INFORMATION VISUALIZATION

Alvitta Ottley

Washington University in St. Louis
GETTING TO KNOW YOU...

Show of hand:
• Know Java?
• Taken Graphics?
• Taken HCI?
• Proficient with GUI frameworks or toolkit
  • Eg. Processing, D3, Javascript/ HTML 5, openGL, Java Swing, etc.
• Design Background?
  • Have taken courses in art or design
What does **Visualization** mean to you?

What do you hope to get from the course?
MY EXPECTATIONS

• Try
• Be creative
• Participate
• Integrity
A visualization is a visual representation of abstract data to aid human cognition

- Must be based on data
- The results must be readable, recognizable and useful
How much data are there?
2010: 1.2 zettabytes
2013: 4.4 zettabytes
2020: ~40 zettabytes
2010: 1.2 zettabytes
2013: 4.4 zettabytes
2020: ~40 zettabytes

Zettabyte ≈ 1,000,000,000,000,000,000,000,000 or $10^{21}$

200x all words ever spoken by humans

Gantz et al 2011
The ability to take data—to be able to **understand** it, to **process** it, to **extract value** from it, to **visualize** it, to **communicate** it—that’s going to be a hugely important skill in the next decades... [Hal Varian, Google’s Chief Economist]
Big Data: Experts say new forms of information analysis will help people be more nimble and adaptive, but worry over humans’ capacity to understand and use these new tools well.

Tech experts believe the vast quantities of data that humans and machines will be creating by the year 2020 could enhance productivity, improve organizational transparency, and expand the frontier of the “knowable future.” But they worry about “humanity’s dashboard” being in government and corporate hands and they are anxious about people’s ability to analyze it wisely.

Janna Quitney Anderson, Elon University
Lee Rainie, Pew Research Center’s Internet & American Life Project
July 20, 2012
WHY does Visualization work?

- Cognition is limited
WHY does Visualization work?

- Cognition is limited
- Memory is limited
calculation exercise...
calculation exercise... $34 \times 28$
calculation exercise...
calculation exercise... 79 \times 16
HOW does Visualization work?

- Uses perception to point out interesting things.
How many R’s are there?
How many R’s are there?

GLNSAGGKLDSANGNASDGN
KLANSGLKNASDGNDFVMD
GJERKJVERJVKENJLVNEKVJEN
VJEAJVJNDJVNAAJBVRKLVLJKD
What is the complexity (in BigO Notation) to find the single B?
What is the complexity (in BigO Notation) for a human to find the single B?
Consider the following dataset:

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<tbody>
<tr>
<td>x</td>
<td>y</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>10.0</td>
<td>8.04</td>
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<td>13.0</td>
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<td>8.81</td>
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<td>14.0</td>
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<td>8.10</td>
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<td>4.26</td>
<td>4.0</td>
<td>3.10</td>
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<td>12.0</td>
<td>10.84</td>
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<td>9.13</td>
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<td>4.82</td>
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<td>7.26</td>
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<td>5.0</td>
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<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Mean of $x$ in each case</td>
<td>9 (exact)</td>
</tr>
<tr>
<td>Sample variance of $x$ in each case</td>
<td>11 (exact)</td>
</tr>
<tr>
<td>Mean of $y$ in each case</td>
<td>7.50 (to 2 decimal places)</td>
</tr>
<tr>
<td>Sample variance of $y$ in each case</td>
<td>4.122 or 4.127 (to 3 decimal places)</td>
</tr>
<tr>
<td>Correlation between $x$ and $y$ in each case</td>
<td>0.816 (to 3 decimal places)</td>
</tr>
<tr>
<td>Linear regression line in each case</td>
<td>$y = 3.00 + 0.500x$ (to 2 and 3 decimal places, respectively)</td>
</tr>
</tbody>
</table>
Anscombe’s Quartet
WHY do we create visualizations?

• answer questions
• generate hypotheses
• make decisions
• see data in context
• expand memory
• support computational analysis
• find patterns
• tell a story
• inspire
Examples of visualizations
Visualization for Storytelling

Napoleon’s March to Moscow (War of 1812)
Visualization for spotting trends
Visualization for information dissemination

Flooding Risk From Climate Change, Country by Country

SEPT. 23

A new analysis of sea levels and flood risk around the world offers more evidence that the brunt of climate change will not be borne equally.
Visualization for information dissemination

Mapping the Decline of ‘Stop-and-Frisk’

SEPT. 19

Mapping and charting the decline of a controversial police practice.
Heavier Babies Do Better in School

OCT. 10

Babies who are allowed to linger in the womb are often healthier and do better in school.
Examples of “bad” visualizations
Examples of “bad” visualizations
Examples of “bad” visualizations
Visualizations that probably should not exist
Questions?
CSE 557A: INFORMATION VISUALIZATION

Course Description

In this course, we study the principles for transforming abstract data into effective information visualizations. We learn about the state-of-the-art in visualization research and development, and we gain hands-on experience with designing and developing information visualizations. We also learn how to critique existing visualizations and how to evaluate the systems we build. Weekly readings include current research papers from the Information Visualization community.

