Perception

Maneesh Agrawala

CS 294-10: Visualization
Fall 2007

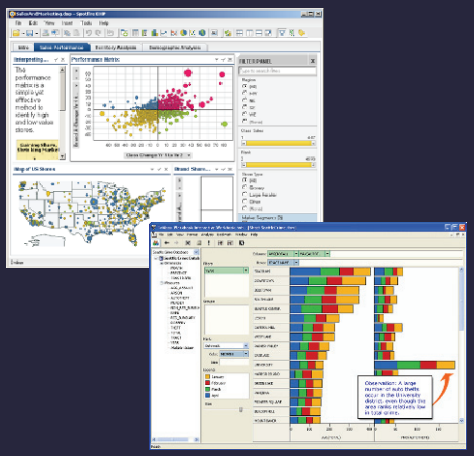
Assignment 2: Creating Visualizations

Use existing software to formulate & answer questions

First steps
- Step 1: Pick a domain
- Step 2: Pose question
- Step 3: Find data
- May need to iterate

Create visualization
- Interact with data
- Question will evolve
- Tableau or Spotfire DXP

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



Due before class on Sep 24, 2007

Data and Image Models

Combinatorics of encodings

Challenge:

Pick the best encoding from the exponential number of possibilities n^8

Principle of Consistency:

The properties of the image (visual variables) should match the properties of the data

Principle of Importance Ordering:

Encode the most important information in the most effective way

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Combinatorics of encodings

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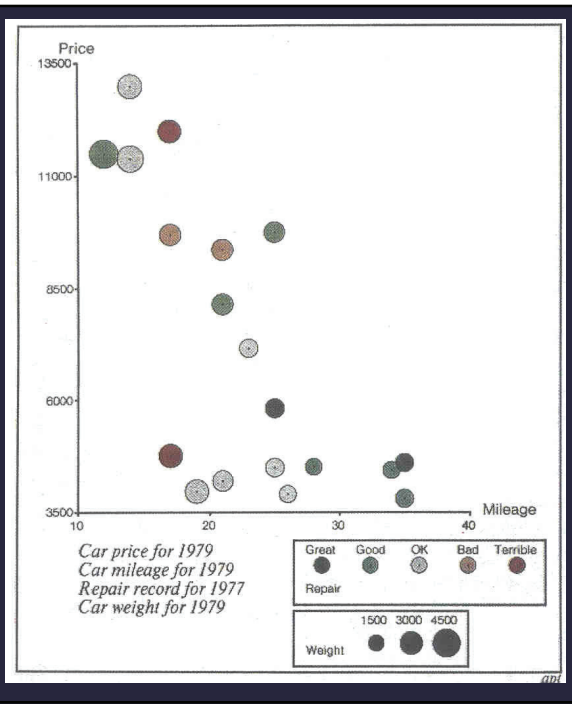
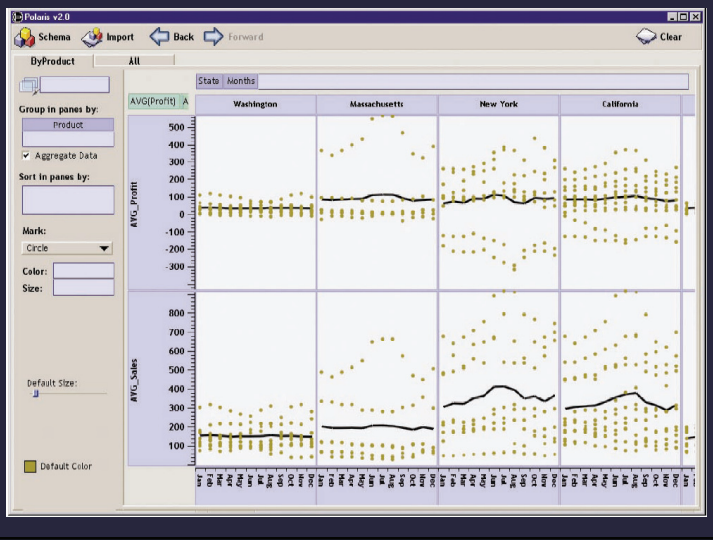


[Mackinlay, APT, 1986]

Visualization Software

Tableau

Research at Stanford: “Polaris” by Stolte and Hanrahan.



