# 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

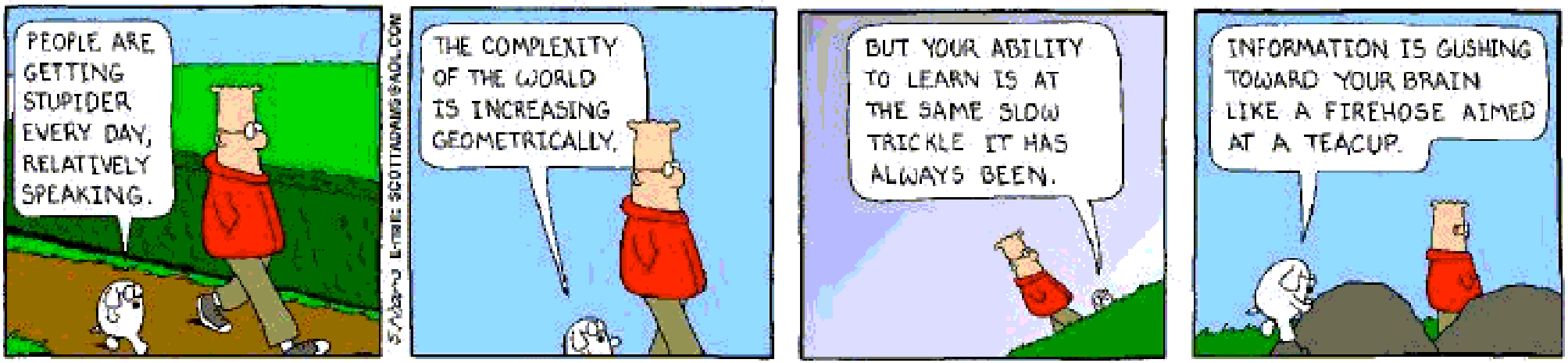
# Introduction

- 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

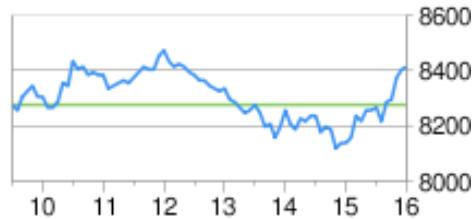


# Motivation

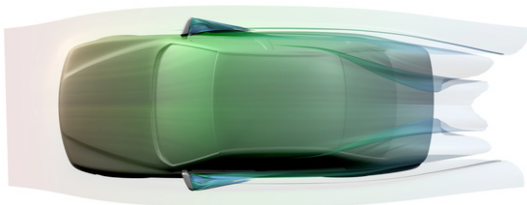
- Purpose of Visualization
  - Transform the data into information (understanding, insight) thus making it useful to people
  - “The purpose of visualization is insight, not pictures”
  - Insight: discovery, decision making, explanation
    - Visuals help us think
    - Provide a frame of reference,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

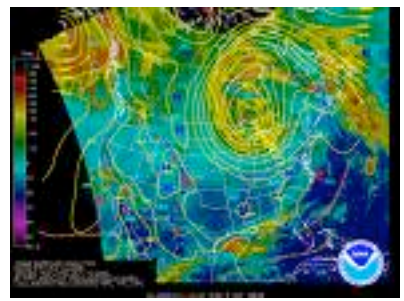
# Definitions

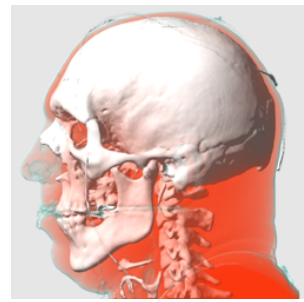
- What is “Information Visualization”?
  - The use of computer-supported, interactive visual representations of data to amplify cognition. [Card, Mackinlay, Shneiderman ‘98]
  - What kinds of data?
    - Information that does not have a direct physical correspondence


- How is it different from Scientific Visualization?
  - SciVis relates to and represents something physical or geometric

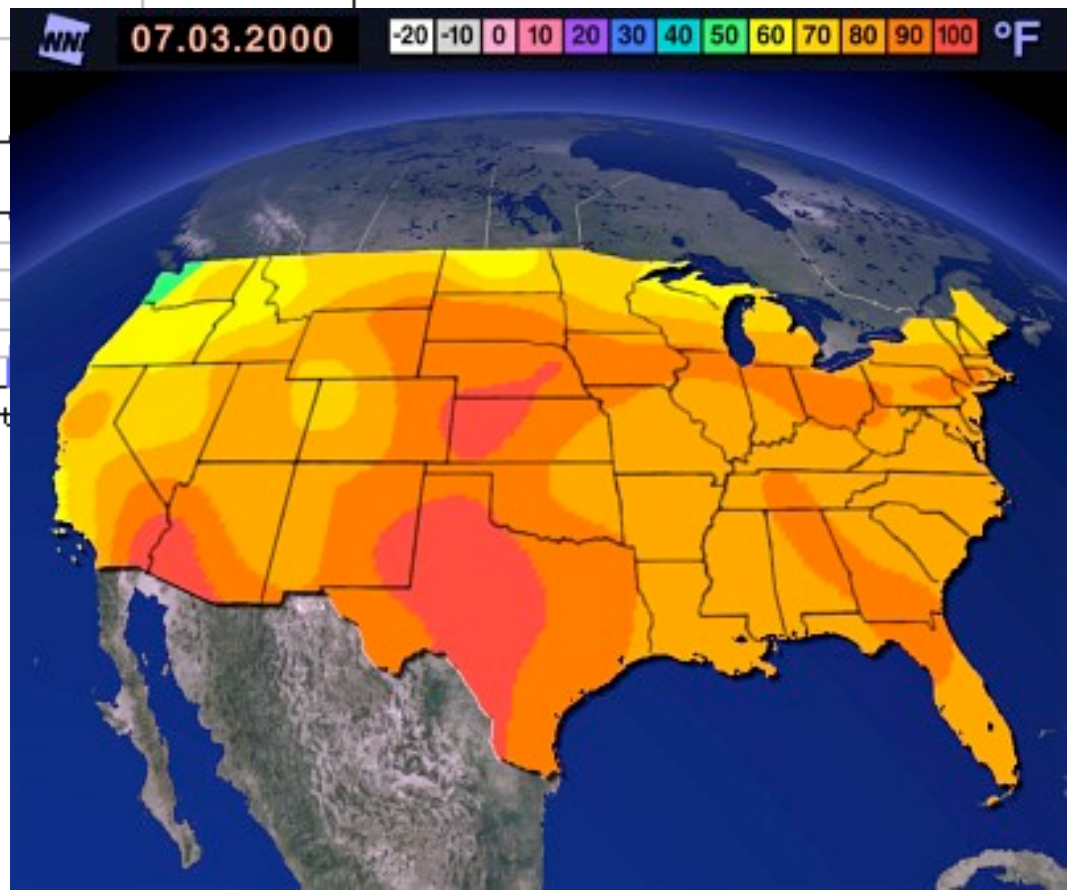






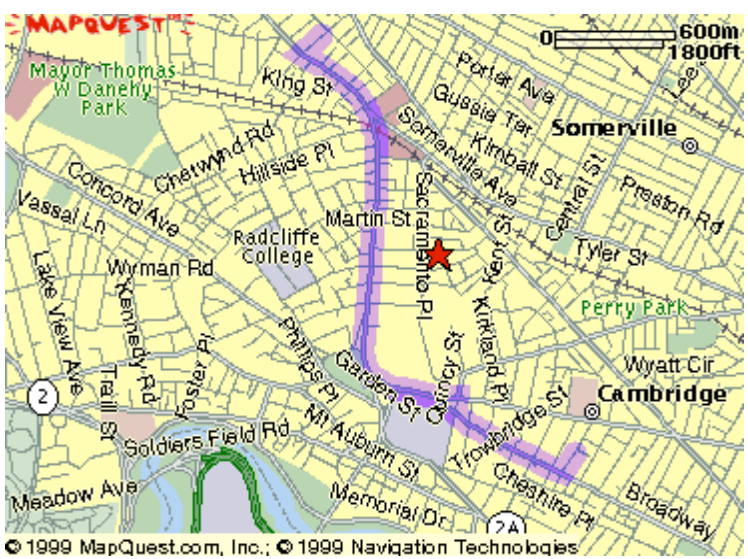
# Visualization Success Stories

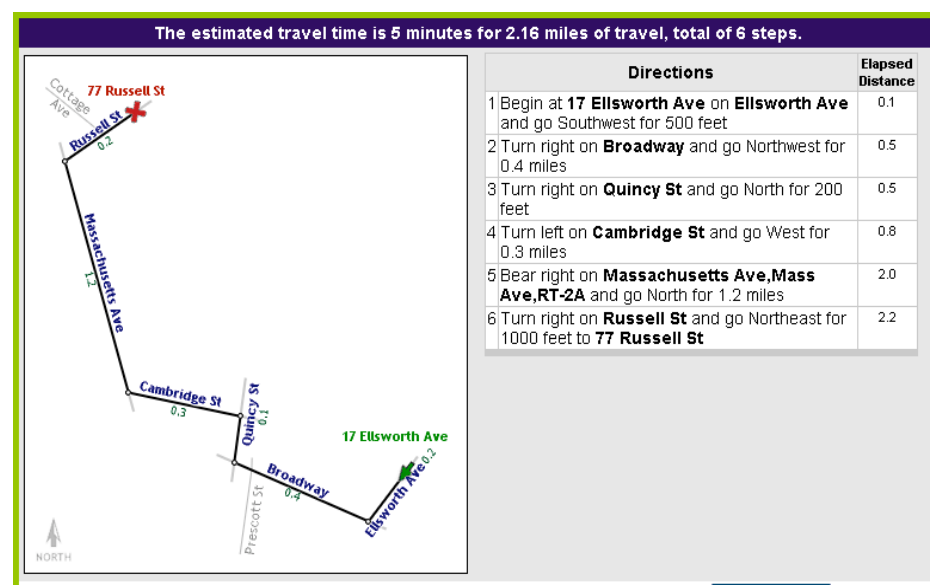




# The Power of Visualization

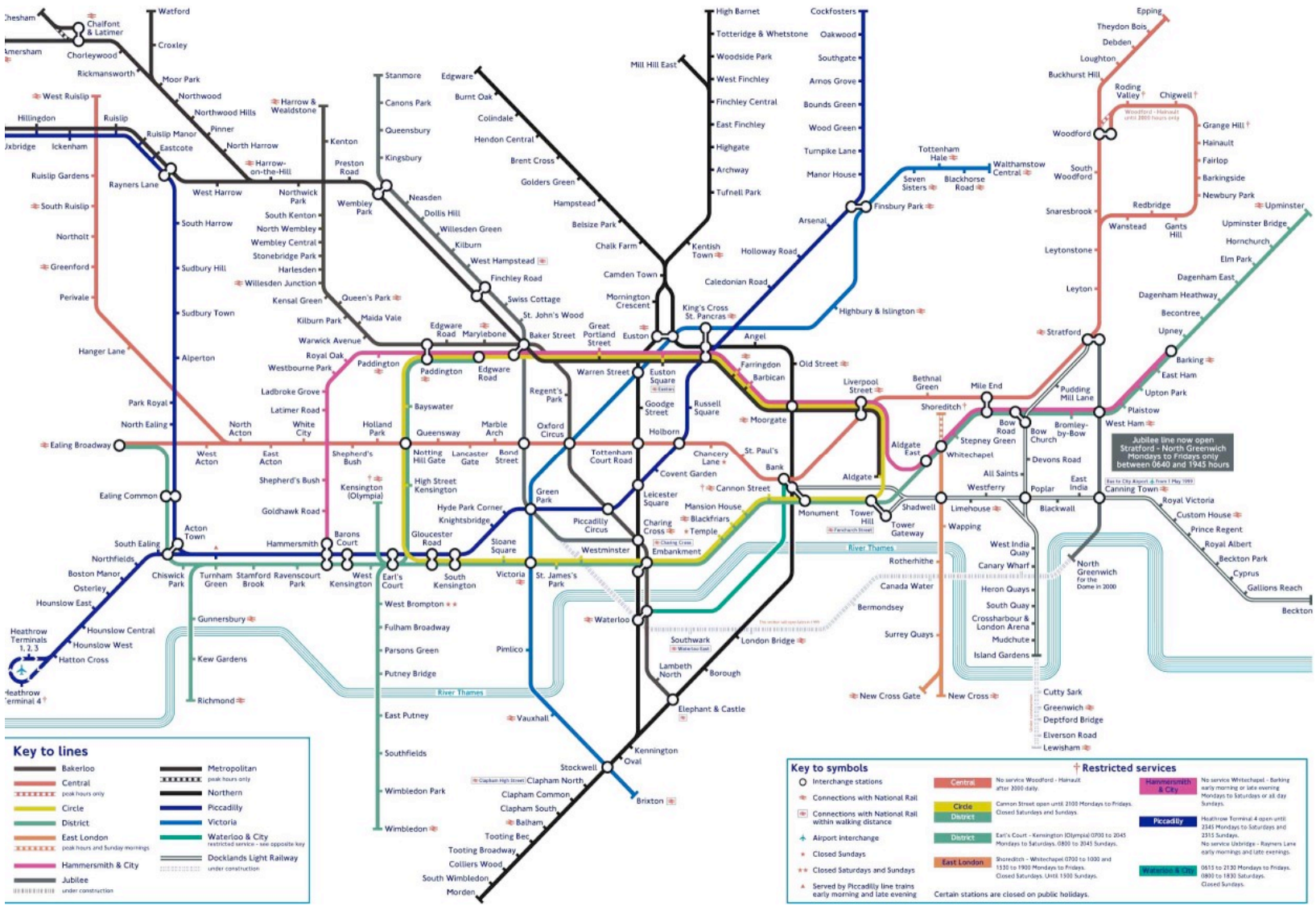
- 1. Start out going Southwest on ELLSWORTH AVE towards BROADWAY by turning right.
- 2: Turn RIGHT onto BROADWAY.
- 3. Turn RIGHT onto QUINCY ST.
- 4. Turn LEFT onto CAMBRIDGE ST.
- 5. Turn SLIGHT RIGHT onto MASSACHUSETTS AVE.
- 6. Turn RIGHT onto RUSSELL ST.



