

Interaction

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CS 448B: Visualization
Spring 2016

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

By GREGOR AISCH and KEVIN QUEALEY 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 1970. [Click here](#) to see 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, [Paul West](#) was good enough to get a player among the league's top 20. On Feb. 27, Curry made [20 3-pointers](#) in a single game.

How can we best put the gap between Curry and the best three-point shooters in history in context? 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-2000s,

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

Find a player

2015-16

1979-80

90

100

200

300

400

500

600

700

800

900

1000

1100

1200

1300

1400

1500

1600

1700

1800

1900

2000

2100

2200

2300

2400

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2600

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3000

3100

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29100

29200

Last Time: Perception

Just noticeable difference

JND (Weber's Law)

$$\Delta S = k \frac{\Delta I}{I}$$

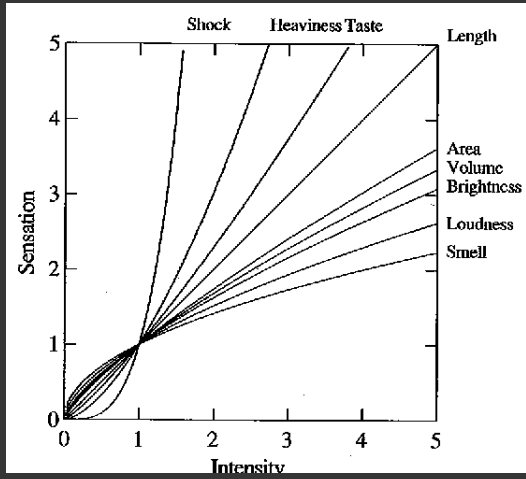
- Ratios more important than magnitude
- Most continuous variations in stimuli are perceived in discrete steps



Steven's power law

$$S = I^p$$

$p < 1$: underestimate
 $p > 1$: overestimate



[graph from Wilkinson 99, based on Stevens 61]

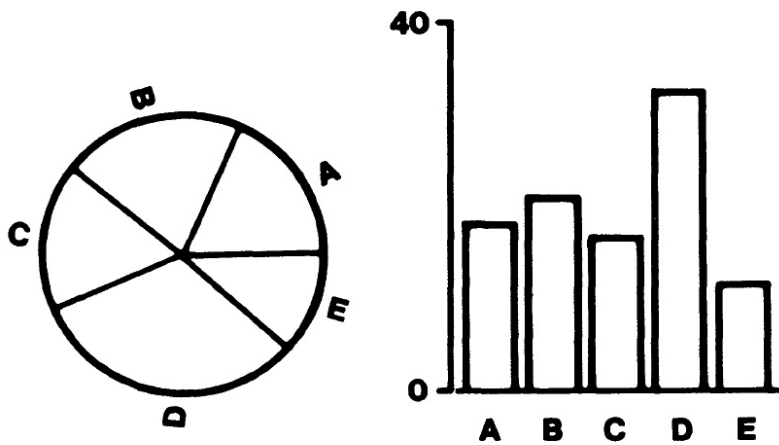
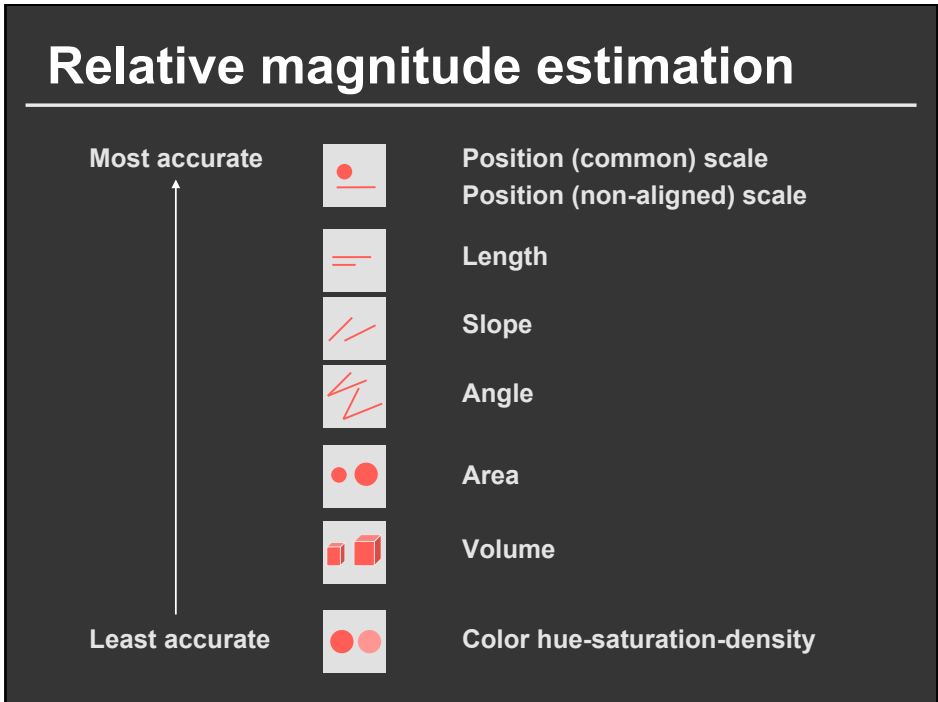
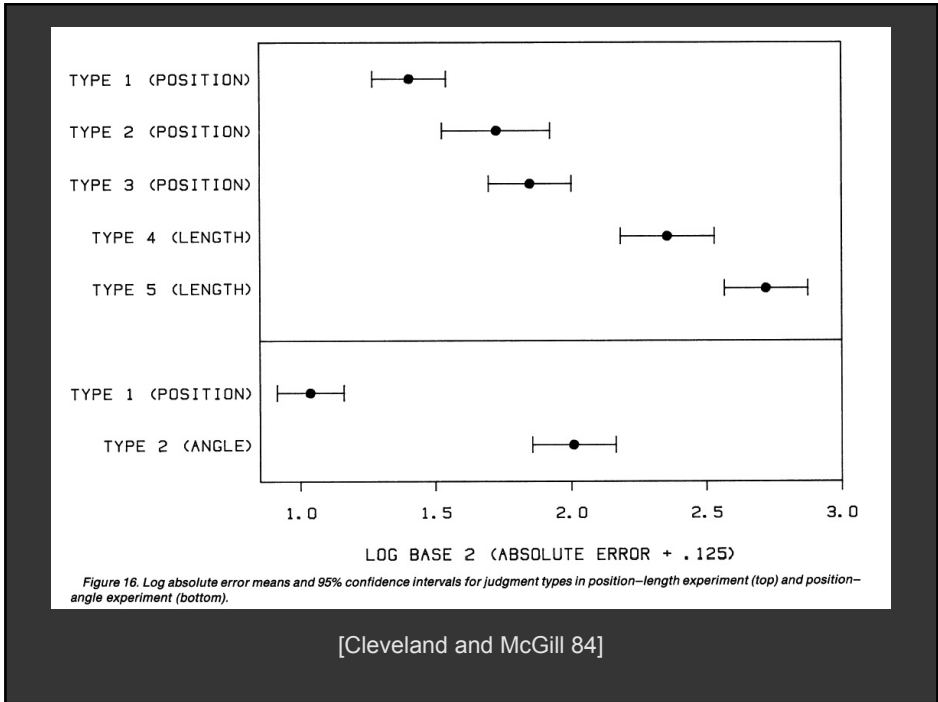


Figure 3. Graphs from position-angle experiment.

[Cleveland and McGill 84]

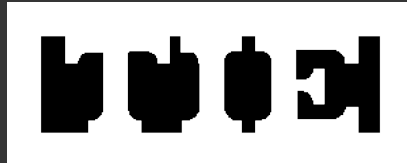


Gestalt

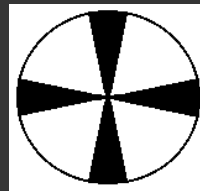
Figure/Ground



Ambiguous



Principle of surroundedness



Principle of relative size

<http://www.aber.ac.uk/media/Modules/MC10220/visper06.html>

Figure/Ground



Ambiguous

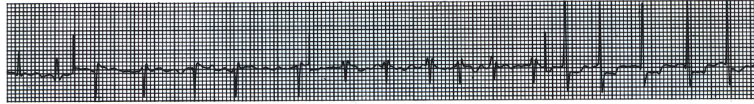


Unambiguous

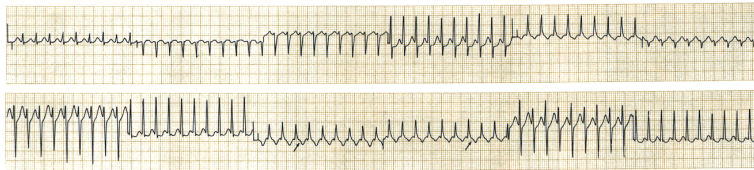
<http://www.aber.ac.uk/media/Modules/MC10220/visper06.html>

Layering and Small Multiples

Layering: Gridlines

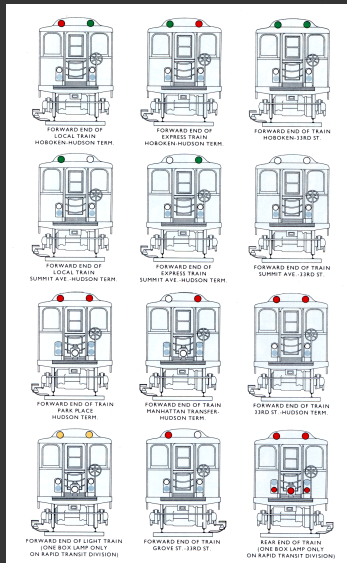


Signal and background compete above, as an electrocardiogram trace-line becomes caught up in a thick grid. Below, the screened-down grid stays behind traces from each of 12 monitoring leads:⁴



Electrocardiogram tracelines [from Tufte 90]

Small multiples



Operating trains. Redrawn by Tufte to emphasize colored lights. [from Tufte 90]

Announcements

Assignment 2: Exploratory Data Analysis

Use **Tableau** to formulate & answer questions

First steps

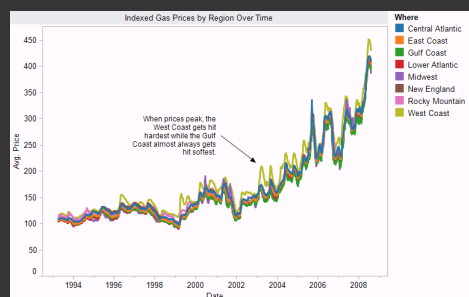
- Step 1: Pick a domain
- Step 2: Pose questions
- Step 3: Find data
- Iterate

Create visualizations

- Interact with data
- Question will evolve
- Tableau

Make wiki notebook

- Keep record of all steps you took to answer the questions



Due before class on Apr 18, 2016

Assignment 3: Dynamic Queries

Create a **small** interactive dynamic query application similar to Homefinder, but for SF Crime Data.