Tableau

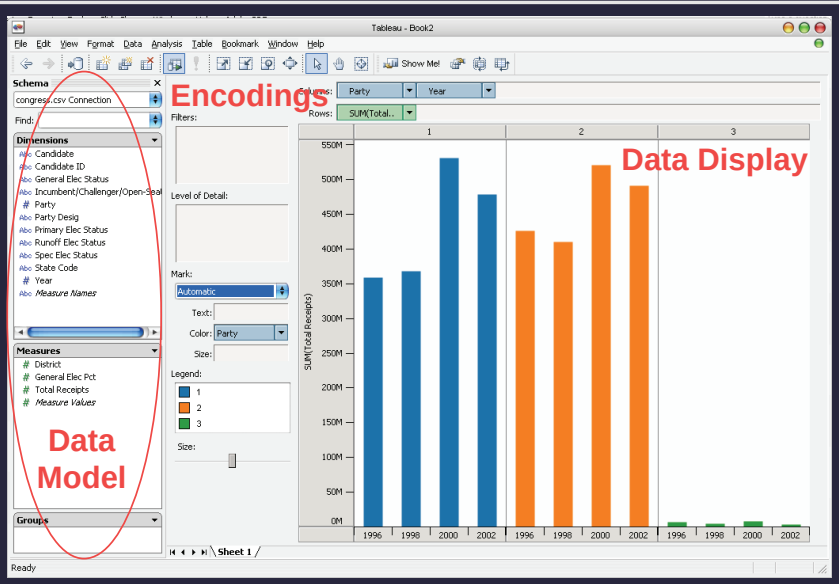


Tableau demo

The dataset:

- Federal Elections Commission Receipts
- Every Congressional Candidate from 1996 to 2002
- 4 Election Cycles
- 9216 Candidacies

Data Set Schema

- Year (Qi)
- Candidate Code (N)
- Candidate Name (N)
- Incumbent / Challenger / Open-Seat (N)
- Party Code (N) [1=Dem,2=Rep,3=Other]
- Party Name (N)
- Total Receipts (Qr)
- State (N)
- District (N)

- This is a subset of the larger data set available from the FEC, but should be sufficient for the demo

Hypotheses?

What might we learn from this data?

Hypotheses?

What might we learn from this data?

- Has spending increased over time?
- Do democrats or republicans spend more money?
- Candidates from which state spend the most money?

Perception

Mackinlay's ranking of encodings

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Val)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Val)
Density (Val)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

Detection

Detecting brightness

Which is brighter?

Detecting brightness

(128, 128, 128)

(144, 144, 144)

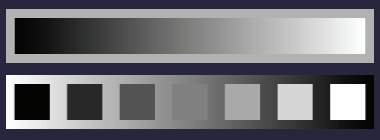
Which is brighter?

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

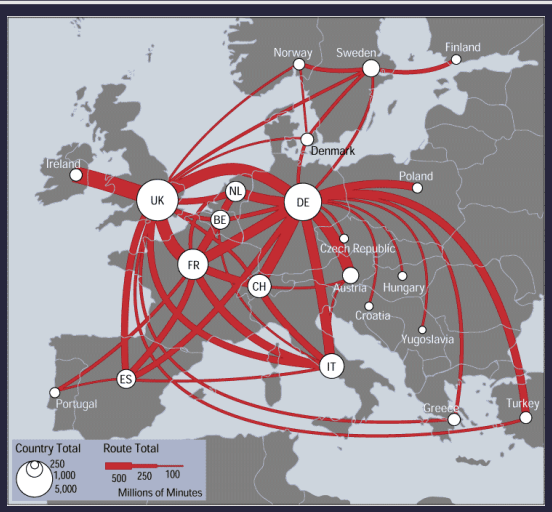


Steps in font size

Sizes standardized in 16th century

a a a a a a a a a a a a a a a a a a
6 7 8 9 10 11 12 14 16 18 21 24 36 48 60 72

Steps in line width



http://mappa.mundi.net/maps/maps_014/telegeography.html

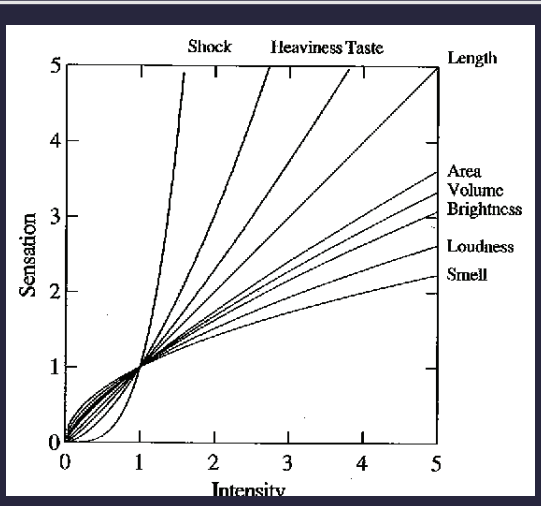
[based on slide from Munzner]

Estimating Magnitude

Steven's power law

$$S = I^p$$

p < 1 : underestimate
p > 1 : overestimate

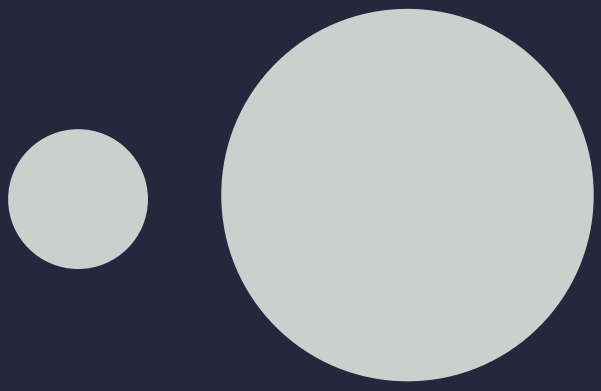


[graph from Wilkinson 99, based on Stevens 61]

Exponents of power law

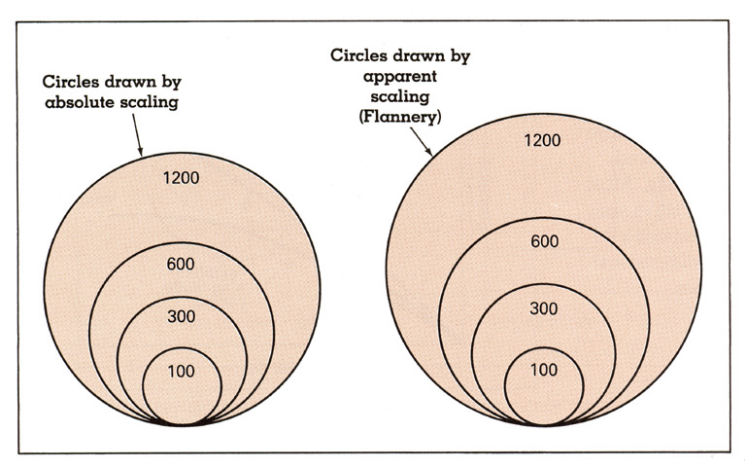
Sensation	Exponent
Loudness	0.6
Brightness	0.33
Smell	0.55 (Coffee) - 0.6 (Heptane)
Taste	0.6 (Saccharine) -1.3 (Salt)
Temperature	1.0 (Cold) – 1.6 (Warm)
Vibration	0.6 (250 Hz) – 0.95 (60 Hz)
Duration	1.1
Pressure	1.1
Heaviness	1.45
Electic Shock	3.5

[Psychophysics of Sensory Function, Stevens 61]



Compare area of circles

Apparent magnitude scaling

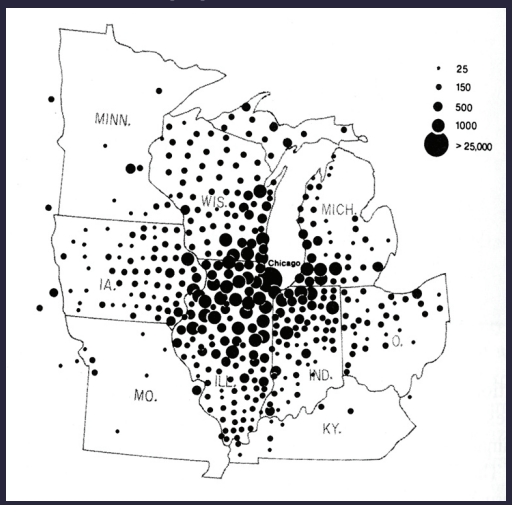


[Cartography: Thematic Map Design, Figure 8.6, p. 170, Dent, 96]

$S = 0.98A^{0.87}$ [from Flannery 71]

Proportional symbol map

Newspaper Circulation



[Cartography: Thematic Map Design, Figure 8.8, p. 172, Dent, 96]

Graduated sphere map

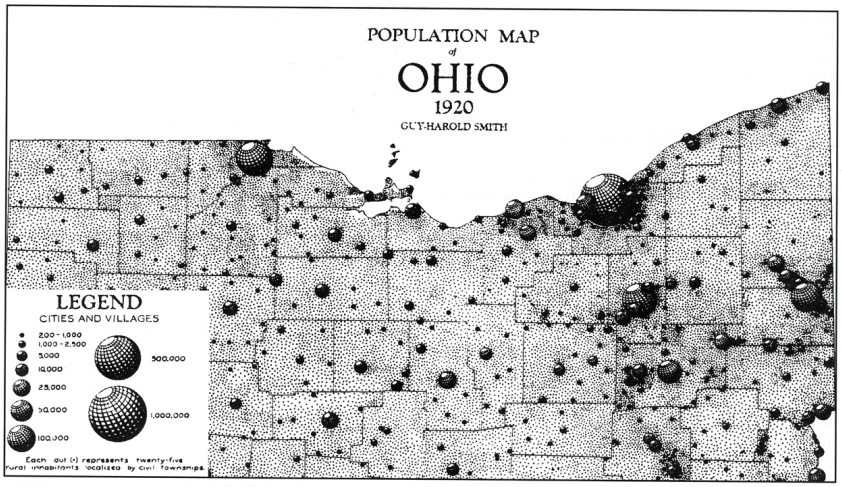


FIGURE 7.4. An eye-catching map created using three-dimensional geometric symbols. (After Smith, 1928. First published in *The Geographical Review,* 18(3), plate 4. Reprinted with permission of the American Geographical Society.)