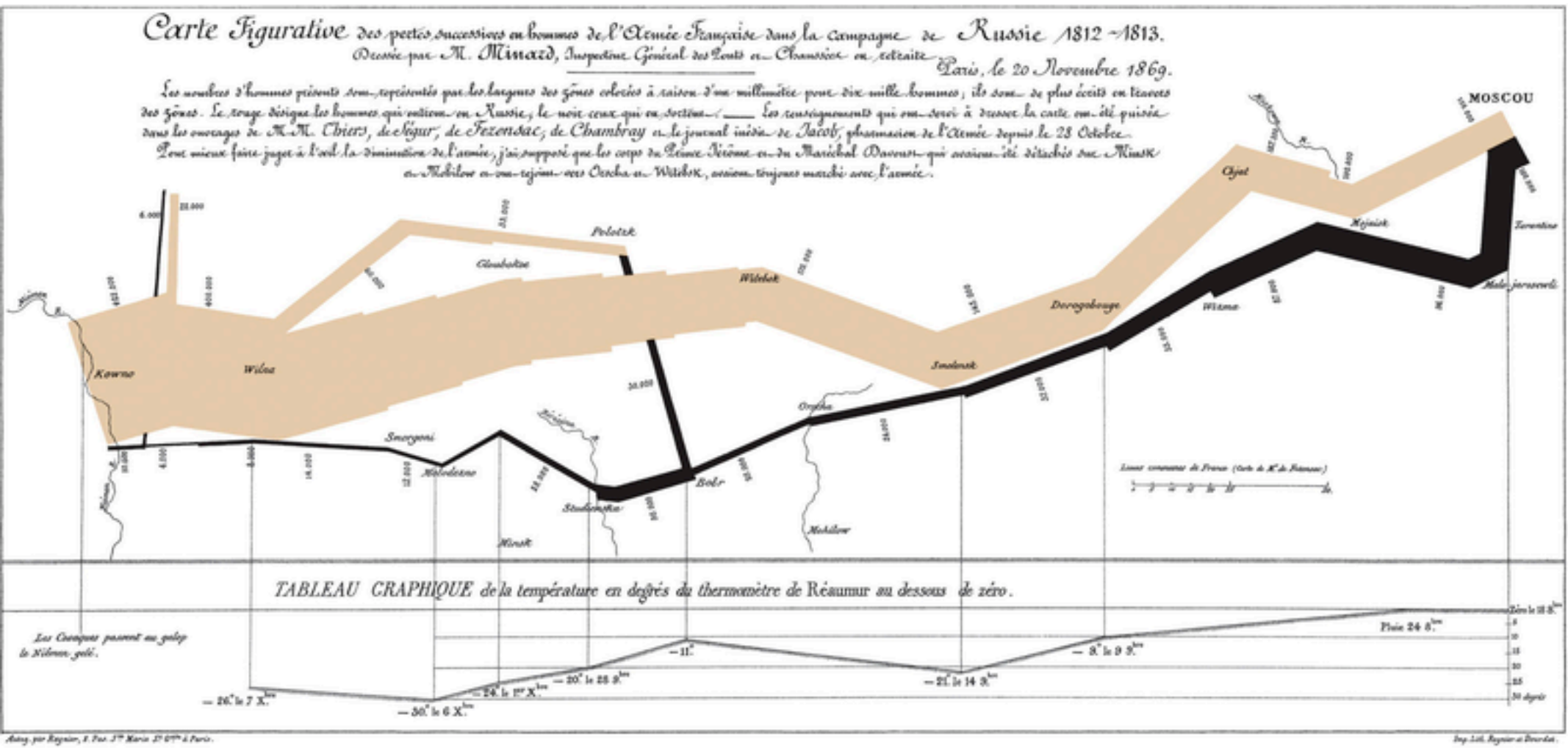
# The Power of Visualization

London Tube Map by Beck
(Topological vs Geographical)



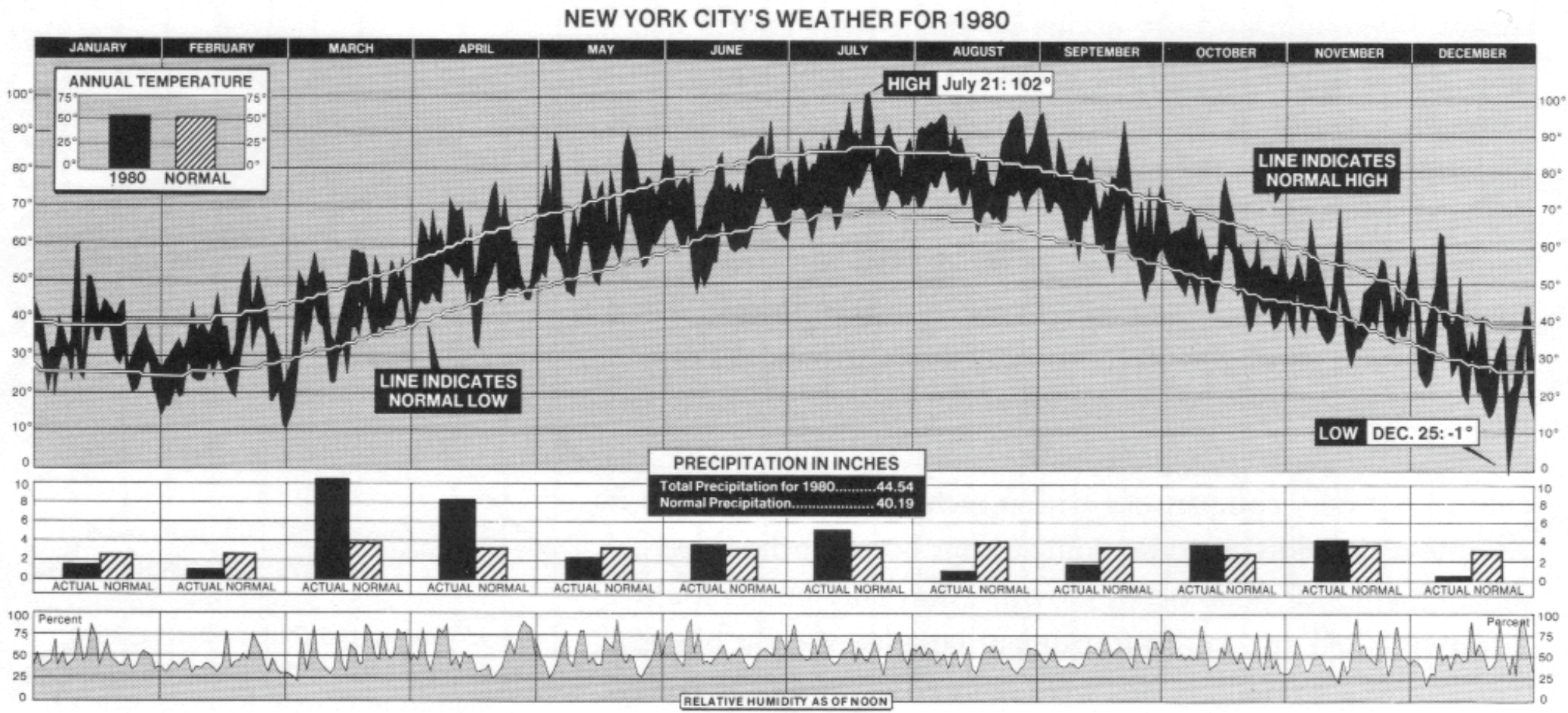
# The Power of Visualization

Napolean's March by Minard
(6 variables represented)



# The Power of Visualization

NYC Weather
(2220 Numbers represented)




*New York Times*, January 11, 1981, p. 32.

# Creating Information Visualizations

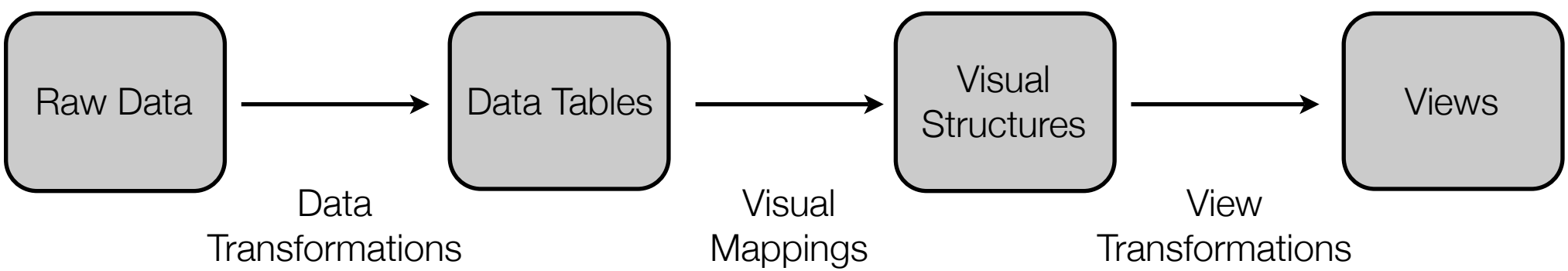
- Tools for InfoVis:
  - Size for quantity
  - Color for distinguishing (selection)
  - Brushing and linking for correspondences
  - Animation for persistence
  - Multiple views for comparison

# Creating Information Visualizations

- Tasks for InfoVis:
  - Searching
  - Browsing
  - Analysis
  - Assimilation
  - Monitoring

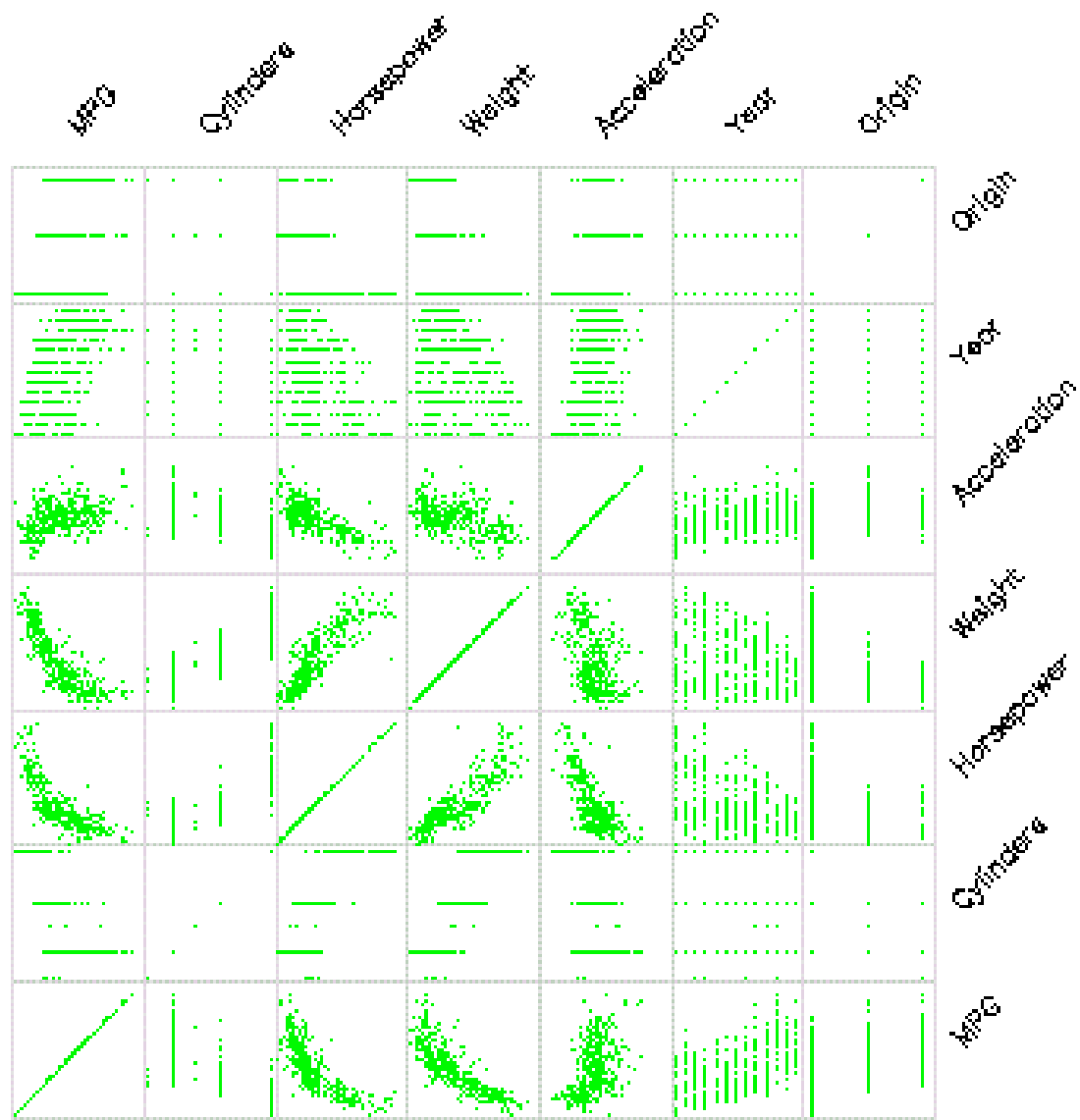
# Creating Information Visualizations

- Process for InfoVis:



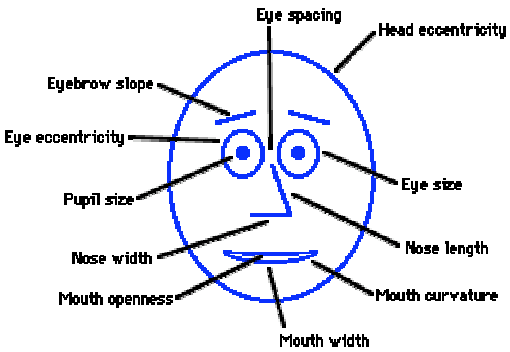
# Multivariate Data

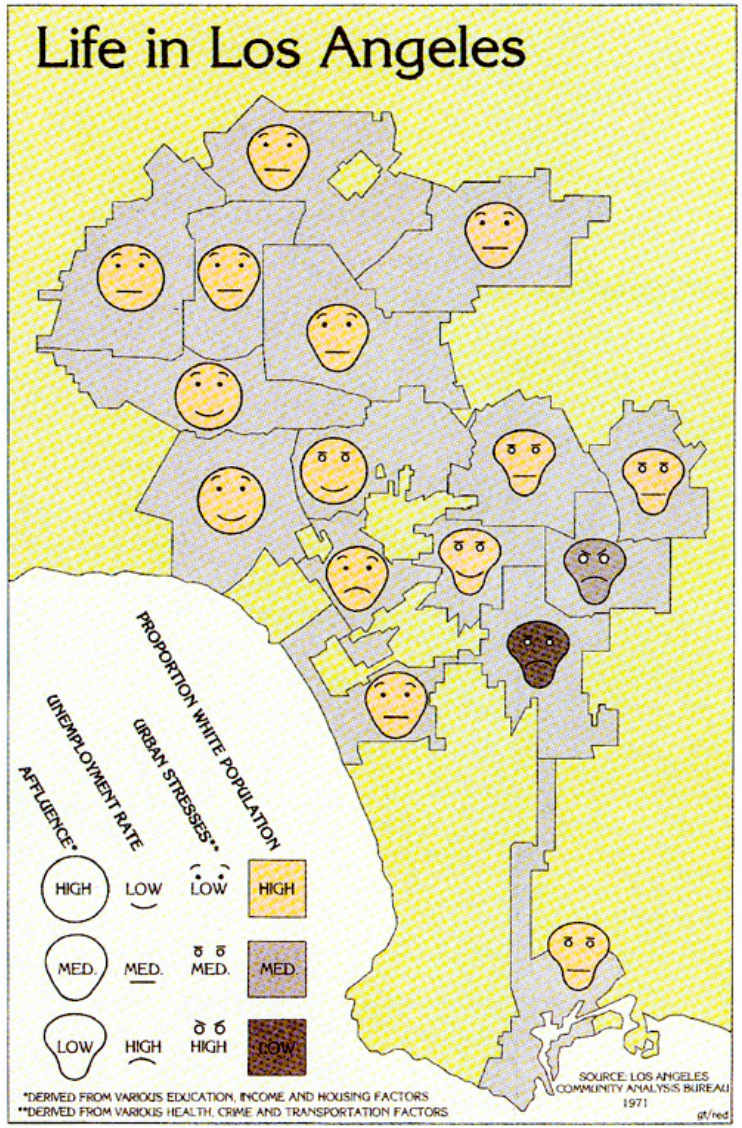
- Scatterplot Matrices

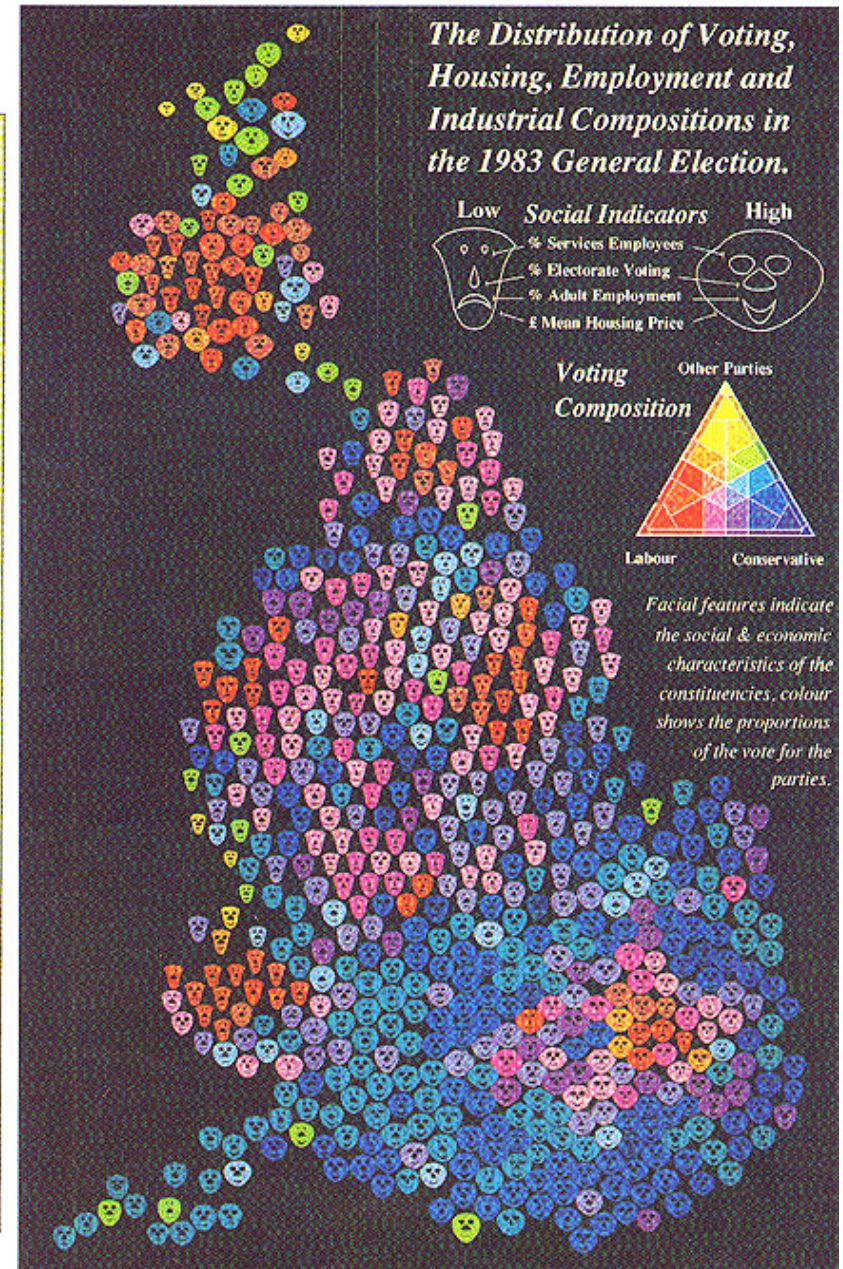


# Multivariate Data

- Chernoff Faces

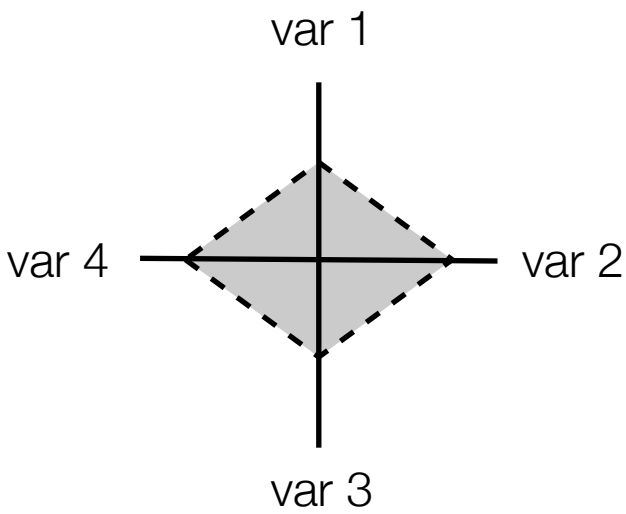


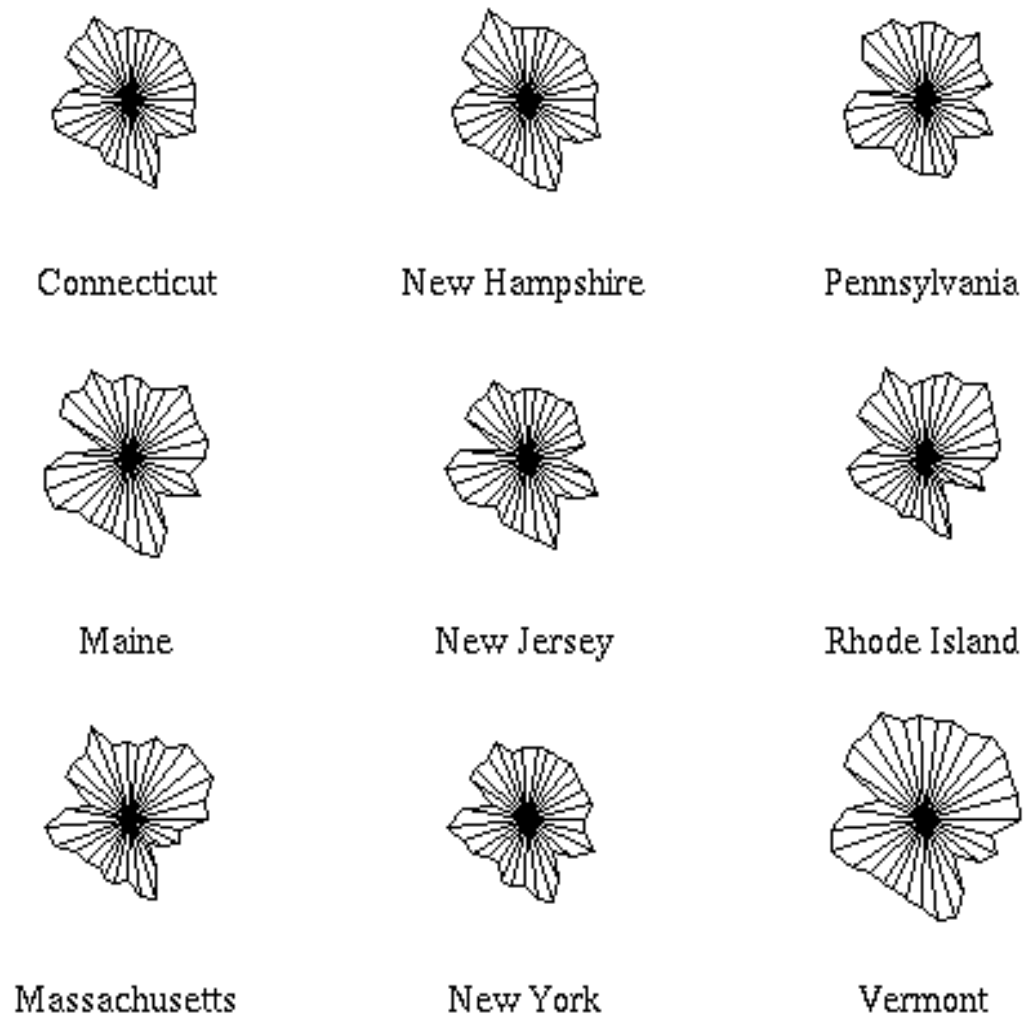



# Multivariate Data

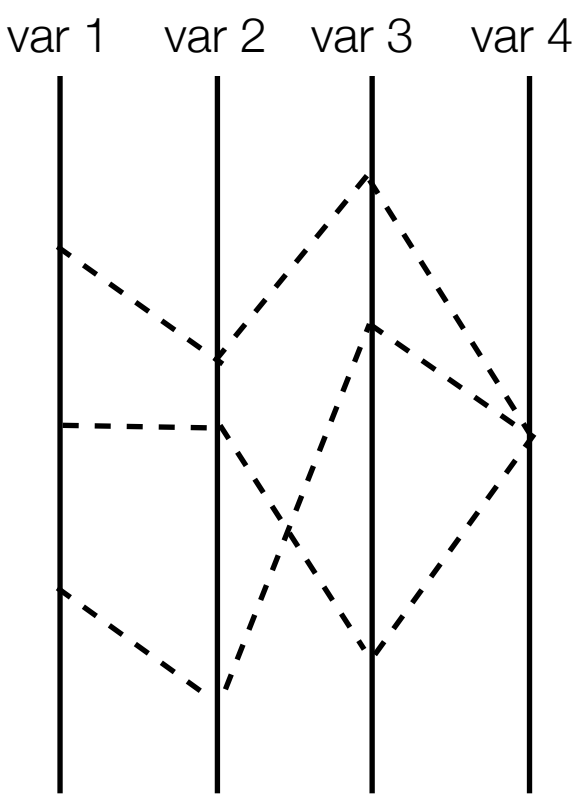
- Star Plots