1. Storyboard interface
2. Implement interface and produce final writeup
3. Submit the application and a final writeup on the wiki

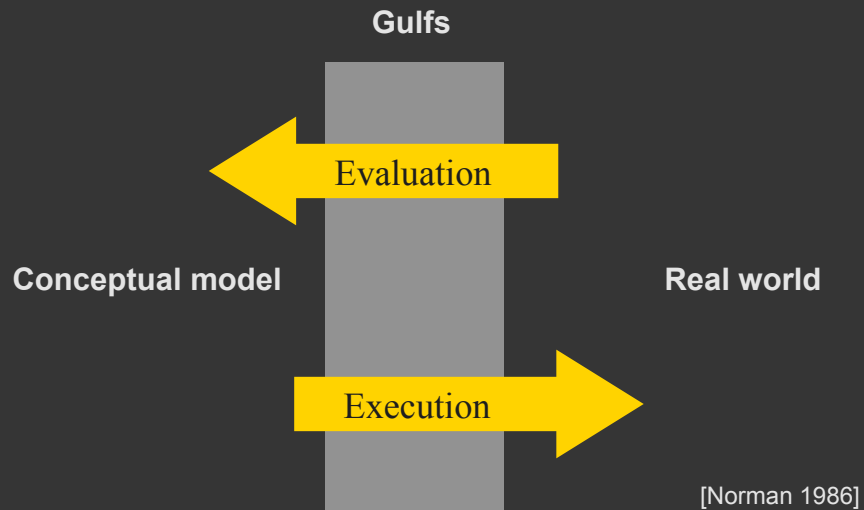


Can work alone or in pairs

Final write up due before class on **May 4, 2016**

Interaction

Gulfs of execution & evaluation



Gulf of Execution

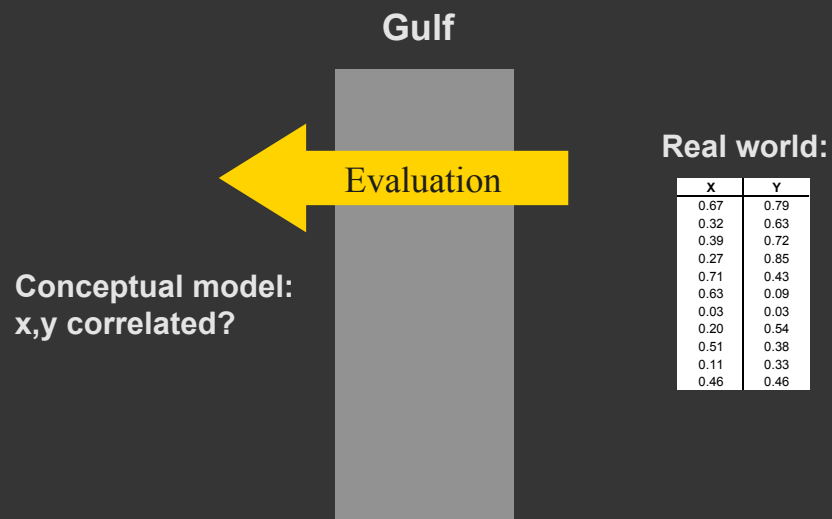
The difference between the user's intentions and the allowable actions.

Gulf of Evaluation

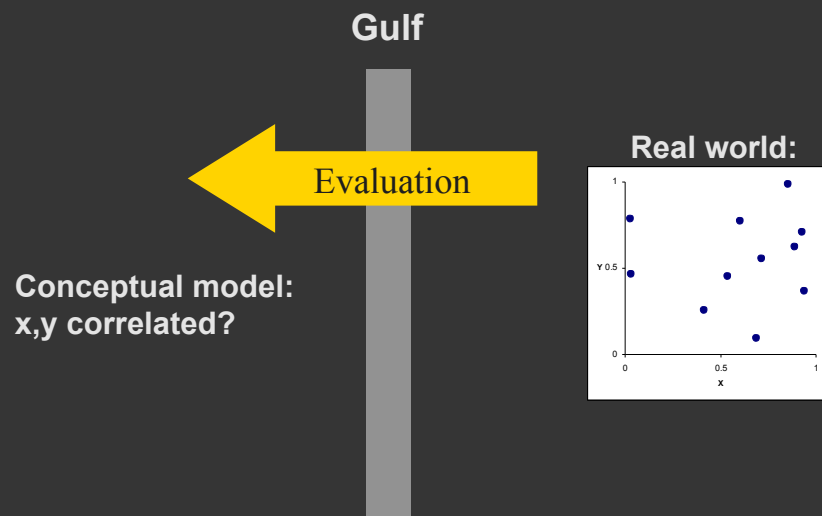
The amount of effort that the person must exert to interpret the state of the system and to determine how well the expectations and intentions have been met.

