Information Visualization

Lecture 1 CPSC 533C, Fall 2005

12 September 2005

Tamara Munzner

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

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

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

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- 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

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
----
```

[5*8=40 + 5 = 45]

```
  6
```

External Representation: multiplication

paper mental buffer

```
   57
x 48
----
```

[5*8=40 + 5 = 45]

```
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
----
```

[5*4=20 + 2 =22]

```
456
 8
```

External Representation: multiplication

paper mental buffer

```
  57
x 48          [5*4=20 + 2 =22]
----
 456
228
```

External Representation: multiplication

paper mental buffer

```
   57
x 48
____
```

```
  456
228
____
   6
```

External Representation: multiplication

paper

mental buffer

```
  57
x 48
----
 456
228
----
   6
```

[8+5 = 13]

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
```

[4+2+1=7]

External Representation: multiplication

paper mental buffer

```
  57
x 48
----
 456
258
----
 736
```

[4+2+1=7]

External Representation: multiplication

paper mental buffer

```
  57
x 48
----
 456
258
----
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

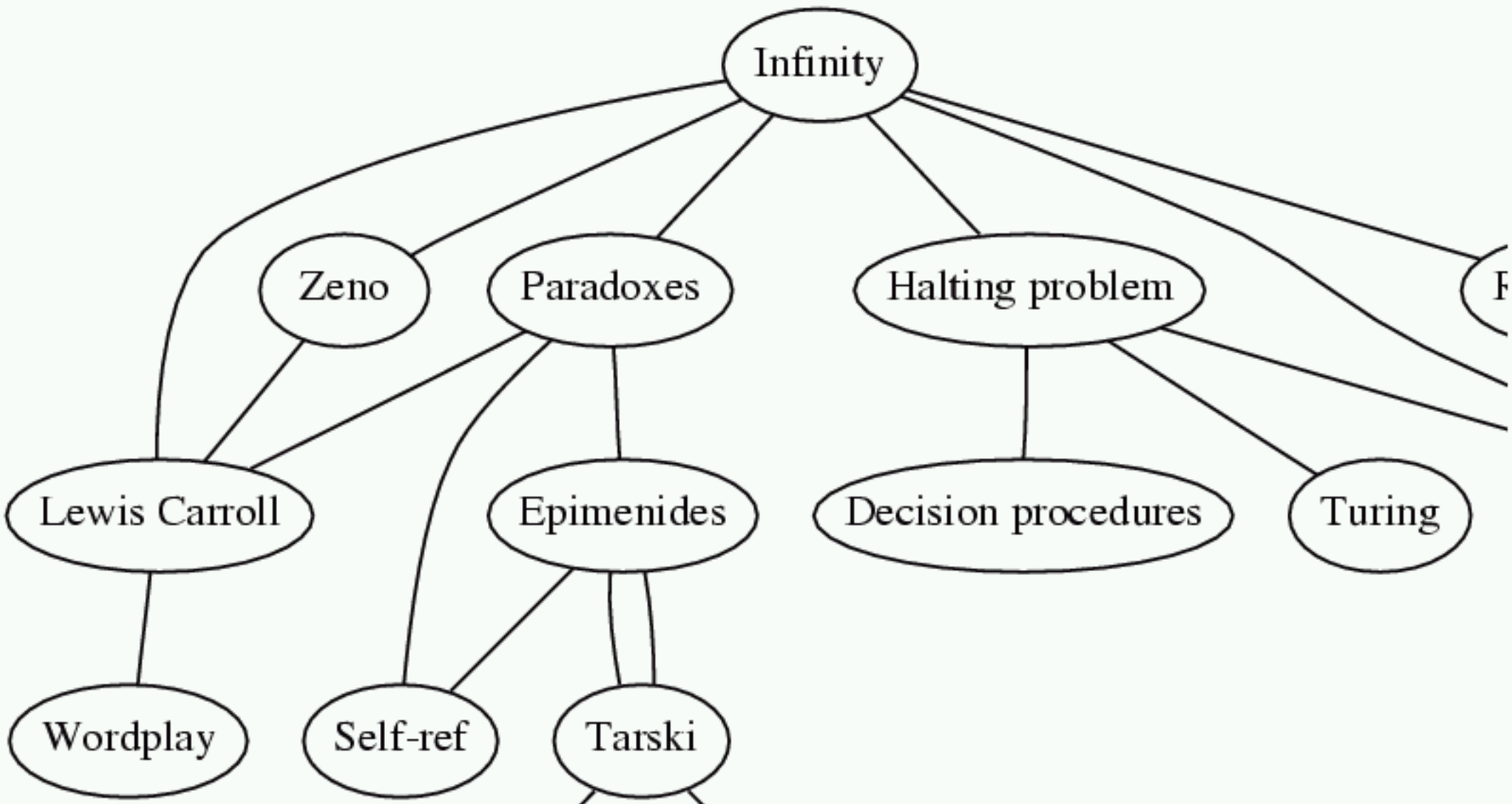
External Representation: Topic Graphs

[Godel, Escher, Bach. Hofstadter 1979]

Paradoxes – Lewis Carroll
Turing – Halting problem
Halting problem – Infinity
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
