

# 可视化与可视计算概论

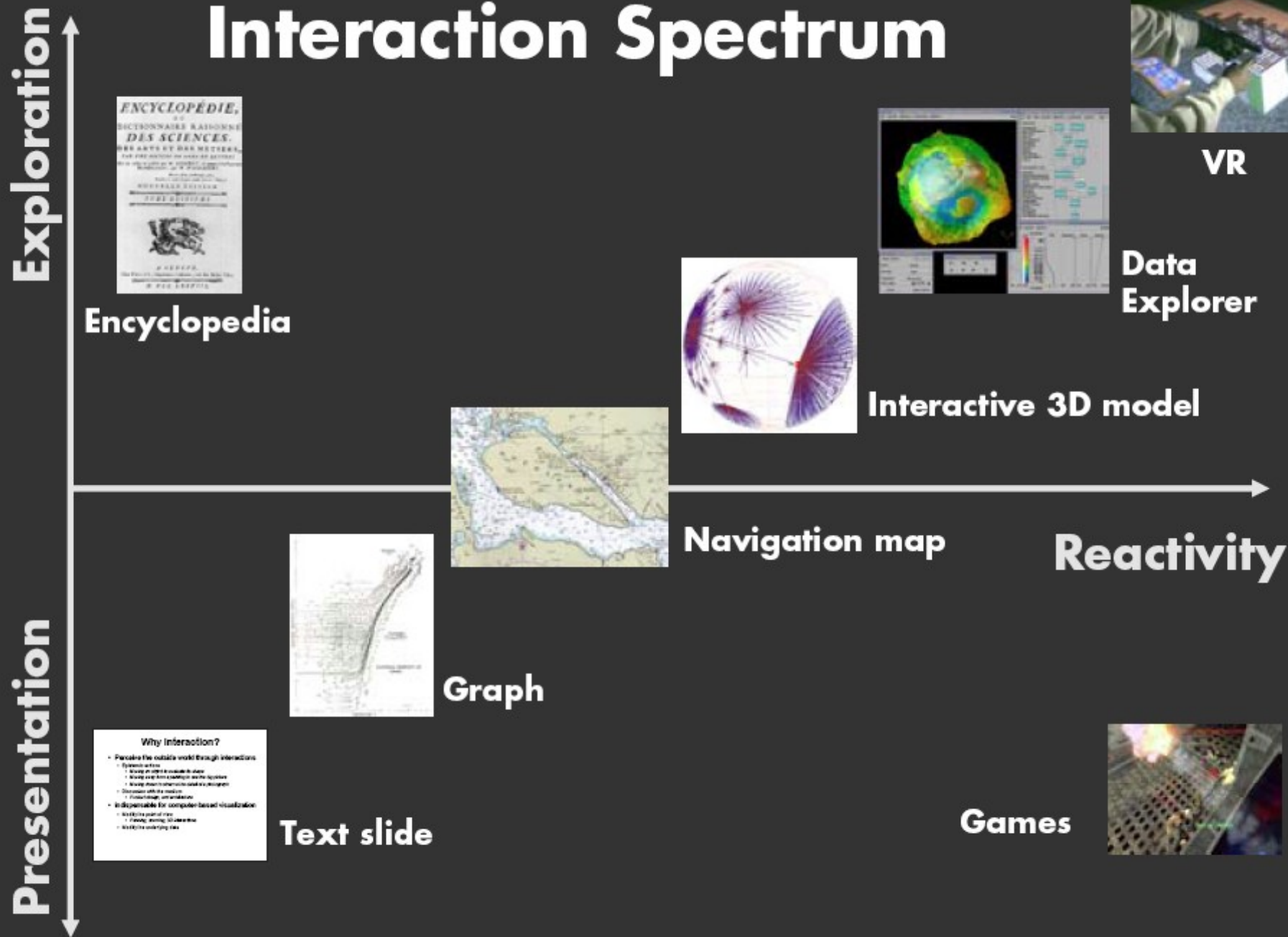
Introduction to Visualization and Visual Computing

董笑菊

2018 年 3 月 20 日

# Interaction

# Interaction Spectrum



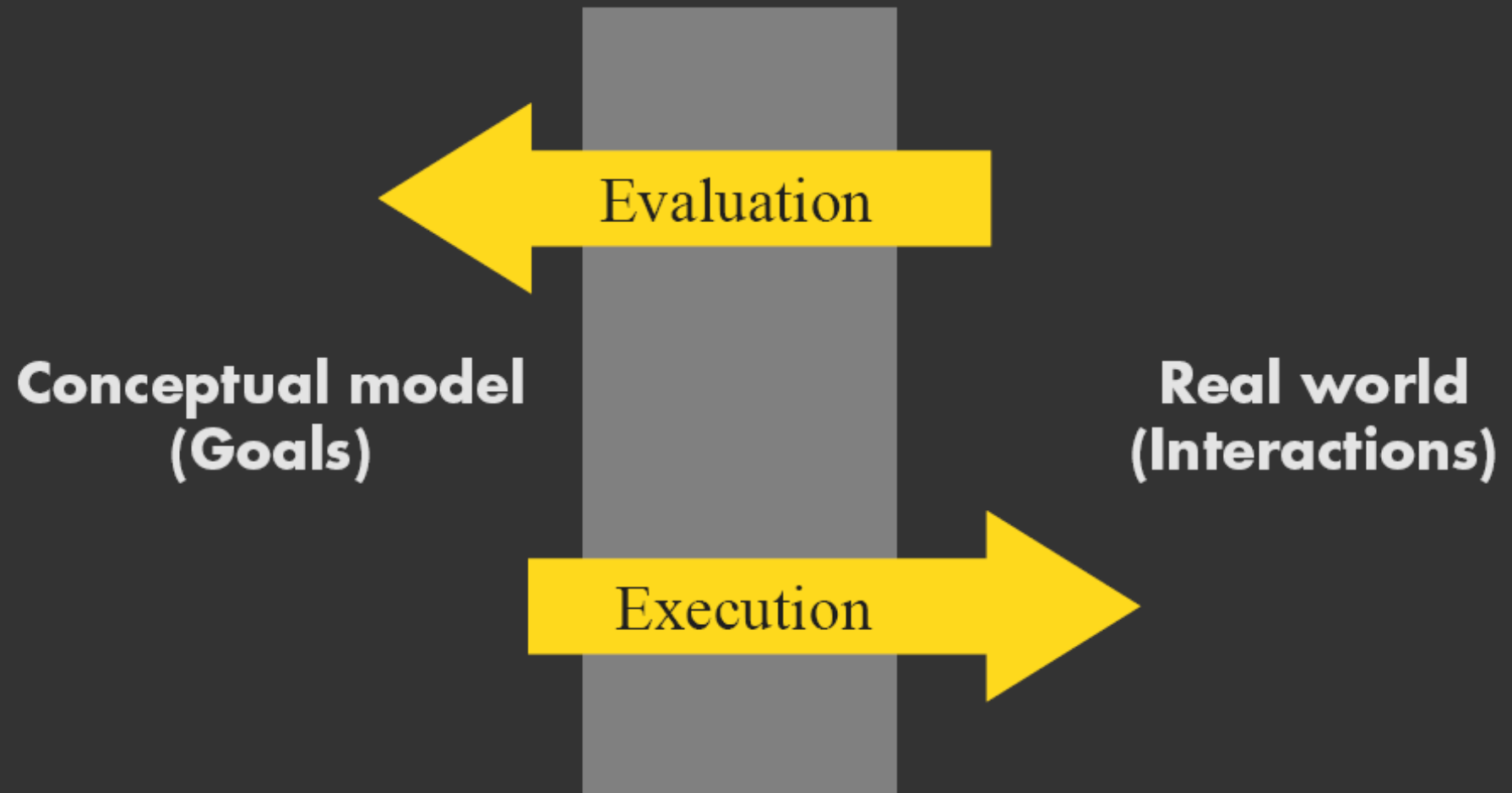
Slide by F. Guimbretiere

# Gulfs of Execution & Evaluation

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**Gulfs**

**Norman 1986**



# Gulf of Evaluation

---

Gulf

Evaluation

**Conceptual  
model:  
x,y correlated?**

**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

# Gulf of Evaluation

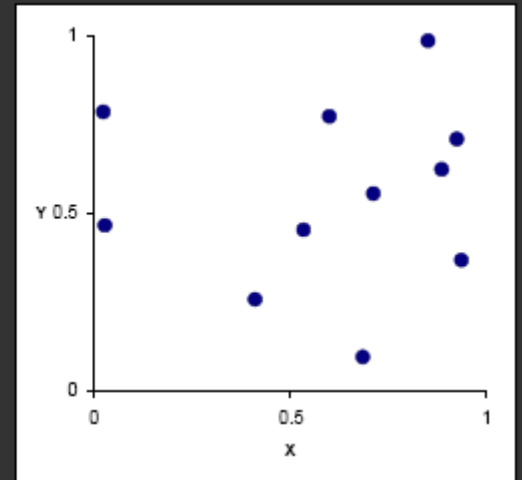
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Gulf

Evaluation

**Conceptual  
model:  
 $x, y$  correlated?**

**Real world:**



# Gulf of Evaluation

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Gulf



**Real world:**

$$\rho = -.29$$

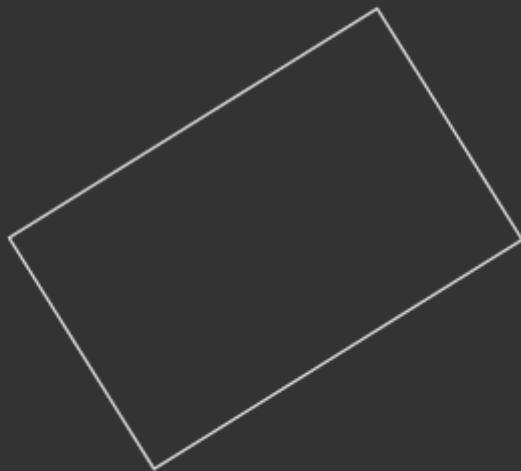
**Conceptual  
model:  
x,y correlated?**

# Gulf of Execution

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**Gulf**

**Conceptual  
model:  
Draw a rectangle**



**Real world**

Move 90 30  
Rotate 35  
Pen down  
...

