

INTERACTION

CS 448B | Fall 2023

MANEESH AGRAWALA

1

READING RESPONSE: QUESTIONS/THOUGHTS

How can micro/macro design principles be harnessed to address information overload while retaining the richness of data? Are there instances where simplification could be more beneficial than a high-density micro/macro design?

It would be interesting to me to learn more about **how micro and macroscopic designed visualizations have changed over time**, especially **because interactive visualizations may be able to help readers** do things such as zoom in How might we leverage interactivity to enhance otherwise static visualizations?

Tufte champions clarity, precision, and efficiency, advising against ornamental designs. Yet, while Micro/Macro compositions epitomize precision, they don't always align with clarity and efficiency. **Do I embrace comprehensive data for its precision, or do I curate what I deem most pertinent, risking the omission of outliers?**

2

LAST TIME

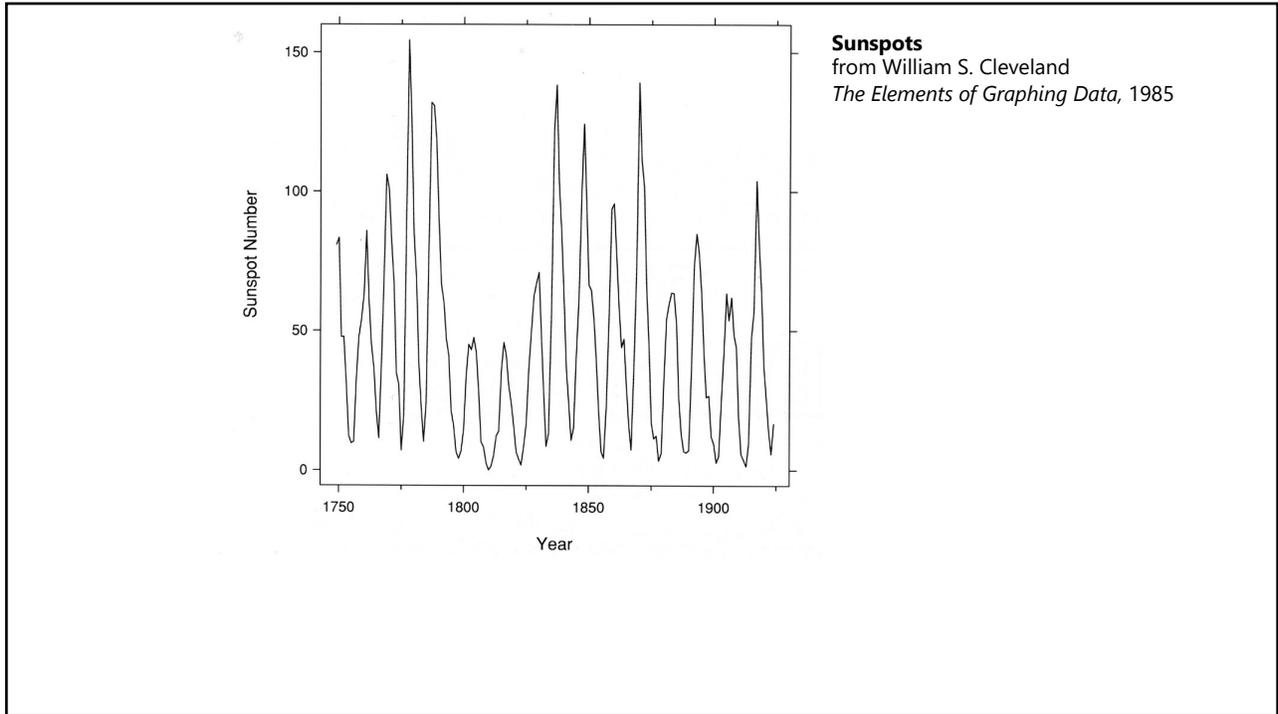
Learning Objectives

1. How to choose good visual encodings from the large set of possibilities.
2. How scales, axes, aspect ratios, fitting and sorting can emphasize different aspects of the data.

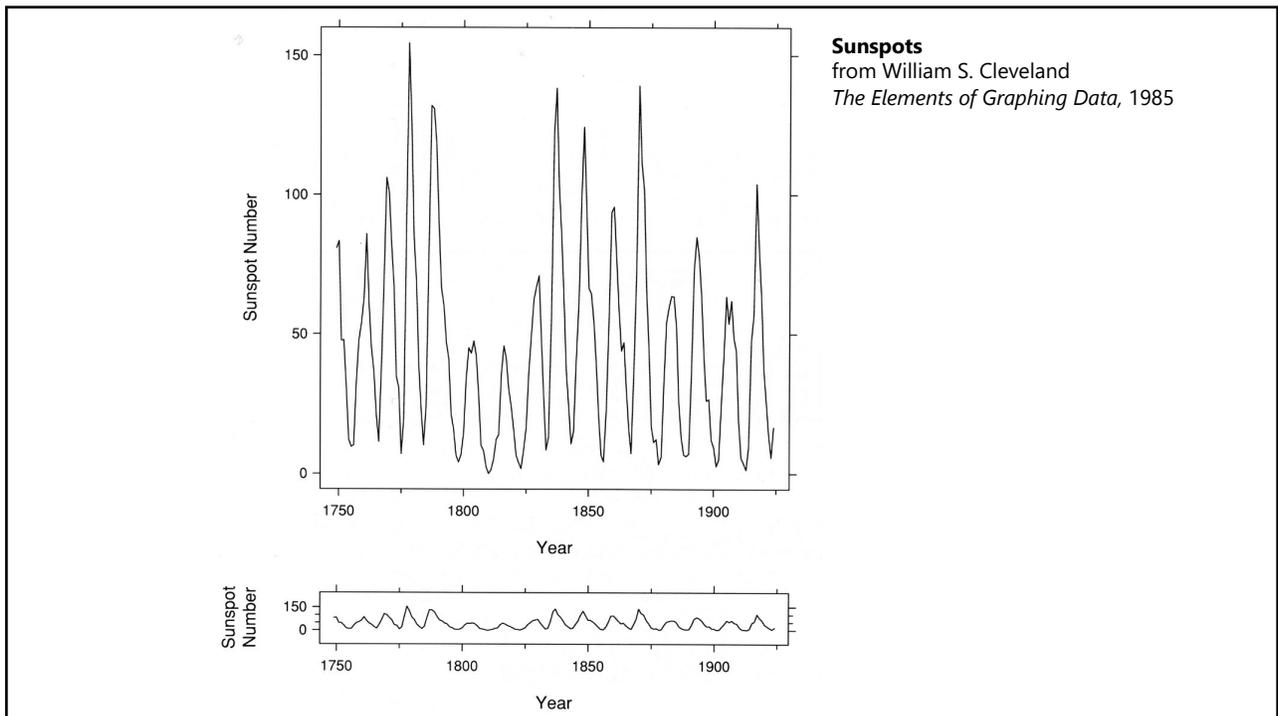
3

SELECTING ASPECT RATIO

4



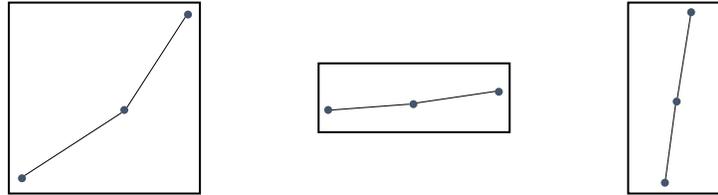
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6

BANKING TO 45° [Cleveland 1985]

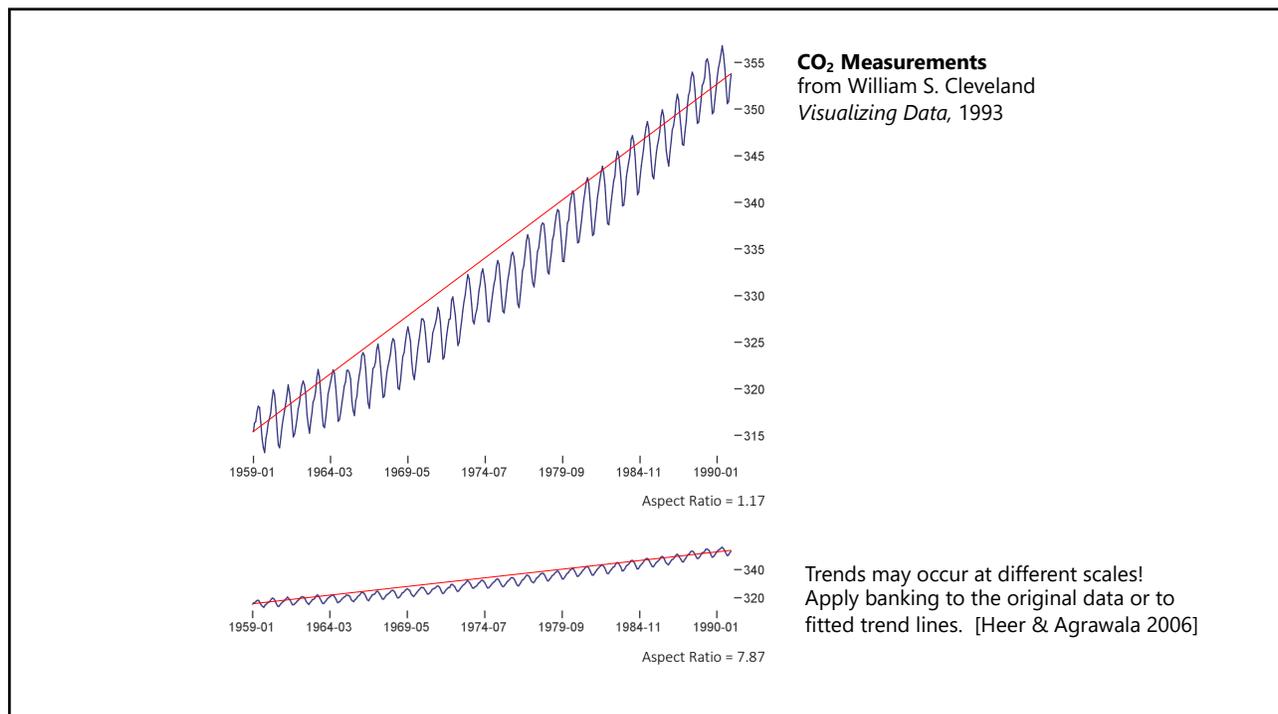
To facilitate perception of trends and maximize the discriminability of line segment orientations



Line segments are maximally discriminable when the absolute angle between them is 45°

Method: Optimize the *aspect ratio* such that the average absolute angle between all segments is 45°

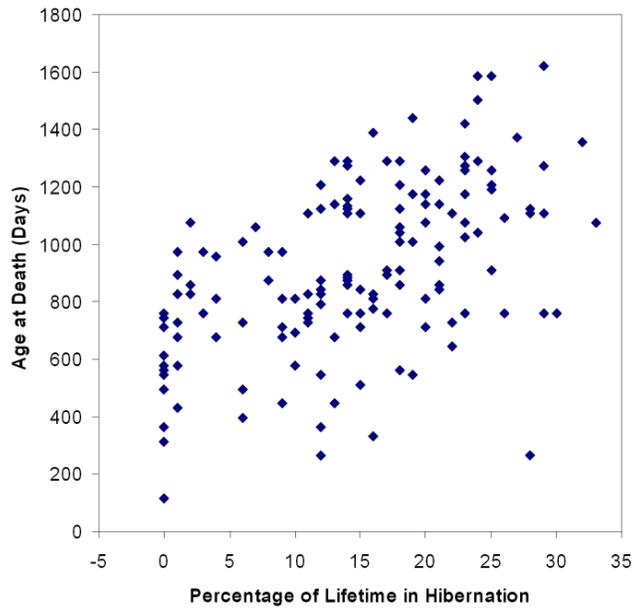
7



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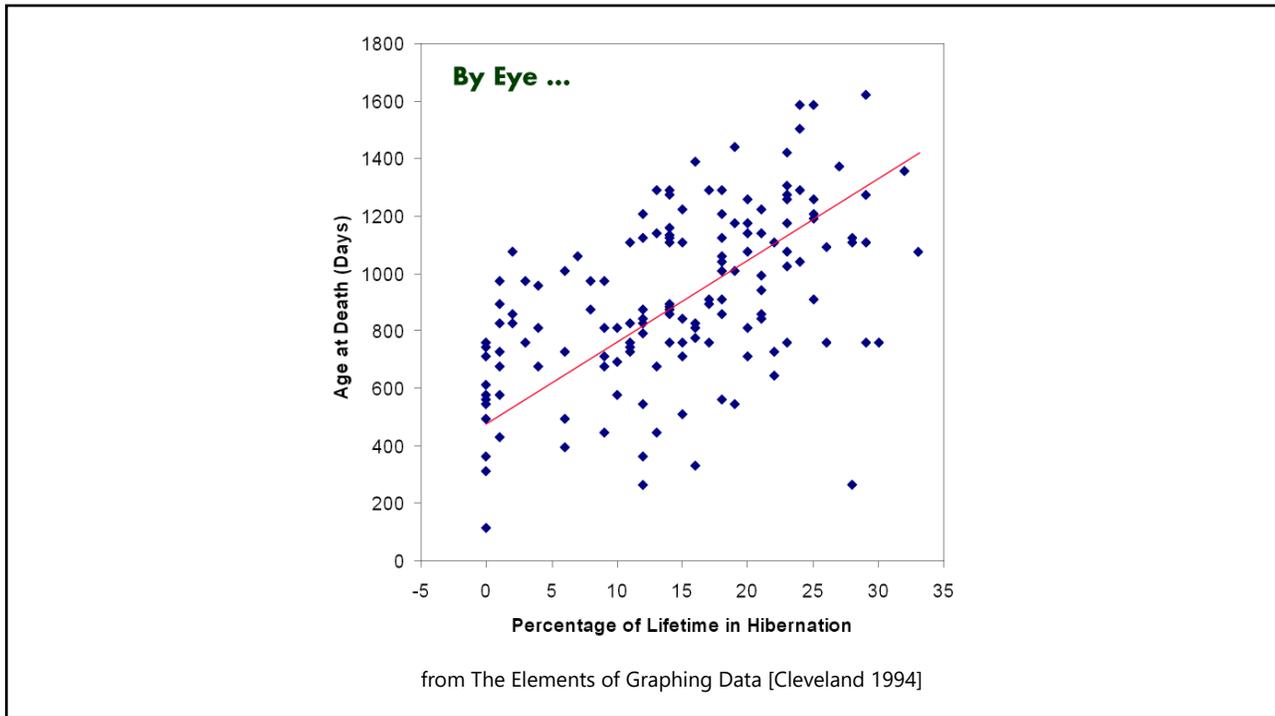
FITTING THE DATA

9

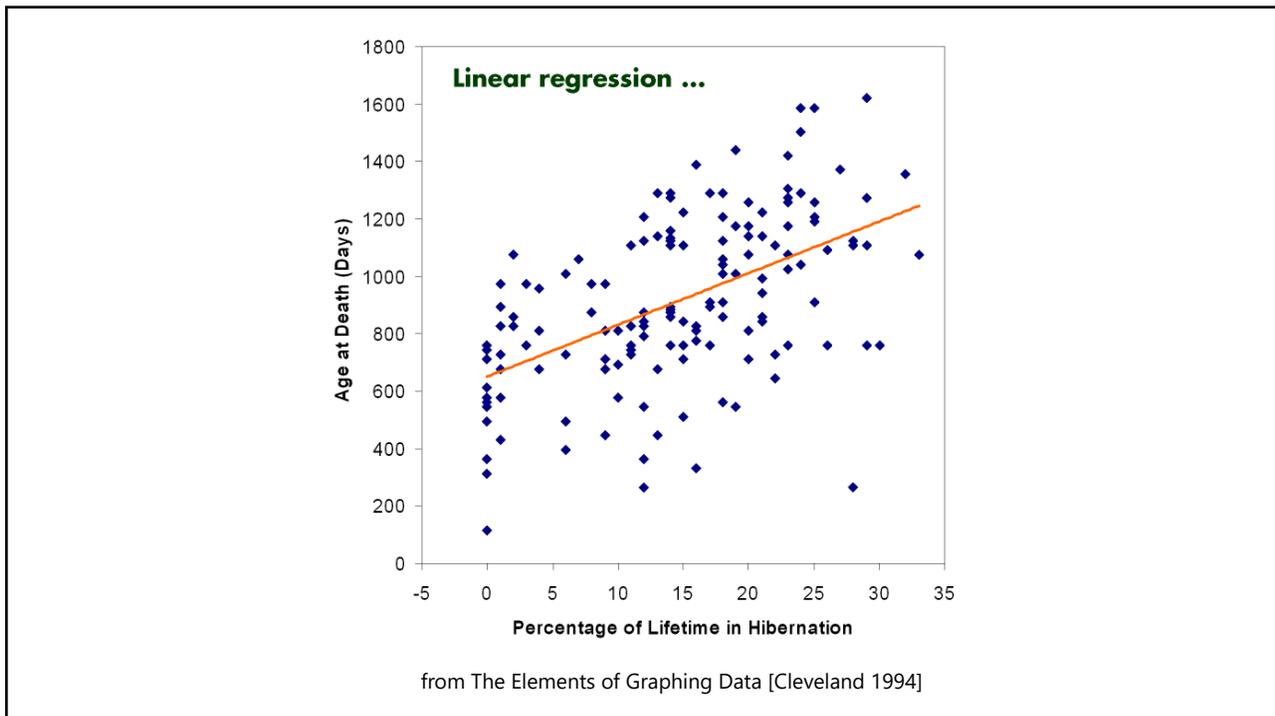


from The Elements of Graphing Data [Cleveland 1994]

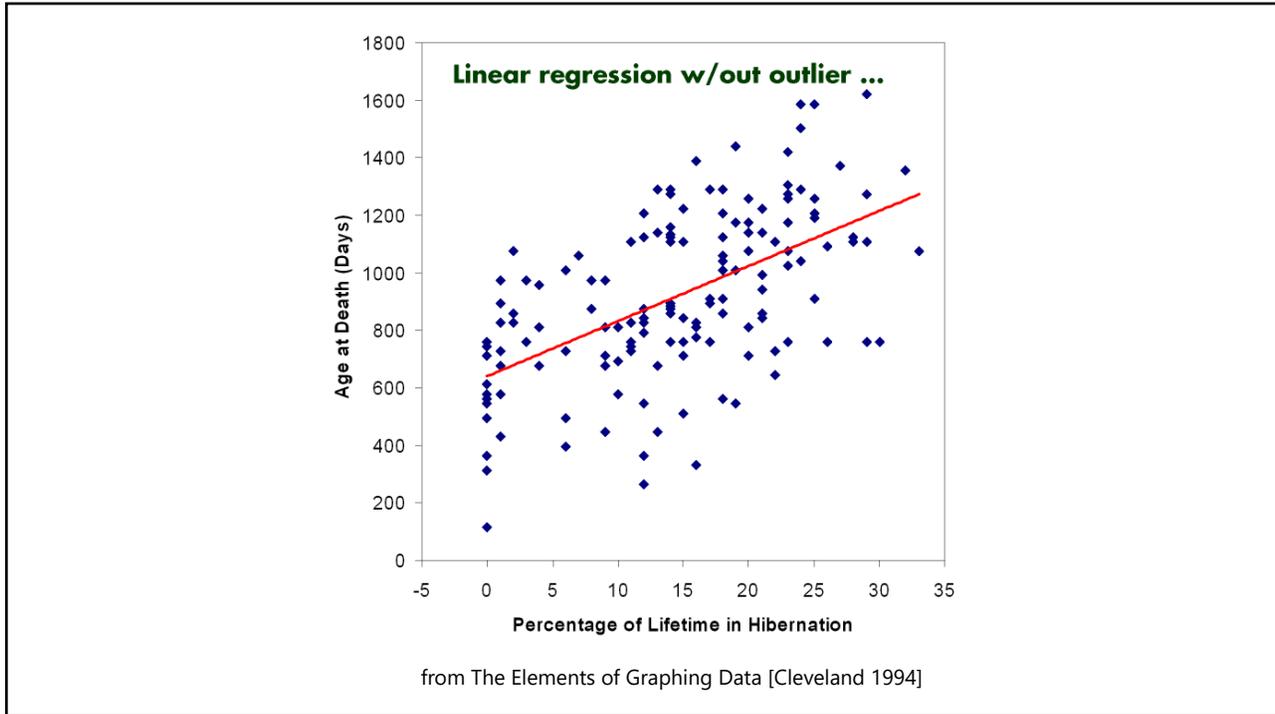
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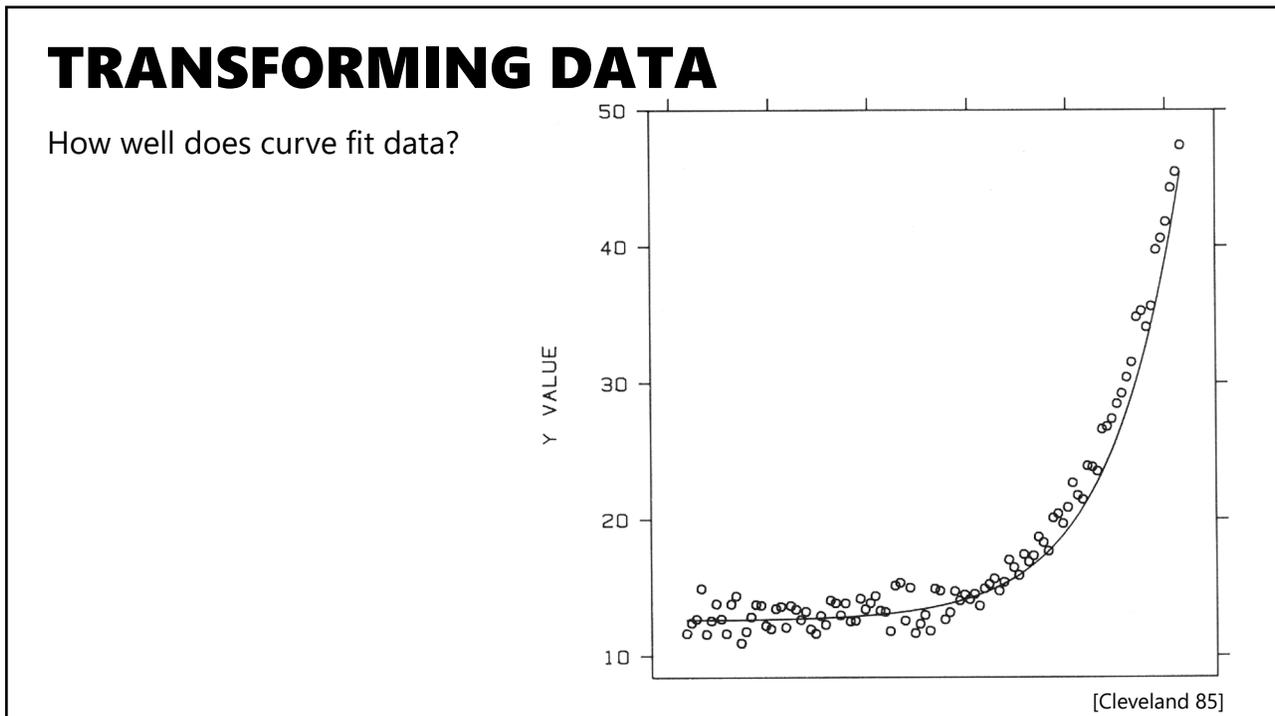
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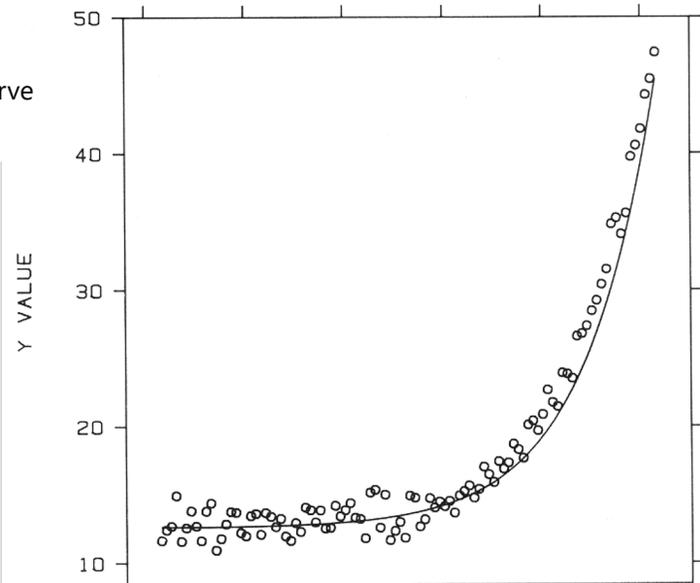
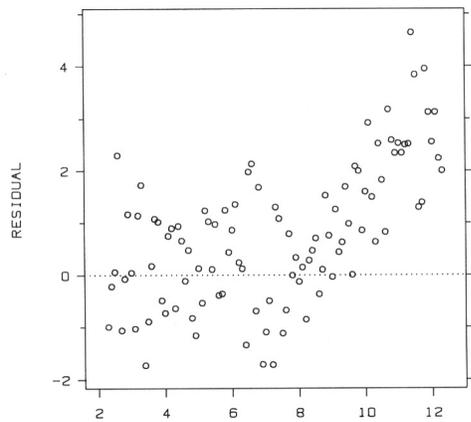


