Lecture 1: Introduction

Information Visualization
CPSC 533C, Fall 2006

Tamara Munzner

UBC Computer Science

12 September 2006

Course Home Page

- main source
  - readings, lecture slides, all information
  - reload frequently, updates common!
- permanent URL
  - www.cs.ubc.ca/~tmm/courses/cpsc533c-06-fall
- shortcut
  - www.cs.ubc.ca/~tmm/courses/533

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
  - one week during term with no classes (Oct 31, Nov 2)

Course Structure Summary

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

- most grading by buckets:
  - great 100%, good 89%, ok 78%, poor 67%, zero 0%

Course Structure

- lectures/readings
  - weeks 1-7
  - professor lectures
  - all do core readings
  - submit questions for each lecture (19%)
  - discussion (6%)
- presentations (25%)
  - weeks 9-12
  - 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

Participation

- 6%: discussions in class
  - both lectures and student presentations
- 19%: 5 questions on required readings
  - due at 9am Tue/Thu for day's reading
- attendance expected
  - if you can't attend: no credit if email after 9am

Questions

- questions or comments
- fine to be less formal than written report
  - (correct grammar and spelling expected nevertheless)
- 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 progarmming library or a set of API or a programming language? how can we use it in our systems, for xample may be programming in TCL or OpenGL may be ?
- I learned some from this paper and got some ideas of my project.

Question Examples: OK

- 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 prevailent 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.

Question Examples: Good

- 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).

Question Examples: Great

- 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 20
- material (exact numbers TBD, depending on enrollment)
  - XX papers from my suggestions
  - XX paper found on your own
- talk
  - slides required
  - not just outline!
    - critical points of papers
    - comparison and critique
- grading
  - per-paper: summary 70%, critique 30%
  - general: presentation style 50%, content preparation 50%

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
  - meetings with me Oct 17-20
  - proposal due Oct 27
  - update presentations Nov 14,16
  - final presentations Dec 14
  - final report Dec 15

Reserve Books

- Information Visualization: Perception for Design, Colin Ware (2nd ed)
- The Visual Display of Quantitative Information, Edward R. Tufte, Graphics Press 1983
- Envisioning Information, Edward R. Tufte, Graphics Press 1990
- Visual Explanations, Edward R. Tufte, Graphics Press 1997
- 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

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
  - HCI: using task to guide design and evaluation

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: multiplication/division

External Representation: multiplication

paper	mental buffer
57 x 48 —-	

External Representation: multiplication

paper	mental buffer
57	
x 48	[7*8=56]
—-	

External Representation: multiplication

paper	mental buffer
5	
57	
x 48	[7*8=56]
—-	
6	

External Representation: multiplication

paper	mental buffer
5	
57	
x 48	
—-	
6	

External Representation: multiplication

paper	mental buffer
5	
57	
x 48	[5*8=40 + 5 = 45]
—-	
456	

External Representation: multiplication

paper	mental buffer
57 x 48 —-	
456	

External Representation: multiplication

paper	mental buffer
57	
x 48	[7*4=28]
—-	
456	

External Representation: multiplication

paper	mental buffer
2	
57	
x 48	[7*4=28]
—-	
456	
8	

External Representation: multiplication

paper	mental buffer
2	
57	
x 48	
—-	
456	
8	

External Representation: multiplication

paper	mental buffer
2	
57	
x 48	[5*4=20+2=22]
—-	
456	
228	

External Representation: multiplication

paper	mental buffer
57 x 48 —-	
456 228	

External Representation: multiplication

paper	mental buffer
57 x 48 —- 456 228 ——— 6	

External Representation: multiplication

paper	mental buffer
57	
x 48	
—-	
1	
456	
228	
———	
36	[8 + 5 = 13]

External Representation: multiplication

paper	mental buffer
57 x 48 —- 1 456 228 ——— 36	

External Representation: multiplication

paper	mental buffer
57	
x 48	
—-	
1	
456	
228	
———	
736	[4+2+1=7]

External Representation: multiplication

paper	mental buffer
57 x 48 —- 456 228 ——— 736	

External Representation: multiplication

paper	mental buffer
57 x 48 —-	
456 228	
2736	

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: multiplication/division
  - infovis example: topic graphs

External Representation: Topic Graphs

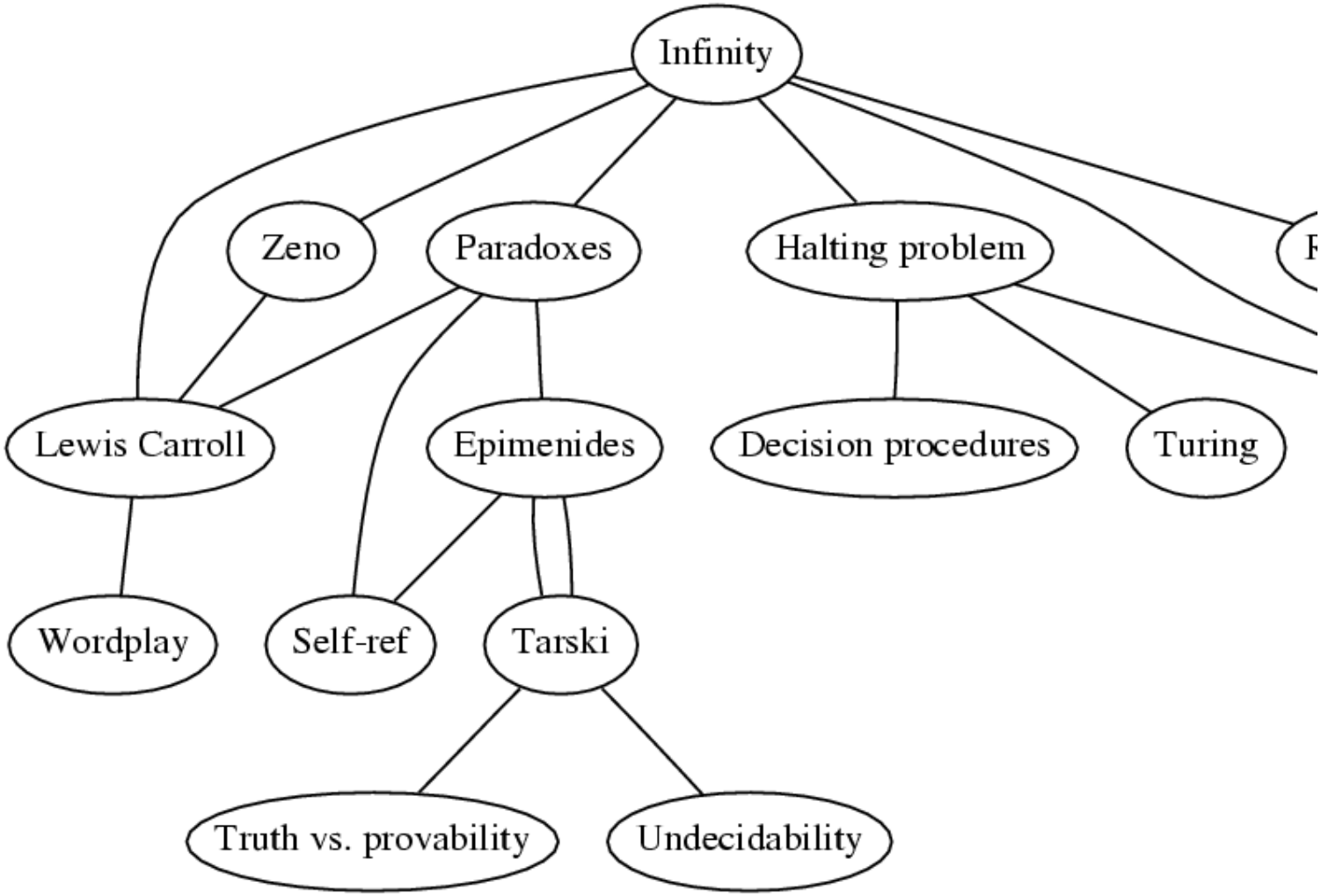
[Godel, Escher, Bach. Hofstadter 1979]

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 - Unpredicta long searches
BlooP and FlooP - Unpredic long searches
BlooP and FlooP - Recursio
Tarski - Truth vs. provability
Tarski - Epimenides
Tarski - Undecidability
Paradoxes - Self-ref
...

