INFO-424: Information Visualization and Aesthetics

Autumn 2005
B.S. Informatics
Information School
University of Washington

Examines the visualization of information: the effects of human perception, the aesthetics of information design, the mechanics of visual display, and the semiotics of iconography. Examples may include census, epidemiological, crime, earth satellite, and medical data in the contexts of special computer applications, user populations, and cultures. Prerequisite: CSE 143.

Course website & Listserv

http://courses.washington.edu/info424

info424a_au05@u.washington.edu
Registered students are subscribed automatically using their UW mail account.

Credit Hours

5 (3 lecture hours; 2 lab hours; 10 outside hours)

Meeting times

Lecture	Tuesday/Thursday 11:00 – 12:20, MGH 254
Lab	Friday 1:30 – 3:20, MGH 430

Instructor

David Hendry, Assistant Professor
330J Mary Gates Hall

Office hours: Thursdays, 3:30 – 5:00 or by appointment.

dhendry@u.washington.edu | http://faculty.washington.edu/dhendry
Tel: 206-616-2316 (Please use for urgent matters only)

Student services

Mariko Navin, Student Services Administrator
470E Mary Gates Hall
mnavin@u.washington.edu
Tel: (206) 616-1197

Please note: If you have any concerns about a course or the TA, please see the TA about these issues as soon as possible. If you are not comfortable talking with the TA or not satisfied with the response that you receive, you may contact the instructor of the course.

If you are still not satisfied with the response that you receive, you may contact Joseph Janes, the Associate Dean for Academics in 370 Mary Gates Hall, by phone at : (206) 616-0987, or by e-mail at jwj@u.washington.edu.

You may also contact the Graduate School at G-1 Communications Building, by phone at (206) 543-5900, or by e-mail at efeetham@u.washington.edu

Overview

For hundreds of years visual displays have been invented to clarify and communicate know facts and to discover new facts latent within a data set. Interactive computing systems are the most recent medium for depicting and interacting with visual information.

The aim of this class is to introduce the field of Information Visualization, which is defined as:

> *The use of computer-supported, interactive visual representations of abstract data to amply cognition* (Card, Mackinlay & Shneiderman, 1999).

We shall examine how graphic aids—sketches, graphs, charts, maps, diagrams, and visualizations—enable problem solving and discover that, depending on the user task, some displays are more effective than others.

The class covers some key principles of human perception and key techniques for visualizing information. You will explore large data sets with tools for visualization, invent new information visualizations, and learn to evaluate and critically discuss information displays.

Textbooks and readings

The required textbook, which is available at the University Bookstore, is:

- Spence, R. (2001). *Information Visualization*. New York: Addison-Wesley.

Occasionally, we will draw upon:

- Card, S. K., J. D. Mackinlay & B. Shneiderman (eds.) (1999). *Readings in Information Visualization: Using Vision to Think*. New York: Morgan Kaufmann.
- Hoffman, D. D. (1998). *Visual Intelligence*. New York: W. W. Norton.
- Horton, W. (1994). *The Icon Book: Visual Symbols for Computer Systems and Documentation*. New York: John Wiley.
- Tufte, E. R. (1983). *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press.
- Tufte, E. R. (1990). *Envisioning Information*. Cheshire, CT: Graphics Press.
- Tufte, E. R. (1997). *Visual Explanations*. Cheshire, CT: Graphics Press.
- Ware, C. (2004). *Information Visualization: Perception for Design* (2nd Edition). New York: Morgan Kaufmann.
- Wurman, S. (2001). *Information Anxiety 2*. Indeanapolis, IN: QUE.

Additional readings are cited in the course schedule below. These readings are generally available at the ACM and IEEE Digital Libraries. Depart to these resources from:

- http://lib.washington.edu/subject/ComputerSci/dr/eljnl.html

Assignment sheets, software, data sets, and other materials will be posted on the course website.

Learning

Aims

The aims of this course are to:

- Develop an understanding for the issues, principles, and techniques of Information Visualization;
- Improve skills in visual literacy, ideation, and critical thinking about visual materials;
- Improve skills in prototyping, writing reports, and giving presentations.

