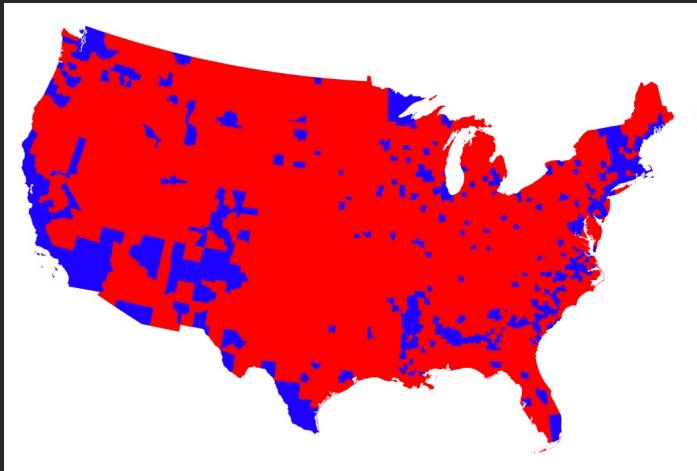
3

Last Time: Using Space Effectively Cartographic Distortion

5

2

Election 2016 map

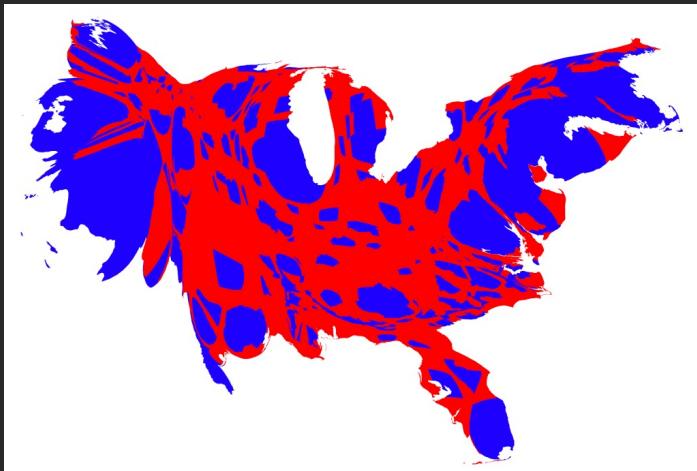


■ majority voted democrat
■ majority voted republican

<http://www-personal.umich.edu/~mejn/election/>

10

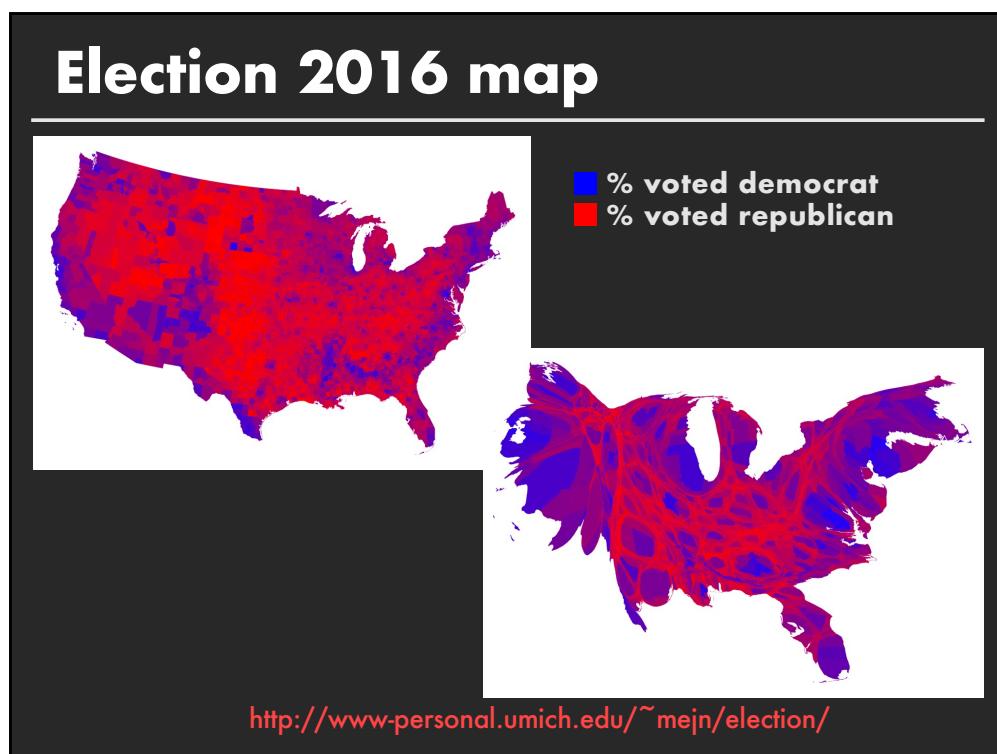
Election 2016 map



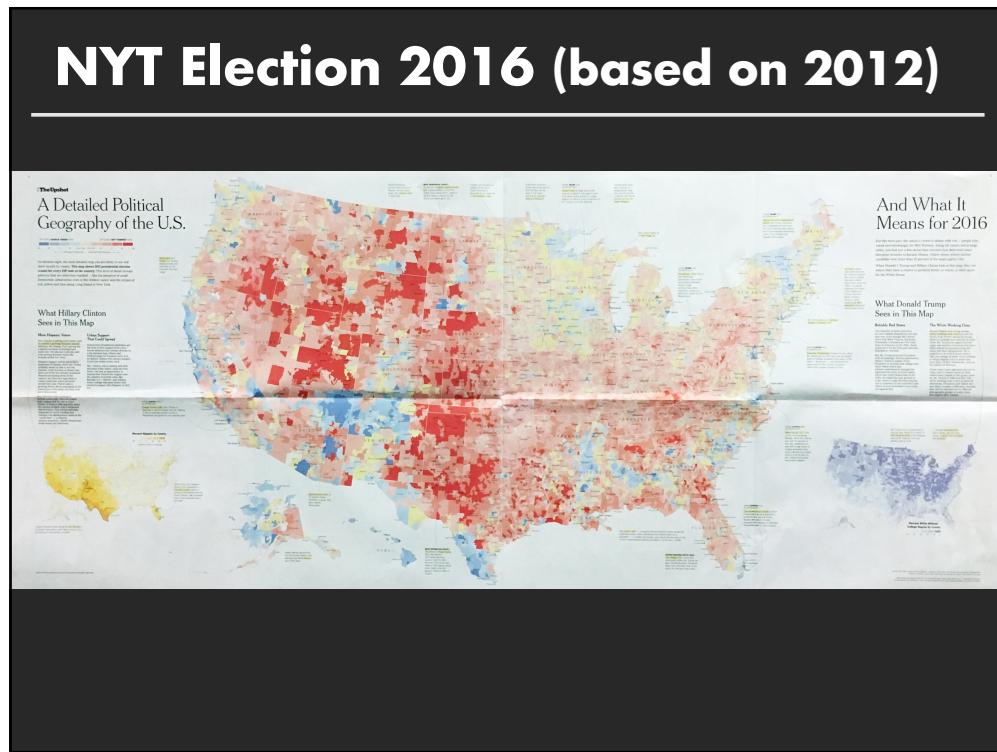
■ majority voted democrat
■ majority voted republican

