Interaction II

Maneesh Agrawala

CS 448B: Visualization
Spring 2016

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

[Graphics and Graphic Information Processing, Bertin 81]

Bertin Matrices

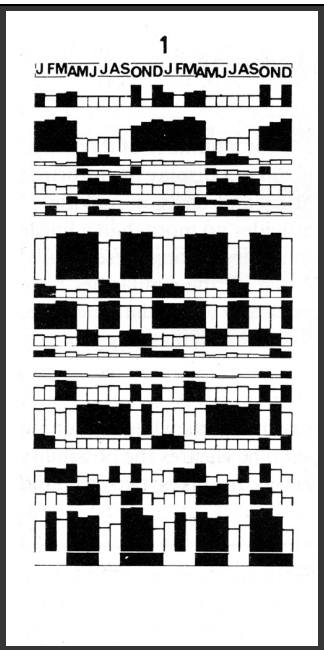
Research question

⬇

Table

⬇

1. Encode table cells visually
2. Group similar rows and columns to reveal patterns



[Graphics and Graphic Information Processing, Bertin 81]

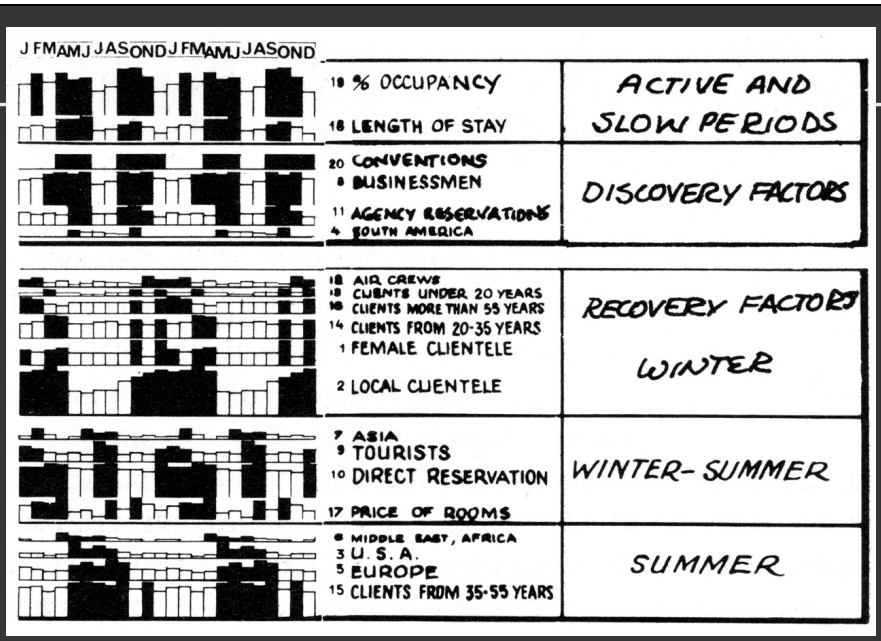
Group similar rows and columns

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

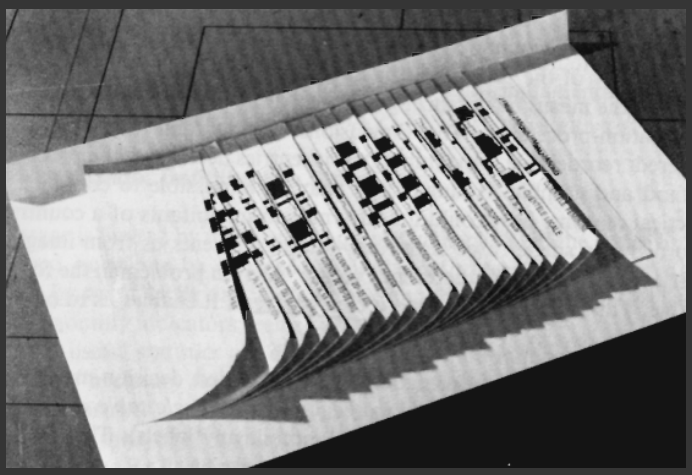
Move similar rows close, opposite rows to bottom. (Creates two opposing groups and a middle group)

Repeat for columns

Iterate



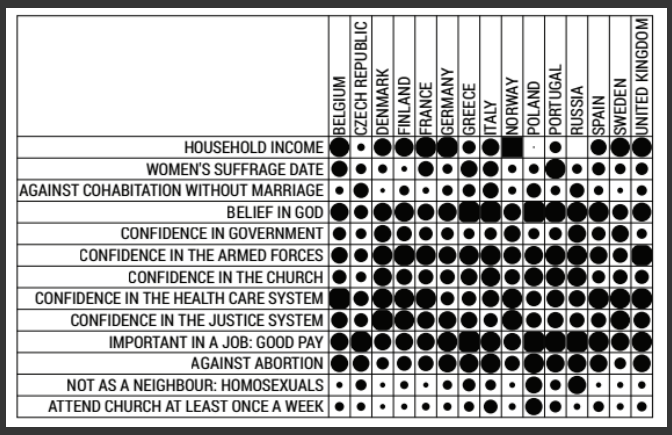
[Graphics and Graphic Information Processing, Bertin 81]



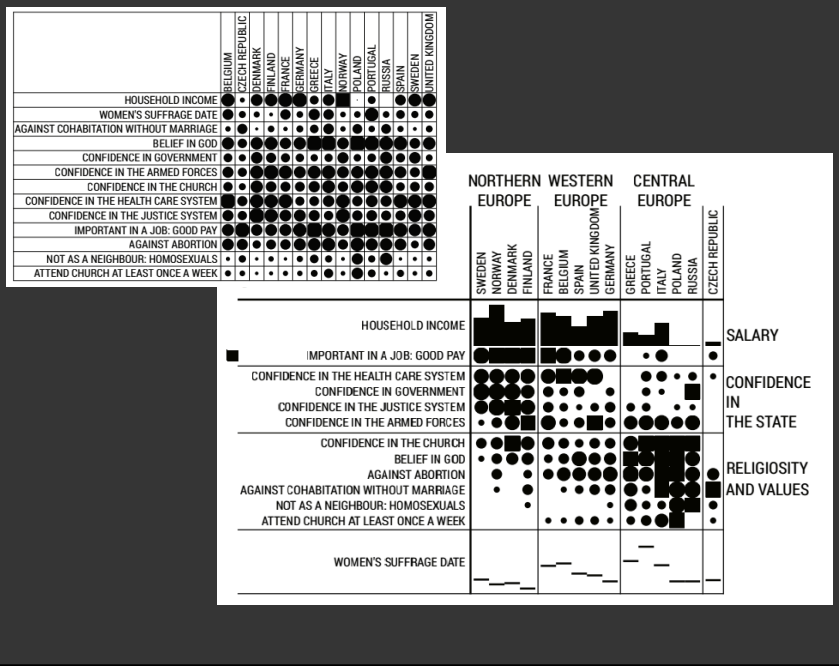
[Graphics and Graphic Information Processing, Bertin 81]