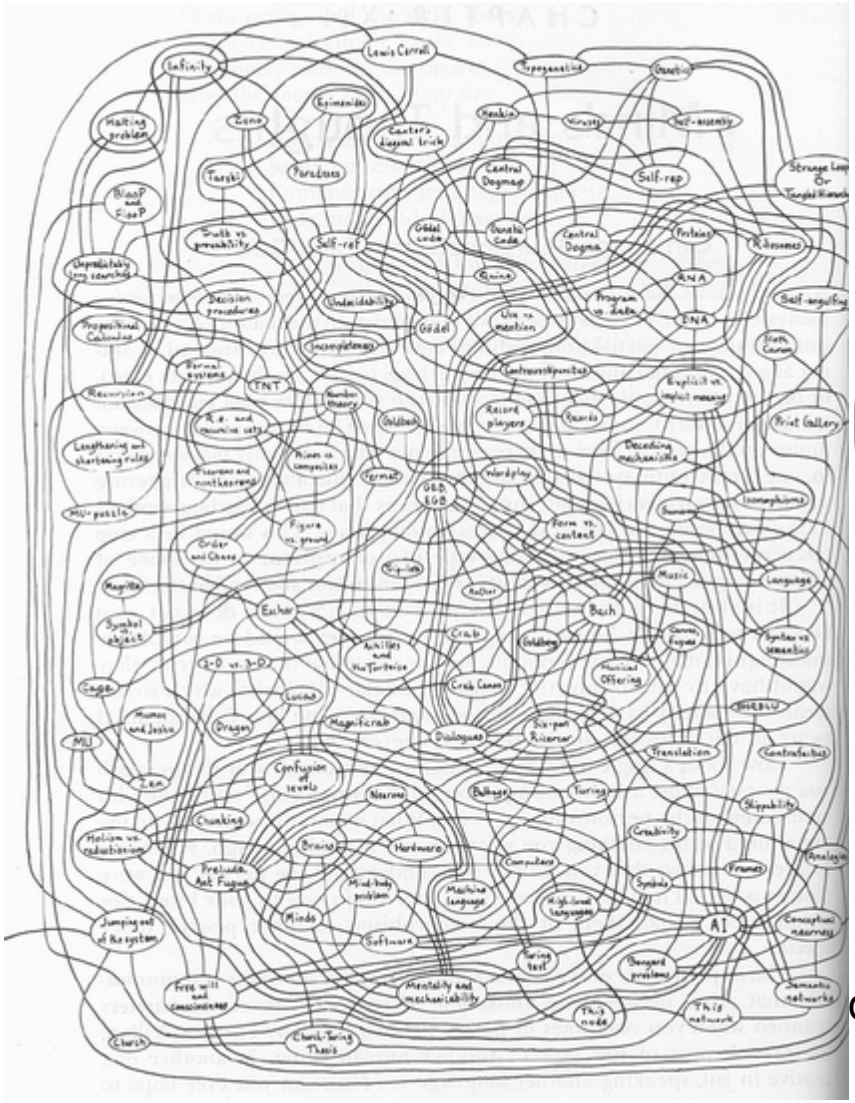
External Representation: Topic Graphs

- offload cognition to visual systems
- minimal attention to read answer



External Rep: Automatic Layout

manual: hours, days



(Godel, Escher, Bach. Hofstader 79)

automatic: seconds

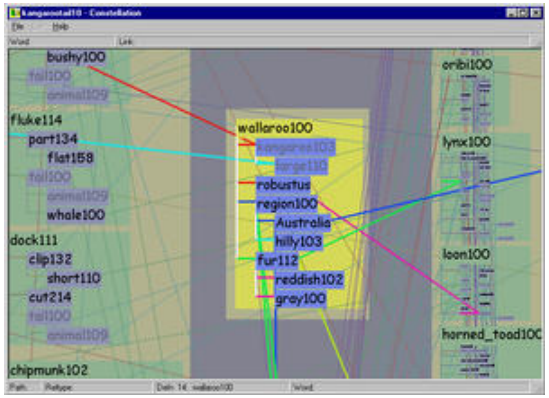
dot, (Gansner et al 93)

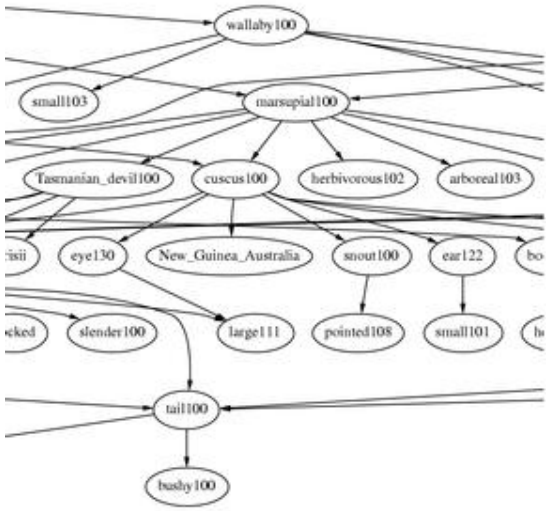
InfoVis vs. SciVis

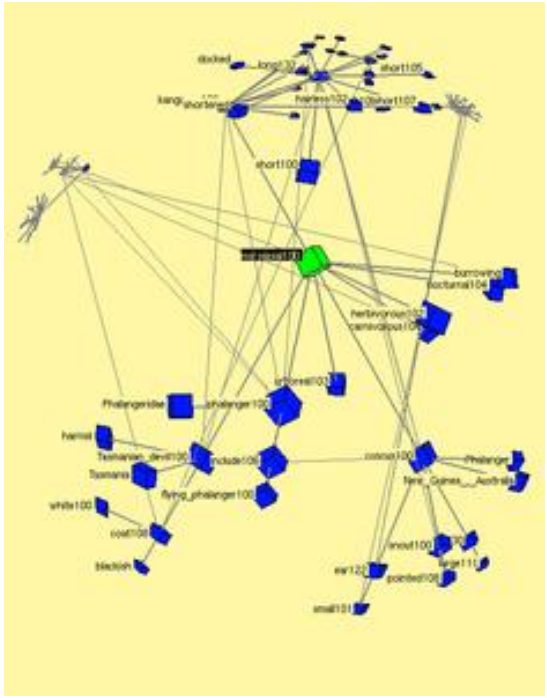
- is spatialization given (scientific visualization) or chosen (information visualization)
  - my definition
- names are unfortunate historical accidents
  - not scivis iff data generated by scientists
  - infovis not unscientific
  - scivis not uninformative
  - but - too late to change
- infovis: how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