Execution



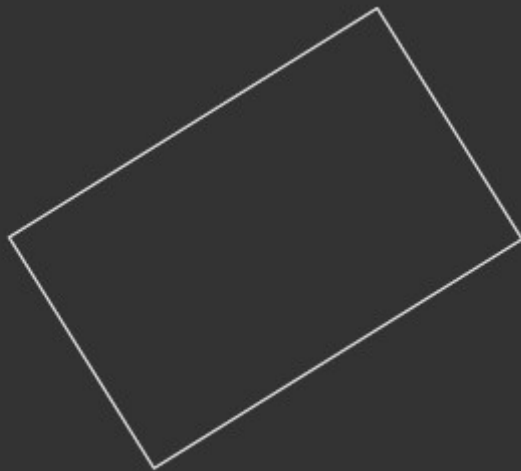


# Gulf of Execution

---

**Gulf**

**Conceptual  
model:  
Draw a rectangle**



**Real world**



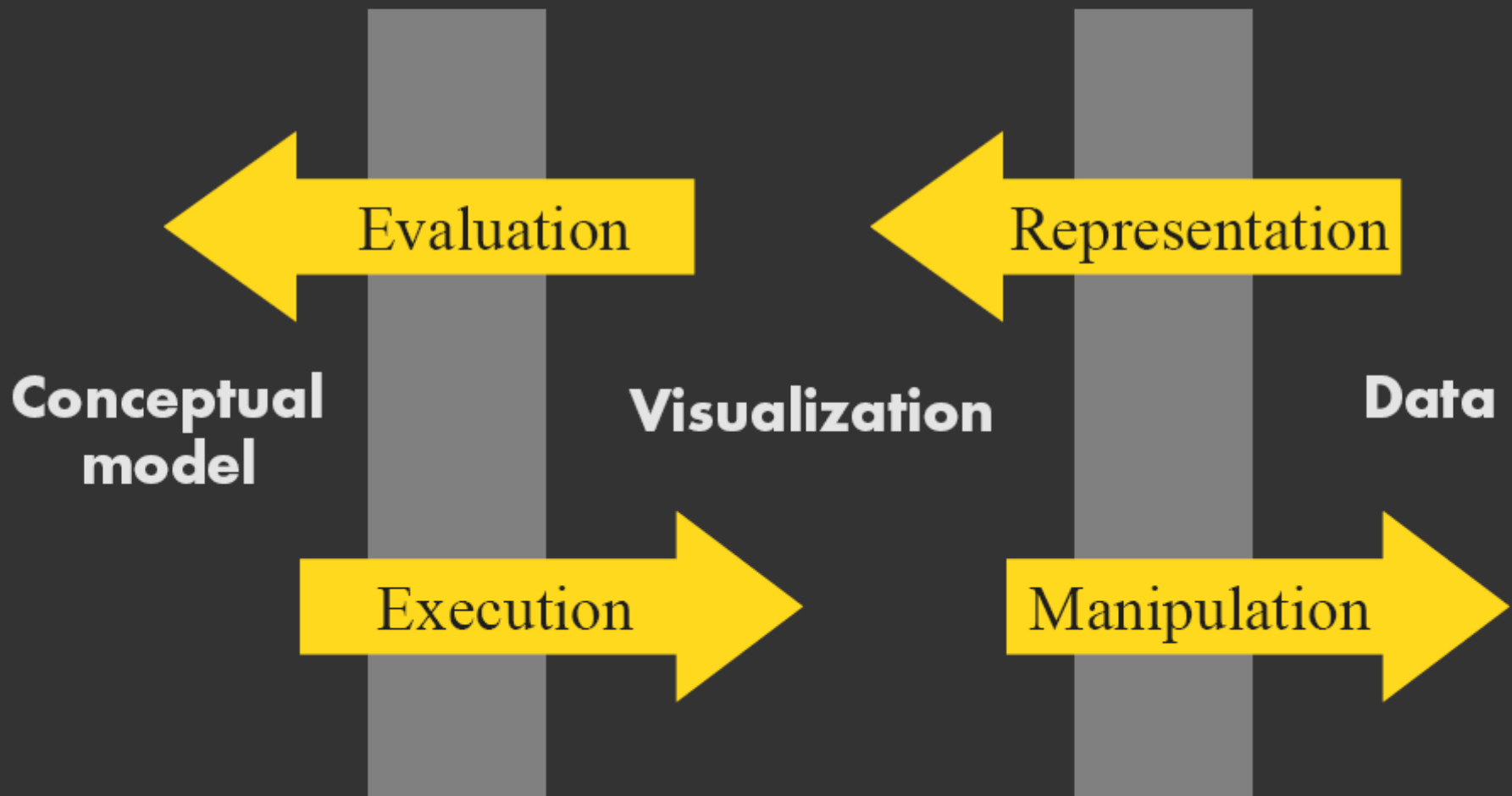
**Execution**



# Visualization: A Double Gulf?

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**Visualization user   Visualization designer**



# Bad visualization?

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Visualization user Visualization designer

Evaluation

Representation

**$x, y$   
correlated?**

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

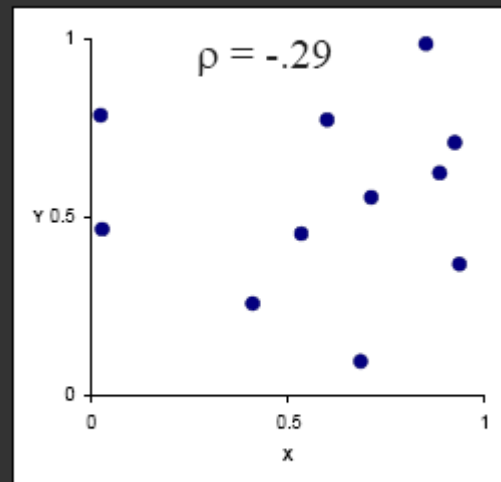
X	Y
0.67	0.79
0.32	0.63
0.39	0.72
0.27	0.85
0.71	0.43
0.63	0.09
0.03	0.03
0.20	0.54
0.51	0.38
0.11	0.33
0.46	0.46

# Good Visualization?

Visualization user Visualization designer

Evaluation

**$x, y$   
correlated?**



Representation

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

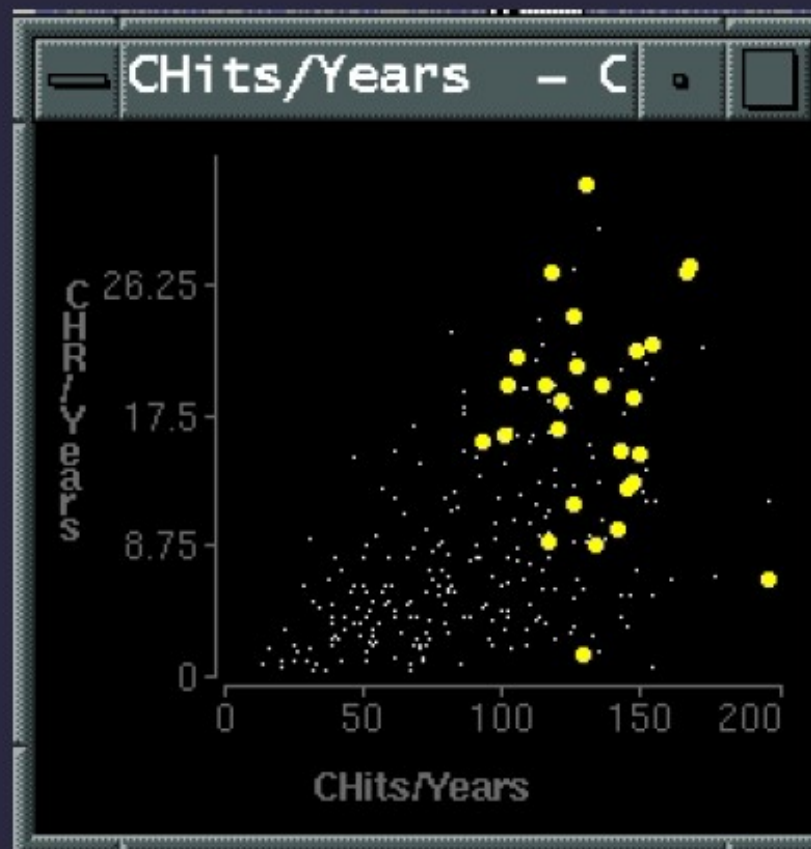
# Topics

- Brushing and Linking
- Dynamic Queries
- Rearrangements

# Brushing and Linking

# Highlighting

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



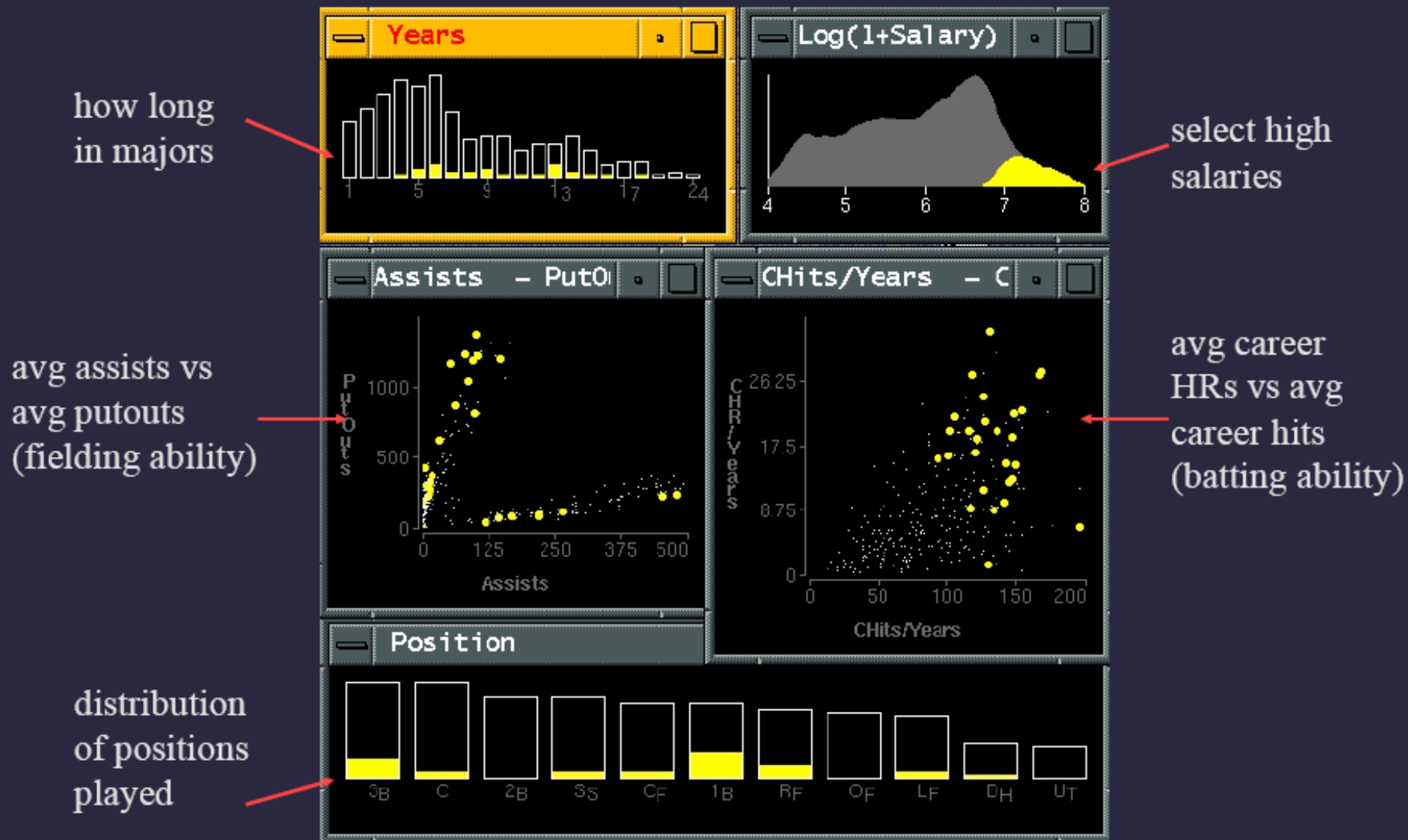
# Brushing

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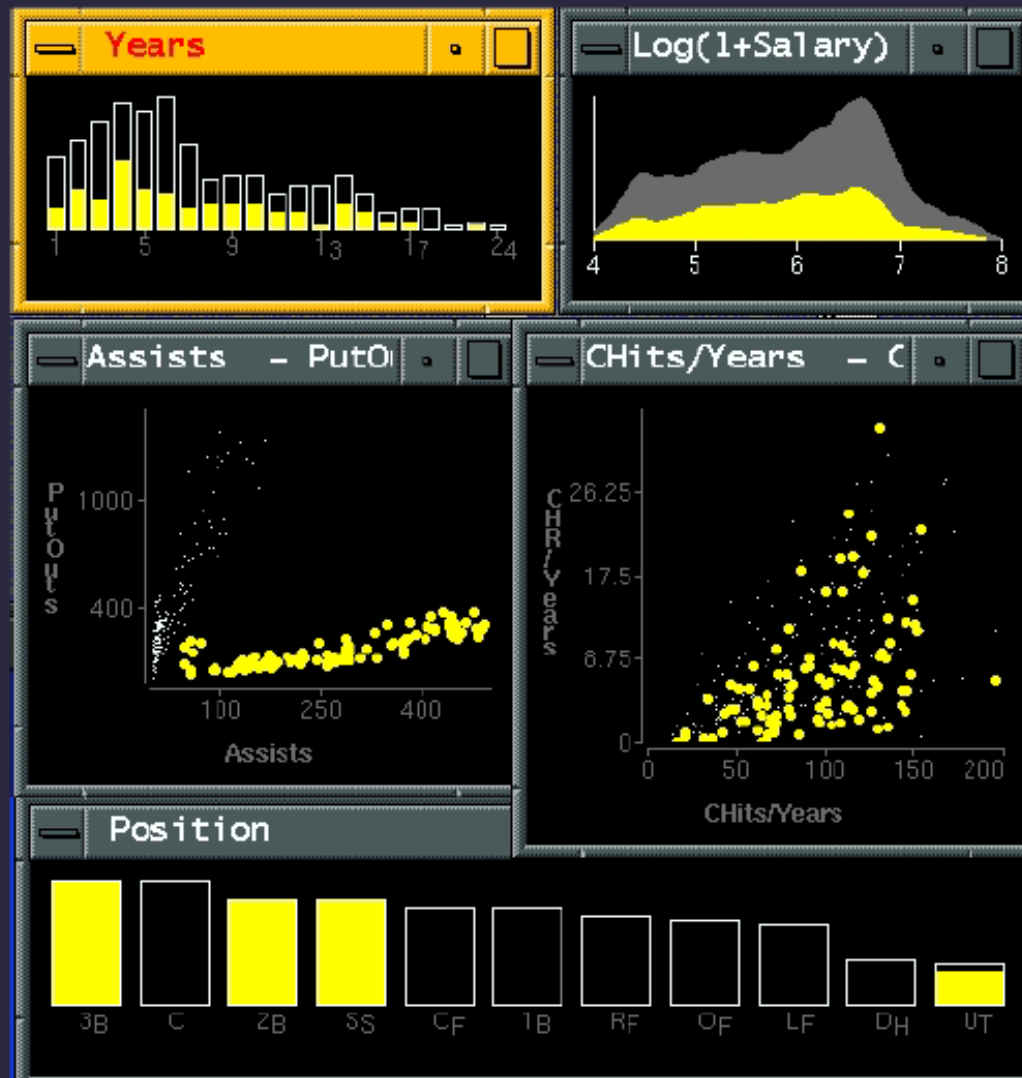
- Interactively select subset of data
- See selected data in other views
- Two things (normally views) must be *linked* to allow for brushing