Cleveland and McGill

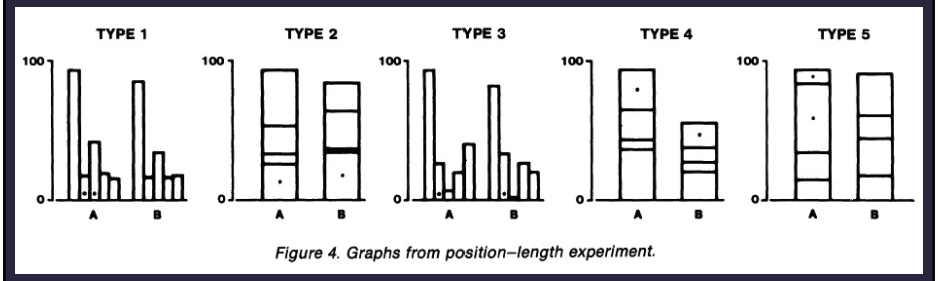


Figure 4. Graphs from position–length experiment.

[Cleveland and McGill 84]

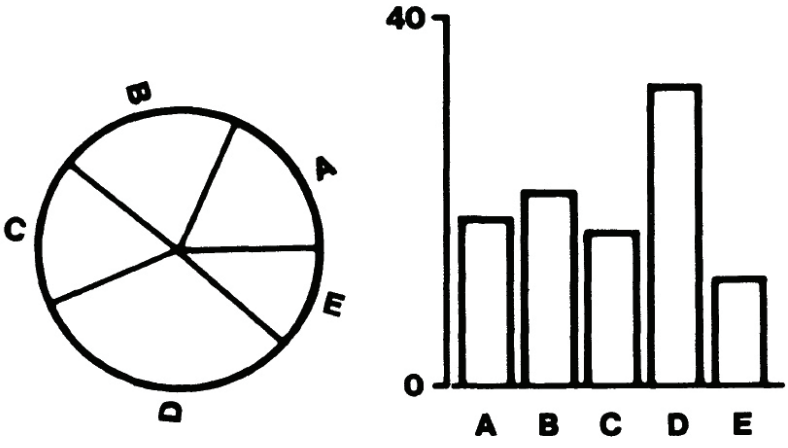


Figure 3. Graphs from position–angle experiment.

[Cleveland and McGill 84]

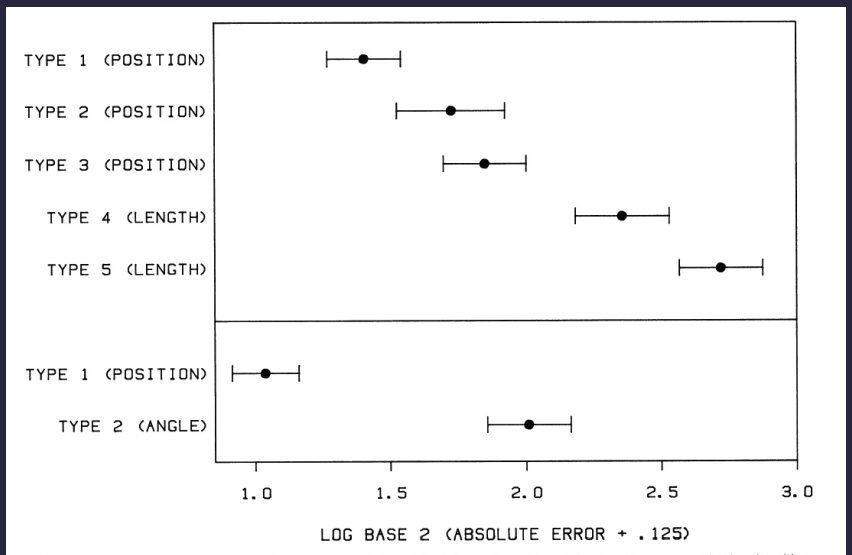


Figure 16. Log absolute error means and 95% confidence intervals for judgment types in position–length experiment (top) and position–angle experiment (bottom).

[Cleveland and McGill 84]