

# CSC 468 Syllabus

## Programming Interactive Data Visualizations for the Web

Spring 2020

### Course Instructor, Dates and Time

#### Instructor

Dr. Eli T. Brown

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**CSC 468 in the subject**

#### Course

Classroom: wherever you are

Website via d2l.depaul.edu

#### Dates

Midterm: May 4

Final Presentations: June 1

Final Projects Due: June 9

### Course Description and Overview

#### Course description

This course teaches students the fundamentals of data visualization, and also shows you how to leverage your programming background to build novel, interactive visualizations from scratch. We will start by implementing common visualizations with JavaScript and D3 (e.g. scatter plots), then learn and implement techniques for more complex types of data (e.g. hierarchical, geospatial, network). You will learn to adapt existing implementations of sophisticated visualizations to your own data, and finish with a project to create your own interactive visualization with a python back-end and a D3 front-end.

#### Course mechanics

This is a **brand-new\* course** so we really can change things as the quarter unfolds. The flip side of that is it is less crystalized than some established classes you are used to, so give me a little leeway with uncertainty. That said, it went well last time so I do not plan to change it extensively. The main goals are to give you the vis theory background you need to design good interactive visualizations, and help you learn the development skills needed to actually do it. (Note I say 'help you learn' because the only way to get good at this is continuing to practice.) Each lecture will have a vis theory component and many will also have a technical/implementation component. Most of the latter type will be done in a lab setting. These labs will include lab assignments, which are an important part of your class grade. For each lab, I will give you a document that has a walk-through or some code or instructions and then an assignment component to extend it. These *lab assignments* will be a significant part of your grade, though they will be graded lightly and are mostly about encouraging practice and engagement. The grade will also come from weekly quizzes, a brief midterm and a final project, with emphasis on the final project (see *Grading*).

\*well, pre-owned... first time as CSC 468, third time taught... hastily online-ified (by an expert)

## Modification for Pandemic Pandemonium (SARS-CoV-Pacocalypse-20)

Here is a summary of the modifications I'm making due to the sudden shift to having no in-person meetings for this quarter. I have modified other parts of this document, but I think it's worth explaining the overall plan for dealing with this difference. Things will remain in place as much as possible.

- Lecture material will be delivered as pre-recorded videos. Some of these are from the new fully-online DSC 465 I made last quarter, so this means you will get more material than usual in this class but it won't take more time, since those were edited down a bit.
- We will have weekly Zoom meetings during lecture time. I will briefly introduce the week and check in for questions. This will be at \_\_\_\_
- I will record the weekly Zoom meetings and post them in VoiceThread so people in the online section can ask questions. Same reply policy as email.
- Labs will be done live via Zoom during a class period. They don't take a full lecture period, though. I will record these and post to VoiceThread just like the typical weekly items.
- Midterm – plan unless I come up with something better is to use D2L to run the midterm. It has software to verify you only have one tab open and records you to verify you're not getting up and checking references. I'm sure you can find a way around it if you really want to. Don't. The midterm won't be super hard if you prepare and it won't be worth too much of your grade.

**Prerequisites** SE450 OR SE 456 OR CSC436 OR CSC438 OR CSC447 OR permission of instructor  
The main intention of these prerequisites is that you are comfortable programming and learning new programming languages. We cannot start from basics with JavaScript and python in one class.

**Learning outcomes:** after this course, you will be able to

- Build common visualizations from scratch in D3, e.g. bar chart, line graph, scatter plot, TreeMap, force-directed layout, tile plot, choropleth
- Send data from a python back-end to a visualization through AJAX (specifically, JSON via XHR)
- Adapt existing implementations of more sophisticated visualizations to use your own data
- Create novel visualizations in D3
- Enable interactions between multiple visualizations on one web page

## Expectations

### Attendance and Participation

Attendance in class (or watching the lectures for online students) is an important part of the class because it enhances the community learning atmosphere. One of the most important parts of a class is building a learning community. I will be expecting you to be available to help each other with constructive suggestions. You are therefore expected to participate in online discussions on the website's forum as well.

The online discussion forums will be made available for you to discuss course topics and current trends in visualization. Inappropriate behavior, such as rude responses will be noted and will count against your participation score. Note also that posting of solutions is forbidden and will result in the forum being shut down, and also may constitute an academic integrity violation. You may give suggestions for how to attack a problem, and may discuss strategies, but code solutions are not to be posted.

### Workload

In this class you should expect to spend a significant amount of time outside of class reviewing course materials and topics and working on lab problems and the project. Throughout the course, I may distribute handouts of notes on various topics, and certain in-class materials including sample programs

will be available on the class website. Nevertheless you are expected to take notes during class and/or review lectures online to make sure you understand each week's material.

### Communications

Make sure you subscribe to the news feed on D2L as that is how I will send messages to the entire class.

## Contacting Me

Please get in touch if you have questions or would like to schedule a meeting outside office hours. Email is the best option. NOTE: I respond quickly when possible, but my policy is that you should receive a response by the night of the next business day (i.e. an email Tuesday gets a response by Wednesday night but a Friday one may have to wait until Monday night). Additionally, do not email me questions to which the answer is right here on the syllabus (e.g. when is the midterm?). Those will go unanswered. You can also come to my office hours or call me during office hours. I encourage you to come get help if you need it. When you email me, **include CSC 468** in the subject.

