SI649/EECS548, Information Visualization

Fall 2018 Instructors: Eytan Adar. Office hours: 9:30-11am on Mondays (NQ4368), but please email if you need another time.
GSI: Hari Subramonyam. Office hours: Mondays 1:00 PM - 2:00 PM (NQ 1274)
Email: You can reach us at eadar or harihars (all "at umich").
Lecture: Wednesday 1 - 2:30 PM (Mason Hall 1449),
Lab section 1: Wednesday 2:30 - 4 PM (Mason Hall 3463) or
Lab Section 2: Wednesday 4 - 5:30 PM (Mason Hall 3463) (everyone attends lectures and one assigned lab section)

Learning Objectives
The increasing amounts of data that we are exposed to is simultaneously creating an increase in cognitive load. Information Visualization (InfoVis) systems and techniques are intended to aid in dealing with this deluge, serving as external cognition “amplifiers” that expand memory, ease comprehension, and support decision making. Note that though there are different uses of the term “information visualization” in different communities, for the purposes of this class, we will treat information visualization as the use of interactive interfaces to visually represent abstract data. The course is intended for students interested in understanding and utilizing information visualization in their own work. The objective of this course is to introduce students to information visualization. Students will learn the visualization pipeline, processing data for visualization, visual representations, the design of interaction in visualization systems, and the impact of perception. Students will also develop the skills necessary to solve visualization problems and critique and evaluate InfoVis systems. This material will be covered through lectures, readings, and a number of assignments and projects. The assignments and large group project will provide students with practical experience in the construction of visualization systems. The course will be taught at a graduate level and will include written and programming work. As such, students should be comfortable with a basic level of programming and be willing to work with and learn graphics APIs and analysis tools.

Tentative Schedule
Sept. 5th  Introduction to Visualization, Lab 1 (Tableau)
Sept. 12th  Data and Image Models, Lab 2 (Vega/Vega Lite)
Sept. 19th  Perception, Lab 3 (Vega/Vega Lite)
Sept. 26th  Design principles, Lab 4 (D3)
Oct. 3rd    Interaction, Lab 5 (D3)
Oct. 10th   Evaluation + Design Lab 1
Oct. 17th   Multidimensional and multivariate data + personal project round robin
Oct. 24th   Temporal Visualization + Design lab 2
Oct. 31st   Hierarchical Visualization + Design lab 3
Nov. 7th   Network Visualization + Design lab 4
Nov. 14th  Text Visualization + Design lab 5
Nov. 21st  Bonus Class (TBD) + No lab
Nov. 28th  Story Telling + Peer Round Robin
Dec. 5th   Final presentations (please note that this is required attendance)

Class format
Class time will be spent as a mixture of discussions, lab activities, quizzes, presentations, peer round robins, and lectures.

Flipped classroom
My goal is to provide you with significant opportunity to apply what you have learned and receive critique in class. To do so with a large group of students requires that we leave plenty of class time for discussion/critique/feedback. So that design labs can effectively take place, I will be reducing the length of in-class lectures and providing expanded pre-recorded lectures. While I will make an effort to provide a high level summary of the material at the start of every class, my expectation is that you will have watched the videos and be prepared to leverage the material from readings and recorded lectures for the various activities we will have in class. Material in these pre-recorded lectures as well as the readings (see below) may be topics of frequent in-class quizzes.

Learning Objectives
I will be providing you with a learning objectives document at the start of the semester (this will be updated as the semester goes). It will cover things I expect for you to learn divided up by week. It will specifically list topics/skills that you should acquire before that week's meeting/lecture (these things will come from the video lectures + readings) as well as a set of things that you should be able to do after that week's meeting (perhaps on completion of the assigned lab). Think of these as an outline of the course. The outline will include things like: "define and be able to apply the definition of expressiveness in analyzing a visualization" or "calculate the data-ink ratio." I would strongly recommend that you use this document as an outline for note-taking where you fill in the details as you go.

In-Class Quizzes
We will have frequent, 1-2 question quizzes. These will be administered at the start of class (if you show up late to class you will not be allowed to take the quiz). They will be scored on a 3 point scale (well, 4 if you count 0). 0 - nothing submitted, 1 - present in class but wrong answer, 2 - partially correct, 3 - correct. These are not intended to be trick questions or difficult. In fact, the questions will be directly drawn
from the learning objectives document (e.g., "list 3 things 'expressed' in this visualization" or "given these parameters, what is the data-ink ratio for this plot?"). The questions will take no more than 5-10 minutes but they will allow me to make sure we’re making progress in the material and you’re picking up key concepts. They will also ensure that we are all on the same page during class discussion sessions. If you need to be away from class (and know in advance), you may take the quiz before the class lecture time. There will be no makeup quizzes after the class as we review the answers immediately. If the reason for missing class is a medical issue please let the course staff know and we will make some accommodation.

**Attendance**

Attendance in the class and participation in labs is mandatory. Repeatedly missing class (> 3 times, unexcused) or failing to participate will lead to a failing grade. See note above on quizzes.

**Readings**

There will be a number of readings assigned for each lecture which you’ll be expected to complete (see note on learning objectives above). The amount will vary from topic to topic but might include 1-2 chapters, and some research papers (all will be provided to you as handouts or PDF files). The readings will come in useful for the design section of the classroom and as such will be part of your class participation grade. The required readings should all be in CTools at the start of the semester (they’ll be the pdf files or links in the lecture directories). I may add additional optional readings to provide more details.

**Labs + Critique Sessions**

We will have labs and critique sessions nearly every time we meet. Specifically, you will encounter:

- **Programming labs** - The first 5 weeks will be programming labs where you will work in pairs to work on a lab assignment. You will complete these labs either in class or on your own time and return the finished lab by the following week (if you finish in class, that's great, but don't always count on being able to do so). You may work individually or with your lab partner to complete the lab. Partners will be randomly assigned and possibly switched between labs. There may be a few non-programming questions in there too.

- **Critiques/peer-to-peer** - We will have sessions where you or your group are presenting your current work on your individual and group assignments. Depending on the number of groups, this will be done in a “round-robin” fashion where you will present to other groups for a short period and then rotate or will be done in front of the class. You will be told what to bring in preparation for these sessions. Often it will be a few slides and your prototypes, but some preparation will be required.
• Design labs - The last type of lab will be a design lab. This will feature a specific problem related to the lecture of the day. The problems are designed to be somewhat open-ended but are based on situations where a "professional" created a solution. You will get to read about the professional solution for the next class and will be asked to generate a reading response (see below). The class will be broken apart into groups and each group will have a short amount of time to come up with a proposed design, creating a lo-fi or mid-fi design to address the problem. Groups will then have a few minutes to present their solution to the class and get critiqued on their proposal and critique the work of others.

• Group activities - In addition to labs we will have small (2-4 person) group activities that are intended to expand on the materials. I may provide a high level question and then have groups discuss. You will often be taking notes and answering these questions into a shared Google Doc.

Attendance/participation for all labs is mandatory.

Response Readings
When we begin the design labs, you will find that one of the readings for the class will be designated as a response reading. The response reading will be on the topic of the in-class project from the last class (so if we worked on the social network vis. problem last time, we'll read about one solution this time). Instead of a few paragraphs, or one pager about the paper, we're going to use a presentation format. Each student is responsible for creating a 3-5 slide deck (or some equivalent if you're a Tufte fan) and be ready to lead a short discussion. Occasionally, I'll put you back in a group to talk over your analysis and then present. What to turn in: I expect your “deck” or whatever prepared materials you’d use for your presentation by 7pm EST on Tuesday. This is to give me enough time to look at the materials. Some additional guidance: You should have ~5-8 slides worth of content. You should spend ~30-45 seconds on the solution (assume people have seen it already) and then split your time between a discussion of pros and cons of their approach relative to the design spec, drawing on what we’ve learned so far. I would specifically like to see you compare their solution to your own from class (individual or group). I would encourage you to scan the image from your shared google doc (or redraw) and have that in a slide to be able to talk about differences. Always end with a discussion slide. Use lots of figures so we know what you’re talking about and very little text (you should NOT be reading off your slides). Make your deck something you can work with, but if I won’t be able to understand where you’re going just by looking at it (e.g., you only have pictures), then please also give me at least an outline with some key bullet points. If you are randomly selected to present but are not present you will receive a 0 for that response reading

Why this format? I think that lots of classes require you to write short responses to readings and this is a great exercise that forces you to read the papers and think about the materials. However, I also believe that it’s important to be able to present information to an audience and this is something we don’t do enough of. I hope that most of you will consider this fun and useful. Realistically, it might mean less work for you. If you have some debilitating fear of public speaking come talk to me and we’ll work something out. Bonus for presenting: If you volunteer (and are selected) to present
I will give you 3 quiz points (so a "perfect" on one quiz). Whether you volunteer or not and are selected to present, you will not have to present again.

**Electronics Policy**
Laptops/phones/tablets/etc. are not allowed while anyone (myself, guest lectures, or students) is up in front of the classroom presenting or leading discussions. All the research, and my personal experience, suggests that everyone learns better and enjoys the course more when the distraction of electronics is removed. In most cases the slides will be available before lecture if you need to print them.

**Assignments**
There will be additional details for each of these on the Website, but here are short descriptions.

**Labs**
The first 5 lectures will feature labs that you will need to complete and turn in by the following week (due Tuesday night @11:59pm). Specifically: Lab 1 will be due Sept 11th, 2 will be due Sept 18th, 3 will be due Sept 25th, 4 will be Oct. 2nd, and 5 will be due Oct. 9th. As the labs build on each other you will NOT be able to turn in these labs late. You may work individually to complete the labs (whatever you didn't finish in class) or with your assigned partner (both of you will need to turn in your answers). You may consult other students in class for high level advice regarding solutions (and of course you may use whatever online resources). You may not copy code from your classmates (in this iteration of the class or any previous instance). Any form of cheating (sharing solutions or copying solutions) will be turned over to the academic advising office. Note that I am extremely good at catching people doing this.

