Information Visualization

Lecture 1 CPSC 533C, Fall 2005

12 September 2005

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Course Home Page

permanent URL
  · www.cs.ubc.ca/~tmm/courses/cpsc533c-05-fall

shortcut
  · www.cs.ubc.ca/~tmm/courses/533

reload frequently, updates common!
Course Structure

first part
  · professor lectures
  · all do core readings

second part
  · student presentations
  · presenter does topic readings

requirements
  · project: 50%
    proposal 10%, update 10%, report 20%,
    presentation 10%, content 50%
  · presentation: 25%
  · class participation: 22%
    questions 75%, discussion 25%
  · small assignment: 3%
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
  · suitable for non-CS students

stages
  · meeting with me in person before proposal writeup
  · proposal Nov 4
  · update presentations Nov 16
  · final present Dec 19
  · final report Dec 20
Presentations

second half of class

sign up by Oct 20

material (exact numbers TBD, depending on enrollment)

- XX papers from my suggestions
- XX paper found on your own

talk

- chance to refine your public speaking skills
- slides required
- critical points of papers
- comparison and critique
- not just outline!
Participation

7%: discussions in class
   - both lectures and student presentations

15%: 5 questions on required readings
   - due at 10am Mon/Wed for afternoon's reading

   - if you can't attend: credit for email by 10am
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
Reserve Books

Information Visualization: Perception for Design, Colin Ware


Readings in Information Visualization: Using Vision To Think; Card, Mackinlay, and Shneiderman, eds; Morgan Kaufmann 1999.

The Visualization Toolkit, 2nd edition; Schroeder, Martin and Lorensen; Prentice Hall 1998
Course Design

reading-intensive course
  · most of reading front-loaded in first 8 weeks
oral presentations
  · small assignment next class
  · 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 :)
schedule
  · two weeks during term with no classes
  · run one week into final exam period
Information Visualization

visual representation of abstract data
  · computer-generated, can be interactive
Interactivity

static images
  · 10,000 years
  · art, graphic design

moving images
  · 100 years
  · cinematography

interactive graphics
  · 20 years
  · computer graphics, human–computer interaction
Information Visualization

visual representation of abstract data
• computer-generated, can be 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
  · HCl: using task to guide design and evaluation

external representation
  · reduces load on working memory
  · offload cognition
  · familiar example: multiplication/division
External Representation: multiplication

paper  mental buffer

\[
57 \times 48
\]
External Representation: multiplication

paper        mental buffer

\[ \begin{array}{c}
57 \\
\times 48 \\
\hline
\end{array} \]  \quad \quad \quad \quad \quad [ \, 7 \times 8 = 56 \, ]
External Representation: multiplication

paper        mental buffer

\[
\begin{array}{c}
5 \\
57 \\
\times 48 \quad [ 7 \times 8 = 56 ] \\
\hline
6
\end{array}
\]
External Representation: multiplication

paper

\[
\begin{array}{c}
5 \\
57 \\
\times 48 \\
\hline \\
6
\end{array}
\]

mental buffer

\[5 \times 8 = 40 + 5 = 45\]
External Representation: multiplication

paper               mental buffer

\[57 \times 48 = 5 \times 8 + 40 + 5 = 45] 

456
External Representation: multiplication

paper    mental buffer

\[
\begin{array}{c}
57 \\
\times 48 \\
\hline
456
\end{array}
\quad [7\times4 = 28]
\]
External Representation: multiplication

\[
\begin{array}{c}
2 \\
57 \\
\times 48 \\
\hline
\end{array}
\]

\[
\begin{array}{c}
456 \\
8 \\
\hline
8
\end{array}
\]

[7\times4=28]
External Representation: multiplication

paper

\[
\begin{array}{c}
  \underline{2} \\
  \underline{57} \\
\times \underline{48} \\
\hline
  \underline{456} \\
  \underline{8} \\
\end{array}
\]