[...]

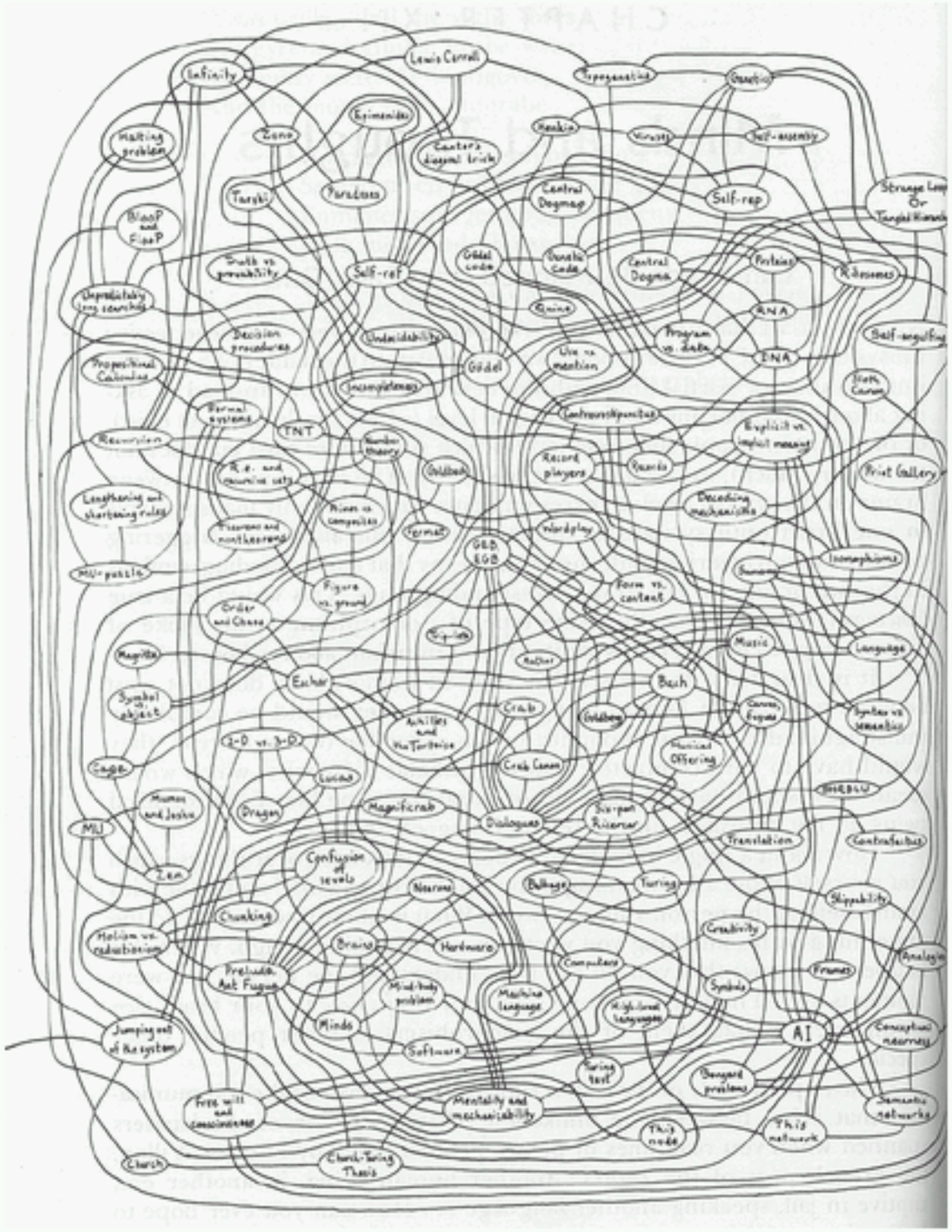
External Representation: Topic Graphs

offload cognition to visual systems
minimal attention to read answer



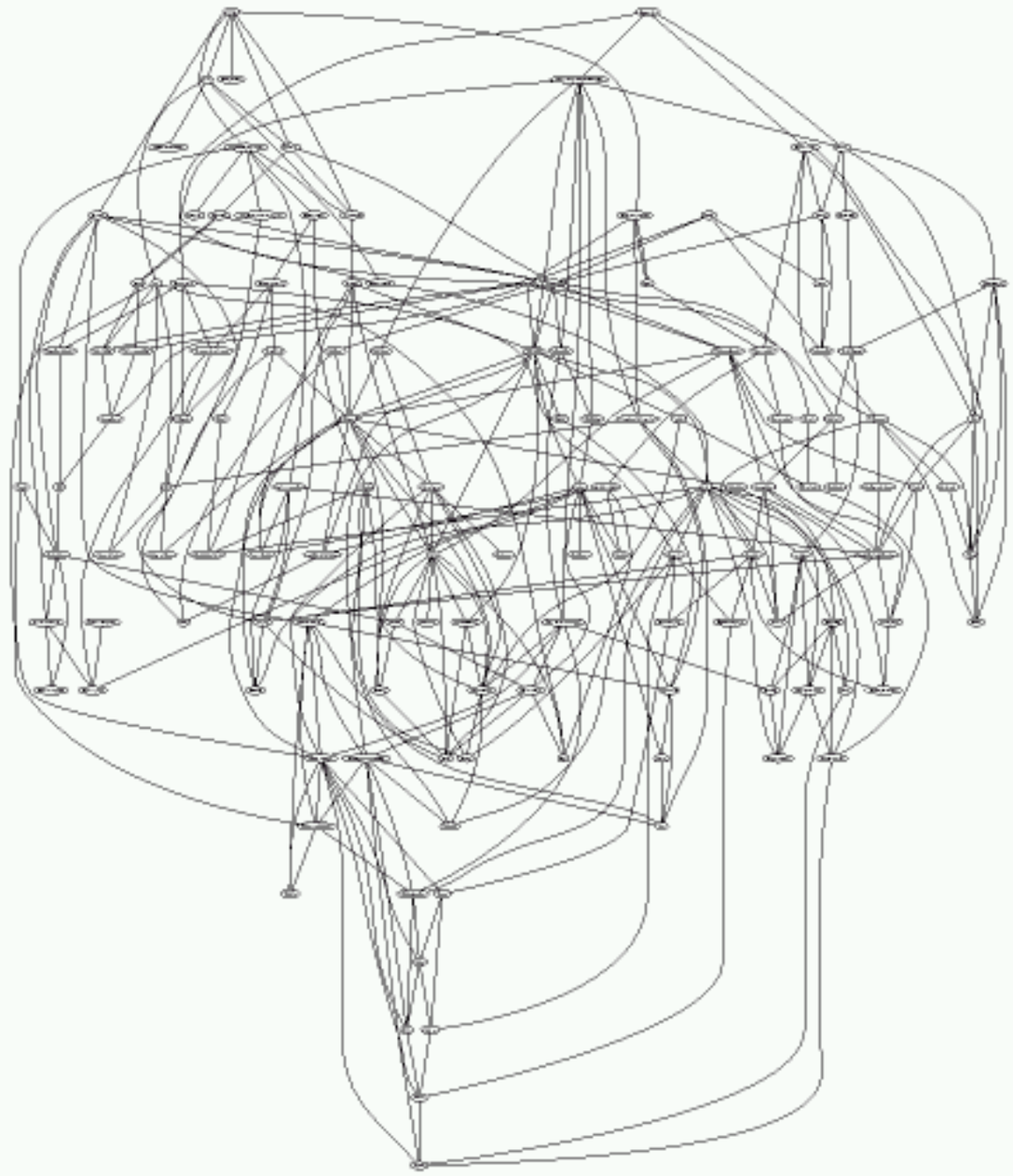
External Rep: Automatic Layout

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)

- 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

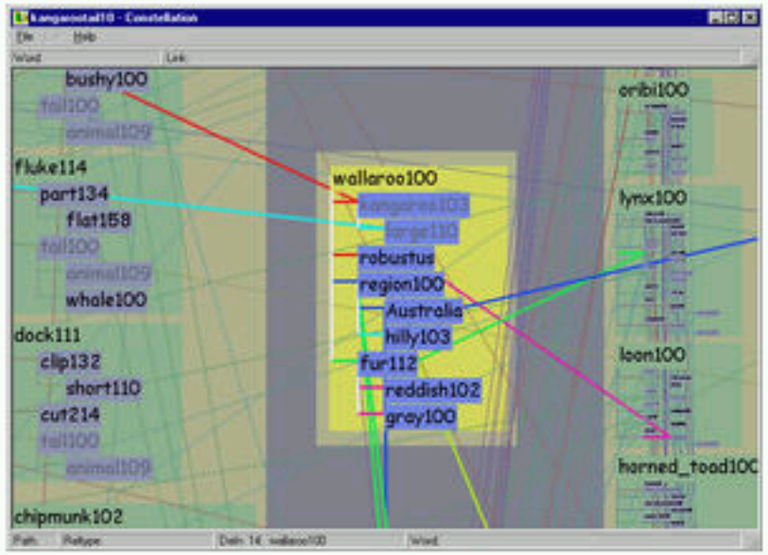