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TRANSFORMING DATA

Residual graph

Plot vertical distance from best fit curve
Residual graph shows accuracy of fit

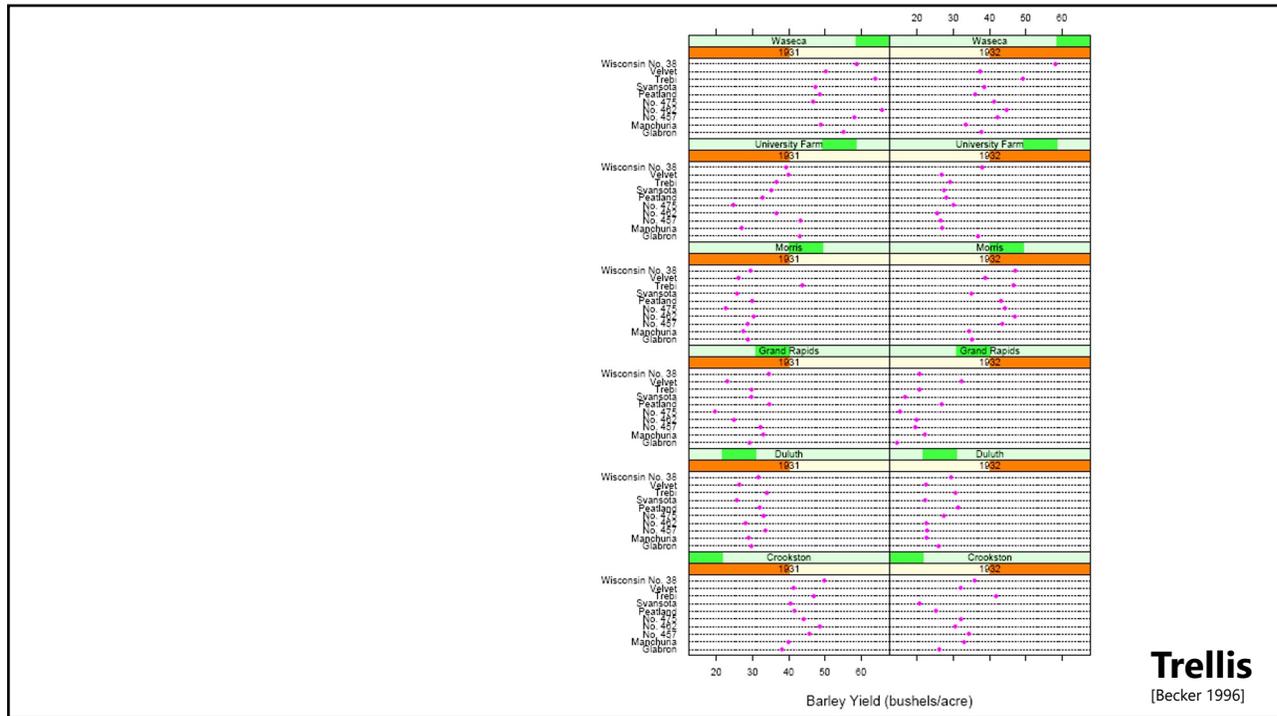


[Cleveland 85]

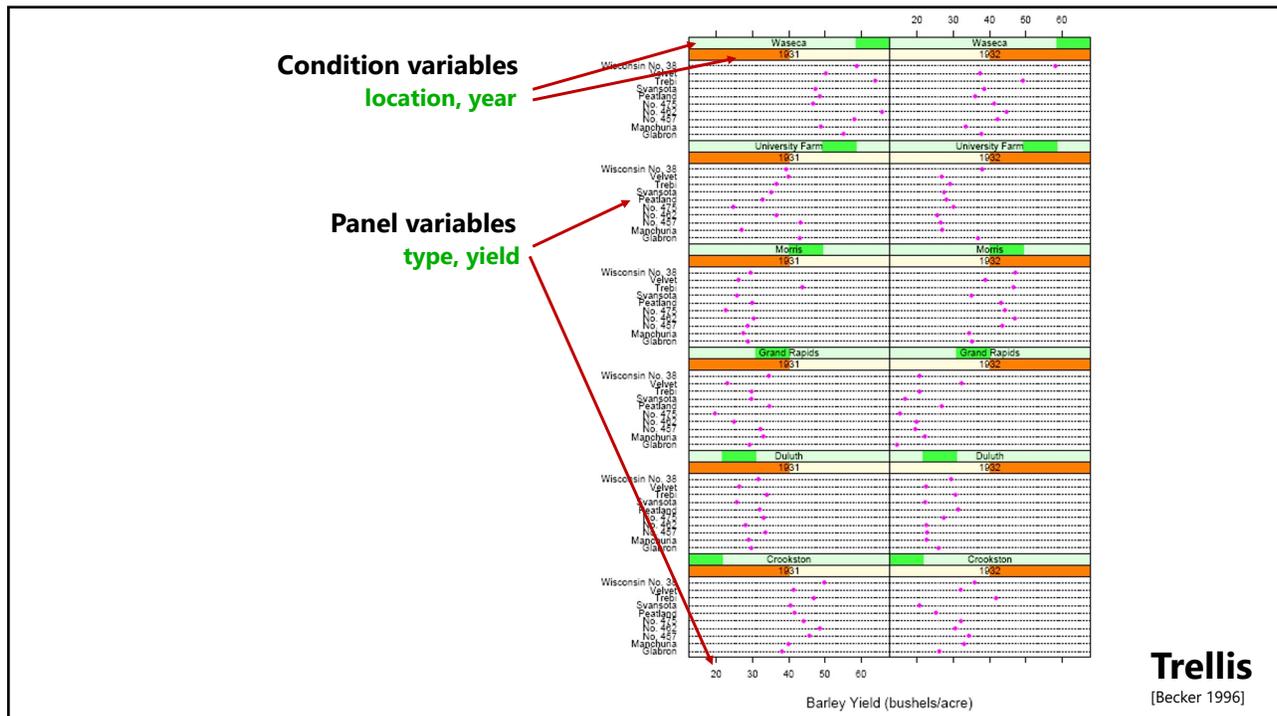
15

SORTING

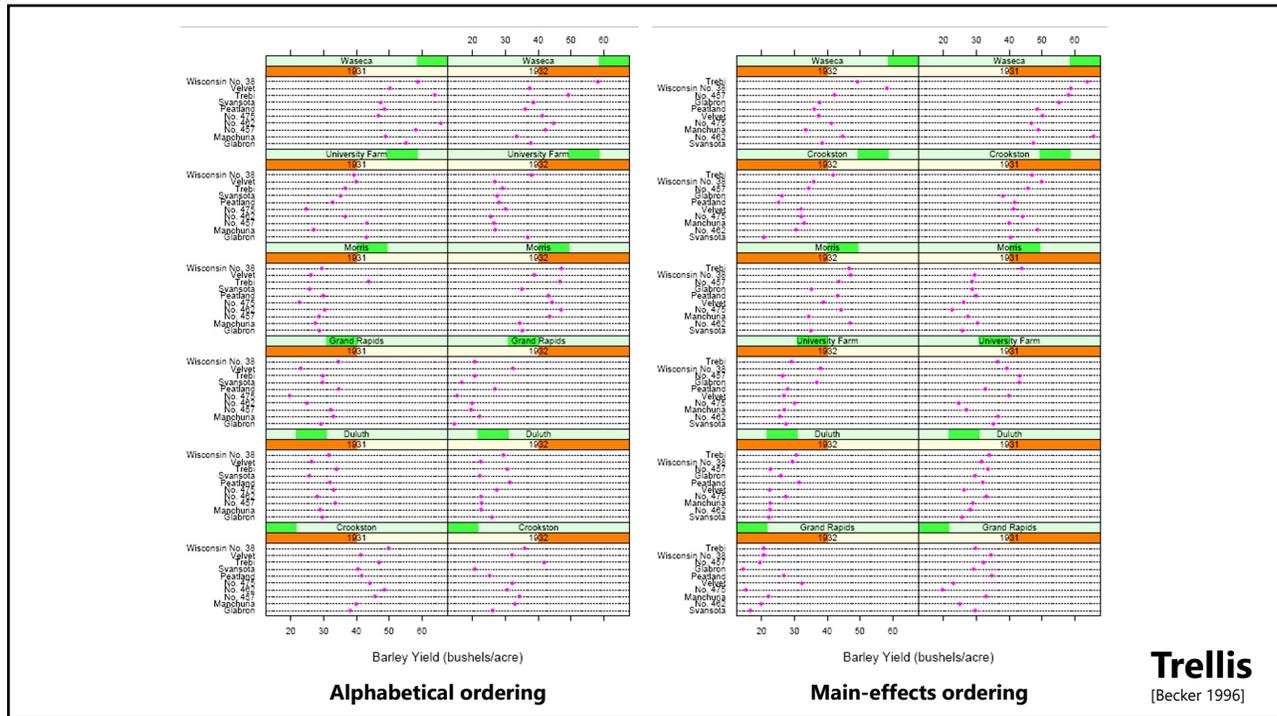
16



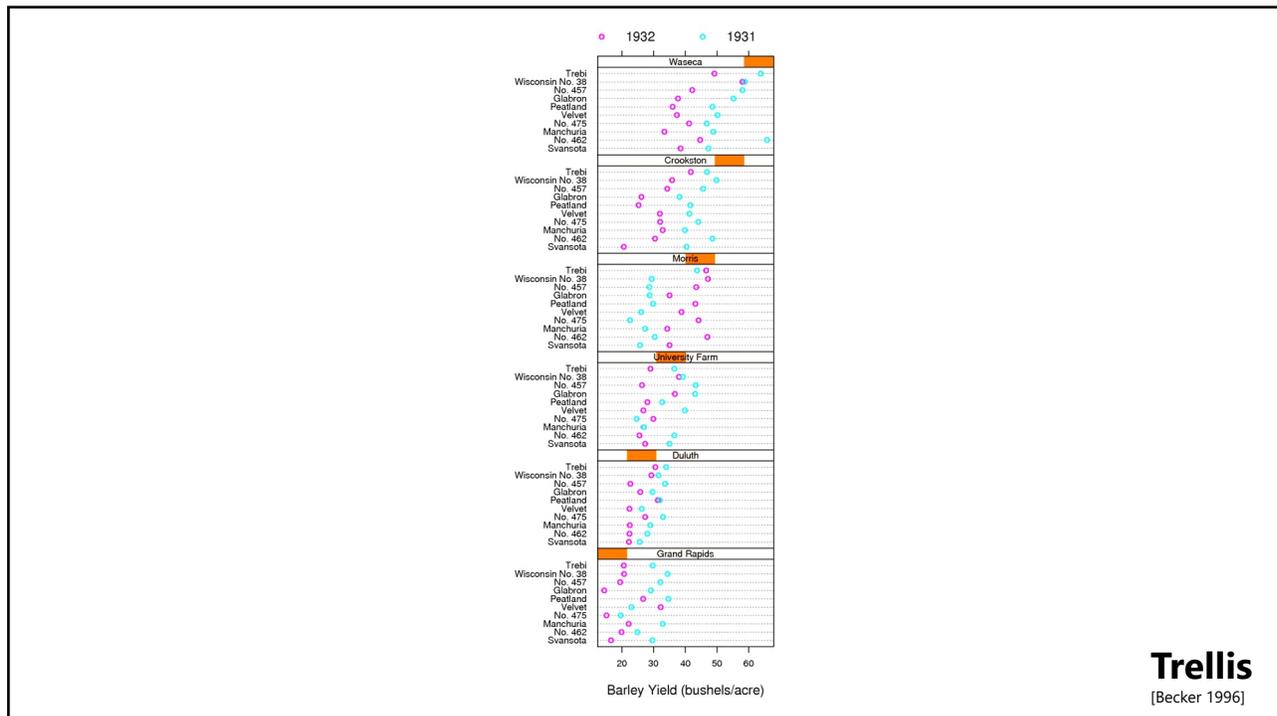
17



18



19



20

SUMMARY

Well designed visualizations

Use *expressive* and *effective* encodings

Avoid *over-encoding*

Emphasize features of the data most relevant to the task

Rarely does a single visualization answer all questions.
Instead, the ability to generate appropriate visualizations quickly is critical!