<http://www-personal.umich.edu/~mejn/election/>

11

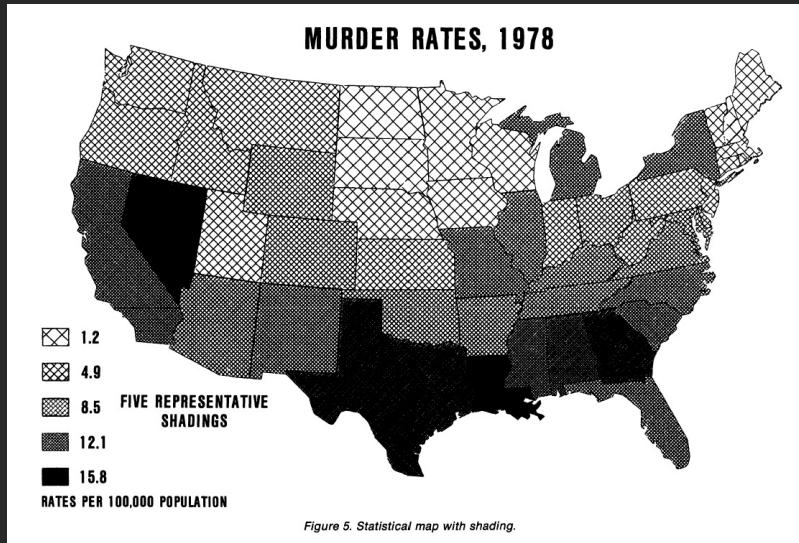


12



13

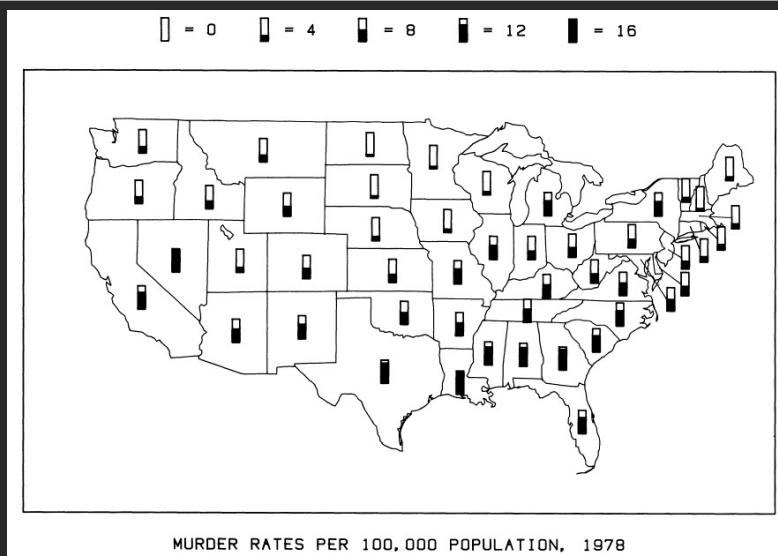
Statistical map with shading



[Cleveland and McGill 84]

14

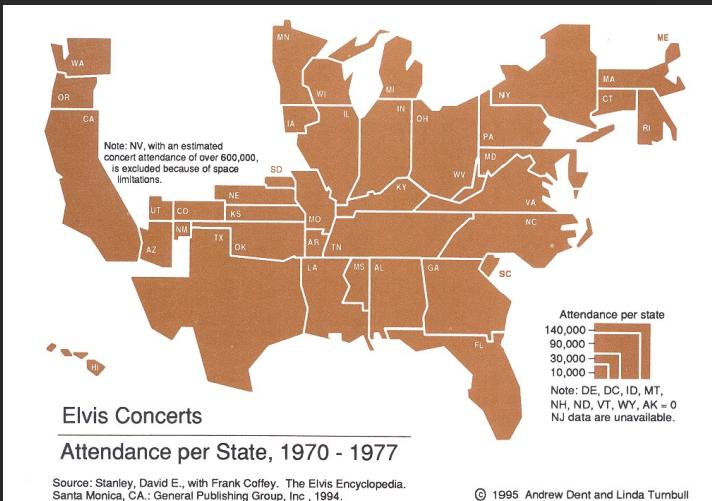
Framed rectangle chart



[Cleveland and McGill 84]

15

Cartograms: Distort areas

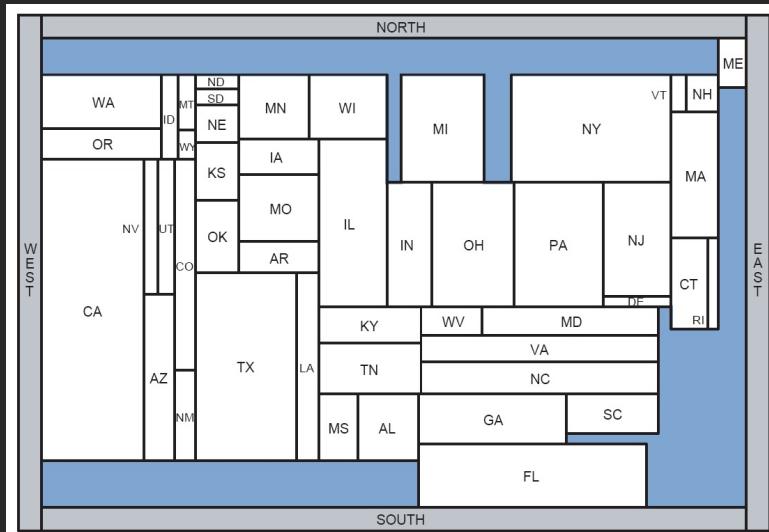


Scale area by data

[From Cartography, Dent]

16

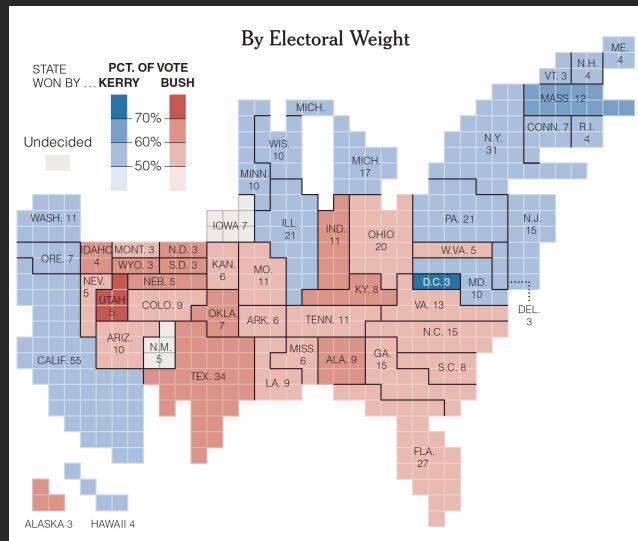
Rectangular cartogram



American population [van Kreveld and Speckmann 04]

17

New York Times Election 2004



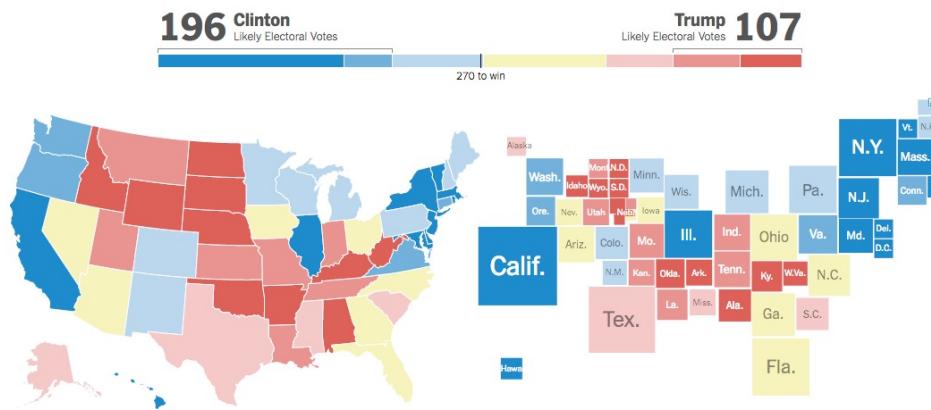
19

New York Times Election 2016

2016 Electoral Map Forecast

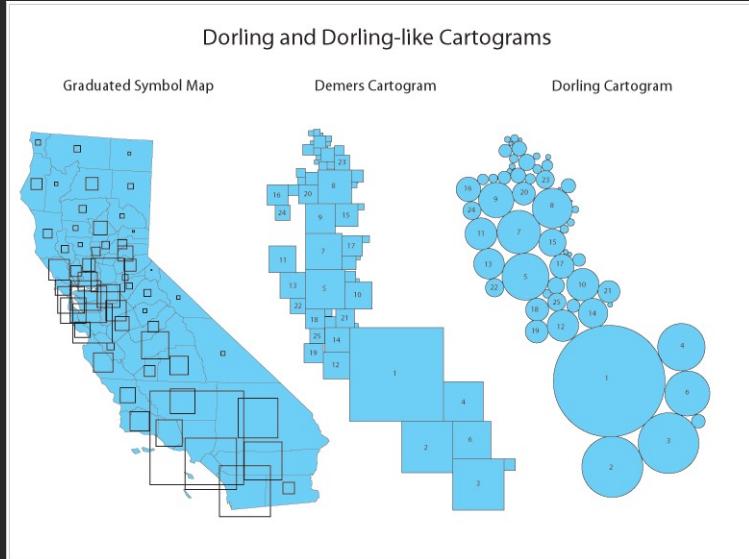
The Upshot's forecast for the presidential race, based on the latest national and state polls.

