CS 7295: Special Topics in Data Visualization

Graduate Course, Khoury College of Computer Sciences
Northeastern University, San Francisco Campus
Spring 2023 Semester

Class Hours: Thursdays 6-9:20PM PST

Class Location: San Francisco 19-102
                    San Jose 10-102

Instructor: John Alexis Guerra Gomez
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1. Course Description

The purpose of **Data Visualization** is to discover insights from data, not just produce pretty pictures. In this course we will cover both the theory behind producing insightful data visualizations, as well as the practical components on how to create them
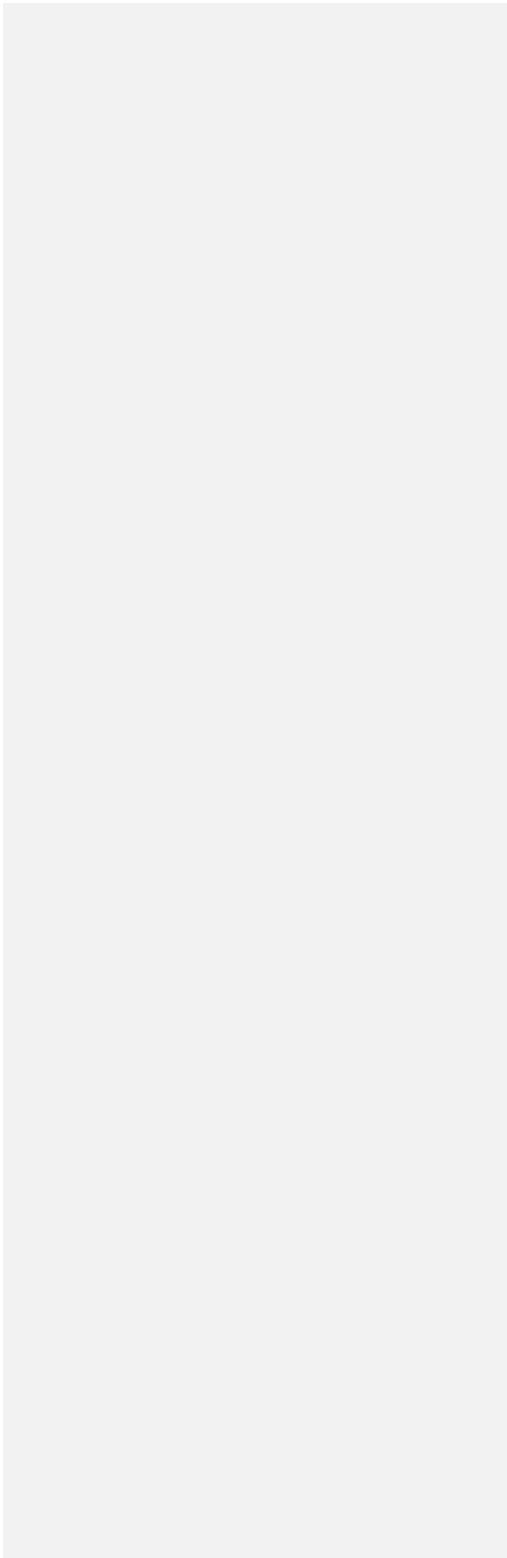
1.1 Course Prerequisites

None

1.2 Course Objectives

- Design efficient and insightful data visualizations based on perception theories and best practices from the research community.
- Implement insightful and interactive, web based data visualizations using D3, Vega-Lite or Tableau.
- Use a systematic approach for abstracting data analysis and visualization problems based on **what** and **why** is being visualized, and **how** is being represented. This will allow you to choose the right visualization for the tasks and data at hand beyond simple subjective rules of thumb.
- Judge data visualizations based on their ability to help the target **users** address the proposed **tasks** on the **data**.
- Conduct basic usability experiments to evaluate the value of a visualization with real users.
- Work with real world clients on real world data problems to help them generate insights

