N328 Visualizing Information

As society continues to generate increasing quantities of data, there is a need for tools to help us make sense of the accumulating information. Visualization, the transformation of information into visual representation, is one of the most effective ways for extracting insights from data. In this course, we will study the principles and practice of information visualization. We will learn about the principles of visual perception and graphical encoding, and apply these principles to create effective visualizations, for the purpose of analysis and communication. Students will gain practical experience in using visualization tools to create representations of their own data, and will become conversant with a variety of statistical graphs and interactive visualization techniques.

Section:	33197	Credit hours: 3
Class time:	Wednesdays 10:00AM - 12:40PM
Location:	IT 257, Informatics & Communications Technology Complex
	535 West Michigan Street, Indianapolis, IN 46202 [map]
First class:	January 11, 2017
Last class:	April 26, 2017
Instructor:	Khairi Reda	redak@iu.edu
Office hours:	Mondays 1:00-3:00PM (room IT 581), or by appointment
TA:	Pratik Nalawade	pnalawad@umail.iu.edu
Office hours:	Fridays 11:00-1:00PM (room IT 460), or by appointment

Learning goals

Upon successful completion of this course, students should be able to:

- Understand the purpose, benefits, and limitations of visualization as a human-centered data analysis medium.
- Become conversant with a broad range of visual representations for a variety of data types.
- Gain practical experience in using modern visualization tools.
- Design, create, and employ visualization for analysis and communication in their own field.

Prerequisites

Students are expected to have a basic understanding of linear algebra, discrete math, and data structures. Programming experience and willingness to learn new tools will be helpful.

Syllabus

The lectures and reading materials will lay the theoretical foundations for visualization design. But the best way to learn how to make effective visualizations is to make a lot of visualizations. Therefore, this course emphasizes project-based learning; There will be three assignments in this class with progressing levels of complexity and one final project. The assignments are designed to give you exposure to a variety of visual representations, and enable you to acquire the skills necessary for the creation of visualizations.

In addition to the three assignments, there will be one final project which will be group-based (with 3-4 students per group). The final project is intended to allow you to delve deeper into a subtopic in visualization, based on your own interests (subject to instructor's approval).

As part of the lectures, we will also have a series of design critique discussions throughout the class. We will select a set of published visualizations and critique them in class. The goal of the discussion is to learn how to critically evaluate visualizations, and present evidence that suggest their effectiveness based on perceptual principles and established design guidelines.

Required textbook
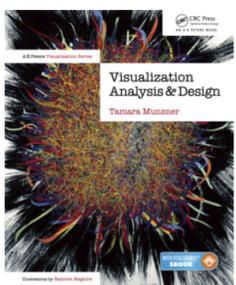
Visualization Analysis and Design
Author: Tamara Munzner
Publisher: CRC Press, 2014
ISBN: 978-1466508910
CRC Press ($56 eBook or $80 Hardcover+eBook) | Amazon ($76 Hardcover)f

We will assign specific chapters for reading every week. The required reading will be indicated on the schedule. On some weeks, we will be supplementing the book with additional readings, which will be made available on Canvas.

Visualization tools

There's a variety of tools available to help you create your visualizations. A comprehensive list of tools is available on the *resources* page. The

choice of tool to use in this course will be up to you. However, we generally recommend that students use Tableau, given its relative ease of use and the availability of online tutorials and resources. As a student, you are also eligible for a *free license*. You can request your license from Tableau's academic page.

Exams/quizzes

There are no exams or quizzes in this course. Instead, you will be graded based on your assignments as well as your participation, both in class and on Canvas.

Visualization critique

Each week, we will have two online critiques on Canvas. The goal of these discussions is to give you experience in critically analyzing visualizations by applying principles learned in the class.

Posting critiques: You are responsible for posting one design critique during the semester on Canvas (please sign up for critique slots; each student should sign for one slot). This will entail finding a visualization, posting a critique, and moderating the discussion. You are allowed to utilize the following sources to find a suitable subject visualization for your critique:

- News media and magazines, such as the New York Times, the Guardian, The Economist, and Newsweek.
- Scientific magazines and journals (PLOS ONE, Nature, Scientific American, Science Popular Science).
- Textbooks

You may not use textbooks or papers on visualization as source material for your critique. Rather, the critique subjects should come from visualization practitioners. That is, people outside the field of visualization, but who employ visualization to communicate information in their own domain. You may use visualizations found on social media provided you are able to track down the original. Please refrain from posting links to social media content. Rather, post link to the original source.

Once you have selected your visualization, explain the data being shown (type and semantics). Describe the visual encodings employed. That is, put into words what the visualization is trying to show. Next, discuss the visualization: what works and what doesn't? Is the visualization clear or does it mislead or distort the data? Do you like it, and why? What would you do to improve the visualization? Compose 3-4 thoughtful paragraphs and post your critique and visualization in a new thread.