By JOSH KATZ and ADAM PEARCE | UPDATED November 2, 2016



20

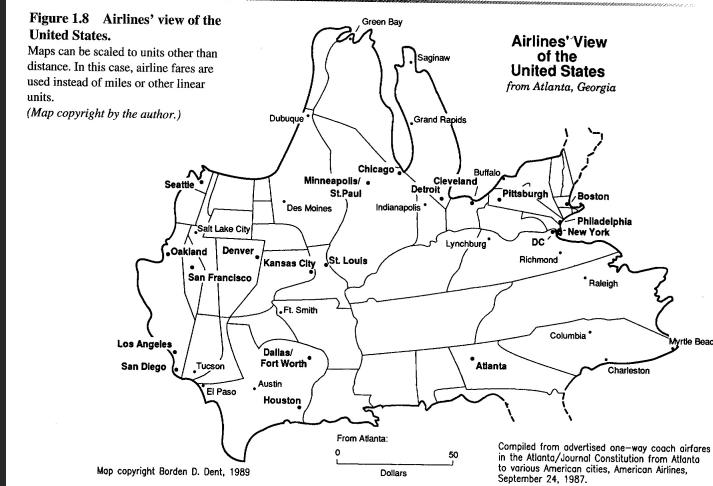
Dorling cartogram



http://www.ncgia.ucsb.edu/projects/Cartogram_Central/types.html

21

Distorting distances



Scale distance by data (airline fare)

[From Cartography, Dent]

22

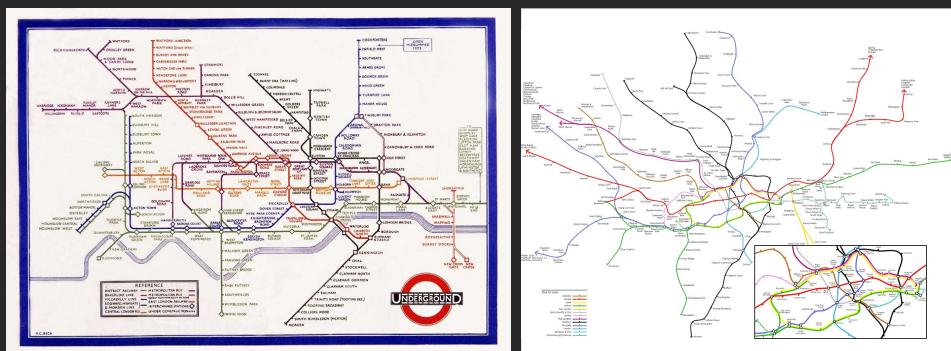
London underground



<http://www.thetube.com/content/history/map.asp>

23

Comparison to geographic map

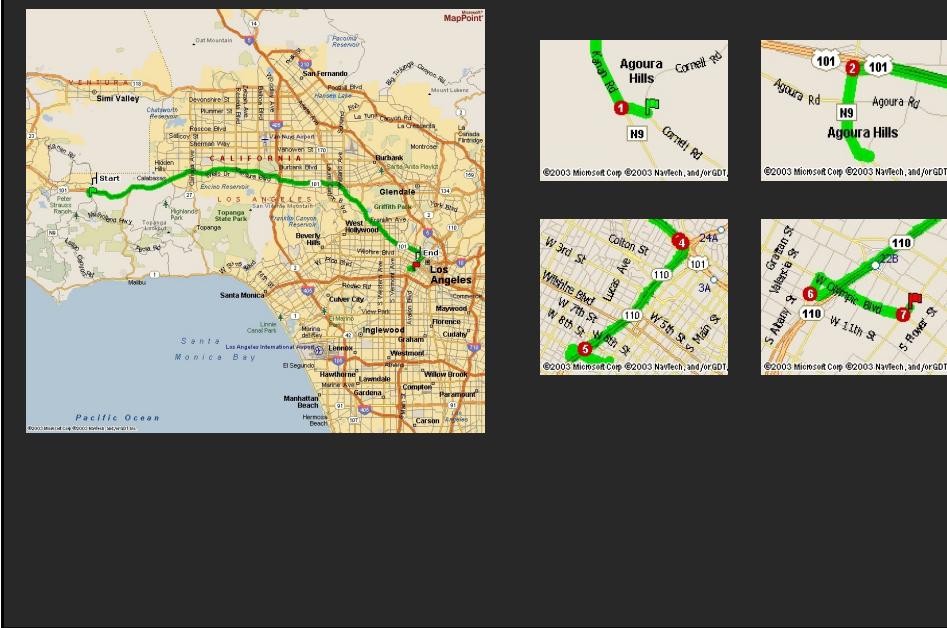


Distorted

Undistorted

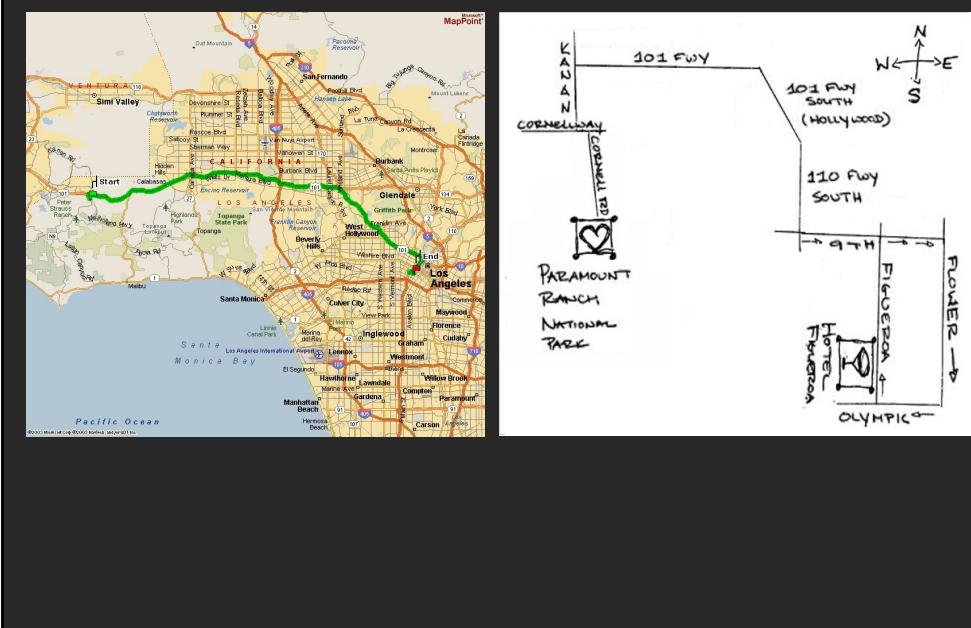
24

Visualizing Routes



25

A Better Visualization

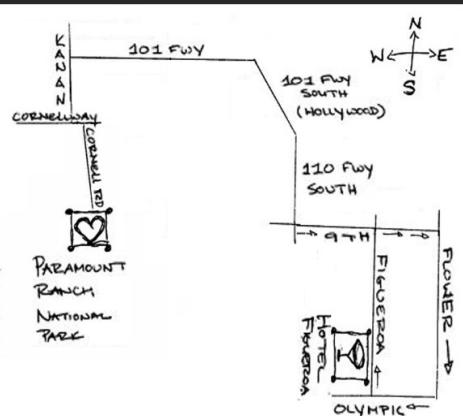


26

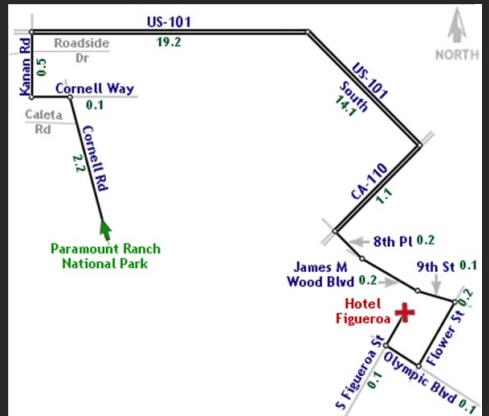
10

LineDrive

[Agrawala & Stoltz 2001]



Hand-drawn route map



LineDrive route map

27

Summary

- Space is the most important visual encoding
- Show data with as much resolution as possible
- Geometric properties of spatial transforms support geometric reasoning
- Use distortions to emphasize important information

28

Announcements

29

A2: Exploratory Data Analysis

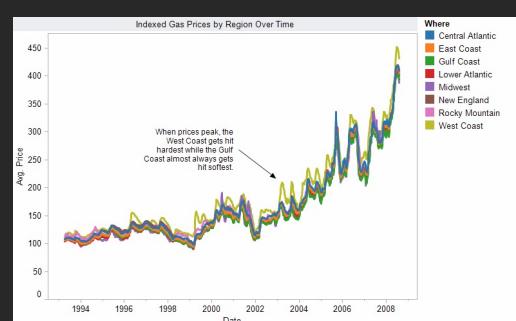
Use **Tableau** or **Vega-Lite** to formulate & answer questions