Lecture Topics

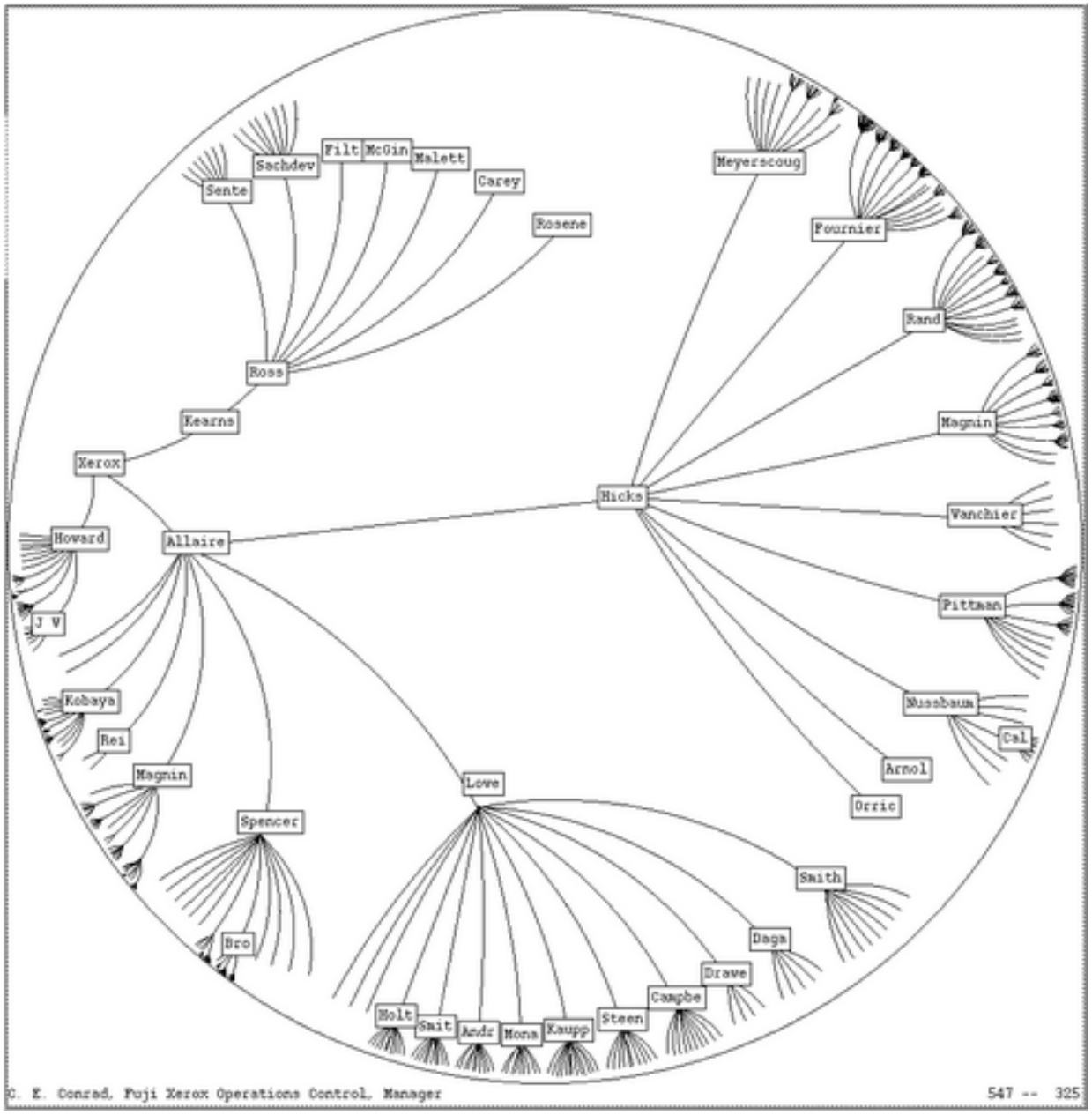
Design Studies



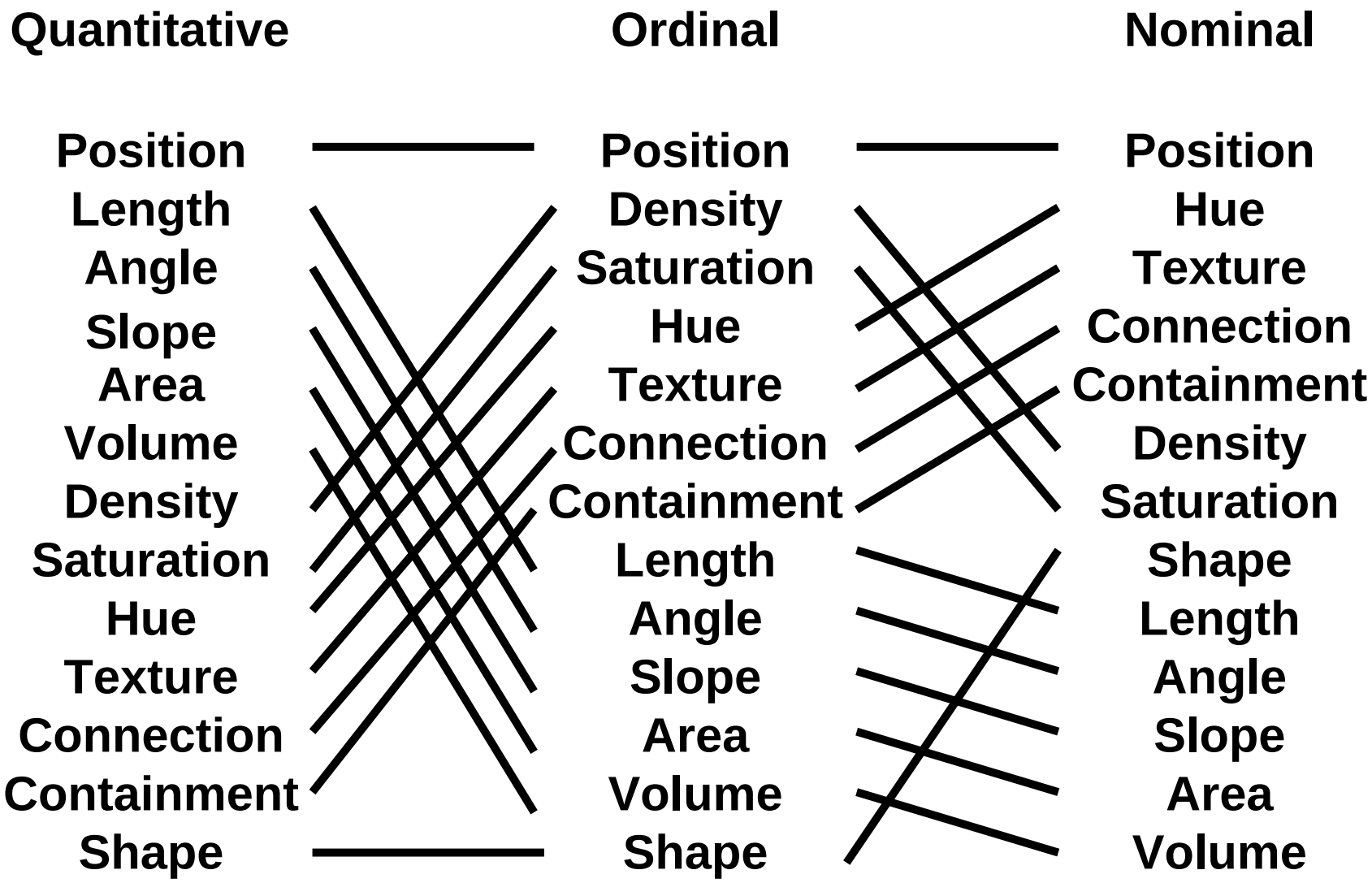




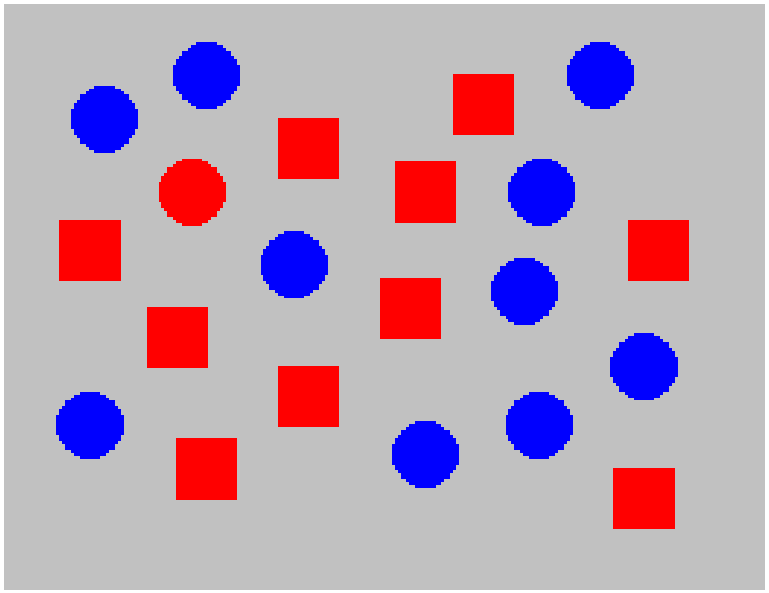
Focus+Context

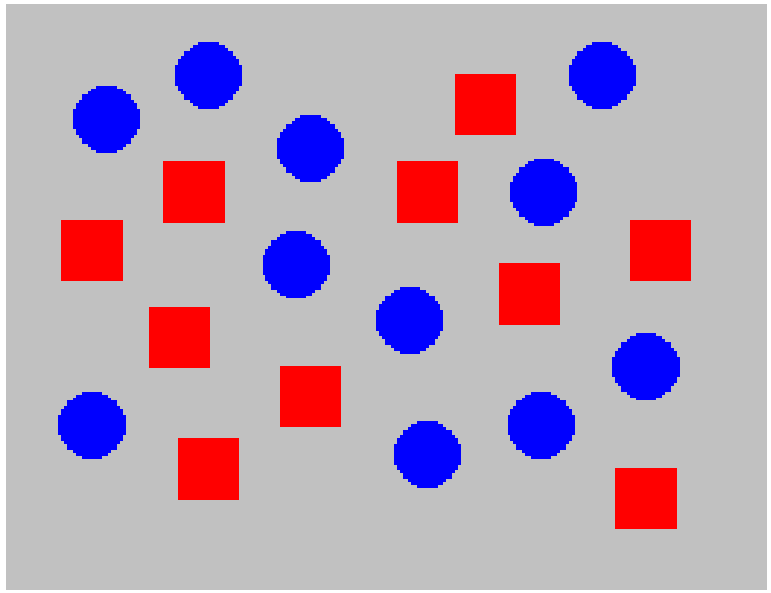


Frameworks/Models