Schedule

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATE</th>
<th>TOPIC</th>
<th>DATE</th>
<th>TOPIC</th>
<th>PAPER</th>
<th>ASSIGNMENT</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1/17</td>
<td>Introduction</td>
<td>1/19</td>
<td>Discussion: Chart Junk Lab 1: Intro to Processing</td>
<td>Bateman et al. 2010</td>
<td>Design Critique</td>
</tr>
<tr>
<td>2</td>
<td>1/24</td>
<td>Design</td>
<td>1/26</td>
<td>Discussion: Visualization Purpose Lab 2: Click Me!</td>
<td>Borkin et al. 2013</td>
<td>Bar and Line</td>
</tr>
<tr>
<td>3</td>
<td>1/31</td>
<td>Data Types</td>
<td>2/02</td>
<td>Discussion: Bars vs. Pies Lab 3: Bars</td>
<td>Cleveland and McGill</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2/07</td>
<td>Visual Encodings</td>
<td>2/09</td>
<td>Discussion: Data Mapping Lab 4: Animated Transition</td>
<td>Polaris</td>
<td>Parallel Coordinates</td>
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<tr>
<td>5</td>
<td>2/14</td>
<td>Tabular Data</td>
<td>2/16</td>
<td>Discussion: TDB Lab 5: Intersection Detection</td>
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<tr>
<td>6</td>
<td>2/21</td>
<td>Perception</td>
<td>2/23</td>
<td>Discussion: Perception Lab 6: Web Basics</td>
<td>Visual Thinking for Design (Chapters 1 &amp; 2)</td>
<td>ThemeRiver</td>
</tr>
<tr>
<td>7</td>
<td>2/28</td>
<td>Trees</td>
<td>3/02</td>
<td>Discussion: Tree Visualizations Lab 7: d3</td>
<td>ThemeRiver Web Tutorial</td>
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<tr>
<td>8</td>
<td>3/07</td>
<td>Graphs</td>
<td>3/09</td>
<td>Discussion: Graph Simplification Lab 8: Electoral Map</td>
<td>Schniederman (Eyes) Scatter Plot Example Basic Template</td>
<td>TreeMap in D3</td>
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<tr>
<td>9</td>
<td>3/15</td>
<td>SPRING BREAK</td>
<td>3/17</td>
<td>SPRING BREAK</td>
<td></td>
<td>Final Project Proposal</td>
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<tr>
<td>10</td>
<td>3/21</td>
<td>Storytelling</td>
<td>3/23</td>
<td>Discussion: Storytelling Lab 8: Final Project</td>
<td>Yt et al. An Empire Built on Sand</td>
<td></td>
</tr>
</tbody>
</table>
General Information

Five Assignments
One Final Project
Weekly Paper Discussions & Labs
Assignment 1: Design Critique
Due: 01-24-2017, 11:59pm (midnight)

In this assignment, you will be looking for visualizations “in the wild” (in books, newspapers, magazines, on the internet, etc.). Specifically, you will be looking for two visualizations – one that you like, and one that you dislike. For the visualization that you like, you need to express why you like the visualization (what is it that makes the visualization good). For the visualization that you dislike, you need to provide a critique, as well as design a better alternate visualization.

Due next Tuesday

Basic Requirements for this Assignment:

1. Find two visualizations in the wild
   a. One that you like
   b. One that you dislike

2. For the visualization that you like, provide a description of what makes the visualization good.

3. For the visualization that you dislike, explain why you dislike it.

4. In addition, for the visualization that you dislike, design an alternate visualization that is better than the original.

5. Explain your design and what problem(s) your design addresses.
To do for next class:

- Download and install Processing
- Bring laptops
- Read paper
Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts

Scott Bateman, Regan L. Mandryk, Carl Gutwin,
Aaron Genest, David McDine, Christopher Brooks
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aaron.genest@usask.ca, dam085@mail.usask.ca, cab938@mail.usask.ca

ABSTRACT
Guidelines for designing information charts often state that the presentation should reduce ‘chart junk’ – visual embellishments that are not essential to understanding the data. In contrast, some popular chart designers wrap the presented data in detailed and elaborate imagery, raising the questions of whether this imagery is really as detrimental to understanding as has been proposed, and whether the visual embellishment may have other benefits. To investigate these issues, we conducted an experiment that compared embellished charts with plain ones, and measured both interpretation accuracy and long-term recall. We found that people’s accuracy in describing the embellished charts was no worse than for plain charts, and that their recall after a two-to-three-week gap was significantly better. Although we are cautious about recommending that all charts be produced in this style, our results question some of the premises of the minimalist approach to chart design.

Author Keywords
Charts, information visualization, imagery, memorability.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms