HCI and Design

SPRING 2016

Topics for today

Visualization principles

Visualization design

Tools for visualization

What is Information Visualization?

"Transformation of the symbolic into the geometric"

(McCormick et al., 1987)

The depiction of information using spatial or graphical representations, to facilitate comparison, pattern recognition, change detection, and other cognitive skills by making use of the visual system.

i.e. To help: explore, calculate, communicate, decorate

Information Visualization

Problem:

- HUGE Datasets: How to understand them?

Solution

- Take better advantage of human perceptual system
- Convert information into a graphical representation.

Issues

- How to convert abstract information into graphical form?
- Do visualizations do a better job than other methods?

Set A		Set B		Set C		Set D	
X	Y	X	Y	X	Y	X	Y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	19	12.5
12	10.84	12	9.11	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89

Summary Statistics

$u_X = 9.0$ $\sigma_X = 3.317$

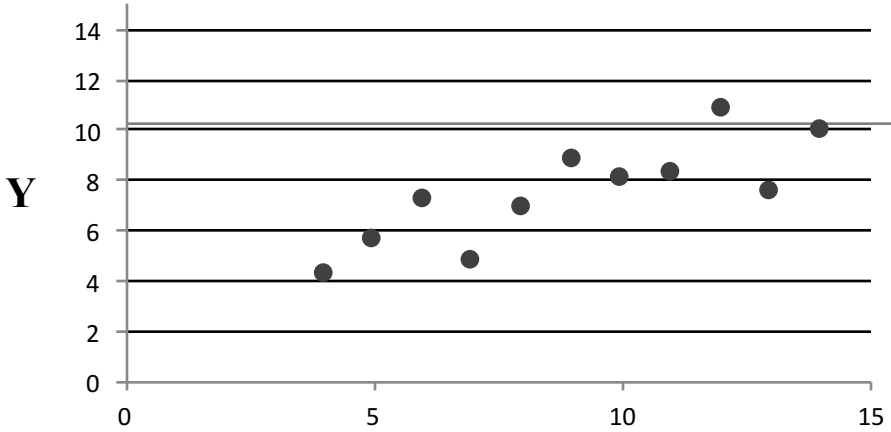
$u_Y = 7.5$ $\sigma_Y = 2.03$

Linear Regression

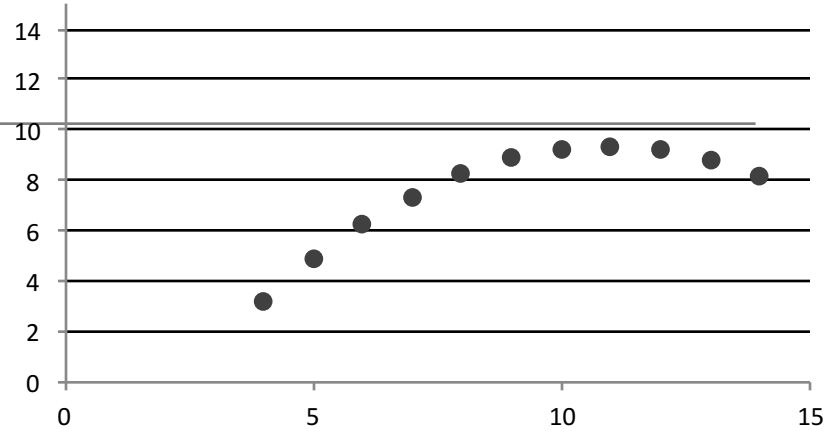
$Y^2 = 3 + 0.5\ X$

$R^2 = 0.67$

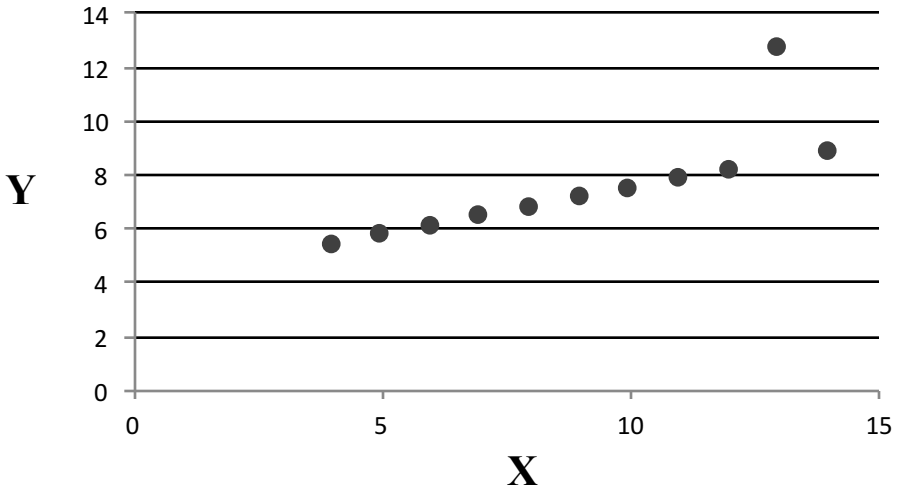
Set A



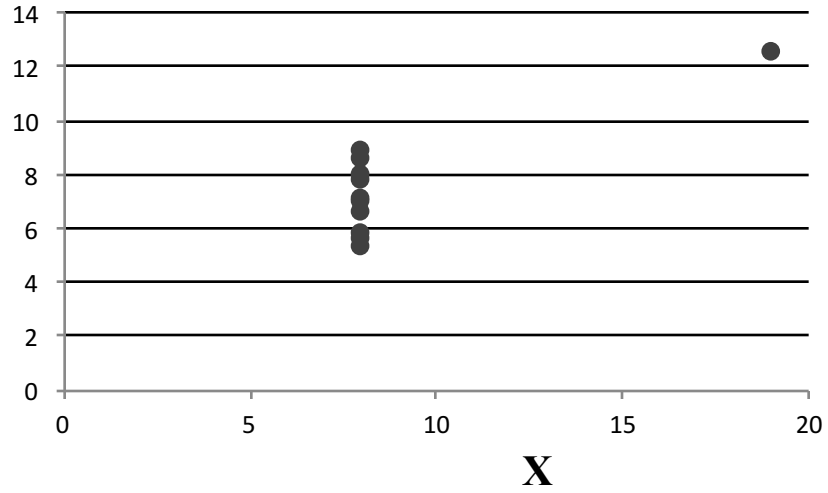
Set B



Set C



Set D



Which state has highest Income?

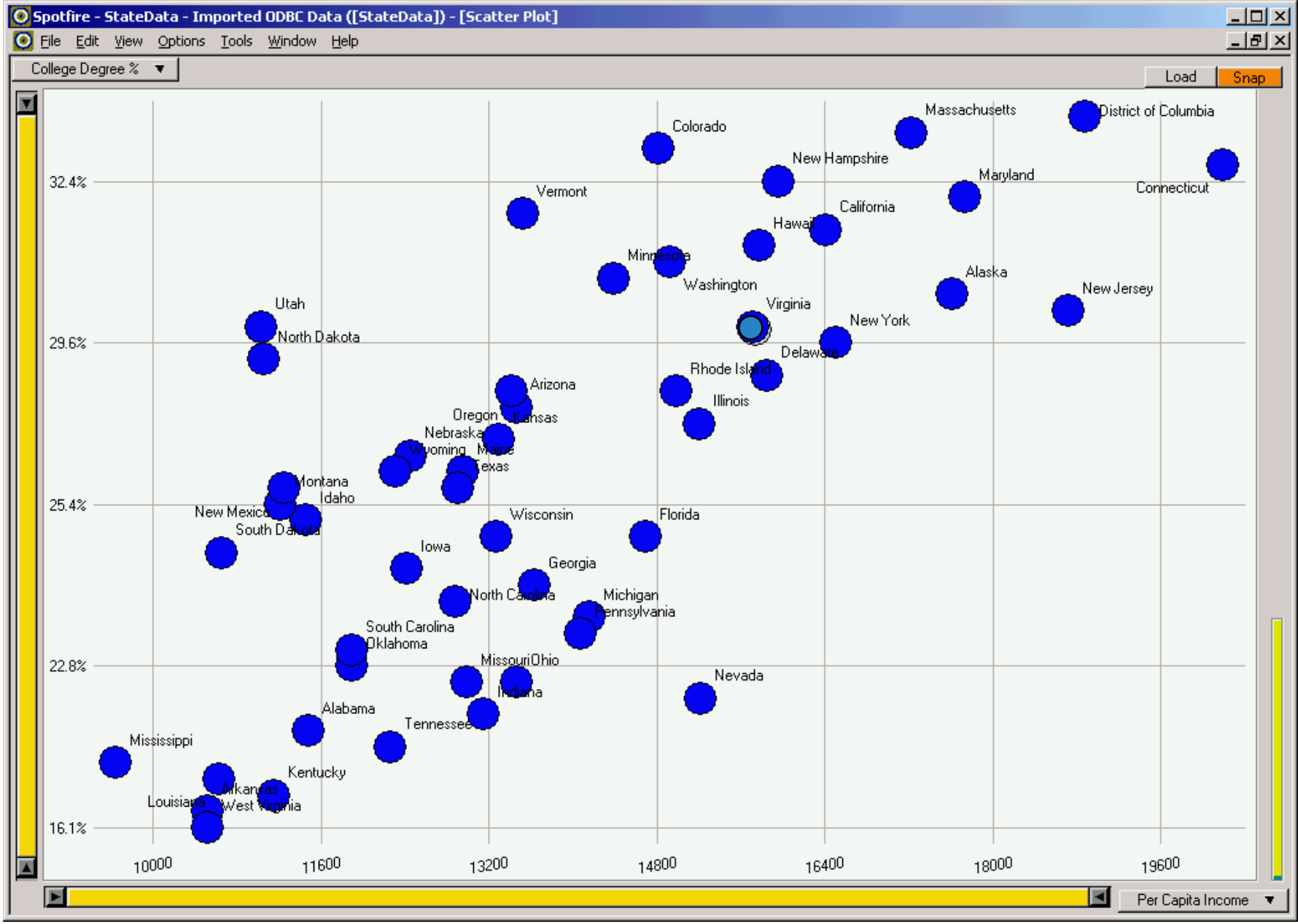
Relationship between Income and Education?

Outliers?