Objectives

On the successful completion of this course, you will be able to:

1. Name and identify the major types and roles of visual information, including images, symbols, icons, diagrams, scientific visualizations, and information visualizations;
2. Critically discuss information displays in terms of Tufte's theory of *maximizing the density of useful information* and characterize information displays with his vocabulary;
3. Name and describe the Gestalt principles of perception;
4. Explain "pop out", define pre-attentive cognition, and construct an experiment to demonstrate it;
5. Outline a reference model for information visualization and describe data types, data tables, visual structures, and views;
6. Outline the knowledge crystallization model and describe standard information extraction and use tasks;
7. Deconstruct visual structures into their basic elements, including points, links, areas, space, color and so on, and use such features to communicate abstract concepts;
8. Describe appropriate mappings between data types and visual elements and analyze displays for inappropriate mappings;
9. Discuss methods and tools for the presentation and exploration of: a) Univariate, bivariate, trivariate, and hypervariate data sets; d) Network and tree structures; and c) Document collections.
10. Develop visualizations that employ distortion, zoom and pan, and semantic zoom techniques;
11. Discuss methods and tools for the dynamic exploration of data sets;
12. Employ the reference model for information visualization and the knowledge crystallization model to analyze visualizations and reason about new visualizations;
13. Prototype and evaluate information visualizations of moderate complexity using existing applications and scripting languages.

Academic accommodations

To request academic accommodations due to a disability, please contact Disabled Student Services: 448 Schmitz, 206-543-8924 (V/TTY). If you have a letter from DSS indicating that you have a disability which requires academic accommodations, please present the letter to me so we can discuss the accommodations you might need in the class.

Academic accommodations due to disability will not be made unless the student has a letter from DSS specifying the type and nature of accommodations needed.

For additional information, see *Statements to Ensure Equal Opportunity and Reasonable Accommodation*, downloaded March 5, 2003, http://www.washington.edu/admin/eoo/eoost.html

Academic honesty

The essence of academic life revolves around respect not only for the ideas of others, but also their rights to those ideas and their promulgation. It is therefore essential that all of us engaged in the life of the mind take the utmost care that the ideas and expressions of ideas of other people always be appropriately handled, and, where necessary, cited. For writing assignments, when ideas or materials of others are used, they must be cited. The format is not that important–as long as the source material can be located and the citation verified, it's OK. What is important is that the material be cited. In any situation, if you have a question, please feel free to ask. Such attention to ideas and acknowledgment of their sources is central not only to academic life, but life in general.

Please acquaint yourself with the University of Washington's resources on academic honesty:
http://depts.washington.edu/grading/issue1/honesty.htm

Students are encouraged to take drafts of their writing assignments to the Writing Center for assistance with using citations ethically and effectively. Information on scheduling an appointment can be found at:
http://www.uwtc.washington.edu/resources/eiwc/

Copyright

All of the expressions of ideas in this class that are fixed in any tangible medium such as digital and physical documents are protected by copyright law as embodied in title 17 of the United States Code. These expressions include the work product of both: (1) your student colleagues (e.g., any assignments published here in the course environment or statements committed to text in a discussion forum); and, (2) your instructors (e.g., the syllabus, assignments, reading lists, and lectures). Within the constraints of "fair use", you may copy these copyrighted expressions for your personal intellectual use in support of your education here in the iSchool. Such fair use by you does not include further distribution by any means of copying, performance or presentation beyond the circle of your close acquaintances, student colleagues in this class and your family. If you have any questions regarding whether a use to which you wish to put one of these expressions violates the creator's copyright interests, please feel free to ask the instructor for guidance.

Privacy

To support an academic environment of rigorous discussion and open expression of personal thoughts and feelings, we, as members of the academic community, must be committed to the inviolate right of privacy of our student and instructor colleagues. As a result, we must forego sharing personally identifiable information about any member of our community including information about the ideas they express, their families, life styles and their political and social affiliations. If you have any questions regarding whether a disclosure you wish to make regarding anyone in this course or in the iSchool community violates that person's privacy interests, please feel free to ask the instructor for guidance.

Knowing violations of these principles of academic conduct, privacy or copyright may result in University disciplinary action under the Student Code of Conduct.

Student Code of Conduct

Good student conduct is important for maintaining a healthy course environment. Please familiarize yourself with the University of Washington's Student Code of Conduct at:

http://www.washington.edu/students/handbook/conduct.html

Assessment

Assessment	% Grade
Class spirit and participation	10%
Exercises and Discussion Questions	30%
Individual Assignments	30%
Project	30%

Class spirit and participation

INFO-424 should be fun, interesting, and challenging. With spirit and friendship, we can all create a supportive and rewarding learning environment. These values are important to the instructor. Here are some ways to contribute:

1. Read carefully and critically prior to class
2. Ask challenging questions in class and labs
3. Comment, build on, or clarify what others have done or said
4. Be an active listener
5. Help your classmates use development tools and technologies
6. Post useful information to the class discussion list, on Wiki's etc.
7. Help configure or administrator servers or software
8. Visit the instructor during office hours
9. Ask questions or give feedback about the course before/after class
10. Tell a joke at an appropriate time.

Please write a 2 or 3 paragraph reflective statement on how your participation in the class improved our learning. You might note the number of classes and labs attended, how you participated in class, how you helped the class with technical issues, etc.

This statement is due at the beginning of the last class, **December 8**.

Exercises and Discussion Questions

The schedule for Exercises and Discussion Questions is available on a separate sheet on the website. As explained on that sheet, you may submit up to 8 responses. The 6 highest grades will make up your final grade for this component of the class. Thus, each response is worth 5% of your final grade.

The aim of exercises and discussion questions is to give you an opportunity to reflect upon the readings for the week. As well, these responses will be read by the instructor prior to class, allowing class discussions to be better aligned with your questions and interests.

Individual Assignments

You will submit 3 individual assignments.

Assignment	**DUE**
A1: Visual Expression	Oct 13
A2: Revealing Relationships and Presentation	Nov 3
A3: Connectivity	Nov 17

Each assignment is worth 10% of your final grade. Assignments are due at the beginning of class. Assignment sheets are available on the website.

Project

Working in groups of 3 or 4, you will develop and evaluate a system for information system visualization.

Deliverable	**DUE**
P1: Project Topic and Team Members	Oct 14
P2: Project Description and Plan	Nov 4
P3: Class Poster Presentation	Nov 28 – Dec 2
P4: Final Report	Dec 8

The details of the project are contained on a separate project sheet.

Grading criteria

Work in this course will be graded to criteria. In other words, you won't be graded on a curve. Each deliverable is designed to test your achievement against one or more of the learning objectives. Different assignments emphasize different learning objectives. The meanings of grades are described below.

General grading information for the University of Washington is available at:

- http://www.washington.edu/students/gencat/front/Grading_Sys.html

The iSchool has adopted its own criteria for grading graduate courses. The grading criteria used by the iSchool is available at:

- http://depts.washington.edu/grading/practices/guidelin.htm

Grade	Performance Quality*
3.9 - 4.0	Superior performance in all aspects of the course with work exemplifying the highest quality. Unquestionably prepared for subsequent courses in field.
3.5 - 3.8	Superior performance in most aspects of the course; high quality work in the remainder. Unquestionably prepared for subsequent courses in field.
3.2 - 3.4	High quality performance in all or most aspects of the course. Very good chance of success in subsequent courses in field.
2.9 - 3.1	High quality performance in some of the course; satisfactory performance in the remainder. Good chance of success in subsequent courses in field.
2.5 - 2.8	Satisfactory performance in the course. Evidence of sufficient learning to succeed in subsequent courses in field.
2.2 - 2.4	Satisfactory performance in most of the course, with the remainder being somewhat substandard. Evidence of sufficient learning to succeed in subsequent courses in field with effort.
1.9 - 2.1	Evidence of some learning but generally marginal performance. Marginal chance of success in subsequent courses in field.

*Taken from Faculty Resource on Grading, downloaded March 5, 2003, http://depts.washington.edu/grading/practices/guidelin.htm

Standard cover sheet

To protect your privacy when exercises are returned and to facilitate communication, submitted work must have a cover sheet. The cover sheet must include the following information and be formatted nicely:

- Course name
- Quarter, program, department, and university
- Assignment name
- Your name and e-mail address
- A date
- A web site address (if relevant).

Staple the exercise pages to the cover sheet.

Late policy

1. If you will miss the deadline, you should inform the instructor as soon as you can, indicating when you will submit the work. The instructor will try to accommodate your needs. You should use this clause only for extraordinary personal reasons.
2. It is at the instructor's discretion to accept late work or assign late penalties (see 1 above). For any late assignment, 10% will be taken off your work per day. After five days, your work will not be accepted.
3. Late work must be handed to the instructor or teaching assistant in person. You may also be able to hand work in at the front desk of the Information School and at student services but this cannot be guaranteed.

Work that is handed in late is penalized for two reasons. First, to be fair, all students should be given the same time limits. Second, if you spend too much time on one assignment, it is quite likely that you will have insufficient time to spend on subsequent assignments.

Right to revise

The instructor reserves the right to revise this syllabus.

Re-grading policy

To have work re-graded, you must submit a Re-grade Request within five days of when your work was returned. The request must be a single page document printed on paper or sent by e-mail. It should contain the following information:

- Re-grade Request
- The information contained on the standard cover sheet
- An explanation for why you believe you deserve a higher grade.

The instructor, possibly in collaboration with the teaching assistant, will consider your request. If the instructor is convinced by your argument, your work will be re-graded. If not, the instructor will send you e-mail explaining why. No re-grades will be considered for late work.

Class Schedule

Week 1: Introduction (Sep 29 – 30)
Read
L1: Introductory Exercise
Lab: Design By Numbers, Self-directed (please see course website)

Week 2: Perspectives on Information Visualization (Oct 3 – 7)
Read: Spence, Chapters 1 – 2
L1: Greetings & Class Overview
L2: Semiotics and Perceptual Psychology
Lab: Design By Numbers, II

Week 3: Visual Communication (Oct 10 – 14)
Read: See course website for links to readings
L1: Basic Visual Elements
L2: Tufte's Design Strategies
Lab: Scalable Vector Graphics, I

Week 4: Cognitive and Engineering Models (Oct 17 – 21)
Read: Spence, Chapter 6
L1: Three Stage Information Processing Model
L2: Engineering Models
Lab: Scalable Vector Graphics, II

Week 5: Quantitative Data (Oct 24 – 28)
Read: Spence, Chapter 3 – 4
L1: Univariate & Bivariate Data Presentations
L2: Trivariate & Hypervariate Data Presentations
Lab: Evaluating Information Visualizations

Week 6: Data Exploration (Oct 31 – Nov 4)
Read: Spence, Chapter 5 & 7
L1: Dynamic Queries, Contextual & Sensitivity Information
L2: Focus and Context, Suppression, Zoom & Pan
Lab: Scalable Vector Graphics, III

Week 7: Connectivity (Nov 7 – 11)
Read: Spence, Chapter 8
L1: Network Visualizations
L2: Tree Visualizations
Lab: Cancelled for Veteran's Day

Week 8: Documents, Information & Social Spaces (Nov 14 – 18)

Read: Spence, Chapter 10
L1: Representing Documents
L2: Representing People and Crowds
Lab: Project Work

Week 9: Continued … (Nov 21 – 25)

Read: Fernanda B. V. & M. Smith. "Newsgroup Crowds and AuthorLines: Visualizing the Activity of Individuals in Conversational Cyberspaces," *hicss*, vol. 04, no. 4, p. 40109b, Proceedings 2004.[Retrieved 09/05/05 from http://doi.ieeecomputersociety.org/10.1109/HICSS.2004.1265288]
L1: Applications
L2: Cancelled for Thanksgiving
Lab: Cancelled for Thanksgiving

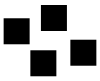
Week 10: Poster Presentations (Nov 28 – Dec 2)

L1: Session #1
L2: Session #2
Lab: Session #3

Week 11: Future Directions (Dec 5 – Dec 9)

L1: Conceptual Opportunities & New Inventions
L2: Visual Literacy
Lab: Demonstrations (Optional)

INFO-424: Information Visualization and Aesthetics
Autumn 2005
Exercises and Discussion Questions (Updated 12 Oct 2005)
Worth: 30%



Objective

The exercises and discussion questions serve two purposes. First, they are intended to prompt you to reflect upon the readings, to develop questions, and to take a position on what the readings say. You may agree with everything in a reading. But, more typically, you may question or disagree with parts of the reading.

Second, the instructor can use your statements to adjust the classroom lectures and exercises to respond to questions and ideas that are shared by many in the class. Thus, the exercises should help you learn the material more thoroughly and help make the classroom discussions more relevant and engaging.

Format

Unless otherwise stated, responses should be sent to dhendry@u.washington.edu as an ordinary e-mail message. Please do *not* include any attachments. Unless otherwise stated, your e-mail must arrive to the inbox by 6AM on the day it is due.

Your responses should consist of around 2 – 4 paragraphs and be less than 300 words.

Finally, please include the following coding in the subject line of the e-mail

INFO-424: xxx

where xxx is the exercise ID (either X1, X2, … Xn). This coding will help organize your responses and allow me to get feedback to you in a timely fashion.

Grading

Your responses will be graded on a three point scale:

- ✓- Needs improvement
- ✓ Satisfactory
- ✓+ Outstanding

Responses that are late will not be graded.

You can respond to a total of eight exercises and discussion questions. The top six scores will count in the calculation of your grade and are worth 30% of your final grade.

Exercises and Discussion Questions

X1: Four Squares Problem (Due Oct 4 @ 6AM)

This problem was given on the first day of class. If you missed the first day of class please see the problem sheet on the website.

X2: Cancer Survival Rates (Due Oct 11 @ 6AM)

Please read the Ask E.T. Cancer Survival Rates: Tables, Graphics, PowerPoint (link found on website).

Select two or three charts or tables from this page and comment on the differences of these displays and how they improved or hurt the effectiveness of the displays. Do you agree with Tufte's assertions about PowerPoint? What's your opinion of the charts that Dave Nash proposed? These are but two of many questions you could propose and then answer.

(Please turn over.)

INFO-424: Information Visualization and Aesthetics
Autumn 2005
Exercises and Discussion Questions (Updated 12 Oct 2005)
Worth: 30%

X3: Mental Models and Visualization (Due Oct 18 @ 6AM)

Please read: Card, S. K., J.D. Mackinlay & B. Shneiderman (eds.) (1999). *Readings in Information Visualization: Using Vision to Think* (Chapter #1). New York: Morgan Kaufmann.

This chapter proposes a user model called Knowledge Crystallization and technical model for mapping data to a visual form. If you could pose a question to the authors about one of these two models, what would the question be? Pose this question and then answer it for yourself as best you can. (Your discussion question will, of course, be stronger if you pose a hard problem.)

X4: Quantitative Data (Due Oct 25 @ 6AM)

Please read: Spence, Chapter 3 and Chapter 5. Different visualizations provide different information. Select two visualizations from this chapter and discuss how your selected visualizations complement each other. That is, how might they add more information (or not) when used together?

X6: SVG Lab (Due Nov 4 @ 5 PM)

Submit a link to your lab solution website. (Details explained in the lab activities sheet.)

X7: Connectivity (Due Nov 8, during class)

Please read: Spence, Chapter 10. Propose a visualization problem concerned with combining Information Retrieval and Information Visualization techniques. Then, using one or more of the techniques outlined in the chapter, propose a solution. The problem statement and solution sketch should be completed on one or more blank pieces of paper with pencil.

X8: Documents, Information & Social Spaces (Due Nov 15 @ 6AM)

Read the paper by Fernanda & Smith (2004) and pose a question about their work. Then, answer the question as best you can.

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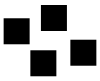
Autumn 2005
Four Squares Problem, Thursday, September 28, 11:00 – 12:20, MGH 254



Greetings!

Unfortunately, I can't be here today. To kick off INFO-424, please work with Martha Smith, a PhD student in the Information School, and follow the exercise outlined below. I hope you find it thought provoking! We will return to it next week.

Best wishes,
David (AKA Prof. Hendry and Dave)

Objective

Graphic designs can stimulate a wide range of responses in their viewers by employing very simple visual elements such as points, lines, shapes, symbols, and colors.

In this class exercise, you will explore how four black squares can be used to express abstract concepts. Please follow this procedure:

Stage 1

1) Divide into groups of 4;

2) Be an **Explorer**. As a group make a list of synonyms and associations for the concept ORDER. Discuss how this concept might be represented visually.

3) Be an **Artist**. Using black construction paper, scissors and glue sticks create 6 compositions that stimulate the feelings of ORDER. Each composition should consist of: Four black squares, no more and no less.

4) Be a **Critic**. Analyze the 6 compositions and select the one that you feel best represents the concept ORDER.

5) Paste the squares on a transparency so that they can be projected in class.

6) Repeat this process for the concept JOY.

Stage 2

1) Four or five groups should present their solution to ORDER, explaining to the class their reasons for selecting it and the process followed by the group.

2) Four of five different groups should present their solution to JOY.

What to hand in? (Worth 5%)

Individually, please write a reflective statement that answers the following two questions:

1) Was it easier to create solutions for ORDER or JOY? Or, was it about the same?

2) The above process followed a common pattern of **exploration**, **ideation**, and **criticism**. Comment on how your group proceeded through these three stages.

The statement should be a well-written e-mail message less than 300 words (please no attachments). **BY 6 AM ON OCTOBER 4th**, submit your statement to:
dhendry@u.washington.edu

PLEASE, PLEASE include the following on the subject line: **INFO-424: X1**

INFO-424: Information Visualization and Aesthetics
Autumn 2005
Assignment #2: Revealing Relationships and Presentation
Worth: 10%

What to hand in?

Your report should consist of two sections:

Treemap

1. For each question, give the answer and illustrate your answer with a screen shot and appropriate commentary.
2. Include a timeline of your learning. The timeline reveal the significant stages of your learning. Briefly, reflect on the ease or difficulty of learning Treemap.

Fish-eye menus

1. In your own words briefly summarize the experiment, stating the **hypothesis** and the **method**.
2. Then, present the **results** in the form of one or more graphs. Briefly discuss the results with the aim of drawing some conclusions about the merits of the fish-eye interaction technique.

Grading Guidelines

1. All answers should demonstrate the principles of good information design. Clarity and conciseness of presentation are valued.

2. You answer the Treemap questions correctly and clearly incorporate graphics into your answers.

3. The timeline of your learning reveals interesting features and structure about your learning. For example, the timeline might show the number of records logged, when significant positive (and negative) events occurred, and the major phases of your learning.

4. The fish-eye menus experiment is introduced and summarized.

5. The data for the fish-eye menus is graphed clearly and the implications of the data are discussed.

INFO-424: Information Visualization and Aesthetics
Autumn 2005
Assignment #2: Revealing Relationships and Presentation
Worth: 10%

Note: You may do this assignment individually or in groups of two. But, if you do it in groups please follow these three rules:

1. Your group of two must not also work together on the project;
2. Your group of two must not have worked together on another assignment; and
3. Your group of two must combine data collected individually and fully synthesize your individual work into a single, joint work.

Note: You must come to the **lab on Oct 28 to collect the data necessary** for Problem B of this assignment. If you do not come to the lab, then points will be taken off. (If, for some reason, you cannot attend the lab, please inform the instructor to make alternative arrangements.)

Problem A: TreeMap

TreeMap provides methods for structuring data and exploring it dynamically. Install TreeMap. (See course website for help.)

While you learn TreeMap, monitor your own learning by keeping notes of your goals and your progress in completing them. You should note what you are doing every two minutes or so and record significant events (either progress or frustration). You should expect to spend approximately 30 – 60 min learning TreeMap.

For the crime data found on the course website, use TreeMap to answer these questions:

1. Does it appear that crimes are differentially committed by one gender or another in different states?
2. Which state seems to have the most number of different crimes?
3. Do crimes by Native Hawaiians or other Pacific peoples seem to occur more frequently in one state or another?
4. Using gender as an example, comment on identifying cases that occur infrequently.
5. As you learned to use TreeMap, briefly discuss three learning phases that you progressed through.

Notes:

1. TreeMap may be more difficult to learn than you might expect. In particular, there are hidden dependencies between options in the legends, filters, and hierarchy. Thus, when learning about the settings, manipulate one at a time while holding the others fixed.
2. If you encounter unexpected effects, click 'Restore default settings' on the main menu tab.

Fisheye Evaluation

In the lab on October 28, we will perform an empirical evaluation of a fish-eye menu system. In this experiment, we will collect performance data on the use of a fish-eye menu system and compare results to other systems. The performance data will include time to complete the task and the number of errors made.

Your task is to graph the data collected in the class and draw some conclusions about the performance of fish-eye menus. Additional details for conducting this experiment will be reviewed in class.

(Please turn over to page #2)

INFO-424: Information Visualization and Aesthetics
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Assignment #3: Connectivity
Worth: 10%

Note: You may do this assignment individually or in groups of two. But, if you do it in groups please follow these three rules:

1. Your group of two must not also work together on the project;
2. Your group of two must not have worked together on another assignment; and
3. Your group of two must combine data collected individually and fully synthesize your individual work into a single, joint work.

Objective

Examine the problem of revealing relationships amongst multiple sets of objects

The problem

The sets X and Y are said to be disjoint if they do not have a member in common. That is, two sets are said to be disjoint if the intersection of them is the empty set; that is, X AND Y = ø.