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ANNOUNCEMENTS

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ASSIGNMENT 2: EXP. DATA ANALYSIS

Due 10/16 11:30am

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

First steps

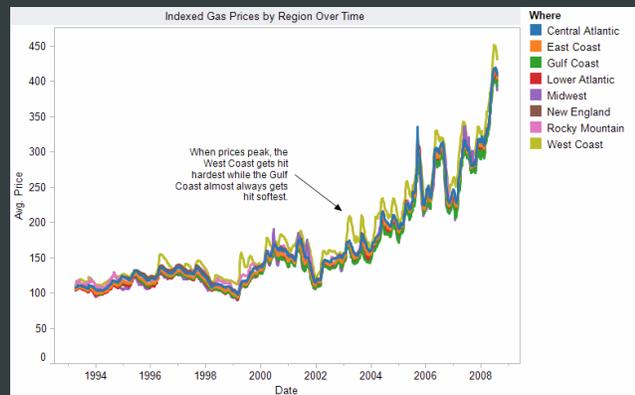
- Step 1: Pick domain & data
- Step 2: Pose questions
- Step 3: Profile data
- Iterate as needed

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



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ASSIGNMENT 3: INTERACTION

Due 10/30 11:30am

Create a small interactive dynamic query application similar to HomeFinder, but for local software companies data.

1. Implement interface
2. Submit the application as a website and a short write-up on canvas

Can work alone or in pairs



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D3 NOTEBOOKS WED & MON

The screenshot displays two D3.js notebooks. The first notebook, titled "Introduction to D3", features a Venn diagram with two overlapping circles. The left circle is labeled "Data" and contains the text "Enter". The right circle is labeled "Elements" and contains the text "Exit". The intersection of the two circles is labeled "Update". The second notebook, titled "Making D3 Charts Interactive", shows a scatter plot with a y-axis labeled "Life Expectancy" ranging from 0 to 80 and an x-axis with values 1 through 5. The plot contains numerous colored dots, with a prominent blue dot at approximately (4.5, 45). The year "1955" is displayed in the bottom left corner of the plot area.

Team · Published
Introduction to D3
You republished 14 hours ago

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

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DESIGN EXERCISE

26

13 8

How many visualizations can you think of for conveying these two numbers?
Feel free to invent tasks or contexts. **Sketch as many as you can!**

Don't stress over quality, go for quantity.

Time: ~5 minutes

27

13 8

Share your designs with fellow students. Introduce yourselves! Then compare your designs. How many ideas are the same? How many are different?

Capture your favorite images and post them on the Slack channel
#in-class-design-activity

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TODAY

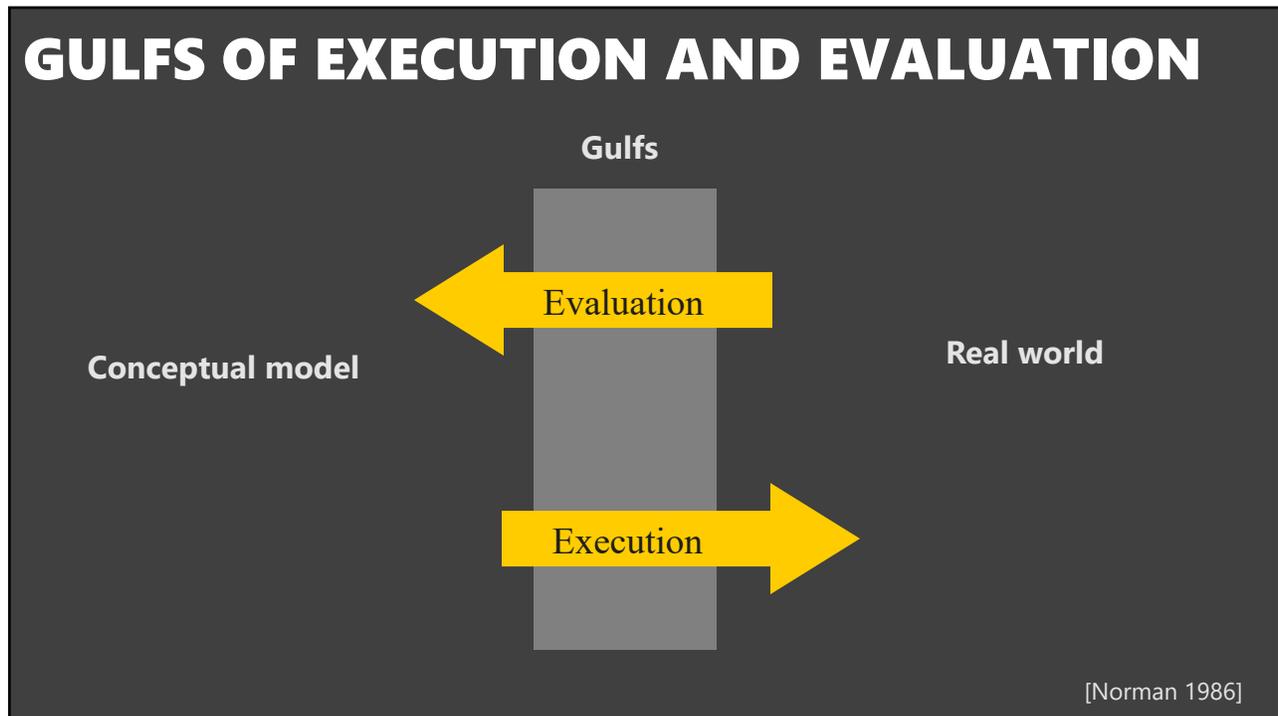
Learning Objectives

1. Conceptual models, system models and the gulfs of execution and evaluation
2. Common interaction techniques: Selection, Brushing and Linking and Dynamic Queries

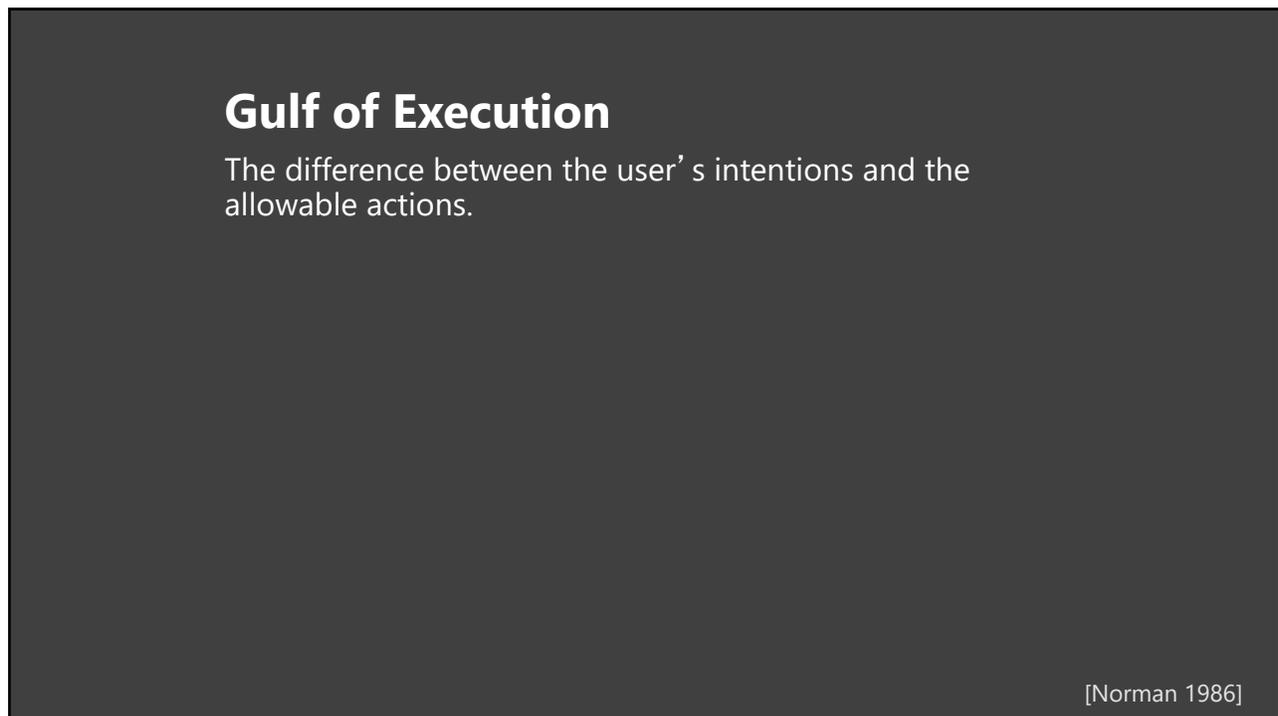
29

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

30



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Gulf of Execution

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

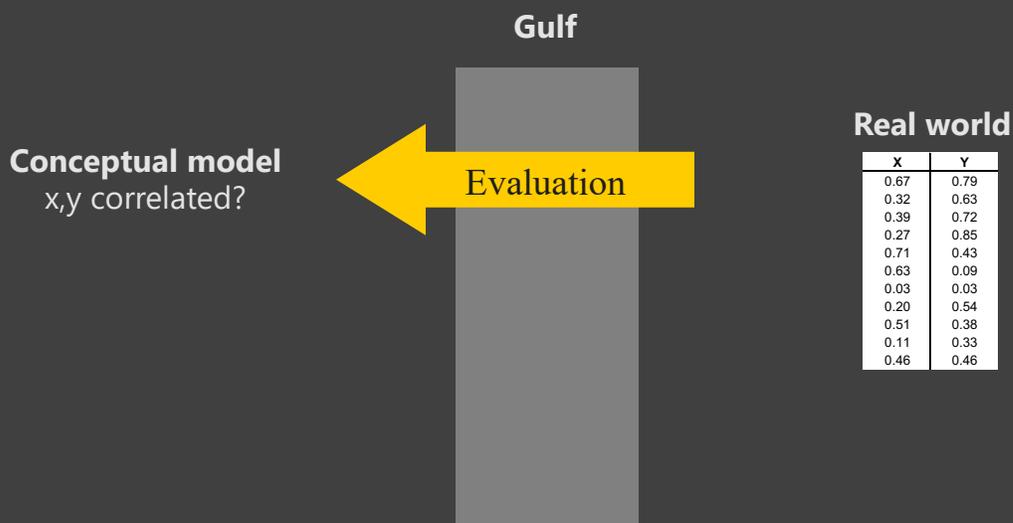
Gulf of Evaluation

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]