- accordion drawing
- multidimensional scaling
- scalable graph drawing
- evaluation

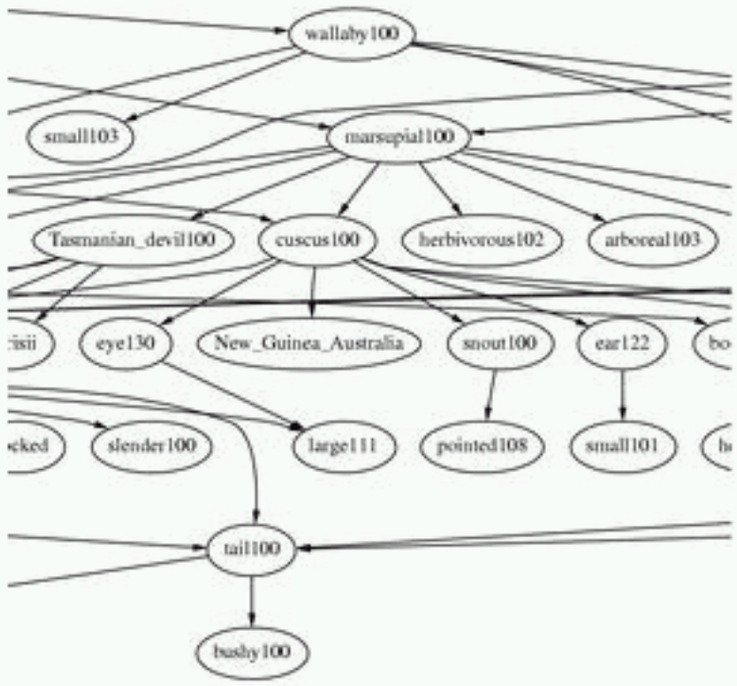
InfoVis Symposium organization

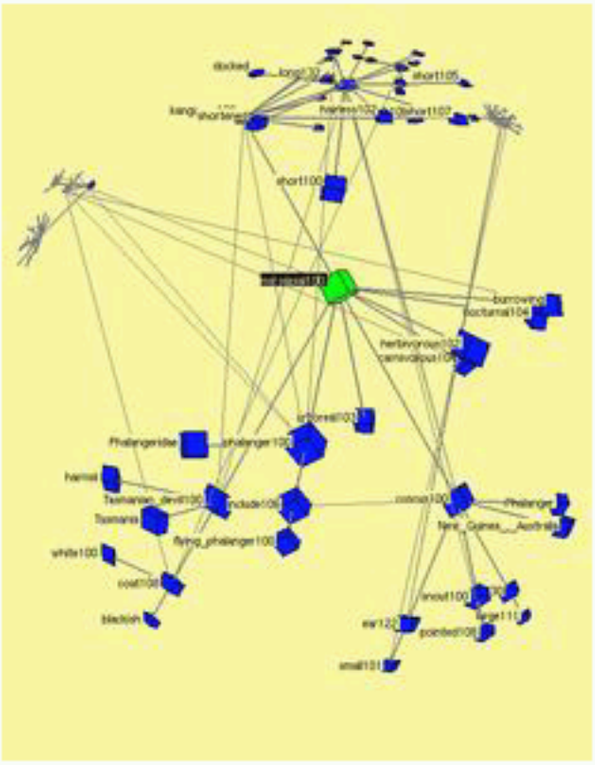
- Program Co-Chair 2003, 2004
- Posters Co-Chair 2001, 2002

Lecture Topics

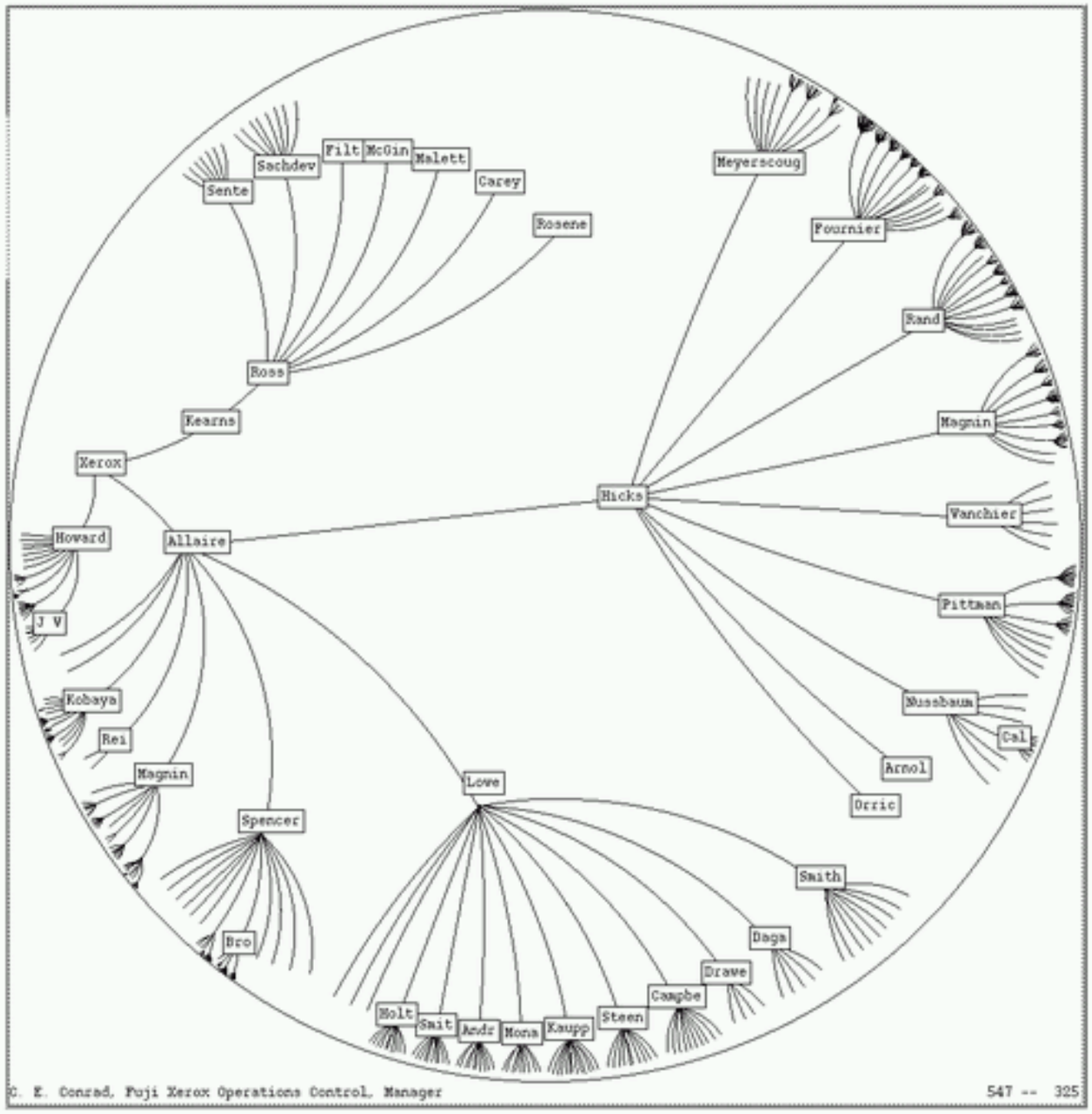
Design Studies



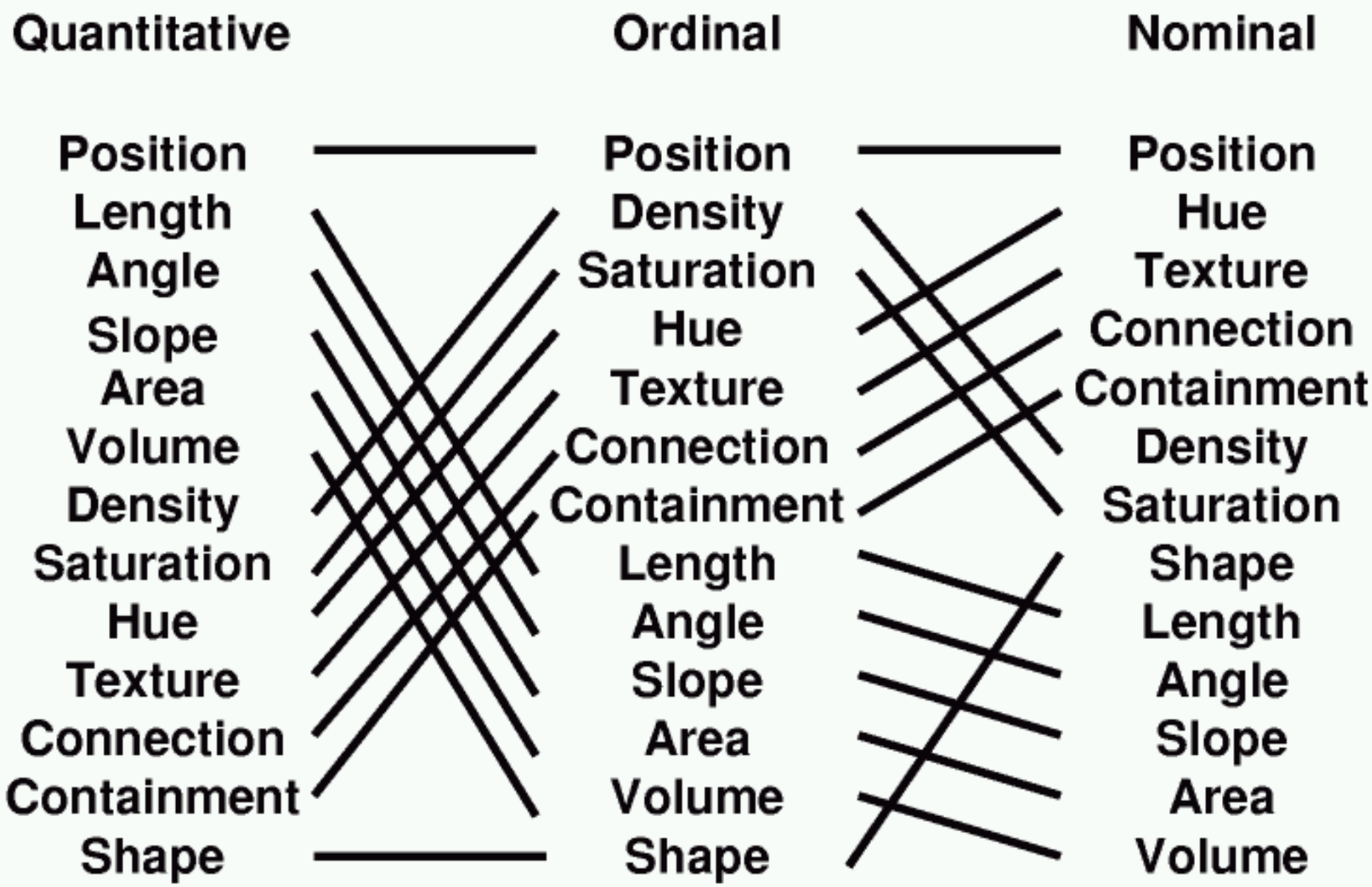




Overviews / Context