[Norman 1986]

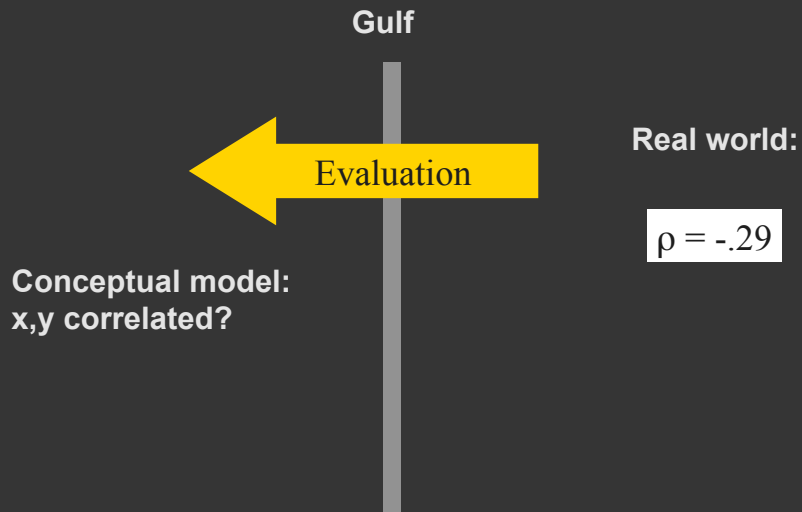
Gulf of evaluation



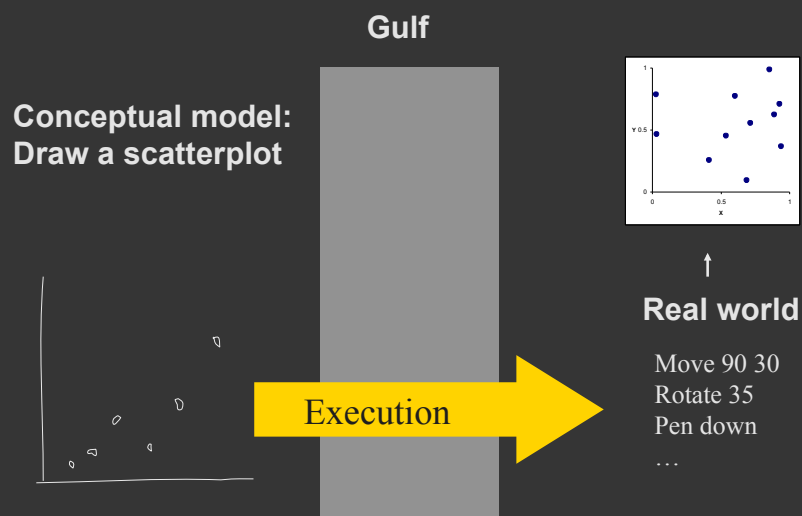
Gulf of evaluation



Gulf of evaluation

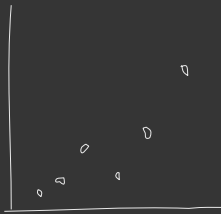


Gulf of execution



Gulf of execution

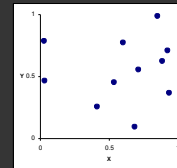
Conceptual model:
Draw a scatterplot



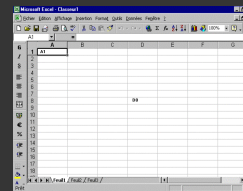
Gulf



Execution



Real world



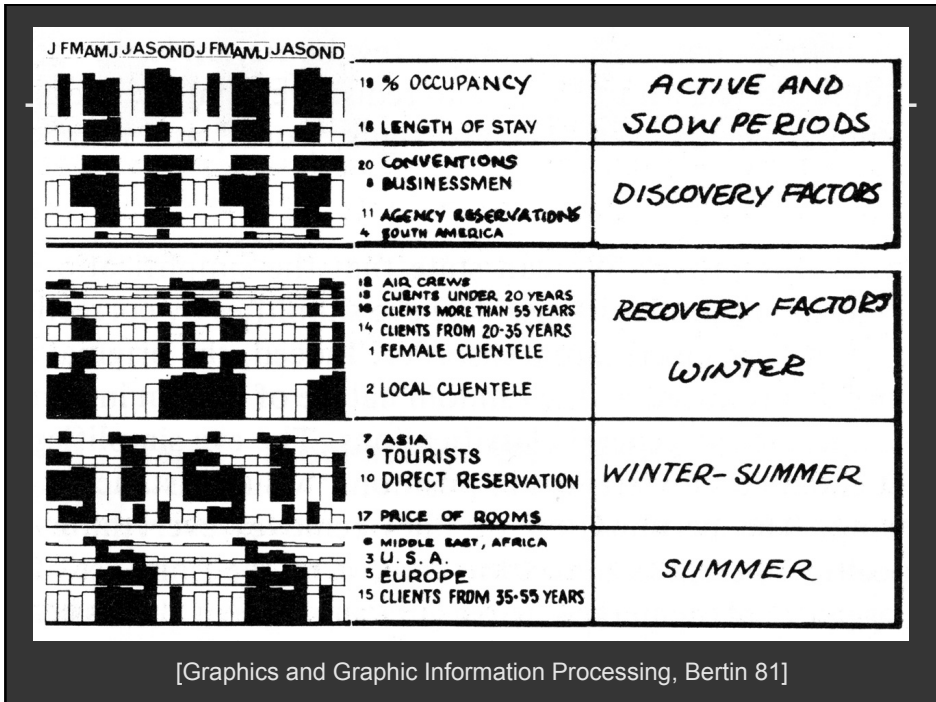
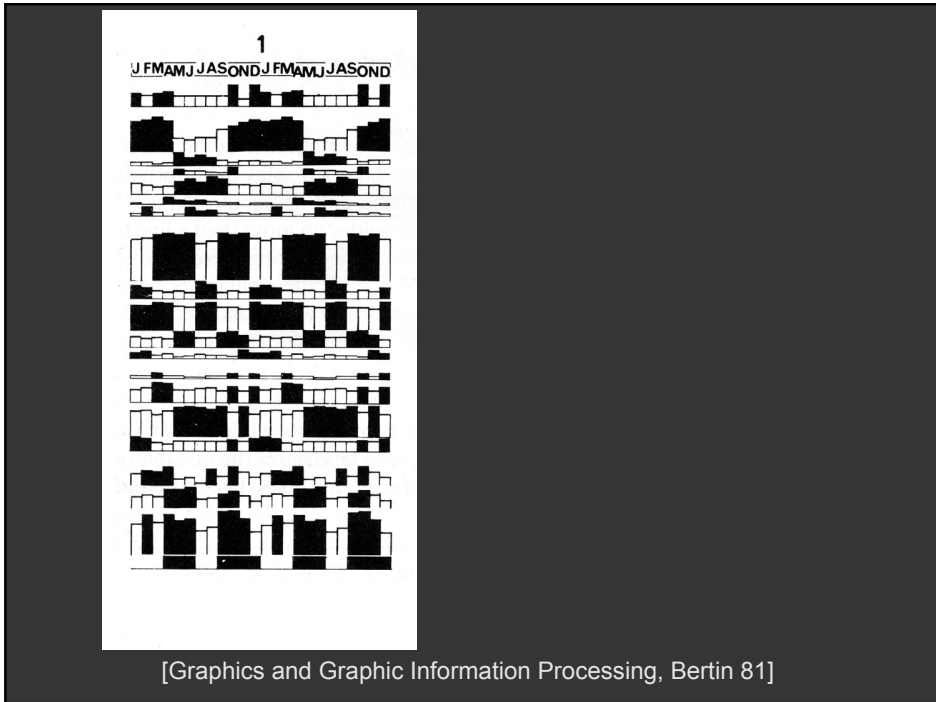
Topics