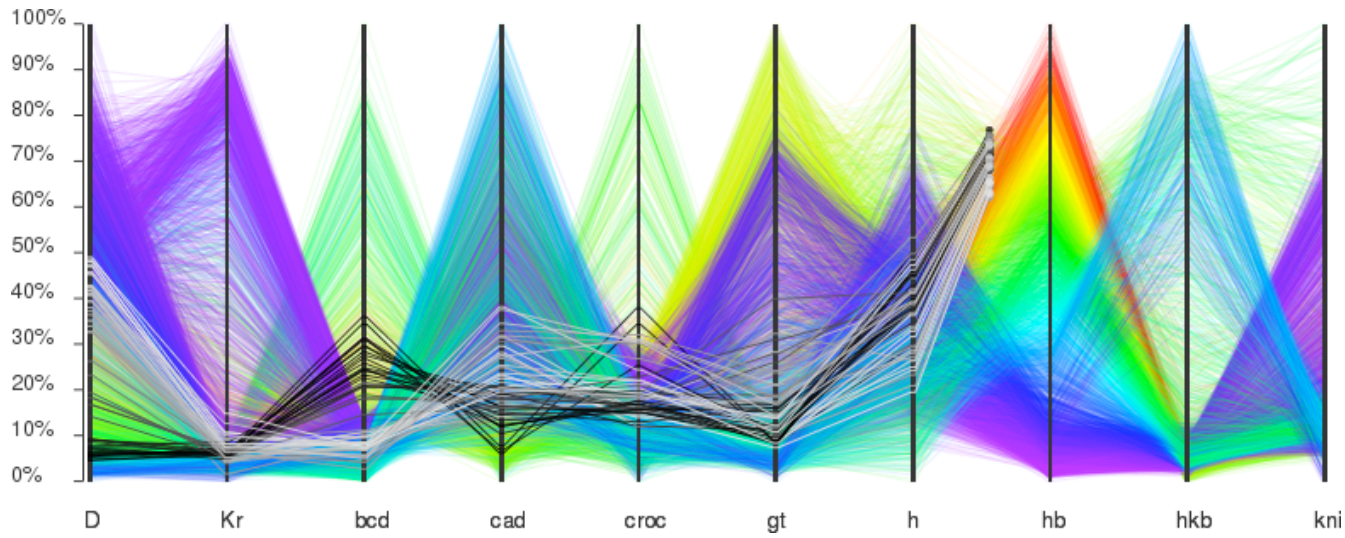


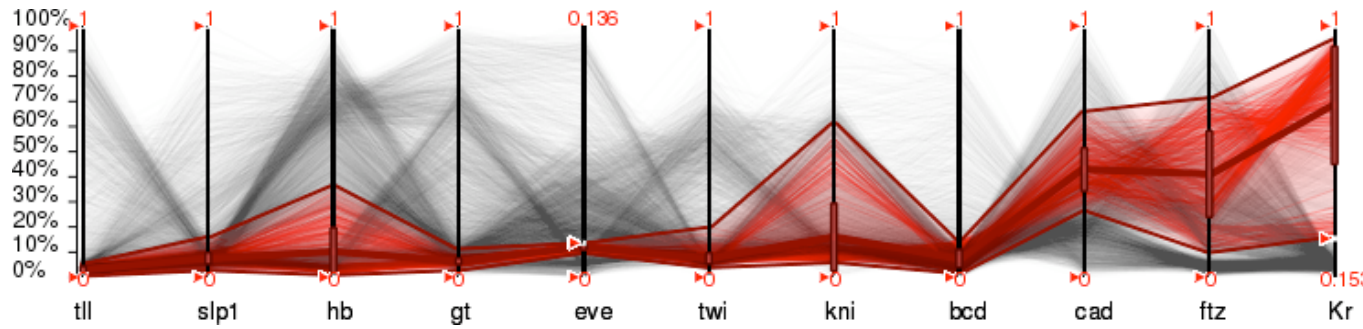



# Multivariate Data

- Parallel Coordinates

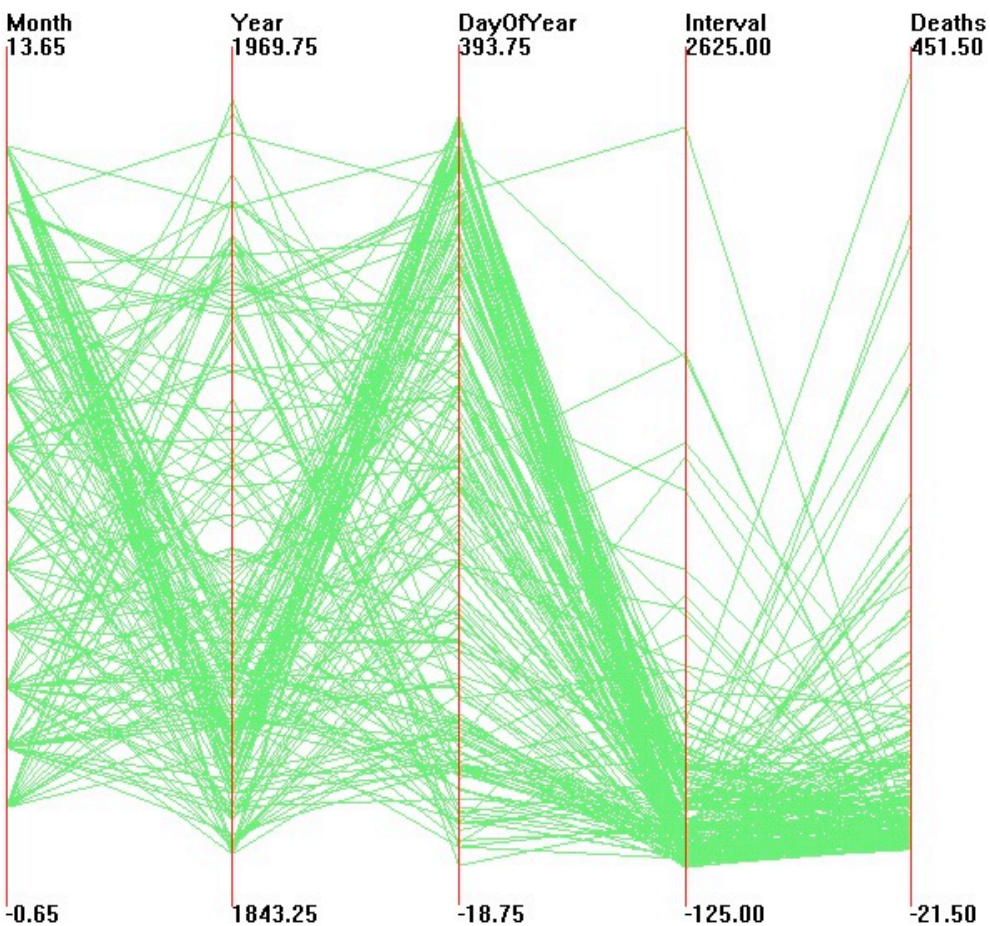


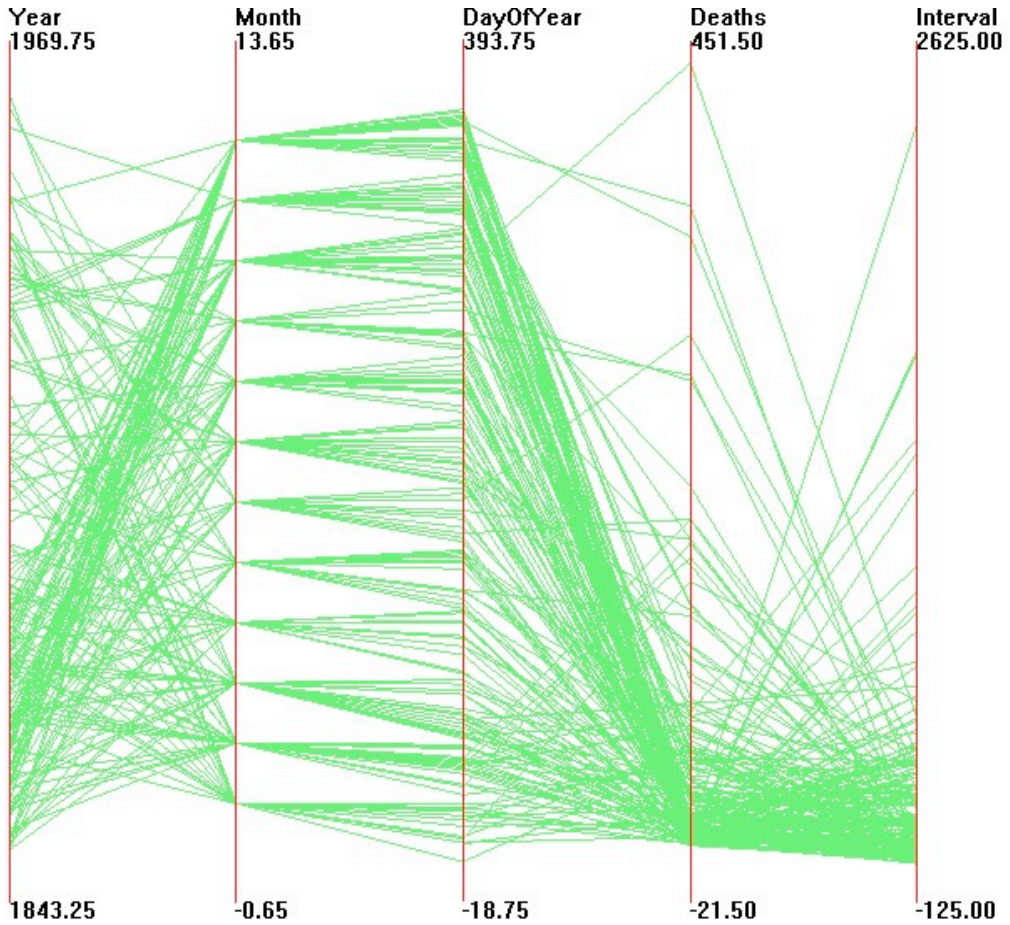



# Multivariate Data

- Parallel Coordinates: Order Matters

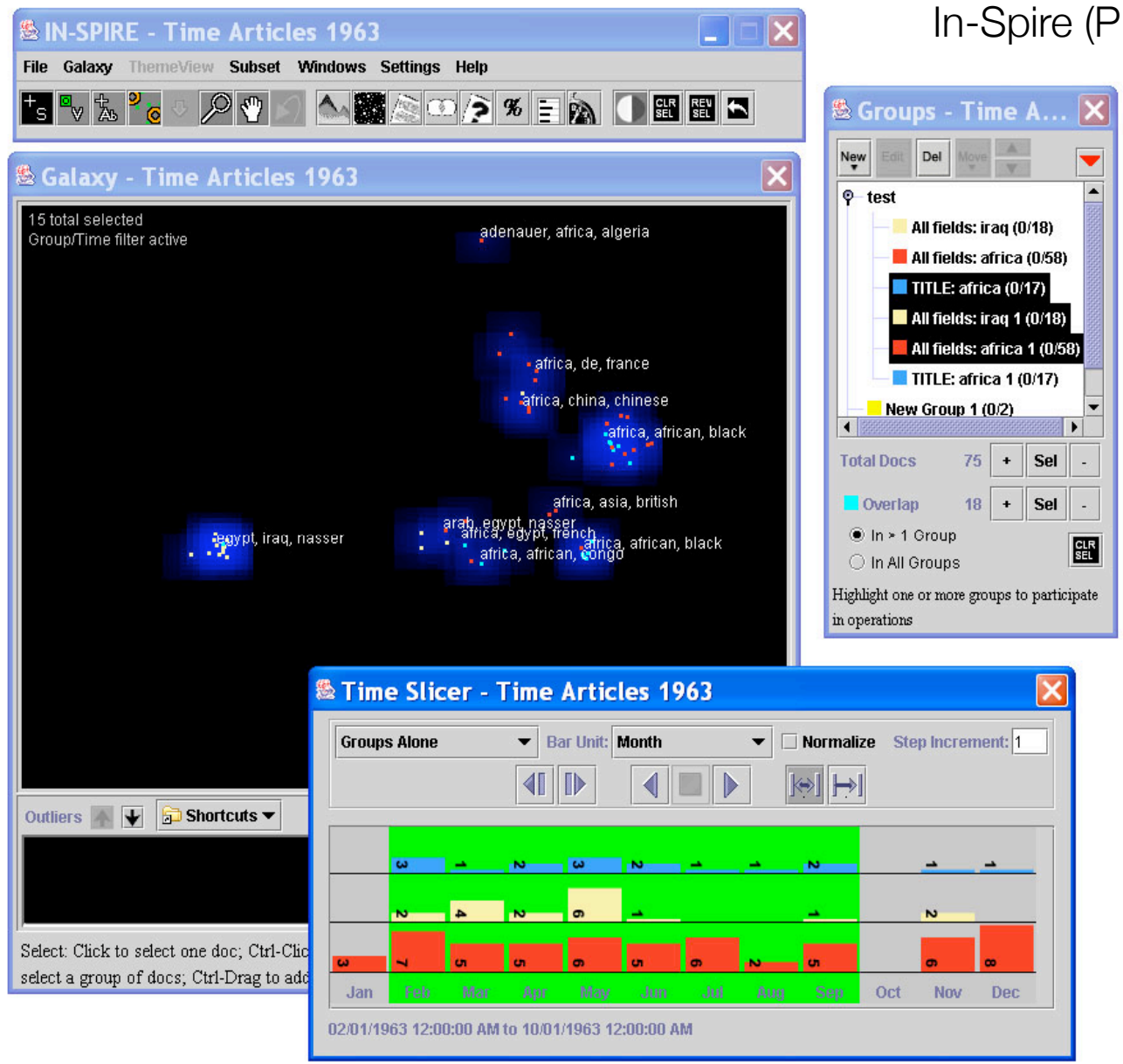


# Multivariate Data

- Clustering

In-Spire (PNL)



