Information Visualization
Using View & Data Distortion

Research Student Seminars

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Information Visualization

- dates back to 2nd century
- relatively new research area
- why do we visualize?
  - to communicate
  - to expose patterns and trends
  - to find correlations and clusters
The Visualization Pipeline

<table>
<thead>
<tr>
<th>Data</th>
<th>Information</th>
<th>Knowledge</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Product 1</th>
<th>Product 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>2005</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>2006</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>2007</td>
<td>100</td>
<td>100</td>
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</table>

Table:

<table>
<thead>
<tr>
<th>0.1</th>
<th>4</th>
<th>0.3</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>45</td>
<td>3</td>
<td>0.1</td>
</tr>
<tr>
<td>0.4</td>
<td>5</td>
<td>1.1</td>
<td>0.58</td>
</tr>
<tr>
<td>0.89</td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>11.0</td>
<td>0.6</td>
<td>9.5</td>
<td>0.7</td>
</tr>
<tr>
<td>1.0</td>
<td>9.01</td>
<td>2.1</td>
<td>0.9</td>
</tr>
<tr>
<td>4.32</td>
<td>0.5</td>
<td>3.3</td>
<td>0.5</td>
</tr>
<tr>
<td>0.11</td>
<td>0.4</td>
<td>3.33</td>
<td>0.9</td>
</tr>
<tr>
<td>0.98</td>
<td>0.7</td>
<td>1.12</td>
<td>0.99</td>
</tr>
<tr>
<td>0.54</td>
<td>7.5</td>
<td>2.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Graph:

- Product 1
- Product 2
Challenges in Visualization

• technology for generating and viewing is continually improving

• but data sets are getting ever-larger!
  • databases, maps, text repositories, software

• there is too much to show
Visualization Paradigms 1

- Overview + Detail
- ‘zoom lens’ approach
- large detail view & small overview
- side-by-side aids comparison
- simple, and ubiquitous
- still easy to get lost in the data
Examples

- as detail increases, context is lost
Visualization Paradigms 2

• **Focus + Context**
  
  • intuitive: show focused data in detail, and show a compressed view of global context
  
  • dynamically re-focus on data elements
  
  • allows a balance to be found between local detail and global context, while keeping the size of the data set manageable
Papers to Discuss

- George Furnas wrote both papers, 20 years apart
- Generalized Fisheye Views, CHI 1986
- A Fisheye Follow-up: Further Reflections on Focus + Context, CHI 2006
Fisheye Visualization

- technique designed for small screens
- natural way to view the world
- focus + context
- finding a balance between detail and context
- (see the forest and the trees)
Degree of Interest Function

- given the currently focused data node, every other node is assigned a number
- dependent on two factors:
  - *a-priori* importance
  - distance from currently-focused node
- general form:
  - \( \text{DOI}_{\text{Fisheye}} (x \mid . = y) = F( \text{API}(x), D(x, y) ) \)
Rooted Trees

- many large structures are represented as trees
- structured programming languages, file systems, taxonomies
- using thresholds we can display different subsets of the original tree, efficiently
- trees can be logarithmically compressed
Applying DOI function

- distances from y

- a-priori importance
Applying DOI function

- Composing these calculations using simple subtractive metric...

- \( DOI_{Fisheye}(x \mid . = y) = AP\!I(x) - D(x, y) \)

- we can now extract subsets of this tree
Example subsets

zero-order fisheye view

```
  root
  ┌───┐
  │   │
  │   │
  │   │
  └───┘
```

DOI(x) ≥ −3

first-order fisheye view

```
  root
  ┌───┐
  │   │
  │   │
  │   │
  └───┘
```

DOI(x) ≥ −5
Two Types of Distortion

- Visual Distortion
  - use DOI metric to decide how much space an element should take up

- Data Distortion
  - selection of which data to include
  - agnostic about geometry
  - useful for non-visual fisheye views
Problems with Visual Distortion

• size/resolution reduction
• aspect ratio preservation
• simultaneity
• topological discontinuity
• ...so, data filtering is generally superior
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>17:00 Lero Automotive, 17:00 Networking with 2 more</td>
</tr>
<tr>
<td>25</td>
<td>11:00 TA for COMP 10, 15:00 Networking lects, 12:00 Networking lects</td>
</tr>
<tr>
<td>26</td>
<td>14:00 Talk by Julien C, 15:00 Graphics mit He, 21:00 Aoife's birthday</td>
</tr>
<tr>
<td>27</td>
<td>11:00 Seminar practice, 14:00 Research Student Sec, 14:00 Student Seminars with 21:00 Albert Niall gig at Y, 21:00 Albert Niall gig at Y</td>
</tr>
<tr>
<td>28</td>
<td>14:30 Pervasive Organisat, 15:00 Aoife's Birthday Din, 17:00 Emmanuel arrives in Laois, 22:20 Keighlao arrives in Laois, 19:30 Meet ID, 21:00 16 blocks in dur</td>
</tr>
<tr>
<td>29</td>
<td>15:00 Aoife's Birthday Din, 20:45 Lennie's gig, 15:00 Aoife's Birthday Din</td>
</tr>
<tr>
<td>30</td>
<td>10:20 Yee Lee Arrives, 11:00 Nick Arrives at Dublin, 11:00 Lillie arrives in Dublin, 13:22 Phil arrives at the hotel, 14:00 Pre-conference meet, 14:30 Pervy volunters me, 15:30 Alex is arriving</td>
</tr>
</tbody>
</table>

**Workshops**
- 09:00 Workshop 1: PERMIE
- 09:00 Workshop 2: Perp
- 09:50 Workshop 7: Interna
- 16:00 W2 poster session

| 01   | Keynote, Research Press, 01:30 Registration, 10:40 Morning Coffee Bre, 12:30 Lunch Break |
| 9    | 14:00 Research Student Sec, 14:00 Research Student Sec, 14:00 Research Student Sec, 14:00 Research Student Sec |
| 17   | 17:00 'Soccer', 18:00 Danny Leaves for Oz |
| 21   | WAC Deadline |
Conclusions

• fisheye views are a natural way to present data

• fisheye views allow a data set to be simplified using nested subsets

• understanding of data is improved by balancing detail and context
Thanks.

- Any questions?