First steps

- Step 1: Pick domain & data
- Step 2: Pose questions
- Step 3: Profile data
- Iterate as needed

Create visualizations

- See different views of data
- Refine questions



Author a report

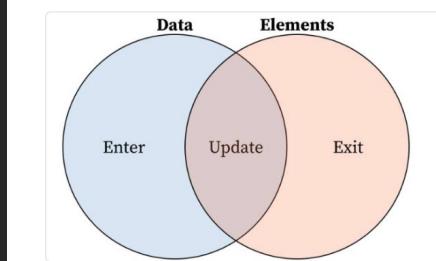
- Screenshots of most insightful views (8+)
- Include titles and captions for each view

Due before class on Oct 11, 2021

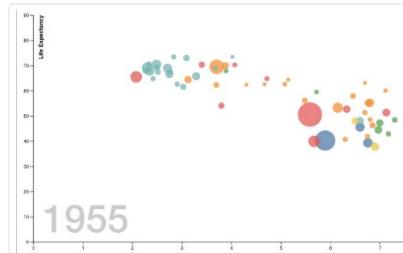
30

12

D3 Notebooks for Next Week



Team · Published
Introduction to D3
You republished 14 hours ago



You · Published
Making D3 Charts Interactive
You republished 14 hours ago

32

Interaction

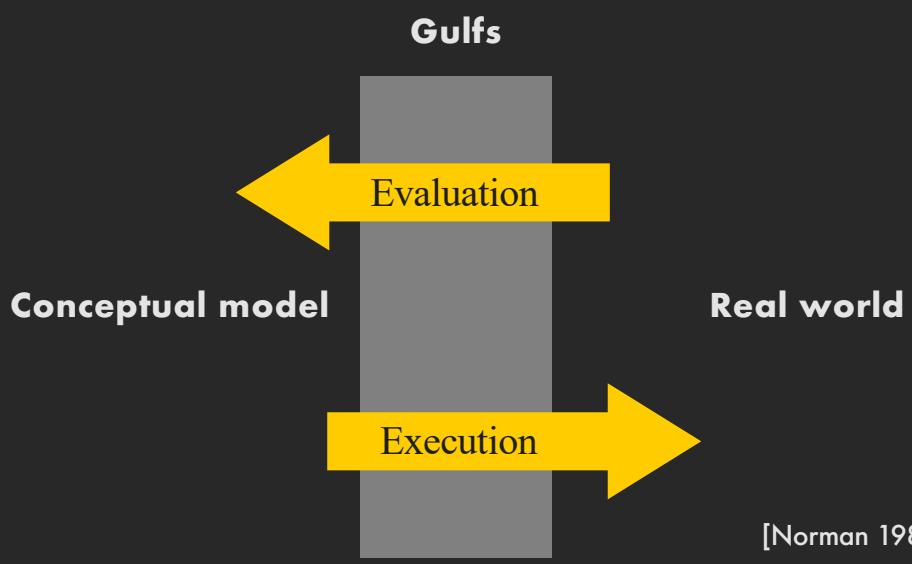
33

13

Interaction between people and machines requires *mutual intelligibility* or *shared understanding*

34

Gulfs of execution & evaluation



35

14

Gulf of Execution

The difference between the user's intentions and the allowable actions.

Gulf of Evaluation

The amount of effort that the person must exert to interpret the state of the system and to determine how well the expectations and intentions have been met.

[Norman 1986]

36

Gulf of evaluation

Gulf



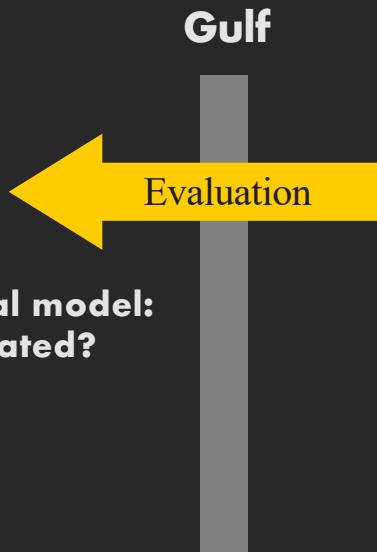
Real world:

X	Y
0.67	0.79
0.32	0.63
0.39	0.72
0.27	0.85
0.71	0.43
0.63	0.09
0.03	0.03
0.20	0.54
0.51	0.38
0.11	0.33
0.46	0.46

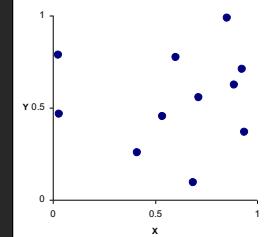
37

Gulf of evaluation

Conceptual model:
 x, y correlated?



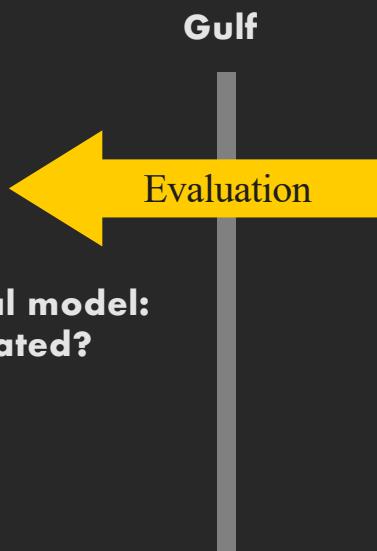
Real world:



38

Gulf of evaluation

Conceptual model:
 x, y correlated?

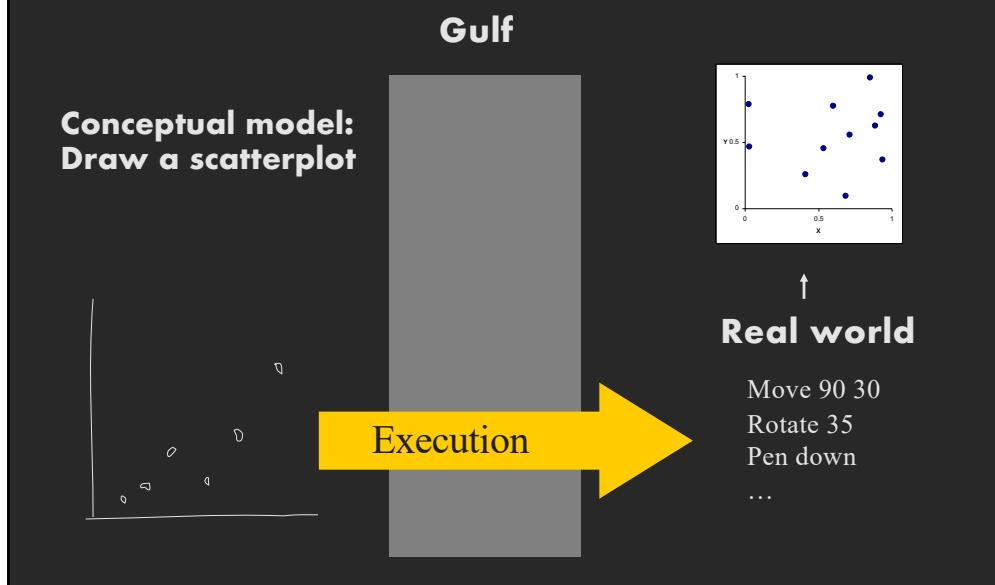


Real world:

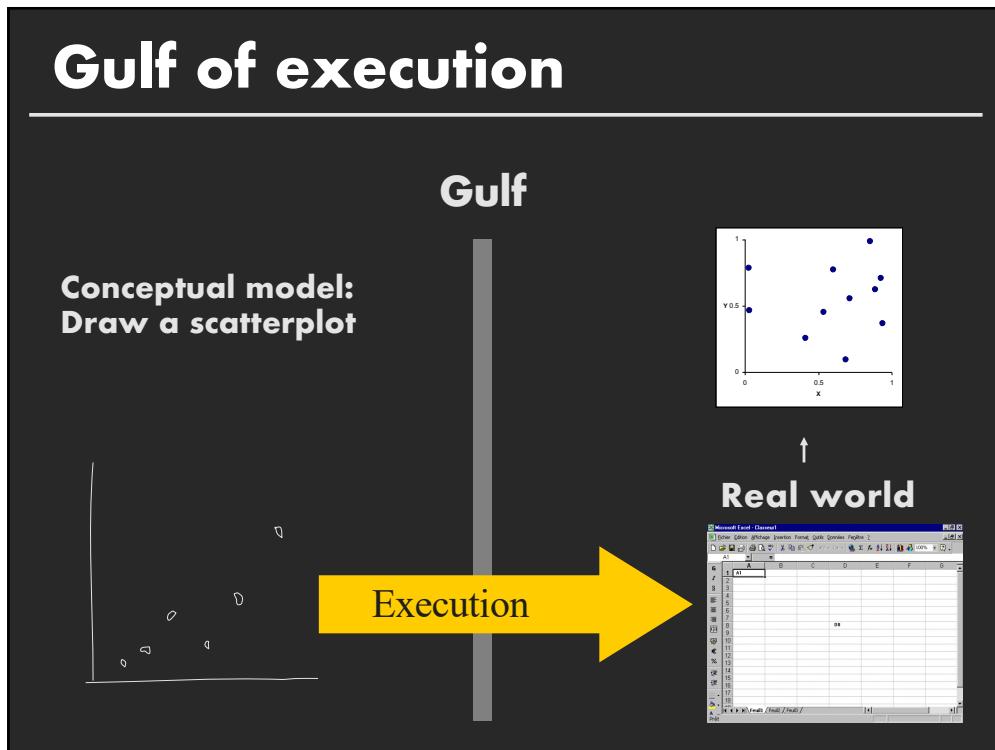
$$\rho = -.29$$

39

Gulf of execution



40



41

Gulf of Execution

The difference between the user's intentions and the allowable actions.

Gulf of Evaluation

The amount of effort that the person must exert to interpret the state of the system and to determine how well the expectations and intentions have been met.

[Norman 1986]

42

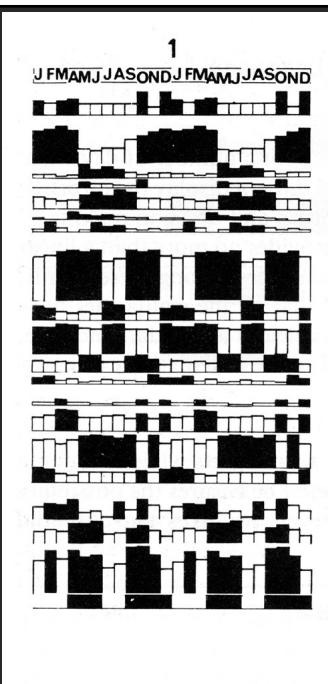
Early Systems

44

J	F	M	A	M	J	J	A	S	O	N	D			
26	21	26	28	20	20	20	20	40	15	40	1	% CLIENTELE FEMALE		
69	70	77	71	37	36	39	39	55	60	68	72	2 %	--" LOCAL	
7	6	3	6	23	14	19	14	9	6	8	8	3 %	--" U.S.A.	
0	0	0	8	6	6	4	2	12	0	0	4	4 %	--" SOUTH AMERICA	
20	15	14	15	23	27	22	30	27	19	19	17	5	5 %	--" EUROPE
1	0	0	8	6	4	6	4	2	1	0	1	6	6 %	--" M.EAST, AFRICA
3	10	6	0	3	13	8	9	5	2	5	2	7	7 %	--" ASIA
78	80	85	86	85	87	70	76	87	85	87	80	8	% BUSINESSMEN	
22	20	15	14	15	13	30	24	13	15	13	20	9	% TOURISTS	
70	70	75	74	69	68	74	75	68	68	64	75	10	% DIRECT RESERVATIONS	
20	18	19	17	27	27	19	19	26	27	21	15	11	% AGENCY	--"
10	12	6	9	4	5	7	6	6	5	15	10	12	% AIR CREWS	
2	2	4	2	2	1	1	2	2	4	2	5	13	% CLIENTS UNDER 20 YEARS	
25	27	37	35	25	25	27	28	24	30	24	30	14	%	--" 20-35 --"
48	49	42	48	54	55	53	51	55	46	55	43	15	%	--" 35-55 --"
25	22	17	15	19	19	19	19	19	20	19	22	16	%	--" MORE THAN 55 --"
163	167	166	174	152	155	145	170	157	174	165	158	17	PRICE OF ROOMS	
1.65	1.71	1.65	1.91	1.90	2.	1.54	1.60	1.73	1.82	1.66	1.44	18	LENGTH OF STAY	
67	82	70	83	74	77	56	62	90	92	78	55	19	% OCCUPANCY CONVENTIONS	
			X	X	X			X	X	X	X	20		

[Graphics and Graphic Information Processing, Bertin 81]

45



[Graphics and Graphic Information Processing, Bertin 81]

47

Group similar rows and columns

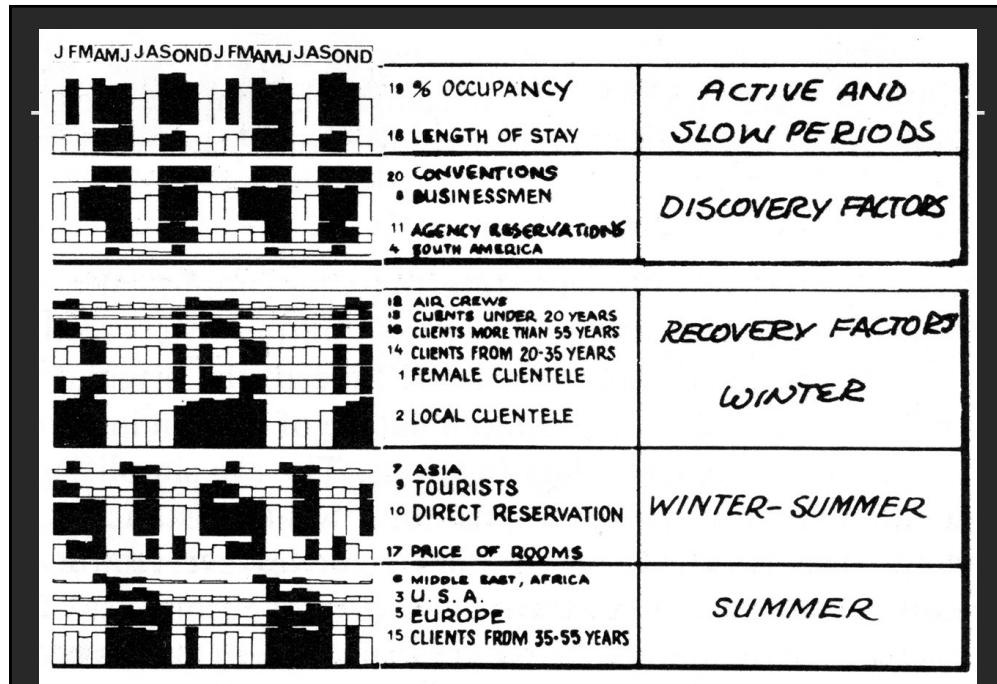
Choose a row with a particular visual aspect. Move to extremity of matrix

Move similar rows close, opposite rows to bottom. (Creates two opposing groups and a middle group)

Repeat for columns (only in some cases)

Iterate

48



[Graphics and Graphic Information Processing, Bertin 81]

49



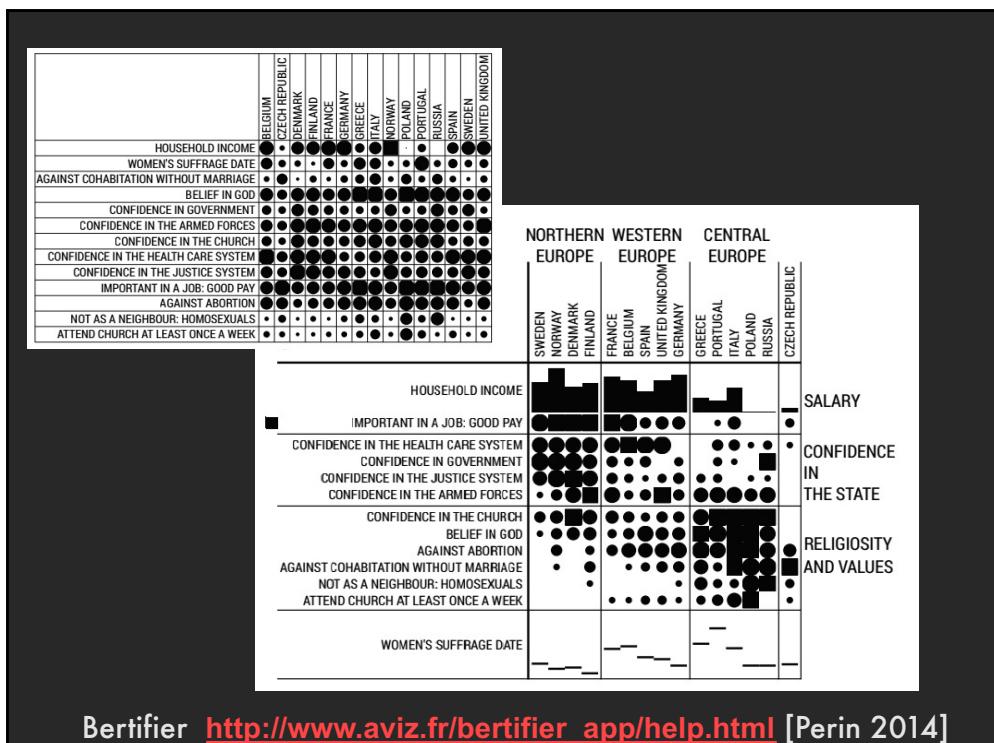
[Graphics and Graphic Information Processing, Bertin 81]