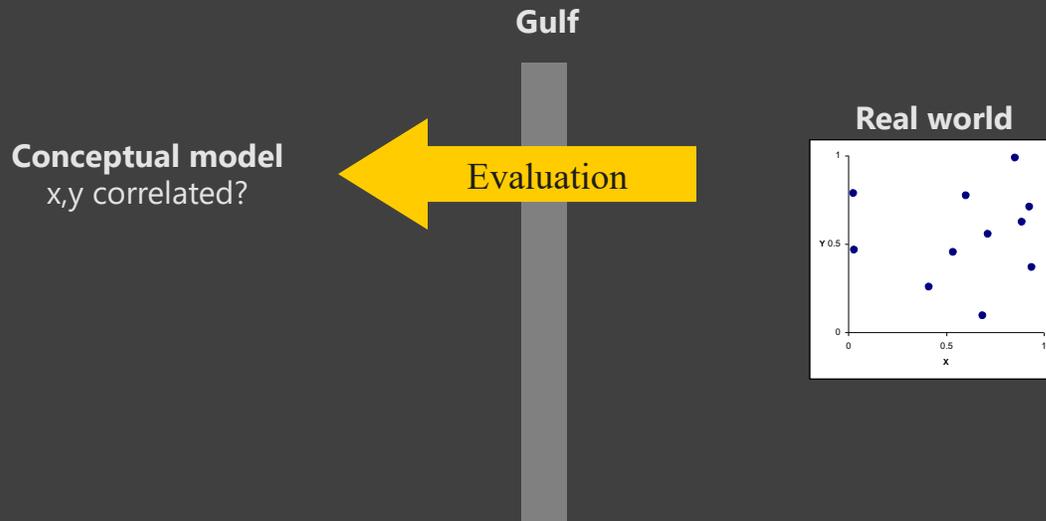
33

GULF OF EVALUATION



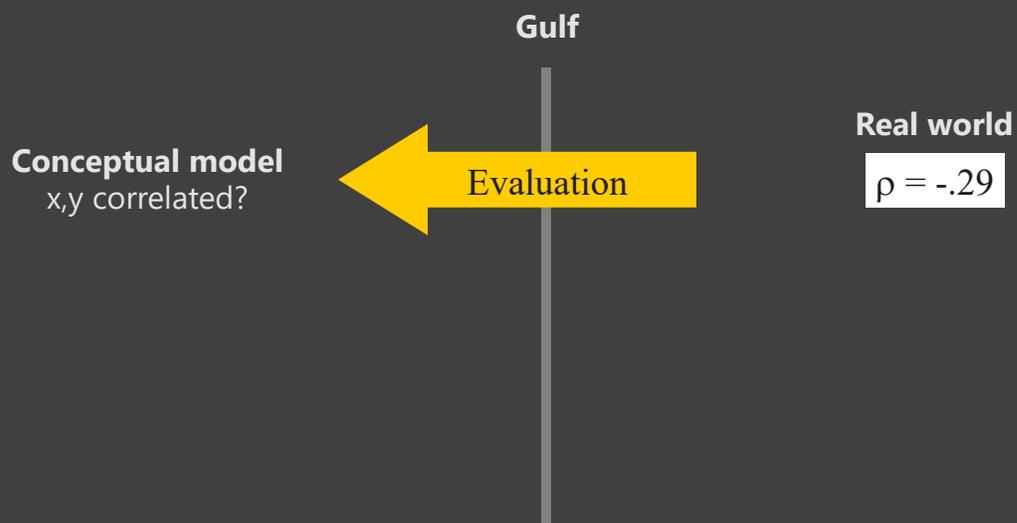
34

GULF OF EVALUATION

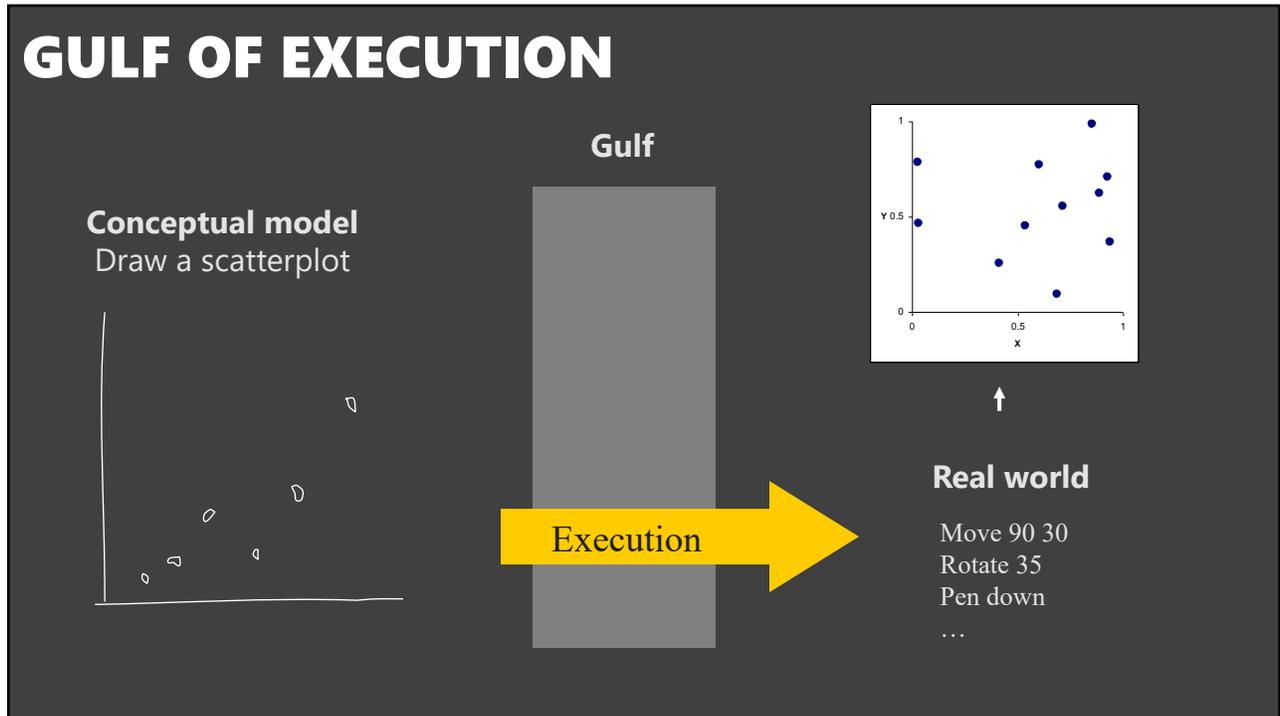


35

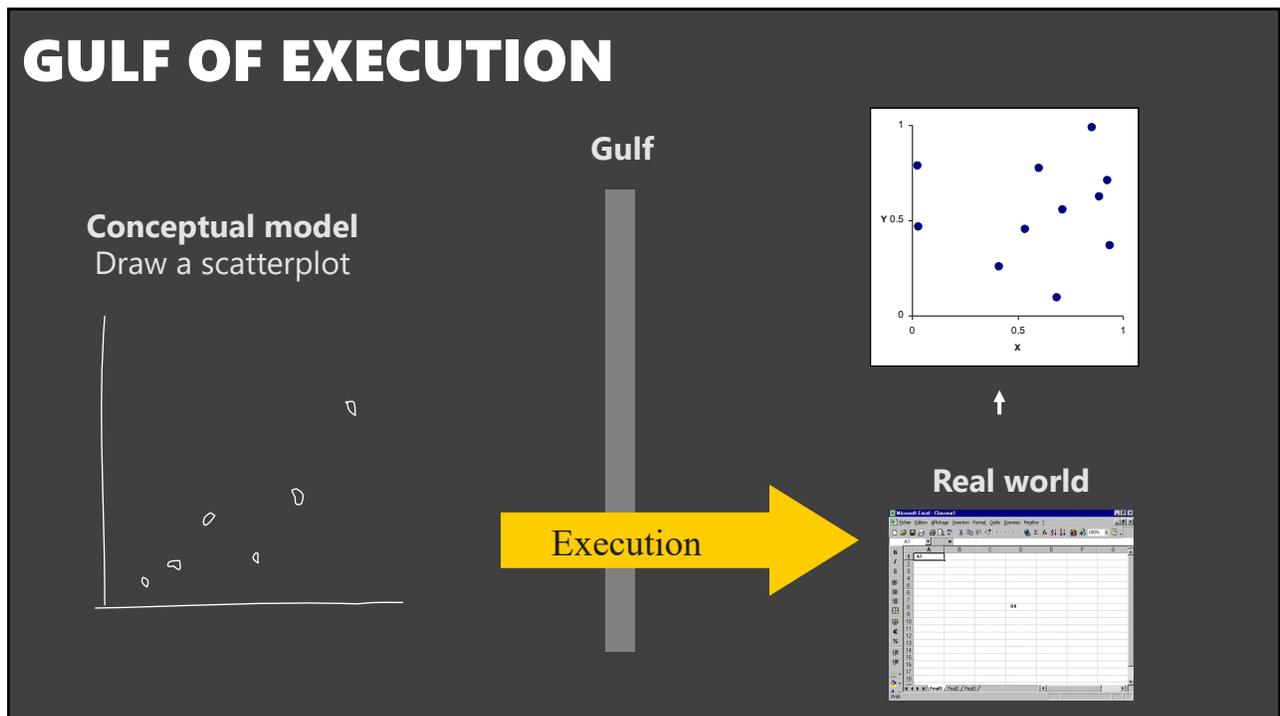
GULF OF EVALUATION



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37



38

Gulf of Execution

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

Gulf of Evaluation

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[Norman 1986]

39

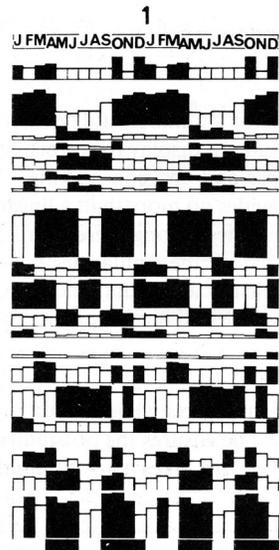
EARLY SYSTEMS

40

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	5	% —" — EUROPE	
1	0	0	8	6	4	6	4	2	1	0	6	% —" — M.EAST, AFRICA	
3	10	6	0	3	13	8	9	5	2	5	7	% —" — ASIA	
78	80	85	86	85	87	70	76	87	85	87	8	% BUSINESSMEN	
22	20	15	14	15	13	30	24	13	15	13	9	% TOURISTS	
70	70	75	74	69	68	74	75	68	68	64	10	% DIRECT RESERVATIONS	
20	18	19	17	27	27	19	19	26	27	21	11	% AGENCY —" —	
10	12	6	9	4	5	7	6	6	5	15	12	% AIR CREWS	
2	2	4	2	2	1	1	2	2	4	2	5	% CLIENTS UNDER 20 YEARS	
25	27	37	35	25	25	27	28	24	30	24	14	% —" — 20-35 —" —	
48	49	42	48	54	55	53	51	55	46	55	15	% —" — 35-55 —" —	
25	22	17	15	19	19	19	19	19	20	19	16	% —" — MORE THAN 55 —" —	
163	167	166	174	152	155	145	170	157	174	165	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	19	% OCCUPANCY	
			X	X	X			X	X	X	X	20	CONVENTIONS

Graphics and Graphic Information Processing [Bertin 81]

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Graphics and Graphic Information Processing [Bertin 81]

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GROUP SIMILAR ROWS AND COLUMNS

Choose a row with a particular visual aspect

Move to extremity of matrix

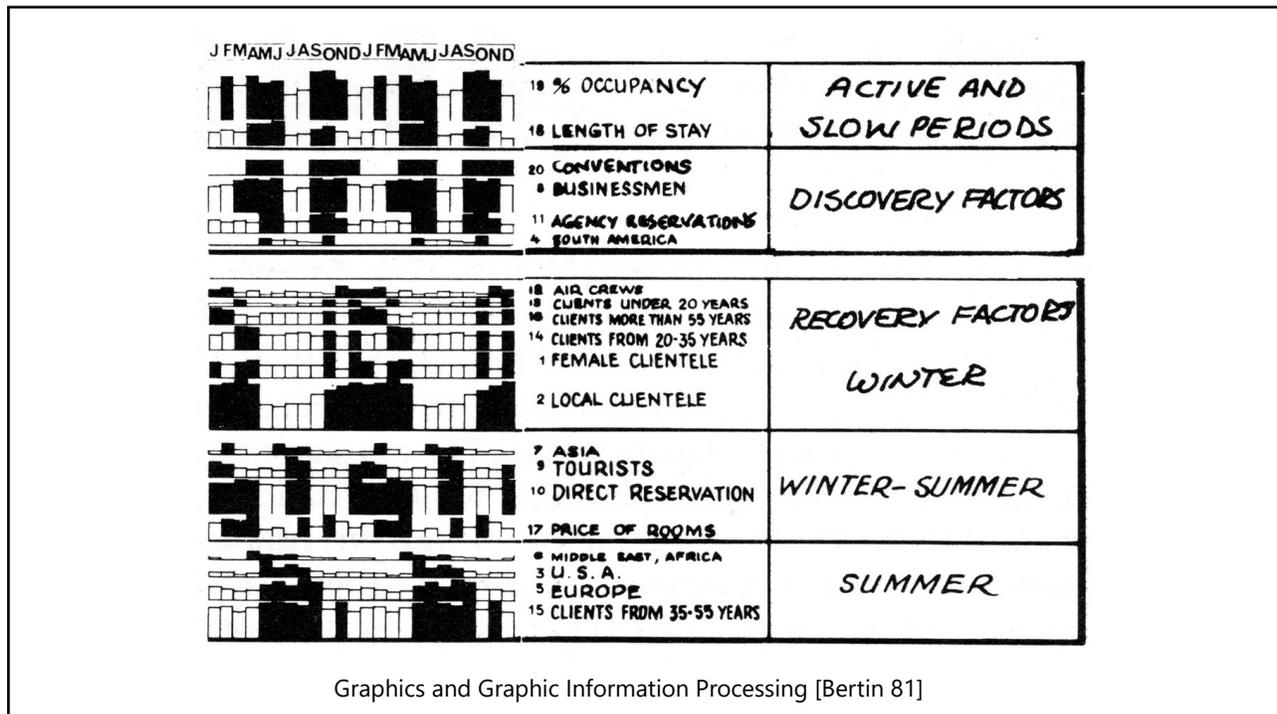
Move similar rows close, opposite rows to bottom

