Lecture 1: Introduction

Information Visualization
CPSC 533C, Fall 2009

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UBC Computer Science

Wed, 9 September 2009
Course Home Page

- main source
  - readings, lecture slides, all information
  - reload frequently, updates common!
- permanent URL
  - http://www.cs.ubc.ca/~tmm/courses/533-09
Course Design

- reading-intensive course
  - reading front-loaded in first 7 weeks
- oral presentations
  - major presentation
  - project update, project final
- writing
  - questions, proposal, final report
- programming
  - project course (unless do analysis option)
  - time management critical: staged development
- no problem sets or exams
- schedule
  - no classes week of Thanksgiving (Oct 12,14)
Course Grading Summary

- class participation: 25%
  - questions 75%, discussion 25%
- presentation: 25%
- project: 50%

- many subitems graded by buckets:
  - great 100%, good 89%, ok 78%, poor 67%, zero 0%
Course Structure

■ lectures/readings
  ■ weeks 1-8 (no classes week 7)
  ■ professor lectures
  ■ core readings required, further readings optional
  ■ submit questions for each lecture (19%)
  ■ discussion (6%)

■ presentations (25%)
  ■ weeks 9-13
  ■ student presentations
  ■ only presenter does topic readings
  ■ discussion (6%)

■ project (50%)
  ■ weeks 6-14
  ■ proposal 10%, update 10%, report 20%, presentation 10%, content 50%
Required Readings

- Ware
  - Information Visualization: Perception for Design
  - 2nd edition
- Tufte
  - Envisioning Information
- many papers
  - most are color PDF downloads from page
  - a few handed out in class as hardcopy
Prerequisites

- no courses required
- HCI very useful
- computer graphics useful
  - no graphics background could constrain your project choices
Participation

- 6%: discussions in class
  - both lectures and student presentations
- 19%: one question for each required reading
  - due at 10am Mon/Wed for day’s reading
- attendance expected, tell me in advance if you’ll miss class
  - question credit still possible if submitted in advance
Questions

- questions or comments
- fine to be less formal than written report
  - correct grammar and spelling expected nevertheless
  - be concise: a few sentences good, one paragraph max!
- should be thoughtful, show you’ve read and reflected
  - poor to ask something trivial to look up
  - ok to ask for clarification of genuinely confusing section
- grading into buckets:
  - great 100%, good 89%, ok 78%, poor 67%, zero 0%
Question Examples: Poor

- Well, what exactly Pad++ is? Is it a programming library or a set of API or a programming language? how can we use it in our systems, for example may be programming in TCL or OpenGL may be ?
- I learned some from this paper and got some ideas of my project.
This seems like something fun to play around with, are there any real implementations of this? Has a good application for this type of zooming been found? Is there still a real need for this now that scroll wheels have become prevalent and most people don’t even use the scroll bar anymore?

Playing with the applet, I find I like half of their approach. It’s nice to zoom out as my scroll speed increases, but then I don’t like the automatic zoom in when I stop scrolling. Searching the overview I found the location I wanted, but while I paused and looked at the overview, I fell back in to the closeup. I think they need to significantly dampen their curve.
It would be interesting to compare the approach in this paper to some other less-mathematically-thought-out zoom and pan solutions to see if it is really better. Sometimes "faking it" is perceived to be just as good (or better) by users.

The space-scale diagrams provided a clear intuition of why zooming out, panning then zooming in is a superior navigation technique. However, I found the diagram too cumbersome for practical use, especially for objects with zoom-dependent representations (Figure 11).
I’m curious as to what would have happened if the authors had simply preselected the values of the free parameters for the participants in their user study, and then had the users compare their technique to the standard magnification tools present in a ’normal’ application (much like the space-scale folks did). Could it be that the users are ‘manufacturing’ a large standard deviation in the free parameter specifications by settling for values that merely produce a local improvement in their ability to manipulate the interface, instead of actively searching for an optimal valuation scheme?

In a related vein, the speed-dependent automatic zooming met with mixed success on some applications. Isn’t this success related to how ”compressible” some information is? i.e. because zooming must necessarily throw out some information, it isn’t obvious which information to keep around to preserve the navigable structure.
Presentations

- second half of class
  - sign up by Oct 23
- material (exact numbers TBD, depending on enrollment)
  - 1 paper from my suggested list
  - 2 papers your choice
- talk
  - slides required
  - summary important, but also have your own thoughts
    - critical points of papers
    - comparison and critique
- grading
  - per-paper: summary 70%, critique 30%
  - general: presentation style 50%, content prep 50%
  - balance depends on num papers, often 25-33% general
Projects

- choice 1: programming
  - common case
  - I will only consider supervising students who do programming projects

- choice 2: analysis
  - use existing tools on dataset
  - detailed domain survey
  - particularly suitable for non-CS students

- stages
  - meetings with me for approval by Oct 23 (at very latest)
  - proposal due Fri Oct 30
  - update presentations Nov 16, 18
  - final presentations Mon Dec 14
  - final report Wed Dec 16
Reserve Books

- Information Visualization: Perception for Design, Colin Ware (2nd ed)
- Readings in Information Visualization: Using Vision To Think; Card, Mackinlay, and Shneiderman, eds; Morgan Kaufmann 1999.
- The Visualization Toolkit, 3rd edition; Schroeder, Martin and Lorensen; Kitware Inc. 2004
Information Visualization

