Using Space Effectively: 2D II

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CS 294-10: Visualization
Spring 2010

Assignment 4: Visualization Software

Create an interactive visualization application – you choose data domain and visualization technique.

1. Describe data and storyboard interface
due March 1 (before class)

2. Implement interface and produce final writeup
due March 8 (before class)

3. Submit the application and a final writeup on the wiki

Can work alone or in pairs
Final write up due before class on Mar 8, 2010

Announcements: Ben Shneiderman

Speaking: March 3, 2010
Noon – 1pm
Banatao Auditorium, Dai Hall

Please attend lecture instead of class

Topics

Displaying data in graphs
Banking to 45 degrees
Fitting data and depicting residuals
Displaying multidimensional data
Graphical calculations
Zooming and distortion
Parallel Coordinates

Parallel coordinates
Visualizing nD in planar image
- Only 2 orthogonal axes
- Use parallel axes instead

Plot each dimension of point \( x \) on separate axis
- \( x = (a, b, c, d, \ldots) \)

[Parallel coordinates diagram]

Parallel coordinates: Axis ordering

No intrinsic axis order
- Interactive axis swap
- Bad: Relies on human examination
- Good: Powerful interaction
- Machine learning of axis order [Inselberg 99]

5D Automobile Data [Wegman 90]

Parallel coordinates
Proximity-based coloring

Visualizing hierarchical clusters [Fua et al. 99]
Graphical Calculations

1. Compute in any direction; fix n-1 params and read nth param
2. Illustrate sensitivity to perturbation of inputs
3. Clearly show domain of validity of computation

Nomograms

Sailing: The Rule of Three

Theory

\[
\begin{pmatrix}
 x_1(u) & y_1(u) & w_1(u) \\
 x_2(v) & y_2(v) & w_2(v) \\
 x_3(s,t) & y_3(s,t) & w_3(s,t)
\end{pmatrix} = 0
\]
Lambert’s graphical construction

Johannes Lambert used graphs to study the rate of water evaporation as function of temperature (from Tufte 83)
Zooming

Eames’ Powers of Ten [http://www.powersof10.com/]

Overview + details

[Hornbaek et al. 2002]

Interactive zooming

Pad++ [Bederson and Holian ’94]
Pad++

Semantic zooming
Change visual representations as zoom level changes

TableLens [Rao & Card 94]

Datelens [Bederson et al. 04]

http://www.youtube.com/watch?v=qWqTrRAC52U
Distortion

Single view detail + context

- Focus area – local details
- De-magnified area – surrounding context
- Like a rubber sheet with borders tacked down

Nonlinear Magnification Infocenter [http://www.cs.indiana.edu/~tkeahey/research/nlm/nlm.html]

Bifocal display [Leung and Apperley 94]

Multifocal display [Leung and Apperley 94]
Fisheye [Leung and Apperley 94]

Nonlinear magnification [Leung and Apperley 94]

3D pliable surface [Carpendale & Montagnese 01]

Aligned and sheared [Carpendale & Montagnese 01]
6 types of distortions [Carpendale & Montagnese 01]

Gaussian, Cosine, Hemisphere, Linear, Inverse Cosine and Manhattan. Top row shows transition from focus to distortion, bottom row from distortion to context.

Cartographic Distortions

Cartograms: Distort areas

Scale area by data [From Cartography, Dent]

Election 2004 map

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

American population [van Kreveld and Speckmann 04]

Native American population [van Kreveld and Speckmann 04]

Dorling cartogram

States as nodes in a graph

Graphical fisheye views of graphs [Sarkar & Brown 92]
Distorting distances

Scale distance by data

[From Cartography, Dent]

London underground

http://www.thetube.com/content/history/map.asp

Comparison to geographic map

Distorted    Undistorted

Summary

- Spatial layout is the most important visual encoding
- Geometric properties of spatial transforms support geometric reasoning
- Show data with as much resolution as possible
- Use distortions to emphasize important information