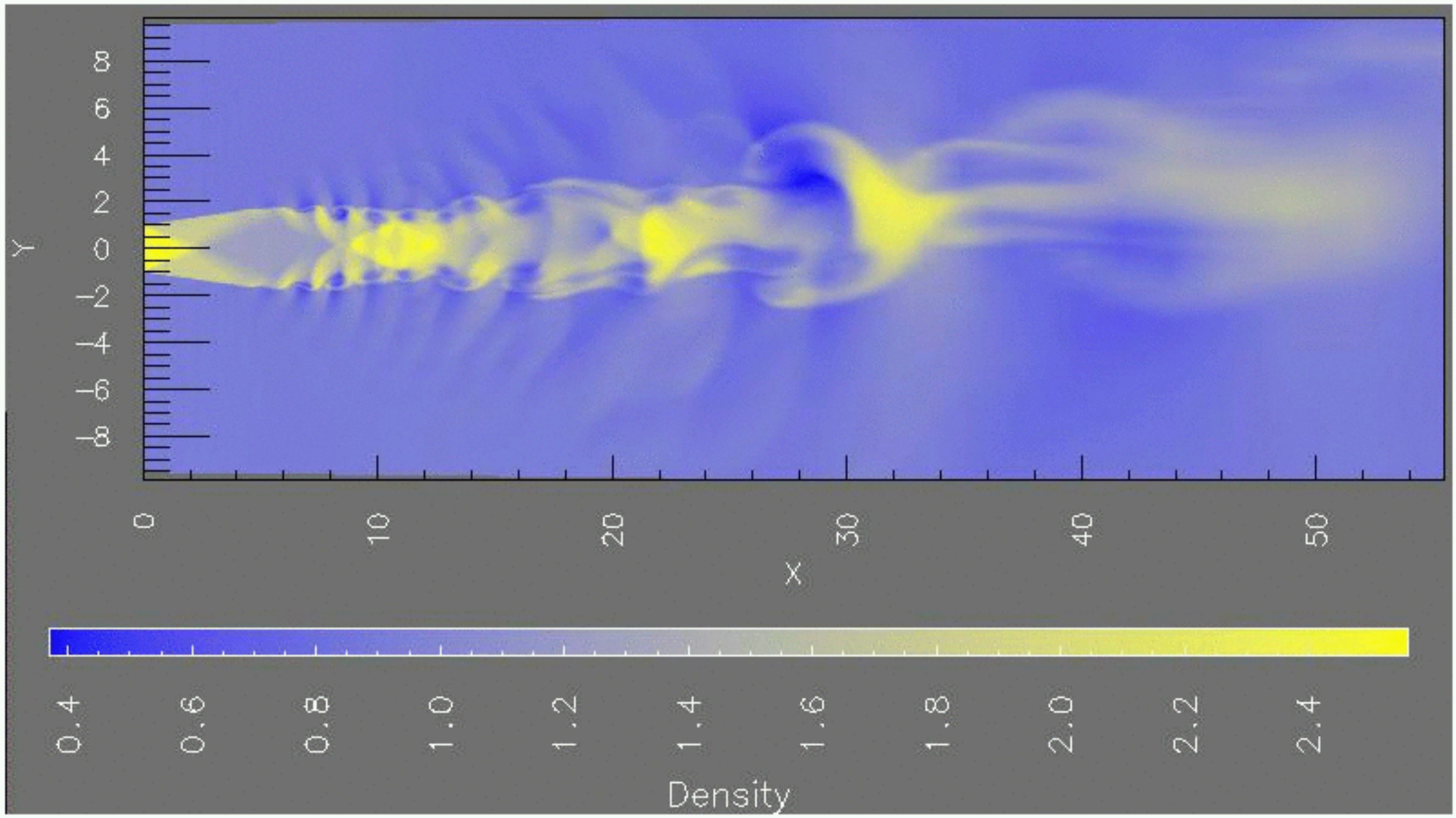


Frameworks/Models

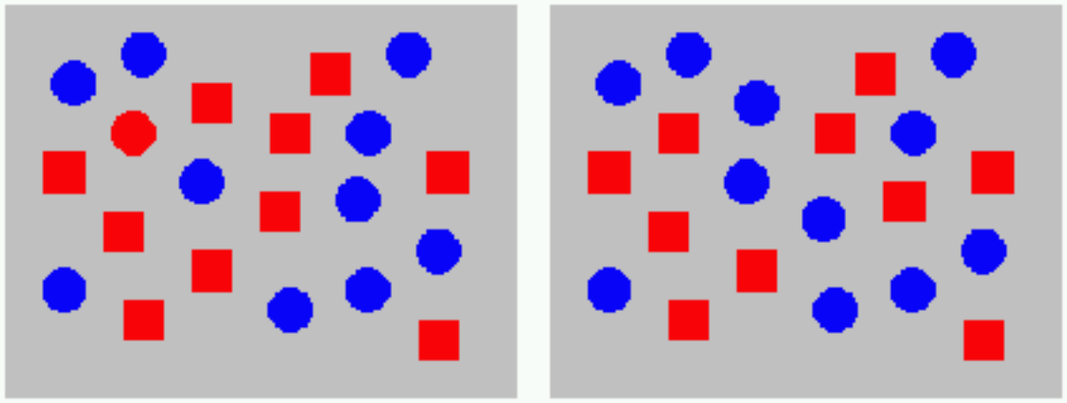


Color

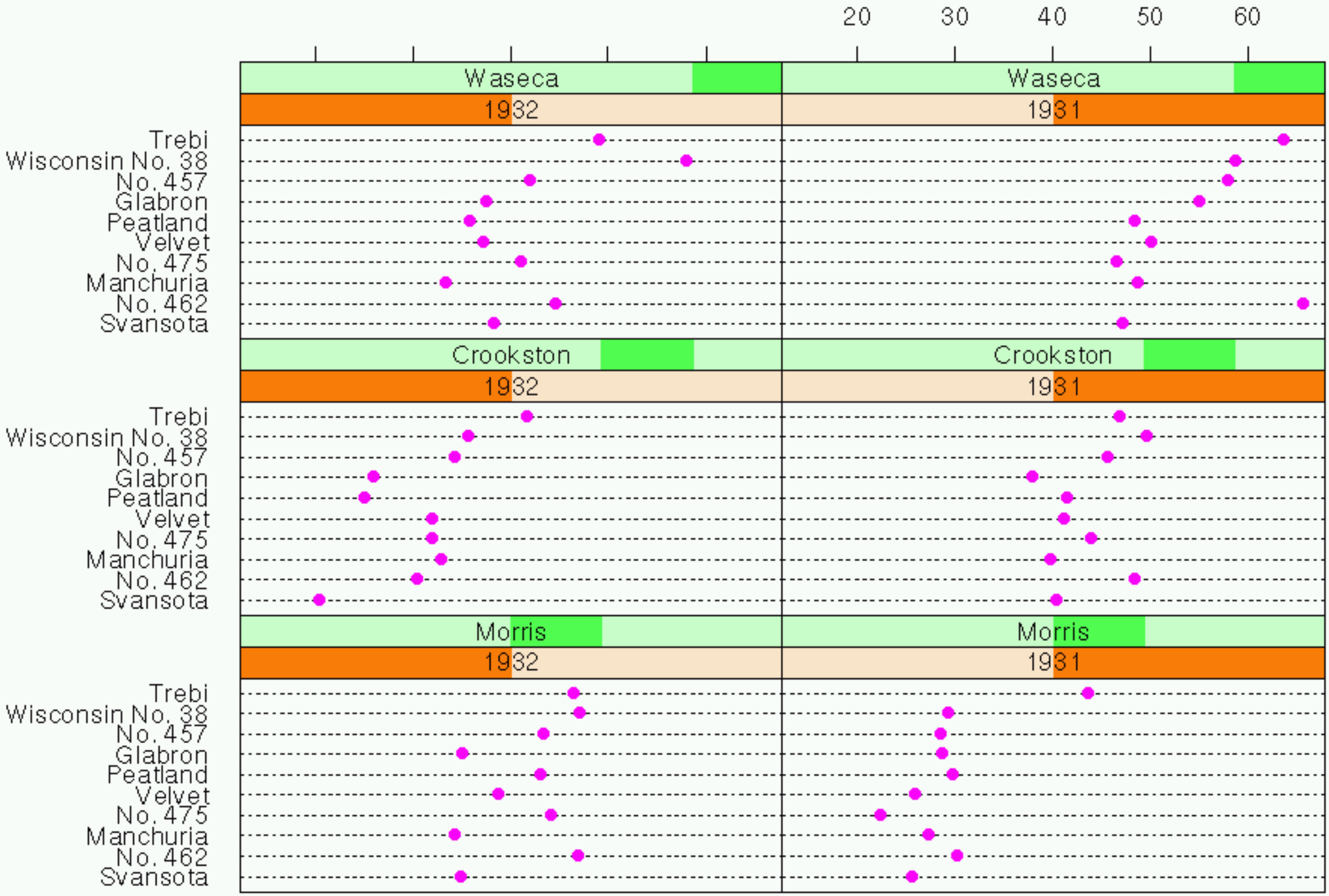
Guest Lecturer: Maureen Stone



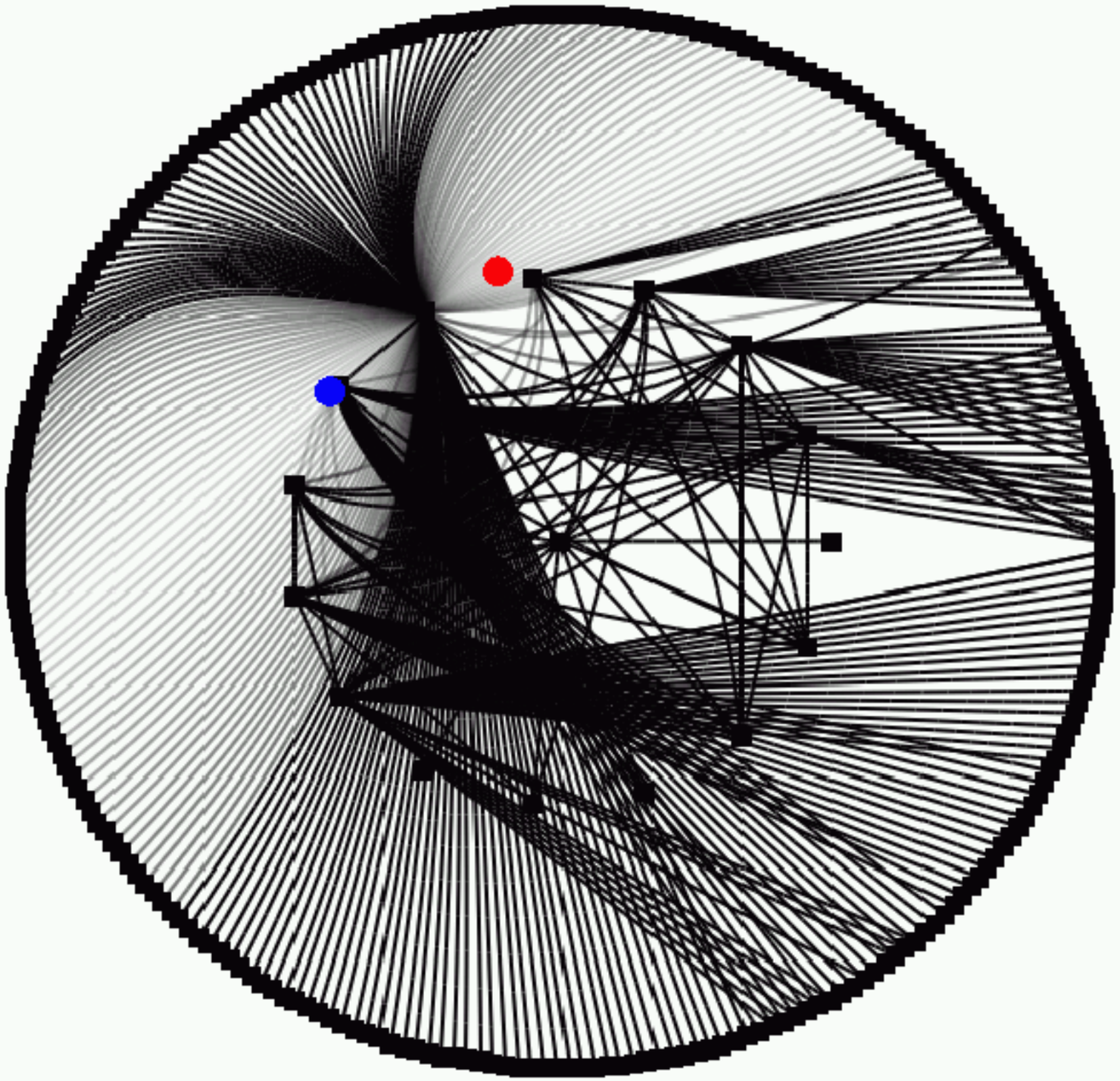
Perception



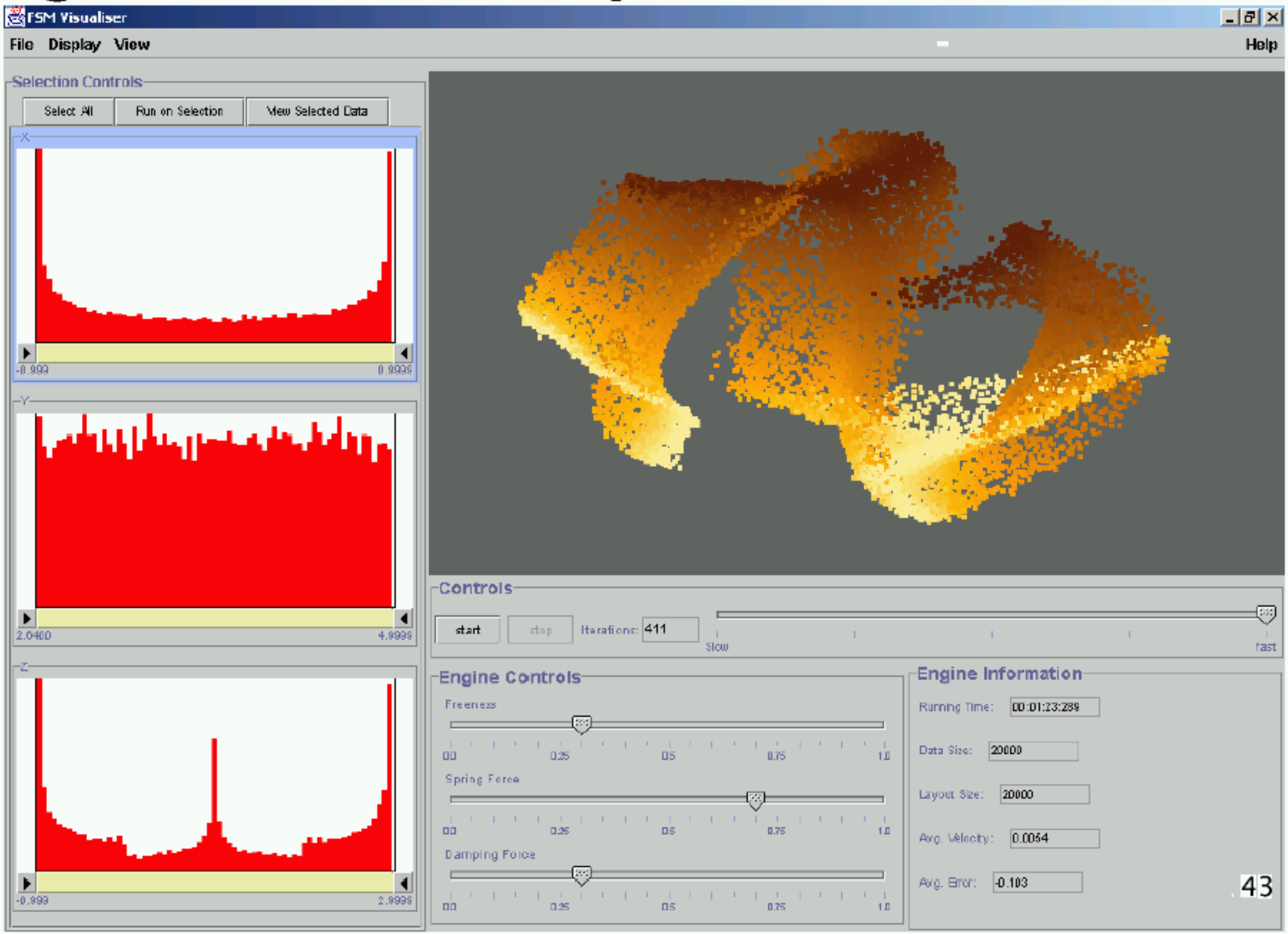
Space/Order


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
Morris
1932
1931

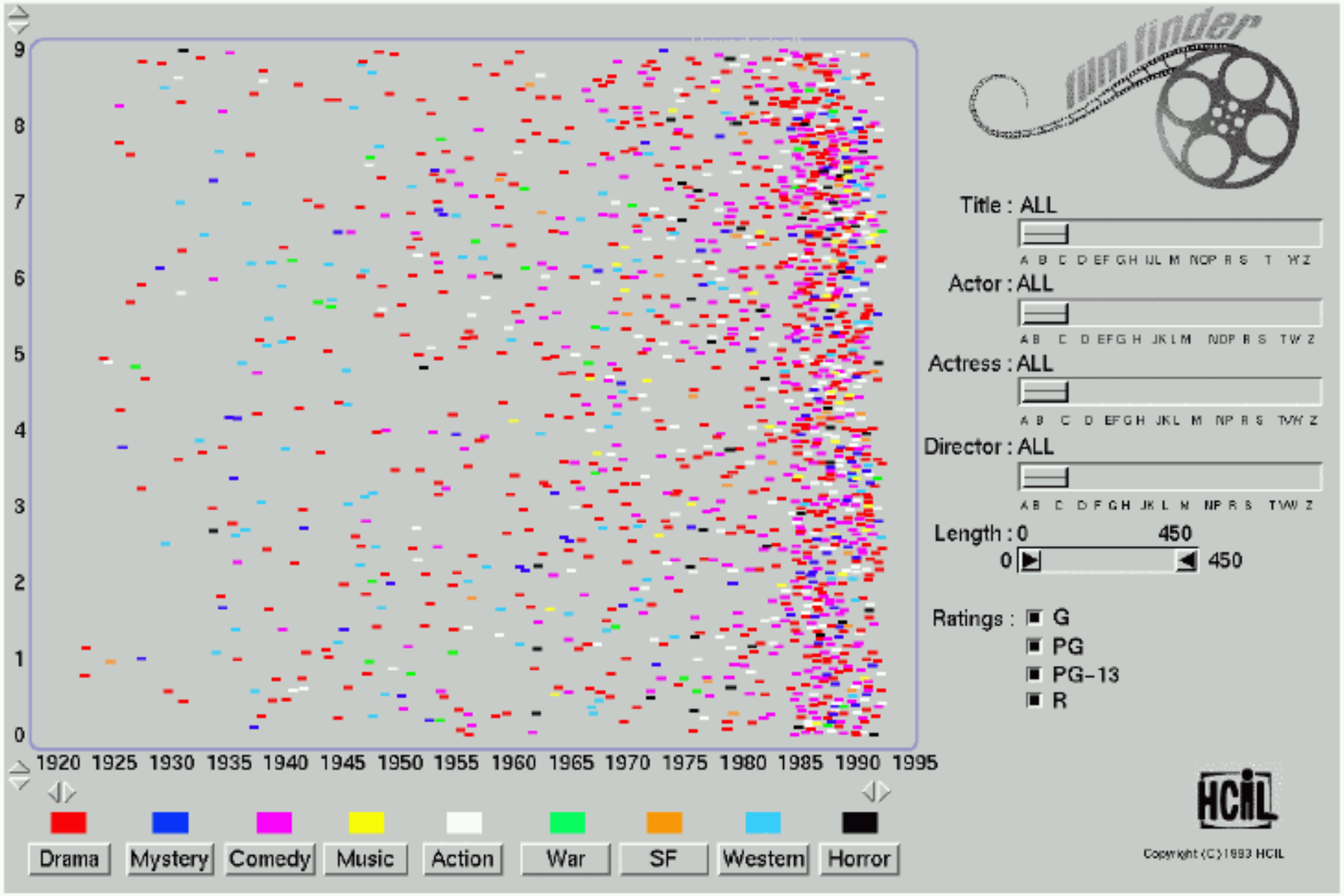