	Bel	Cze	Den	Fin	Fra	Ger	Gre	Ita	Nor	Pol	Por	Rus	Spa	Swe	Uni
Household in	268	169	246	257	283	287	204	242	314	153	193	152	228	262	269
Women's suf	194	192	191	190	194	191	195	194	191	191	197	191	193	192	192
Against coha	12	42	4	18	8	20	30	46	12	39	17	39	16	6	19
Belief in God	61	36	63	69	52	63	93	91	56	96	86	77	76	46	65
Confidence	32	21	55	42	34	29	22	28	51	23	30	60	35	54	19
Confidence	50	34	72	83	73	58	70	75	57	63	75	73	57	41	89
Confidence	36	20	63	47	41	40	52	67	44	65	67	67	31	39	36
Confidence	91	42	75	73	78	34	39	54	74	44	58	51	79	75	80
Confidence	50	35	87	73	56	58	50	36	78	44	48	41	42	69	51
Important in	60	85	54	58	58	73	94	76	56	93	88	93	77	62	75
Against abo	56	51	28	40	44	60	65	72	42	75	61	63	57	25	57
Not as a nei	7	22	5	12	5	16	30	21	6	52	21	61	5	7	10
Attend churc	15	13	5	7	11	12	19	35	9	54	25	8	21	9	17

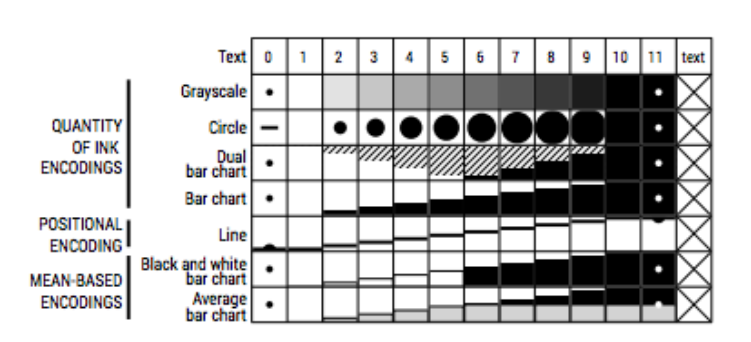
Bertifier [Perin 2014]



Bertifier [Perin 2014]



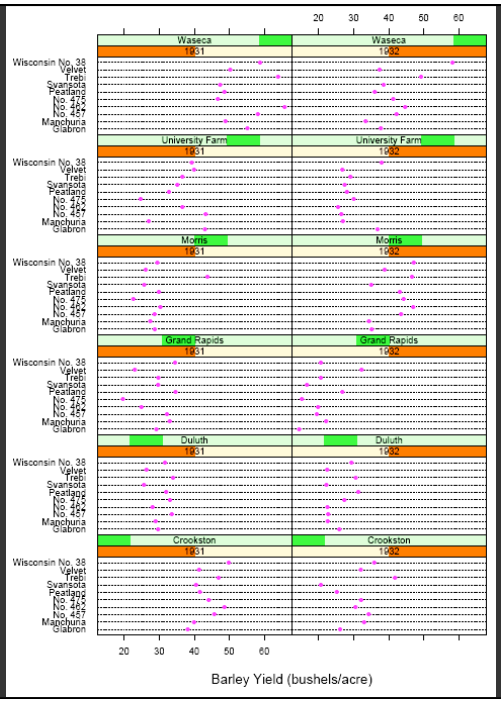
Visual encodings



Quantity of ink is proportional to the normalized data value

Trellis

[Becker, Cleveland, and Shyu 96]