Creates two opposing groups and a middle group

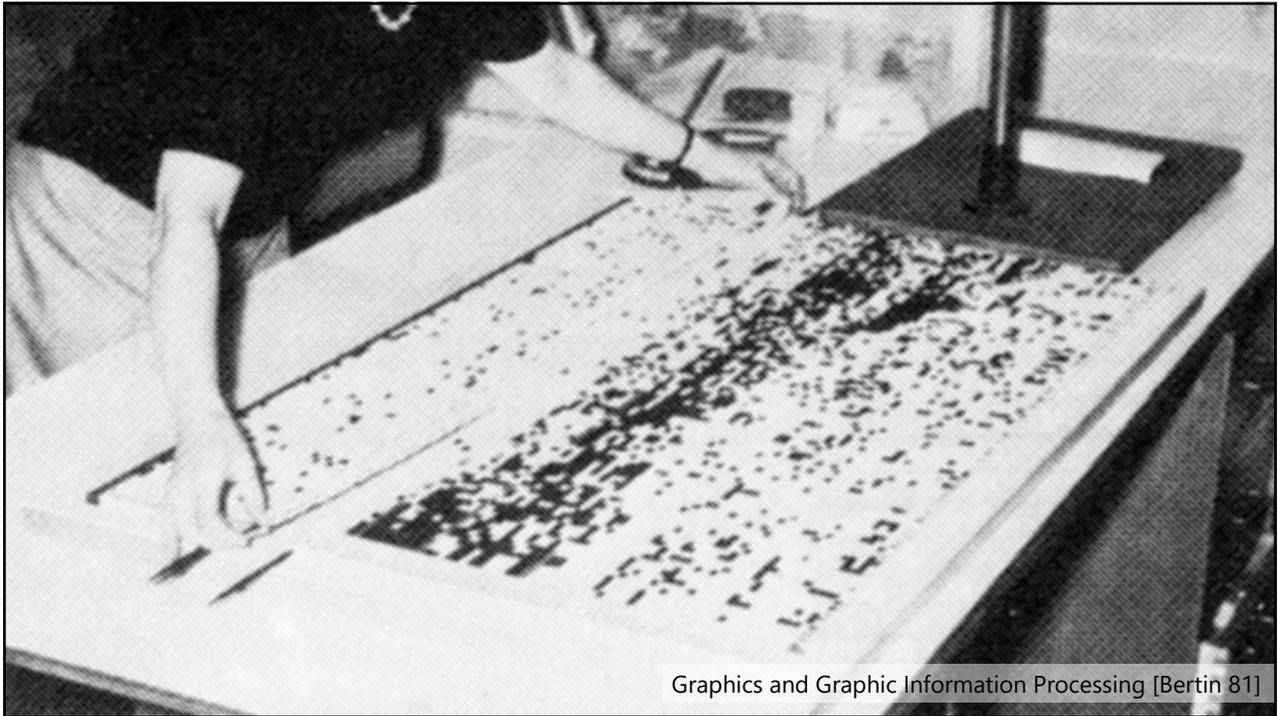
Repeat for columns (can only do this with some kinds of data)

Iterate

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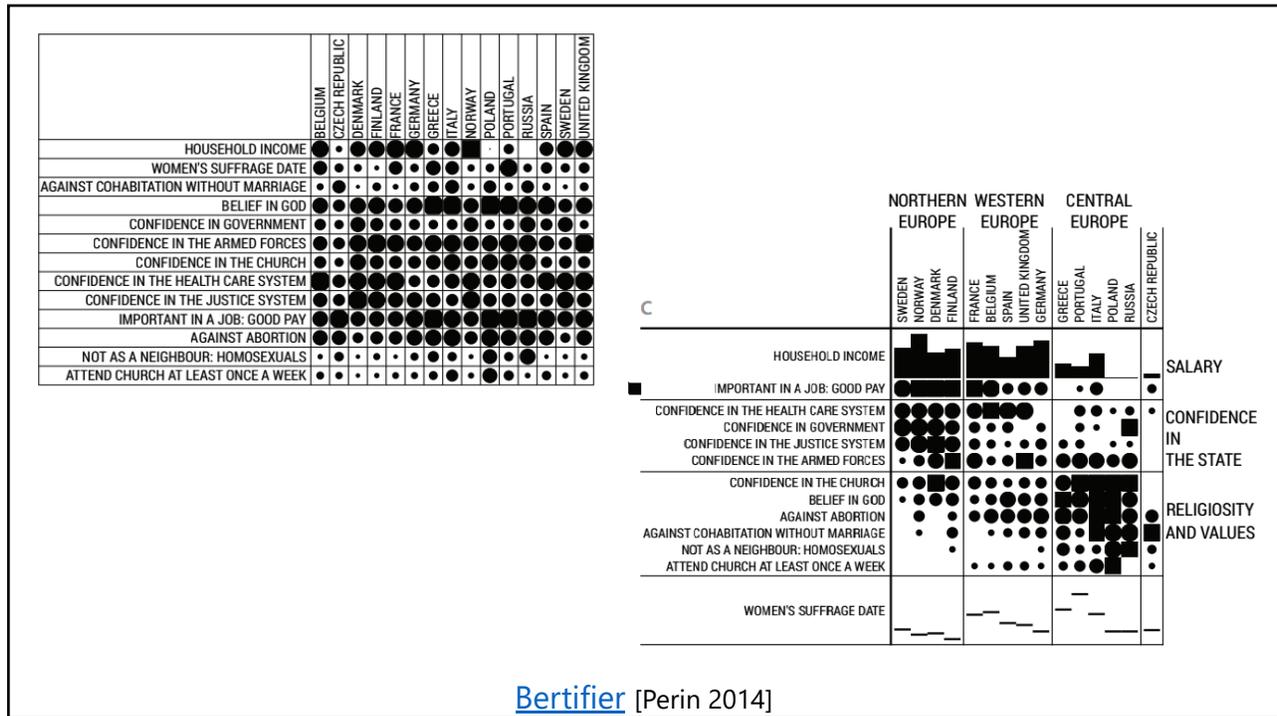
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Bertifier [Perin 2014]

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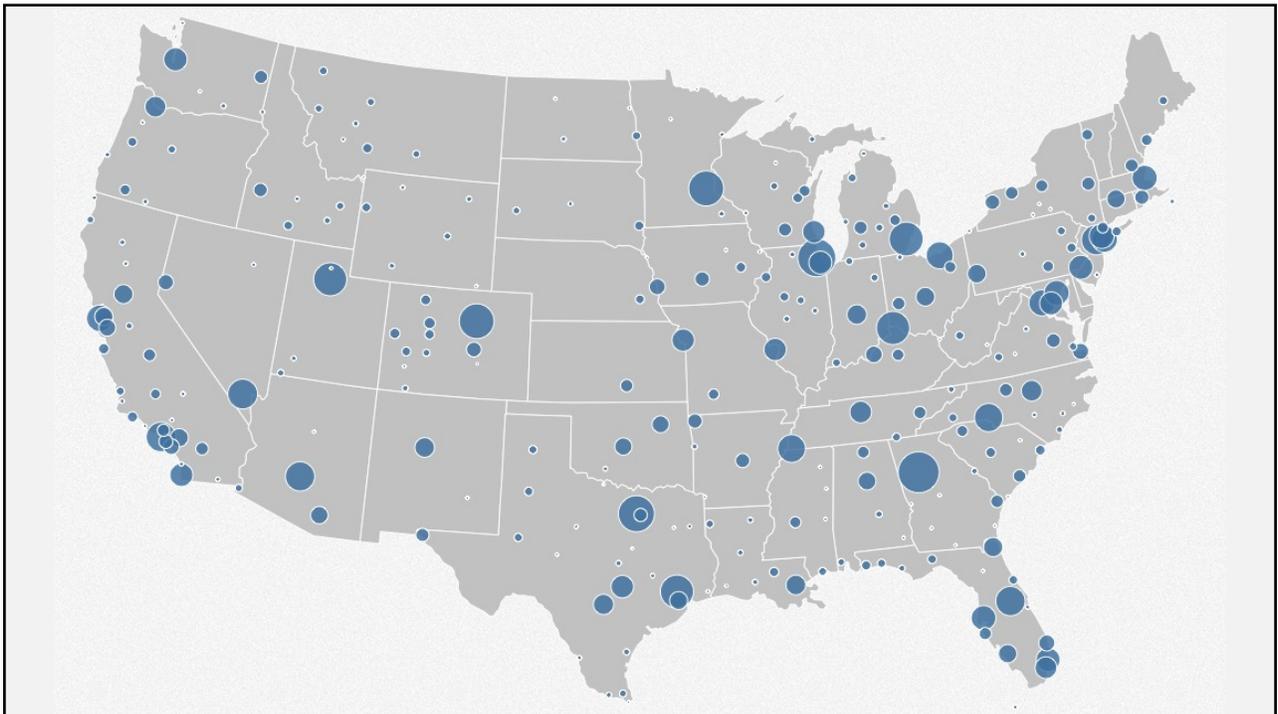


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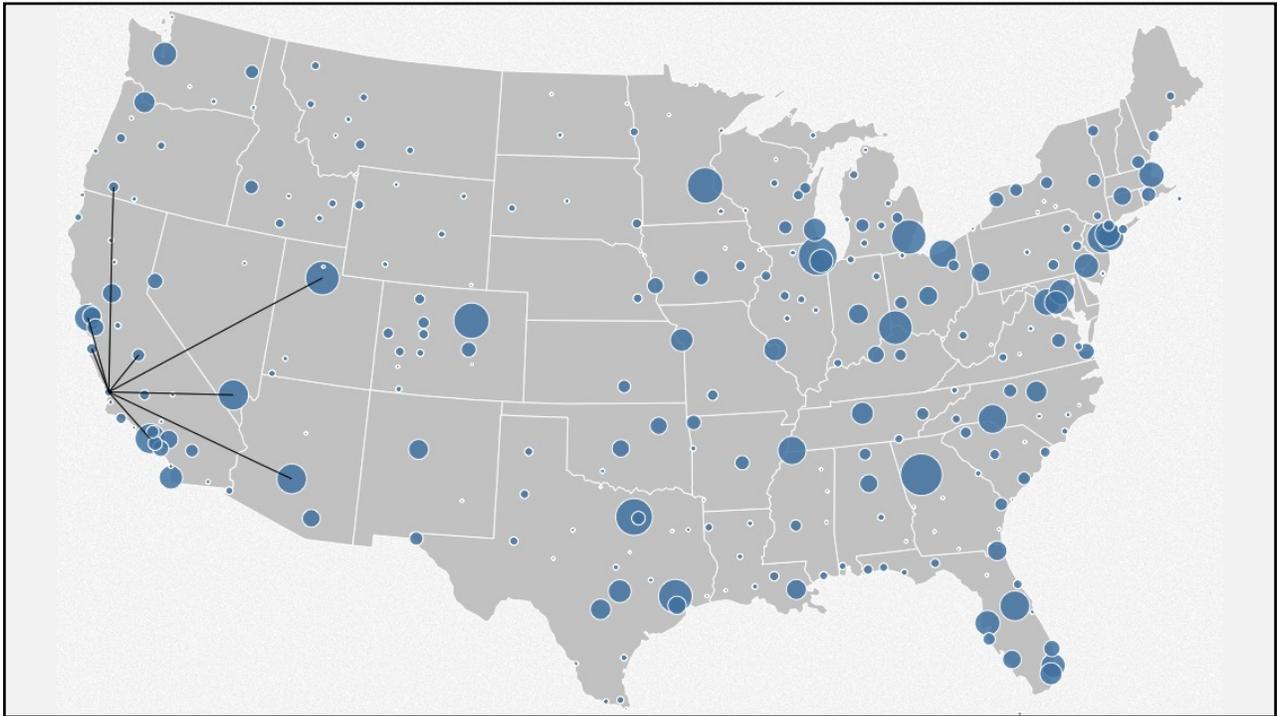
BASIC SELECTION METHODS