Depth/Occlusion



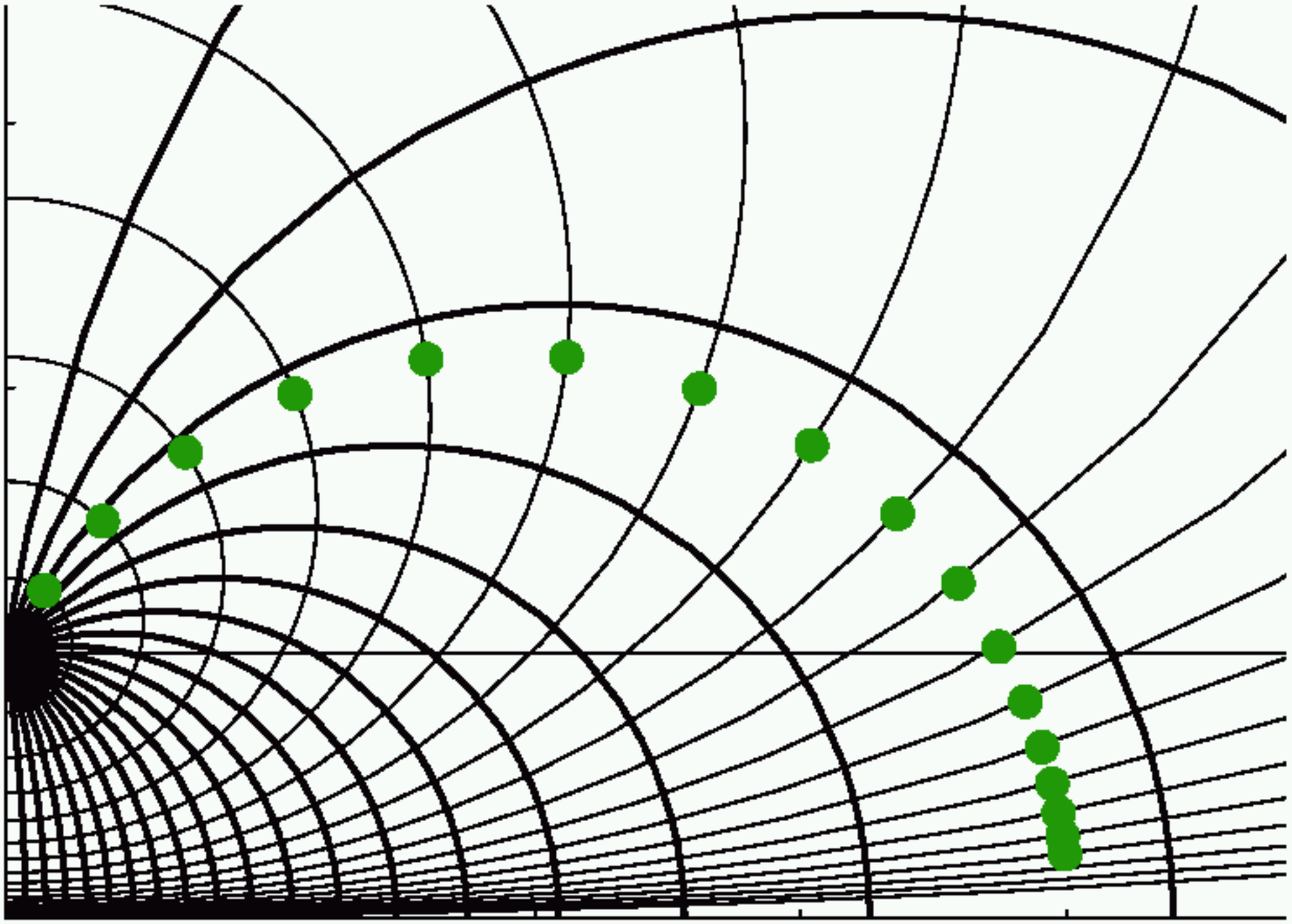
High Dimensionality



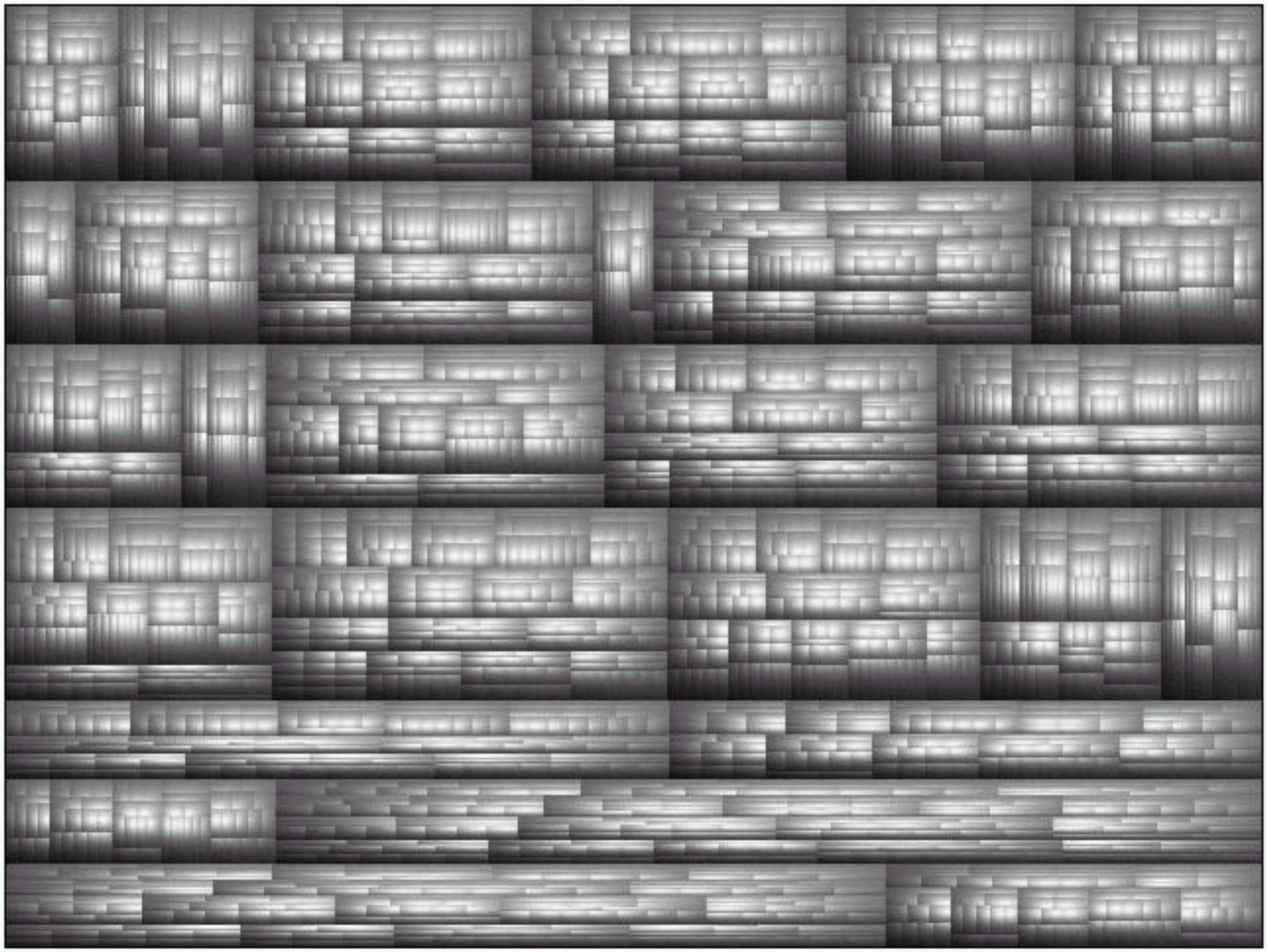
Interaction



Navigation/Zooming

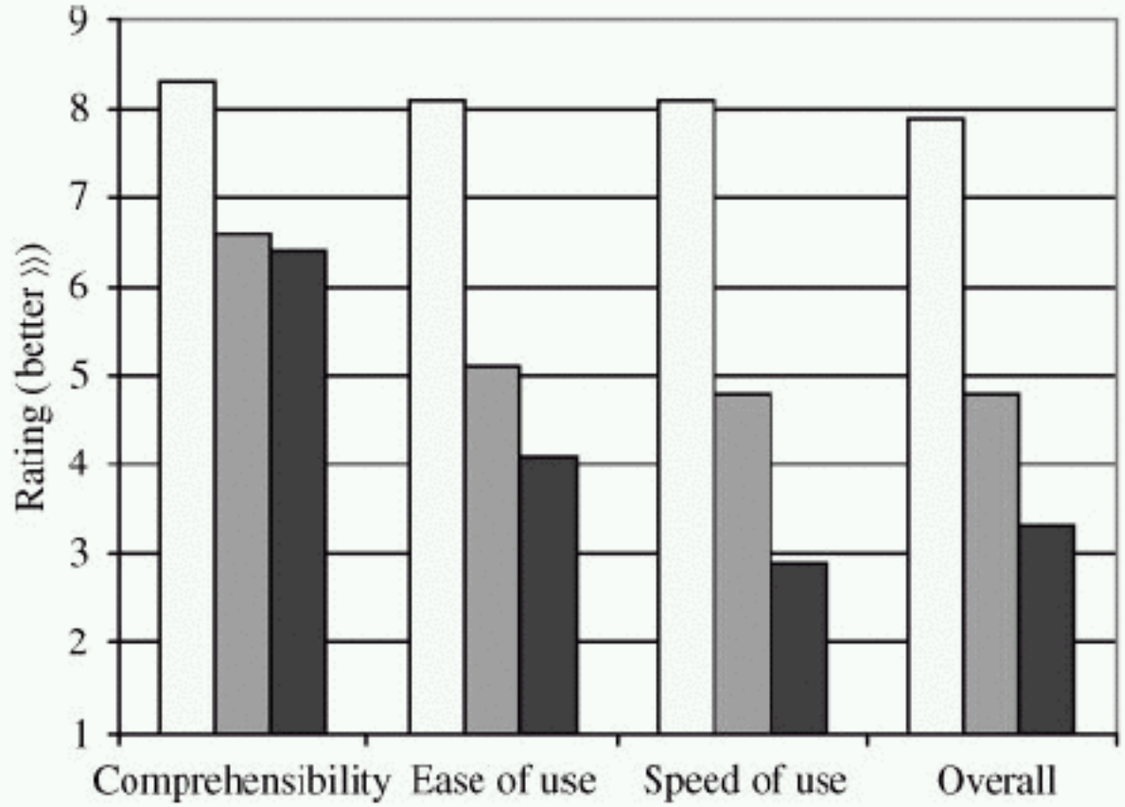


Graphs/Trees



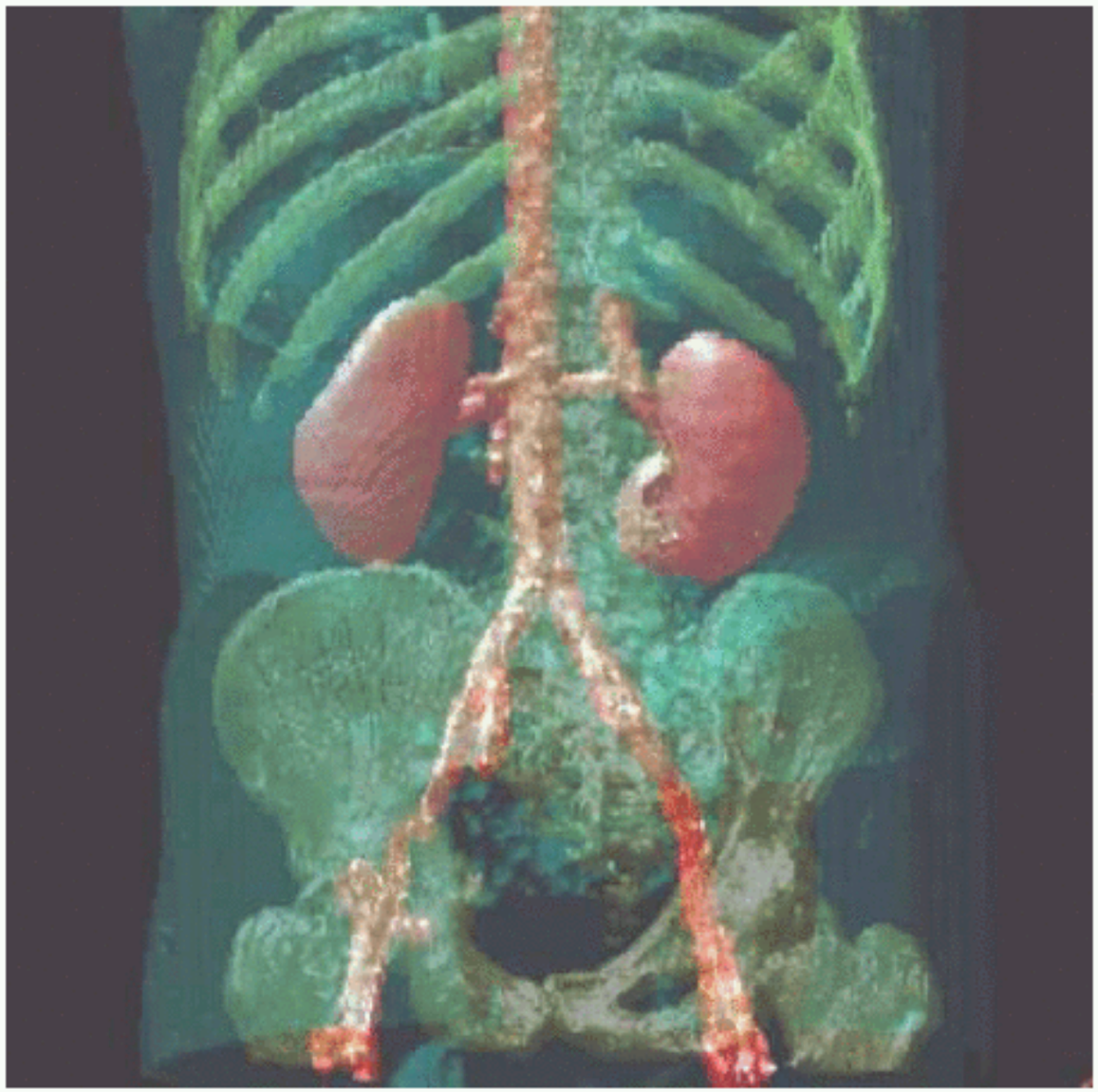
Evaluation

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
  - accessability
  - 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, ...