# Multivariate Data

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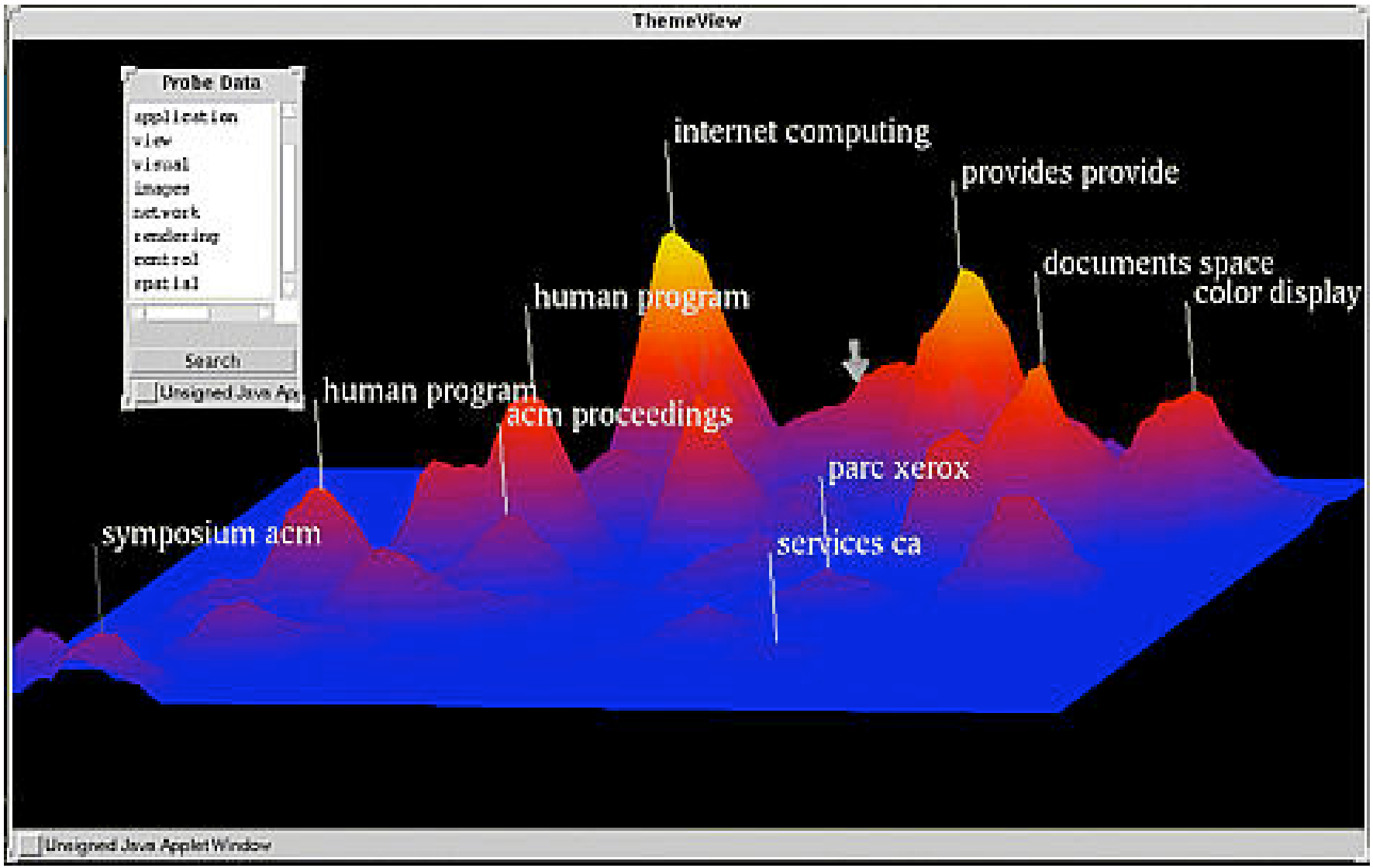
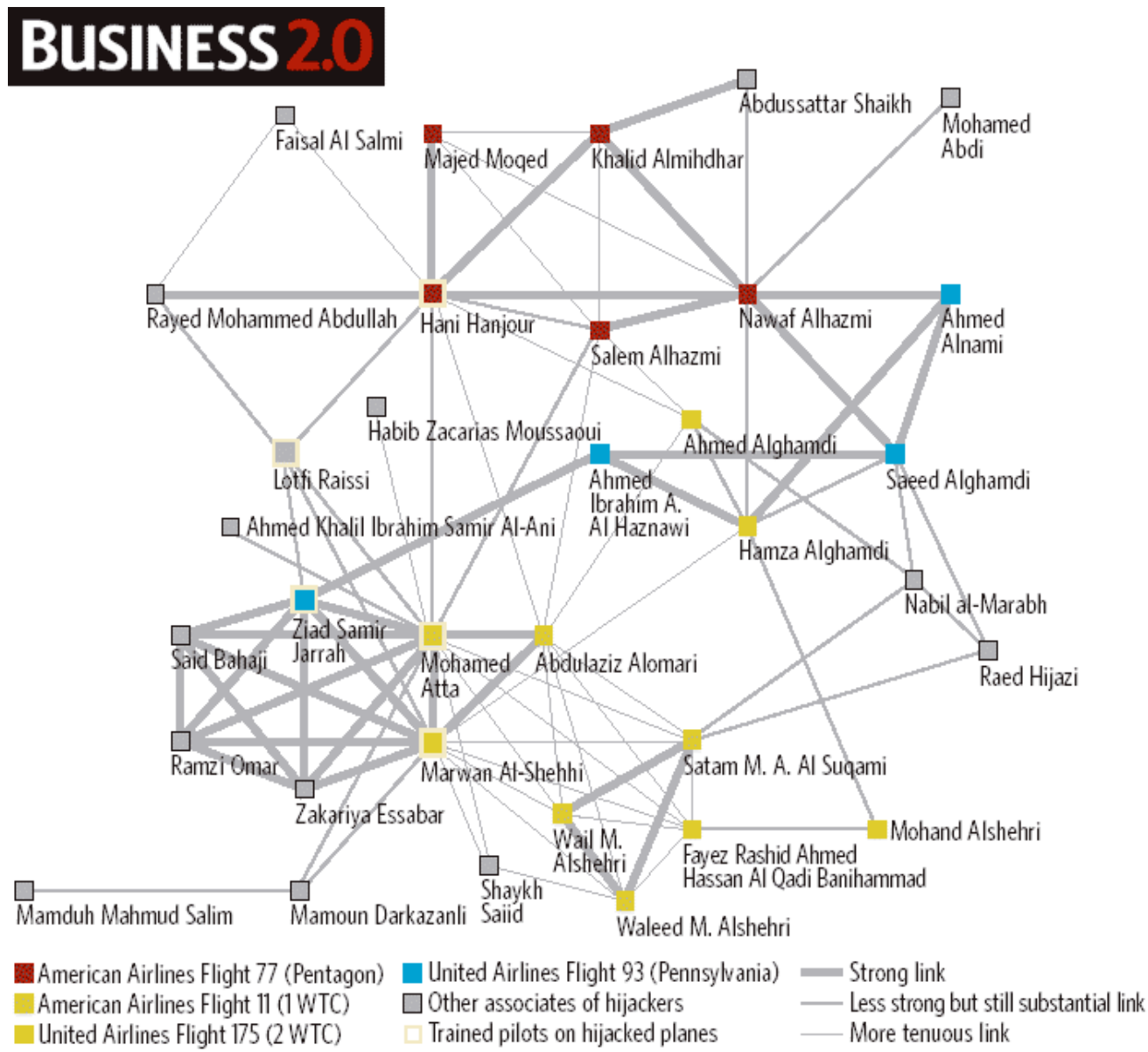