[\text{mental buffer}]

\[5 \times 4 = 20 + 2 = 22\]
External Representation: multiplication

paper    mental buffer

\[
\begin{array}{c}
57 \\
\times 48 \\
\_\_\_\_\_\_\\
456 \\
228
\end{array}
\]

[5*4=20 + 2 =22]
External Representation: multiplication

paper  mental buffer

\[
\begin{array}{c}
57 \\
\times 48 \\
\end{array}
\]

\[
\begin{array}{c}
456 \\
228 \\
\end{array}
\]

\[
\begin{array}{c}
6 \\
\end{array}
\]
External Representation: multiplication

57  
\times 48

456
228
---
6

[8+5 = 13]
External Representation: multiplication

57
x 48
---
1
456
228
---
36

[8 + 5 = 13]
External Representation: multiplication

paper  mental buffer

\[
\begin{align*}
57 \\
\times 48 \\
\hline
1 \\
456 \\
\hline
228 \\
\hline
36
\end{align*}
\]

\[4 + 2 + 1 = 7\]
External Representation: multiplication

paper

mental buffer

\[ \begin{array}{c}
57 \\
\times 48 \\
\end{array} \]

\[ \begin{array}{c}
456 \\
258 \\
\hline
736 \\
\end{array} \] \quad [4+2+1=7]
External Representation: multiplication

paper  mental buffer

\[
\begin{array}{c}
57 \\
\times 48 \\
\hline
456 \\
258 \\
\hline
2736
\end{array}
\]
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
  - HCl: using task to guide design and evaluation

external representation
  - reduces load on working memory
  - offload cognition
  - familiar example: multiplication/division
  - infovis example: topic graphs
External Representation: Topic Graphs

[Godel, Escher, Bach. Hofstadter 1979]

Paradoxes – Lewis Carroll
Turing – Halting problem
Halting problem – Infinity

Paradoxes – Infinity
Infinity – Lewis Carroll
Infinity – Unpredictably long searches
Infinity – Recursion
Infinity – Zeno

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

[...]

30
External Representation: Topic Graphs

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

manual: hours, days

automatic: seconds

[Godel, Escher, Bach. Hofstader 79]

dot, [Gansner et al 93]
InfoVis vs. SciVis

is spatialization given (scientific visualization) or chosen (information visualization)
  - my definition

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
My Current Interests

domains
· evolutionary trees
· genomic sequences
· transaction logs
· environmental sustainability
· power grid control

techniques/projects
· accordion drawing
· multidimensional scaling
· scalable graph drawing
· evaluation

InfoVis Symposium organization
· Program Co-Chair 2003, 2004
· Posters Co-Chair 2001, 2002
Lecture Topics
Design Studies
Overviews / Context
Frameworks/Models

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
Color

Guest Lecturer: Maureen Stone
Depth/Occlusion
High Dimensionality
Interaction
Navigation/Zooming
Graphs/Trees
Evaluation

Guest Lecturer: Melanie Tory
Scientific Visualization

Guest Lecturer: Melanie Tory
More Guest Lectures

stayed tuned, things may shuffle
Assignment 1

find and critique two images
  · one good visualization
  · one bad visualization

make web page, send me URL by 10am Wed
  · pictures, two paragraphs for each
  · first par: story
  · second par: specific critique
    accessibility
    clarity
    accuracy
    other important design criteria
  · send to tmm@cs.ubc.ca

be prepared to concisely present in class
  < 5 min
Assignment 1

sources
  · textbook
  · journal
    Journal of Applied Optics, ...
  · science magazine
    Nature, Science, Scientific American, ...
  · news magazine or newspaper
    Newsweek, Economist, NY Times, USA Today, ...

domains
  · mathematics
  · physical sciences
    astronomy, physics, chemistry, ...
  · biological sciences
    ecology, medicine, bioinformatics, ...
  · social sciences
    economics, crime statistics, ...