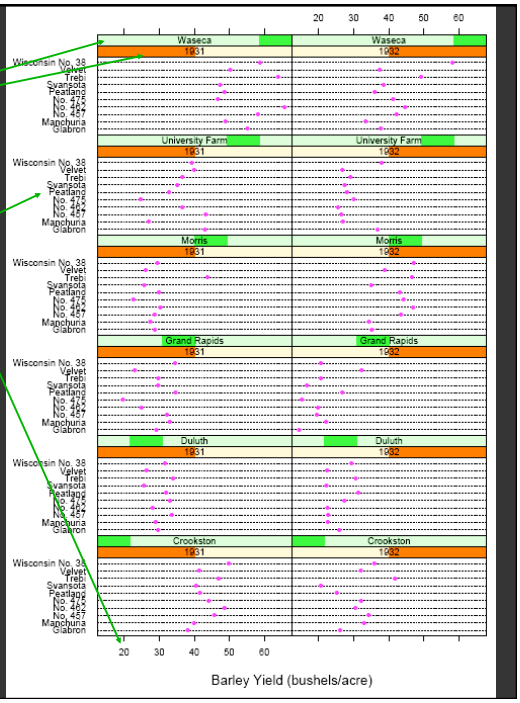


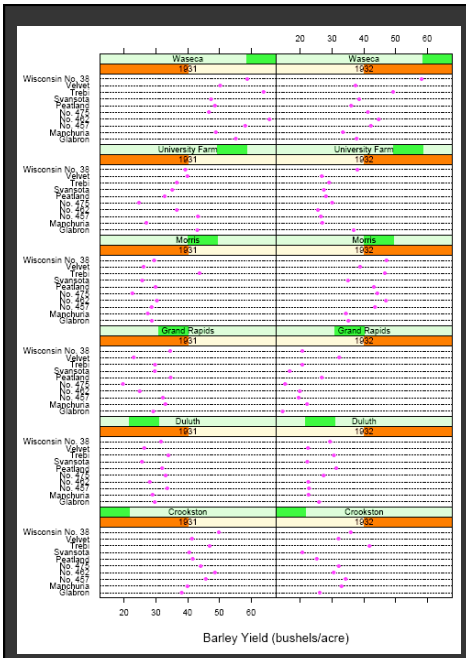
Condition variables
location, year

Panel variables
type, yield

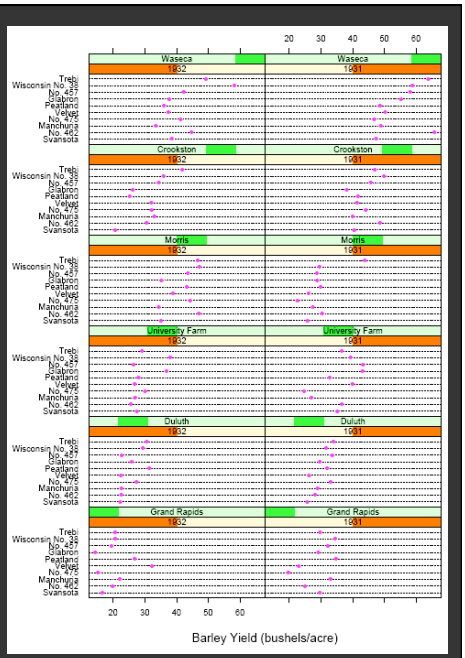
Trellis

[Becker, Cleveland, and Shyu 96]

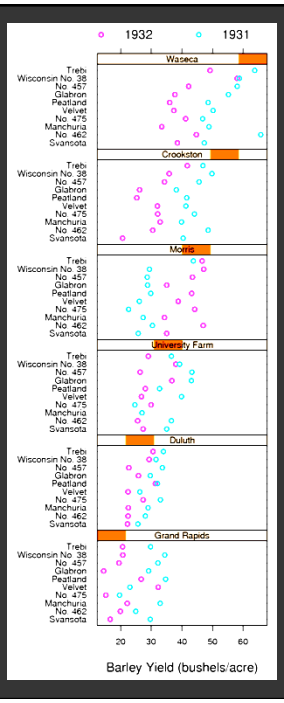




Alphabetical ordering

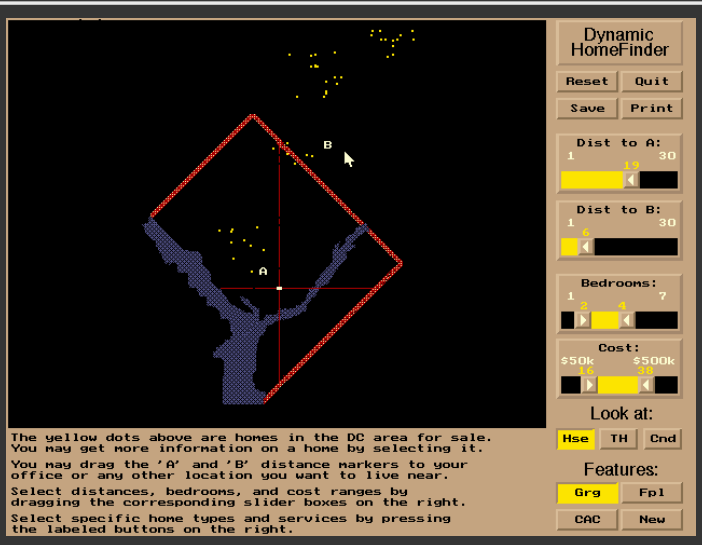


Main-effects ordering



Dynamic Queries

HomeFinder



[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

How quick does in need to be? *(rules of thumb)*

- 0.1s: Instantaneous
- 1.0s: Flow of thought uninterrupted
- 10s: Keeping user's attention on dialogue

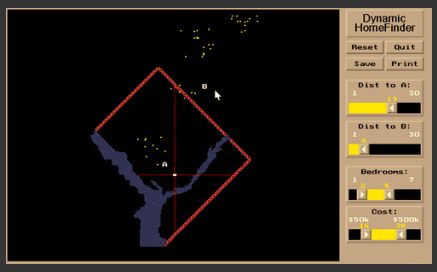
[Miller 1968]

Announcements

Assignment 3: Dynamic Queries

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

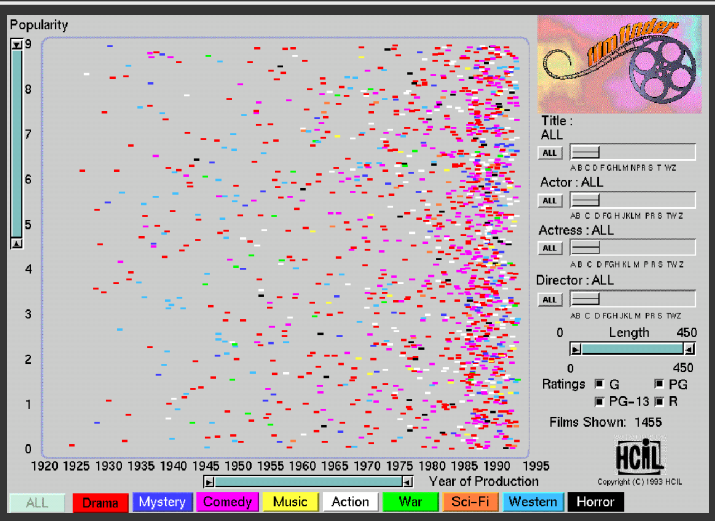
1. Storyboard interface
2. Implement interface and produce final writeup
3. Submit the application and a final writeup on the wiki



Can work alone or in pairs

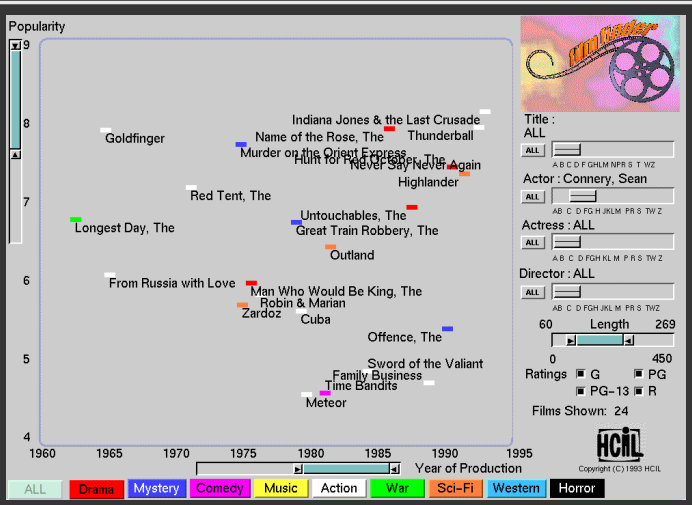
Final write up due before class on **May 4, 2016**