- Early interactive systems
- Brushing and linking
- Dynamic queries
- Generalized selections

Early Systems

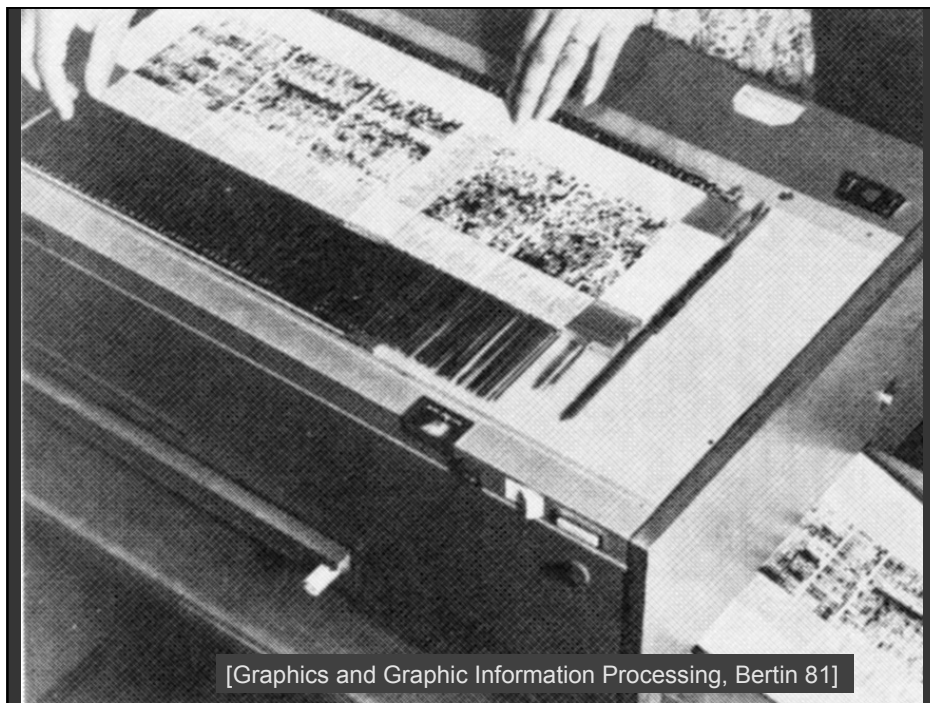
J	F	M	A	M	J	J	A	S	O	N	D		
26	21	26	28	20	20	20	20	40	15	40	1	% CLIENTELE FEMALE	
69	70	77	71	37	36	39	39	55	60	68	2	% —" — LOCAL	
7	6	3	6	23	14	19	14	9	6	8	3	% —" — U.S.A.	
0	0	0	0	8	6	6	4	2	12	0	4	% —" — SOUTH AMERICA	
20	15	14	15	23	27	22	30	27	19	19	17	5	% —" — EUROPE
1	0	0	8	6	4	6	4	2	1	0	1	6	% —" — M.EAST, AFRICA
3	10	6	0	3	13	8	9	5	2	5	2	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	57	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	156	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
			X	X	X			X	X	X	X	20	CONVENTIONS

[Graphics and Graphic Information Processing, Bertin 81]