50



[Graphics and Graphic Information Processing, Bertin 81]

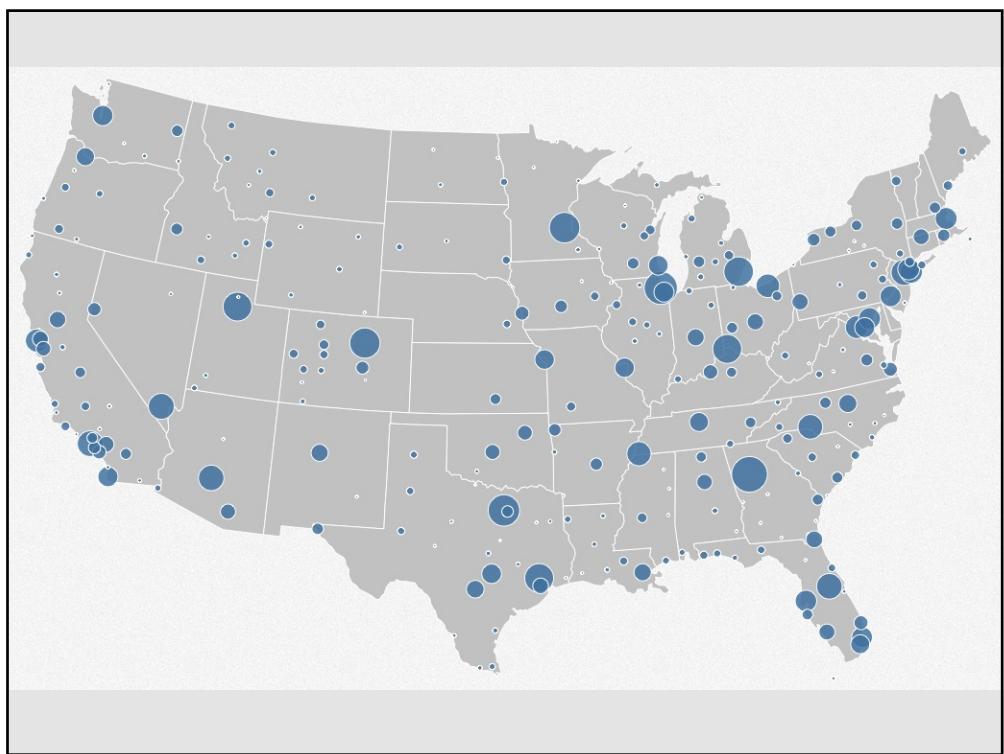
52



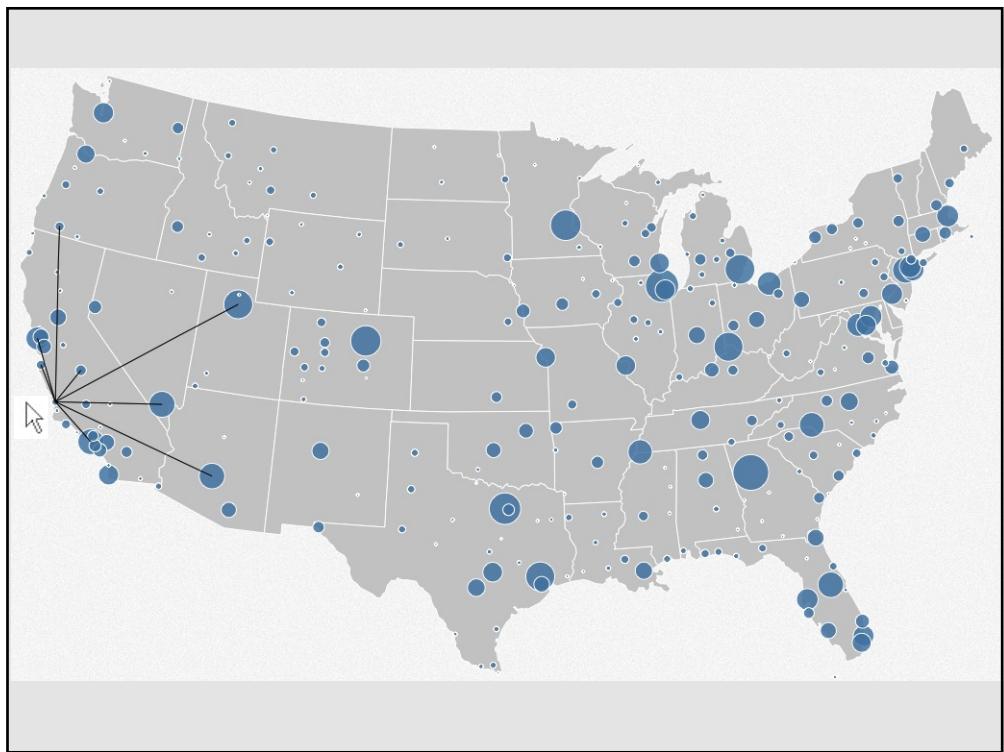
55

Pointing

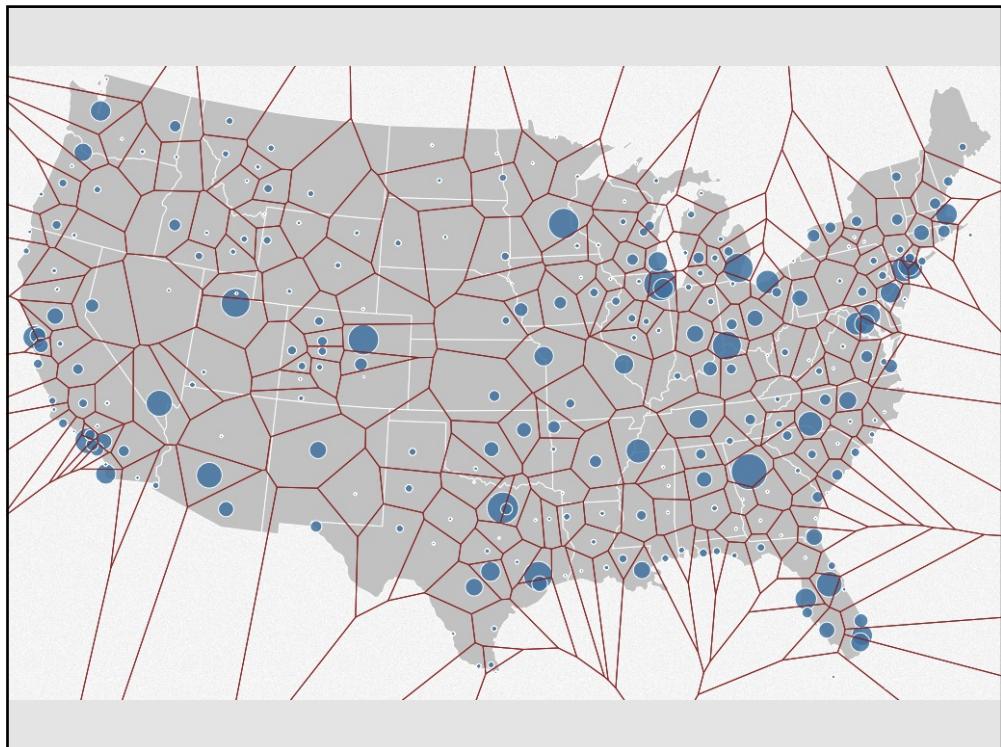
61



63



64



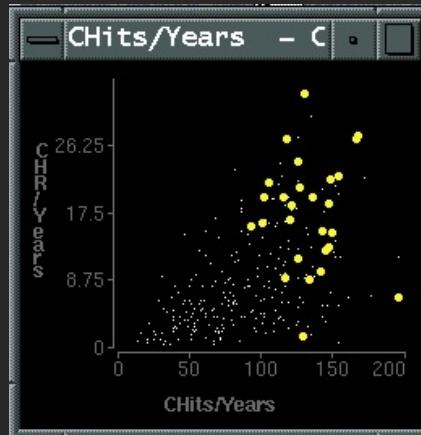
65

Brushing and Linking

67

Highlighting

Focus user attention on a subset of the data within one graph [from Wills 95]