FilmFinder



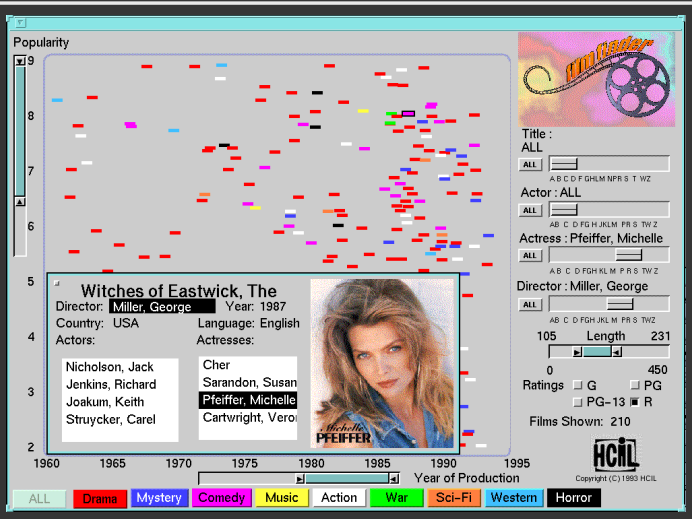
[Ahlberg and Schneiderman 93]

FilmFinder



[Ahlberg and Schneiderman 93]

FilmFinder

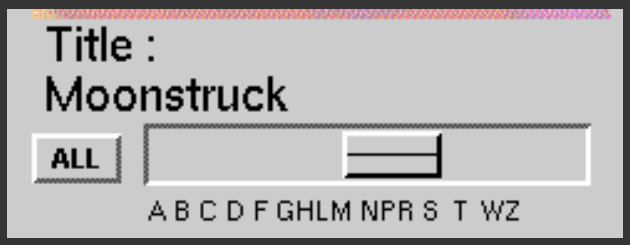


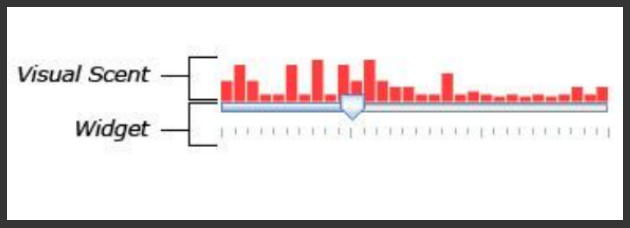
[Ahlberg and Schneiderman 93]

Alphaslider

[Ahlberg and Schneiderman 94]

Scented Widgets



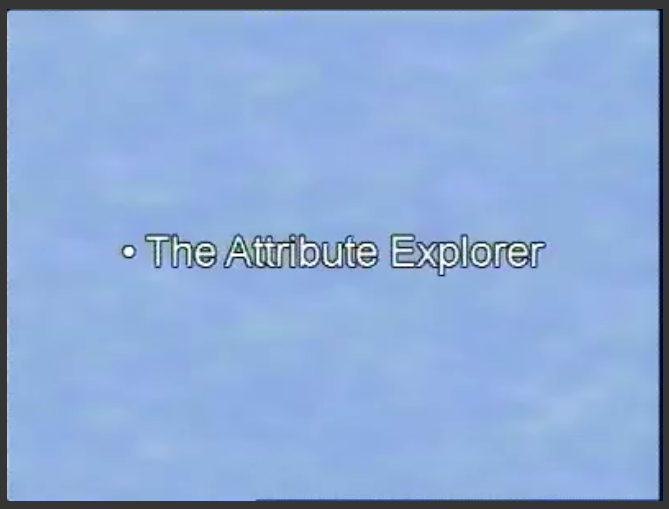


[Willett 2007]

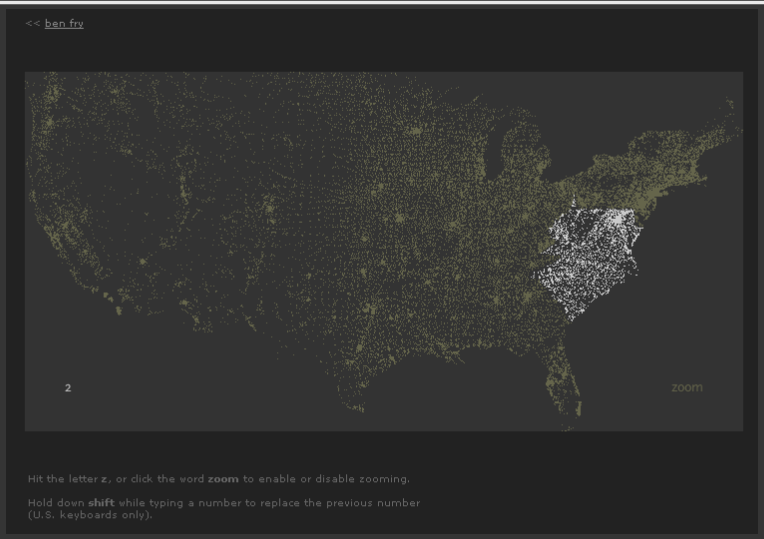
Name	Description	Example
Hue	Varies the hue of the widget (or of a visualization embedded in it)	Option A Option B
Saturation	Varies the saturation of the widget (or of a visualization embedded in it)	Option A Option B
Opacity	Varies the saturation of the widget (or of a visualization embedded in it)	Option A Option B
Text	Inserts one or more small text figures into the widget	(2) Option A (10) Option B
Icon	Inserts one or more small icons into the widget.	Option A Option B
Bar Chart	Inserts one or more small bar chart visualizations into the widget	Option A Option B
Line Chart	Inserts one or more small line chart visualizations into the widget	Option A Option B

[Willett 2007]

Attribute explorer [Spence and Tweedie 98]

