Interaction

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CS 294-10: Visualization
Fall 2014

Last Time: Perception
Layering and Small Multiples

Layering: Gridlines

Signal and background compete above, as an electrocardiogram trace-line becomes caught up in a thick grid. Below, the screened-down grid stays behind traces from each of 12 monitoring leads.

Electrocardiogram tracelines [from Tufte 90]
Layering: Gridlines

Stravinsky score [from Tufte 90]

Setting Gridline Contrast

How light can gridlines be and remain visible?  
How dark can gridlines be and not distract?

Safe setting:  
20% Alpha  
[Stone & Bartram 2009]
Layering: Color and line width

IBM Series III Copier [from Tufte 90]

Small multiples

[Figure 2.11, p. 38, MacEachren 95]
Small multiples

Operating trains. Redrawn by Tufte to emphasize colored lights. [from Tufte 90]

Change blindness

[Example from Palmer 99, originally due to Rock]
Change detection
Choosing effective visual encodings requires knowledge of visual perception.

**Visual features/attributes**
- Individual attributes often preattentive
- Multiple attributes may be separable, often integral

**Gestalt principles provide higher level design guidelines**

*We don’t always see everything that is there*
Announcements

Assignment 2: Exploratory Data Analysis

Use existing software to formulate & answer questions

First steps
- Step 1: Pick a domain
- Step 2: Pose questions
- Step 3: Find data
- Iterate

Create visualizations
- Interact with data
- Question will evolve
- Tableau

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

Due before class on Sep 29, 2014
Interaction

Gulfs of execution & evaluation

Gulfs

Evaluation

Conceptual model

Real world

Execution

[Norman 1986]
**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]
Gulf of evaluation

Real world:

Conceptual model:
x, y correlated?

Evaluation

Gulf

ρ = -.29
Gulf of execution

Conceptual model:
Draw a scatterplot

Real world

Move 90 30
Rotate 35
Pen down
...

Execution

Gulf of execution

Conceptual model:
Draw a scatterplot

Real world

Execution
Topics

Early interactive systems
Brushing and linking
Dynamic queries
Generalized selections

Early Systems
[Graphics and Graphic Information Processing, Bertin 81]
PRIM-9, Tukey, Fisherkeller, Friedman 1972
Pointing

Basic Pointing Methods

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

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

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

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

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

Brushing Scatterplots, Becker & Cleveland 1982
Baseball statistics [from Wills 95]

- how long in majors
- avg assists vs avg putouts (fielding ability)
- distribution of positions played
- select high salaries
- avg career HRs vs avg career hits (batting ability)

Linking assists to positions
GGobi: Brushing

http://www.ggobi.org/

Dynamic Queries
Query and results

```sql
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
HomeFinder

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
FilmFinder

[Ahlberg and Schneiderman 93]

FilmFinder

[Ahlberg and Schneiderman 93]
Alphaslider

Title: Moonstruck

FilmFinder

[Witches of Eastwick, The
Director: George Miller
Country: USA
Year: 1987
Language: English
Actors: Cher, Susan Sarandon, Richard Dreyfuss, Jack Nicholson, Bette Midler, Jane Curtin, Verna

[Ahlberg and Schneiderman 93]
Attribute explorer [Spence and Tweedie 98]

Zipdecode [from Fry 04]

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

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

[http://www.babynamewizard.com/voyager](http://www.babynamewizard.com/voyager)

**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]
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?