Information Esthetics

manifesto
- information content can enhance aesthetic experience
  and aesthetic consideration can enhance information content

successful infovis as example
- design guidelines for visual encoding as interplay of
  perception, cognition, esthetics, and data/task characterization

Outline

15 Views
- Traditional Graphs
- Nontraditional Representations
- Focus+Context Trees

Wrapup

Visual Channels

visual attribute of geometric mark
- position, color, size, shape, orientation, ...

separable vs. integral

[Ware. Information Visualization: Perception for Design. Morgan Kaufmann 1999.]
Critique

strengths
- easy to create

weaknesses
- requires too much memory and cognition
- does not exploit human perceptual system

Visual External Representation

read off answers from node–link graph drawing
- connections drawn between nodes
- offload cognition to visual system

3: Dot

data: semantic network

automatically compute positions for nodes, edges

strengths
- fast: one second to create
- careful routing of curved edges

weaknesses
- low information density
  - can't read labels

Graph Layout Criteria

minimize
- crossings, area, bends/curves

maximize
- angular resolution, symmetry
Graph Layout Criteria

- minimize crossings, area, bends/curves
- maximize angular resolution, symmetry

most criteria individually NP-hard
- cannot just compute optimal answer
- heuristics: try to find something reasonable

Critique

- strengths
  - intuitive model
  - many mathematical approaches

- weaknesses
  - does not scale to large datasets

5: TopoLayout

multilevel decomposition and layout
- automatic detection of topological features
  - chop into hierarchy of manageable pieces
- lay out using feature-appropriate algorithms

[work in progress: Daniel Archambault, Tamara Munzner, and David Auber]

Multilevel Hierarchies

data: web sites, network backbones
- strengths: handles large class of graphs
- weaknesses: poor if no detectable features

[work in progress: Daniel Archambault, Tamara Munzner, and David Auber]
6: Animated Radial Layouts

dynamic graphs that change over time
- minimize visual changes
- stay true to current dataset structure
[video: www.sims.berkeley.edu/~ping/gv]


Critique

strengths
- smoother transitions

weaknesses
- not scalable to large datasets

7: Constellation

data: semantic network from dictionary entry
- nodes: English words, links: used together in entry
information density
- design tradeoff with visual salience


Traditional Layout

avoid crossings
- considered "aesthetic criterion"
reason: avoid false attachments

A
B
C
D

ambiguity artifact salience

Selective Emphasis

highlight sets of boxes and edges
- additional perceptual channels based on interaction
avoid perception of false attachments
- avoid hidden state
[video: graphics.stanford.edu/videos/const]

Critique

strengths
- highly specialized
- good information density in final version
- perceptual layering successful

weaknesses
- highly specialized
- custom system design is expensive

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8: Treemaps

data: filesystems, stock performance

show structure with containment not connection
- size according to node attribute


Critique

strength: popout for extreme attributes

weaknesses: difficulties seeing structure


9: Cushion Treemaps

data: filesystems

show structure with shading
- scale parameter controls global vs. local


Critique

strengths
- shows more topological structure than plain treemaps
- keeps power to show attribute outliers
- allows color to be used to encode other info

weaknesses
- still considerably worse than node-link representation for showing topological structure
10: Themescapes

**data:** news stories, gene expression

- from graph to terrain

Davison et al. Cluster Stability and the Use of Noise in Interpretation of Clustering. InfoVis 01


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11: Multilevel Call Matrices

**data:** large software project

- link matrix vs. node–link network
- matrix force-directed layered subset (dot)

- position: box shows link between nodes in row/column
- color: calls not in specification in red


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Critique

**strengths:** tasks successfully supported

- spotting unwanted calls in implementation but not specification
- previous summary shown to be incomplete

**weaknesses**

- matrix views poor for some tasks


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Outline

**Visual Encoding**

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**Focus + Context**

combine overview, details into integrated view
- vs. single detail view
- vs. multiple linked windows

**12: SpaceTree**

data: org charts, species relationships
interaction: expand/contract
- [demo: www.cs.umd.edu/hcil/spacetree]

strengths
- animated transitions easy to follow
weaknesses
- cannot have multiple areas of focus


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**13: 2D Hyperbolic Trees**

data: org charts, web sites
node: document
link: hyperlink between pages
carefully chosen distortion
- fisheye effect: single focus from hyperbolic geometry
- [demo: ucsps.berkeley.edu/map2.html]


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**Critique**

strengths
- scales to over 10,000 nodes
weaknesses
- distortion poor for distance judgement tasks
- still possible to get lost in large graphs

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**14: H3**
data: web sites, species relationships
3D fisheye from hyperbolic geometry
- [demo: graphics.stanford.edu/~munzner/h3]


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**Critique**

strengths
- scales to over 100,000 nodes
weaknesses
- distortion poor for distance judgement tasks
- still possible to get lost in large graphs
15: TreeJuxtaposer

data: species evolutionary relationships
task: side by side comparison
accordion drawing
- guaranteed visibility of landmarks
- stretch and squish navigation
  [demo: olduval.sf.net/tj]

Guaranteed Visibility
drawing colored marks
- easy with small datasets
- hard with big datasets
reasons a mark could be invisible
- outside the window
- underneath other marks
- smaller than a pixel
benefits of GV
- minimizes amount of navigation required
- guides necessary navigation choices
- provides visible landmarks

Critique
strengths
- scalability to millions of nodes
  guaranteed frame rate
- guaranteed visibility
- supports multiple focus areas
weaknesses
- stretch and squish navigation inappropriate for tasks
  requiring distance estimation
- computationally intensive

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Hard Problems
designing within huge space of possibilities
scalability
- size of dataset
- number of pixels
- kinds of data
dynamic data
characterizing Focus+Context
- how and when does it help

Grand Challenge
"visual Google for nontextual data"
not search for images
web search made available text data usable
- for general and surprising uses beyond original intent
infovis browsing
- could make available nontext data useful/visible
More Information

this talk
- www.cs.ubc.ca/~tmm/talks.html#ie05

my grad course
- www.cs.ubc.ca/~tmm/courses/infovis

conferences
- InfoVis symposia: www.infovis.org/symposia.php
  IEEE Symposium on Information Visualization
- Graph Drawing conferences: www.gd2005.org