Participating in critique discussions: You are required to actively participate in one of the new threads for that week. You should post thoughtful comments. Saying "I like it" is not enough. Your comments should address whether you agree with the critique. You should also try to add something new to the discussion. Did the original post miss anything interesting about the visualization? Do you agree with the critique? If so, why (or, why not)? Did the critique miss anything? Did you learn something new? Please be constructive.

Grading: We will check that discussion threads have been created by Tuesday midnight. You will be graded on how well you describe and critique the visualization based on the vocabulary and concepts we cover in the class. We will also make sure that each class member has commented on a new thread by midnight each Sunday. If you posted a critique for the week you do not need to comment on another critique. However, you should participate in the discussion on your thread; don't leave a good discussion hanging, especially if there are questions! Your discussion activity each week will be part of the participation component of your final grade.

Assignments

There will be 3 assignments in this class. The assignments will explore issues in the design, implementation, evaluation, and critique of visualizations.

Assignment 1: Visualizing a simple dataset. We will explore the basic process of mapping information to visual representations
Assignment 2: Exploratory visual analysis. We will employ visualization in an iterative fashion to analyze and extract insights from a moderately complex dataset.
Assignment 3: Critiquing and evaluating visualizations. We will apply what we have learned in class to critique visualizations and evaluate their potential based on established design guidelines and perceptual principles.

Final project

There is one final project in this class. This will be a group project with 3-4 students per group (preferably 3 students). In the final project, you will design and implement and interactive visualization for a particular dataset. The deliverables of the project will consist of a live, usable visualization on a website. You will also produce a documentation video demonstrating your visualization, as well as a final write-up detailing your design process, solution, and findings. You will also present your project to the class in the final week of the course.

Grading

Deliverable	Percentage
Assignment 1	15%
Assignment 2	20%
Assignment 3	15%
Final project	35%

Participation in design critiques	15%

Participation

In-class participation will be evaluated according to the following rubric:

0 points: Not physically present OR behaved in ways that were distracting
1 point: Not mentally present OR was engaged in other activities not related to the discussion
2 points: Was consistently engaged, listening to the discussion
3 points: Contributed productively to the discussion once or twice
4 points: Contributed productively to the discussion three or more times

Online (Canvas) discussions will be graded according to the following criteria:

0 points: Nothing was posted
1 point: Late posting of discussion
2 points: Minimally done, or does not respond to the topic of discussion
3 points: Done well and responds substantively to the majority of the questions/discussion points
4 points: Above and beyond the call of duty

You get two 'free passes' for the online discussion throughout the semester. After that, missing online discussions will start to affect your grade.

Grading scale

A+	97 - 100	Outstanding achievement
A	93 - 96.9	Excellent achievement
A-	90 - 92.9	Very good quality of work
B+	87 - 89.9	Good quality of work
B	83 - 86.9	Modestly acceptable quality of work
B-	80 - 82.9	Marginally acceptable quality of work
C+	77 - 79.9	Unacceptable work
C	73 - 76.9	Unacceptable work

No credits toward major, minor, or certificate requirements are granted for a grade below B-.

Deliverables

You are responsible for completing each deliverable (e.g., project, homework) by its deadline and submitting it by the specified method. Deadlines are outlined in the syllabus. Should you miss a class, you are still responsible for completing the deliverable and for finding out what was covered in class, including any new or modified deliverable. In fairness to the instructor and students who completed their work on time, a grade on a deliverable shall be reduced 10%, if it is submitted late and a further 10% for each 24-hour period it is submitted after the deadline.

Collaboration policy

Unless explicitly prohibited, you may discuss the homeworks with others in order to better understand them. However, the work you turn in must be your own (or in the case of the final project, yours and your teammates'). That is, you design and produce your own visualizations, and critically evaluate the results in your own words. You may not submit the same or similar work to this course that you have submitted to another. Nor may you provide or make available solutions to homeworks or projects to individuals who take or may take this course in the future.

Warning: cheating and plagiarism are serious academic misconducts, and will be prosecuted accordingly. The minimum penalty for cheating is receiving a grade of zero for the assignment. Plagiarism will result in deducted points proportional to the severity of the oversight, and up to receiving a zero for the assignment. A repeat offense will result in an F grade for the course. Please make sure you read and understand the code of conduct.

Quoting sources

You must acknowledge any external resources that you replied upon in your assignment deliverables. You may use examples or tutorials you find on the web as a starting point. You must quote the sources using proper citations (author, year, title, time accessed, and/or URLs). You may not use existing complex combinations or large examples. For example, you may not use a ready to use multiple linked view visualization. However, you may use parts out of such examples.