2 Course Structure

Week	Date	Topic	Tech Videos	Homeworks	Final Project
1	01/11	Class welcome and logistics Introduction Readings: CH1 VAD	Web Development Basics for Visualization ObservableHQ: From nothing to an interactive tree visualization in 20 mins Introduction to D3 with Observable Introduction to Vega-Lite for Observable Introduction to Tableau		
2	01/18	What we visualize Readings: CH2 VAD	Javascript Fundamentals for Information Visualization Introduction to Observable's not Javascript Data files for dataviz: JSON vs CSV Array operations, map, filter, reduce and above Nesting, Pivoting and Folding in JavaScript Tableau for Nesting, Folding and Pivoting Data	HW1 Adapting communitie's visualizations	

| 3 | 01/25 | Why we visualize
Readings: CH3 VAD | SVG, the building blocks of dataviz on the web
Introduction to web Canvas for visualization
Webgl for even more performant data visualizations
Setting up D3 for Observable and local development
Setting up the Vega-lite Javascript API for Observable and beyond
Setting up Tableau | |
| 4 | 02/01 | How we visualize
Readings: CH5 VAD | D3 v6 Selections explained
Translating Marks and Channels visualization theory to practice with D3
Translating marks and channels visualization theory to practice with the Vega-Lite JS API
Translating Marks and Channels Visualization theory to practice with Tableau Calculate | HW2 Basic Vega-Lite Viz |

			d Fields, Level of Detail (LOD) Functions	
5	02/08	Rules of thumb Readings: CH6 VAD	D3 v6 Data Binding explained using Observable Towards reusable d3 v6 charts on Observable Vega-Lite API custom charts How to use D3 path to generate lines, areas, shapes and more Other scales in D3: scaleSqrt, scaleTime, scalePoint and more D3: Creating a Histogram step by step D3 Stack and other layouts	HW3 Visualization Problem Abstraction
6	02/15	Tabular, Multidimensional Data Readings: CH7 VAD	Using D3 for creating a donut chart step by step Creating a Donut Chart with Vega-Lite API Creating stacked and radial charts in Tableau	Select team and topic
7	02/22	Temporal Data	Using D3 with temporal data How to create a D3 heatmap from scratch Creating temporal	HW4 Multidimensional data

			[visualizations with Vega-Lite API](#) [Visualizing temporal data with Tableau](#)		
8	03/01	Midterm recap Midterm	[Visualizing Node-Link Networks with D3 v6 and Observable](#) [Visualizing Node-Link Networks with Vega-Lite-API, D3 and Observable](#) [Network Visualization with Tableau (and D3 + Observable)](#) [Using color in D3](#) [Working with color in Vega-Lite API](#) [Working with Color in Tableau](#)	Initial proposal (15%)	
9	03/08	Spring Break			
10	03/15	[Networks and Color](#) Readings: CH9 and CH10 VAD	[Visualizing Trees with D3 v6 and Observable](#) [Visualizing Trees with Vega-Lite API](#) [Visualizing Trees with Tableau](#) [Visualizing Geo with D3](#) [Using Vega-Lite for Maps and Geographical Data](#)	HW5 Temporal	

			[Visualizing Maps with Tableau and Mapbox](#)		
11	03/22	[Trees and Geo](#) Readings: CH8-10 VAD	[D3 Transitions and animations in Observable](#) [Animations with the Vega Lite API on Observable](#)	HW6 Networks	Project progress report and presentation (20%)
12	03/29	[Evaluation](#) Readings: CH10-14 VAD	[How to create a scrolly-telling visualization](#) [D3 Faceting visualizations into multiple views](#) [Vega-Lite API faceting into multiple views](#) [Tableau faceting into multiple views](#)	HW7 Trees	
13	04/05	[Manipulating Views](#) Readings: CH11 VAD	[How to implement crossfiltering across charts in Observable](#) [Filtering attributes and items in Javascript](#) [Tableau Data Preparation](#)		
14	04/12	[Faceting](#) Readings: CH12 VAD			Usability Study Result (25%)
15	04/19	[Reducing Advanced Concepts](#)			

| Finals 04/2 week 6 | Project presentation/Blog/Demo (40%) |

3 Course Assessment

- Participation (15%): 7.5% Tweets + 7.5% Lottery points
- Homeworks (40%)
- Final Project (30%)
- Midterm (15%)

Considerations

- Participation will be computed as the average of your tweets and lottery grades.
- Your tweets and lottery grade will be computed with reference to the class median. If you have the same or more points than the class median, you will get [100%, 110%]. If you have less, you will get [-100% , 100%) proportionally
- Tweets and lottery will be computed on a [-100%, 110%] interval, so your grade can be negative.

