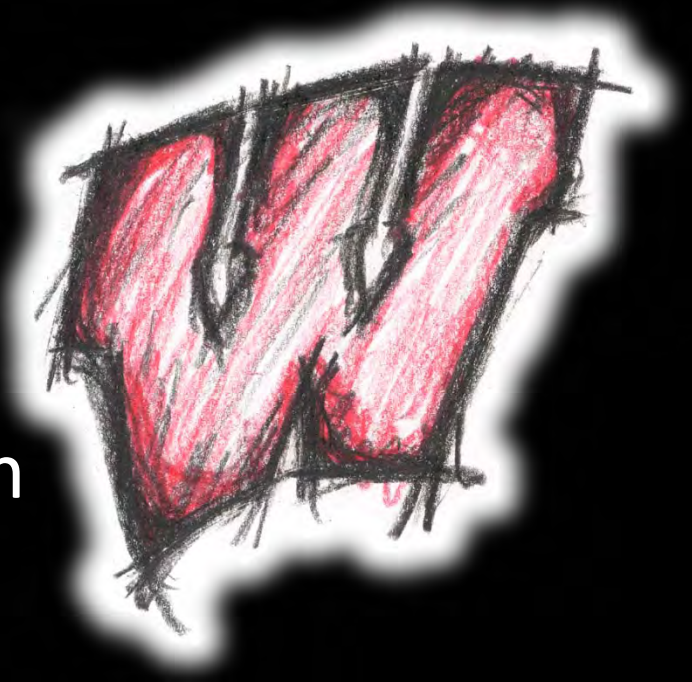
A Conversation about Visualization

Michael Gleicher

Dept of Computer Sciences
University of Wisconsin - Madison



What I do instead of preparing this talk?

HCC: Small: Designing Effective Gaze Mechanisms for Cross-modal Embodied Agents

Project Description

Advances in computing technology, particularly in machine learning, computer vision, and speech processing and generation, promise the introduction of embodied agents. Our vision is that these agents will be participants in valuable application domains including education, training, rehabilitation, or collaborative work. However for embodied agents to effectively serve in this range of roles, they will need t[illegible] essential capabilities. First, they wi[illegible] need to draw on the full e[illegible]ent of hu[illegible]an communicati[illegible] [illegible] interactions [illegible] people are sh[illegible]n to rely on nonverbal [illegible]th producing and interpreting social behavior in a variety of situations (Mehrabian & Wiener, 1967; Tepper & Haase, 1978). Second, agents will need to work in a variety of modalities and different forms of presentations as the range of applications will impose different constraints on agent design and presentation. For instance, a physically embodied social robot might be an appropriate presentation for tasks that require physical mobility, while a virtual agent might be a more appropriate presentation in an immersive learning environment. Some examples of different modalities and presentations are illustrated in Figure 1. Achieving our vision of agents participating effectively requires that agents augment their communication with nonverbal cues, such as gaze and gesture, whether their embodiment is a physical robot, a life-sized character in a virtual environment, or an avatar on a handheld display.

The goal of our project is to design social cues for embodied agents that work as effective communicative mechanisms across presentations and task contexts. We focus on designing gaze cues as a starting point for our long-term study of social cues in embodied agents. Gaze cues are a particularly interesting set of social cues as they have evolutionary underpinnings and a tight coupling with high-level social and cognitive processes. Humans have specifically evolved to use gaze cues: of all primate species, humans are the only one to have a white sclera (Kobayashi & Kohshima, 1997), facilitating the perception of others' gaze direction and use of this information to learn about objects in the environment—what is called "referential active communication" (Emery, 2000).

A central component of our vision is that embodied agents can draw on the communicative power of gaze cues to evoke social and cognitive responses in their interaction with people. People use gaze cues as

Figure 1. Examples of embodied agents with different presentations: (a) a virtual memory trainer on a handheld device, (b) a virtual patient used to train clinical psychologists, (c) an avatar in an immersive virtual environment as presented to the user, (d) a social robot designed for autism therapy, (e) an avatar in a learning environment in Second Life, (f) virtual peers designed for autism therapy, (g) a virtual character developed for interactive games, (h) a collaborative robotic assistant for NASA's Space Mission tasks.

Pictures from Piles of Data

How Graphics, Multimedia, Vision, Visualization, Animation and Cartography All Connect

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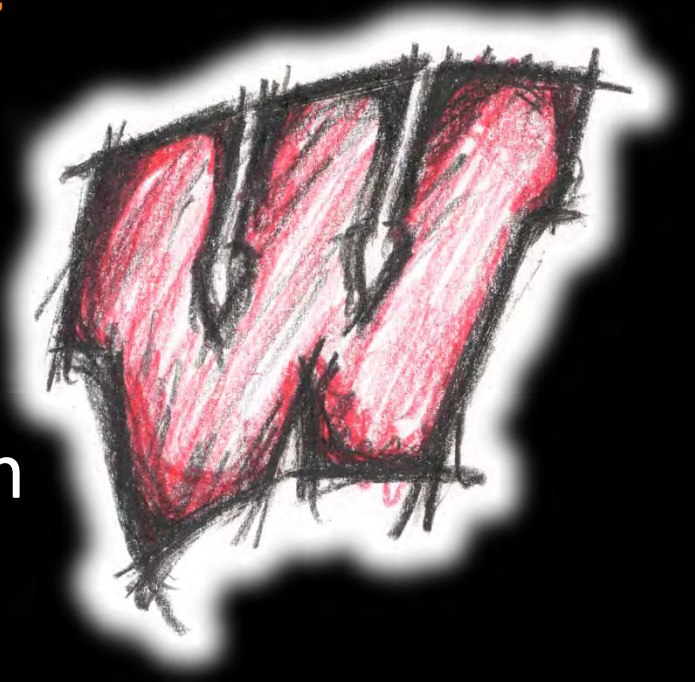

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Who is this guy?

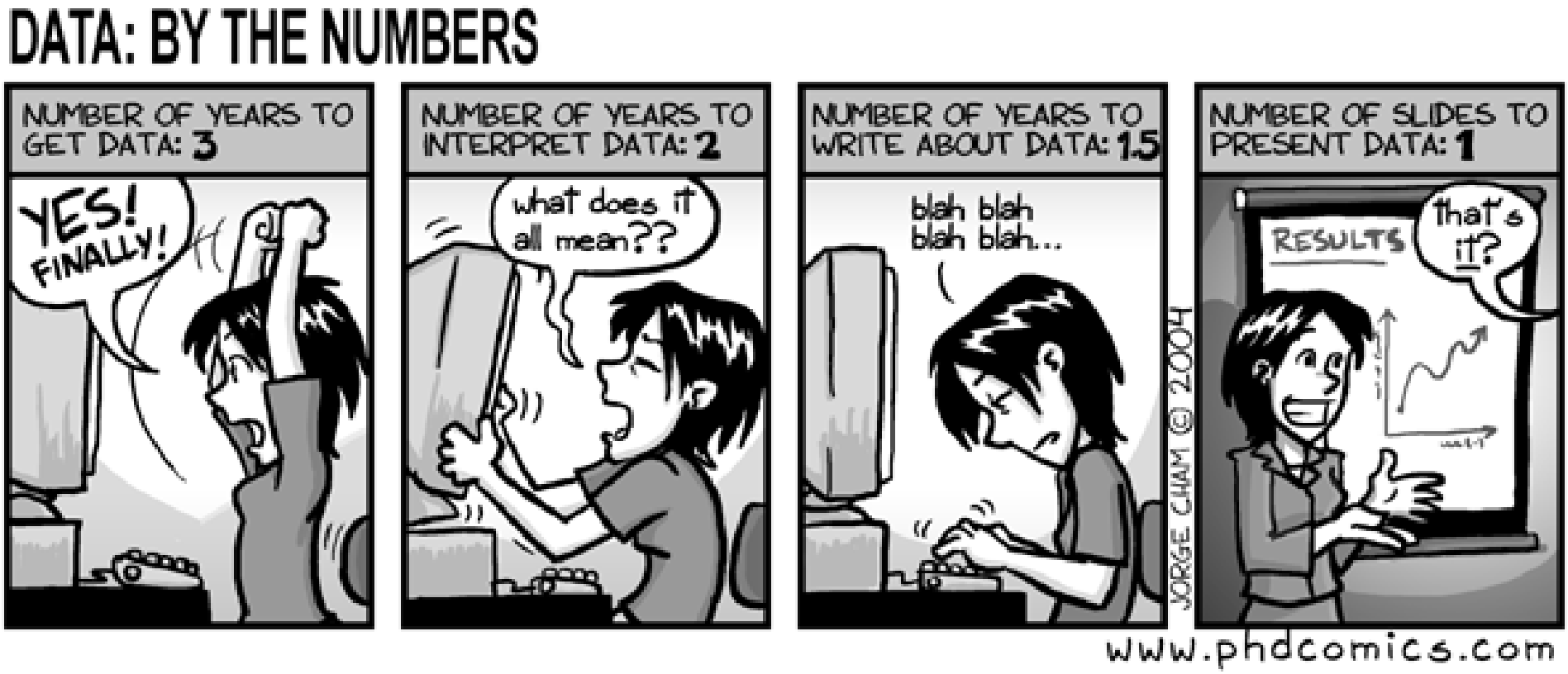
What's he doing here?

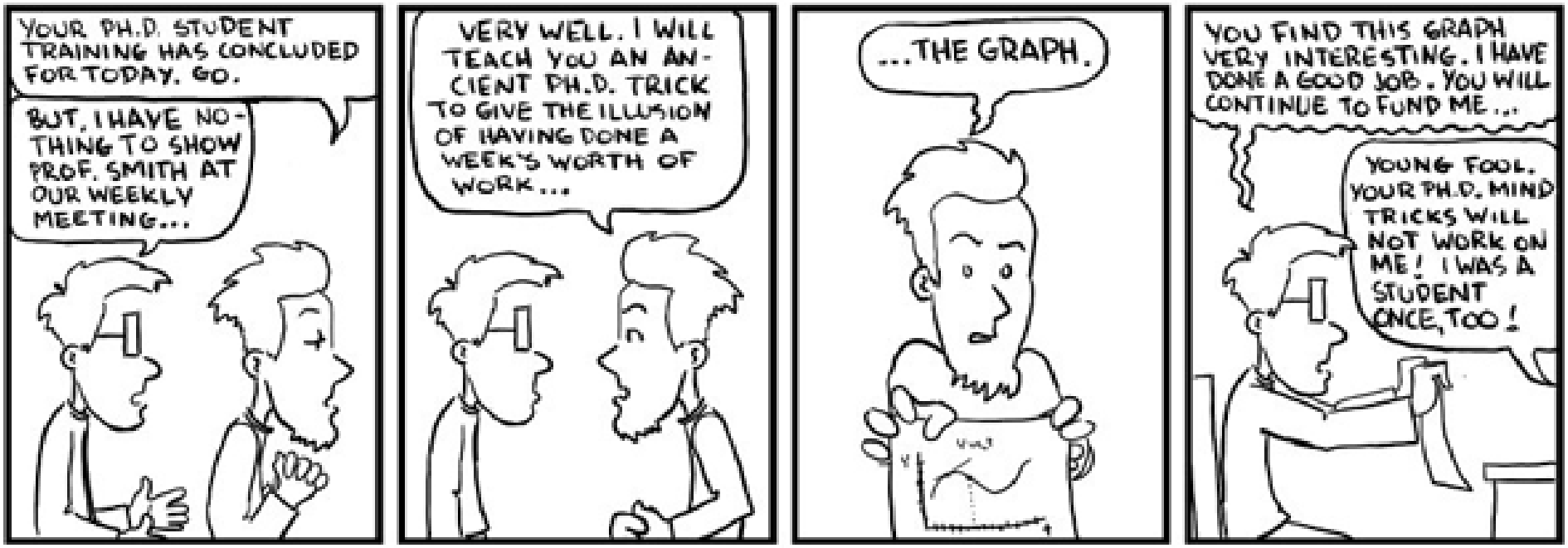
Michael Gleicher

Dept of Computer Sciences

University of Wisconsin - Madison

Why are **you** here?





JORGE CHAM ©THE STANFORD DAILY

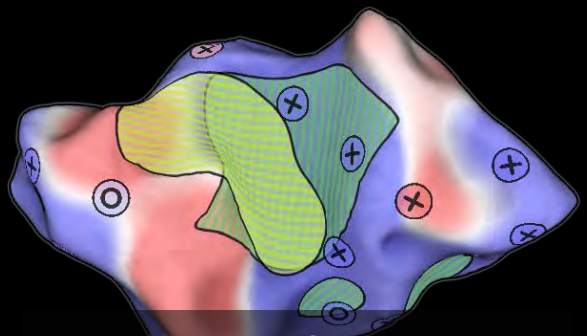
Why am I here?

- Promote a new class
- Tell you about the kinds of things we do
- Spread the gospel of visualization
- Build Connections

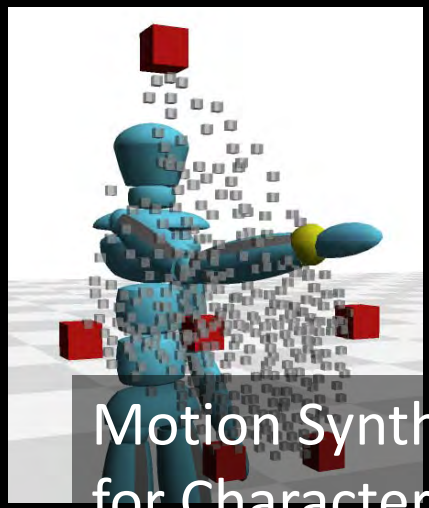
Why am I here?

- ~~Promote a new class~~
  Get some feedback on a new class
- Tell you about the kinds of things we do
- Spread the gospel of visualization
- Build Connections

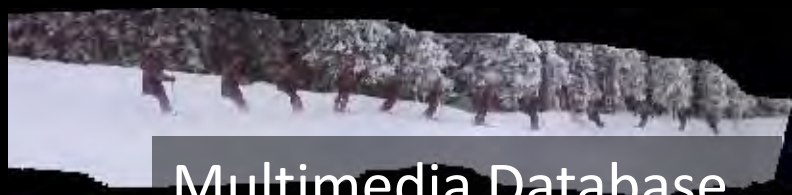
What do these have in common?



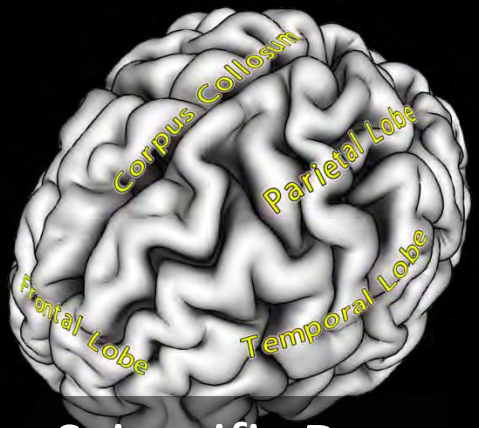
Analysis of Proteins



Motion Synthesis for Characters



Multimedia Database Information Extraction



Scientific Data Display

Video Quality Improvement

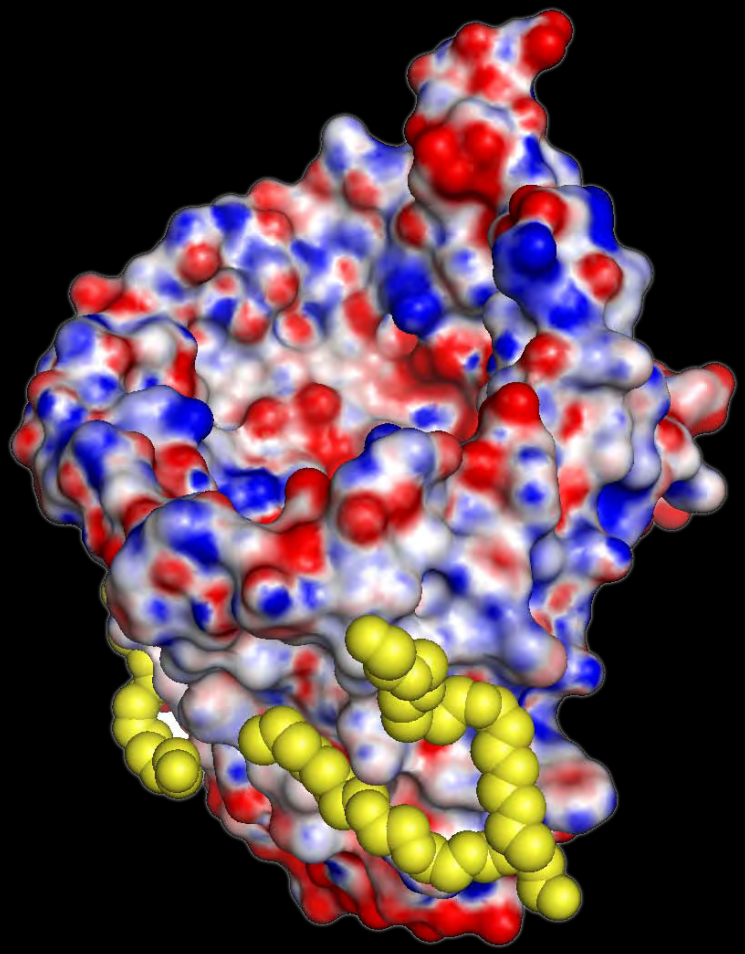
Image and Video Retargeting

What do these have in common?

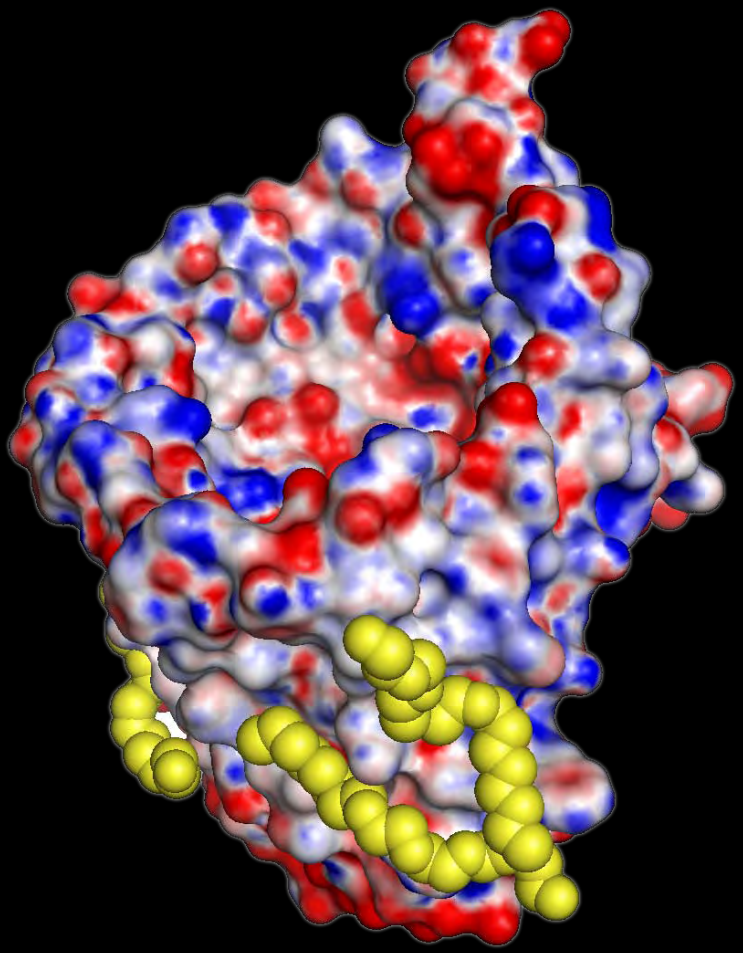
- It's all stuff I've done in the past few years
- It involves large amounts of data
- It involves creating effective presentations
- It requires some understanding of the data in order to simplify it

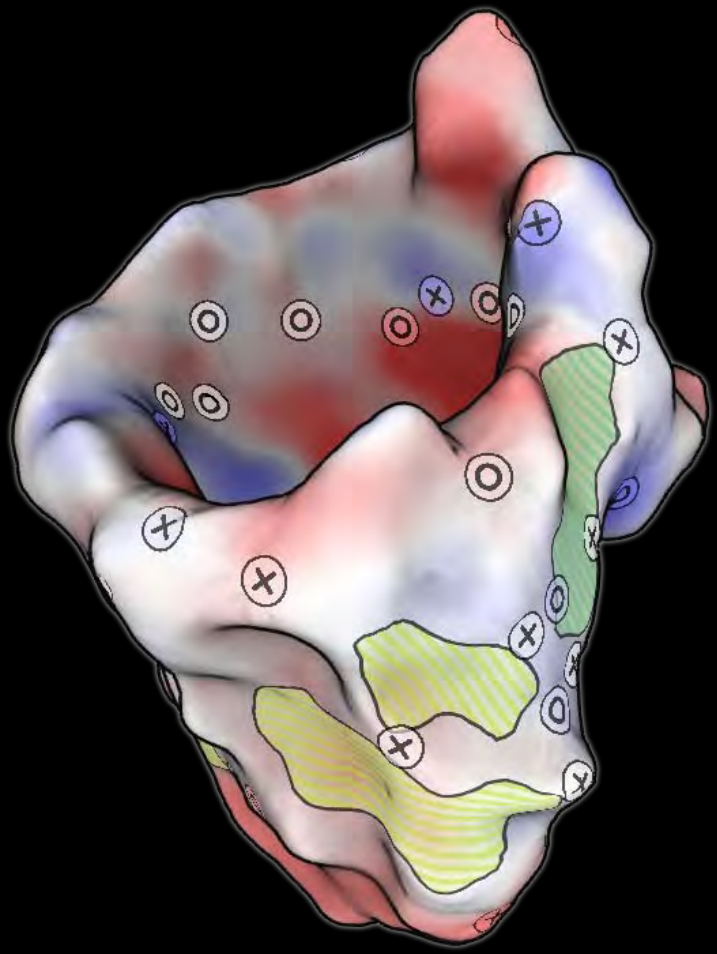
How can we use our understanding of human perception and artistic traditions to improve our tools for communicating and data understanding.

A Protein Surface

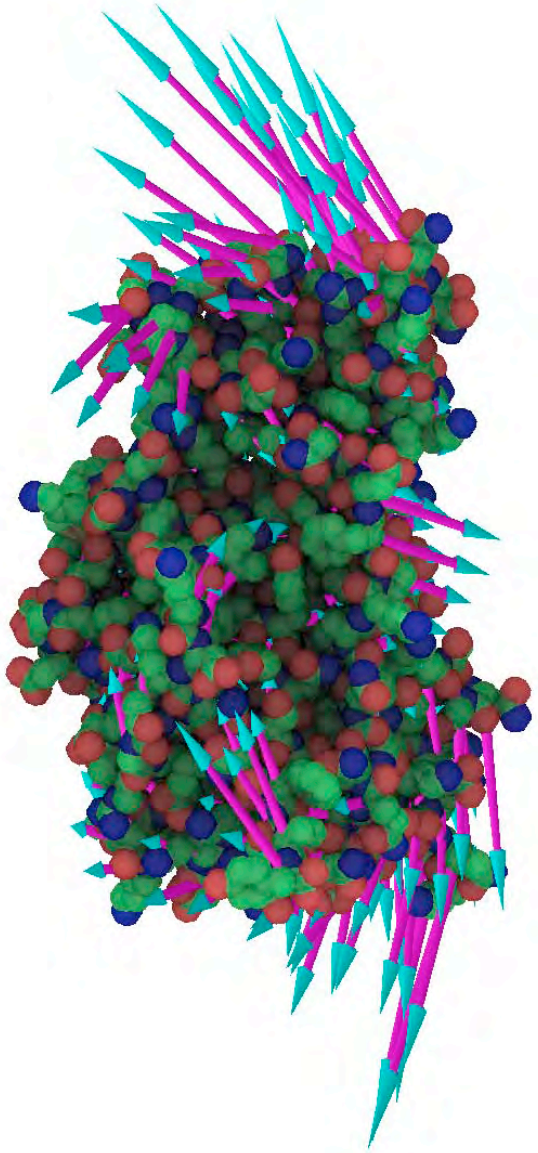


Molecular Surface Abstraction

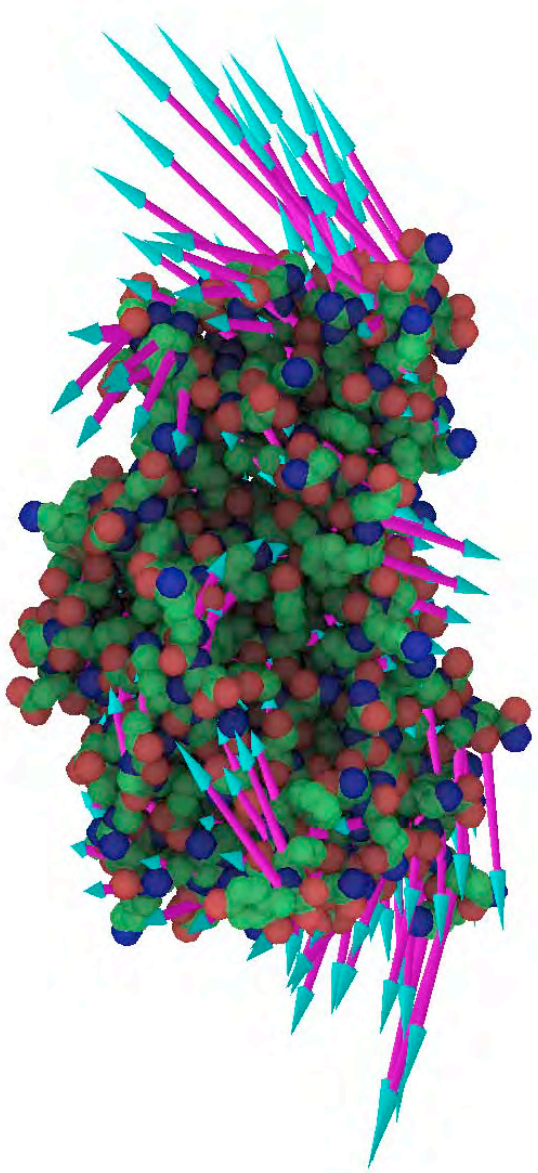


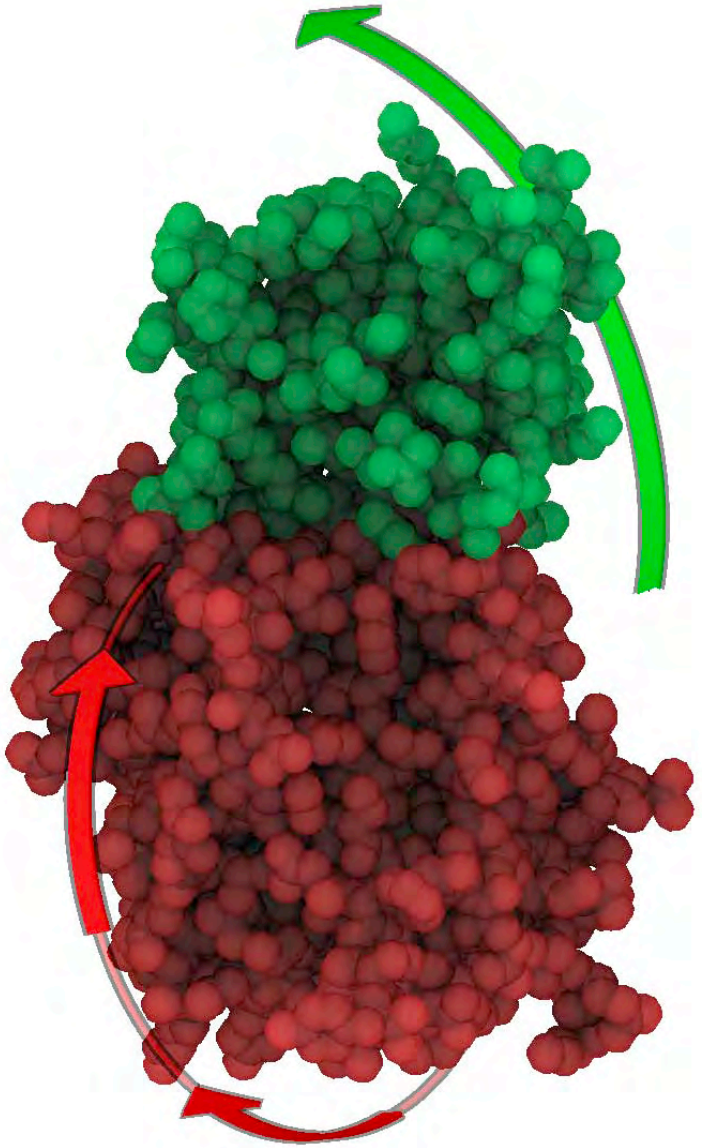


Molecular Motions

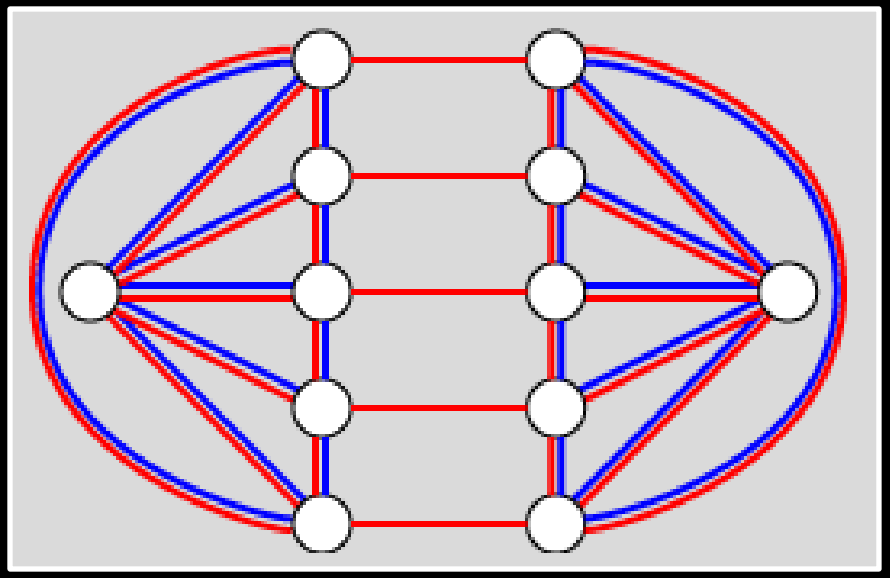


Motion Illustration





Not just Biochemistry

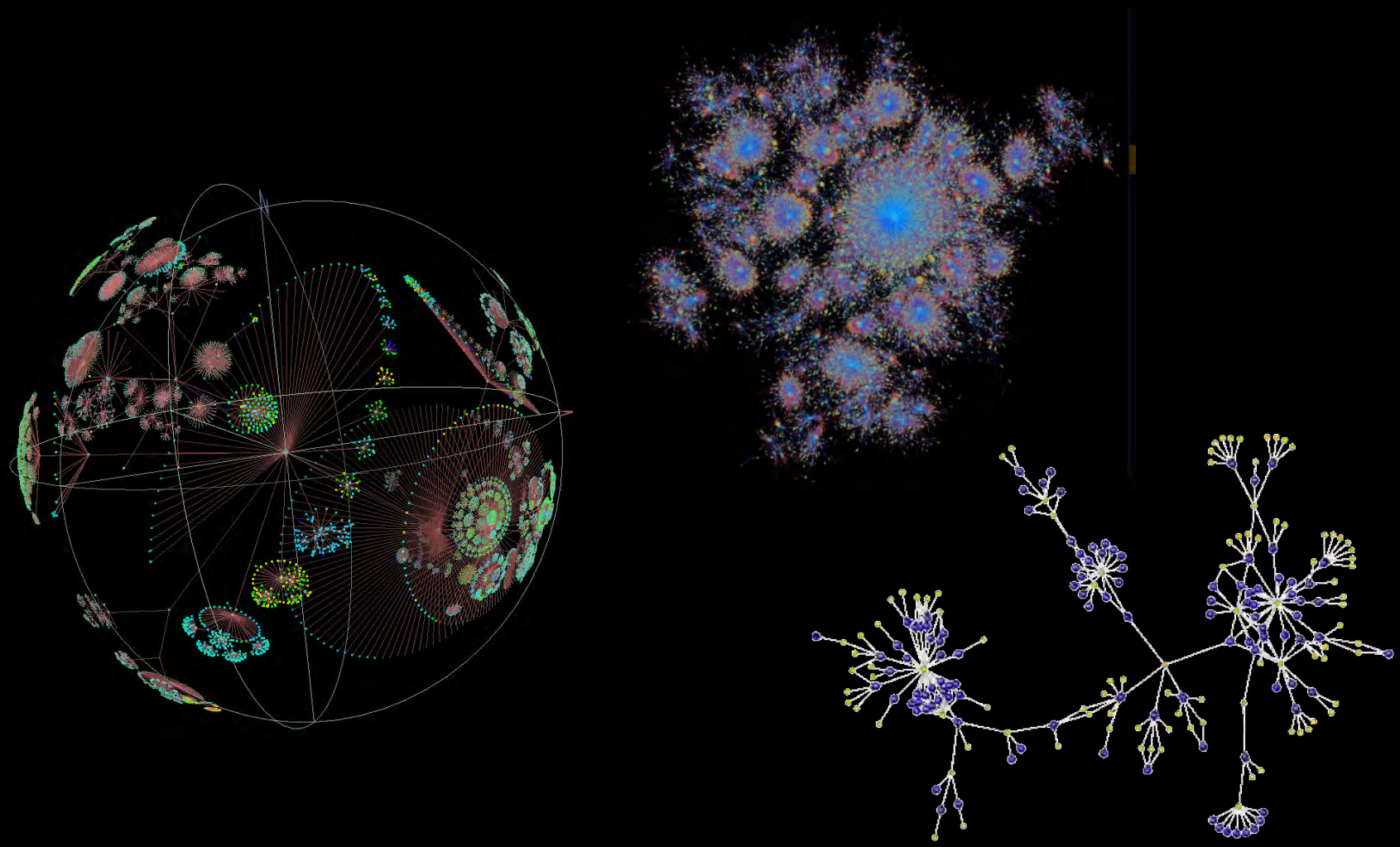


Educational Psychology:
Epistemic Frame Networks

Comparing small, dense, weighted networks evolving over time

How to compare networks?

Isn’t this just graph visualization?

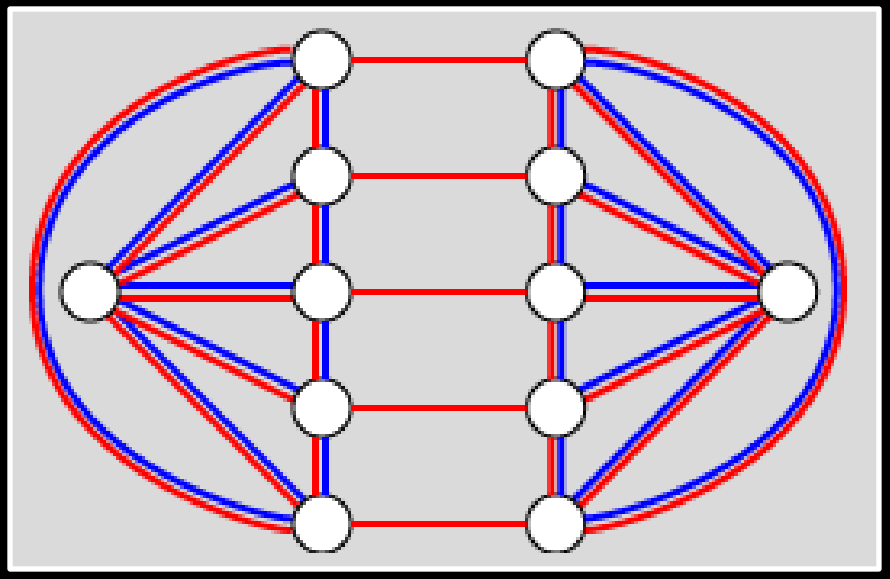


A different problem

- Small, dense, weighted graphs

- Comparison Problems
  - Compare 2, 3,4, … n
  - See evolution over time (animate n steps)
  - Compare Trajectories

Epistemic Frame Comparison



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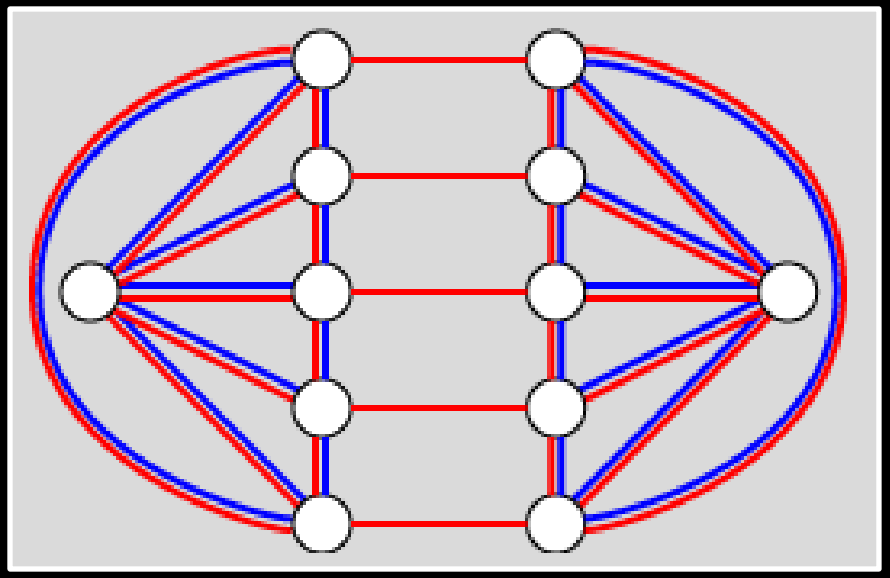

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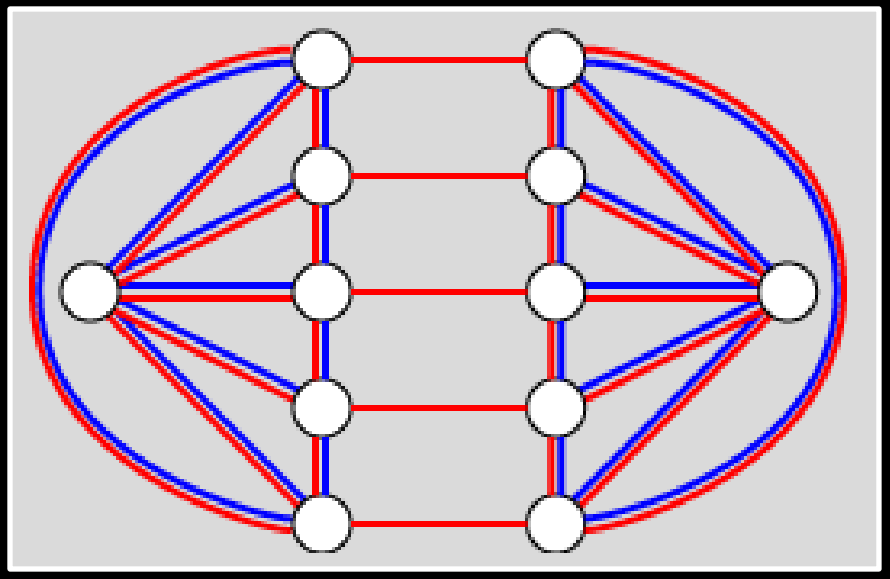

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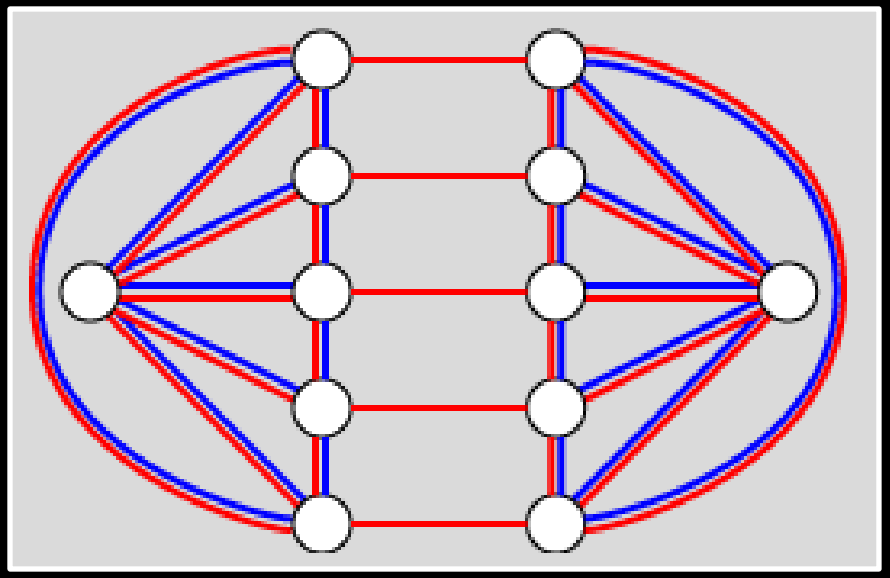

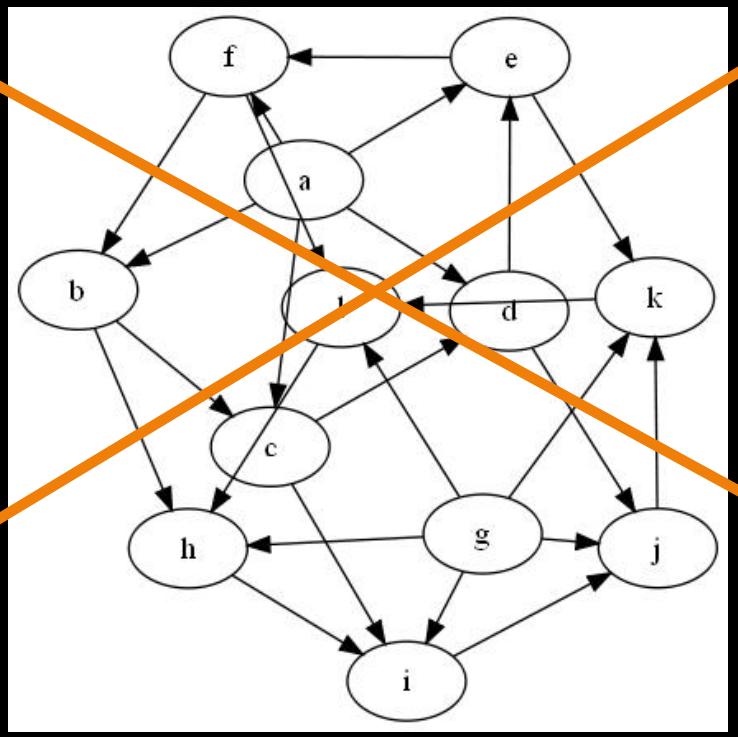

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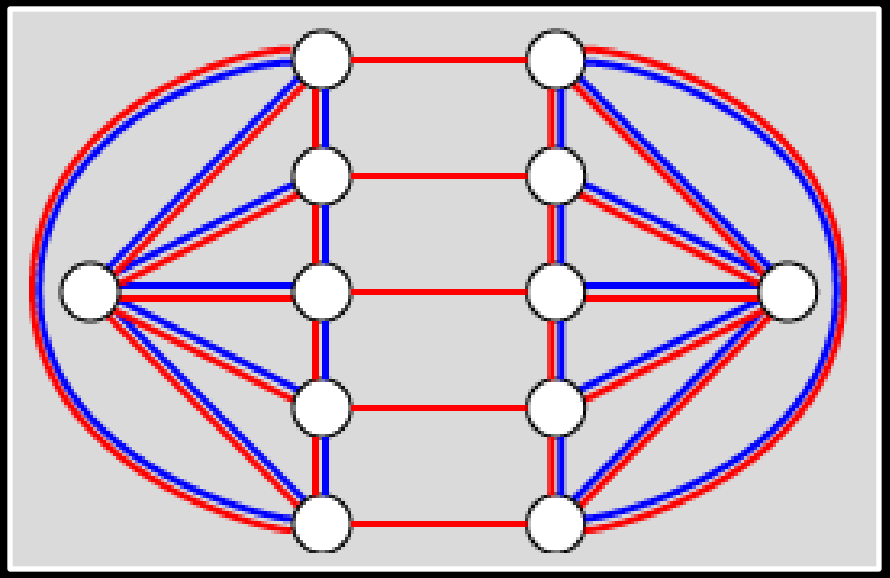

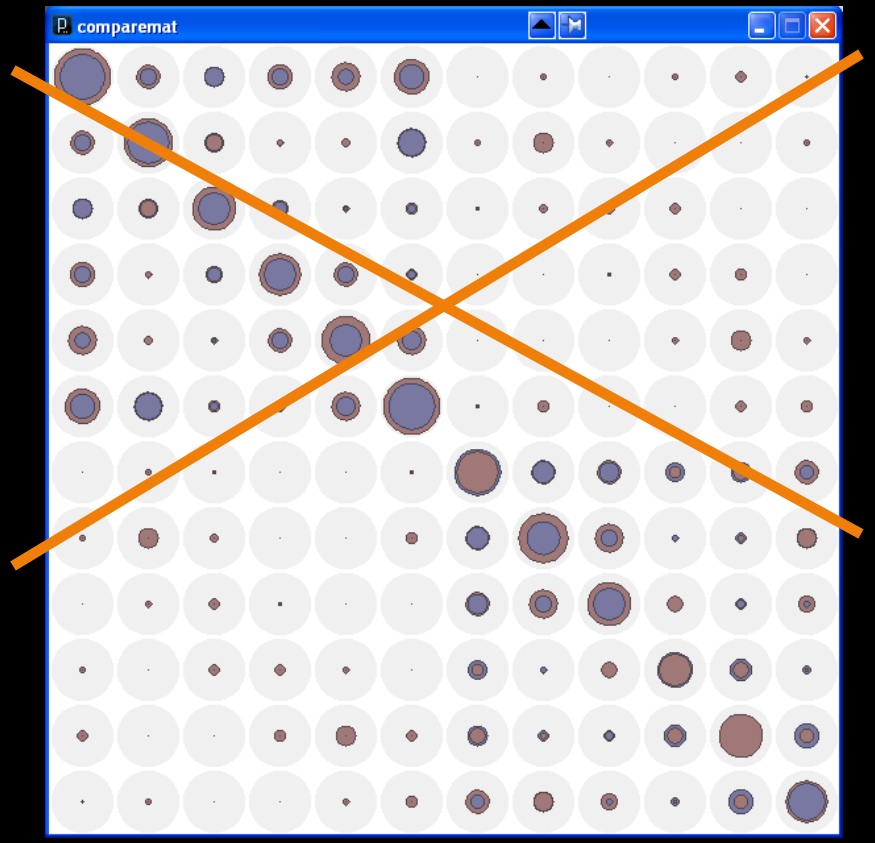

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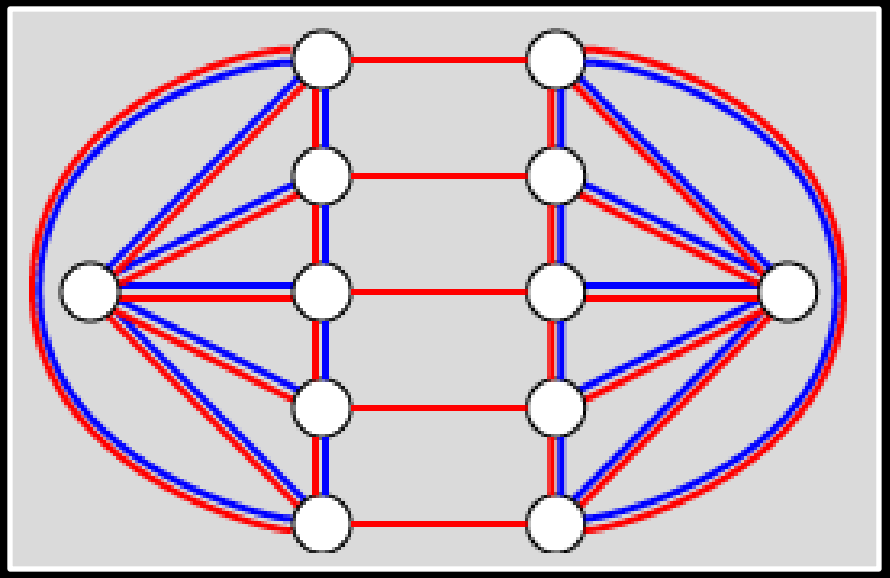

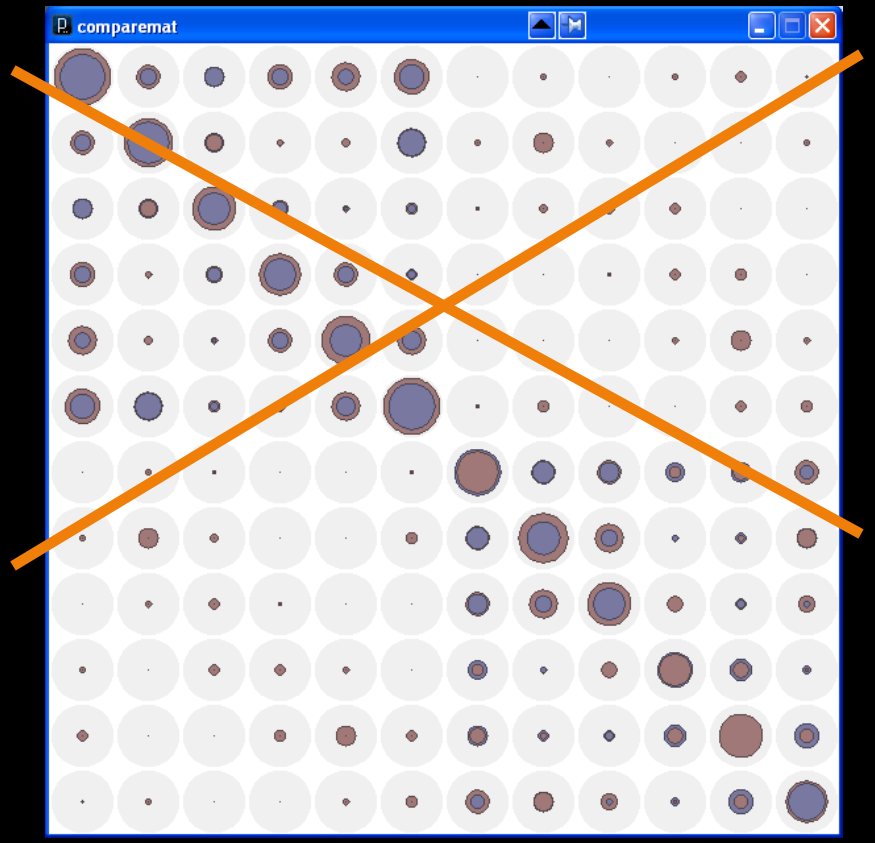

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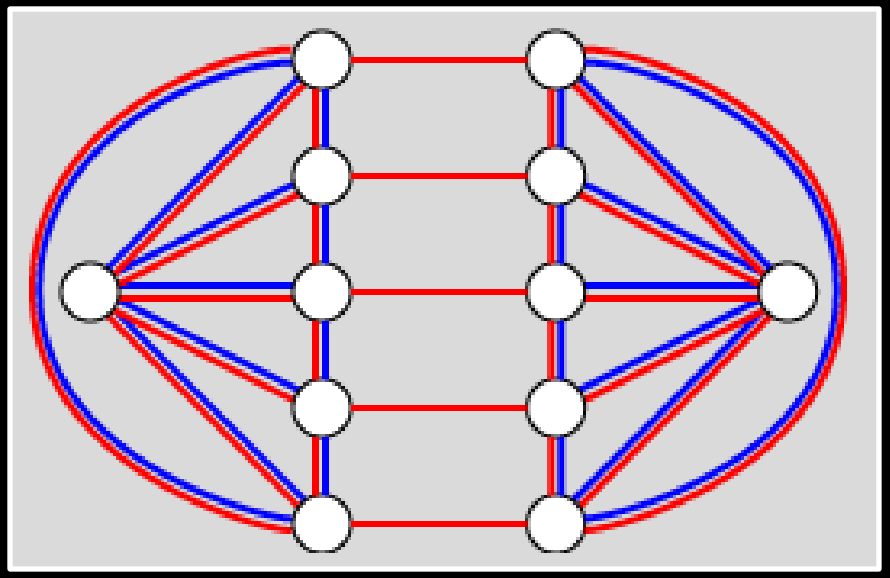

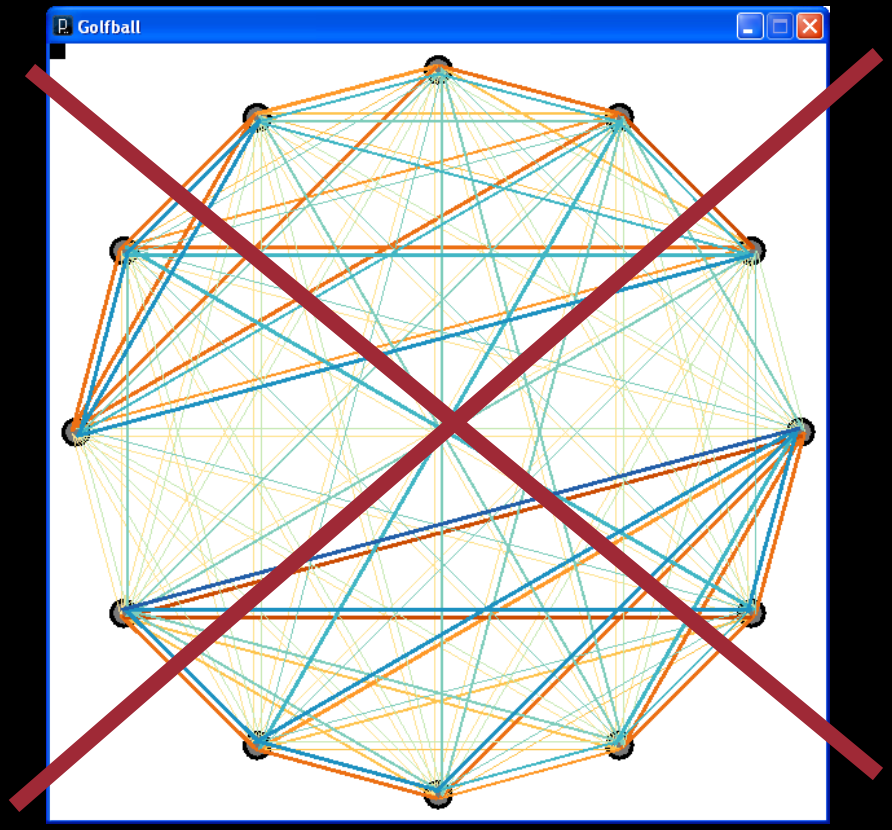

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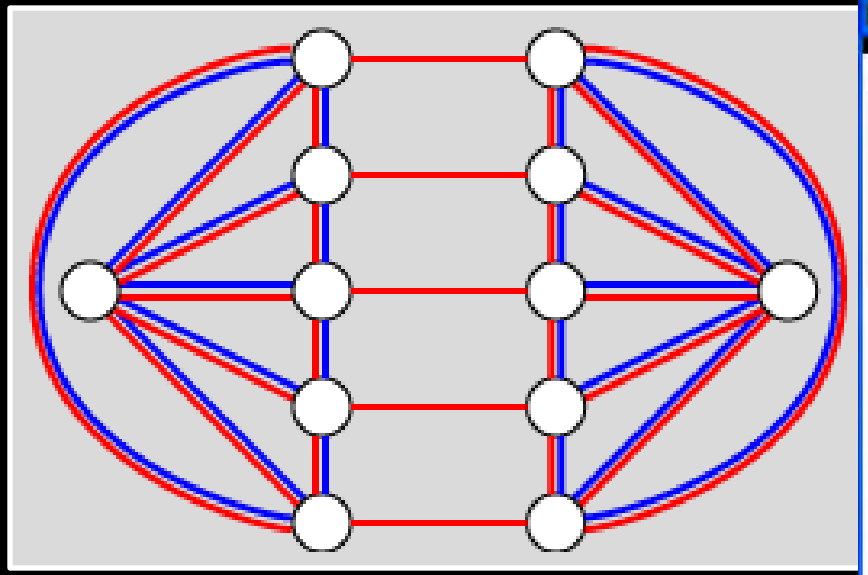

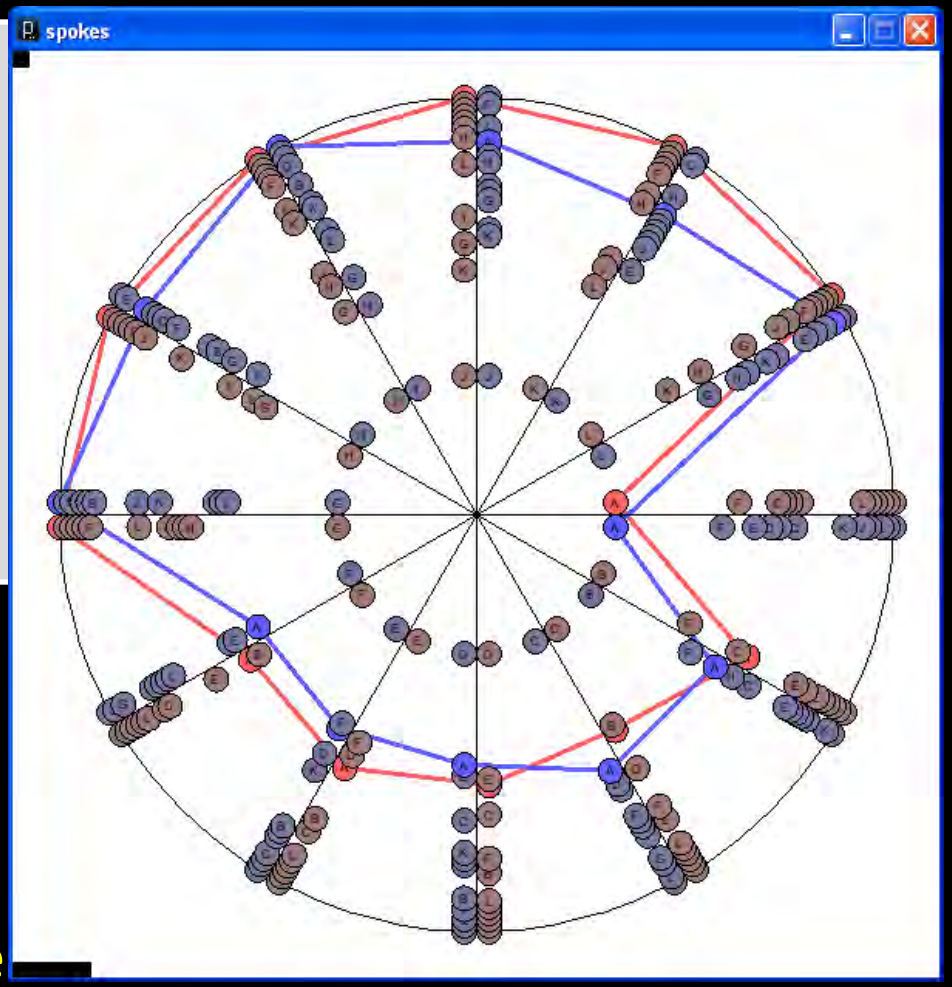

Educational Psychology:
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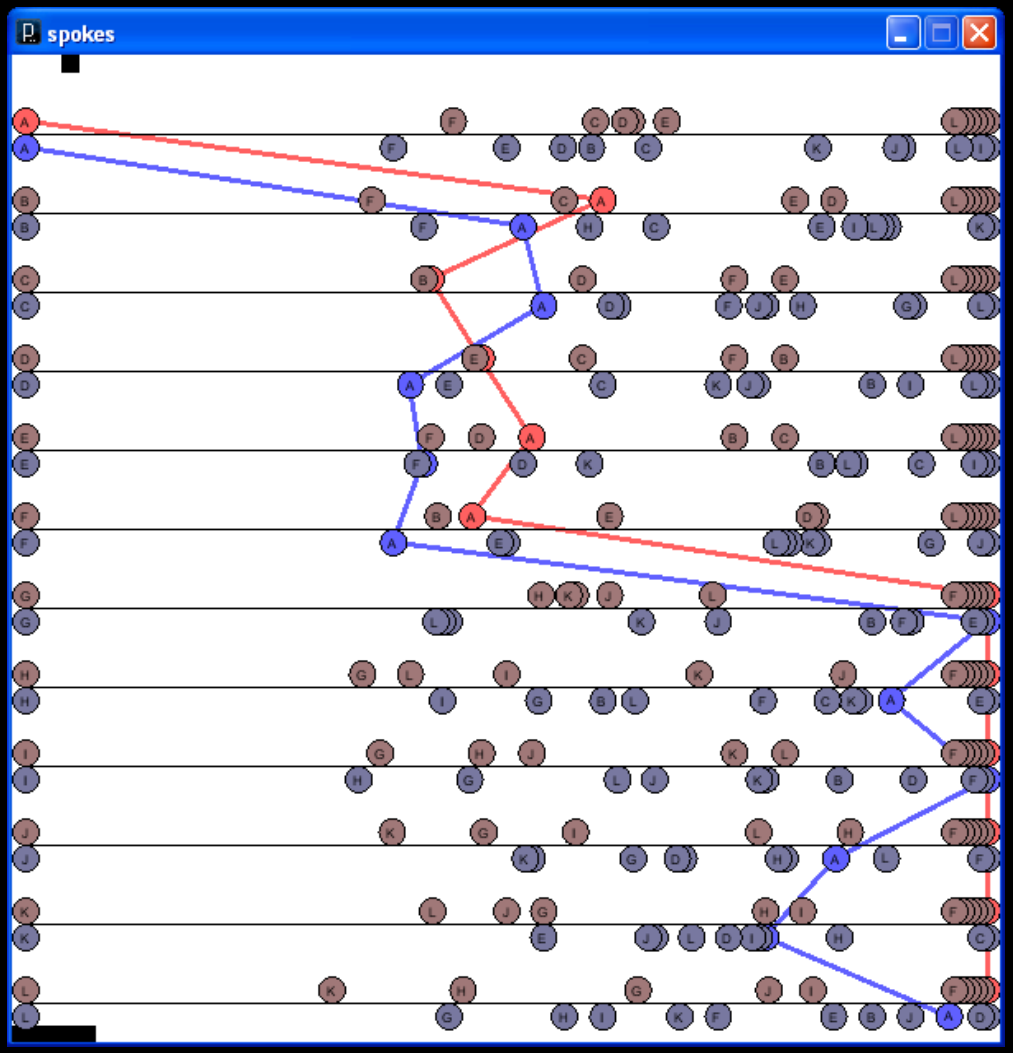
networks evolving over time

Keep Generating Ideas?

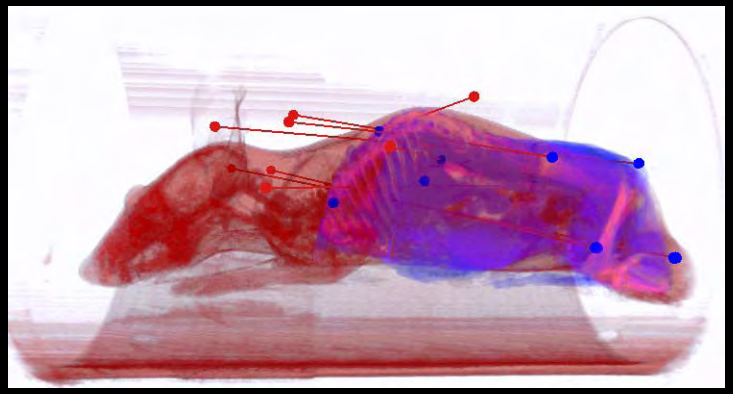
(and learn from mistakes!)

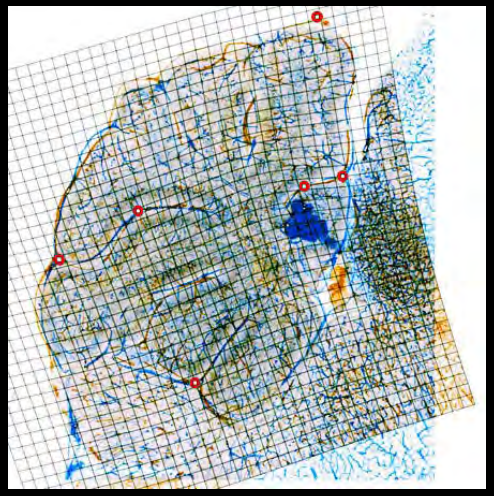
Idea 8b:
Superimposed Horizontal Spokes

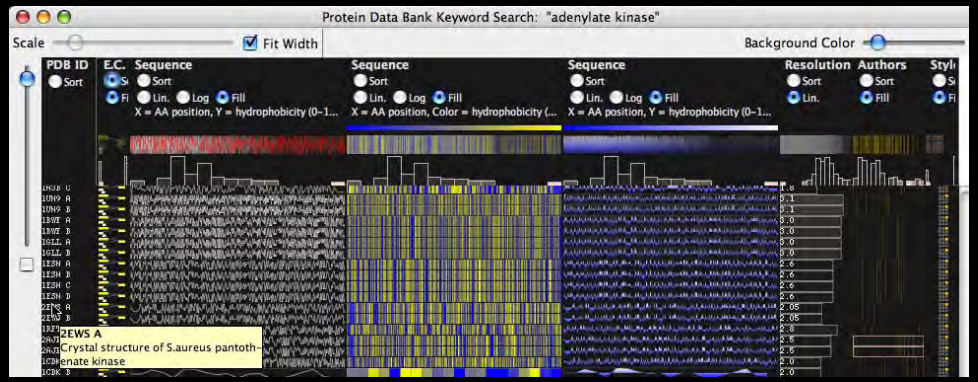


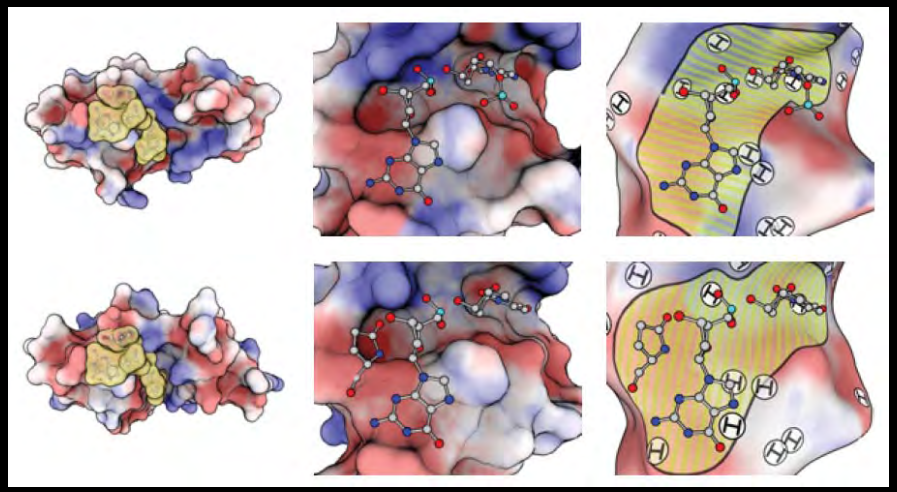
Is there a science to this?

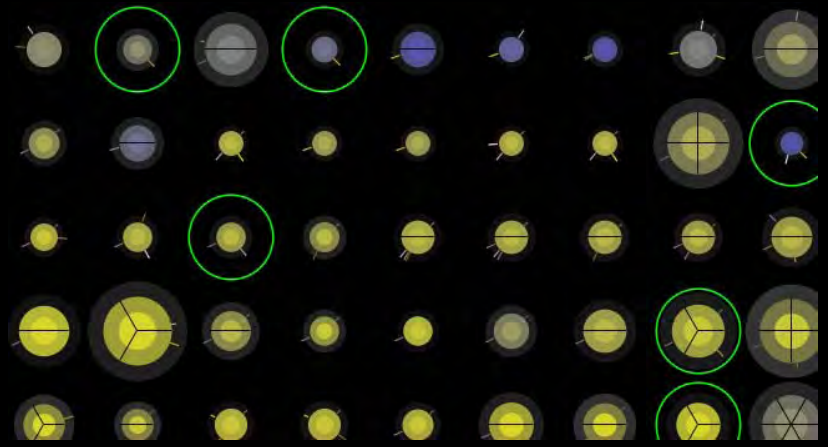
Visual Comparisons



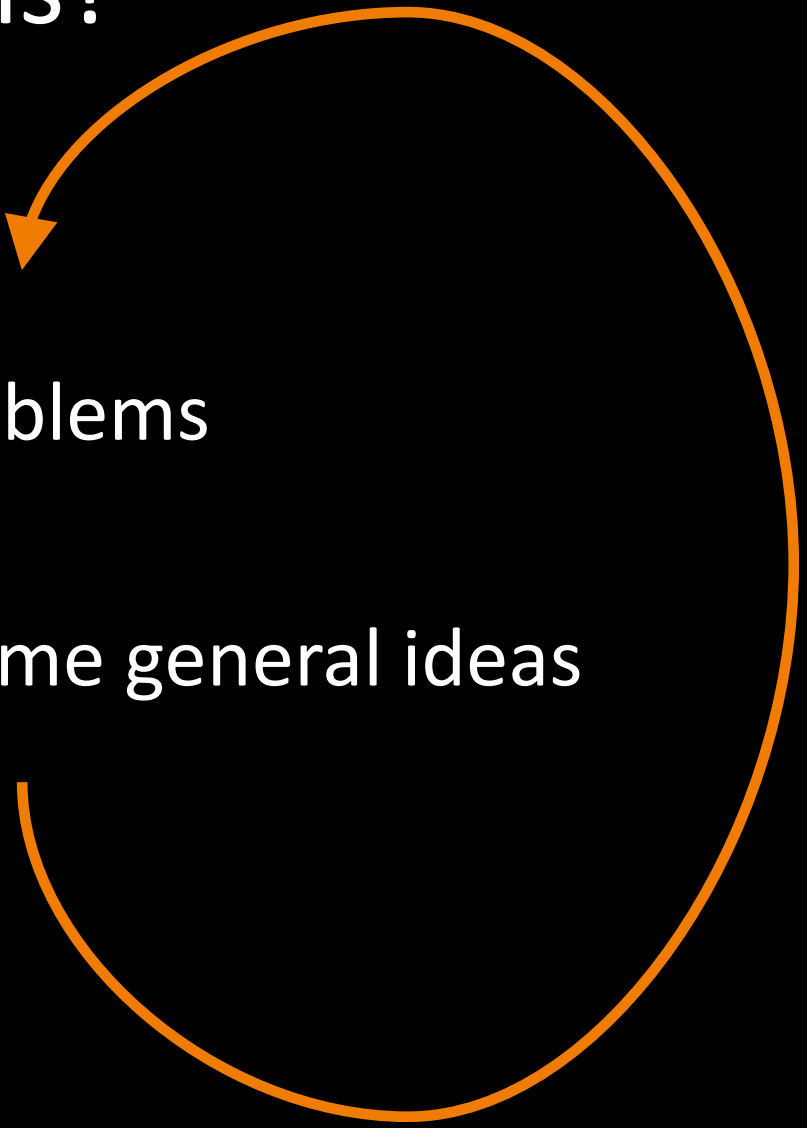






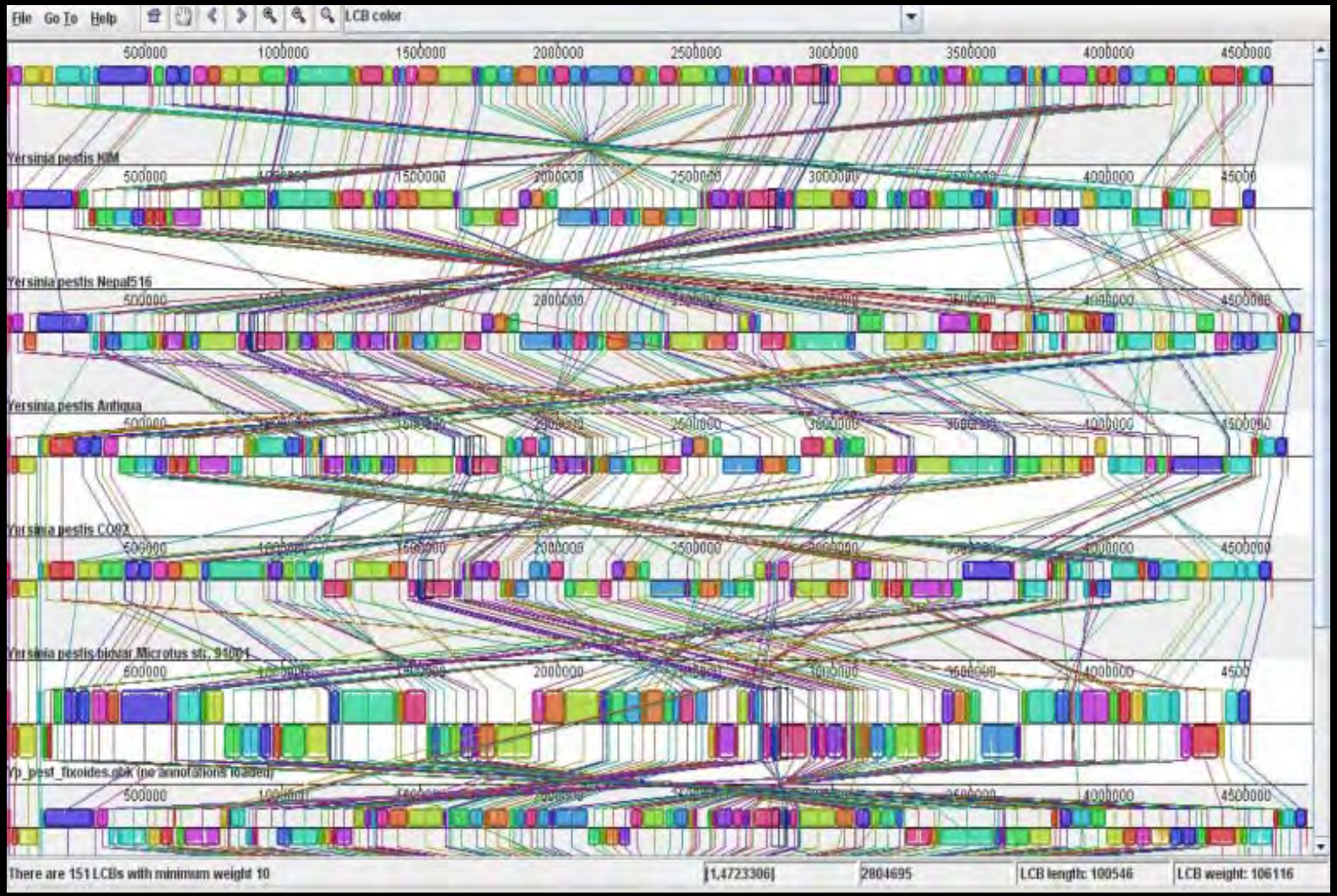


How do we do this?



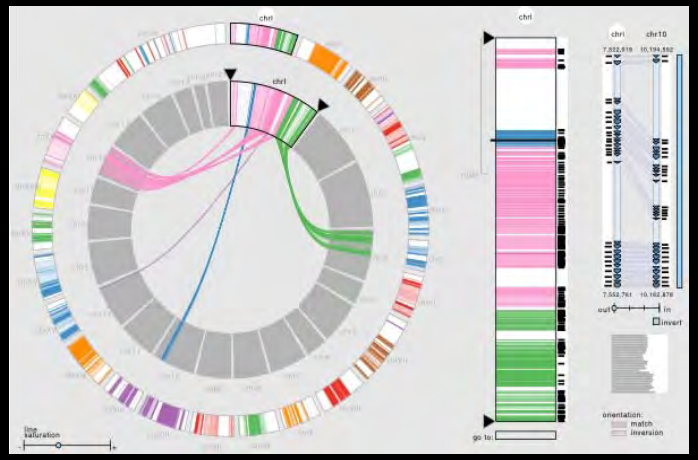
- Pick some sample problems
- See if we can learn some general ideas

What else are we trying?

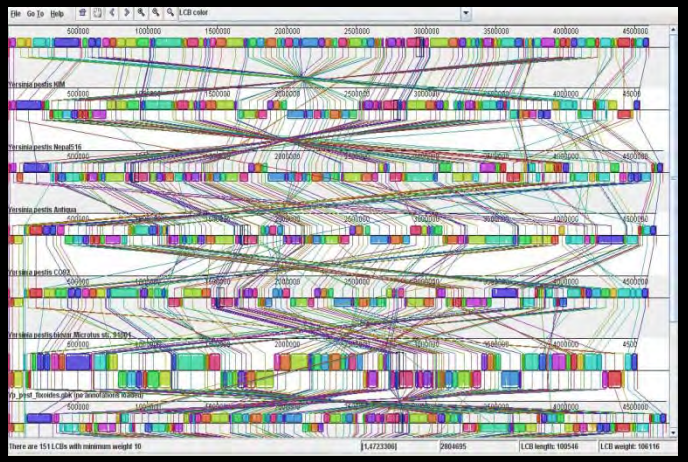


Genome Sequence Comparison

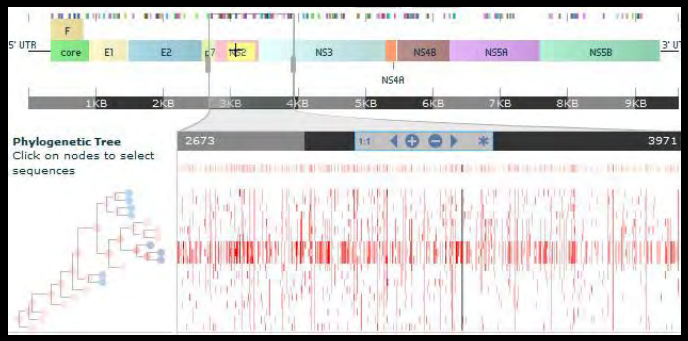
- No single view is sufficient for the large and complex data encountered in comparative genomics!



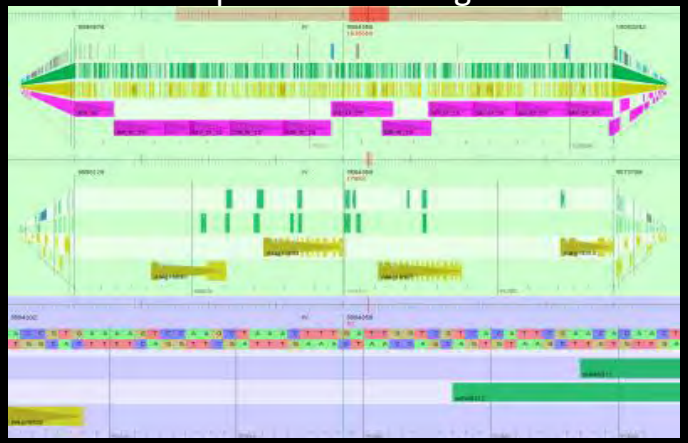
Mizbee: Multiscale Synteny Browser



Mauve: Multiple Genomic Alignment

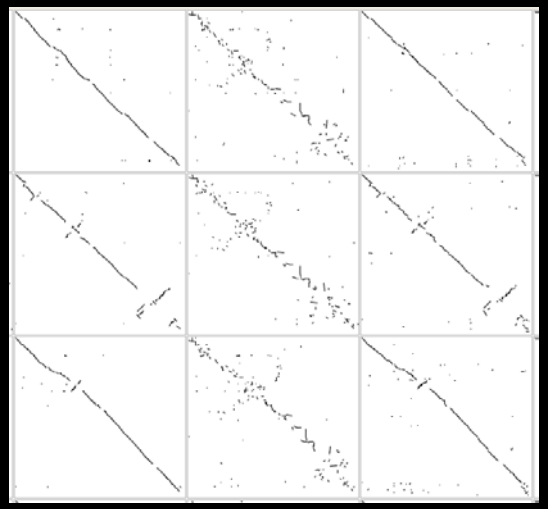


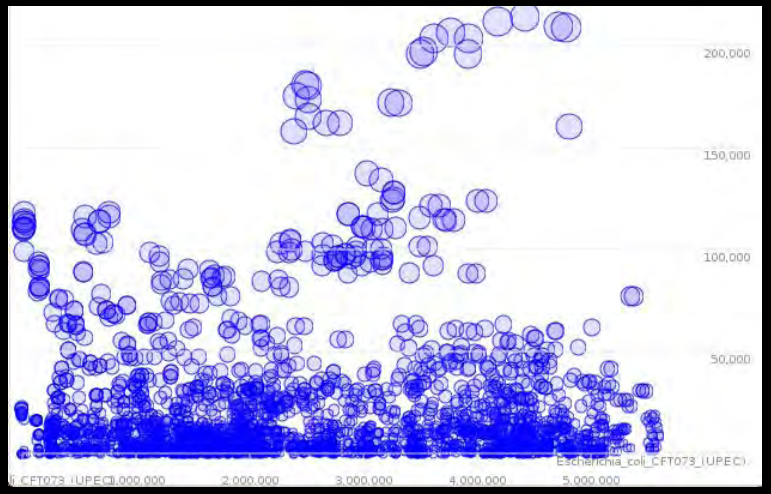
Broad Institute Hepatitis C Database

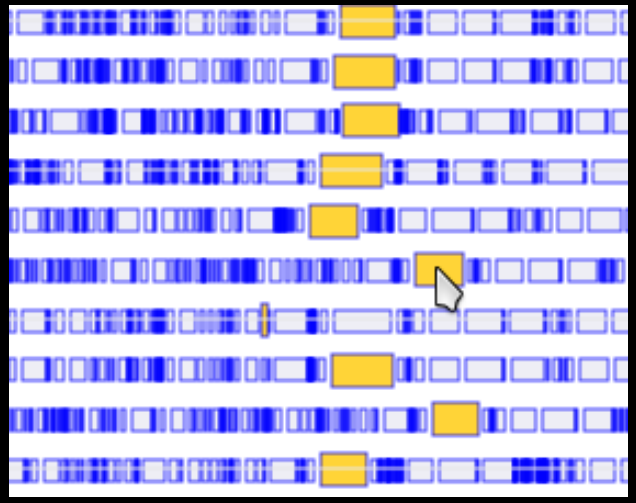


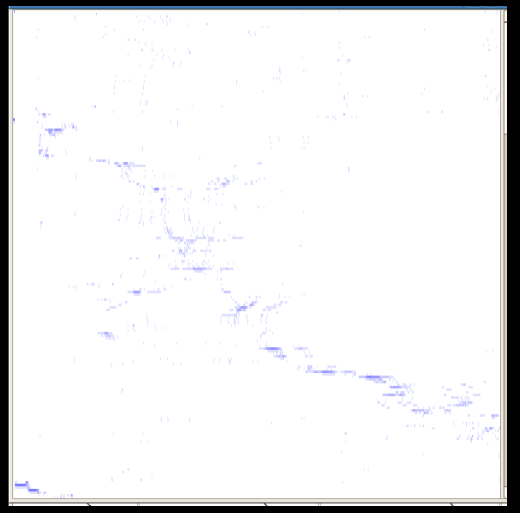
DNAVis

A Multi-View Approach









How do we move this forward?

- Need good problems to work on
- Need students who can do it

How do we move this forward?

What will make this fun for me?

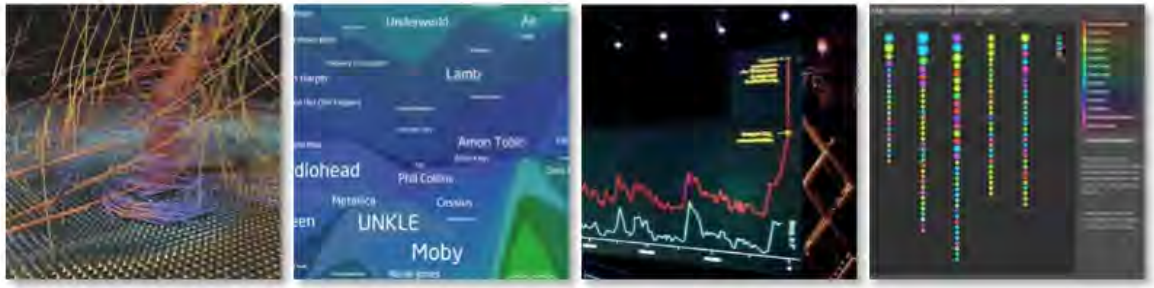
- Need good problems to work on
- Need students who can do it
  - Interesting domain science
  - Cool people to work with

An inspiration...

Harvard
School of Engineering
and Applied Sciences

CS 171 Visualization

Home News Syllabus Schedule Lectures Homework Projects Downloads Site Map



Description

The amount and complexity of information produced in science, engineering, business, and everyday human activity is increasing at staggering rates. The goal of this course is to expose you to visual representation methods and techniques that increase the understanding of complex data. Good visualizations not only present a visual interpretation of data, but do so by improving comprehension, communication, and decision making.

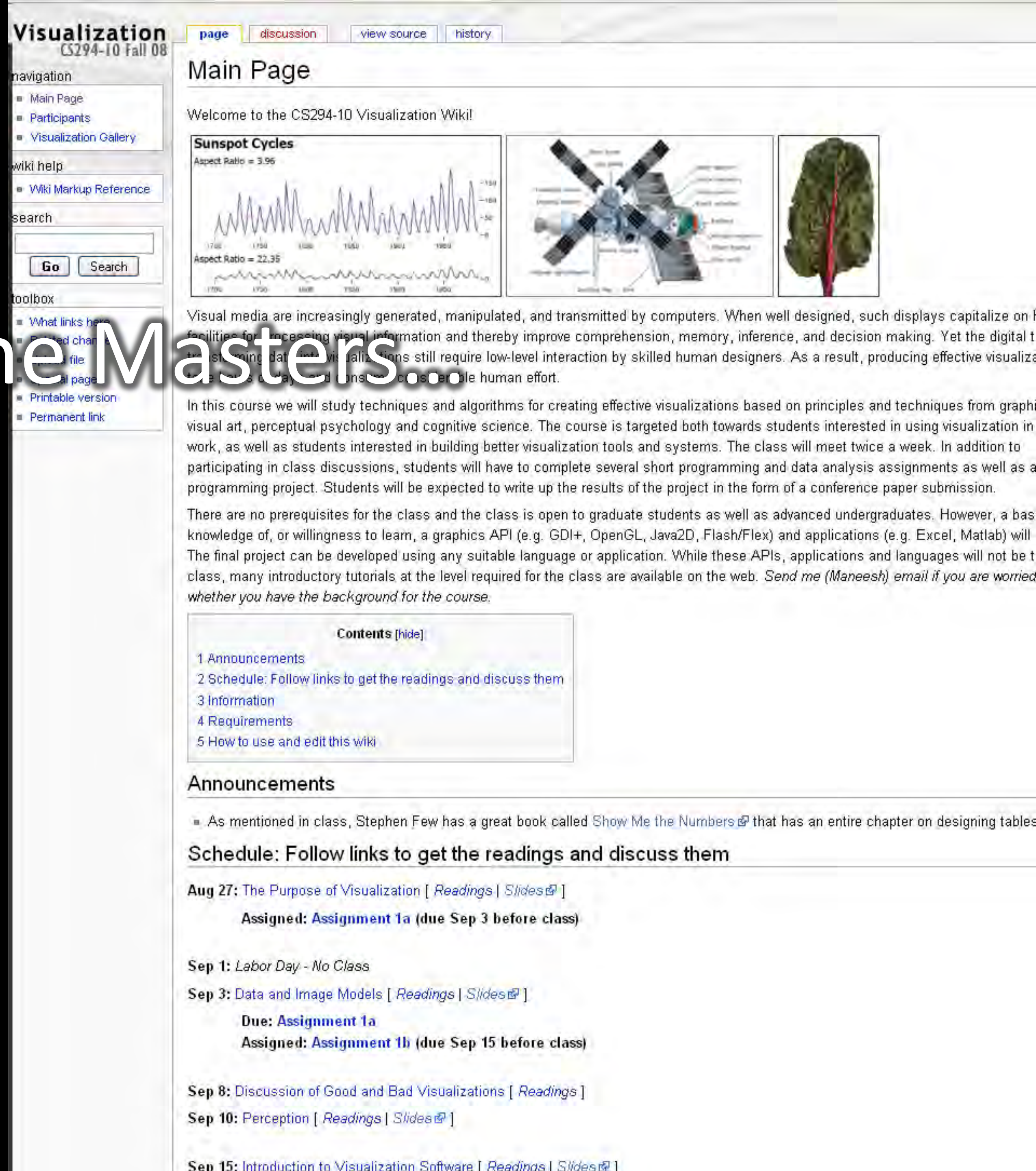
In this course you will learn how the human visual system processes and perceives images, good design practices for visualization, tools for visualization of data from a variety of fields, collecting data from web sites with Python, and programming of interactive visualization applications using Processing.

Information

Instructor: Hanspeter Pfister
Head TF: Miriah Meyer
Lectures: M W 1-2:30 pm
Sections: F 1-2:30 pm
Location: 1 Story St. Rm 304
Lecture Slides & Links
Live Video (during lectures)
Video Archive

2008 Course
2008 Videos on iTunes U

Learn from the Masters…



Visualization
CS294-10 Fall 08

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- Main Page
- Participants
- Visualization Gallery

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- What links here
- Printable version
- Permanent link

Main Page

Welcome to the CS294-10 Visualization Wiki!

Sunspot Cycles
Aspect Ratio = 3.96
Aspect Ratio = 22.35

Visual media are increasingly generated, manipulated, and transmitted by computers. When well designed, such displays capitalize on h
facilities for processing visual information and thereby improve comprehension, memory, inference, and decision making. Yet the digital t
… still require low-level interaction by skilled human designers. As a result, producing effective visualiza
… human effort.

In this course we will study techniques and algorithms for creating effective visualizations based on principles and techniques from graphi
visual art, perceptual psychology and cognitive science. The course is targeted both towards students interested in using visualization in
work, as well as students interested in building better visualization tools and systems. The class will meet twice a week. In addition to
participating in class discussions, students will have to complete several short programming and data analysis assignments as well as a
programming project. Students will be expected to write up the results of the project in the form of a conference paper submission.

There are no prerequisites for the class and the class is open to graduate students as well as advanced undergraduates. However, a bas
knowledge of, or willingness to learn, a graphics API (e.g. GDI+, OpenGL, Java2D, Flash/Flex) and applications (e.g. Excel, Matlab) will
The final project can be developed using any suitable language or application. While these APIs, applications and languages will not be t
class, many introductory tutorials at the level required for the class are available on the web. *Send me (Maneesh) email if you are worried whether you have the background for the course.*

Contents [hide]

1 Announcements
2 Schedule: Follow links to get the readings and discuss them
3 Information
4 Requirements
5 How to use and edit this wiki

Announcements

- As mentioned in class, Stephen Few has a great book called Show Me the Numbers that has an entire chapter on designing tables

Schedule: Follow links to get the readings and discuss them

Aug 27: The Purpose of Visualization [*Readings* | *Slides*]

Assigned: Assignment 1a (due Sep 3 before class)

Sep 1: *Labor Day - No Class*

Sep 3: Data and Image Models [*Readings* | *Slides*]

Due: Assignment 1a
Assigned: Assignment 1b (due Sep 15 before class)

Sep 8: Discussion of Good and Bad Visualizations [*Readings*]

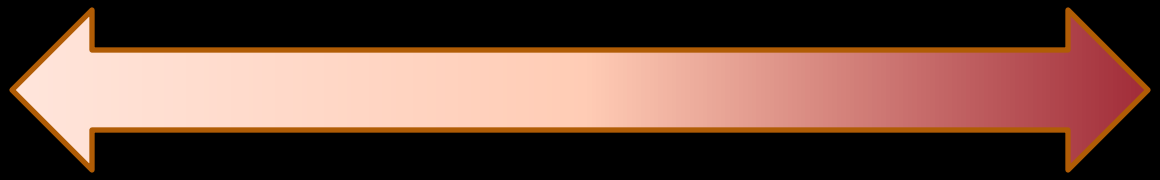
Sep 10: Perception [*Readings* | *Slides*]

Sep 15: Introduction to Visualization Software [*Readings* | *Slides*]

Am I Crazy?

- A voluntary overload
- A wide range of students
  - Different interests
  - Different goals
  - Different skills
  - Different time commitments
- A Diverse topic

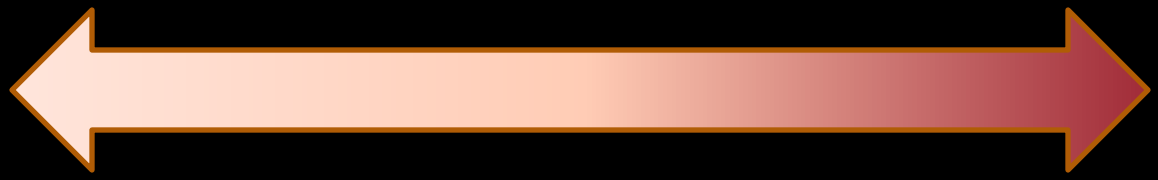
The spectra of Visualization



"Information" Visualization

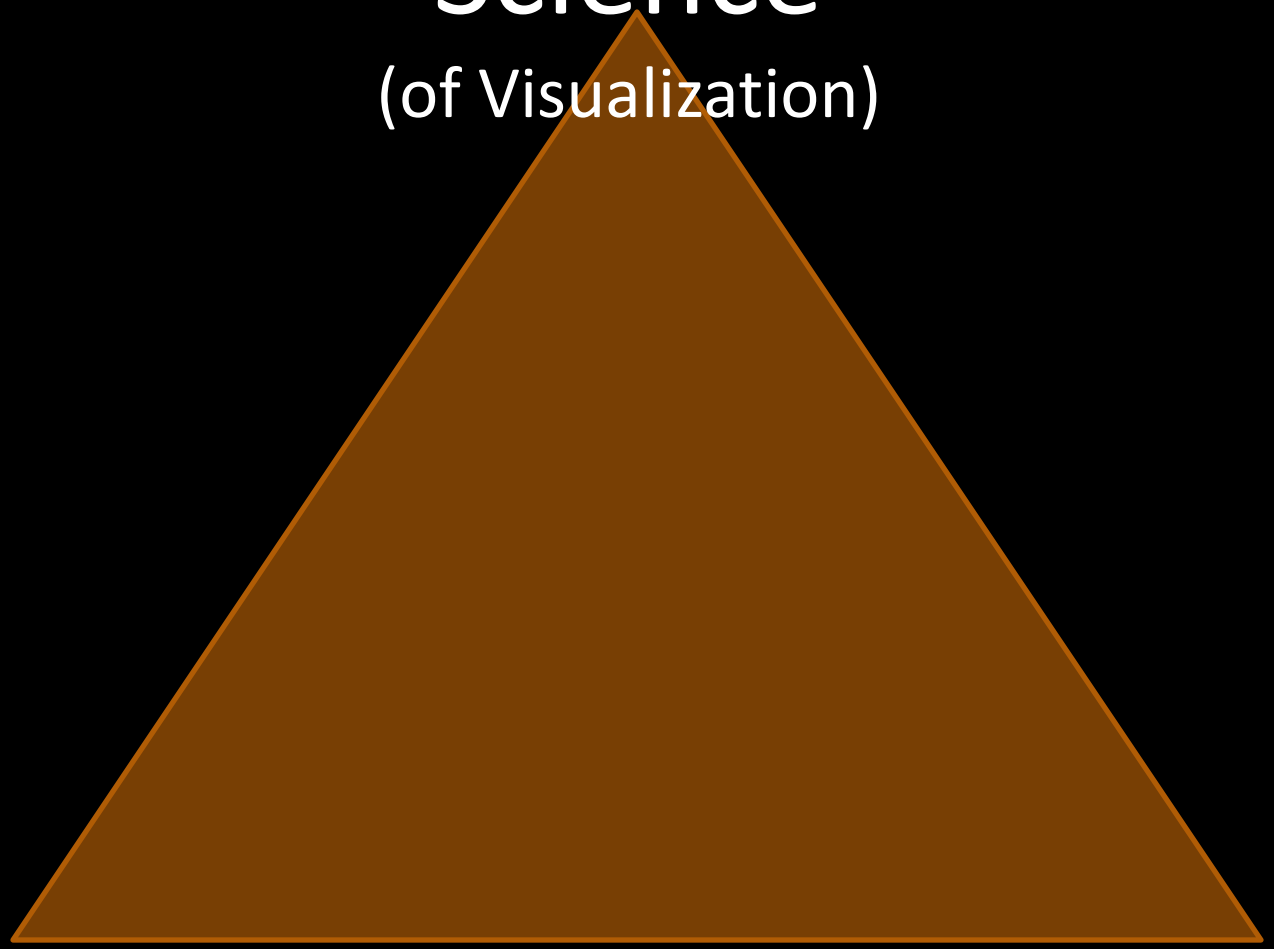
"Scientific" Visualization

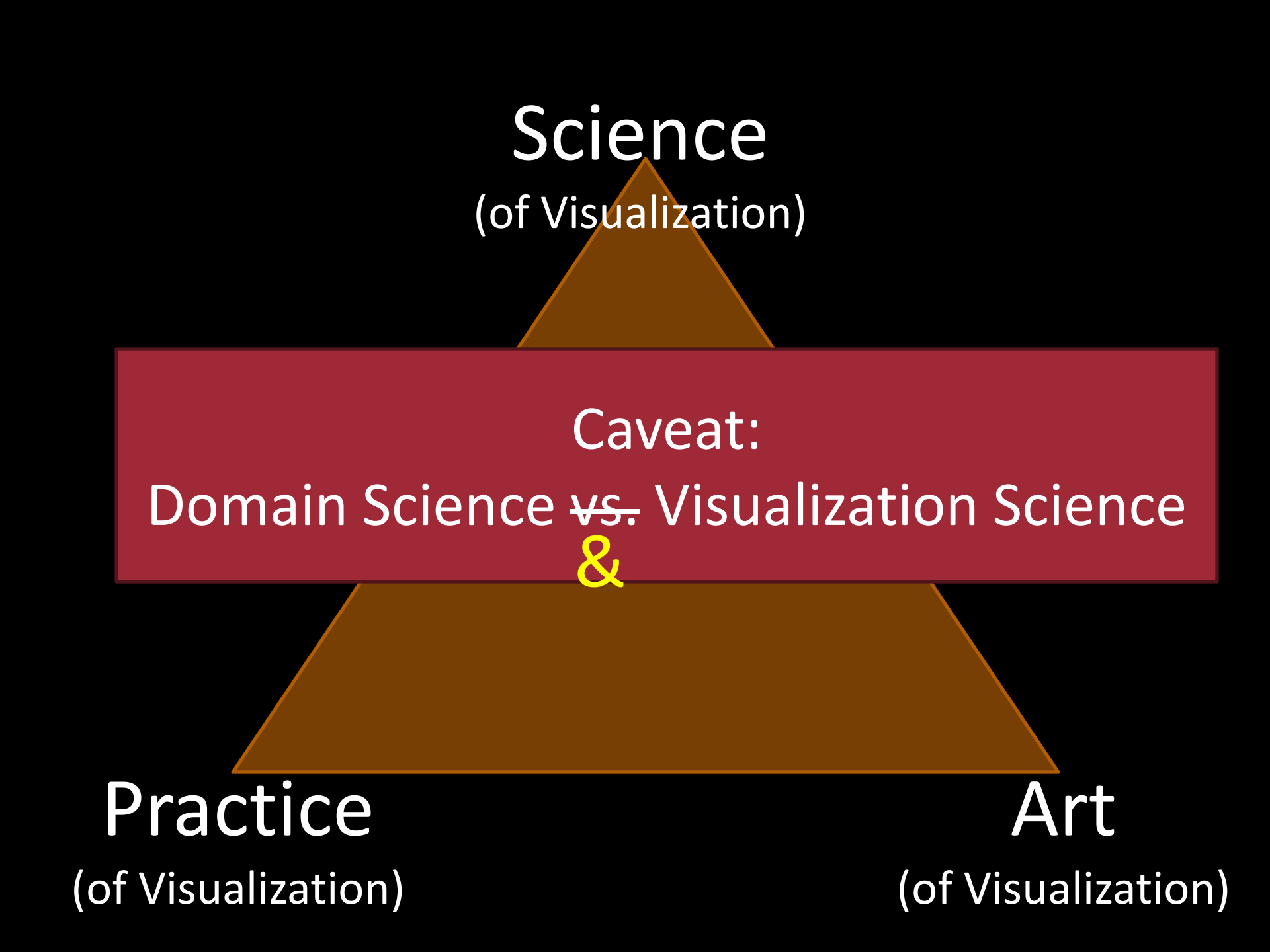
The spectra of Visualization

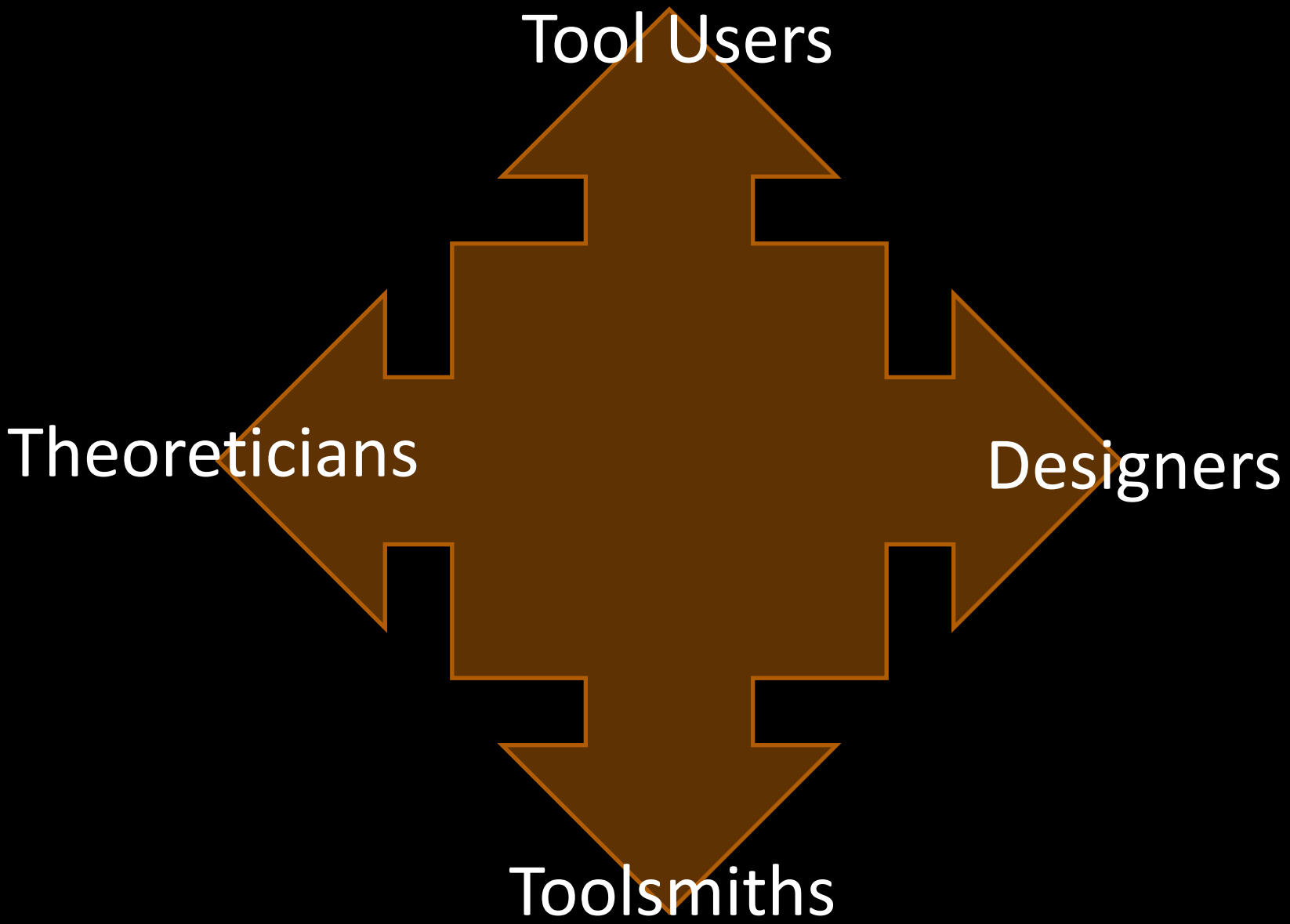


Presentation Visualization

Exploratory Visualization


Science
(of Visualization)
Practice
(of Visualization)
Art
(of Visualization)


Science
(of Visualization)
Caveat:
Domain Science ~~vs.~~ Visualization Science
&
Practice
(of Visualization)
Art
(of Visualization)


Tool Users
Theoreticians
Designers
Toolsmiths

The Class

Mike Gleicher's Web

Recent Changes - Search: Go

Home

My Research
Project Descriptions
Select Publications (by project)
Papers (date order)
Videos (date order)
Talks (date order)

Teaching
CS559 Graphics Fall '09
Advanced Graphics S'09
CS679 Game Tech '08
Other Courses

List of All Pages
RecentChanges

Courses / Vis09Announce

Course Announcement for Spring 2010:
CS838: Visualization: getting from data to understanding

Spring Course Announcement:
CS838: Visualization: getting from data to understanding

Instructor
Mike Gleicher
Time
Tuesday/Thursday 11-12:15
Prerequisites
none
Intended Audience
students who work with data and need to use visualizations effectively and students who are interested in creating tools to help people work with data
Credits
nominally 3, but variable credit possible (especially for dissertators)

Please contact the instructor if you are interested.

This course will explore the foundations of visualization: how we turn data into pictures to help in understanding or communicating it. We'll cover visualization in the broad sense: including *scientific visualization*, *information visualization* (the presentation of abstract data), and visual analytics (the use of interactive tools for exploring large and/or complex data sets).

The *content* (the topics, not the teaching style) of this course is modeled after the visualization courses at Harvard (cs171) and Berkeley (cs294). Here, we will teach the class in a bit more of a "seminar" style - using class time more for discussion and student presentations than lectures.

Overview

Visualizations range from crayon sketches on the back of a napkin to immersive virtual reality display

How not to use powerpoint:

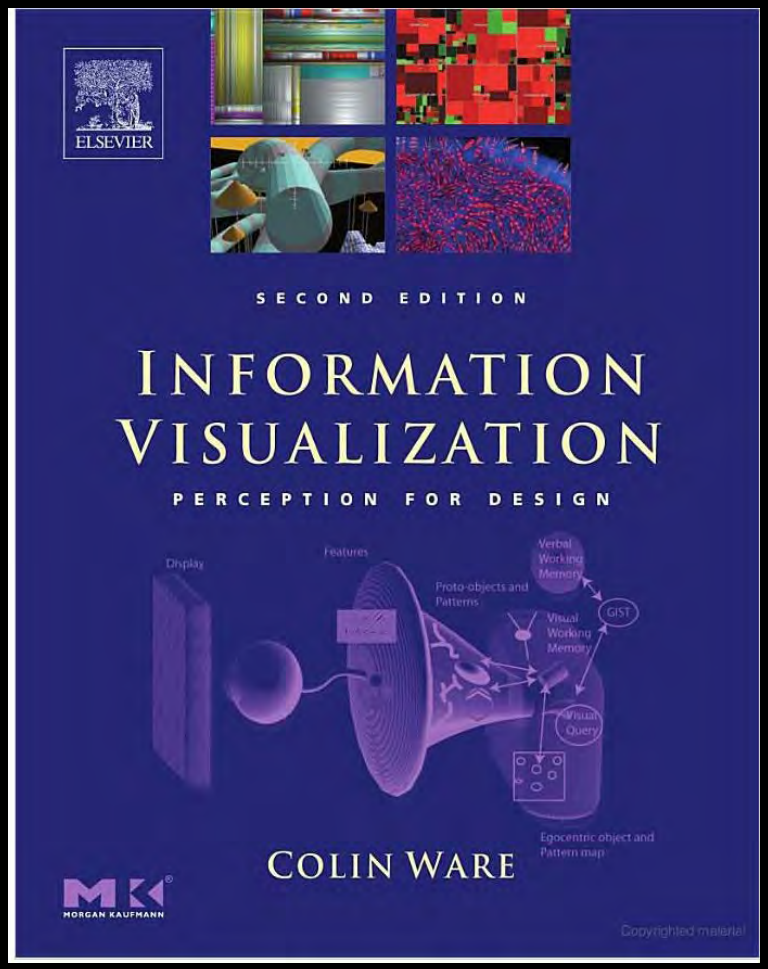
Powerpoint should not be notes for the speaker!

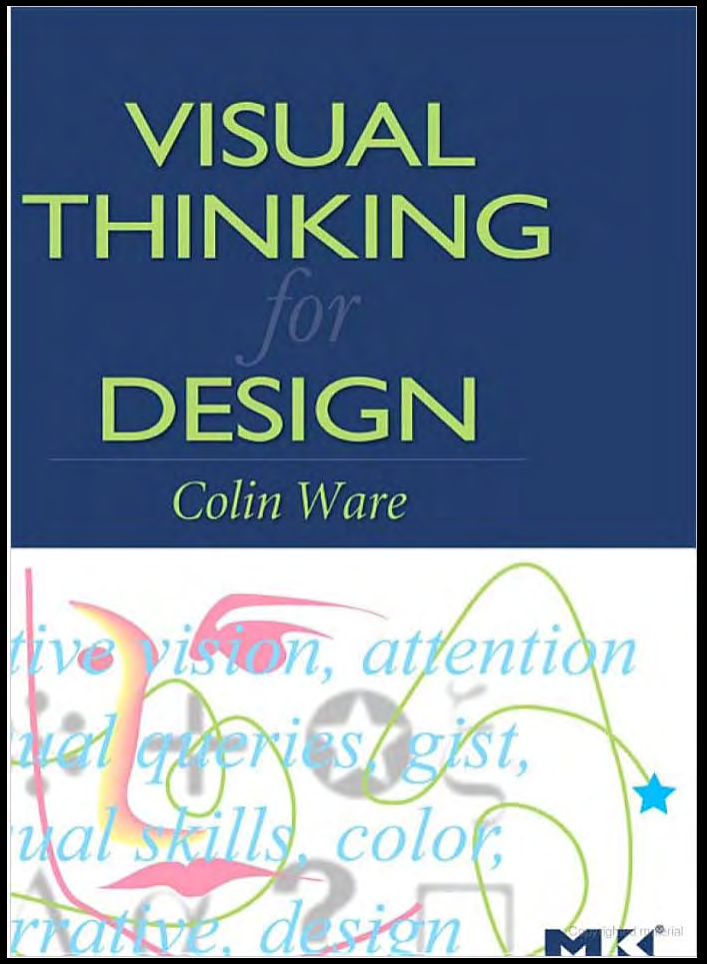
- Why is it 838?
- Why is it 3 credits?
- Why is it 11am Tuesday/Thursday?
- Why is it in some weird place?
- Will anyone be there?
- Can I be part of it?
- What kinds of things will you talk about?

If its not clear…

- I’m making this up as I go along.

Which Book? (if any)





How should this work? What topics?

- You tell me

Acknowledgements

- To you, for inviting me and listening

- My students for doing the stuff I talked about
  - Greg, Aaron, Danielle, David, Feng, Yuzhen, …

- The folks who pay the bills
  - NSF, NIH (GM&AB training)