Introduction to Information Visualization

CS 5630/6630: Scientific Visualization
Overview

• Historical examples
• What is infoVis?
• Principles of InfoVis
• Classic techniques in InfoVis
  • Clustering
  • Star Maps
  • Parallel Coordinates
  • Tree Maps
  • Hyperbolic Layouts
  • Cartograms
Introduction

• Problem
  • Huge, multivariate datasets are everywhere, how do we understand them?

• Solution
  • Take advantage of the human visual system
  • Convert data into graphical form

• Issues
  • How do we convert abstract data into graphical form?
  • Are visualizations better than other methods?
Motivation

- Data Increasing Exponentially
  - Between 1 and 2 exabytes of unique info produced per year
  - $1000000000000000000\ (10^{18})$ bytes
  - 250 meg for every man, woman and child
  - Printed documents only .003% of total

Peter Lyman and Hal Varian, 2000
Cal-Berkeley, Info Mgmt & Systems
www.sims.berkeley.edu/how-much-info
Motivation

• Purpose of Visualization
  • Transform the data into information (understanding, insight) thus making it useful to people
  • “The purpose of visualization is insight, not pictures”
  • Insight: discovery, decision making, explanation
    • Visuals help us think
    • Provide a frame of reference, a temporary storage area
  • External cognition:
    • Role of external world in thinking and reason
Definitions

• What is “Information Visualization”?
  • The use of computer-supported, interactive visual representations of data to amplify cognition. [Card, Mackinlay, Shneiderman ‘98]

• What kinds of data?
  • Information that does not have a direct physical correspondence

• How is it different from Scientific Visualization?
  • SciVis relates to and represents something physical or geometric
Visualization Success Stories
The Power of Visualization

1. Start out going Southwest on ELLSWORTH AVE towards BROADWAY by turning right.
2. Turn RIGHT onto BROADWAY.
3. Turn RIGHT onto QUINCY ST.
4. Turn LEFT onto CAMBRIDGE ST.
5. Turn SLIGHT RIGHT onto MASSACHUSETTS AVE.
6. Turn RIGHT onto RUSSELL ST.
The Power of Visualization

London Tube Map by Beck
(Topological vs Geographical)
The Power of Visualization

Napoleon’s March by Minard
(6 variables represented)
The Power of Visualization

NYC Weather
(2220 Numbers represented)

Creating Information Visualizations

• Tools for InfoVis:
  • Size for quantity
  • Color for distinguishing (selection)
  • Brushing and linking for correspondences
  • Animation for persistence
  • Multiple views for comparison
Creating Information Visualizations

• Tasks for InfoVis:
  • Searching
  • Browsing
  • Analysis
  • Assimilation
  • Monitoring
Creating Information Visualizations

- Process for InfoVis:

Raw Data → Data Tables → Visual Structures → Views
Multivariate Data

- Scatterplot Matrices
Multivariate Data

- Chernoff Faces
Multivariate Data

- Star Plots

Connecticut  New Hampshire  Pennsylvania
Maine  New Jersey  Rhode Island
Massachusetts  New York  Vermont
Multivariate Data

• Parallel Coordinates
Multivariate Data

- Parallel Coordinates: Order Matters
Multivariate Data

- Clustering

In-Spire (PNL)
Multivariate Data

- Clustering
Connected Data

- Graph Layouts
Hierarchical Data

- Standard Trees

Graphviz
Hierarchical Data

- Standard Trees
Hierarchical Data

- Phylogenetic Trees
Hierarchical Data

- Radial Trees

Sunburst
Hierarchical Data

• Radial Trees
Hierarchical Data

- Hyperbolic Trees
Hierarchical layouts

- Tree Maps

Johnson and Schneiderman
Hierarchical Data

- Tree Maps
Hierarchical Layouts

- Tree Maps: Layout matters

- Slice and Dice
- Cluster
- Squarify
- Pivot by Middle
- Pivot by Size
- Strip
Map Data

- Cartograms

http://www-personal.umich.edu/~mejn/election/2008/
3D Techniques
Interactive Techniques

- Brushing and Animation