3.1 Late/Makeup Policy

- The late penalty is 5% off for each day or fraction of a day that you are late

3.2 Bonus points

The professor might adjust any of the grade categories by providing bonus points or other mechanisms to offer students chances to catch up with points. This might be handled as a courtesy, to compensate for minor mistakes in the TAs grading or other situations. However, policies might apply for each one of these bonuses, for example they might be lost in case a regrading is necessary. These bonuses and their policies would be advertised on Slack.

3.3 Pre-class Work

Before every class, students must tweet something they learned from the readings with the hashtag **#Dataviz** and the handle **@NortheasternCA**. The comments should be original, shouldn't repeat what was said before, and demonstrate the proficiency of the required reading.

These tweets are going to considered for the class participation grade. Each comment will be rated as follows:

2 points: An interesting and original comment
1 points: An interesting comment but that was mentioned before by another student
0 points: A non-interesting comment
-1 points: Didn't tweet

3.3 Participation

You are required pay attention and to participate actively in the class. For this the professor would use among other techniques a lottery that randomly selects a student to ask them a question. The points would be assigned at the professor's discretion, but most of the time would be:

  -1 points: The student wasn't in class or wasn't paying attention
  0 points: Wrong answer
  1 point: Regular answer
  2 points: Great answer

For computing the participation grades, the median of the number of points of the class will be used. Students' grades would be proportional to their difference to the median, i.e. if the student is on the median it will obtain 100%, if it is below less than 100%.

3.5 Grade Calculations

Grades will be calculated on an absolute basis: there will be no overall curving. A weighted average will be calculated according to the percentages attributed to each assessment method listed in section 3.1. The mapping of the weighted average to letter grades is given below. Please note that these grade boundaries may move slightly at the discretion of the instructor, but the grade boundary for A is unlikely to change.

93.00–100.00	A
90.00–92.99	A-
86.00–89.99	B+
82.00–85.99	B
77.00–81.99	B-
73.00–76.99	C+
69.00–72.99	C
65.00–68.99	C-
0.00–59.99	F

4 Course Materials

Our main communication channel will be Slack https://infovis-neu.slack.com. I recommend you downloading Slack on your computer and your phone and turning on notifications. Students are encouraged to use slack to ask questions, coordinate their work and collaborate.

Some guidelines:

  Use #**general** for general issues, questions etc.
  Use #**project** for proposing projects and requesting approval. All projects must be approved by the teacher.
  Only the teaching assistants and the professor should create threads on #**announcements**. This channel is used for major announcements.
  Use #**random** for sharing random stuff.
  Use #**classchat** for the class conversation.

There is also an associated Canvas site for this course. We will use it to help keep track of the deadlines. Please make sure to submit both to canvas and the class submission form.

4.1 Textbook

- Required -- VAD: Tamara Munzner: Visualization Analysis and Design AK Peters 2014.
- Suggested -- Scott Murray: Interactive Data Visualization for the Web, 2nd Ed..

4.2 Computing Environment

Our main programming language for the class will be EcmaScript (JavaScript) and we will be using most of the time Observable as a coding platform. Later in the semester you will also learn D3, Vega-Lite and Tableau. Please make sure to watch the tech videos in this playlist to get used to both

4.3 Handing in Assignments

Students will submit their homeworks and projects using canvas and the class submission form. We will also be using Observable and Github for the final project. For the project you will need to create video demonstrations and presentations apart from a well-documented Github Project published under the MIT License. More of this will be explained as we move forward during the semester. The instructor can modify elements of this process.

5 General Policies

5.1 Attendance

Students are expected to attend classes regularly, take tests, and submit assignments and other work at the times specified by the instructor.

Students who are absent repeatedly from class will be evaluated by faculty responsible for the course to ascertain their ability to achieve the course objectives and to continue in the course.

