Interaction

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CS 294-10: Visualization
Spring 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
Interaction

**Gulfs of execution & evaluation**

- Conceptual model
- Real world
- Evaluation
- Execution

[Norman 1986]
Gulf of evaluation

Real world:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>0.07</td>
<td>0.79</td>
</tr>
<tr>
<td>0.32</td>
<td>0.63</td>
</tr>
<tr>
<td>0.39</td>
<td>0.72</td>
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<tr>
<td>0.27</td>
<td>0.65</td>
</tr>
<tr>
<td>0.71</td>
<td>0.43</td>
</tr>
<tr>
<td>0.63</td>
<td>0.09</td>
</tr>
<tr>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>0.20</td>
<td>0.34</td>
</tr>
<tr>
<td>0.51</td>
<td>0.38</td>
</tr>
<tr>
<td>0.11</td>
<td>0.33</td>
</tr>
<tr>
<td>0.46</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Gulf of evaluation

Real world:

![Scatter plot with data points]

Conceptual model: x,y correlated?
Gulf of evaluation

- Conceptual model: $x, y$ correlated?
- Evaluation

\[ \rho = -0.29 \]

Real world:

Gulf of execution

- Conceptual model: Draw a scatterplot
- Execution

Real world:

- Move 90 30
- Rotate 35
- Pen down
- ...
Gulf of execution

Conceptual model:
Draw a scatterplot

Execution

Real world

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]

[www.sims.berkeley.edu/courses/is247/s02/lectures/Lecture3.ppt]
Brushing

- 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]

- 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)

[www.sims.berkeley.edu/courses/is247/s02/lectures/Lecture3.ppt]
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
```

<table>
<thead>
<tr>
<th>Number</th>
<th>House</th>
<th>Detailed Address</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>House</td>
<td>5056 E. Capital St</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>4</td>
<td>House</td>
<td>5556 E. Lincoln St</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>5</td>
<td>House</td>
<td>5165 James Street</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>8</td>
<td>House</td>
<td>4070 James Street</td>
<td>Beltsville, MD</td>
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<tr>
<td>9</td>
<td>House</td>
<td>4670 James Street</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>11</td>
<td>House</td>
<td>5466 E. Capital St</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>12</td>
<td>House</td>
<td>5406 E. Capital St</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>20</td>
<td>House</td>
<td>5406 E. Capital St</td>
<td>Beltsville, MD</td>
</tr>
<tr>
<td>25</td>
<td>Condo</td>
<td>5406 E. Lincoln St</td>
<td>Laurel, MD</td>
</tr>
<tr>
<td>26</td>
<td>Condo</td>
<td>5001 E. Lincoln St</td>
<td>Laurel, MD</td>
</tr>
<tr>
<td>29</td>
<td>Condo</td>
<td>5105 Hamilton Street</td>
<td>Laurel, MD</td>
</tr>
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<td>32</td>
<td>Condo</td>
<td>5025 E. Lincoln St</td>
<td>Laurel, MD</td>
</tr>
<tr>
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<tr>
<td>35</td>
<td>Condo</td>
<td>4999 James Street</td>
<td>Laurel, MD</td>
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<td>Condo</td>
<td>4677 James Street</td>
<td>Laurel, MD</td>
</tr>
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<td>Condo</td>
<td>4699 E. Capital St</td>
<td>Laurel, MD</td>
</tr>
<tr>
<td>49</td>
<td>Condo</td>
<td>5009 E. Capital St</td>
<td>Laurel, MD</td>
</tr>
<tr>
<td>50</td>
<td>Condo</td>
<td>5006 E. Capital St</td>
<td>Laurel, MD</td>
</tr>
<tr>
<td>51</td>
<td>Condo</td>
<td>5002 E. Lincoln St</td>
<td>Laurel, MD</td>
</tr>
</tbody>
</table>
```
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

[Image of HomeFinder interface with text: 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

[Alphaslider]

[Ahlberg and Schneiderman 94]
FilmFinder

[Ahlberg and Schneiderman 93]

FilmFinder

[Ahlberg and Schneiderman 93]
FilmFinder

[Ahlberg and Schneiderman 93]

Cellphones

http://www.myrateplan.com/cellphones/
Zipdecode [from Fry 04]

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

Attribute explorer [Spence and Tweedie 98]

Video Clip
**TimeSearcher** [Hochheiser & Schneiderman 02]

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

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

(a)  
(b)  
(c)  
(d)
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

![Table](image)

[Graphics and Graphic Information Processing, Bertin 81]
[Graphics and Graphic Information Processing, Bertin 81]

<table>
<thead>
<tr>
<th>因素</th>
<th>解释</th>
</tr>
</thead>
<tbody>
<tr>
<td>% 占用率</td>
<td>活跃和慢淡季</td>
</tr>
<tr>
<td>平均停留时间</td>
<td>DISCOVERY FACTORS</td>
</tr>
<tr>
<td>会议和展览</td>
<td></td>
</tr>
<tr>
<td>商业客人</td>
<td></td>
</tr>
<tr>
<td>咨询公司</td>
<td></td>
</tr>
<tr>
<td>南美洲</td>
<td></td>
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<tr>
<td>航空公司</td>
<td>恢复因素</td>
</tr>
<tr>
<td>客户在20-35岁</td>
<td>WINTER</td>
</tr>
<tr>
<td>女性客户</td>
<td>WINTER-SUMMER</td>
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<tr>
<td>当地客户</td>
<td></td>
</tr>
<tr>
<td>亚洲</td>
<td>SUMMER</td>
</tr>
<tr>
<td>旅游者</td>
<td></td>
</tr>
<tr>
<td>直接预订</td>
<td></td>
</tr>
<tr>
<td>房价</td>
<td></td>
</tr>
<tr>
<td>中东和非洲</td>
<td></td>
</tr>
<tr>
<td>美国</td>
<td></td>
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<tr>
<td>欧洲</td>
<td></td>
</tr>
<tr>
<td>客户在35-55岁</td>
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</tr>
</tbody>
</table>

[Graphics and Graphic Information Processing, Bertin 81]
[Graphics and Graphic Information Processing, Bertin 81]
Rivet: Interactive reordering

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

Trellis [Becker, Cleveland, and Shyu 96]
Panel variables
type, yield

Condition variables
location, year

Trellis
[Becker, Cleveland, and Shyu 96]
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