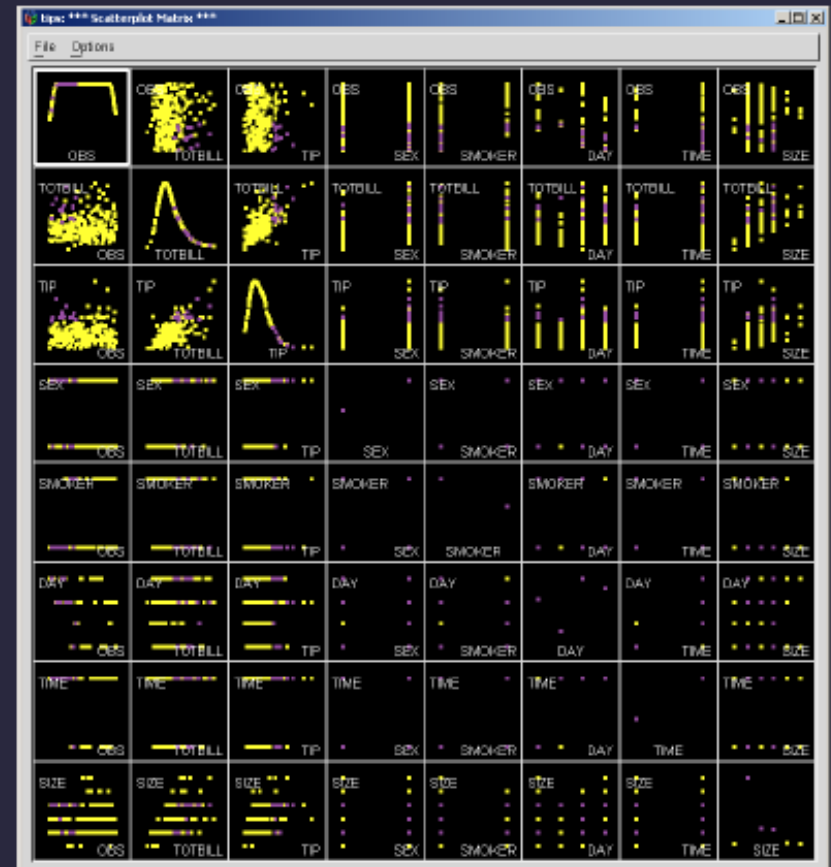
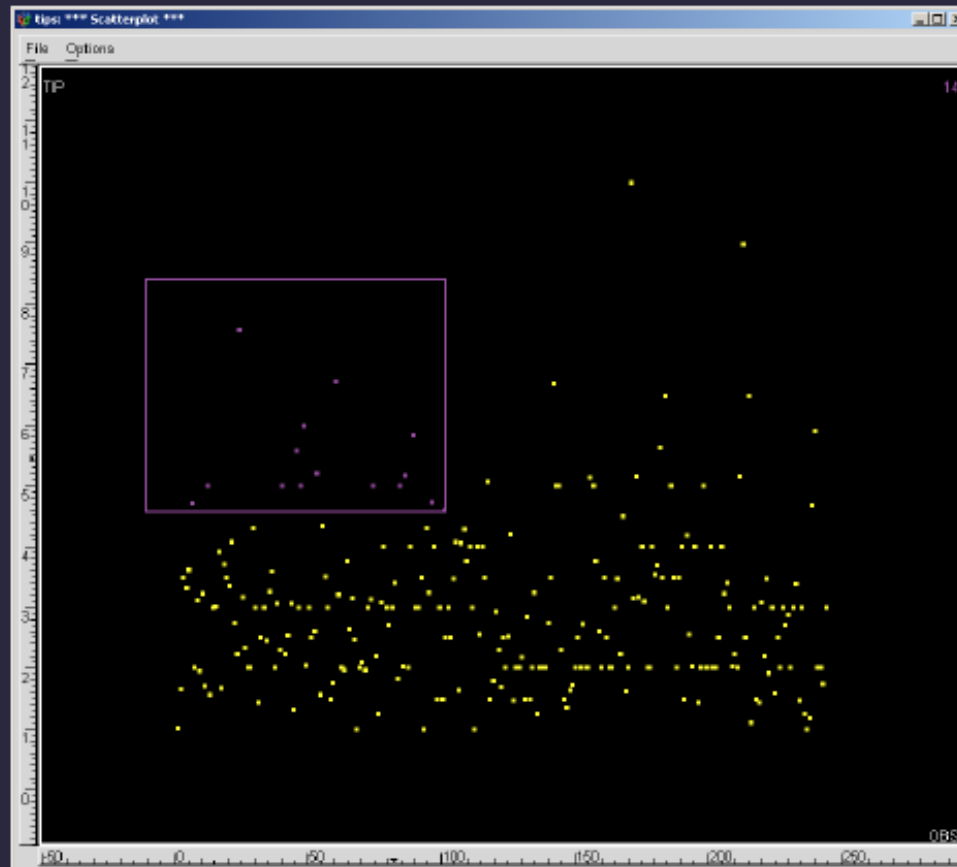
# Baseball statistics [from Wills 95]