# Connected Data

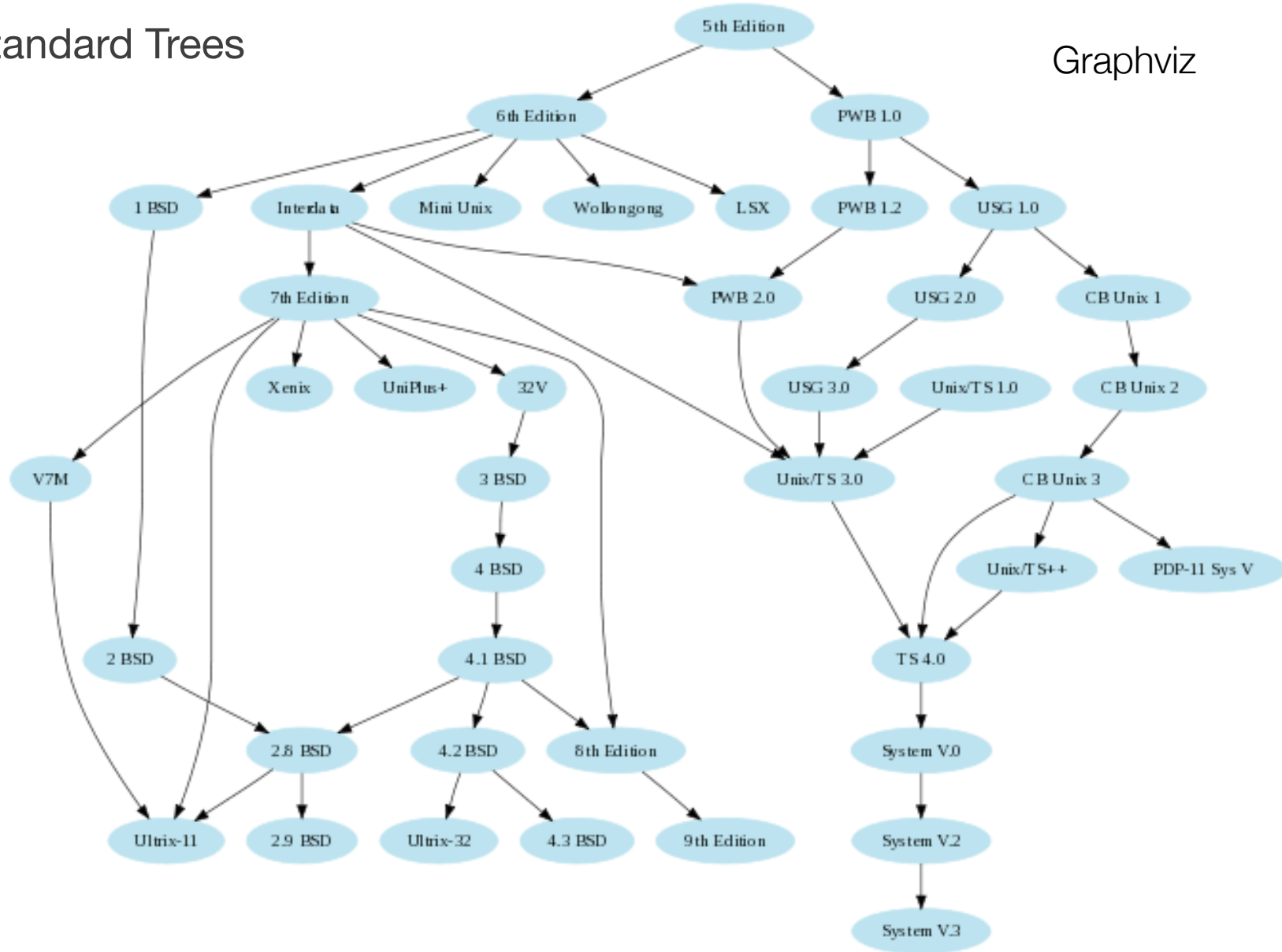
- Graph Layouts



# Hierarchical Data

- Standard Trees

Graphviz



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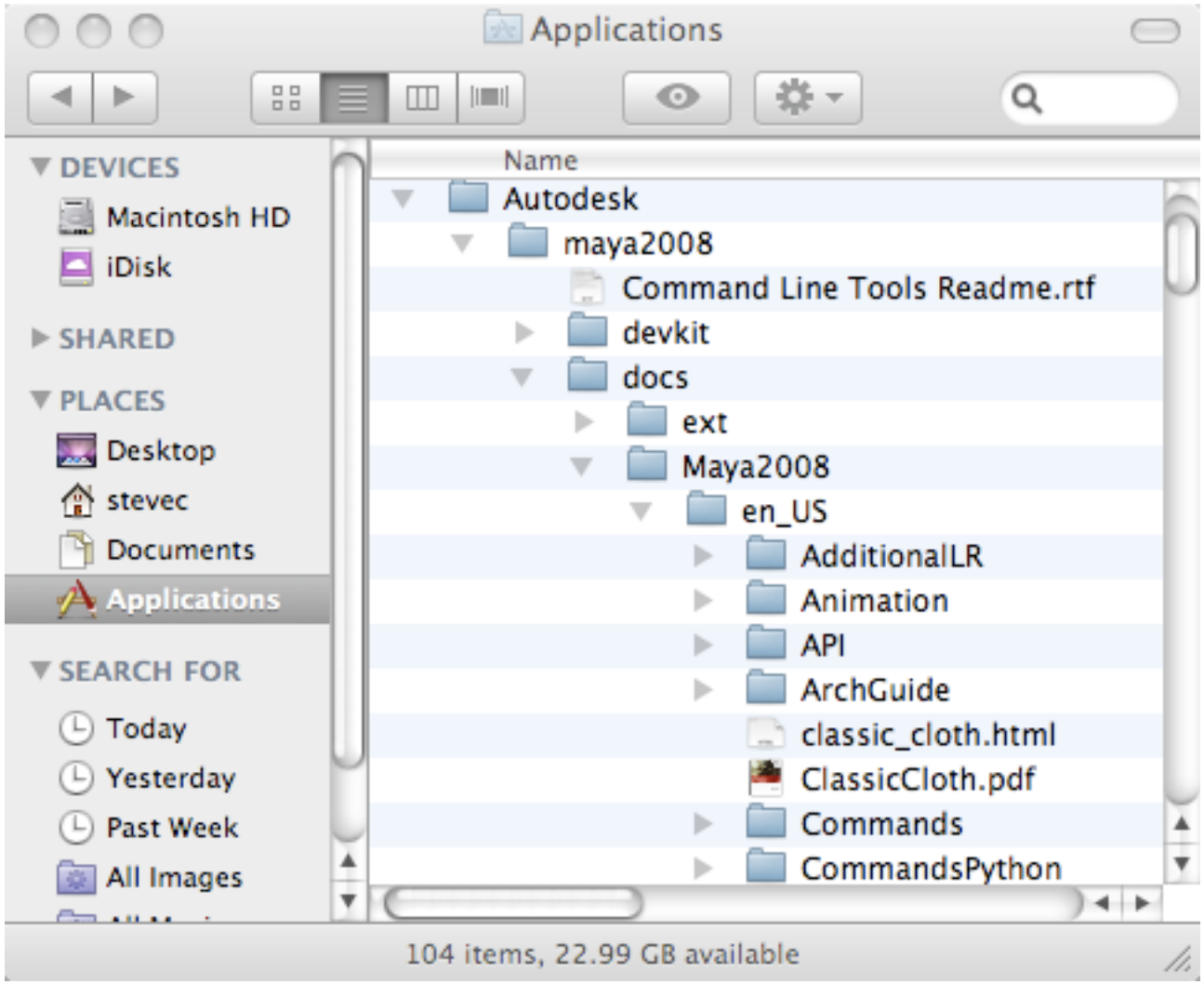
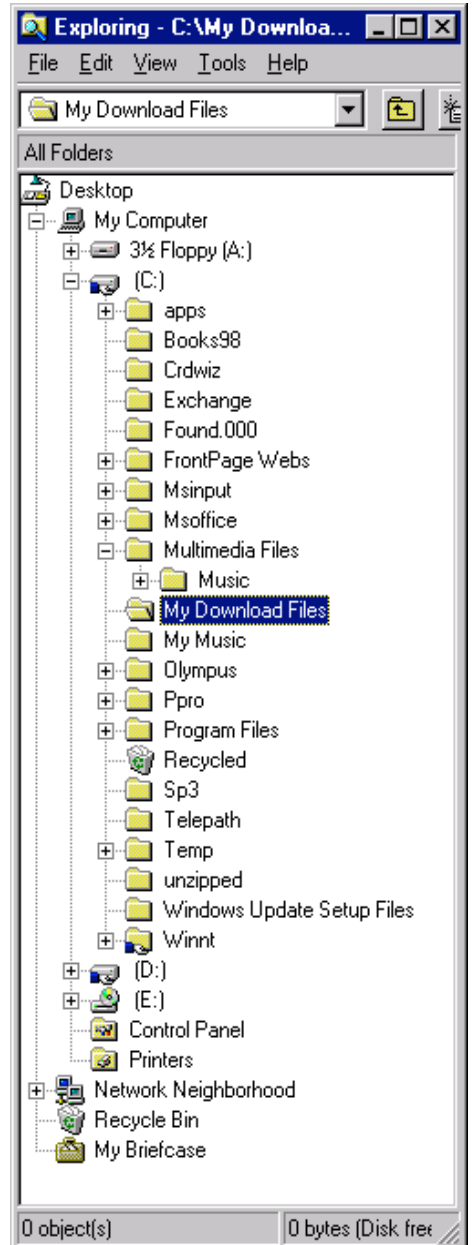
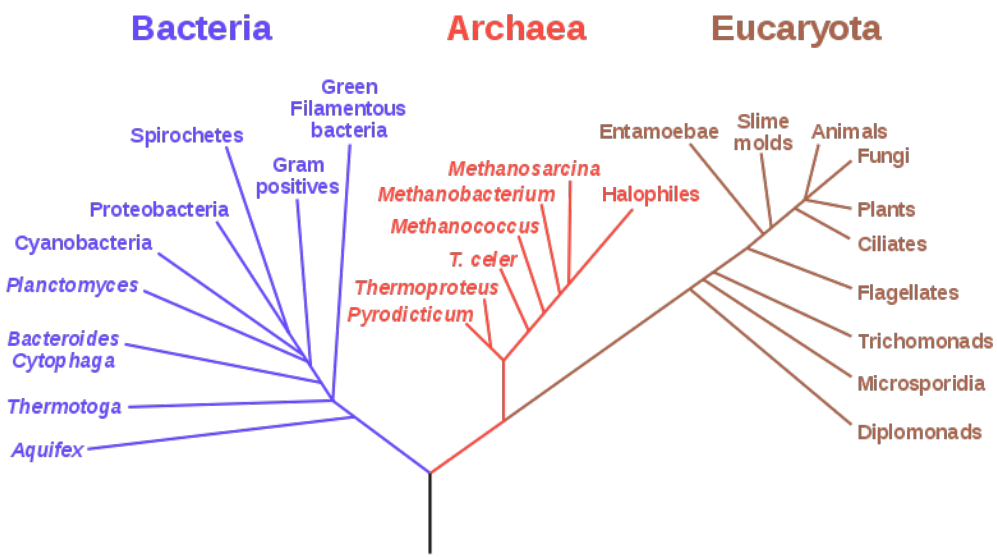
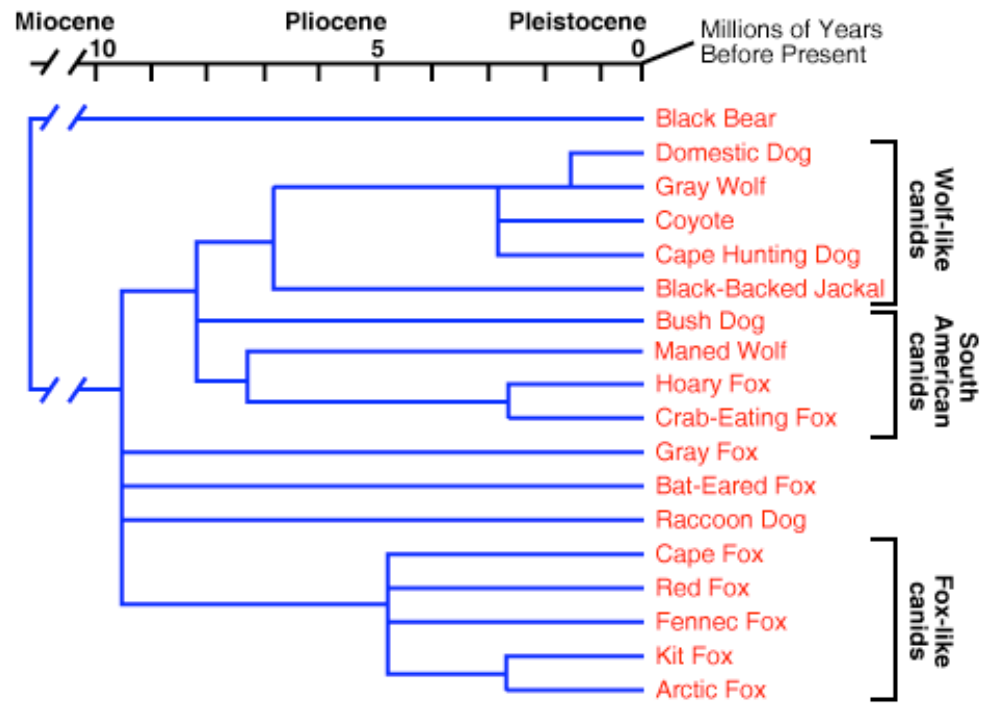