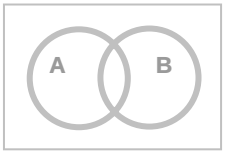
Now, consider the sets,

A = {x, y, z} and
B= {m, n, x, y}

and the disjoint subsets of A and B:

A NOT B	~ Items in A but not B, {z}
B NOT A	~ Items in B but on A, {m, n}
A AND B	~ Items in both A and B, {x, y}

These cases are easily located in this Venn diagram:



A Venn diagram also works well when N is 3 but what happens when N is 4 or even larger? (*Note*: For N sets, there are 2^N-1 disjoint subsets.)

Explore several solutions for revealing the disjoint subsets amongst the four sets. Select two of these solutions and fully elaborate a computerized design for them. In other words, your design should include an outline for how a working system would be implemented in SVG or similar system. One representation should be textual in nature and the other should be graphical.

Briefly discuss:

- The fundamental difficulty of this problem;
- The differences between the two representations;
- How your representations might be applied to Boolean search systems.

What to hand in?

1. The two designs
2. A discussion section
3. An appendix that includes your rough sketches. Where appropriate, please annotate your sketches.

Project: Burton Acres Shell Midden
Worth: 30%

Burton Acres Shell Midden: Visualizing its History

Introduction

An enormous amount of data is generated by archaeologists when working at a field site. Material is excavated, screened, and sorted. From this process a variety of different kinds of objects are uncovered including bones from fish, birds, and animals, shells and shell fragments from various kinds of shellfish, stone tools, and so on. Once an object is found, it is identified and carefully documented. Among the things recorded are: type of object, location, weight, whether it is burned or not, and other information. Over a period of several months, archaeologists might document tens of thousands of objects.

This raw data is extremely valuable—once a site is excavated the data is all that remains. The data allows specialists to analyze the contents of the site, to form hypotheses and draw conclusions about who used the site, over what periods of time, and for what purposes. For non-specialists, the data can be used to rediscover the site and to better appreciate how cultures and the natural world have changed over time. The data, in short, can tell a story about people and can complement ethnographic accounts and oral histories.

In this project, you will have an opportunity to develop a system for visualizing archaeological data. This project has been developed in cooperation with Peter Lape, Laura Phillips, and Diane Quinn of the Burke Museum. The Puyallup Tribe of Indians has also been notified of this project.

The Burke is particularly interested in your solutions. Interested students with strong projects may have an opportunity to further develop their work in collaboration with the Burke Museum and we expect that some teams will present posters of their work at the Undergraduate Research Symposium in the spring.

Background

The *Burton Acres Shell Midden* is a site of historical significance on Vashon Island in Southern Puget Sound. Archaeological evidence shows that from around 1000 AD to 1930s people visited the site to catch and process fish and shellfish.

A *midden* is a refuse dump, typically containing domestic waste from day-to-day life such as bones, shells, broken pottery, and so on. Middens often build up layers over many generations of use. Studying the objects found in layers within the ground provides a lens on to a culture and how it changed over time.

In the summer of 1996, the *Burton Acres Shell Midden* was excavated in a public education project. This work generated thousands of objects within these categories:

Historical artifacts
Lithic artifacts (stone tools)
Bone and antler artifacts
Mammal and bird bones
Fish bones
Shells

The location of the each of the objects is documented as well as other attributes that are specific to the type of object. The data set contains approximately 3,000 objects.

A short description and summary of *Burton Acres Shell Midden* is available on the course website.

Vision

Your objective is to design, implement, and evaluate a system for visualizing the *Burton Acres Shell Midden* data set. Your system should allow people to:

Appreciate the history of the *Burton Acres Shell Midden*
By **Exploring** and **Searching** the data set

Scenarios of use

Here is a possible scenario of use. You are free to use this scenario. Or, you may choose to revise this scenario or propose another.

Charlie is a 9th grade student in a local high school. He wants to learn about the foods that ingenious peoples of the Puget Sound once ate and to compare that diet with the foods that are available at the local supermarket. He comes to the *Archaeology Site Visualizer* and selects a button that shows the locations of all food items found in *Burton Acres Shell Midden.* Colors are used to show the different types of food. The scientific and everyday names of the food items are shown and Charlie is able to click on a link to learn more about these animals at the Burke Museum website.