[Graphics and Graphic Information Processing, Bertin 81]



[Graphics and Graphic Information Processing, Bertin 81]



Pointing

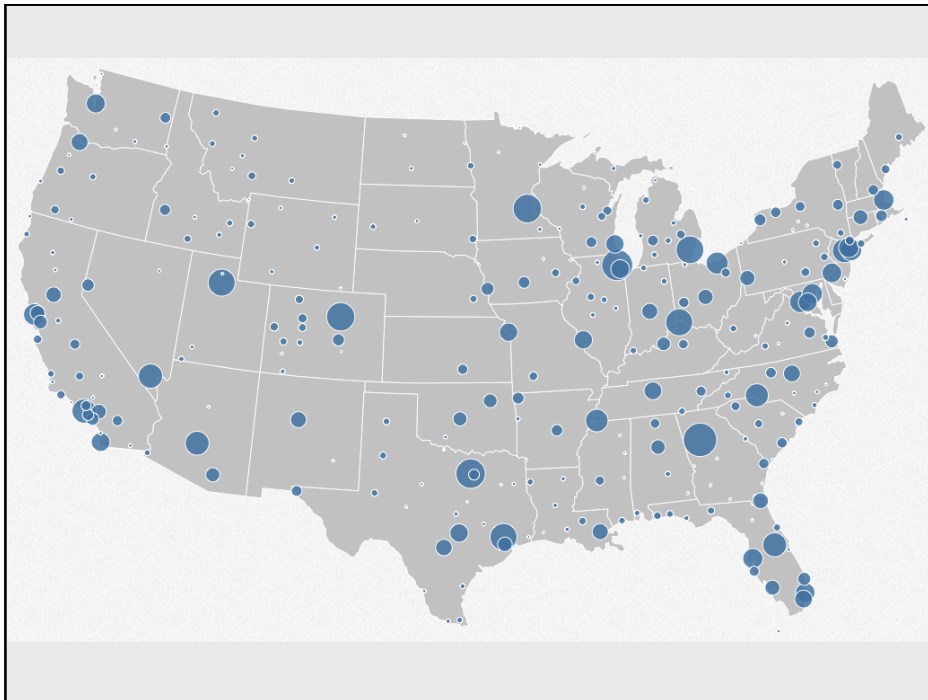
Basic Pointing Methods

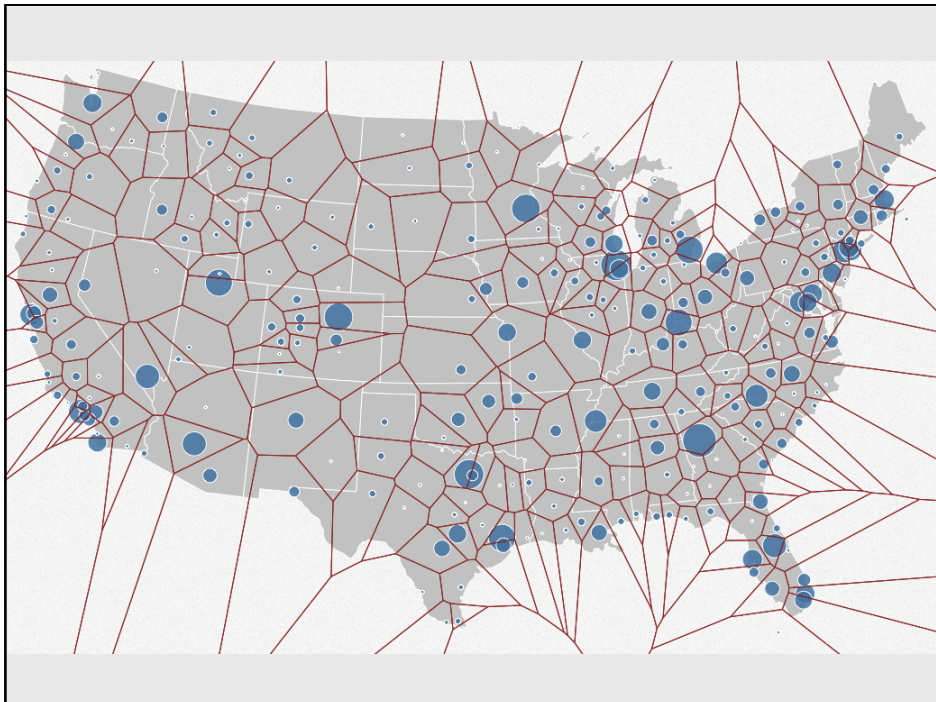
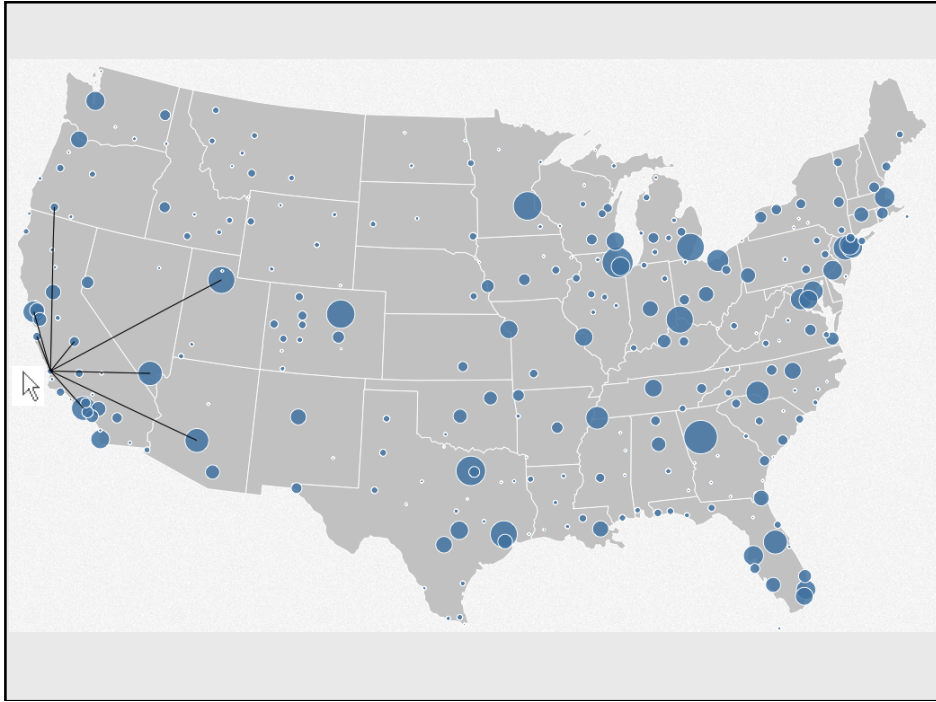
Point Selection