# Hierarchical Data

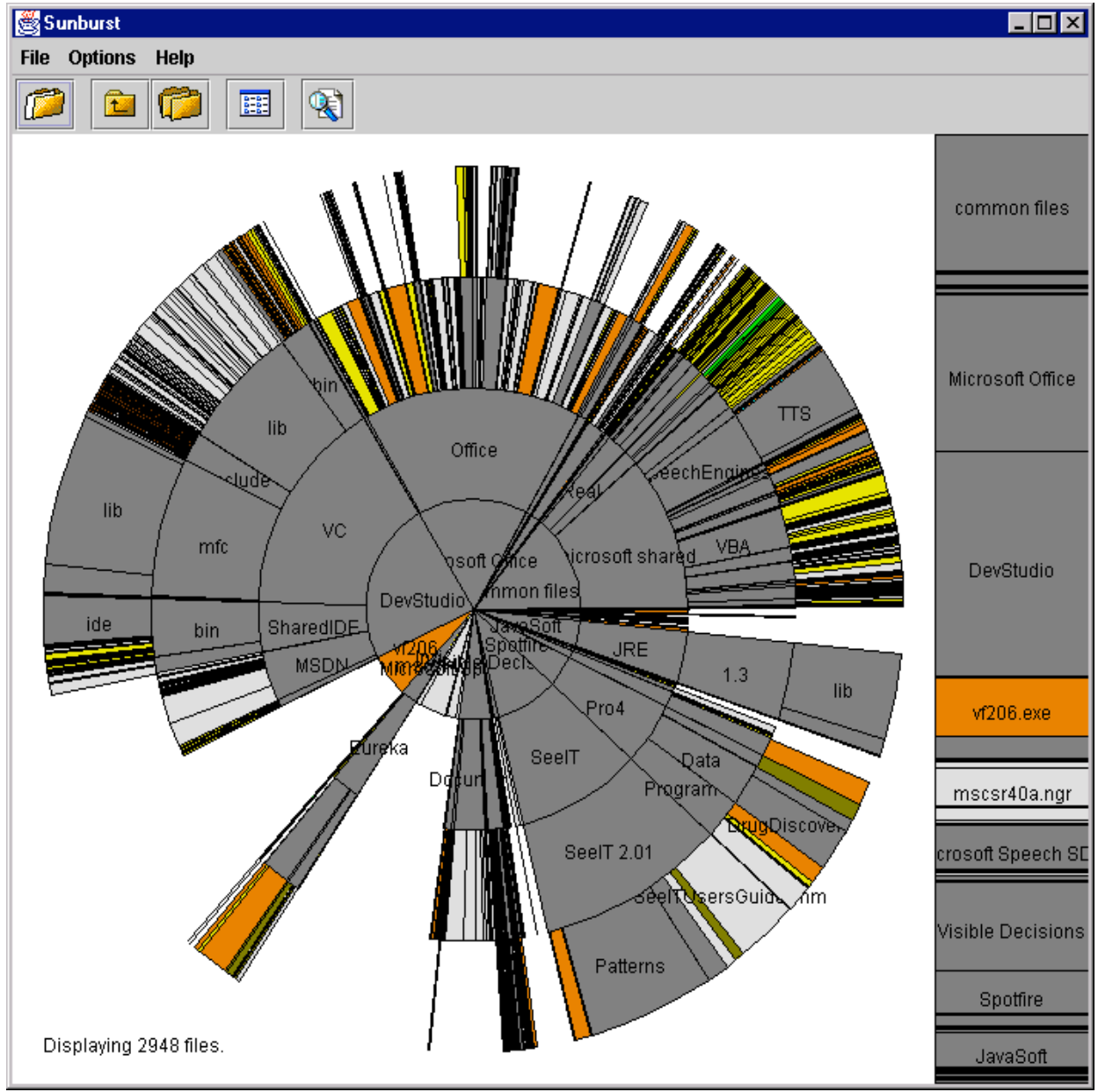
- Phylogenetic Trees



# Hierarchical Data

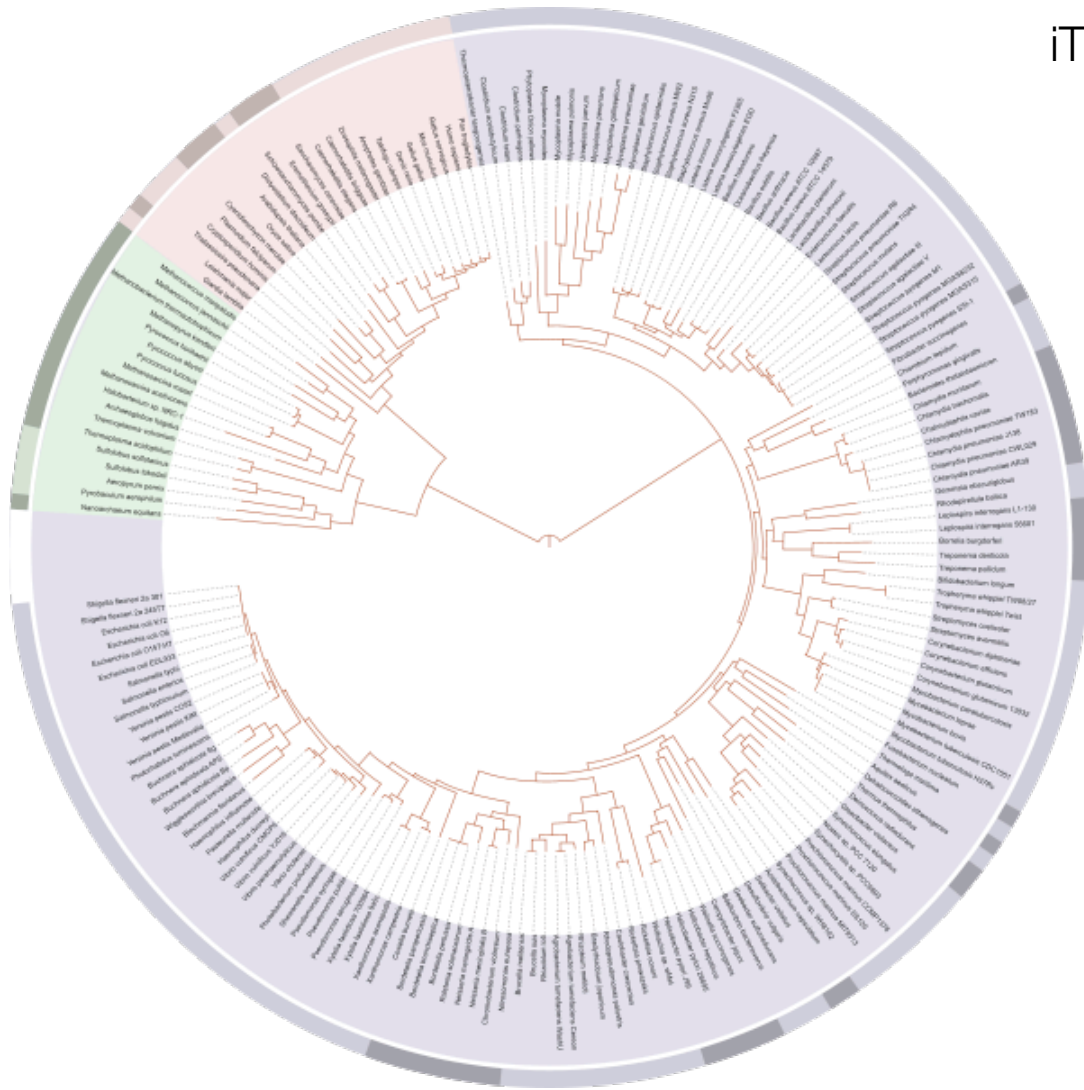
- Radial Trees




Sunburst

# Hierarchical Data

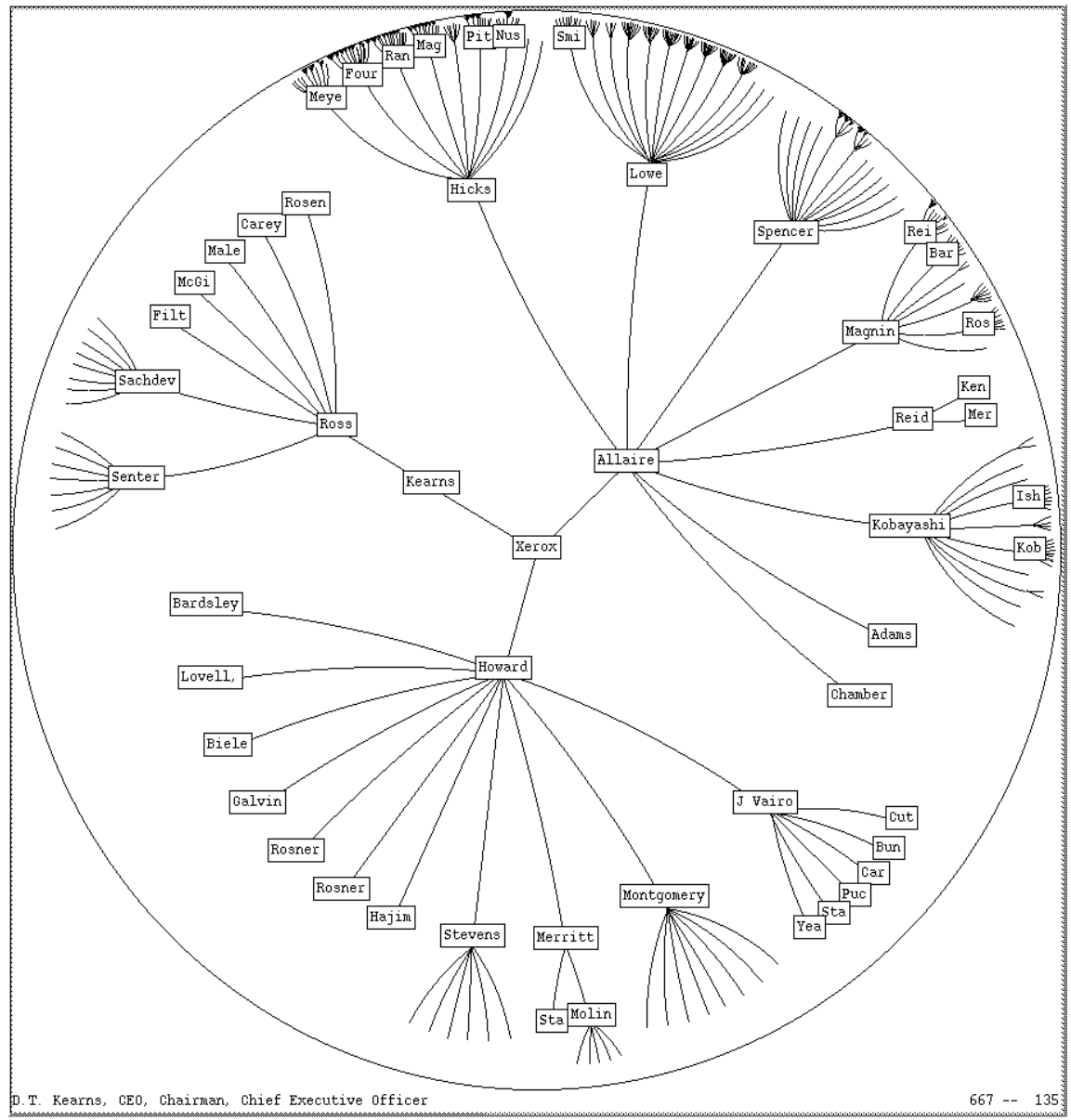
- Radial Trees



iTOL

# Hierarchical Data

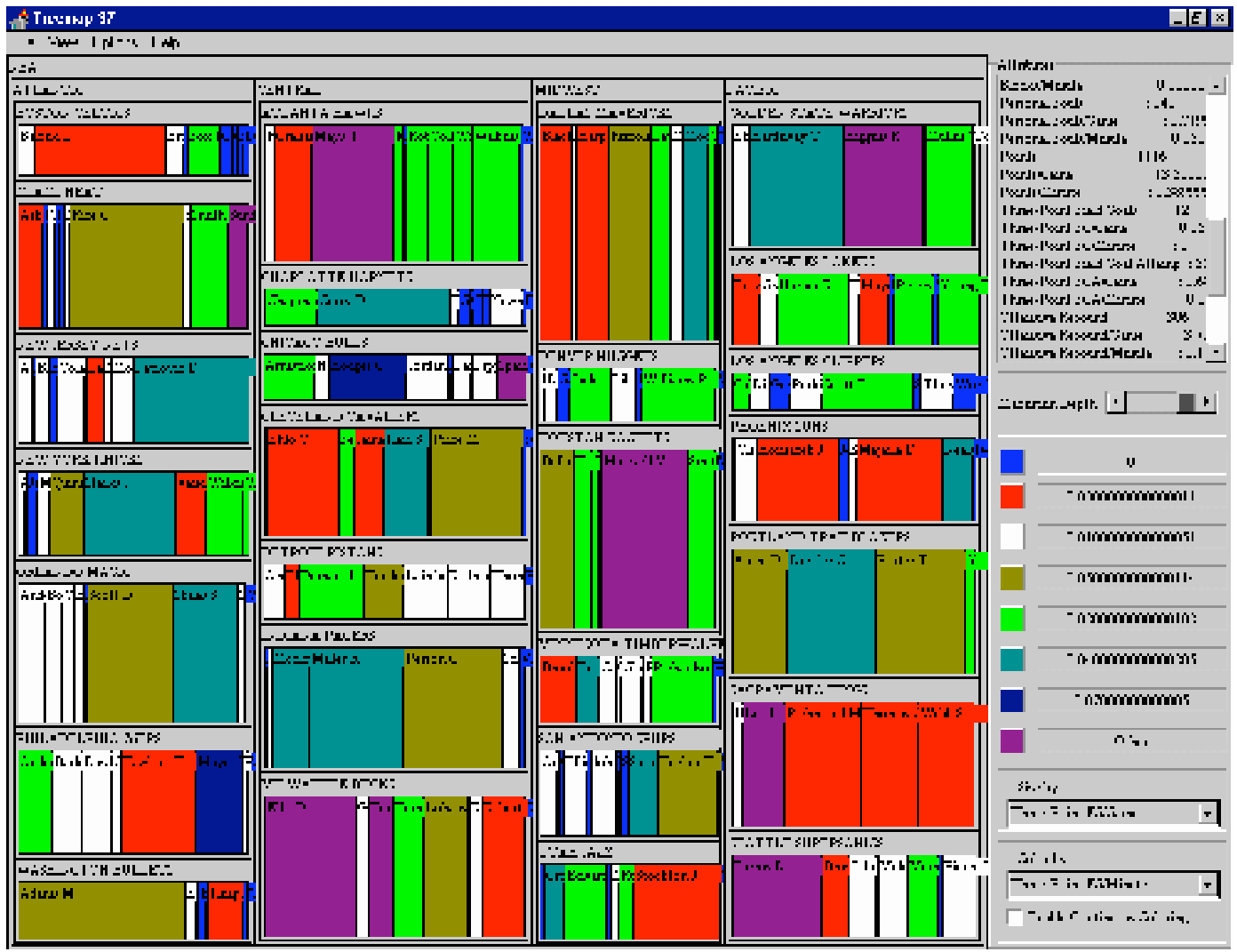
- Hyperbolic Trees



# Hierarchical layouts

- Tree Maps

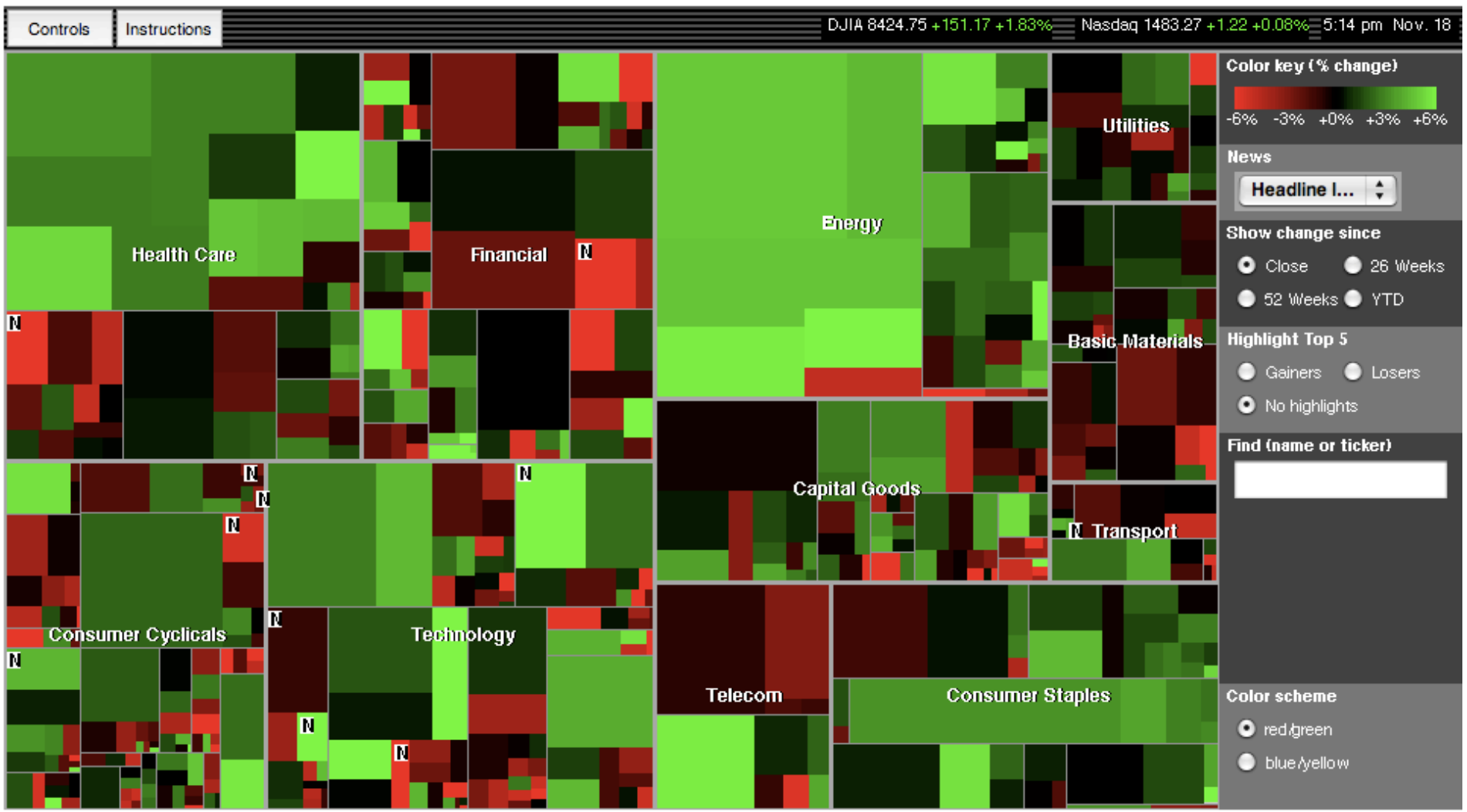
Johnson and Schneiderman



# Hierarchical Data

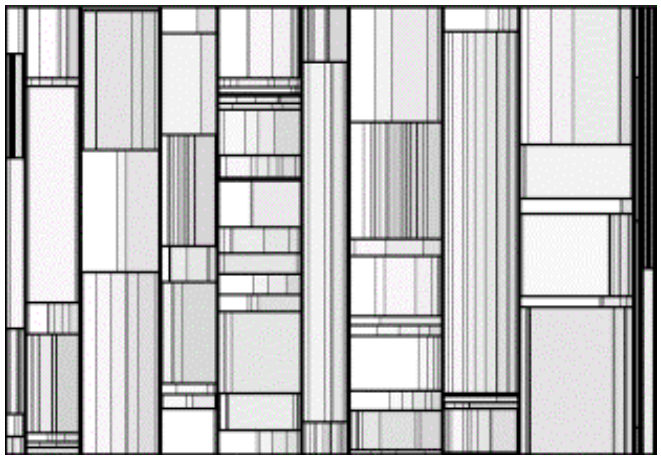
- Tree Maps

smartmoney.com

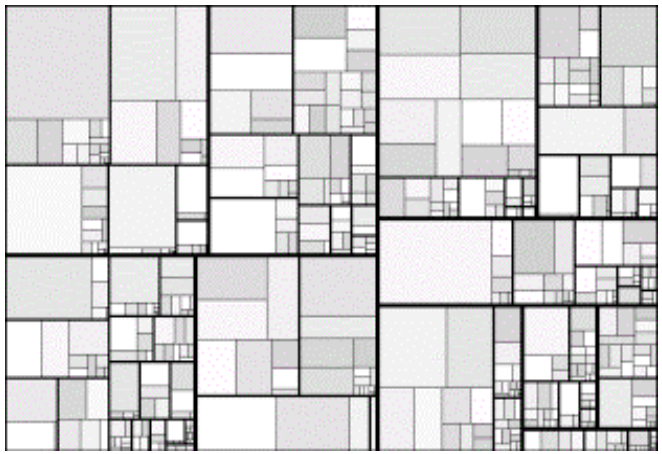