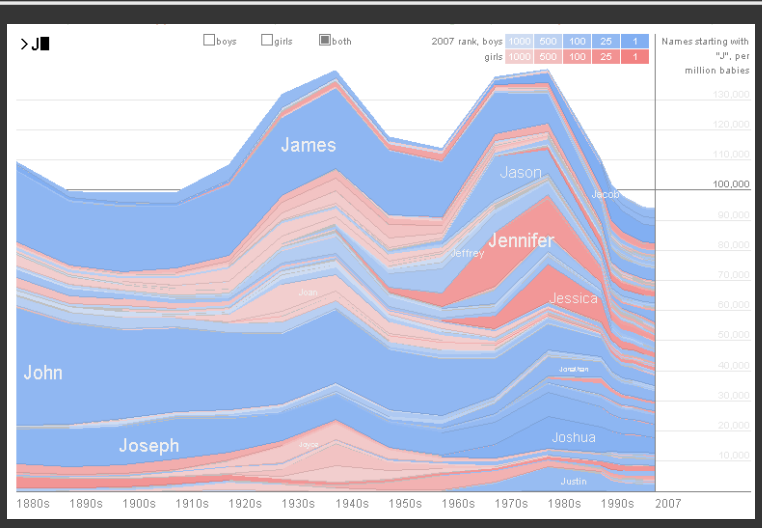


Zipdecode [from Fry 04]



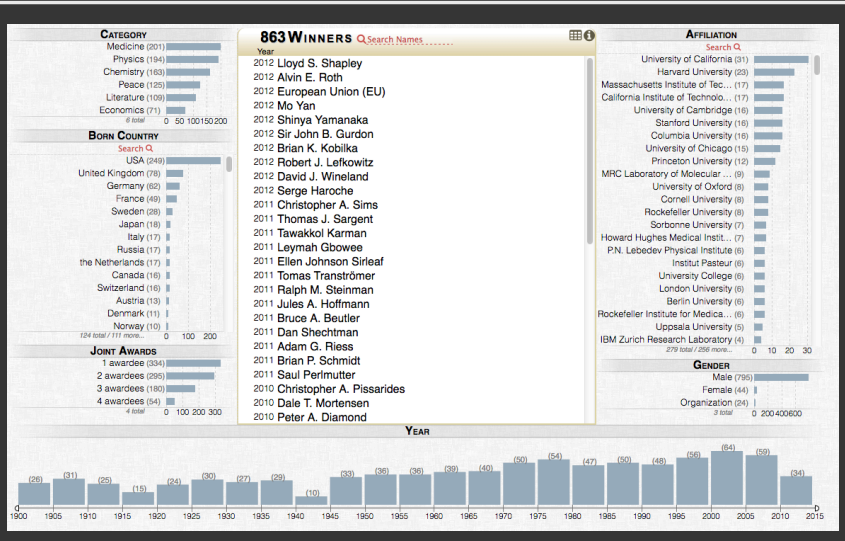
http://acg.media.mit.edu/people/fry/zipdecode/

NameVoyager



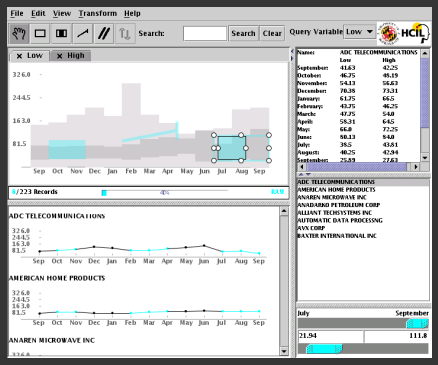
http://www.babynamewizard.com/voyager

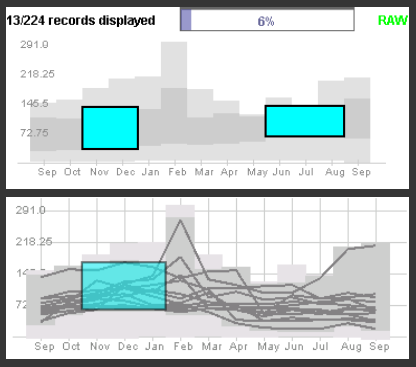
Keshif



https://www.cs.umd.edu/hcil/keshif/

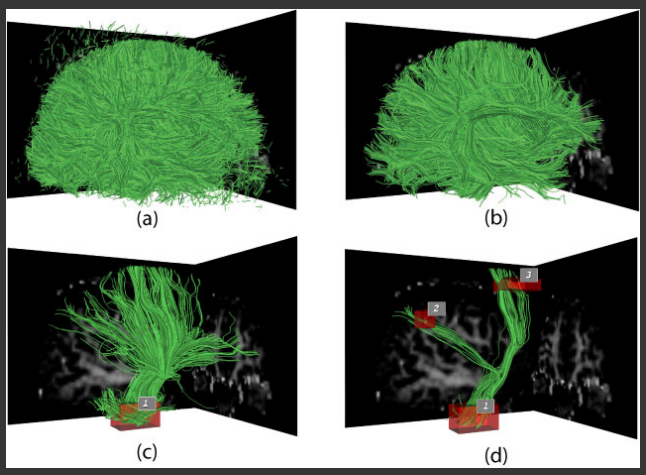
TimeSearcher [Hochheiser & Schneiderman 02]



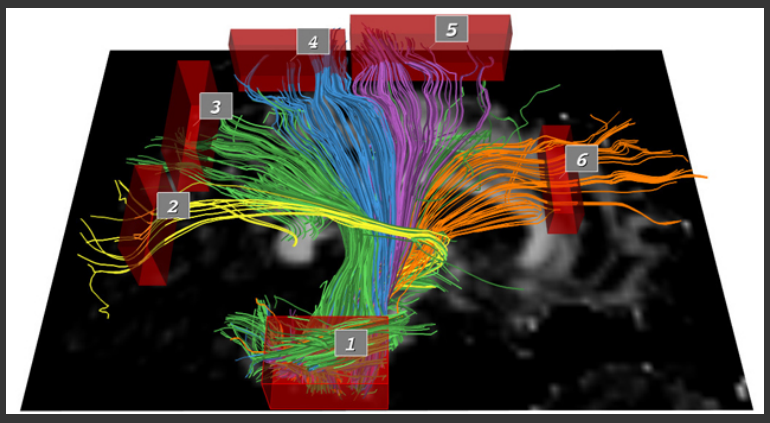


Based on Wattenberg's [2001] idea for sketch-based queries of time-series data.

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

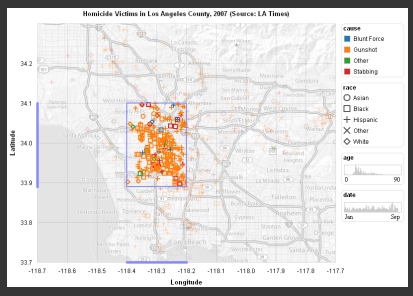
- Simple queries
- Lots of controls
- Amount of data shown limited by screen space

Who would use these kinds of tools?

Generalized Selection

Visual Queries

Model selections as declarative queries



$(-118.371 \leq \text{lon} \text{ AND } \text{lon} \leq -118.164) \text{ AND } (33.915 \leq \text{lat} \text{ AND } \text{lat} \leq 34.089)$

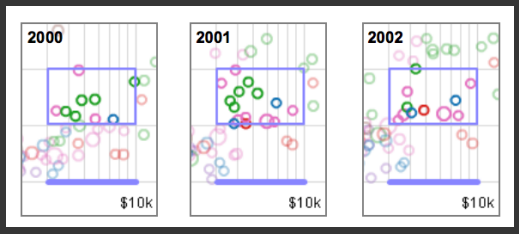
Visual Queries

Model selections as declarative queries

Applicable to dynamic, time-varying data

Retarget selection across visual encodings

Perform operations on query structure



"Select items like this one."

Generalized Selection

Point to an example and define an abstraction based on one or more properties [Clark, Brennan]

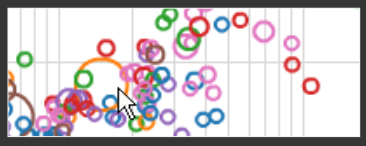
"Blue like this"
"The same shape as that"

Abstraction may occur over multiple levels

Generalized Selection

Provide *generalization mechanisms* that enable users to *expand a selection query* along *chosen dimensions* of interest

Expand selections via query relaxation



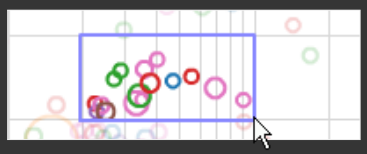
Interactor

Query Builder

Query Builder

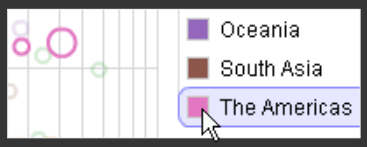
Click: Select Items

(id = 'China')



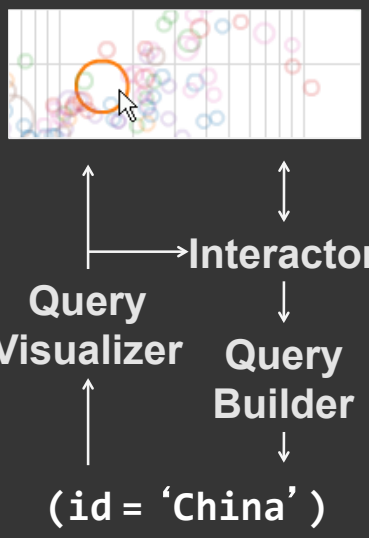
Drag: Select Range

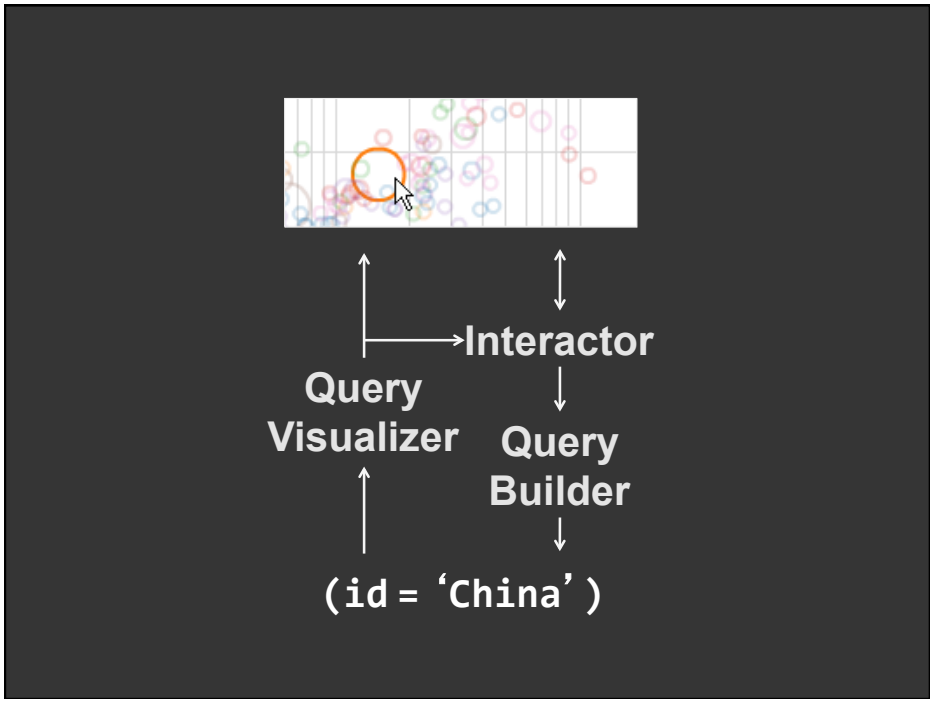
(2000 < gni AND gni < 10000) AND (.1 < internet AND internet < .2)

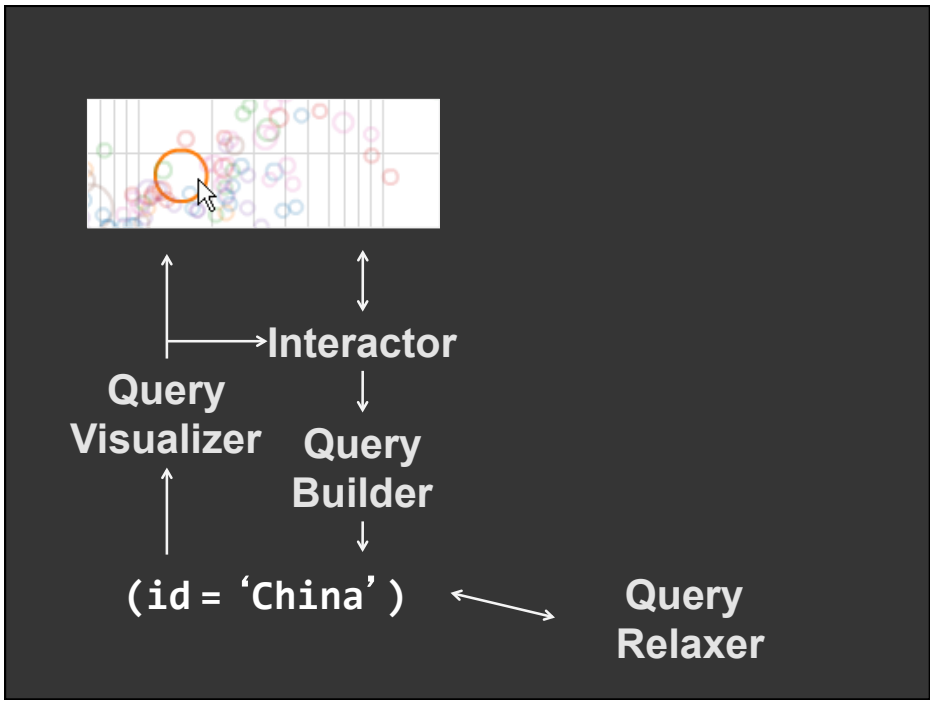


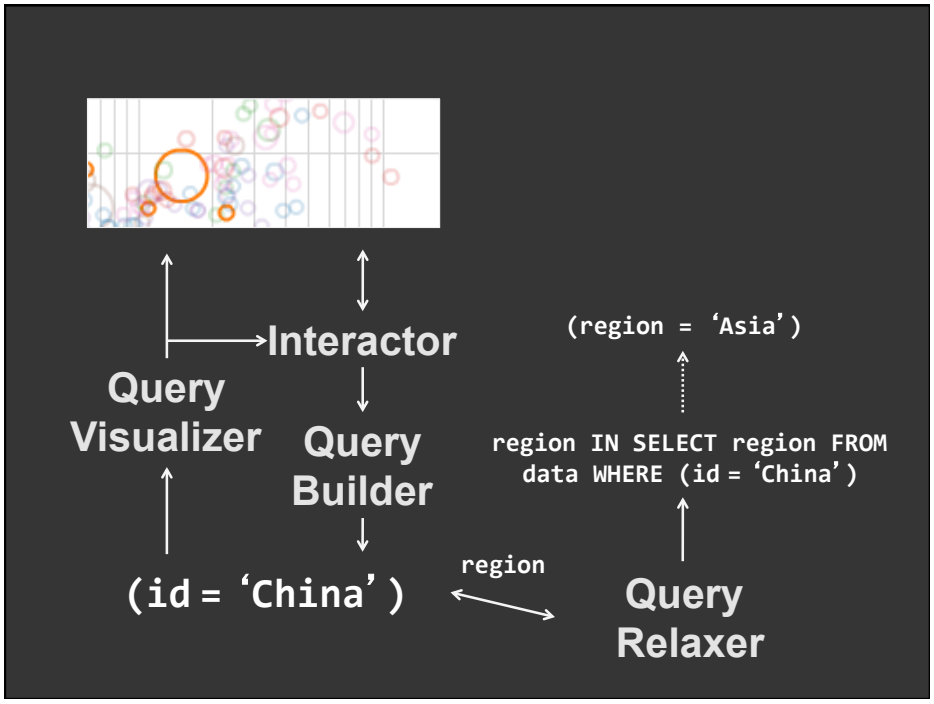
Legend: Select Attributes

(region = 'The Americas')




Interactor
Query Visualizer
Query Builder
(id = 'China')

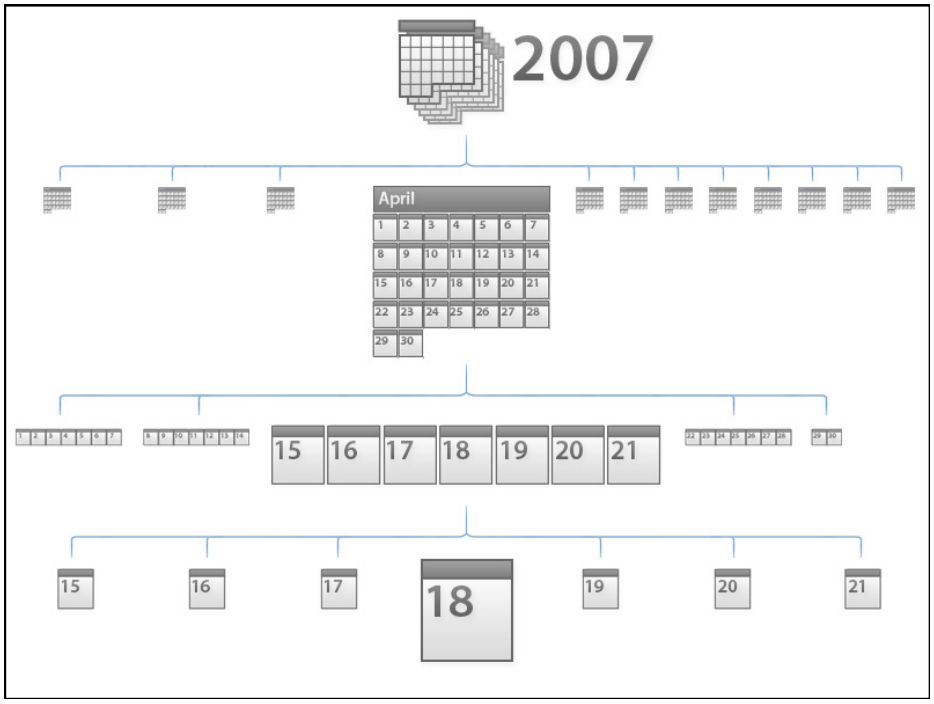

Interactor
Query Visualizer
Query Builder
(id = 'China')
Query Relaxer



Query Relaxation

Generalize an input query to create an expanded selection, according to:

1. A semantic structure describing the data
2. A traversal policy for that structure

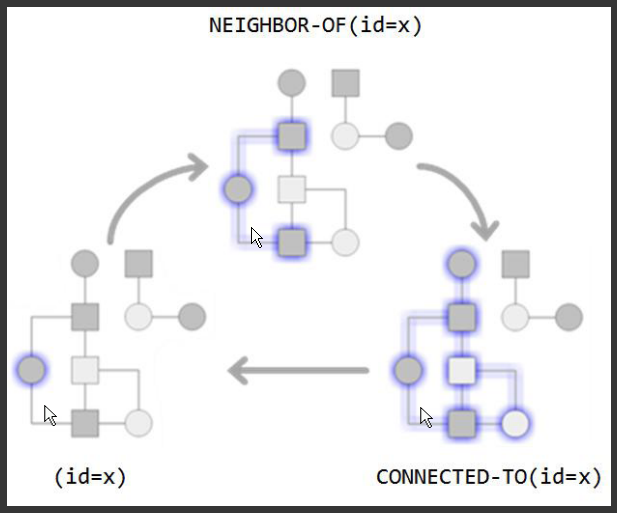


Relaxation using Hierarchies

Relax using abstraction hierarchies of the data
Traverse in direction of increasing generality

Examples
A Priori: Calendar, Categories, Geography
Data-Driven: Nearest-Neighbor, Clustering

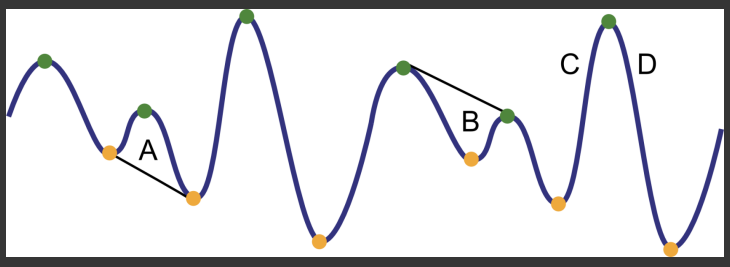
Relaxation of Networks



Lesson

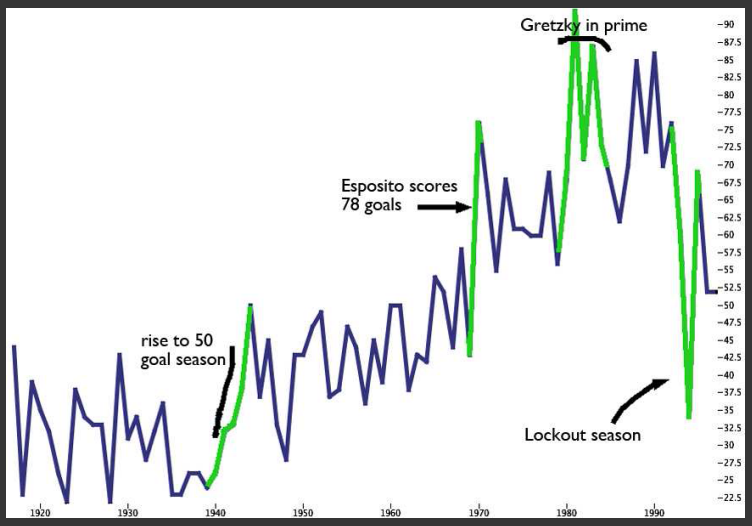
Consider how the structure and/or semantics of the data might be leveraged to aid analysis

Extension: look beyond data features to incorporate perceptual features of the display



Peaks, valleys, & slopes

Perceptual Annotation [Kong & Agrawala 09]



Other Input Modalities

Multi-touch

- Tables, wall displays, tablets, whiteboards
- Does is facilitate visual analysis?
- What affordances are gained/lost?

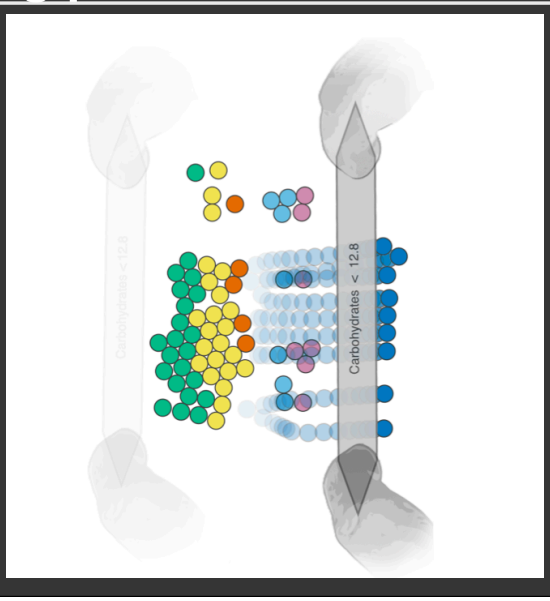
Kinetica

Kinetica

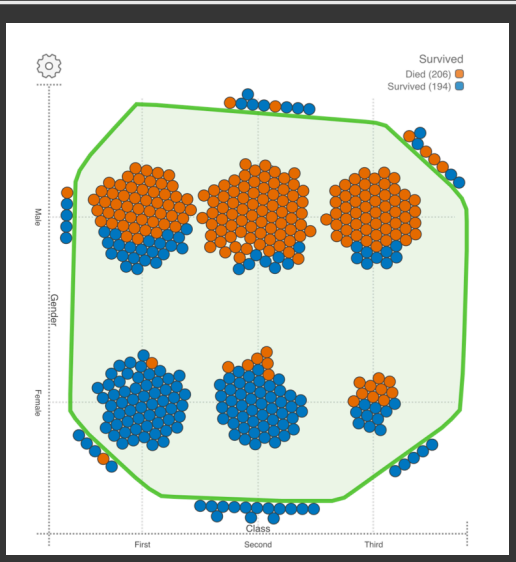
Naturalistic Multi-touch Data Visualization

Jeffrey M. Rzeszotarski, Aniket Kittur
Human-Computer Interaction Institute
Carnegie Mellon University

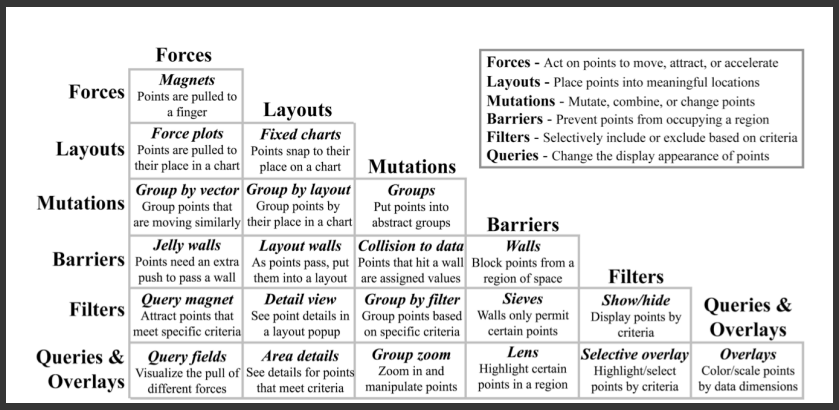
Filtering points



Filtering points



Framework



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