Mouse Hover / Click

Touch / Tap

Select Nearby Element (e.g., Bubble Cursor)





Basic Pointing Methods

Point Selection

Mouse Hover / Click

Touch / Tap

Select Nearby Element (e.g., Bubble Cursor)

Region Selection

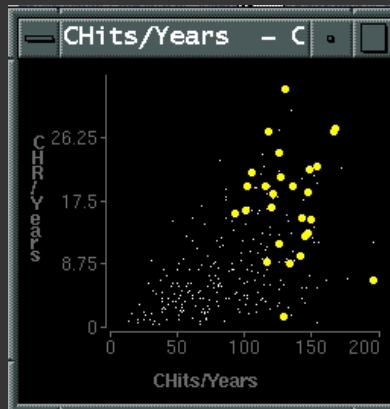
Rubber-band or Lasso

Area Cursors (“Brushes”)

Brushing and Linking

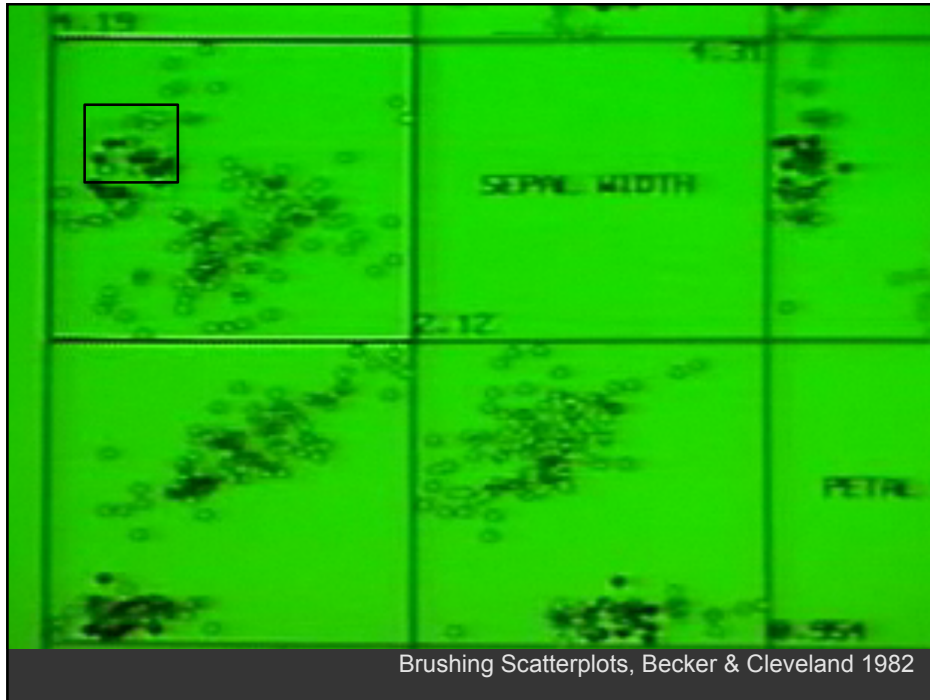
Highlighting

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

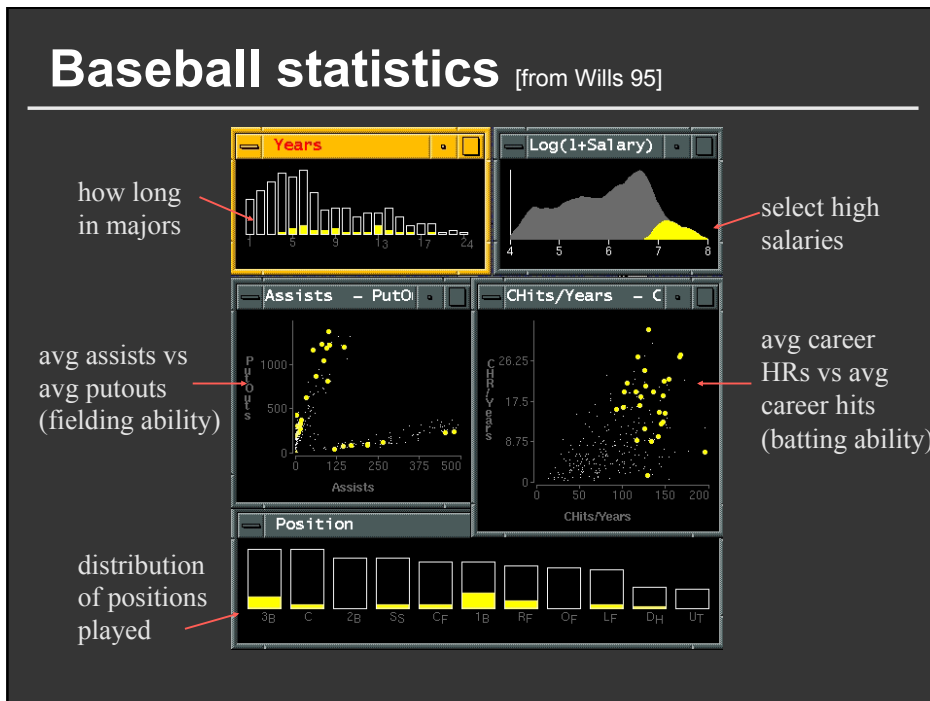


Brushing

- Interactively select subset of data
- See selected data in other views
- Two things (normally views) must be *linked* to allow for brushing



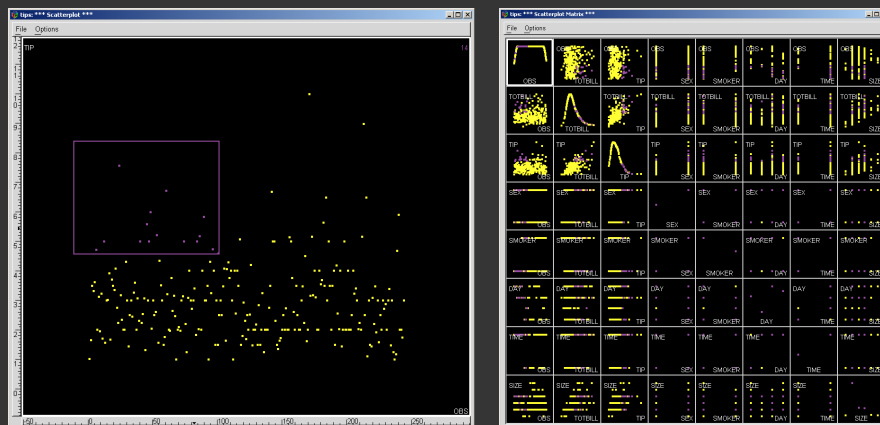
Baseball statistics [from Wills 95]



Linking assists to positions



GGobi: Brushing



<http://www.ggobi.org/>

Dynamic Queries

Query and results

```
SELECT house  
FROM east bay  
WHERE price < 1,000,000 AND bedrooms > 2  
ORDER BY price
```

Dunamic Browser : DC Home Finder

IdNumber	Dwelling	Address	City
2	House	5256 S. Capitol St.	Beltsville, MD
4	House	5536 S. Lincoln St.	Beltsville, MD
5	House	5165 Jones Street	Beltsville, MD
8	House	5007 Jones Street	Beltsville, MD
9	House	4872 Jones Street	Beltsville, MD
17	House	5408 S. Capitol St.	Beltsville, MD
20	House	5496 S. Capitol St.	Beltsville, MD
85	Condo	5459 S. Lincoln St.	Laurel, MD
86	Condo	5051 S. Lincoln St.	Laurel, MD
88	Condo	5159 Hamilton Street	Laurel, MD
92	Condo	5132 Hamilton Street	Laurel, MD
93	Condo	5221 S. Lincoln St.	Laurel, MD
94	Condo	5043 S. Lincoln St.	Laurel, MD
95	Condo	4970 Jones Street	Laurel, MD
97	Condo	4677 Jones Street	Laurel, MD
98	Condo	4896 S. Capitol St.	Laurel, MD
99	Condo	5048 S. Capitol St.	Laurel, MD
100	Condo	4597 31st Street	Laurel, MD
101	Condo	5306 S. Lincoln St.	Laurel, MD
103	Condo	5562 Glass Road	Laurel, MD
105	Condo	5546 Hamilton Street	Laurel, MD
152	House	7670 31st Street	Upper Marlboro, MD

Issues

1. For programmers
2. Rigid syntax
3. Only shows exact matches
4. Too few or too many hits
5. No hint on how to reformulate the query
6. Slow question-answer loop
7. Results returned as table

HomeFinder



The yellow dots above are homes in the DC area for sale. You may get more information on a home by selecting it. You may drag the 'A' and 'B' distance markers to your office or any other location you want to live near. Select distances, bedrooms, and cost ranges by dragging the corresponding slider boxes on the right. Select specific home types and services by pressing the labeled buttons on the right.

Dynamic HomeFinder

Reset Quit

Save Print

Dist to A:
1 30

Dist to B:
1 30

Bedrooms:
1 7

Cost:
\$50k \$500k

Look at:
Hse TH Cnd

Features:
Grg Fp1
CAC New

[Ahlberg and Schneiderman 92]

Direct manipulation

1. Visual representation of objects and actions
2. Rapid, incremental and reversible actions
3. Selection by pointing (not typing)
4. Immediate and continuous display of results