Data Visualization Literacy

- Andee: What does education want from data visualization?
- Joe: What do data visualizations need to be comprehensible?
- Katy: What frameworks can we provide for understanding data visualizations?
- Peggy: How do we make data visualization accessible on the museum floor?
- Bryan: How do we make data visualization accessible on the museum floor?

ASTC Conference
Tampa, Florida

September 25, 2016

@katycns

Data Visualization Literacy: Visualization Frameworks

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School of Informatics and Computing and
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Indiana University, USA

ASTC Conference
Tampa, Florida

September 25, 2016

@katycns
How to Classify (Name & Make) Different Visualizations?

By
- User insight needs?
- User task types?
- Data to be visualized?
- Data transformation?
- Visualization technique?
- Visual mapping transformation?
- Interaction techniques?
- Or?
Different Question Types

Find your way
Find collaborators, friends
Identify trends

Different Levels of Abstraction/Analysis

Macro/Global Population Level
Meso/Local Group Level
Micro Individual Level
Tasks

**LEVELED**

<table>
<thead>
<tr>
<th>MICRO (individual level)</th>
<th>Meso (local level)</th>
<th>Macro (critical level)</th>
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<td>about 2,000-10,000 records</td>
<td>more than 100,000 records</td>
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**TYPES**

- Statistical Analysis
- Temporal Analysis
- WHERE: Generational Analysis
- WHERE: Temporal Analysis
- WITH WHERE: Mathematical Analysis

**READ**

- Validation
- Interpretation

**ANALYZE**

Types and levels of analysis determine data, algorithms & parameters, and deployment.

**VISUALIZE**

- Visually encode data
- Overlay data
- Select visualization type

**DEPLOY**

Stakeholders

See page 5
Needs-Driven Workflow Design

Stakeholders

Validation
Interpretation

Types and levels of analysis determine data, algorithms & parameters, and deployment

Data

READ

ANALYZE

DEPLOY

Visually encode data
Overlay data
Select visualiz. type

Visualization Framework

Insight Need Types
- category/cluster
- order/rank/sort
- distributions (also outliers, gaps)
- comparisons
- trends (process and time)
- geospatial
- compositions (also of text)
- correlations/relationships

Data Scale Types
- nominal
- ordinal
- interval
- ratio

Visualization Types
- table
- chart
- graph
- map
- network layout
- geometric symbols
- point
- line
- area
- surface
- volume
- linguistic symbols
- text
- numerals
- punctuation marks
- pictorial symbols
- images
- icons
- statistical glyphs

Graphic Symbol Types
- spatial
- position
- outline
- form
- color
- optical motion

Graphic-Variable Types

Interaction Types
- overview
- zoom
- search and locate
- filter
- details-on-demand
- history
- extract
- link and brush
- projection
- distortion

See page 24
### Visualization Framework

#### Basic Task Types

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### Visualization Framework

#### Insight Need Types

- categorized/cluster
- order/rank/sort
- distributions (also outliers, gaps)
- comparisons
- trends (process and time)
- geospatial
- compositions (also of text)
- correlations/relationships

#### Data Scale Types

- nominal
- ordinal
- interval
- ratio

#### Visualization Types

- table
- chart
- graph
- map
- network layout

#### Graphic Symbol Types

- geometric symbols
- point
- line
- area
- surface
- volume
- linguistic symbols
- text
- numerals
- punctuation marks
- pictorial symbols
- images
- icons
- statistical glyphs

#### Graphic-Variable Types

- spatial position
- spatial form
- color
- optics motion

#### Interaction Types

- overview
- zoom
- search and locate
- filter
- details-on-demand
- history
- extract
- link and brush
- projection
- distortion
Visualization Types (Reference Systems)

1. **Charts**: No reference system—e.g., Wordle.com, pie charts

2. **Tables**: Categorical axes that can be selected, reordered; cells can be color coded and might contain proportional symbols. Special kind of graph.

3. **Graphs**: Quantitative or qualitative (categorical) axes. Timelines, bar graphs, scatter plots.

4. **Geospatial maps**: Use latitude and longitude reference system. World or city maps.

5. **Network graphs**: Node position might depends on node attributes or node similarity. **Tree graphs**: hierarchies, taxonomies, genealogies. **Networks**: social networks, migration flows.

IVMOOC App – More than 60 visualizations

The “IVMOOC Flashcards” app can be downloaded from Google Play and Apple iOS stores.
Visualization Framework

<table>
<thead>
<tr>
<th>Insight Need Types</th>
<th>Data Scale Types</th>
<th>Visualization Types</th>
<th>Graphic Symbol Types</th>
<th>Graphic Variable Types</th>
<th>Interaction Types</th>
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<td>page 30</td>
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<td>(also outliers, gaps)</td>
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<td>projection</td>
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<td>(also of text)</td>
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<td>spatial position</td>
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<td>correlations/relationships</td>
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<td>statistical glyphs</td>
<td>spatial position</td>
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</tr>
</tbody>
</table>

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See page 24

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Graphic Variable Types Versus Graphic Symbol Types

### Geometric Symbols

- **Point**: 
  - •
  - ○
  - □
- **Line**: 
  - —
  - —
  - —
- **Area**: 
  - □
  - ○
  - △

### Color

- Red
- Green
- Blue
- Yellow

### Value

- Low
- Medium
- High

### Plan

- Top
- Side
- Front
The Information Visualization MOOC
ivmooc.cns.iu.edu

Students from ~100 countries
370+ faculty members
#ivmooc

Books Used in the IVMOOC

Teaches timely knowledge:
Advanced algorithms, tools, and hands-on workflows.

Teaches timeless knowledge:
Visualization framework—exemplified using generic visualization examples and pioneering visualizations.
Course Schedule

Part 1: Theory and Hands-On

• Session 1 – Workflow Design and Visualization Framework
• Session 2 – “When:” Temporal Data
• Session 3 – “Where:” Geospatial Data
• Session 4 – “What:” Topical Data

Mid-Term

• Session 5 – “With Whom:” Trees
• Session 6 – “With Whom:” Networks
• Session 7 – Dynamic Visualizations and Deployment

Final Exam

Part 2: Students work in teams on client projects.

Final grade is based on Class Participation (10%), Midterm (30%), Final Exam (30%), and Client Project(30%).
Load One File and Run Many Analyses and Visualizations

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<thead>
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<th>Times Cited</th>
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<th>Country</th>
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<td>MALDEN</td>
<td>USA</td>
<td>CTS-CLINICAL AND TRANSLATIONAL SCIENCE</td>
<td>Advancing the Science of Team Science</td>
<td>Research &amp; Experimental Medicine</td>
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Sci2 Tool Interface Components
Download tool for free at [http://sci2.cns.iu.edu](http://sci2.cns.iu.edu)

Co-author and many other bi-modal networks.
References


All papers, maps, tools, talks, press are linked from http://cns.iu.edu
These slides will soon be at http://cns.iu.edu/docs/presentations

CNS Facebook: http://www.facebook.com/cnscenter
Mapping Science Exhibit Facebook: http://www.facebook.com/mappingscience