Table - StateData ()

Load | Snap

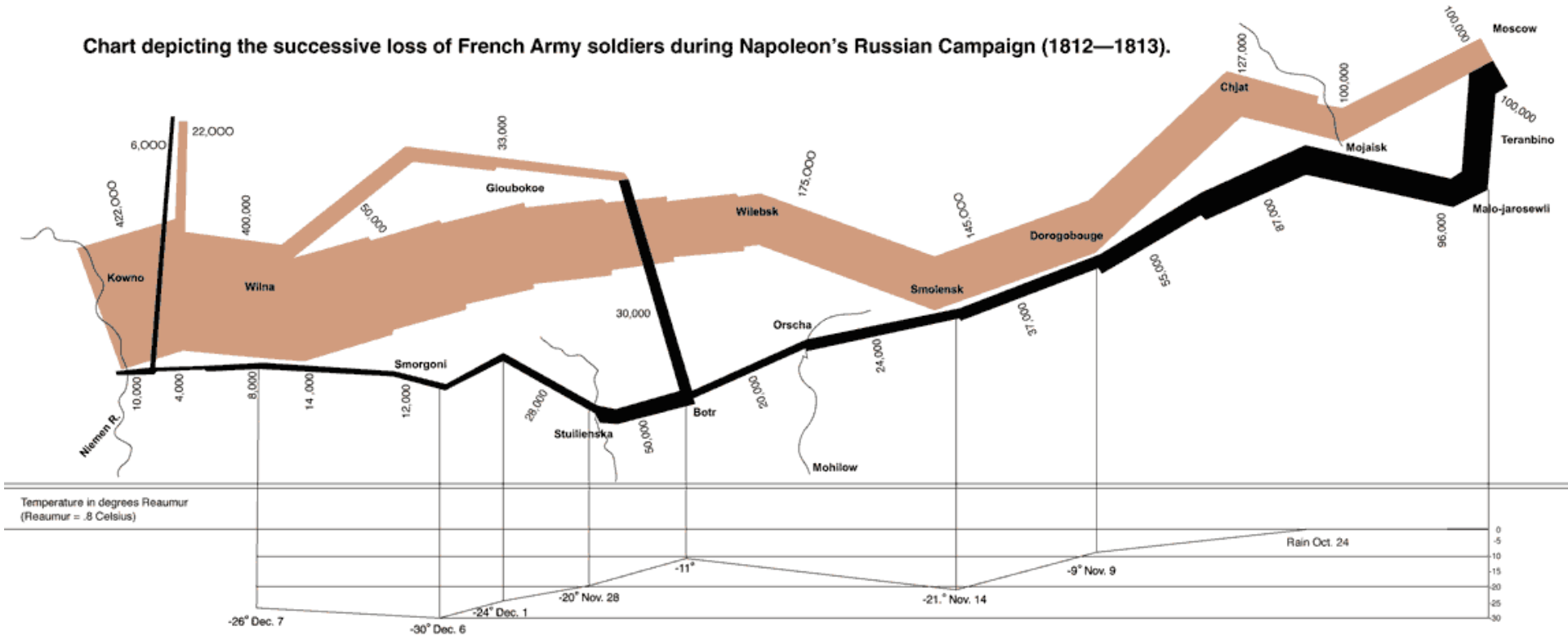
State	College Degree %	Per Capita Income
Alabama	20.6%	11486
Alaska	30.3%	17610
Arizona	27.1%	13461
Arkansas	17.0%	10520
California	31.3%	16409
Colorado	33.9%	14821
Connecticut	33.8%	20189
Delaware	27.9%	15854
District of Columbia	36.4%	18881
Florida	24.9%	14698
Georgia	24.3%	13631
Hawaii	31.2%	15770
Idaho	25.2%	11457
Illinois	26.8%	15201
Indiana	20.9%	13149
Iowa	24.5%	12422
Kansas	26.5%	13300
Kentucky	17.7%	11153
Louisiana	19.4%	10635
Maine	25.7%	12957
Maryland	31.7%	17730
Massachusetts	34.5%	17224
Michigan	24.1%	14154
Minnesota	30.4%	14389
Mississippi	19.9%	9648
Missouri	22.3%	12989
Montana	25.4%	11213
Nebraska	26.0%	12452
Nevada	21.5%	15214
New Hampshire	32.4%	15959
New Jersey	30.1%	18714
New Mexico	25.5%	11246
New York	29.6%	16501
North Carolina	24.2%	12885
North Dakota	28.1%	11051
Ohio	22.3%	13461
Oklahoma	22.8%	11893
Oregon	27.5%	13418
Pennsylvania	23.2%	14068
Rhode Island	27.5%	14981
South Carolina	23.0%	11897
South Dakota	24.6%	10661
Tennessee	20.1%	12255
Texas	25.5%	12904
Utah	30.0%	11029
Vermont	31.5%	13527
Virginia	30.0%	15713
Washington	30.9%	14923
West Virginia	16.1%	10520
Wisconsin	24.9%	13276
Wyoming	25.7%	12311



College Degree %

Per Capita Income

Napolean's March



Two Different Primary Goals: Two Different Types of Viz

Explore/Calculate

Analyze

Reason about Information

Communicate

Explain

Make Decisions

Reason about Information

A Key Question

How do we

Convert abstract information into a visual representation

While still preserving the underlying meaning

And at the same time providing new insight?