The objects can also be shown by age. Noticing a possible trend, she selects some sliders so that only shellfish and stone tools are shown on the display. She notices that one kind of shellfish seems to frequently occur in the presence of a particular kind of stone tool. This prompts Charlie to pose a more specific query to show only shellfish of a particular kind.

Project: Burton Acres Shell Midden
Worth: 30%

Requirements

You are free to develop any kind of visualization, subject to these constraints:

1. Your system allows people to browse and search
2. You use the *Burton Acres Shell Midden* data set.

You may either implement a system of your own design or you may use an existing tool. With either approach, however, you must:

1. Conduct a task analysis that identifies the specific tasks that your system will support;
2. Describe the visualization techniques employed and critically discuss how the prototype supports users in completing the tasks;
3. Evaluate your system with participants from outside the class;
4. Critically discuss the merits of the prototype as a tool for visualizing archaeology data.

If you choose to use an existing tool, your evaluation is expected to involve 4–8 people and be quite thorough. If you build a prototype, the evaluation component can be less thorough so that more time is available for development work.

Deliverables

P1: Project Topic and Team Members (Due: Oct 20)
In this one page report you should outline project goals and plan. The report should contain the following information:

1. The list of team members and the name of your team
2. The URL for your team's website
3. A list of 5 – 10 questions that you have about this project.

Your project team should **consist of 4 members** (one or two teams may consist of fewer members).

P2: Project Description and Plan (Due: Nov 11)
In this short report (less than 4 pages + appendices), you should describe the objective of your project and your plan for obtaining the objective. You should:

1. Name the project and describe the project vision
2. Describe a user scenario and outline the tasks that users will be able to complete with the prototype
3. Describe how you will build and evaluate the prototype
4. Document any risks to the completion of the project
5. Include an appendix showing your design ideas/sketches for the project
6. Include an appendix containing peer review feedback.

Please note: You must have another person or team review your project. This feedback must be included in an appendix. (Reviewing a project report is an excellent way to gain participation credits in the class.)

P3: Class Poster Presentation (Due: Nov 28 – Dec 2)
You will present a poster on your project and give a demonstration of your prototype to the class. The presentation is to be an informal technical review.

Please note: You may not user PowerPoint for the presentation. Rather, you should create a poster to review the main ideas of your work and use the time to present a demonstration of your system. To support your presentation, you may choose to give the class a handout.

P4: Final Report (Due: Dec 8)
The final report should be less than 10 pages and be a revision and expansion of the earlier report. The report, together with your website, should document your project and address the requirements given above.

The suggested outline of the report:

1. Title page
2. Introduction and vision
3. User scenario and tasks
4. The Prototype
5. User Evaluation
6. Discussion & Next steps
7. Appendix A: Team reflection on project
8. Appendix B: Design sketches

In Appendix A, please include a statement on what you learned in the project, what worked well, and what you would do differently if you could repeat the project.

In Appendix B, please include a record of your design ideas and sketches that contributed to the final solution.

Fair Use Statement

Data from the Burton Acres Shell Midden Project

1. Information gathered during the archaeological excavations and analysis of the Burton Acres Shell Midden is available for use for educational purposes to help us understand archaeology and past and present culture.

2. This information and any products resulting from the use of this information should be used, displayed and distributed with respect for this region's Native Americans and their ancestors who left a record of their lives in the shell midden at Burton Acres.

Project: Burton Acres Shell Midden
Worth: 30%

Grading Criteria

General

- The objectives are stated clearly;
- Assumptions are made explicit and justified;
- The solutions are elegant *and* simple;
- Relevant work is cited;
- The merits of solutions are critically discussed;
- The writing is clear, concise, and interesting.

Problem and User Needs & Tasks (30%)

- A narrow, interesting problem is found and described;
- User needs are situated within the *knowledge crystallization framework*;
- User tasks are well-defined.

Prototype (50%)

- A linkage between the user tasks and the prototype is established;
- The prototype is well-executed technically;
- The prototype is evaluated with users;
- Appropriate conclusions are drawn.

Report & Presentation (20%)

- The writing meets the *iSchool Performance Outcomes for Student Writing*
- The reading is a high quality peer-reviewed paper appropriate for the class
- The presentation is well-organized and engaging (more criteria to be discussed)

(All team members will receive the same grade except in extraordinary circumstances.)