# Linking assists to positions



# GGobi: Brushing



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

# Dynamic Queries

# Query and results

**SELECT** house

**FROM** east bay

**WHERE** price < 1,000,000 **AND** bedrooms > 2

**ORDER BY** price

Dynamic 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 19 30

Dist to B:  
1 6 30

Bedrooms:  
1 2 4 7

Cost:  
\$50k 16 \$500k 38

Look at:  
Hse TH Cnd

Features:  
Grg Fp1  
CAC New

# 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**



# Alphaslider

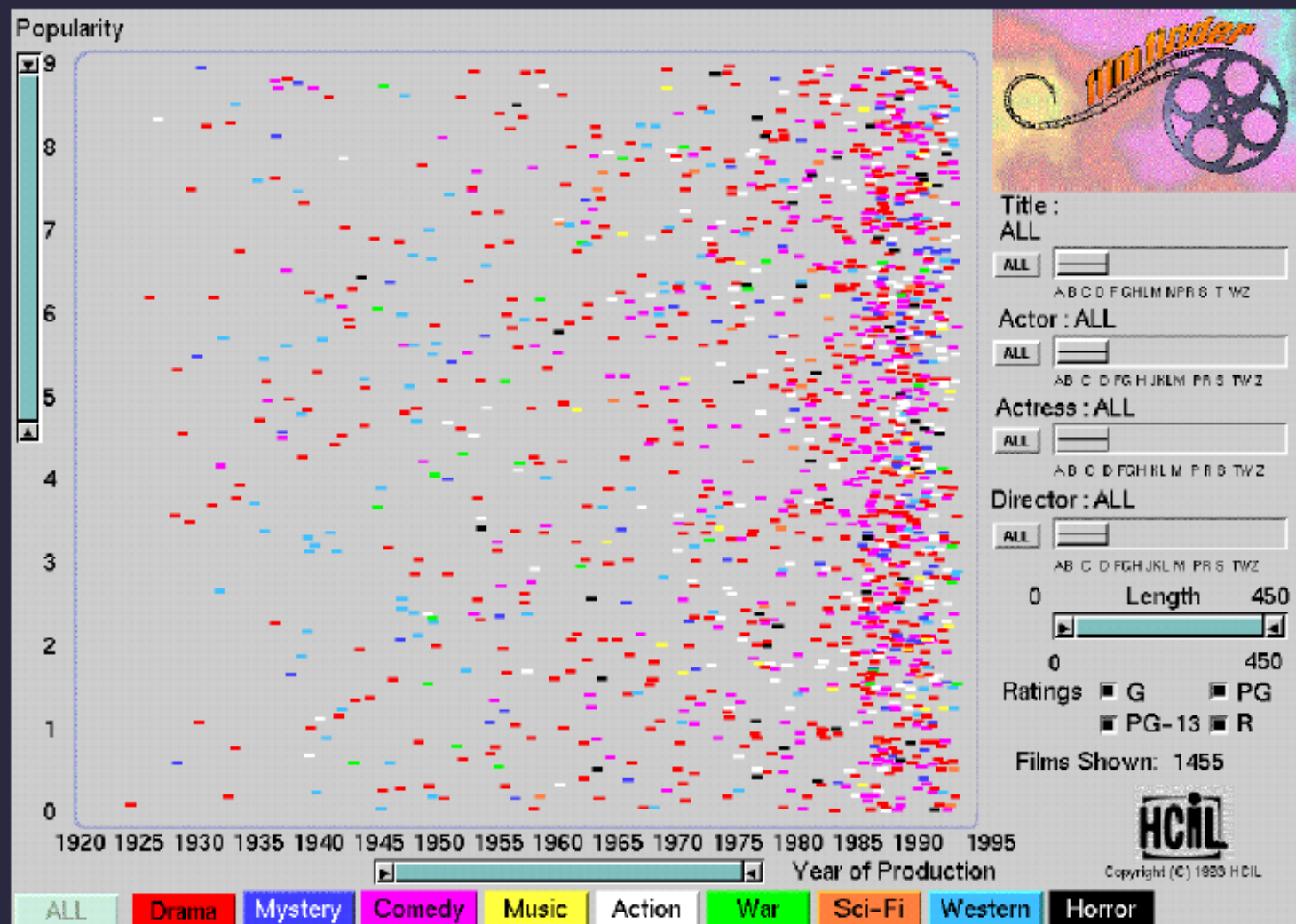
---

Title :  
Moonstruck

ALL

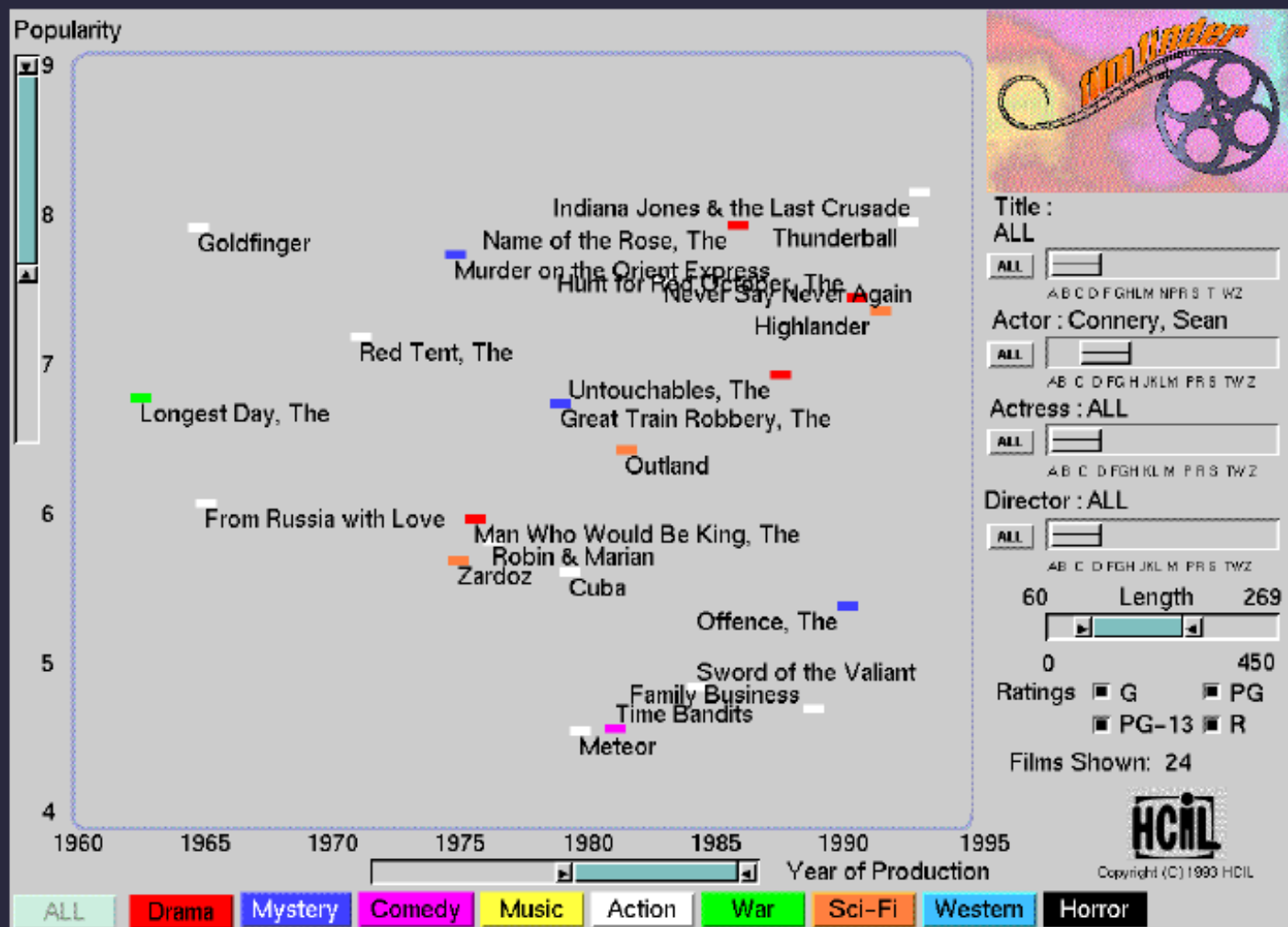
A B C D F G H L M N P R S T W Z

# FilmFinder



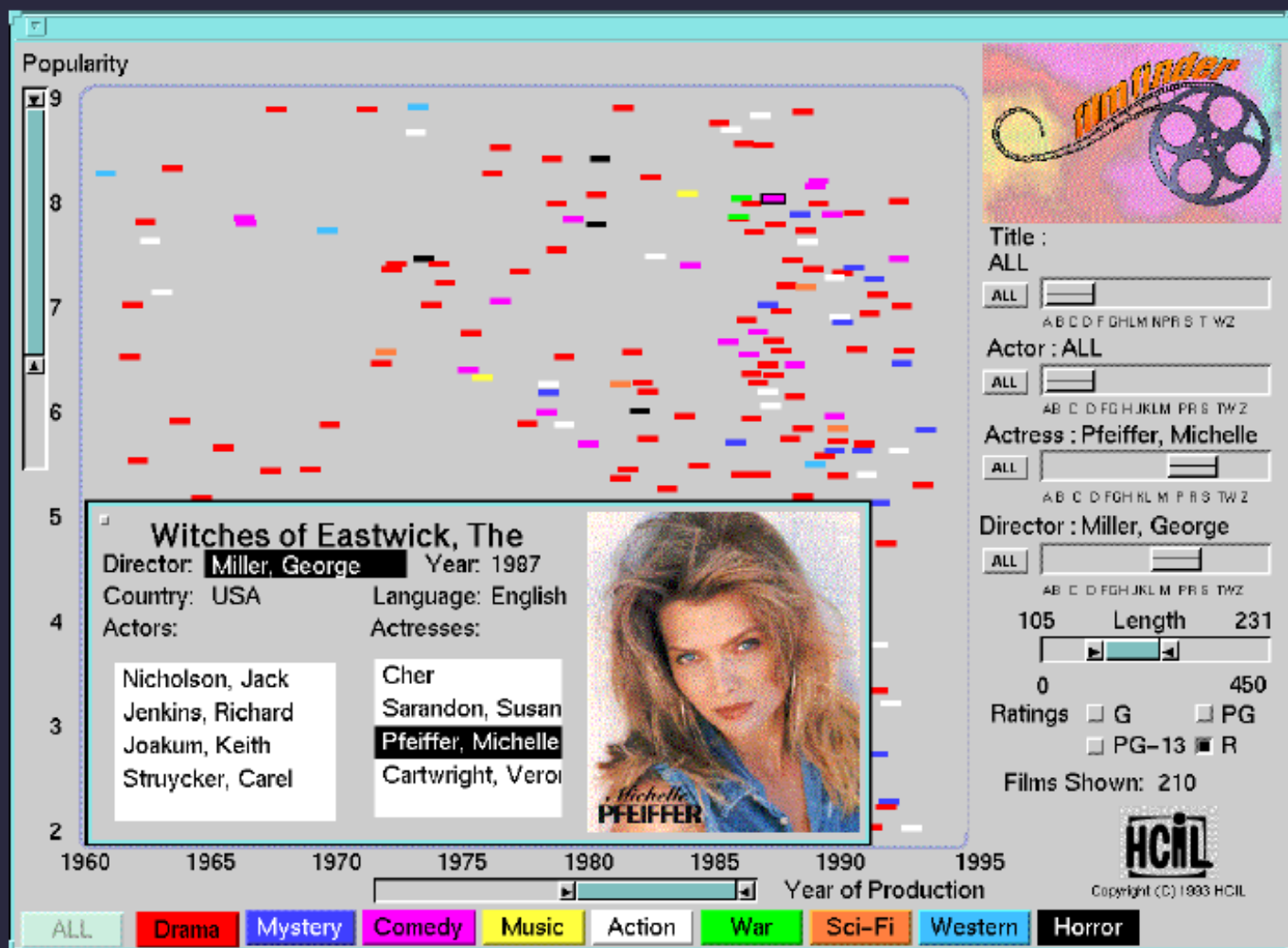
[Ahlberg and Schneiderman 93]

# FilmFinder



[Ahlberg and Schneiderman 93]

# FilmFinder



[Ahlberg and Schneiderman 93]

# Cellphones

Zip Code: **98105**
Reset

maximum PRICE\*
\$ 700

maximum HEIGHT WEIGHT
7 7
inches ounces

minimum TALK TIME STANDBY TIME
100 60
minutes hours

CARRIERS:
Cingular
Verizon
T-Mobile
Sprint
AT&T
Nextel

BRANDS:
Nokia
Sony-Eric
Motorola
Samsung
Siemens
LG
All Others

Digital Camera
resolution
low medium high

Phone Design
Any

Color Screen
Don't Need

Data/Net Access
Any

Text Messaging
Don't Need

Video Recorder
Don't Need

Speakerphone
Don't Need

Special Roaming
Don't Need

Push-to-Talk
Don't Need

PDA
Don't Need

Music
Don't Need

Bluetooth
Don't Need

MyPhoneFinder

The cell phones currently available in your location appear below. As you use the toggles and levers at left, the number of phones will decrease. At any time, you can click on a phone image, and specific information about that phone will appear in this area of the page.

Best Price:
Carrier:
Height:
Weight:
Talk Time:
Standby:
Technology:

Purchase

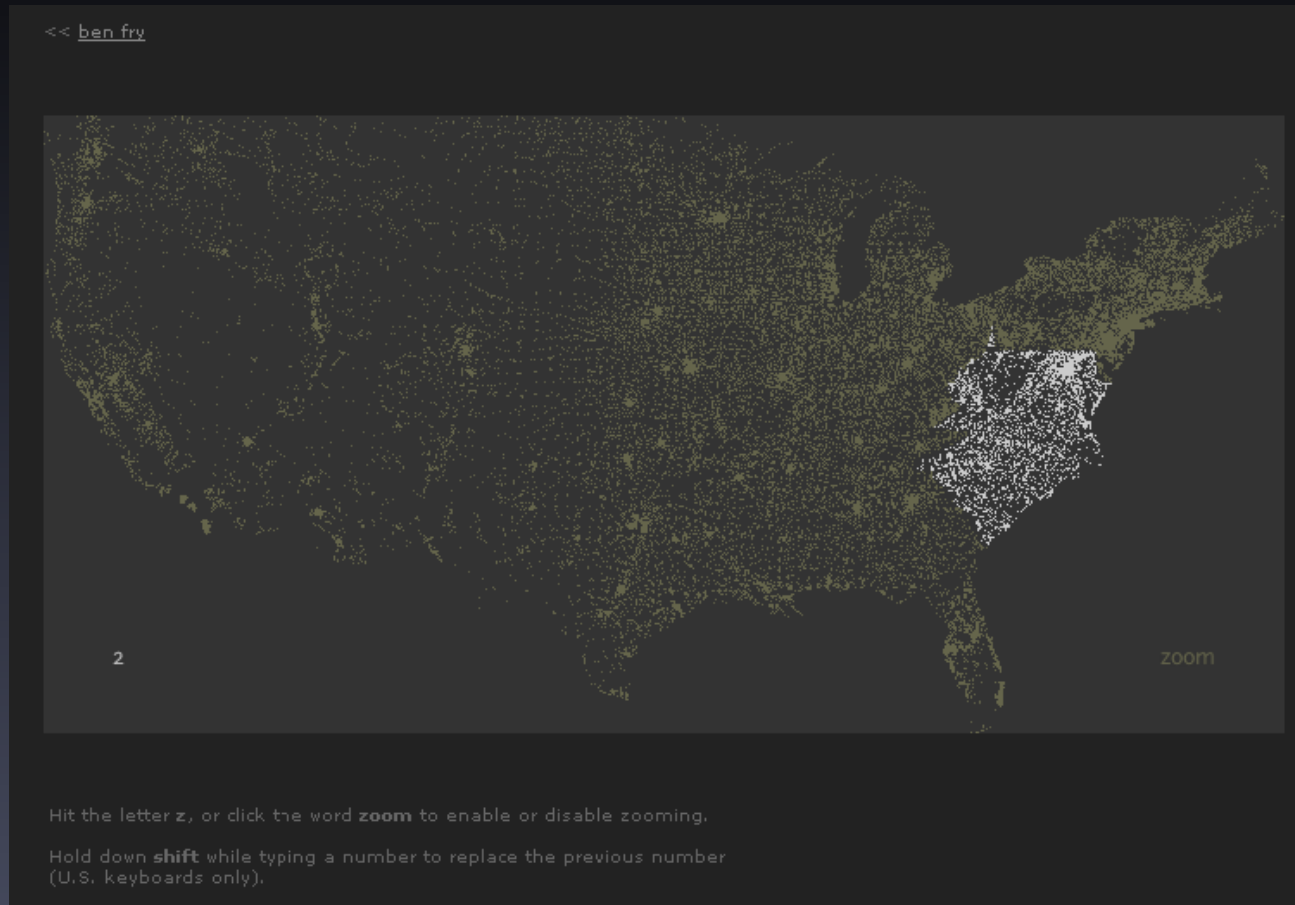
98 of 99 phones for Seattle, WA shown

Help

<http://www.myrateplan.com/cellphones/>

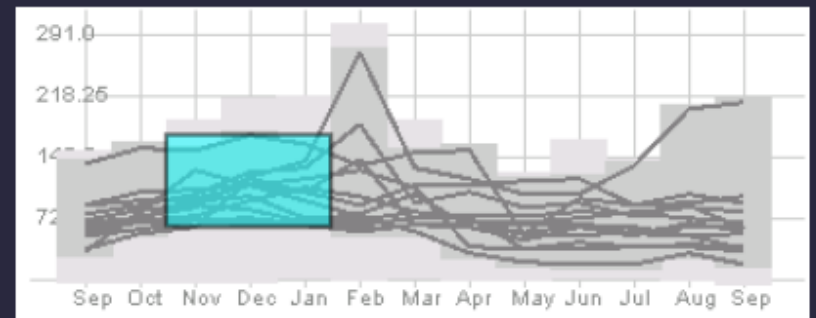
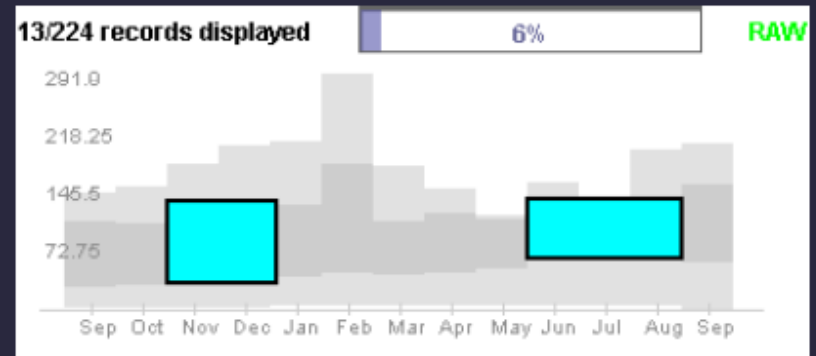
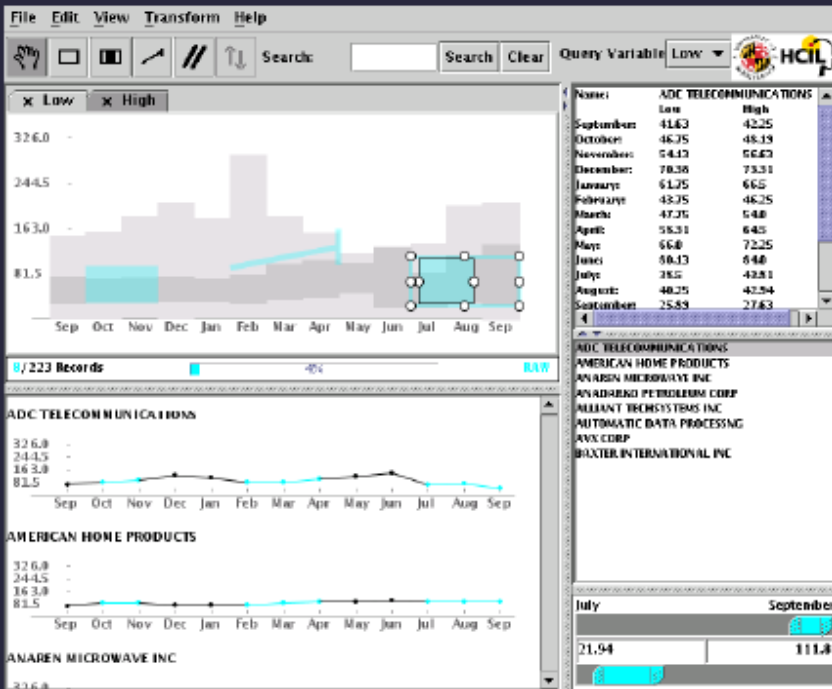


# Zipdecode



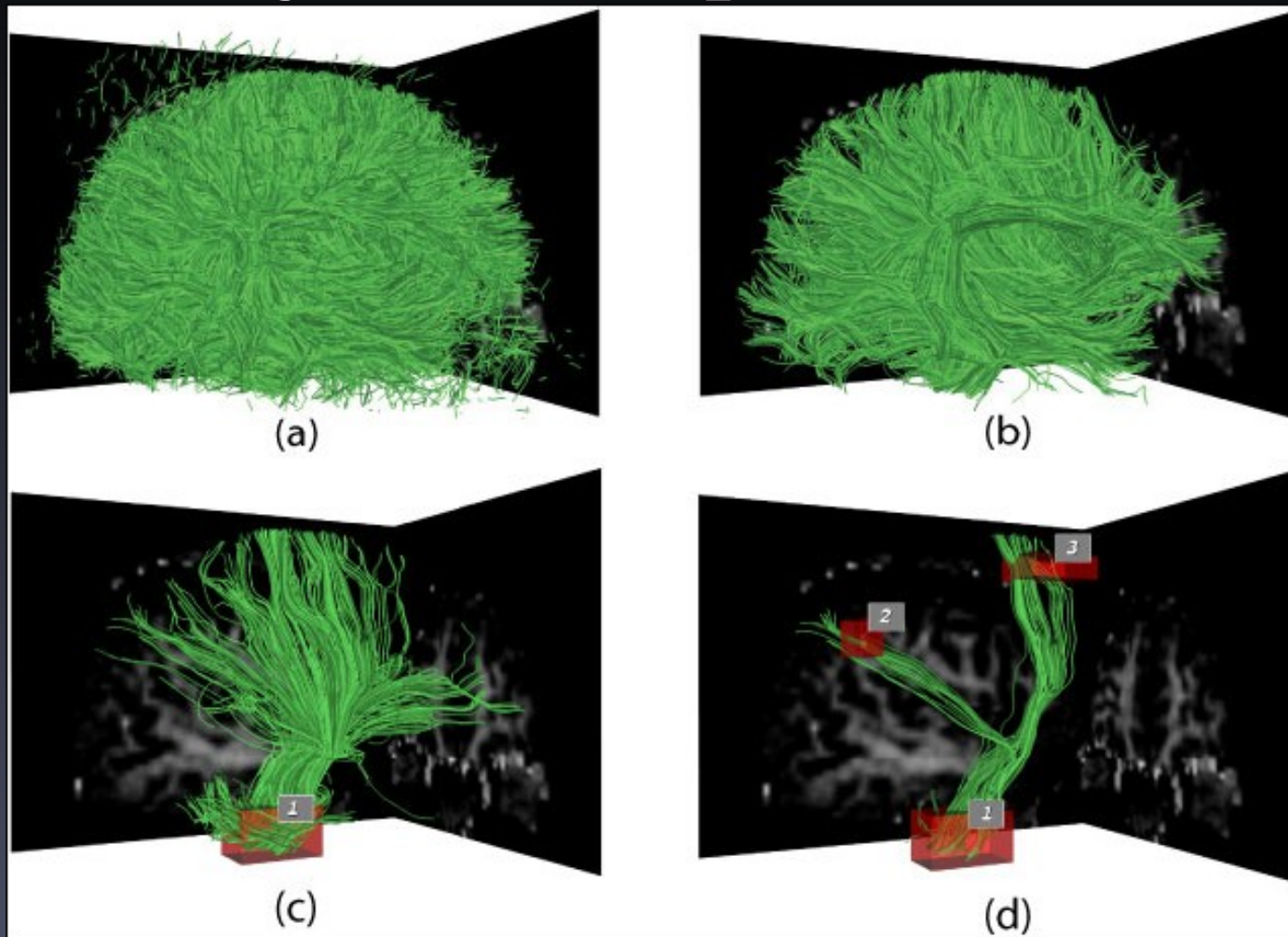
<http://acg.media.mit.edu/people/fry/zipdecode/>

# TimeSearch [Hochheiser & Schneiderman 02]



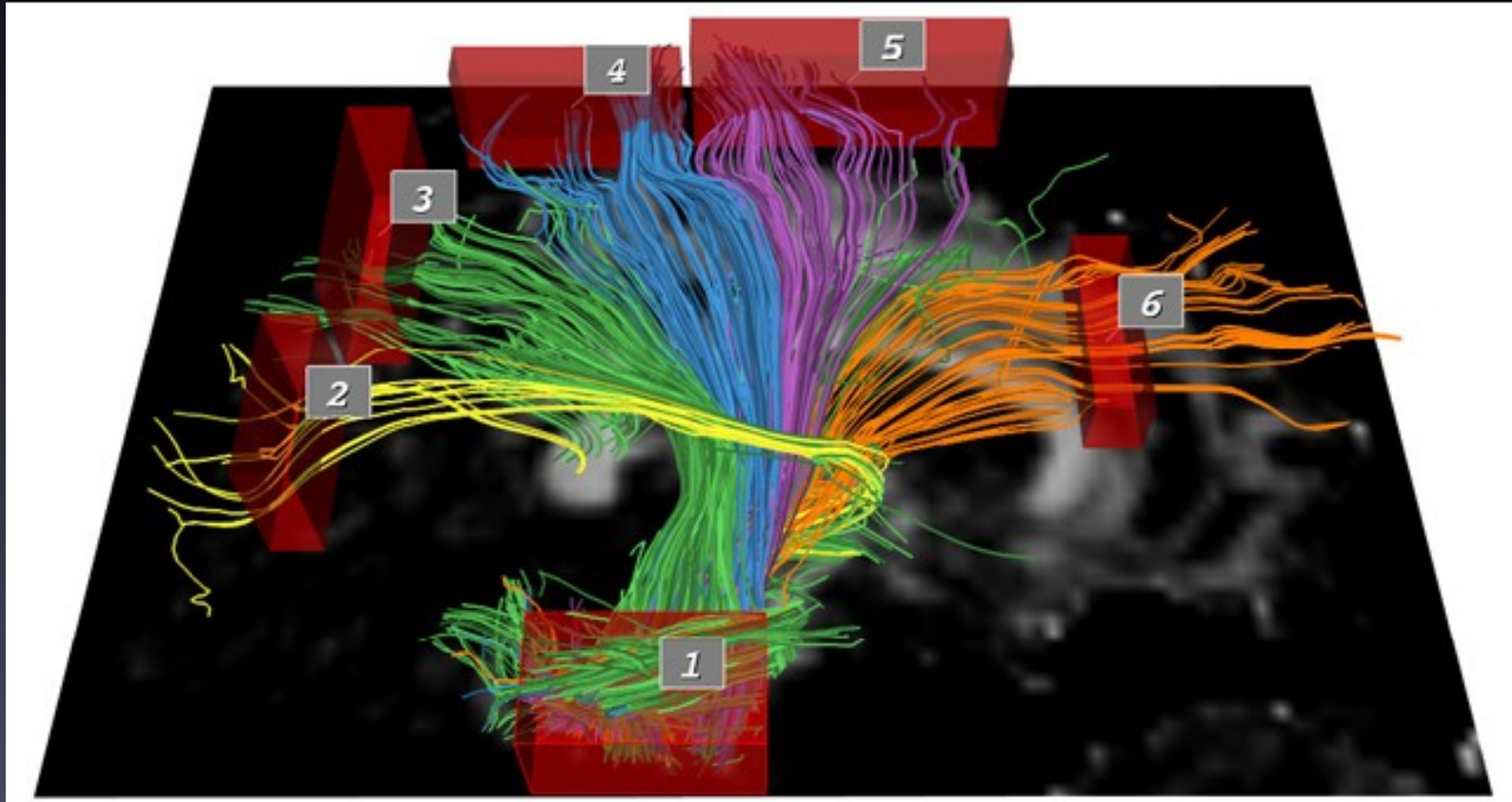
**Based on Wattenberg's [2001] idea for sketch-based queries of time-series data.**