**Individual mini-project**
Rather than having you struggle with data for this first assignment, I will ask you to build a communicative, interactive visualization that is specifically targeted at teaching a mathematical/technical/algorithmic concept. This is motivated by the examples proposed by Bret Victor, specifically: "[Scientific Communication as Sequential Art](https://www.bretvictor.com/scientificcommunication/)
"[Explorable Explanations](https://www.bretvictor.com/explorableexplanations/)."
I will ask you to pick a particular concept (we'll likely offer a set of choices to guide you, but you can propose alternatives). You will be asked to define a set of learning objectives for a student wanting to learn that concept, and then construct a visualization that would help them. The Victor example, above, is a nice demonstration since you get to play with parameters for various things to see how they influence models (through visualization). You should not pick overly simple things (e.g., visualizing a gaussian and letting a single slider control the sigma is probably too simple). The nice thing about this is that while you can use external data if it helps (you can, for example, demonstrate Poisson
distributions using real Hurricane data) but can also create fake data. For this project there will be an intermediate deadline where I and your peers provide quick feedback on your sketchbook (worth 10% of this assignment's grade). You will turn in a working system (complete with interactive components) for the final deadline. You may use whatever language/environment you want as long as I can run it in the end. You will be responsible for keeping and updating a sketchbook. I will give you a template for this. Your grade will be a mix of your sketchbook (50%) and implementation (40%).

**Individual Assignment proposal: TBD (midnight)**

**Individual Assignment "sketch": TBD (midnight)**

**Final Individual Assignment Due: TBD (midnight)**

**Final Project**

**Group Project** This is an open-ended project intended to give you an experience with designing, implementing and evaluating a visualization method or system. You will work in groups of 3-5 (talk to me if you want to propose something that’s bigger or smaller, but unless there is a really good reason, I probably won’t allow it). There will be 3 milestones for this project: 1) a proposal (1% of class grade), 2) an interim sketch (3% of class grade), and 3) a final submission (sketchbook + presentation + implementation + peer feedback -- 21% of class grade). Although it is my expectation that most projects have a **working artifact** at the end, you can propose other projects (i.e., an evaluation of visualization techniques, etc.). As with the individual assignment you will have a sketchbook that you will need to keep updated. There will be a couple of peer round-robin discussions (a short one on March 25th and a longer one on April 10th) to get feedback from your classmates. You will be asked to evaluate your team members and that feedback will be part of the final project grade. To turn in: 1) Your code and pointers to working system (if it’s hosted). Try to make a short video for me if it’s not hosted and is hard to set up. 2) Your final sketchbook - so a cleaned up version. All questions answered and everything clear (pay specific attention to getting the right set of tasks, expressiveness, and effectiveness arguments). 3) Your slides from the presentation. **Assignment proposal: TBD**

**Assignment "sketch": TBD**

**Final Assignment presentation:**

**Final Assignment due: TBD**

**Grading**

- 25% Quizzes
- 10% Response Decks
- 5% Class Participation (attendance required)
- 15% Labs 1-5
- 20% Individual Assignment
- 25% Final Project

**Lateness Policy**
All reading responses must be turned in by 7pm EST on the Tuesday before class. I recognize that the Flu season is hard sometimes and that emergencies happen. As such, you can turn in one reading response up to the time of class (Wednesday @1pm) without penalty. You only get to do this once. The labs are due as posted (midnight on Tuesday). You can turn *1* in late, but it still needs to come in before Wednesday lab (i.e., by 2:30pm on Wednesday, these build off each other so falling behind is bad). The due dates for projects and milestones will be posted. A late turn-in within 24 hours will cost you one letter grade or equivalent (so the best you'll be able to get is a “B”). A later turn in between 24 and 48 hours will cost you 2 letter grades. Nothing will be accepted after the 48 hour “grace” period. The (final) final project report will be due on time since I need to get grades in.

Office Hours & E-mail policy
TBA. I will do my best to answer questions by e-mail within ~48 hours (just don't count on a response an hour before a deadline). A discussion board will be set up on CTools. You might be better off posting your questions there (especially programming questions).

Commercial Systems
In the past, Tableau has kindly offered us a licensed version of their application for the semester and I'm going to try to get a similar arrangement again. Please download Tableau from here. (Links to an external site.) Once you have it, you can activate it with the key: TCNH-EEAF-AD30-D927-D000

Original Work
Unless otherwise specified in an assignment, all submitted work must be your own, original work. You may discuss general approaches with others on individual assignments, but may not copy code or other work and must indicate on your turned-in assignment who you worked with. You may not provide your solutions to other students. Any excerpts from the work of others must be clearly identified as a quotation, and a proper citation provided. Any violation of the School's policy on Academic and Professional Integrity (stated in the Master's and Doctoral Student Handbooks) will result in severe penalties, which might range from failing an assignment, to failing a course, to being expelled from the program, at the discretion of the instructor and the Associate Dean for Academic Affairs.

Accommodations for Students with Disabilities
If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way we teach may be modified to facilitate your participation and
progress. As soon as you make me aware of your needs, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate accommodations. SSD (734-763-3000; http://www.umich.edu/sswd/) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. I will treat any information you provide as private and confidential.