Point Selection
Mouse Hover / Click
Touch / Tap
Select Nearby Element (e.g., Bubble Cursor)

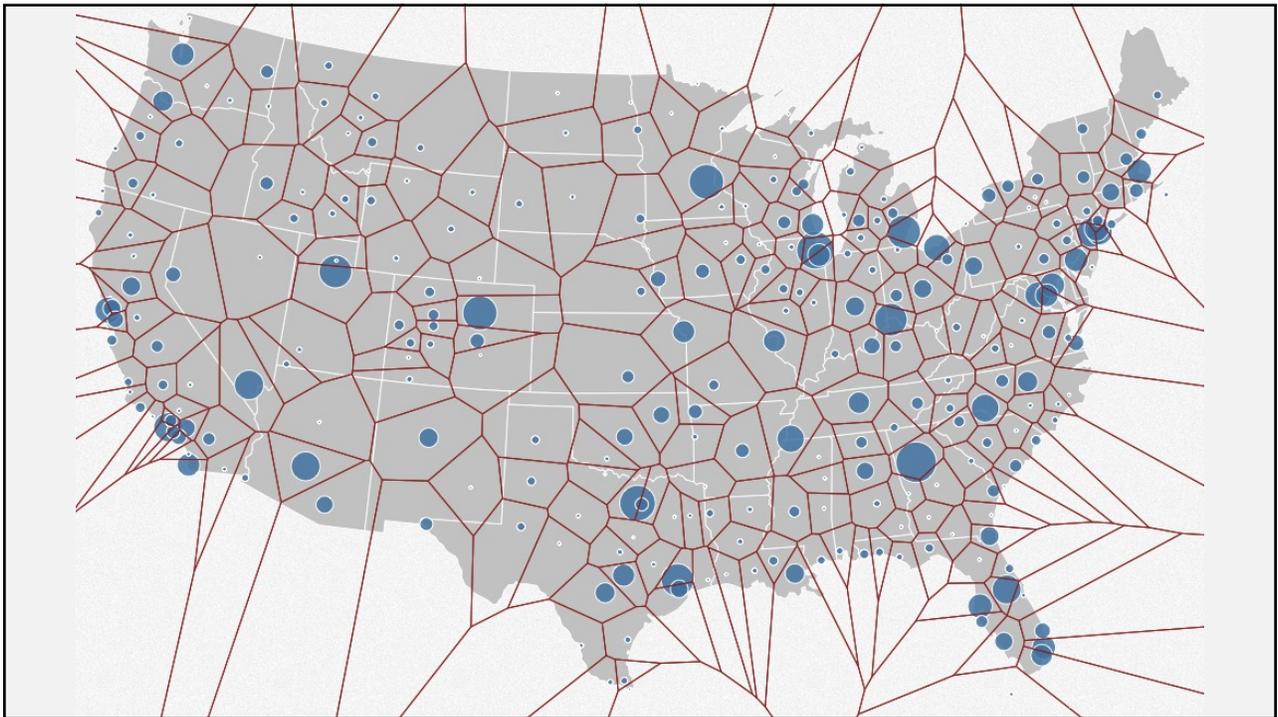
57



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BASIC SELECTION METHODS

Point Selection
Mouse Hover / Click
Touch / Tap
Select Nearby Element (e.g., Bubble Cursor)

Region Selection
Rubber-band or Lasso
Area Cursors ("Brushes")

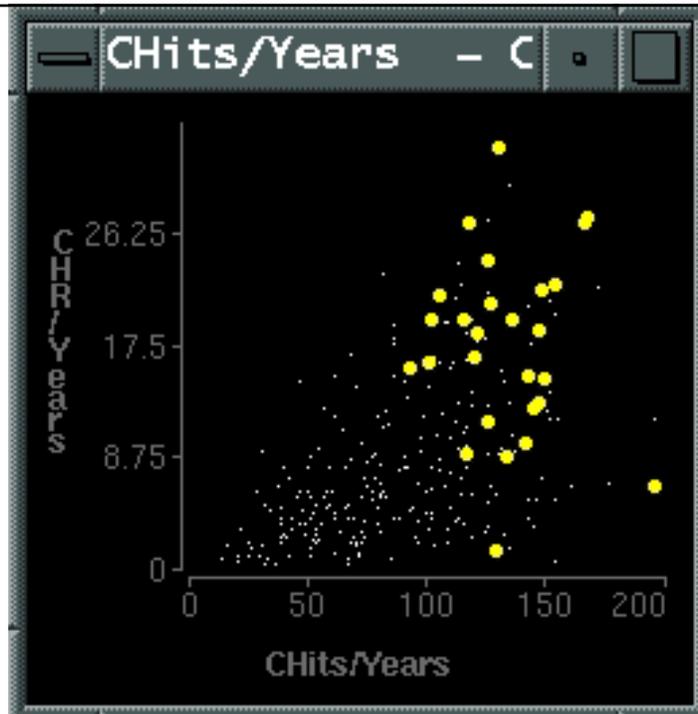
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BRUSHING AND LINKING

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BRUSHING

Direct attention to a subset of the data [Wills 95]



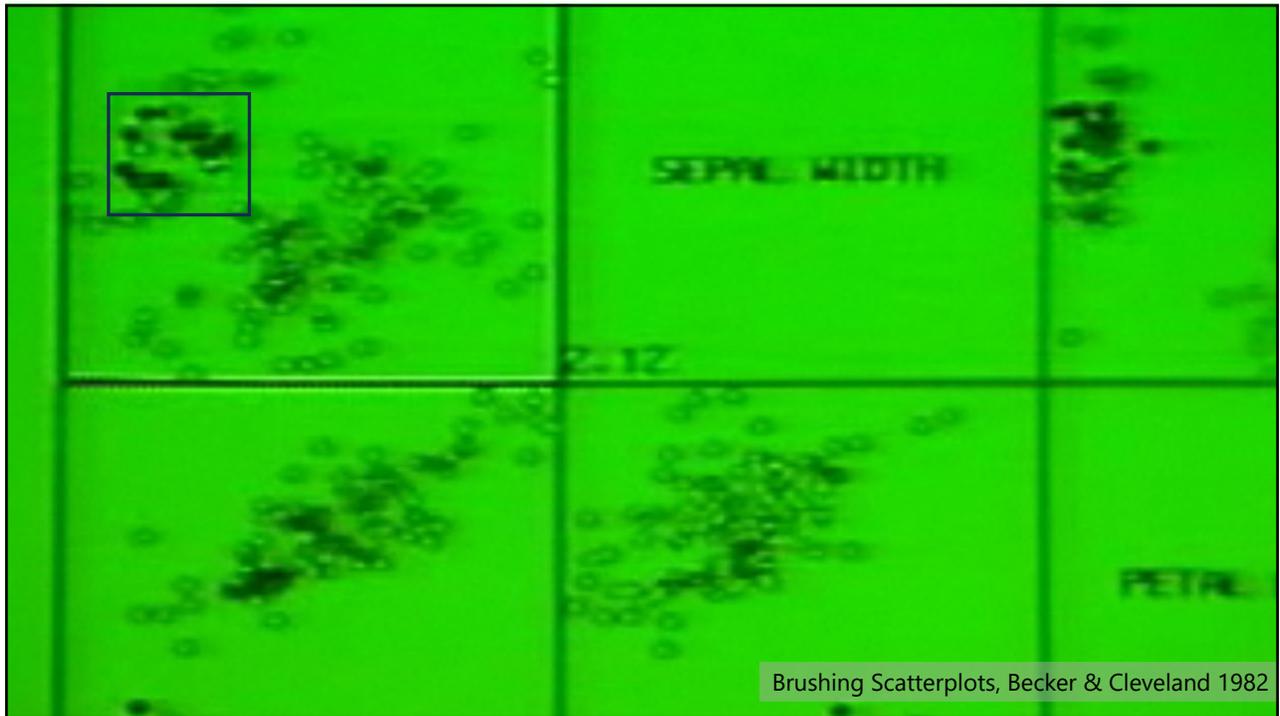
63

BRUSHING & LINKING

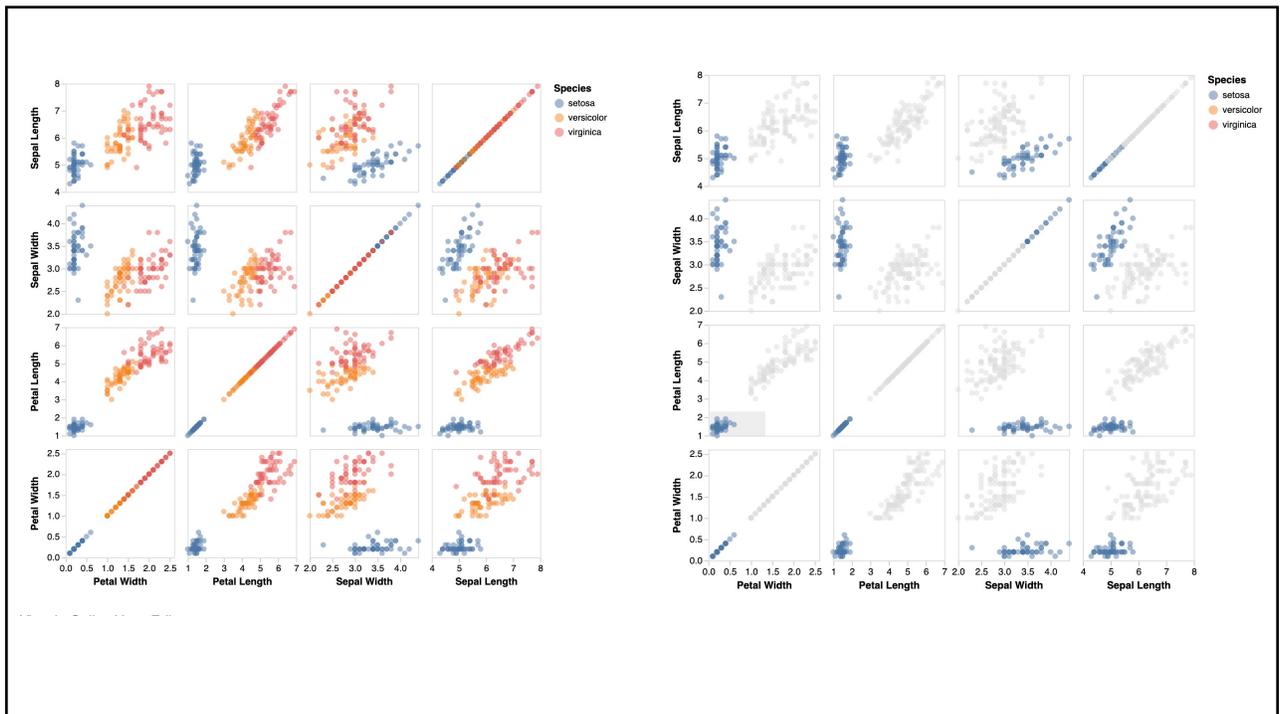
Select ("**brush**") a subset of data
See selected data in other views

The component views must be *linked*
by *tuple* (matching same data point across views), or
by *query* (matching range or values of fields)

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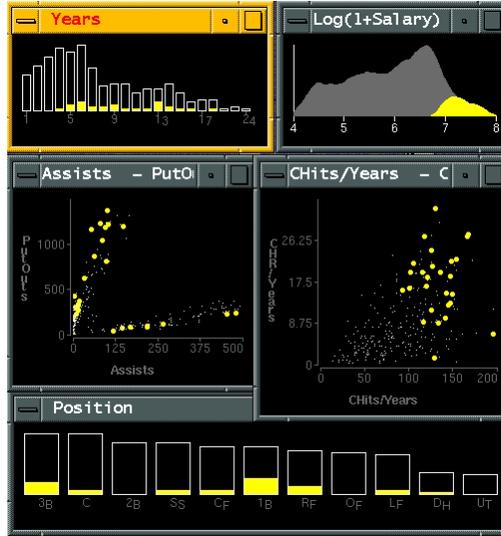