# 3D dynamic queries [Akers et al. 04]





# 3D dynamic queries [Akers et al. 04]



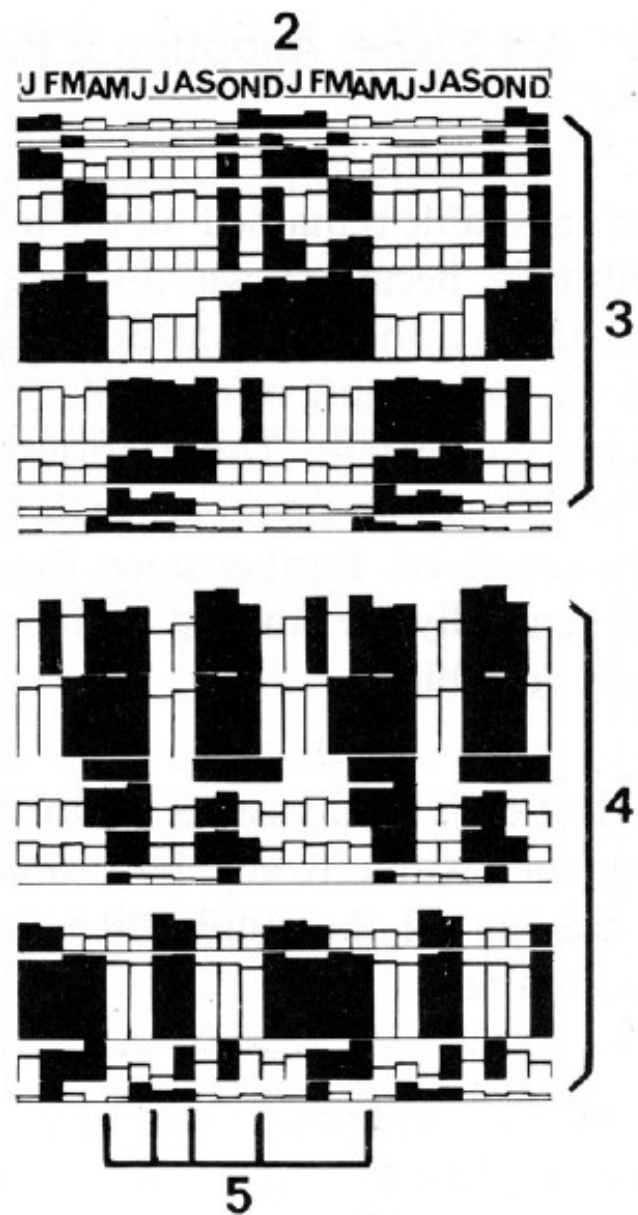
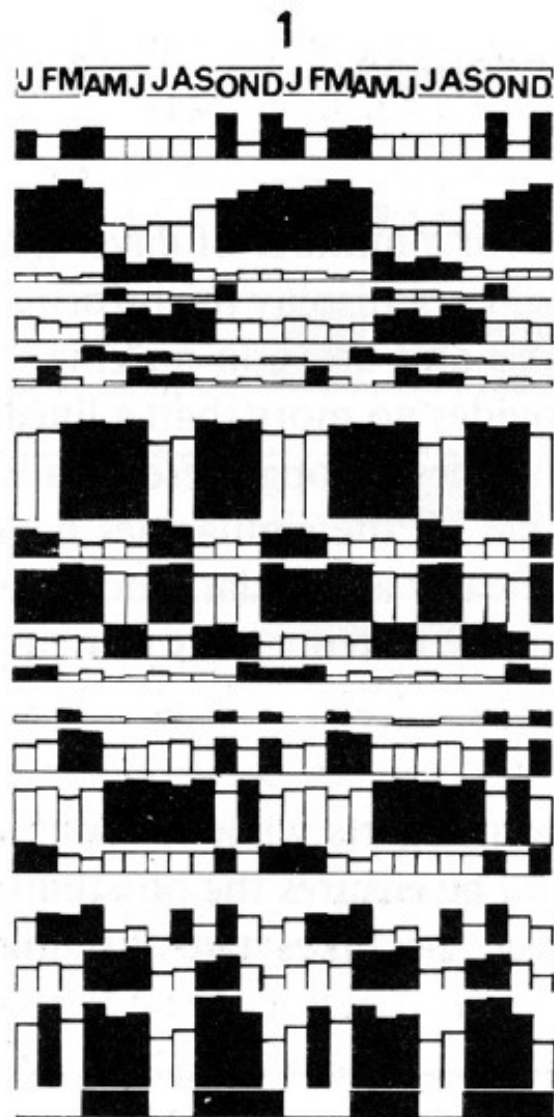
# Pros and cons

- **Pros**
  - Controls useful for both novices and experts
  - Quick way to explore data
- **Cons**
  - Simple queries
  - Lots of controls
  - Amount of data shown limited by screen space
- **Who would use these kinds of tools?**

# Rearrangements

J	F	M	A	M	J	J	A	S	O	N	D		
26	21	26	28	20	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	0	8	6	6	4	2	12	0	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	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	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





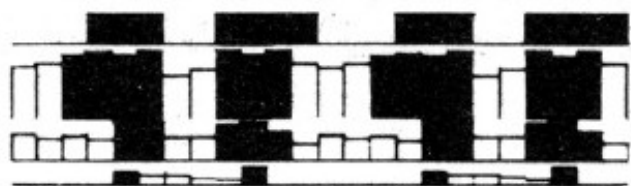
J F M A M J J A S O N D J F M A M J J A S O N D



10 % OCCUPANCY

18 LENGTH OF STAY

*ACTIVE AND  
SLOW PERIODS*



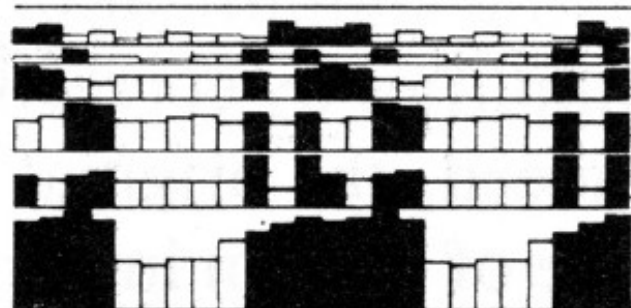
20 CONVENTIONS

8 BUSINESSMEN

11 AGENCY RESERVATIONS

4 SOUTH AMERICA

*DISCOVERY FACTORS*



18 AIR CREWS

18 CLIENTS UNDER 20 YEARS

18 CLIENTS MORE THAN 55 YEARS

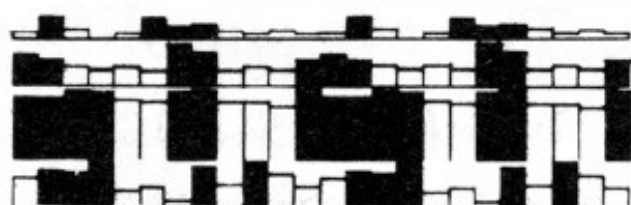
14 CLIENTS FROM 20-35 YEARS

1 FEMALE CLIENTELE

2 LOCAL CLIENTELE

*RECOVERY FACTORS*

*WINTER*



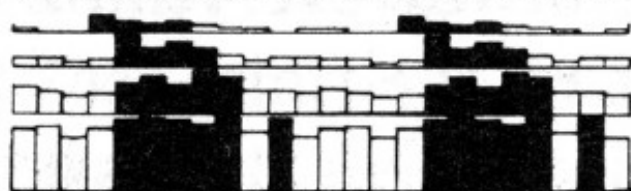
7 ASIA

9 TOURISTS

10 DIRECT RESERVATION

17 PRICE OF ROOMS

*WINTER-SUMMER*



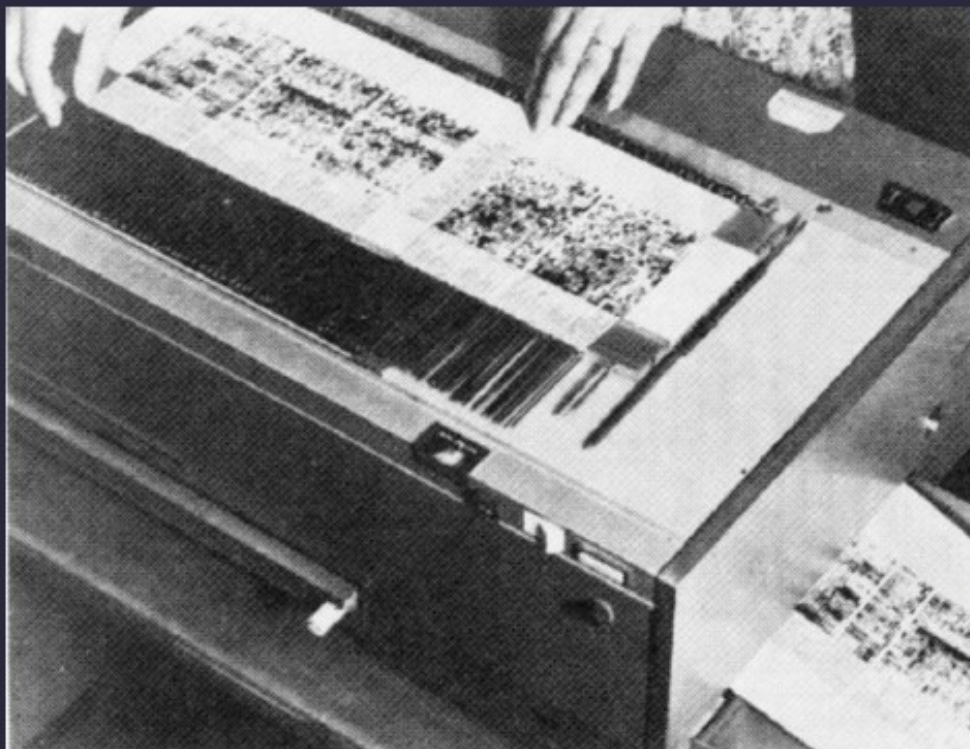
6 MIDDLE EAST, AFRICA

3 U.S.A.

5 EUROPE

15 CLIENTS FROM 35-55 YEARS

*SUMMER*



[Graphics and Graphic Information Processing, Bertin 81]



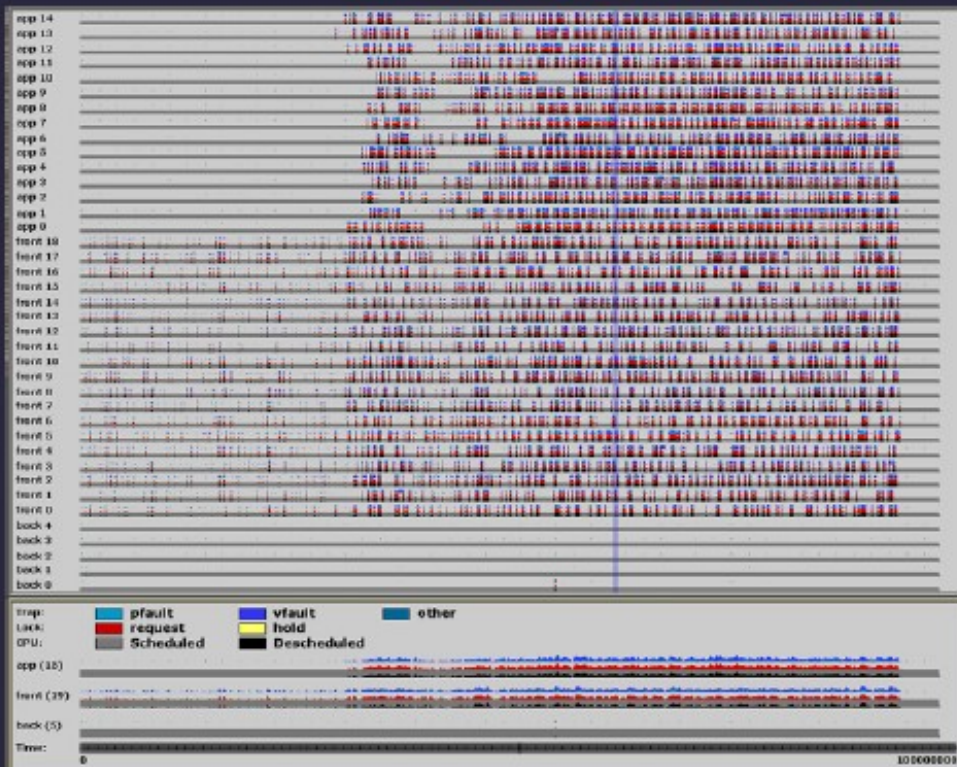


[Graphics and Graphic Information Processing, Bertin 81]