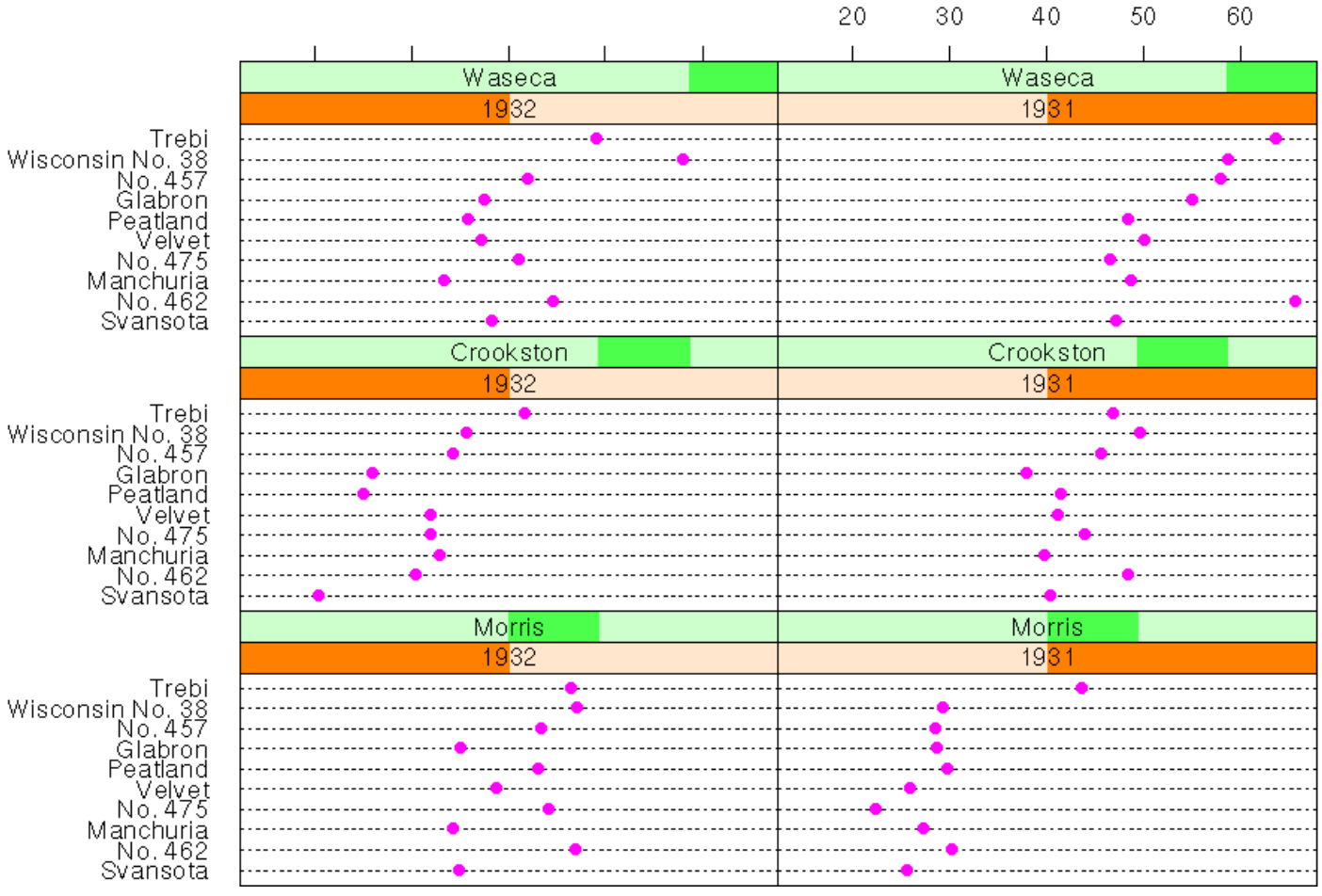


Perception

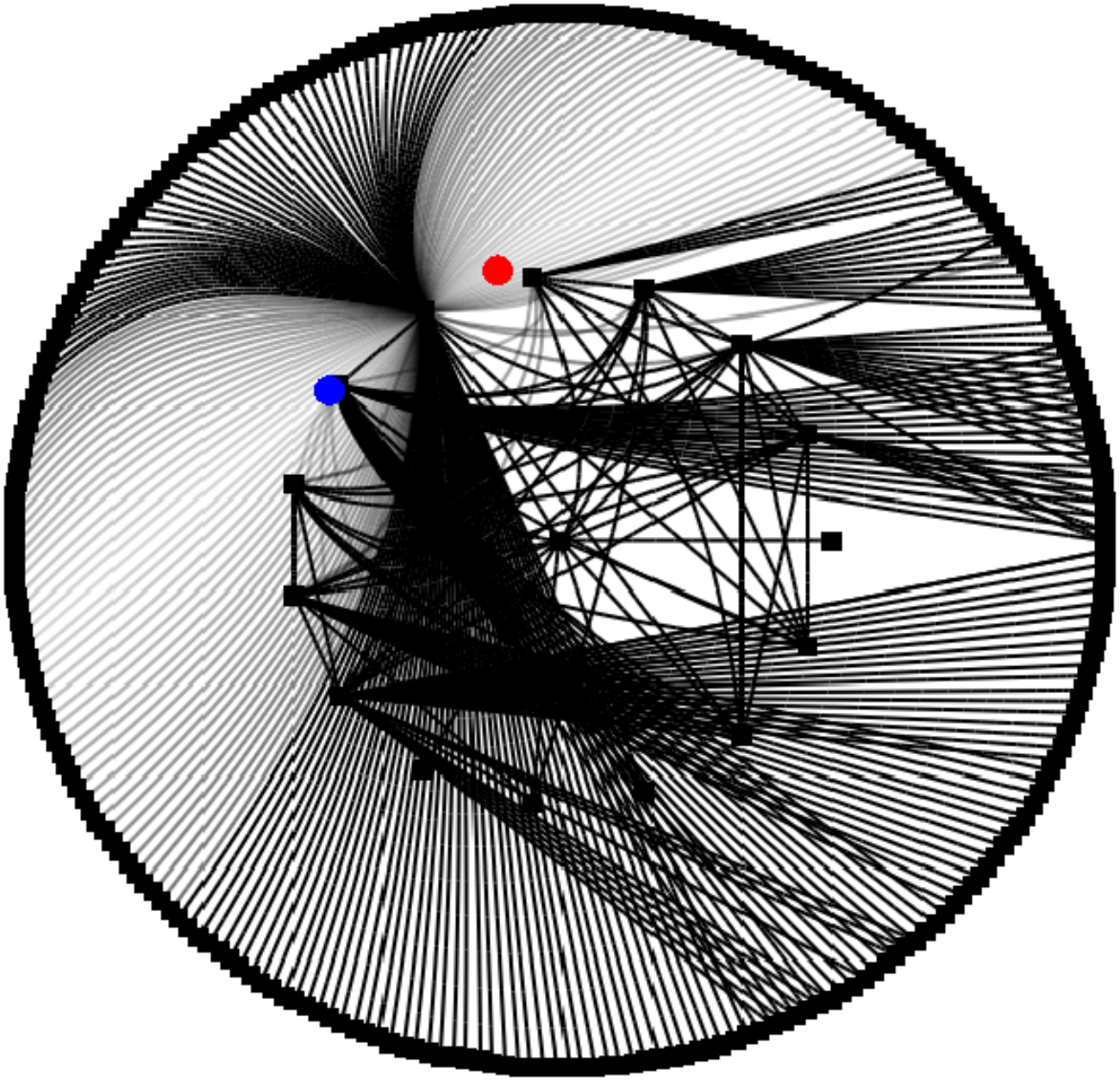




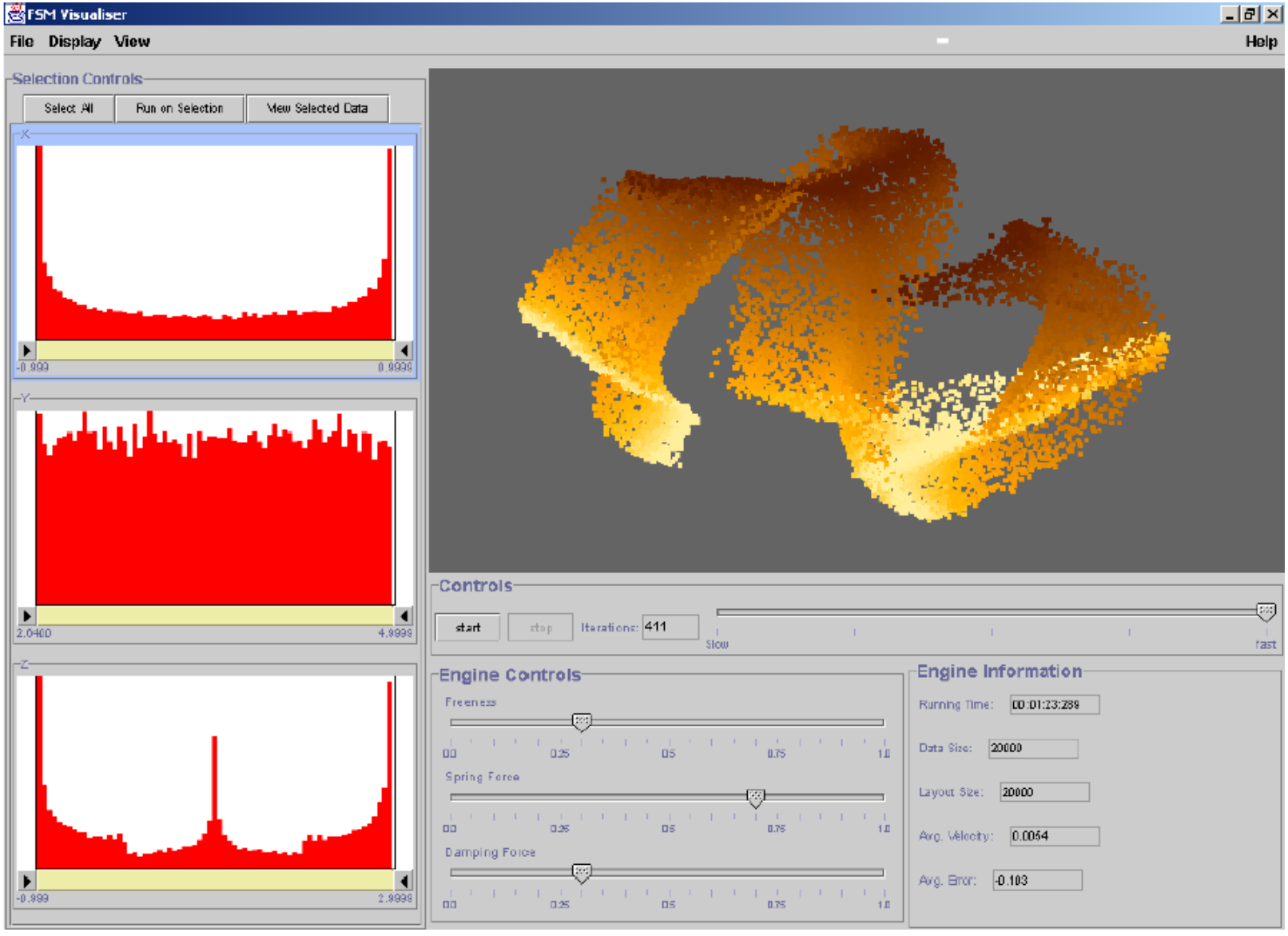
Space/Order


20
30
40
50
60
Waseca
1932
1931
Trebi
Wisconsin No. 38
No. 457
Glabron
Peatland
Velvet
No. 475
Manchuria
No. 462
Svansota
Crookston
1932
1931
Trebi
Wisconsin No. 38
No. 457
Glabron
Peatland
Velvet
No. 475
Manchuria
No. 462
Svansota
Morris
1932
1931
Trebi
Wisconsin No. 38
No. 457
Glabron
Peatland
Velvet
No. 475
Manchuria
No. 462
Svansota