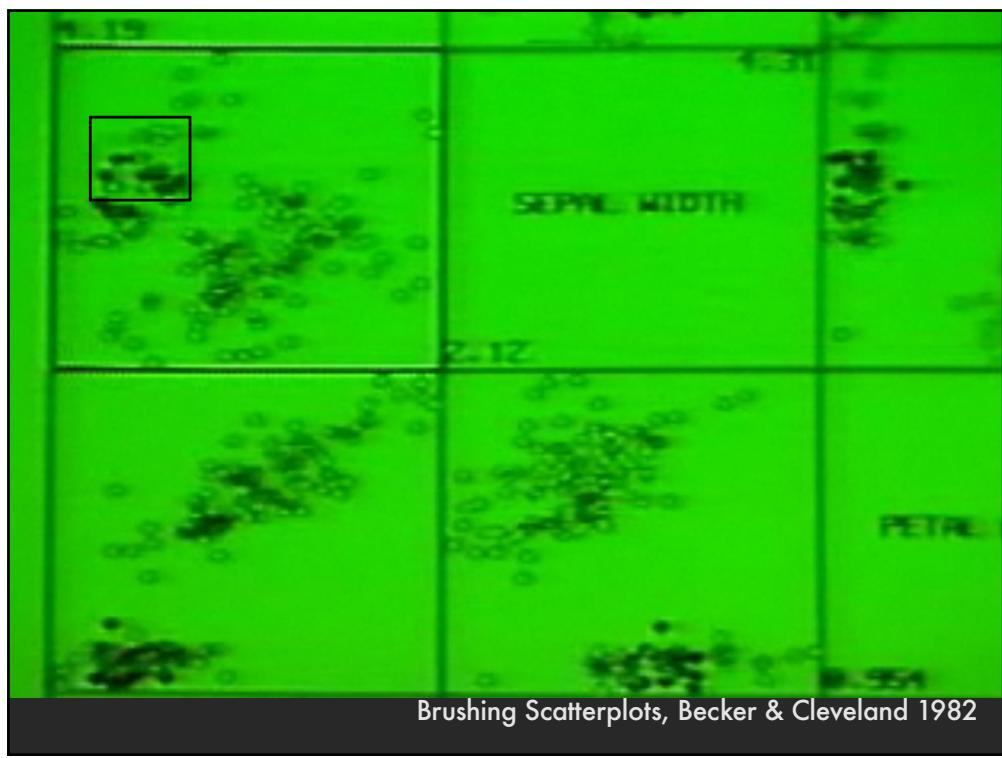
68

Brushing and Linking

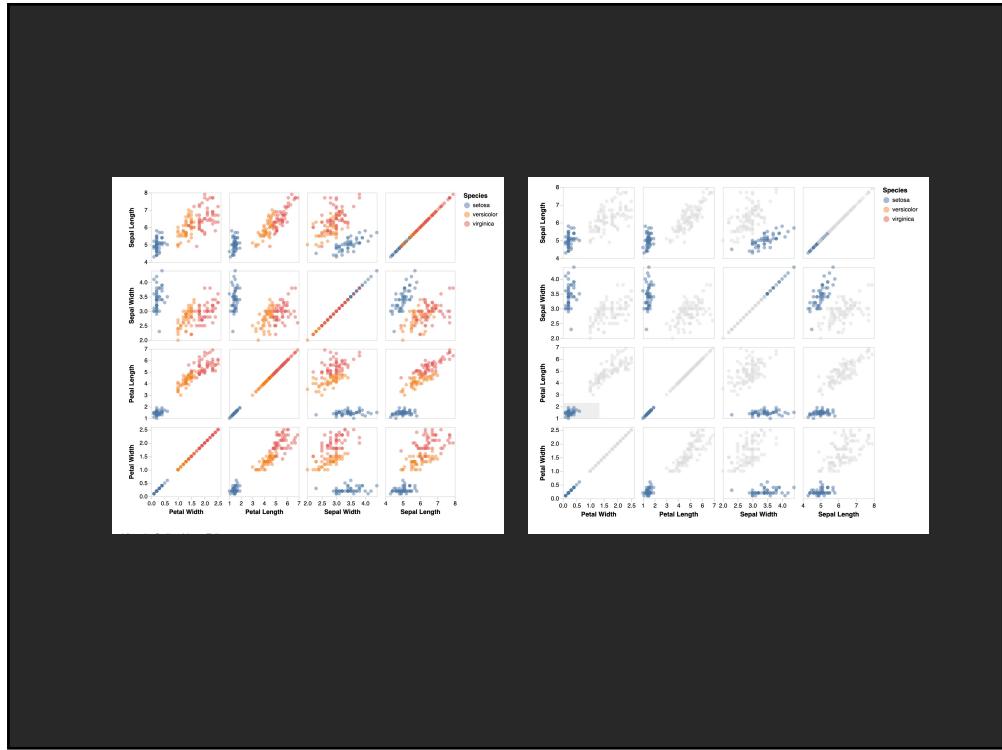
**Select ("brush") a subset of data
See selected data in other views**

**The views must be *linked*
by *tuple* (matching data points), or
by *query* (matching range or values)**

69

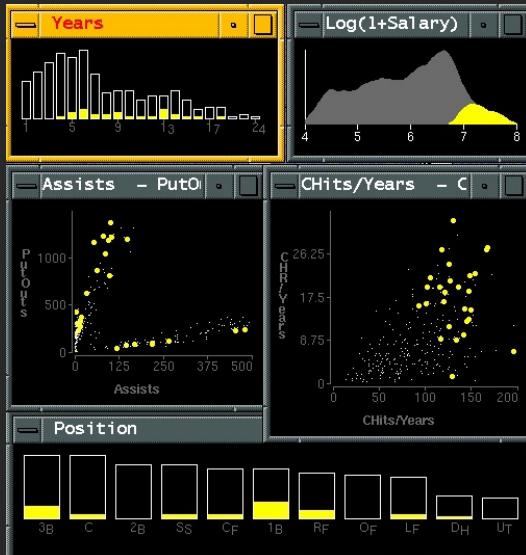


70



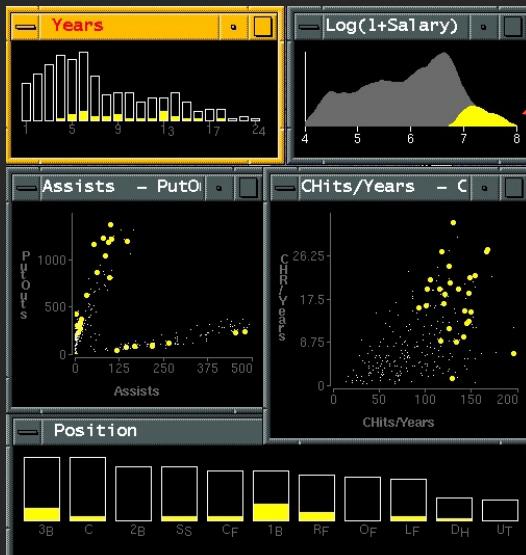
71

Baseball statistics [from Wills 95]



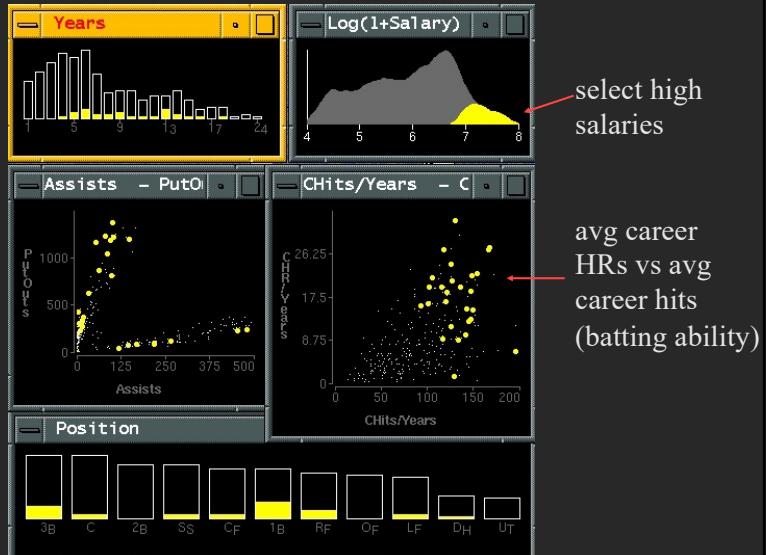
72

Baseball statistics [from Wills 95]