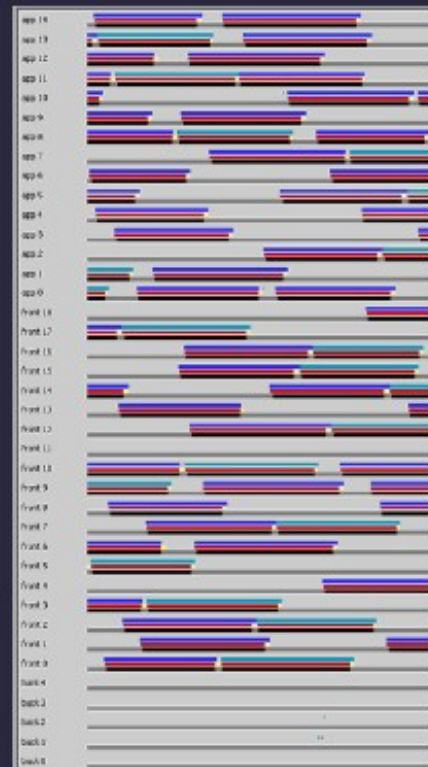


# Rivet: Interactive reordering

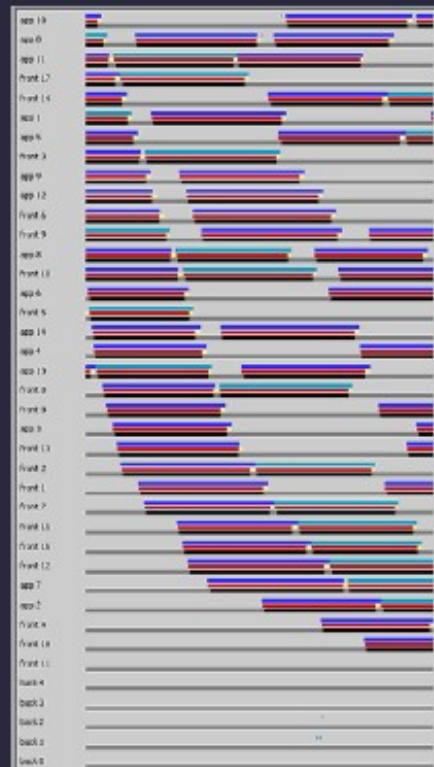
## Overview



## Zoom



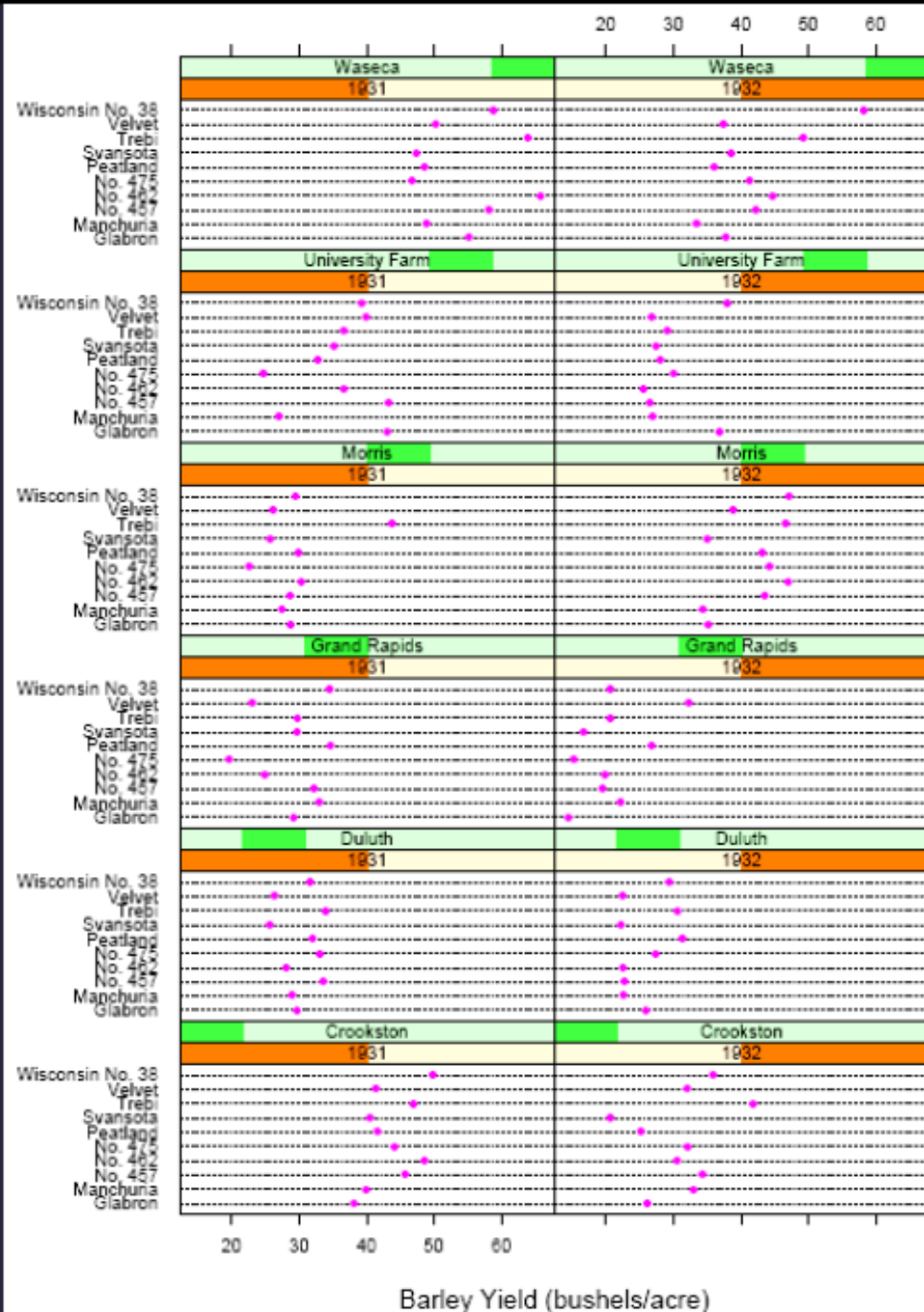
## Reorder



Performance Analysis and Visualization of Parallel Systems Using SimOS and Rivet: A Case Study [Bosch et al. 00]

# Trellis

[Becker, Cleveland, and Shyu 96]