Depth/Occlusion

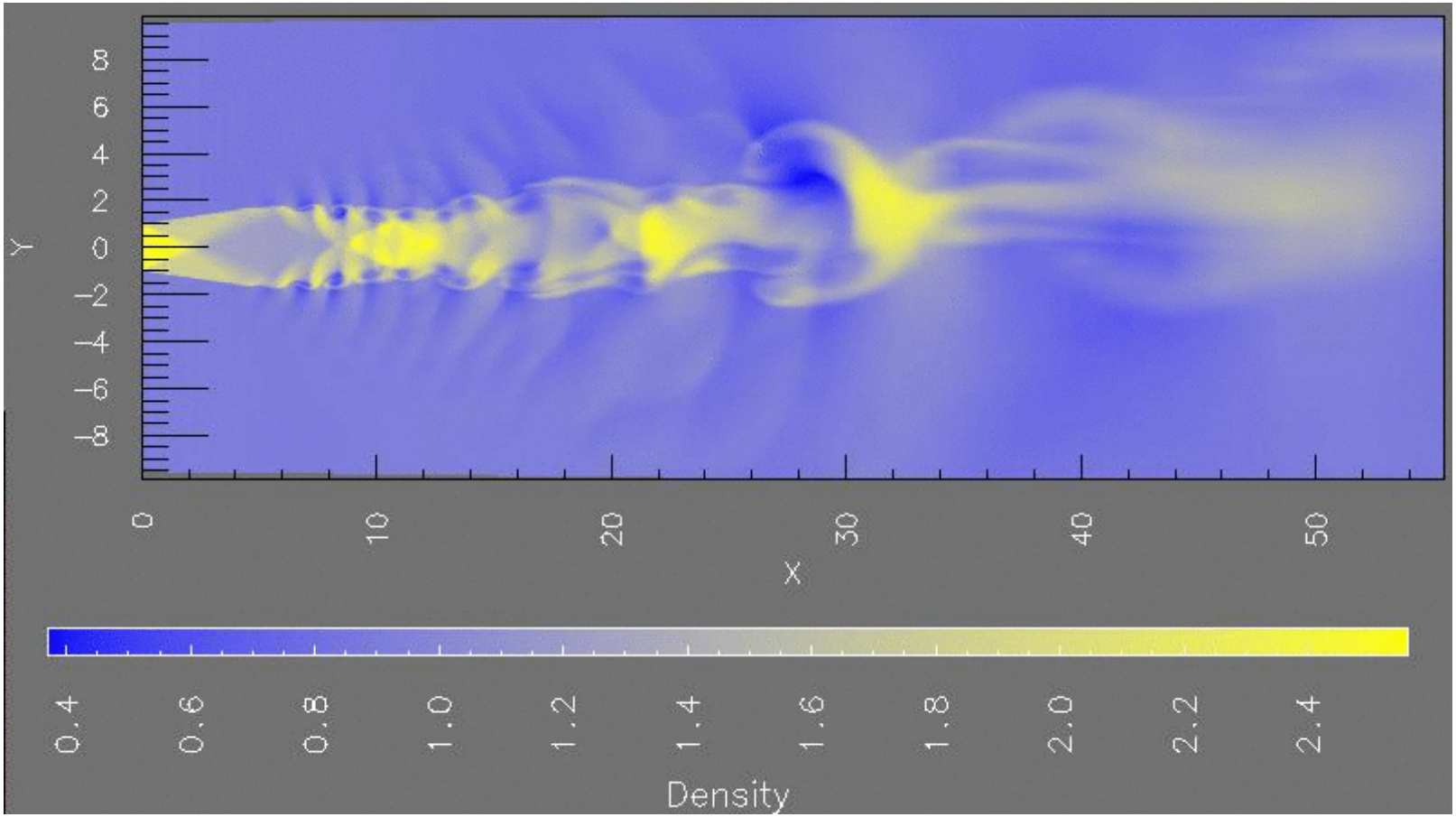


High Dimensionality



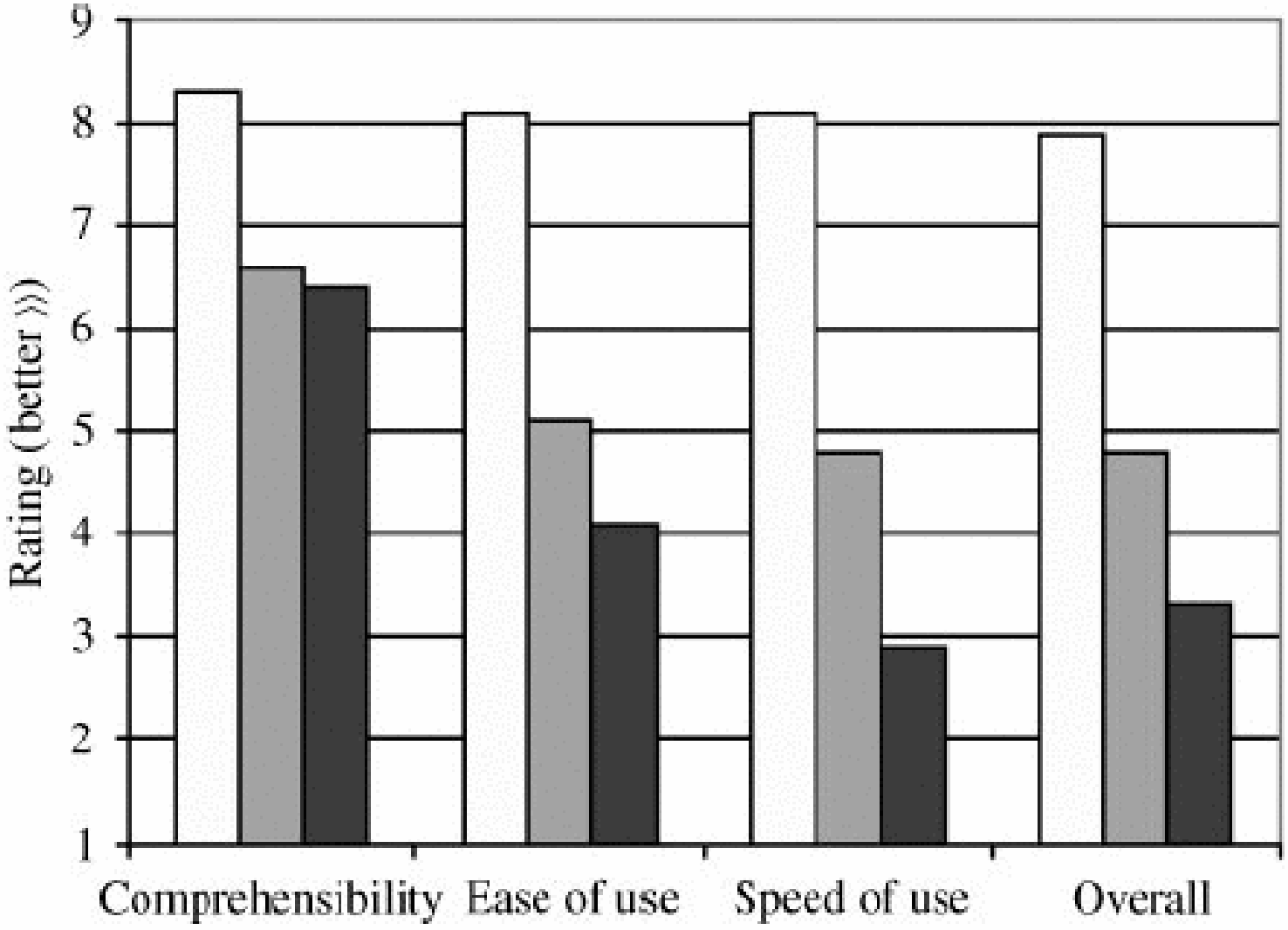
Color

Guest Lecturer: Maureen Stone

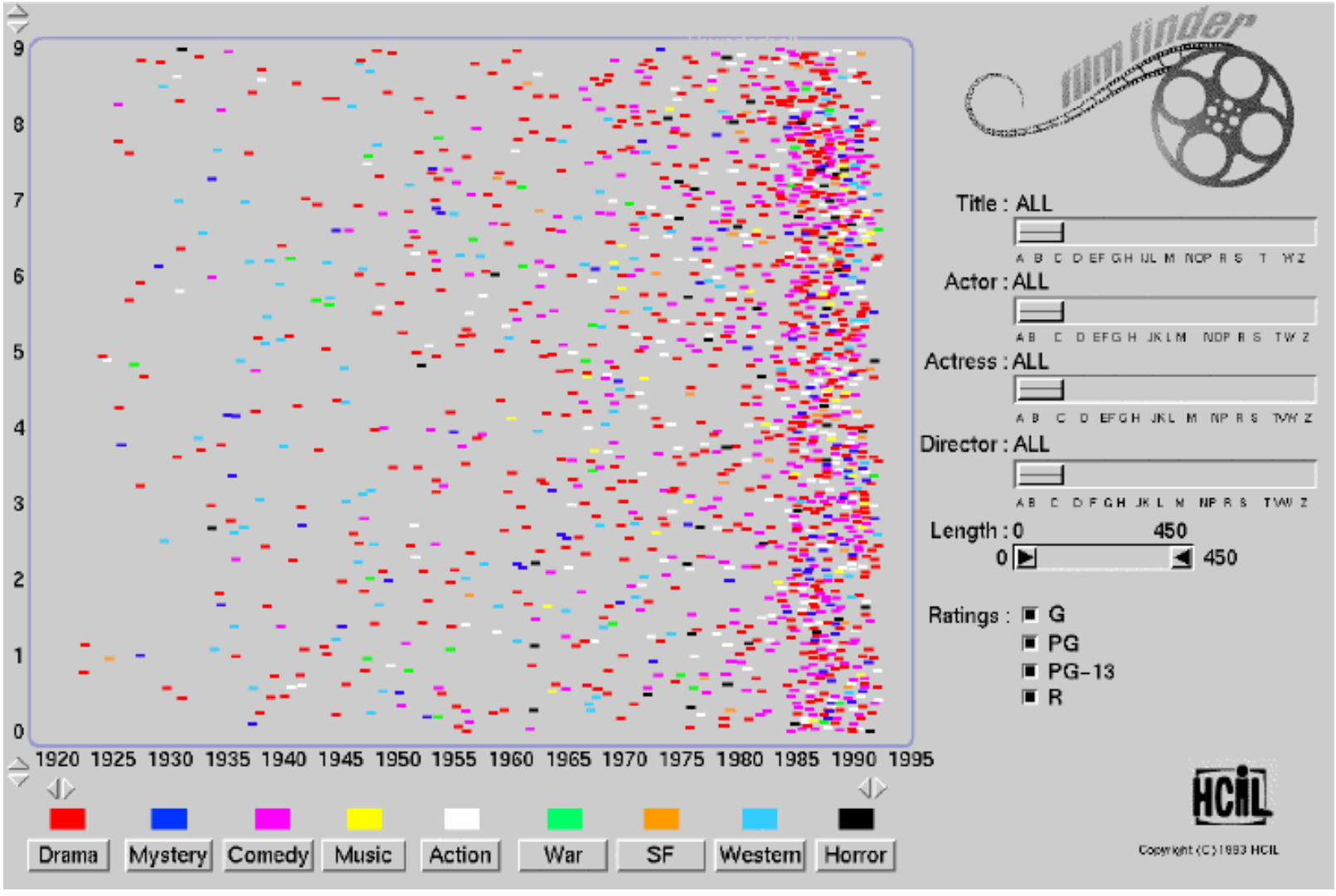


Evaluation

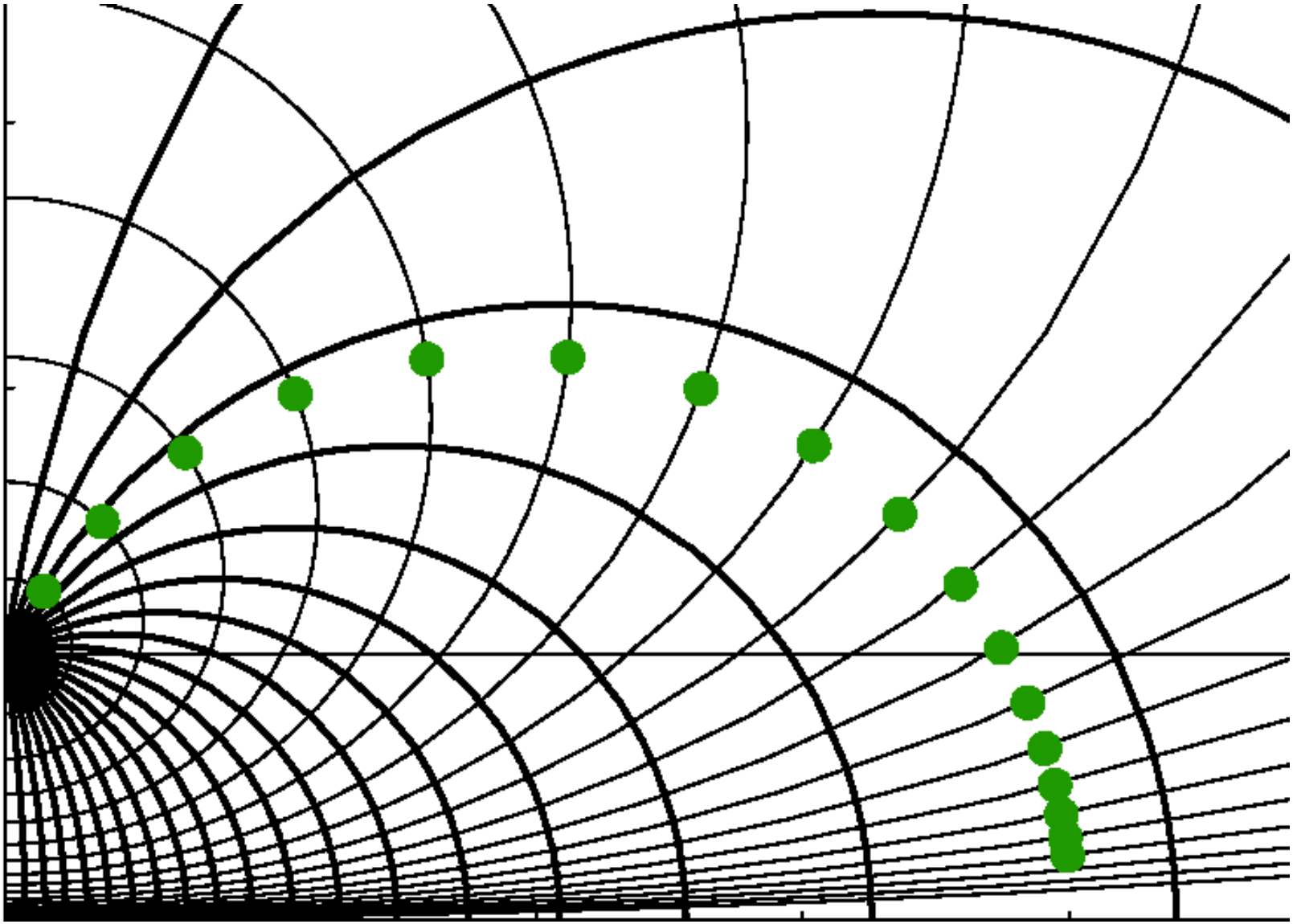
Guest Lecturer: TBD