Instructors may include, as part of the semester's grades, marks for the quality and quantity of the student's participation in class.

5.2 Academic Integrity

- This class has very strict standards for borrowing code: if you borrow anything for use in your project, you must have a reference.
- A good guideline is that if you take more than three lines of code from some source, you must include the information on where it came from.
- A URL or a notation (e.g., "MATLAB help files") is fine.
- If it is an entire function, note it at the beginning of the code segment and include any original credit information.
- Provide a qualitative description of what you used, and what you changed/contributed.

Here are a few examples of academic dishonesty:
- Working with one or more partners on an assignment that is to be completed individually.
- Submitting a copy of work done by another student, with or without their knowledge.
- Submitting work that was primarily found on the web or provided by someone else outside of this class.
- Submitting work by anybody who took this course in the past whether the course was here at Northeastern or at another campus or institution.
- Providing or receiving significant help to another student on an assignment.

If you have a question about what is considered a violation of this policy, **please ask!**

Unless stated otherwise (e.g., group project), assignments reflect individual work.
- While you may discuss concepts and ideas with other students, there is to be no direct collaboration.

- If you steal someone else's work, you fail the class.
- If someone uses your work, you fail the class.

If you are unsure about this policy, **ask the instructor**.

The university's academic integrity policy discusses actions regarded as violations and consequences for students http://www.northeastern.edu/osccr/academic-integrity.

5.3 Reasonable Accommodations
One goal of instructors is that every student should be able to participate in this course. If you require any special accommodations, let me know immediately so that we can work out appropriate arrangements.

5.4 Student Feedback
Your opinions are very important to me. Teaching is my passion, and I'm always looking for ways to improve it. Please let me know if you can think of a better way of teaching you.

All students are strongly encouraged to use the TRACE (Teacher Rating and Course Evaluation) system https://www.northeastern.edu/trace/ near the end of the course to evaluate this course. A reminder about TRACE should arrive via email about two weeks before the end of the course. In addition, I will be asking for your feedback at least once about halfway through the semester. However, if you have concerns about the course, don't wait until you are asked. You can contact me any time!

5.5 Classroom Environment

- To create and preserve a classroom atmosphere that optimizes teaching and learning, all participants share a responsibility in creating a civil and non-disruptive forum for the discussion of ideas.
- Students are expected to conduct themselves at all times in a manner that does not disrupt teaching or learning.
- Your comments to others should be constructive and free from harassing statements.
- You are encouraged to disagree with other students and the instructor, but such disagreements need to respectful and be based upon facts and documentation (rather than prejudices and personalities).
- The instructor reserves the right to interrupt conversations that deviate from these expectations.
- Repeated unprofessional or disrespectful conduct may result in a lower grade or more severe consequences.
- Part of the learning process in this course is respectful engagement of ideas with others.

5.6 Title IX

Title IX of the USA Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty and staff.

Faculty members are considered "responsible employees" at Northeastern University, meaning they are required to report all allegations of sex or gender-based discrimination to the Title IX Coordinator.

The university offers confidential resources for medical treatment, emotional support and counseling through Confidential Employees. Confidential Employees are not required to disclose information about Prohibited Offenses to the Title IX Coordinator without prior consent of the student. Confidential Resources on campus include University Health and Counseling Services (UHCS) staff, Sexual Violence Resource Center (SVRC), Office of Prevention and Education and the Center for Spiritual Dialogue and Service (CSDS). [From Title IV Policy, Section III.C]

Alleged violations can be reported to the Title IX Coordinator within The Office for University Equity and Compliance at: titleix@northeastern.edu and/or through NUPD (844) 688-6287.
Reporting Prohibited Offenses to NUPD does NOT commit the victim/affected party to future legal action.

In case of an emergency, please call 911.

Please visit The Office for University Equity and Compliance for the full Title IX Policy, a complete list of reporting options and resources both on- and off-campus.

5.7 Students with disabilities
Students with disabilities who wish to receive academic services and/or accommodations should visit the Disability Resource Center or call (844) 688-6287.

If you have already done so, please provide your letter from the DRC to the instructor early in the semester to arrange those accommodations.