Visualization

- Combine and integrate visual marks into more complex structural forms to encode information
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- But why?
This report details the number of West Nile Virus human cases in Ontario from January 2012 to November 2014. In January 2012 there were two human cases, in February there were three cases, in March, there were five cases, in April there were seven cases, in May there were nine cases, in June there were eleven cases, in July there were thirteen cases, in August there were fifteen cases, in September there were seventeen cases, in October there were nineteen cases, in November, there were twenty-one cases, in December there were twenty-three cases. In January 2013, there were forty cases, in February there were forty-two cases, in March there were thirty-eight cases, in April, there were thirty-four cases, in May there were thirty cases, in June there were twenty-six cases, in July there were twenty-two cases, in August there were twenty cases. In September of 2013, there were twenty cases, in October there were twenty cases, in November there were twenty-two cases, in December there were twenty-three cases. In January of 2014, there were twenty-four cases, in February there were twenty-five cases, in March there were twenty-seven cases, and in April there were thirty cases. In May there were thirty-five cases and in June there were forty new human cases.
What do we know about this text?
<table>
<thead>
<tr>
<th>Month</th>
<th>Number of West Nile Virus Human Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 12</td>
<td>19</td>
</tr>
<tr>
<td>Nov 12</td>
<td>21</td>
</tr>
<tr>
<td>Dec 12</td>
<td>23</td>
</tr>
<tr>
<td>Jan 13</td>
<td>40</td>
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<tr>
<td>Feb 13</td>
<td>42</td>
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<tr>
<td>Mar 13</td>
<td>38</td>
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<tr>
<td>Apr 13</td>
<td>34</td>
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<tr>
<td>May 13</td>
<td>30</td>
</tr>
<tr>
<td>Jun 13</td>
<td>26</td>
</tr>
<tr>
<td>Jul 13</td>
<td>22</td>
</tr>
<tr>
<td>Aug 13</td>
<td>20</td>
</tr>
<tr>
<td>Sep 13</td>
<td>20</td>
</tr>
<tr>
<td>Nov 13</td>
<td>22</td>
</tr>
<tr>
<td>Dec 13</td>
<td>23</td>
</tr>
</tbody>
</table>
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- Different types of visualizations are fit for different tasks
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- But why?
- Different types of visualizations are fit for different tasks:
  - illustrate relationships
  - discover trends, patterns, and outliers
  - get attention of recipients
  - support remembering and recall
  - facilitate learning
  - tell a story
Visualization

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- Relate to and depend upon other disciplines, such as human perception, cognition theory, computer science, etc.
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- Need interaction to be more effective:
  - InfoViz.org
  - Force-Directed Graph
  - Sunburst Partition
  - Hierarchical Edge Bundling
  - US Map + Voronoi
  - Scatterplot Matrix
  - Treemap
Big Data
Big Data

Big Data: Expanding on 3 fronts at an increasing rate.

Data Volume

Data Variety

Data Velocity

- Real Time
- Near Real Time
- Periodic
- Batch
- Table

- Social
- Video
- Web
- Audio
- Unstructured
- Mobile
Data Storage

Graph 1: Overall Exabytes from 1986 to 2007.

Graph 2: Detail of Data Storage as a % of Exabytes from 1986 to 2007:
- Digital: 1, 3, 54, 295
- Analog: 99, 97, 75, 94

100% = 1 + 3 + 54 + 295
Computational Capacity

### Overall

- **1986:** 1
- **1993:** 0.004
- **2000:** 0.289
- **2007:** 6.379

### Detail

- **Pocket Calculators:**
  - **1986:** <0.001
  - **1993:** 6
  - **2000:** 6
  - **2007:** 6

- **Supercomputers:**
  - **1986:** 41
  - **1993:** 23
  - **2000:** 86
  - **2007:** 25

- **Video Game Consoles:**
  - **1986:** 9
  - **1993:** 64
  - **2000:** 5
  - **2007:** 3

- **Servers and Mainframes:**
  - **1986:** 33
  - **1993:** 6
  - **2000:** 6
  - **2007:** 66

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Western
# Data Availability

The type of data generated and stored varies by sector

<table>
<thead>
<tr>
<th></th>
<th>Video</th>
<th>Image</th>
<th>Audio</th>
<th>Text/numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banking</td>
<td></td>
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<td>High</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Securities and investment services</td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Discrete manufacturing</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Process manufacturing</td>
<td></td>
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<td>Professional services</td>
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<td>Low</td>
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<tr>
<td>Consumer and recreational services</td>
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<tr>
<td>Health care</td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Communications and media</td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Utilities</td>
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</tr>
<tr>
<td>Education</td>
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</tr>
</tbody>
</table>
Visual Analytics

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1 etymonline.com
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- Analytics = “The science and/or art of of studying” the analyses of data in various forms
- Remember the “other disciplines” point?
  - Human perception, cognition theory, computer science, etc.
Human Cognition
Distributed Cognition
Back to Visualization

- So anything will work right?!
Back to Visualization

Percentage of New WNV Cases

- Jan-13
- Feb-13
- Mar-13
- Apr-13
- May-13
- Jun-13
- Jul-13
- Aug-13
- Sep-13
- Oct-13
Back to Visualization
A Human-Centered Approach

Consider:
- intended audience or users
- tasks to be performed
- context
A Human-Centered Approach

• Learn about visual elements:
  ○ points
  ○ lines
  ○ surfaces
  ○ volumes
A Human-Centered Approach

- Learn about visual properties:
  - size/length
  - orientation
  - color
  - direction
  - area
  - texture
  - shape
  - curvature
  - shading
  - saturation
  - ...

Western
Gestalt Principles

- Proximity
- Similarity
- Enclosure
- Connection
- Continuity
- Symmetry
- Figure & Ground
- Closure
- Common Fate
Human-Centered Analytics

People

Processes

Processes

Analytics
Human-Centered Analytics
Human-Centered Analytics
Tools for Developers

1. D3.js
2. FusionCharts
3. Chart.js
4. Google Charts
5. Highcharts
6. Leaflet
7. dygraphs
Tools for Non-Developers

1. Datawrapper
2. Tableau
3. Raw
4. Timeline JS
5. Infogram
6. Plotly
7. ChartBlocks
OpenData Tools

1. visualizing.org
2. FlowingData
3. Google Chart Tools
4. GeoCommons
5. Quadrigram
6. Journalism in the Age of Data
7. JavaScript InfoVis Toolkit
8. Google Public Data Explorer
9. Maps Marker WP-Plugin
10. DataMaps.eu
11. Ushahidi
12. Eclipse BIRT
Knowledge exists to be imparted.

- Ralph Waldo Emerson
TIME FOR QUESTIONS