Goals of Information Visualization

More specifically, a visualization should:

- Make large datasets coherent
  - (Present huge amounts of information compactly)
- Present information from various viewpoints
- Present information at several levels of detail
  - (from overviews to fine structure)
- Support visual comparisons
- *Tell stories about the data*

How to create visualizations

Use the eye for pattern recognition; people are good at
- scanning
- recognizing
- remembering images

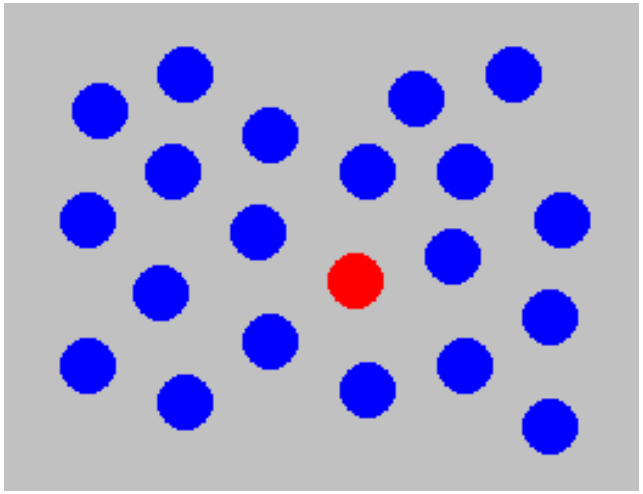
Graphical elements facilitate comparisons via
- length
- shape
- orientation
- texture

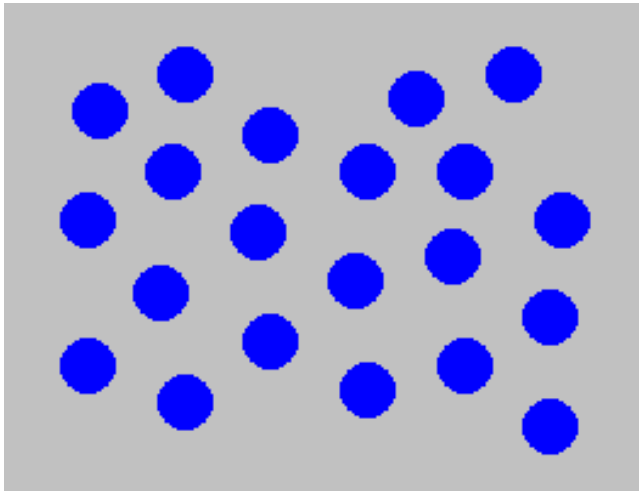
Animation shows changes across time

Color helps make distinctions

Aesthetics make the process appealing

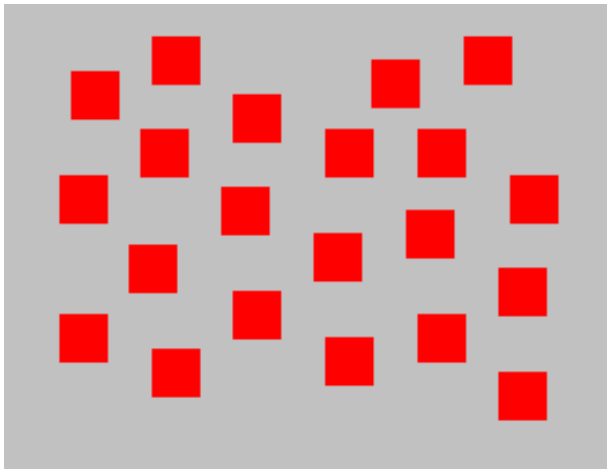
Example: Color Selection

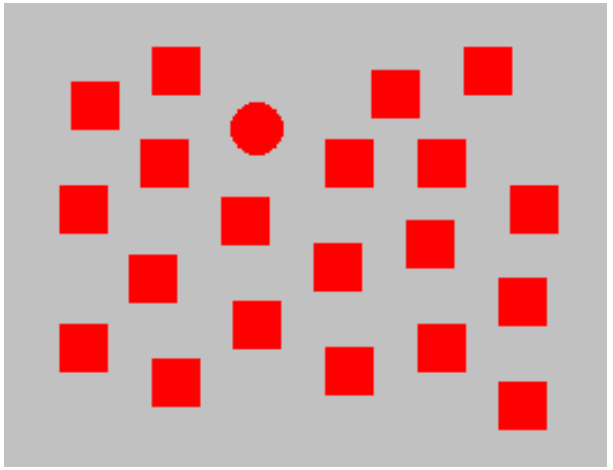




Viewer can rapidly and accurately determine
whether the target (red circle) is present or absent.
Difference detected in color.

Example: Shape Selection

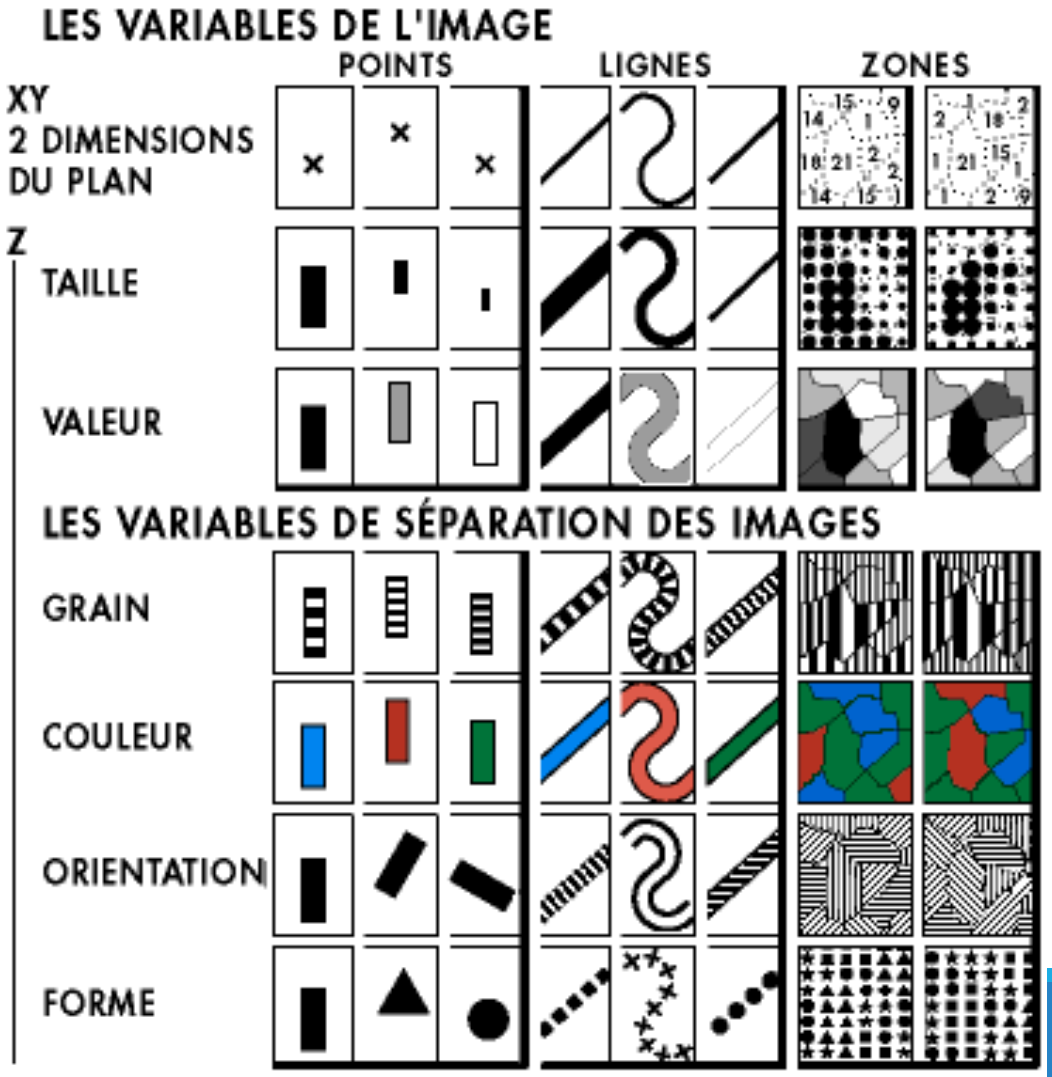




Viewer can rapidly and accurately determine
whether the target (red circle) is present or absent.
Difference detected in form (curvature)

Visual encoding variables

Position (x2)
Length
Area
Volume
Value
Texture
Color
Orientation
Shape
Transparency
Blur / Focus …



More on Design....

Midway Reports

Are graded.

Link to feedback and grade in the google spreadsheet that you used to submit your reports.

Assignment 4

Is posted!

You have 1.5 weeks

Start now. *It will take longer than you think.*

Keep it simple.

- Choose a minimal set of visualizations/interactions that enables you to tell a story.

Keep the design clean.

Promote engagement.

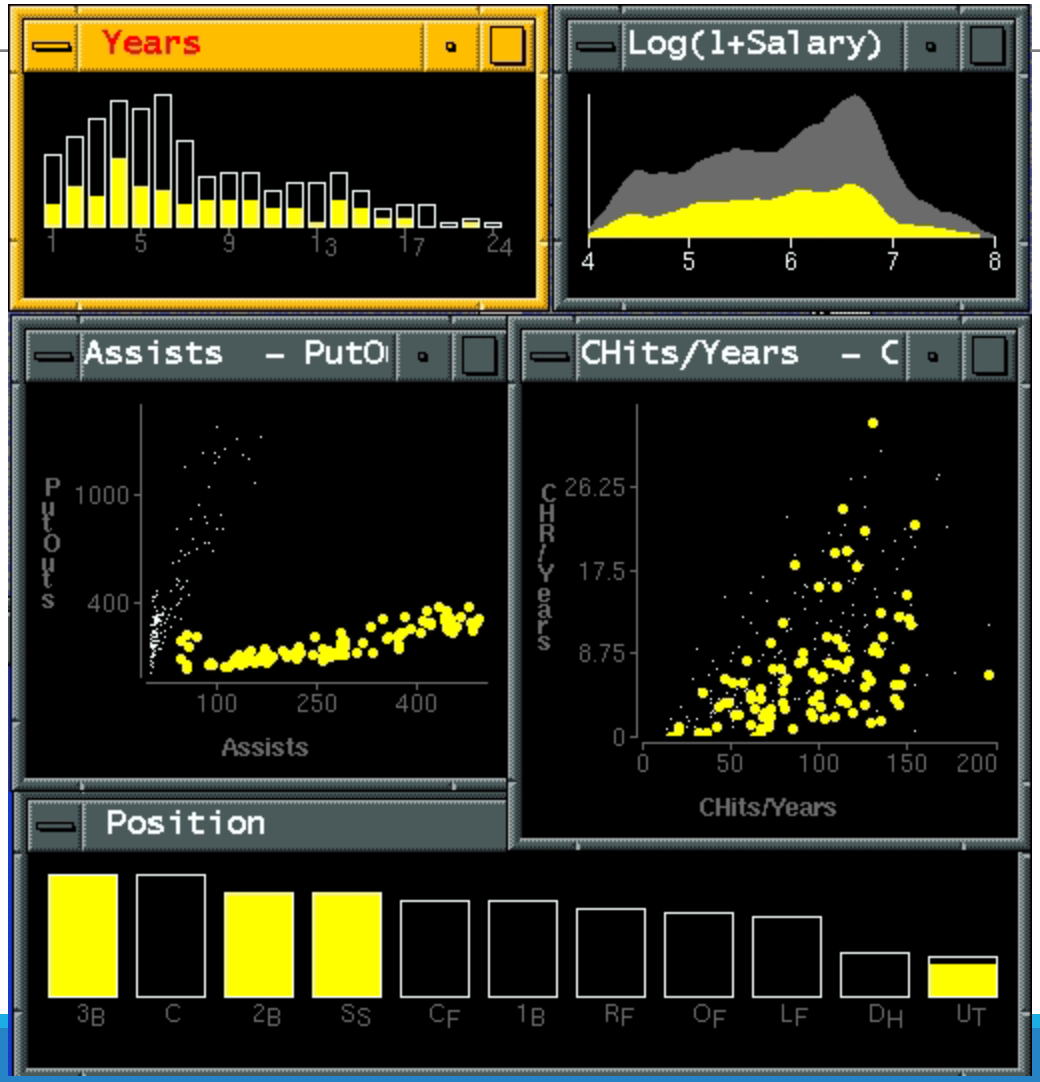
- How do your chosen visualization(s) tell a story?

Telling Stories with Data

Key questions to ask about a visualization:

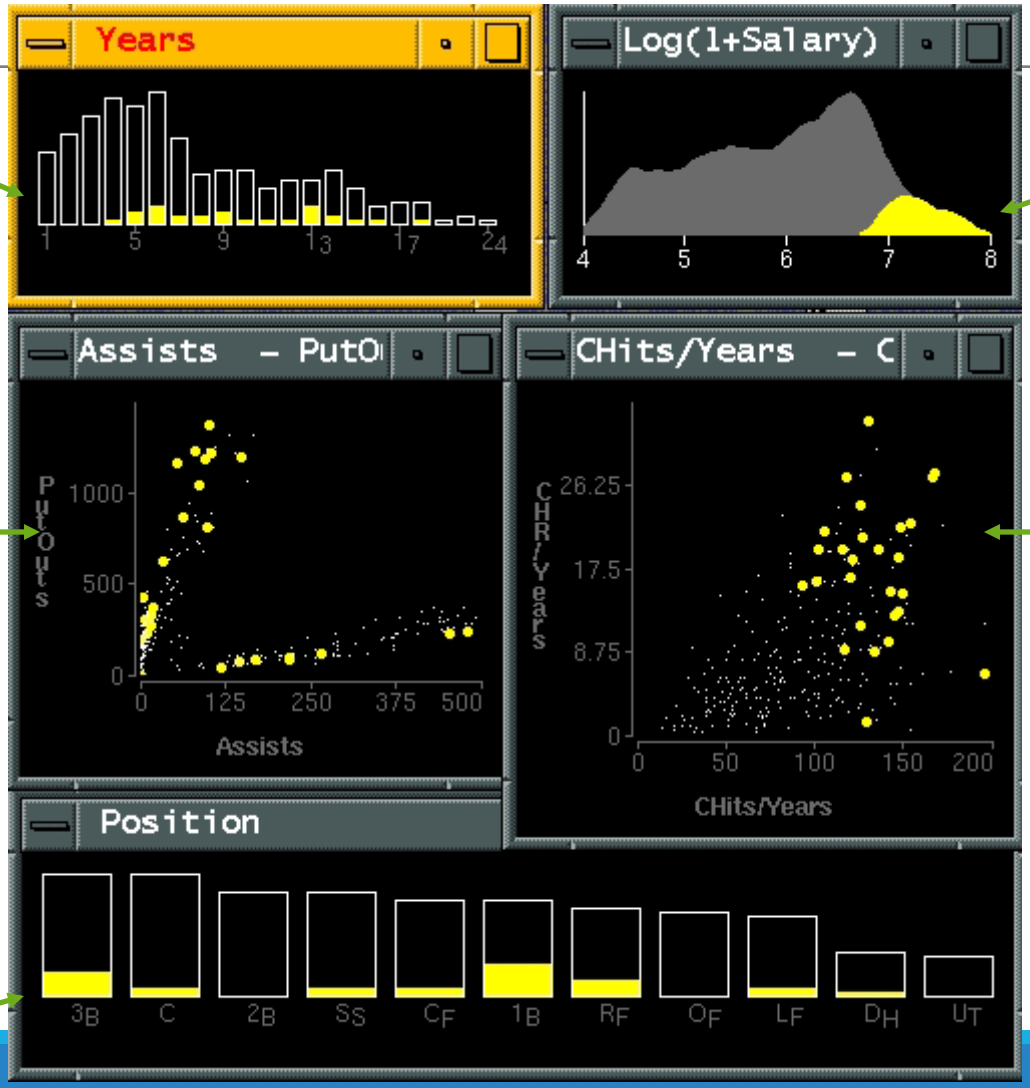
1. What does it teach/show/elucidate?
2. What is the key contribution?
3. What are some compelling, *useful* examples?
4. Could it have been done more simply?
5. Have there been usability studies done? What do they show?