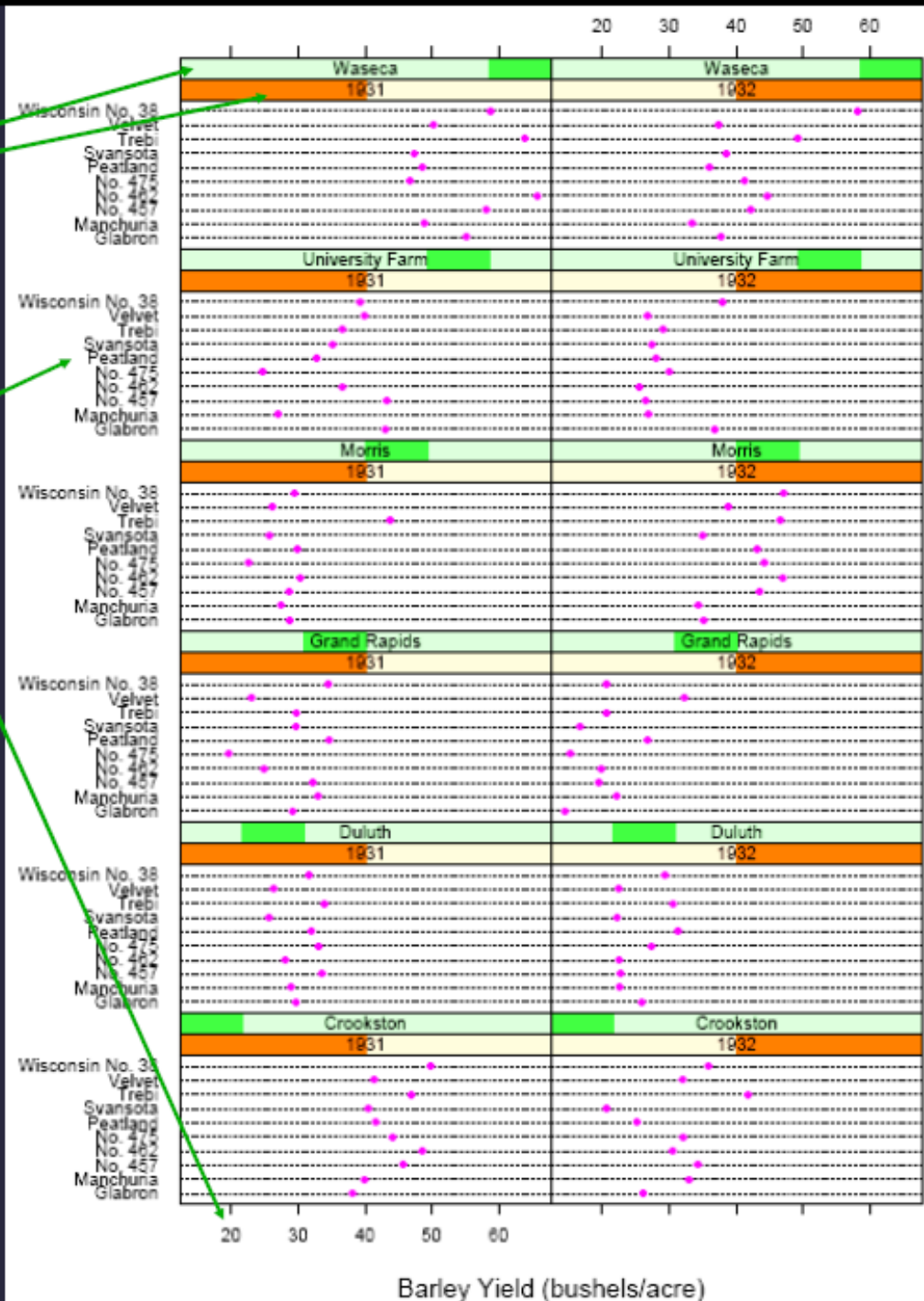


Condition variables  
location, year

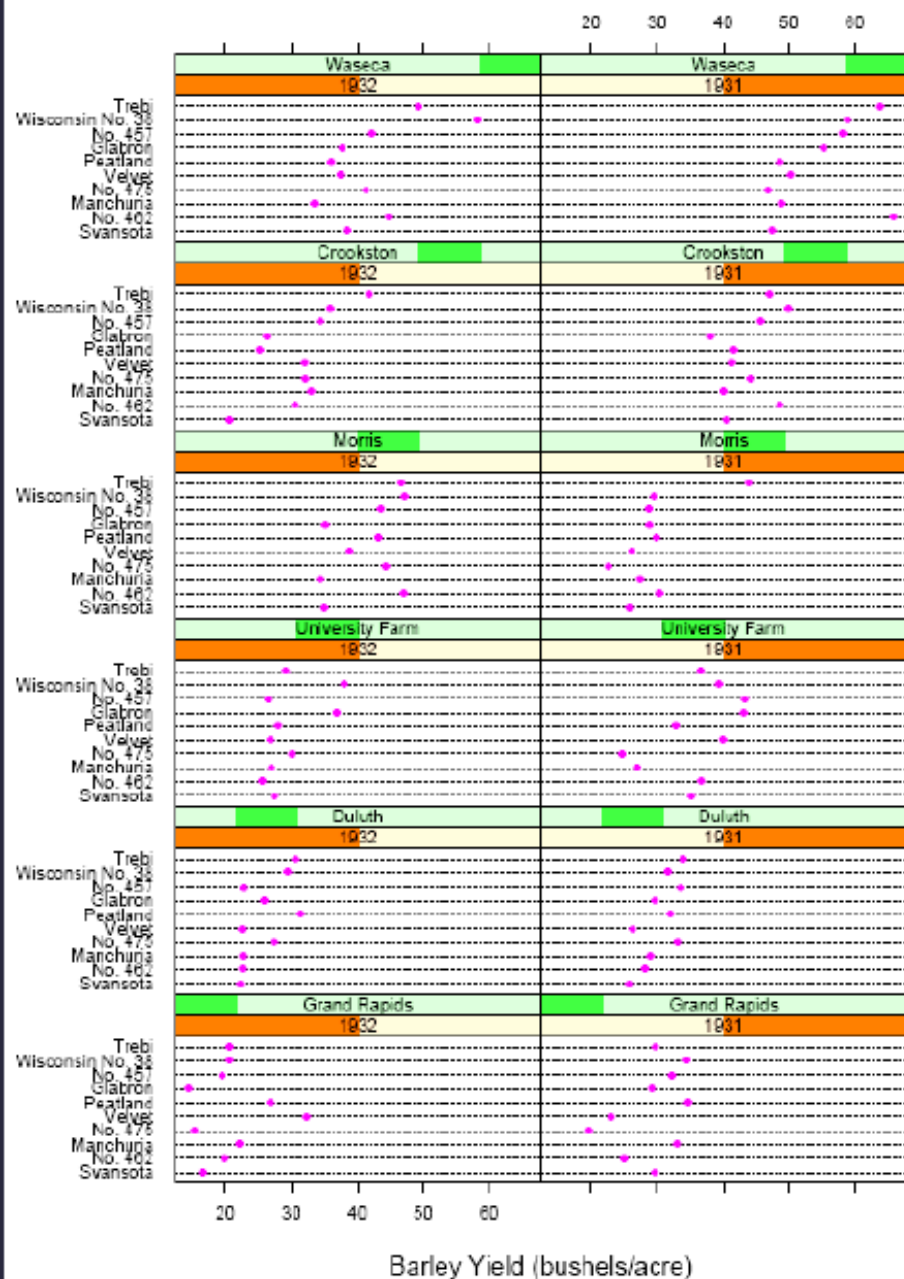
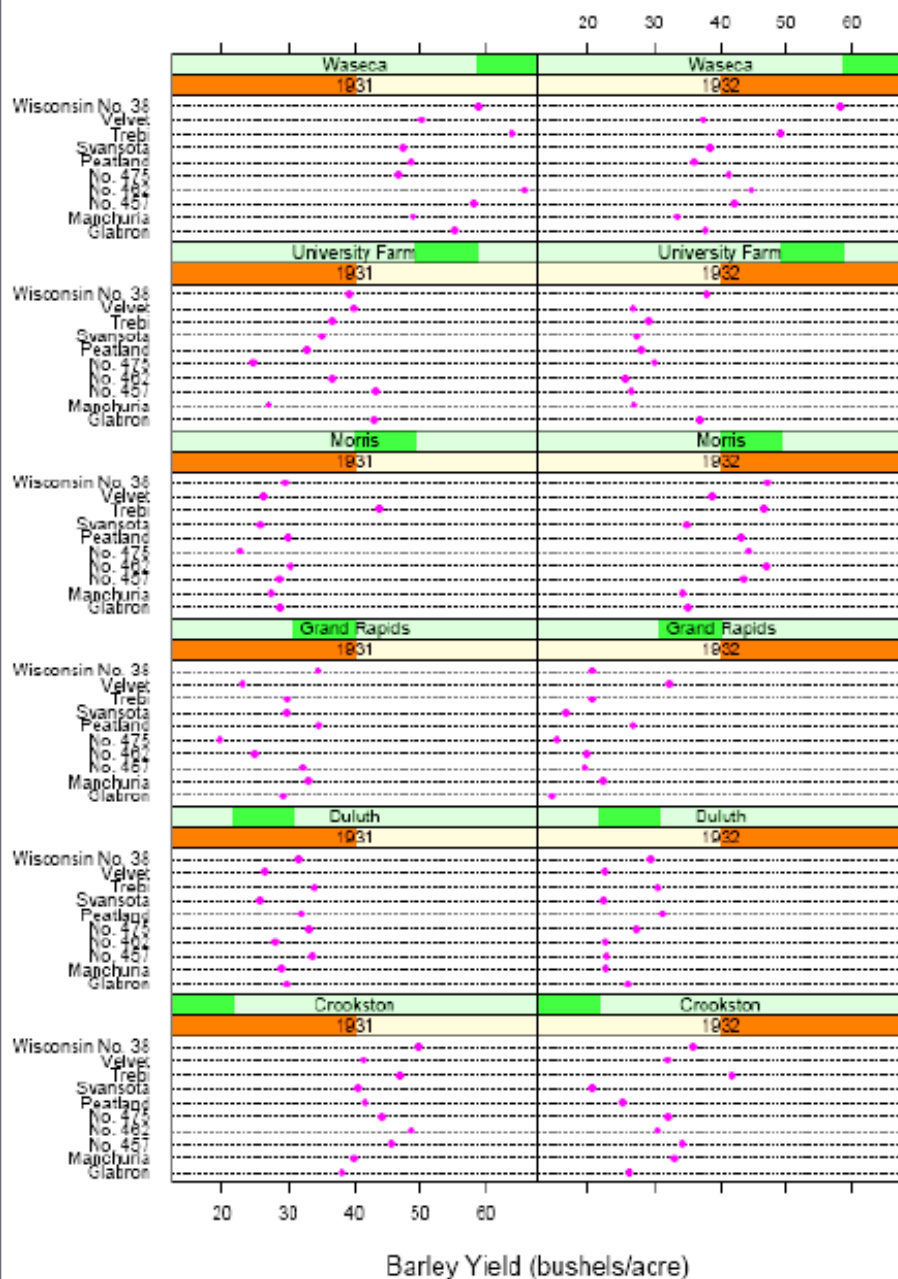
Panel variables  
type, yield

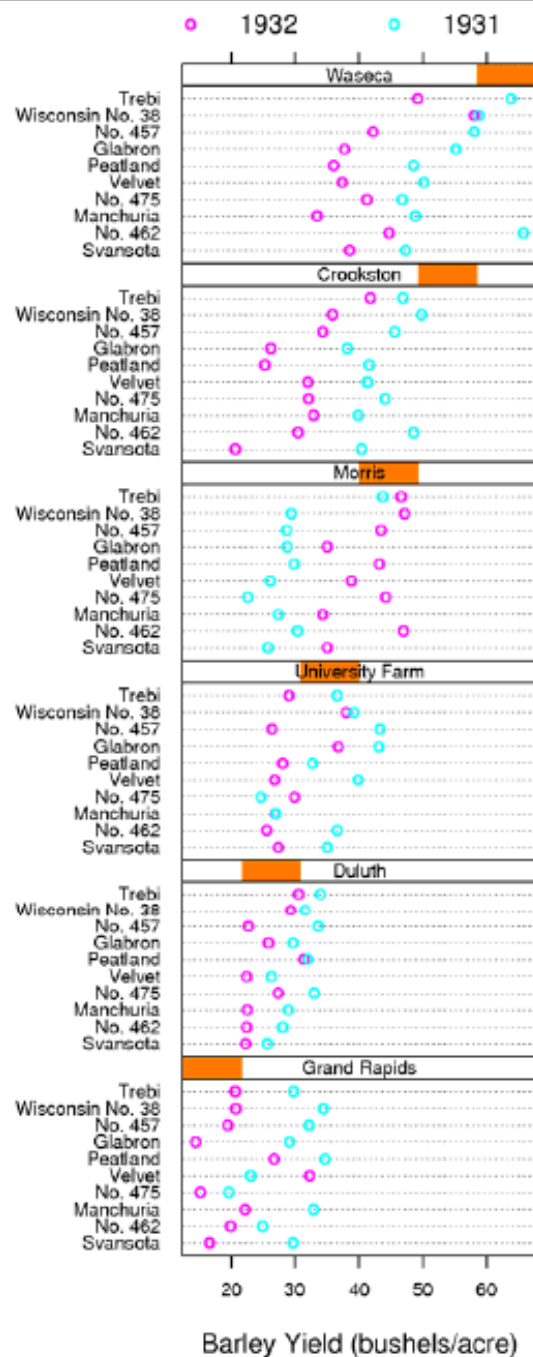
# Trellis

[Becker, Cleveland, and Shyu 96]

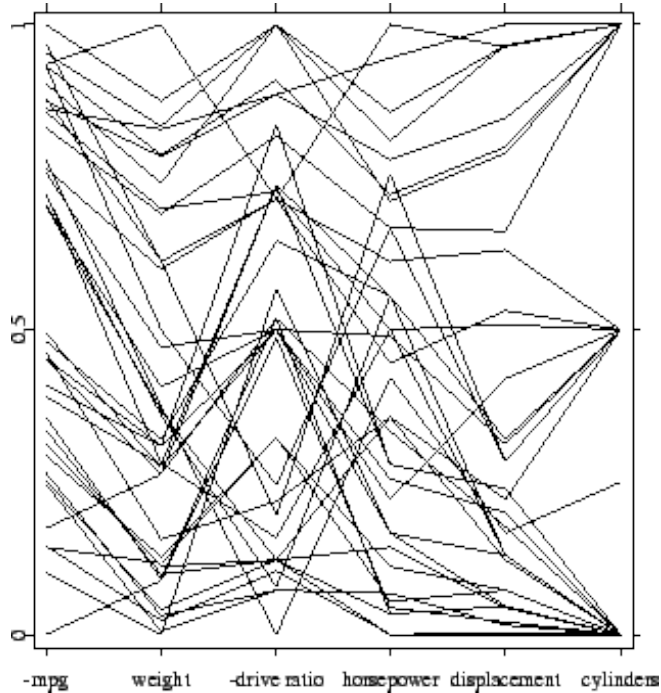




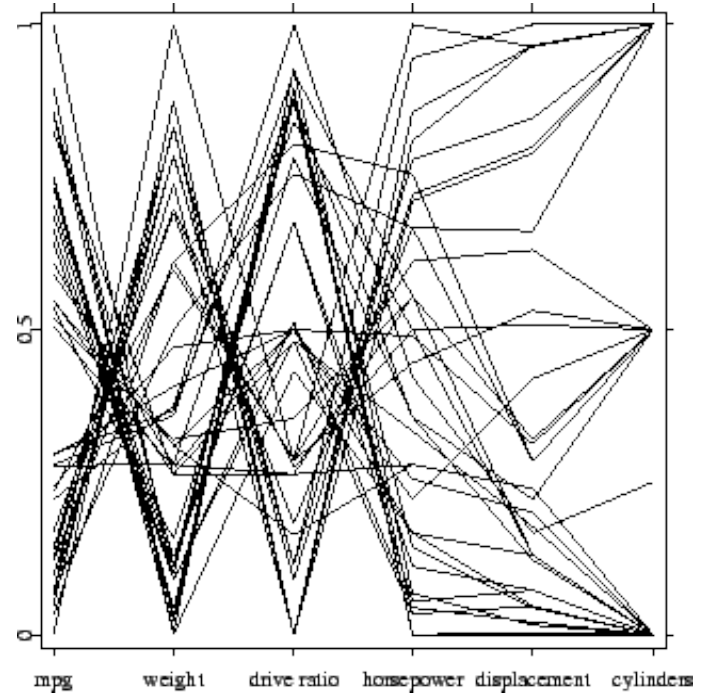




# Reorder Parallel Coordinates



Original



Reordered

# Table Lens [CHI94]

							G	H								
4							G4	H4								
5							G5	H5								
6							G6	H6								

# Table Lens: Baseball Player Statistics

Calculate: "Hits" / "At Bats" = "Avg"

		Avg								Career Avg						Team					Salary 87				
Larry Herndon		0.24734983								0.27282876						Det.					225				
Jesse Barfield		0.2886248								0.27268818						Tor.					1237.5				
Jeffrey Leonar		0.27859238								0.27260458						S.F.					900				
Donnie Hill		0.28318584								0.2725564						Oak.					275				
Billy Sample		0.285								0.2718601						Atl.					NA				
Howard Johnson		0.24545455								0.25232068						N.Y.					297.5				
Andres Thomas		0.250774								0.2521994						Atl.					75				
Billy Hatcher		0.25775656								0.25211507						Hou.					110				
Omar Moreno		0.2339833								0.2518029						Atl.					NA				
Darnell Coles		0.2725528								0.25153375						Det.					105				

Row 304: Mike Lavalliere;

Column 20: Put Outs

Value: 468

810 -- 2163



Calculate:	
------------	--

[illegible]

Row 25: Harold Baines;	Column 17: Position	Value: RF	717 -- 8689
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# Summary

- Most Visualizations are interactive
  - Even passive media elicit interactions
- Good Visualizations are task dependant
  - Choose the right space
  - Pick the right Interaction technique
- Human factors are important
  - Leverage human strengths
  - Assist to get past human limitations

# Discussion

1. **How to improve menus?**
2. **How to improve an online map?**
3. **Interaction for large display environment?**

# Assignment2

In this part of the assignment, you are required to provide a good interaction examples. You need to provide:

- (1) Detailed description to the examples you found.
- (2) Your findings and comments to the examples.
- (3) Your learning from them, or advice for improvement.