- visual representation of abstract data
  - computer-generated, often interactive
Interactivity

- static images
  - 10,000 years
  - art, graphic design
- moving images
  - 150 years
  - cinematography
- interactive graphics
  - 30 years
  - computer graphics, human-computer interaction
Information Visualization

- visual representation of abstract data
  - computer-generated, often interactive
  - help human perform some task more effectively
Information Visualization

- visual representation of abstract data
  - computer-generated, can be interactive
  - help human perform some task more effectively
- bridging many fields
  - graphics: drawing in realtime
  - cognitive psych: finding appropriate representation
  - HCI: using task to guide design and evaluation
Information Visualization

- visual representation of abstract data
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- bridging many fields
  - graphics: drawing in realtime
  - cognitive psych: finding appropriate representation
  - HCI: using task to guide design and evaluation

- external representation
  - reduces load on working memory
  - offload cognition
  - familiar example: multidigit multiplication
### External Representation: multiplication

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**External Representation: multiplication**

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Information Visualization

- visual representation of abstract data
  - computer-generated, can be interactive
  - help human perform some task more effectively
- bridging many fields
  - graphics: drawing in realtime
  - cognitive psych: finding appropriate representation
  - HCI: using task to guide design and evaluation
- external representation
  - reduces load on working memory
  - offload cognition
  - familiar example: multidigit multiplication
  - infovis example: topic graphs
External Representation: Topic Graphs

[Godel, Escher, Bach. Hofstadter 1979]

Turing - Halting problem
Halting problem - Infinity
Paradoxes - Lewis Carroll
Paradoxes - Infinity
Infinity - Lewis Carroll
Infinity - Unpredictably long searches
Infinity - Recursion
Infinity - Zeno
Infinity - Paradoxes
Lewis Carroll - Zeno
Lewis Carroll - Wordplay

Halting problem - Decision procedures
BlooP and FlooP - AI
Halting problem - Unpredictably long searches
BlooP and FlooP - Unpredictably long searches
BlooP and FlooP - Recursion
Tarski - Truth vs. provability
Tarski - Epimenides
Tarski - Undecidability
Paradoxes - Self-ref

...
External Representation: Topic Graphs

- offload cognition to visual systems
- minimal attention to read answer
External Rep: Automatic Layout

manual: hours, days

(Godel, Escher, Bach. Hofstader 79)

automatic: seconds

dot, (Gansner et al 93)
InfoVis vs. SciVis

- is spatialization **given** (scientific visualization) or **chosen** (information visualization)
- names are unfortunate historical accidents
  - **not** scivis iff data generated by scientists
  - infovis not unscientific
  - scivis not uninformative
  - but - too late to change
- infovis: how to represent
  - choosing, doing, evaluating
  - huge space of possibilities: random walk ineffective
  - need design guidelines
Lecture Topics
Fundamentals

Quantitative

Position
Length
Angle
Slope
Area
Volume
Density
Saturation
Hue
Texture
Connection
Containment
Shape

Ordinal

Position
Density
Saturation
Hue
Texture
Connection
Containment
Length
Angle
Slope
Area
Volume
Shape

Nominal

Position
Hue
Texture
Connection
Containment
Density
Saturation
Shape
Length
Angle
Slope
Area
Volume
Perception
Color
Statistical Graphics
Multiples/Interaction

![Diagram showing multiples and interaction between different locations and crops.]

- Waseca
  - 1932
  - 1981
  - Various crops
- Crookston
  - 1932
  - 1981
  - Various crops
- Morris
  - 1932
  - 1981
  - Various crops
Space/Layers/Order
Navigation/Zooming
Focus + Context
High Dimensionality
Graphs/Trees
User Studies
Guest Lectures

- 11/4: Text - Keith Andrews, Univ. Graz
- 11/9: Scientific Visualization - Stefan Bruckner, SFU
Office Hours

- 2-3 Wed after class, or by appointment
- office in X661, ICICS/CS X-Wing
My Own Current Research Interests

- problem-driven work
- technique-driven work
- user studies
Problem-driven work

- evolutionary tree comparison
  - TreeJuxtaposer

- protein-gene interaction networks
  - Cerebral

- linguistic graphs
  - Constellation
Problem-driven work

• web logs
  – SessionViewer

• large-scale system monitoring
  – LiveRAC
Technique-driven work

- 3D hyperbolic graphs
  - H3

- dimensionality reduction
  - steerable
    - MDSteer
  - GPU accelerated
    - Glimmer

- general multilevel graphs
  - layout
    - TopoLayout
  - interaction
    - Grouse, GrouseFlocks, TugGraph
Studies: different flavors

• head to head system comparison (HCI)
  – H3 vs. 2D web browser

• psychophysical characterization (cog psych)
  – impact of distortion on visual search
  – on visual memory
Studies: different flavors

- characterize technique applicability, derive design guidelines
  - stretch and squish vs. pan/zoom navigation
  - separate vs. integrated views
  - 2D points vs. 3D landscapes
Studies: different flavors

• requirements analysis (before starting)
  – semi-structured interviews
  – watch what they do before new tool introduced: current workflow analysis

• field study of deployed system (after prototype refined)
  – watch them use tool: characterize what they can do now