# Hierarchical Layouts

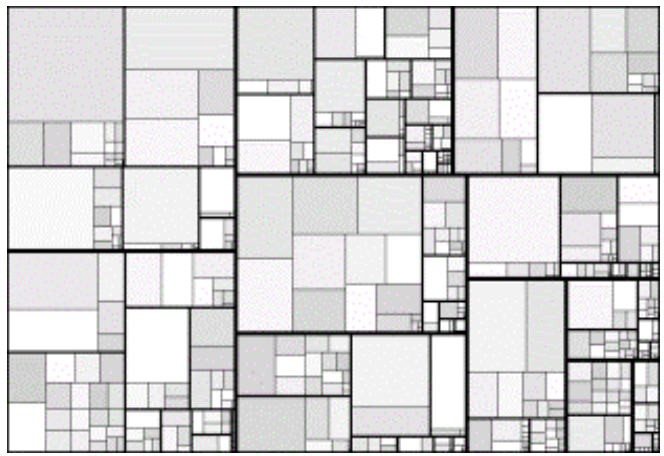
- Tree Maps: Layout matters



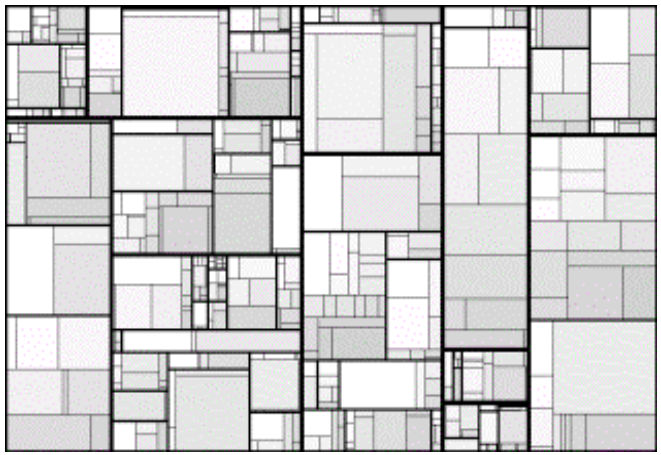
Slice and Dice



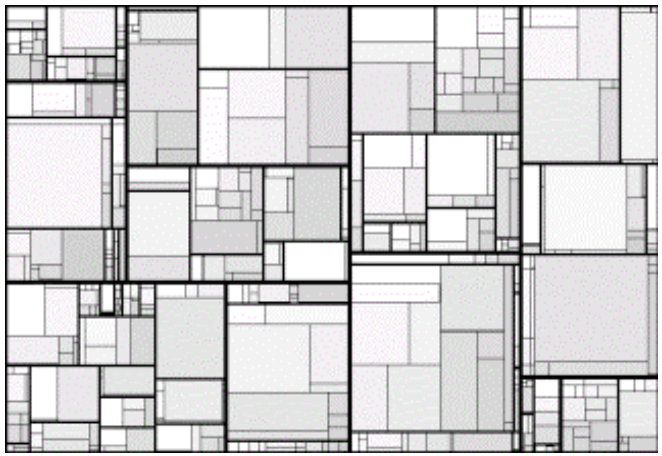
Cluster



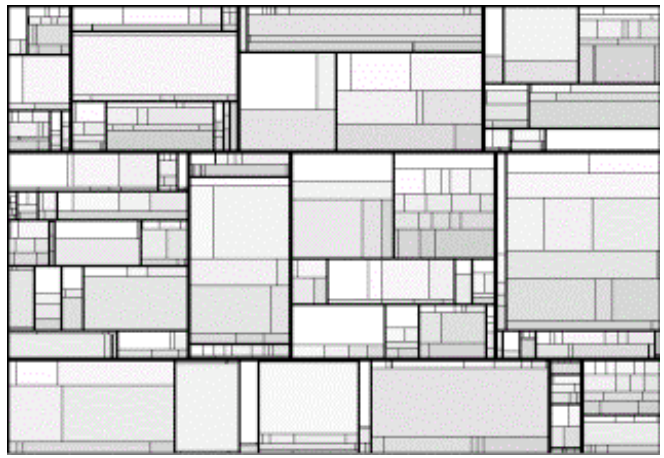
Squarify



Pivot by Middle



Pivot by Size



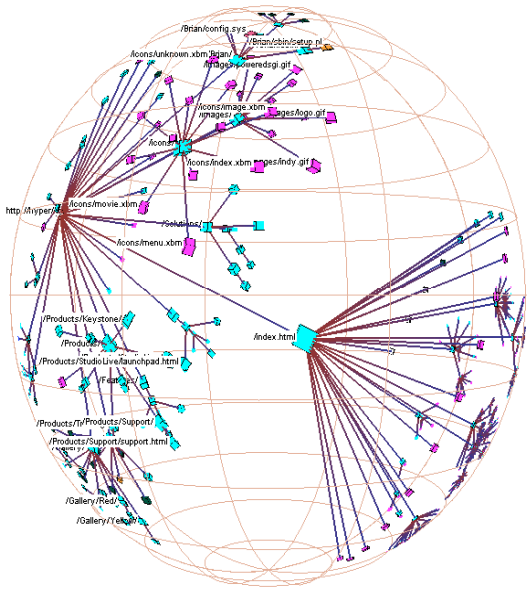
Strip

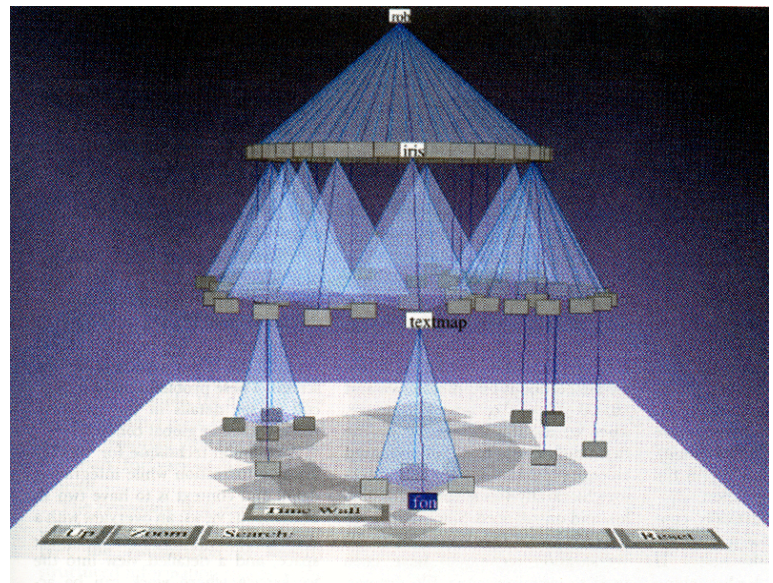
# Map Data

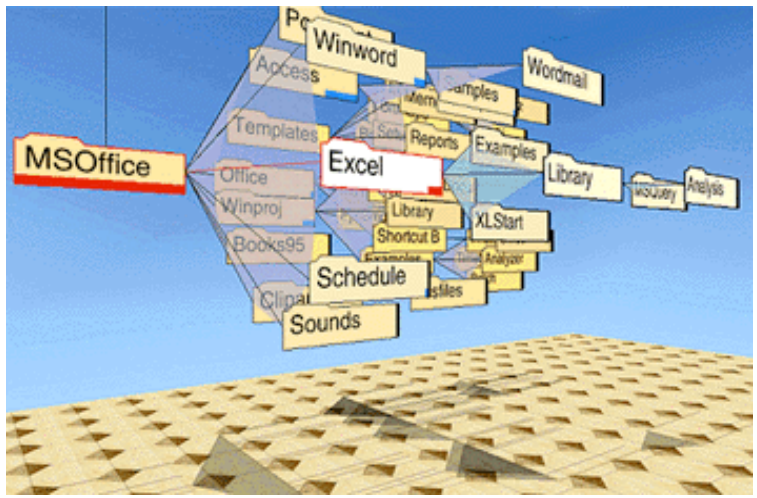
- Cartograms

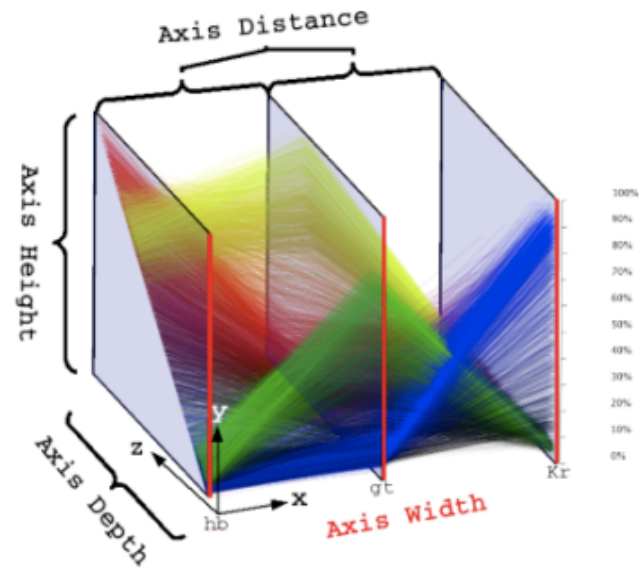
http://www-personal.umich.edu/~mejn/election/2008/

# 3D Techniques



# Interactive Techniques

- Brushing and Animation