Example: Linking types of assist behavior to position played (from Eick & Wills)



Baseball data: Scatterplots and histograms and bars (from Eick & Wills)

how long in majors



select high salaries

avg assists vs avg putouts (fielding ability)

avg career HRs vs avg career hits (batting ability)

distribution of positions played

What was learned from interaction with this baseball data?

- Seems impossible to earn a high salary in the first three years
- High salaried players have a bimodal distribution (peaking around 7 & 13 yrs)
- Hits/Year a better indicator of salary than HR/Year
- High paid outlier with low HR and medium hits/year. Reason: person is player-coach
- There seem to be two differentiated groups in the put-outs/assists category (but not correlated with salary) Why?

High-level Design Goals for Information Visualization

- Tailor to the application and the domain
- Create highly interactive and integrated systems
- Embed the visualization within a larger application
- Provide alternative views

Low(er)-Level Tasks for Information Visualization

- Tasks:
  - Overview
  - Zoom
  - Filter
  - Details-on-demand

Other good guidelines for visualizations

Use graphics appropriately

- Don’t use images gratuitously
- Don’t lie with graphics!
  - Link to original data
- Don’t conflate area with other information
  - e.g., use area in map to imply amount

Make it interactive (feedback)

- Brushing and linking
- Multiple views
- Overview + details

Match mental models

Tools for creating visualizations

There are many….

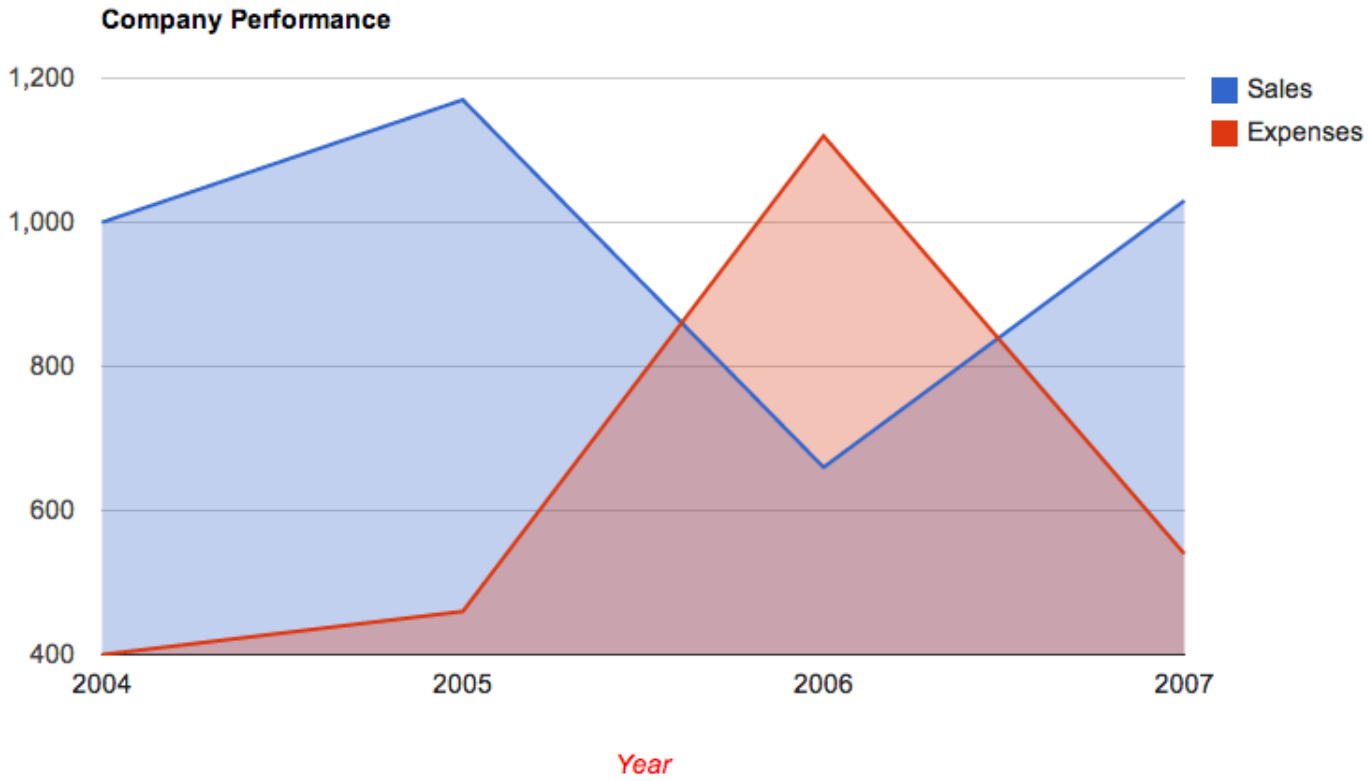
I've put some on the class website:

http://nixdell.com/classes/HCI-and-Design-Spring-2016/Resources.html

Feel free to post any others you know/use on the Slack channel for the class to share ☺

Google Chart API

http://code.google.com/apis/chart/interactive/docs/gallery.html



Tableau

http://www.tableau.com

Designed to be accessible for non-programmers

Drag and drop style

Tableau Desktop
(free for students I think)

Tableau public (free)

D3.js

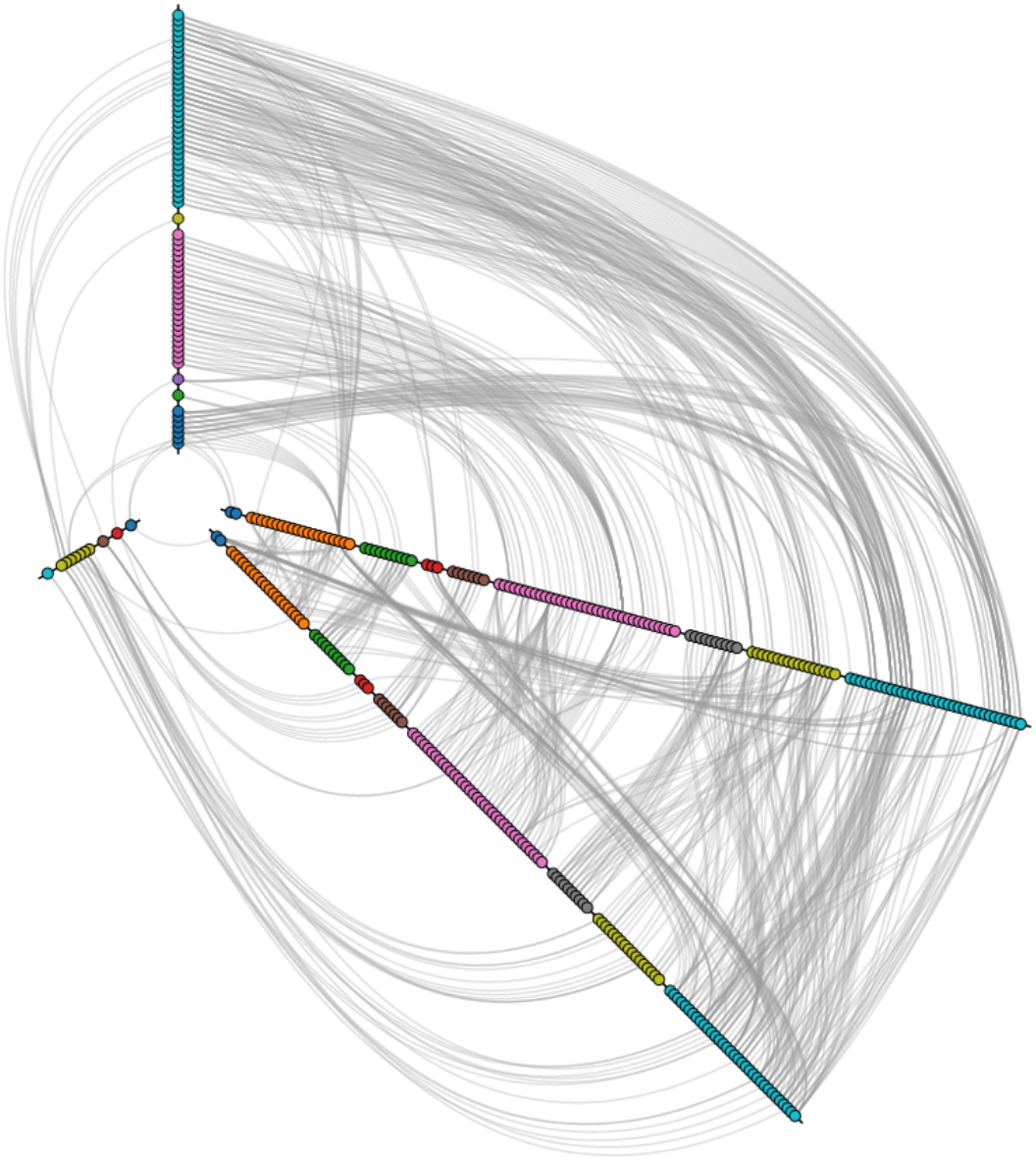
Data Driven Documents

http://d3js.org/

Javascript library

Available on Github

Bind data to DOM



Next time

Usable security and privacy