65



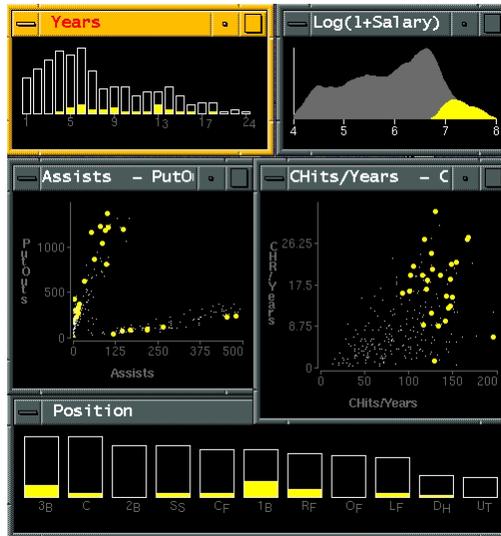
66

BASEBALL STATISTICS [Wills 1995]



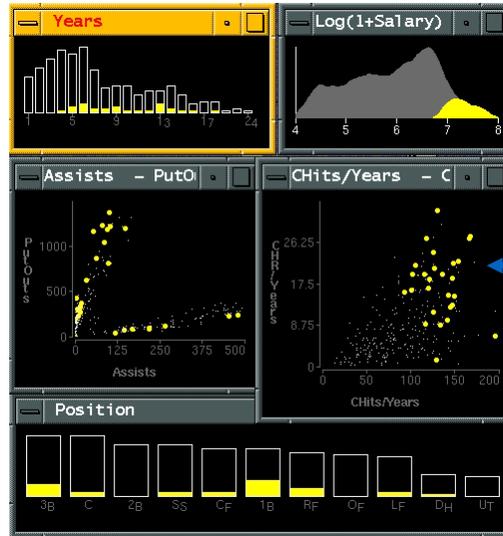
67

BASEBALL STATISTICS [Wills 1995]



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BASEBALL STATISTICS [Wills 1995]

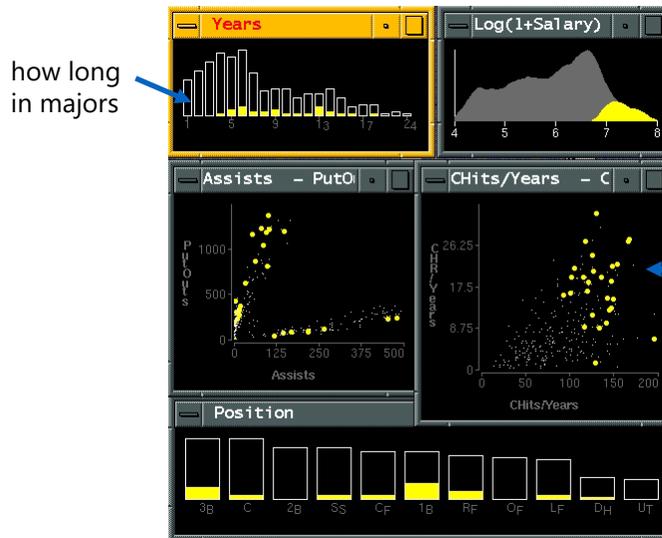


select high salaries

avg career HRs vs avg career hits (batting ability)

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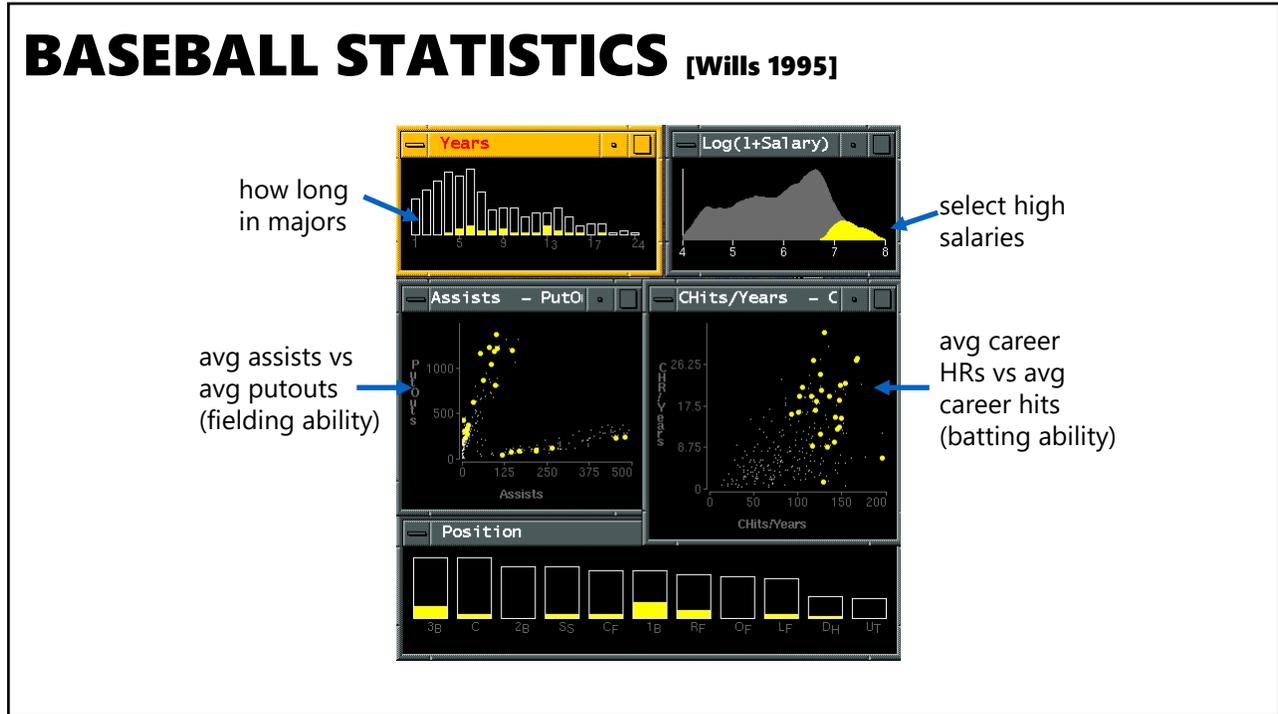
BASEBALL STATISTICS [Wills 1995]



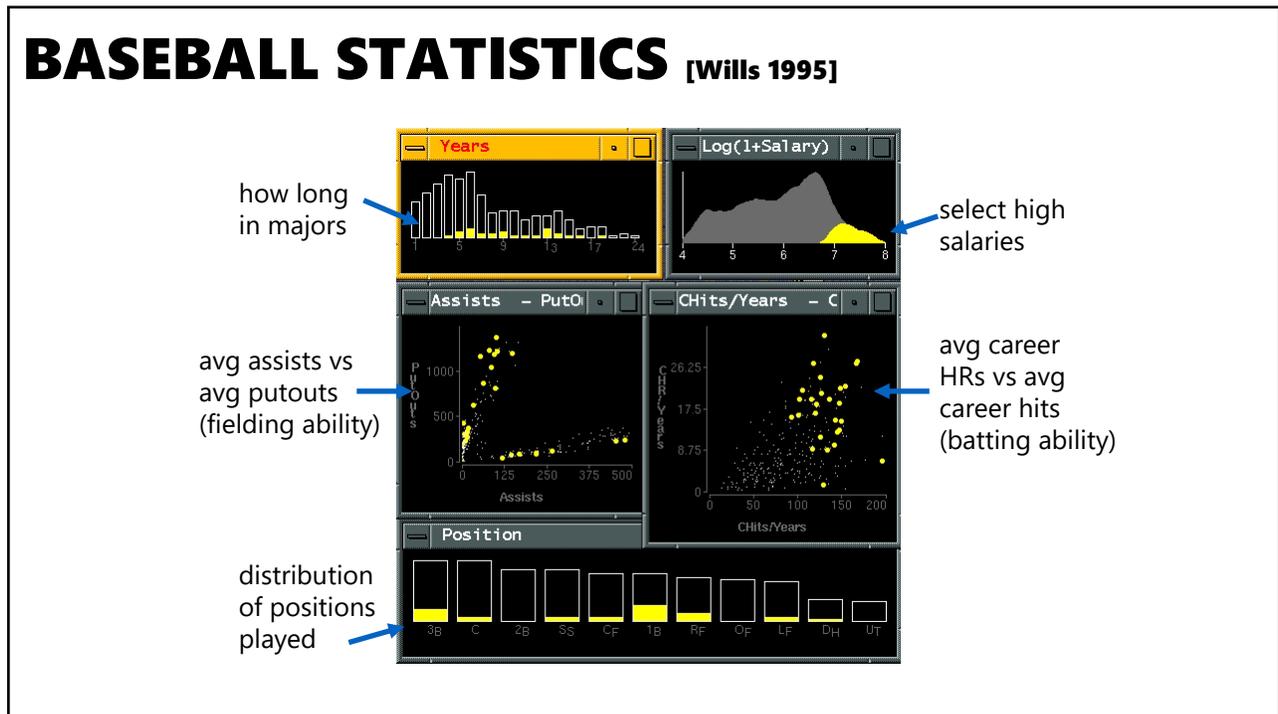
select high salaries

avg career HRs vs avg career hits (batting ability)

70

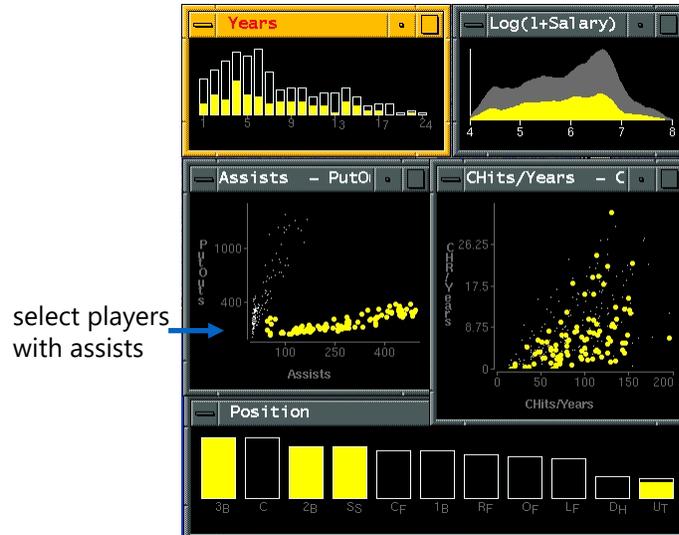


71



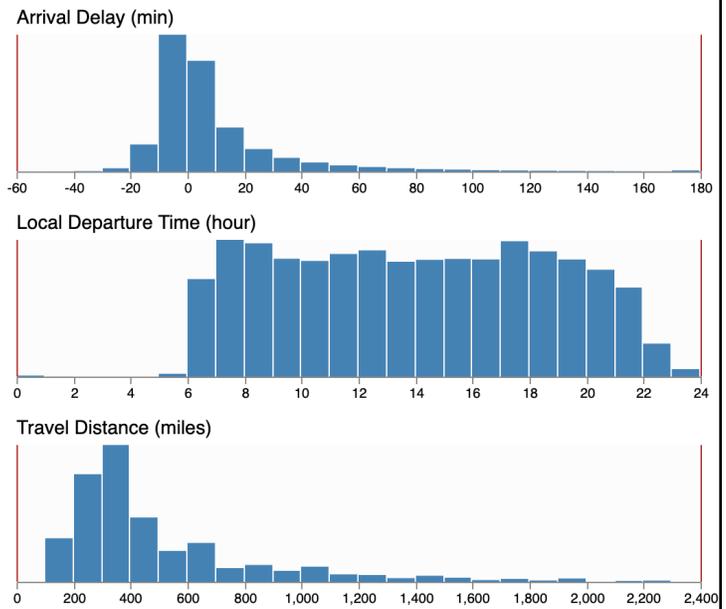
72

BASEBALL STATISTICS [Wills 1995]



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CROSS-FILTERING



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DYNAMIC QUERIES

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QUERY & RESULTS

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

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

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

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Dynamic HomeFinder

Reset Quit
Save Print

Dist to A:
1 30
19

Dist to B:
1 30
6

Bedrooms:
1 3 4 7
4

Cost:
\$50k \$500k
10 30

Look at:
Hse TH Cnd

Features:
Grg Fp1
CAC New

HOMEFINDER
[Ahlberg 1992]

Direct Manipulation

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

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.

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