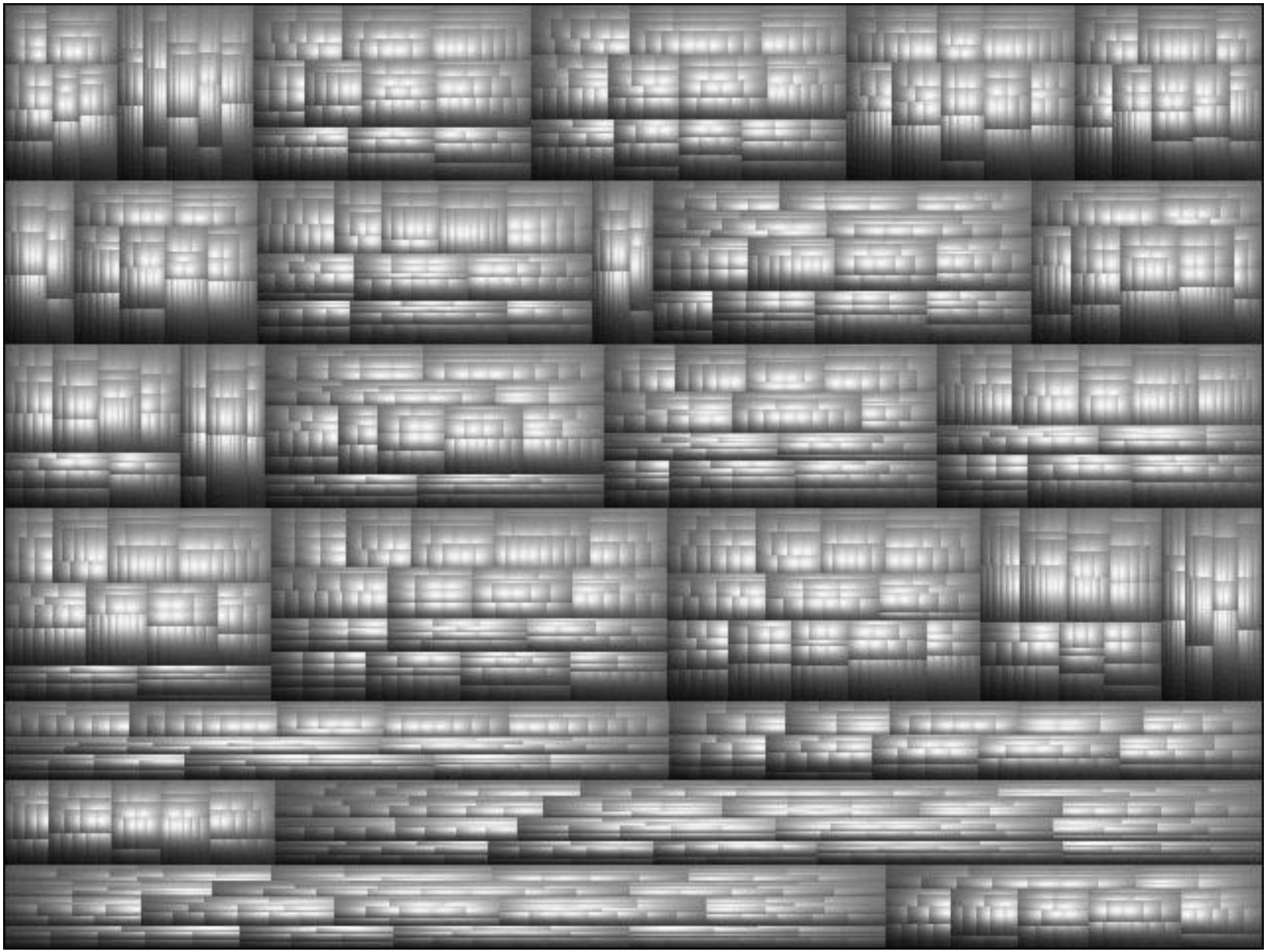
Interaction



Navigation/Zooming



Graphs/Trees



More Guest Lectures

- stayed tuned, things may shuffle

Office Hours

- domains
  - bioinformatics
    - evolutionary trees
    - genomic sequences
    - protein-protein interaction
  - computer science
    - networking
    - security
    - cluster monitoring
  - environmental sustainability
- techniques/projects
  - Focus+Context
  - multidimensional scaling
  - scalable graph drawing
  - evaluation
- 1:30-2:30 Tuesdays or by appointment
  - office in X661, ICICS/CS