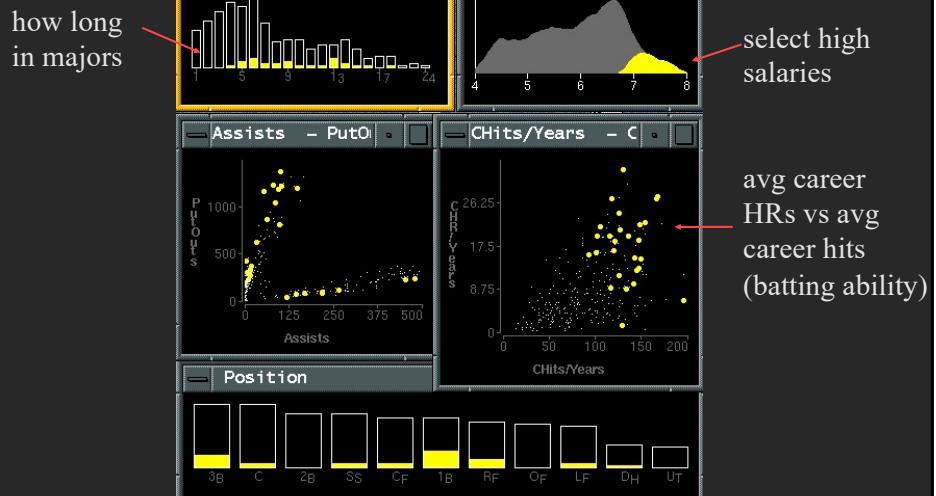
73

Baseball statistics [from Wills 95]



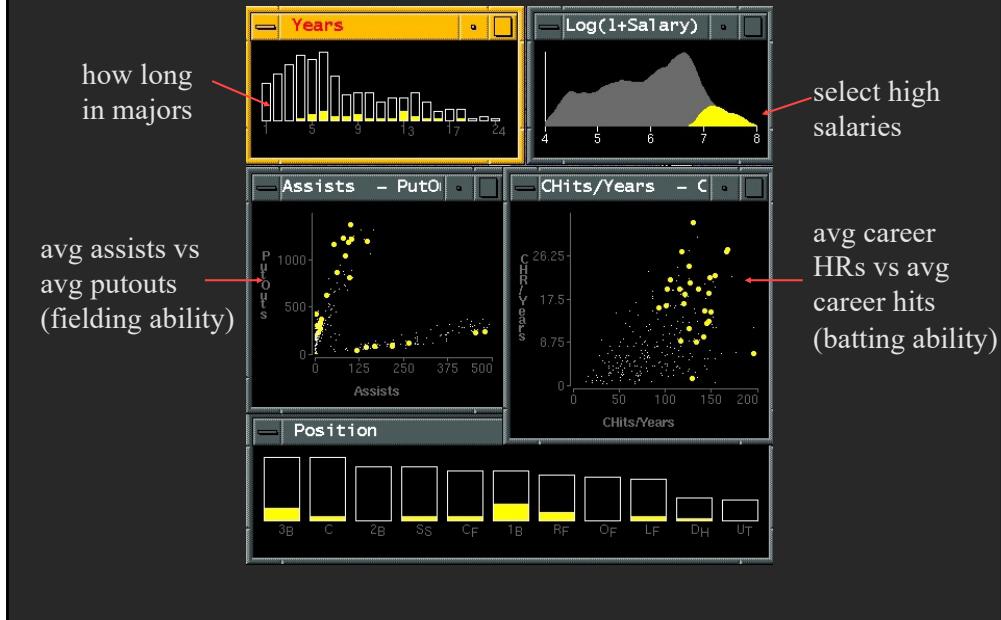
74

Baseball statistics [from Wills 95]



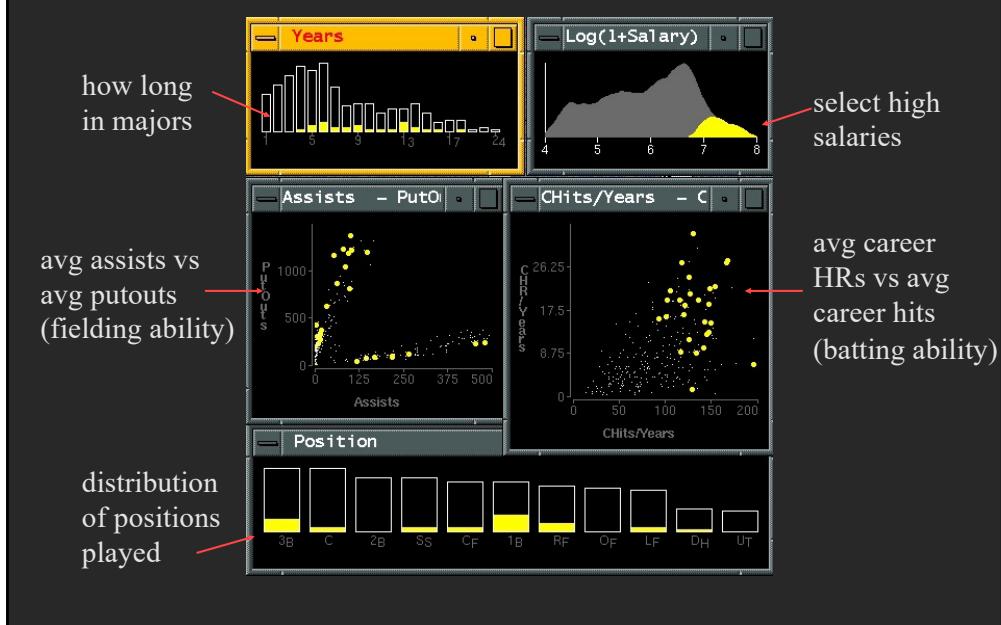
75

Baseball statistics [from Wills 95]



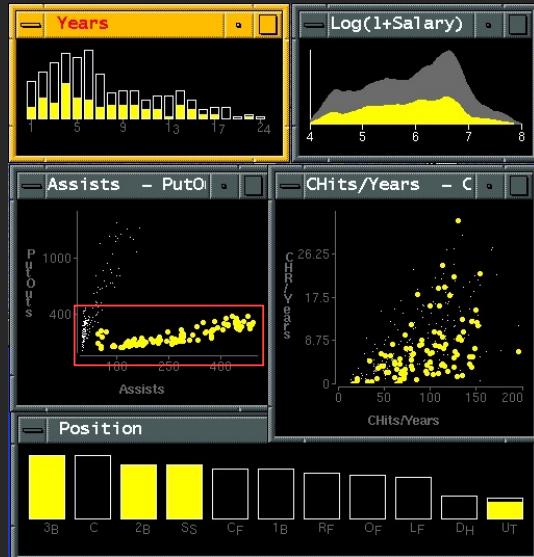
76

Baseball statistics [from Wills 95]



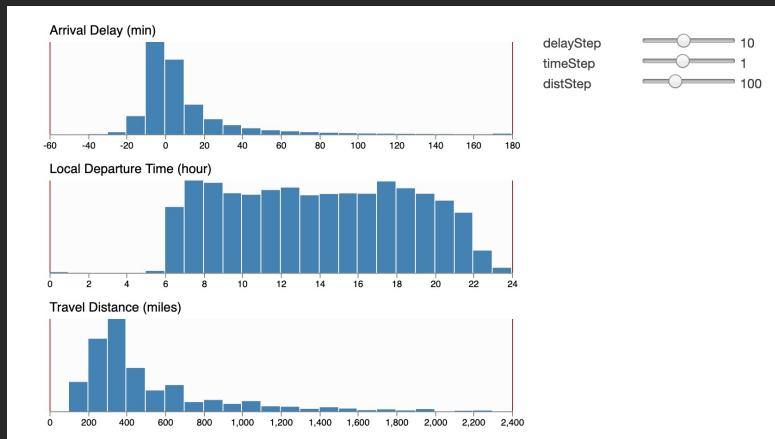
77

Linking assists to positions



78

CrossFiltering



79