Attendance

A basic requirement of this course is that you will participate in all class meetings, whether online or face-to-face, and conscientiously complete all required course activities and assignments. Class attendance is required for classroom-based courses. It entails being present

and attentive for the entire class period. Attendance shall be taken in every class. If you do not sign the attendance sheet while in class, you shall be marked absent. Signing the attendance sheet for another student is prohibited. The instructor is required to submit to the Registrar a record of student attendance, and action shall be taken if the record conveys a trend of absenteeism.

Only the following are acceptable excuses for absences: death in the immediate family (e.g. mother, father, spouse, child, or sibling), hospitalization or serious illness; jury duty; court ordered summons; religious holiday; university/school coordinated athletic or scholastic activities; an unanticipated event that would cause attendance to result in substantial hardship to one's self or immediate family. Absences must be explained with the submission of appropriate documentation to the satisfaction of the instructor, who will decide whether missed work may be made up. Absences that do not satisfy the above criteria are considered unexcused. To protect your privacy, doctor's excuses should exclude the nature of the condition and focus instead on how the condition impacts your attendance and academic performance.

Missing class reduces your grade through the following grade reduction policy: You are allowed two excused or unexcused absences. Each additional absence, unless excused, results in a 5% reduction in your final course grade. More than four absences result in an F in the course. Missing class may also reduce your grade by eliminating opportunities for class participation. For all absences, the student is responsible for all covered materials and assignments.

Incomplete grade

The instructor may assign an Incomplete (I) grade only if at least 75% of the required coursework has been completed at passing quality and holding you to previously established time limits would result in unjust hardship to you. All unfinished work must be completed by the date set by the instructor. Left unchanged, an Incomplete automatically becomes an F after one year. Please see: http://registrar.iupui.edu/incomp.html for university policy on Incomplete grades.

Code of conduct

All students should aspire to the highest standards of academic integrity. Using another student's work on an assignment, cheating on a test, not quoting or citing references correctly, or any other form of dishonesty or plagiarism shall result in a grade of zero on the item and possibly an F in the course. Incidences of academic misconduct shall be referred to the Department Chair and repeated violations shall result in dismissal from the program.

All students are responsible for reading, understanding, and applying the Code of Student Rights, Responsibilities and Conduct and in particular the section on academic misconduct. Refer to The Code > Responsibilities > Academic Misconduct at http://www.indiana.edu/~code/. All students must also successfully complete the Indiana University Department of Education "How to Recognize Plagiarism" Tutorial and Test: https://www.indiana.edu/~istd. You must document the difference between your writing and that of others. Use quotation marks in addition to a citation, page number, and reference whenever writing someone else's words (e.g., following the Publication Manual of the American Psychological Association). To detect plagiarism instructors apply a range of methods, including Turnitin.com: http://www.ulib.iupui.edu/libinfo/turnitin.

Cheating is considered to be an attempt to use or provide unauthorized assistance, materials, information, or study aids in any form and in any academic exercise or environment.

1. A student must not use another person as a substitute in the taking of an examination or quiz, nor allow other persons to conduct research or to prepare work, without advanced authorization from the instructor to whom the work is being submitted.
2. A student must not use materials from a commercial term paper company, files of papers prepared by other persons, or submit documents found on the Internet.
3. A student must not submit substantial portions of the same academic work for credit or honors more than once without permission of the instructor or program to whom the work is being submitted.

Plagiarism is defined as presenting someone else's work, including the work of other students, as one's own. Any ideas or materials taken from another source for either written or oral use must be fully acknowledged, unless the information is common knowledge.

1. A student must not adopt or reproduce ideas, opinions, theories, formulas, graphics, or pictures of another person without acknowledgment.
2. A student must give credit to the originality of others and acknowledge indebtedness whenever:
    - directly quoting another person's actual words, whether oral or written;
    - using another person's ideas, opinions, or theories;
    - paraphrasing the words, ideas, opinions, or theories of others, whether oral or written;
    - borrowing facts, statistics, or illustrative material; or
    - offering materials assembled or collected by others in the form of projects or collections without acknowledgment

Acknowledgments

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missing or that you would rather have removed.

Weekly Schedule

Week	Topics	Assignments
1	Introduction & brief history to data visualization	Assignment 1 out
2	Data visualization tools (Tableau & Polestar) Data abstraction and data types	
3	Fundamental of human visual perception	Assignment 1 due Assignment 2 out
4	Marks and Channels Introduction to HTML and SVG	
5	Color Perception Introduction to JavaScript & D3	
6	IUPUI Wellness Day -- class canceled	Assignment 2 due
7	Assignment 2 presentations	
8	Chart, tables, and multivariate data	Final Project out
9	Multiple views D3 and JavaScript (continued)	
10	Maps and cartograms	
11	Networks and Tree	
12	D3 Lab	
13	Open-ended time for collaboration	
14	Final project presentations	Final Project due