## Schedule (tentative)

Many weeks we will have a lab component as well as a lecture component. The lectures will cover data visualization fundamentals, while the labs will provide introductions to the implementation tools covered by the course. **Labs are in... wherever**

1. Lecture: Introduction to data visualization
  - a. Why use vis and what we'll be studying
  - b. Visualization on the web
  - c. Interactive machine learning
  - d. Start of vis principles (visual perception and mappings, plot types, graphical integrity)
2. Lecture: Visualization technology on the web
  - a. Vis principles part 2
  - b. Our web stackLab: data visualization for the web (HTML, CSS and SVG)
3. Lecture: Hierarchical Data; Color  
Lab:
  - a. Modifying SVG with D3
  - b. Modifying based on HTML controls
4. Lecture: Geospatial Data and Graph Data  
Lab: Maps in d3 and adopting existing vis examples as components
5. Lecture: Multiple coordinated views, Timeseries, Axis Transforms  
Lab: interaction between visualizations
6. Lecture: Text Data and High-dimensional Data
7. MIDTERM  
Second half: data show and tell after midterm (very informal)
8. Lecture: Categorical Data  
Lab: python backends
9. Lecture: can adjust topics but likely high-dimensional data, interactive machine learning, color choice detail, graph data
10. Final Project Presentations!

## Textbook

We will use two practical O'Reilly guides to building visualizations for the web, supplemented by online materials. I strongly recommend that you buy both of these and also buy one of the more visualization theory based books mentioned below.

*Data Visualization with Python and JavaScript* by Kyran Dale. O'Reilly Media. 2016.

*Interactive Data Visualization for the Web, 2<sup>nd</sup> Edition* by Scott Murray. O'Reilly Media. 2017. (available through DePaul's Safari subscription at <https://proquestcombo-safaribooksonline-com.ezproxy.depaul.edu/book/databases/business-intelligence/9781491921296>)

Here are some more theory-based books. Again I strongly recommend picking one up to anchor the other materials for you. I haven't followed a single book and I figured people would appreciate different flavors, which is why there isn't a textbook for the class.

- An actual visualization textbook, written by one of the top scientists and most influential people in the field. It could serve as a textbook for this course and I recommend it heartily. It isn't just about visualization theory and practice, but also about how to perform design studies to make interactive visualizations.  
Visualization Analysis and Design. Tamara Munzner. A K Peters/CRC Press. December 2014.
- Also nearly a textbook for the course, but a much more succinct treatment and more data-science oriented: Fundamentals of Data Visualization. Claus O. Wilke. O'Reilly Media, April 2019.
- Focused on human perception. Colin Ware, Visual Thinking for Design, ISBN-13: 978-0123708960
- More design-based view of vis. Alberto Cairo, The Functional Art: An introduction to information graphics and visualization, ISBN-13: 978-0321834737

Strongly recommended on static graphics, used for DSC 465: Data Visualization, great tools to use for prototyping.

- Covers the world of R libraries for data manipulation and more on ggplot: R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. Hadley Wickham and Garrett Grolemund. O'Reilly Media, January 2017. <https://r4ds.had.co.nz/>
- Winston Chang, R Graphics Cookbook: Practical Recipes for Visualizing Data, Publisher: O'Reilly Media, December 2012
- Edward Tufte, The Visual Display of Quantitative Information, 2nd Edition, ISBN-13 978-0961392147

## Grading

There will be a fairly low stakes midterm to make sure everyone has the basics down. Most of the grade comes from the final project. The quizzes are a give-away because we review them in class and you can retake them. The labs are lightly graded but are the most important way to show your progress.

- Weekly(ish) Quizzes: 11%
- Lab Assignments: 32%
- Midterm: 15%
- Final project: 42%

### Extra Credit

There is an extra credit opportunity for this course. Human-computer interaction (HCI) courses and psychology courses and the like need to run experiments as part of their curriculum. They need participants. Typically, this involves trying out some software or answering a survey or being observed while completing a task. If you help out with this by volunteering, you get extra credit in this course. There is a system setup to manage this at <https://depaulurparticipant.sona-systems.com/>. You signup there and then you can see and signup for the studies as they become available, usually later in the quarter. You can get up to half a letter grade from this.

### Quizzes

These are here to help you learn the material. I go over them in class and you can retake them as much as you want so there's no reason you can't get the full credit at the end of the quarter for these.

### Labs

Each lab will include a demonstration and some instructions for how to do something. Some have partial implementations and some you write from scratch. They will be started in the classroom where you can ask questions and I will demo things before you start. You will finish them on your own time and turn them in for credit. They are graded on a 0/check minus/check/check plus system. Getting all checks will get you a median course grade which is at the edge of a B+/A-. There are a total of 5 labs. To get a full A for the course, you need to get a check plus on at least 2 of those labs. To get a check plus, just go a bit beyond the basic assignment. For example, if it says to implement a bar chart that can switch to a line graph, add an option that makes a scatterplot or add a way to change the colors.

### Midterm

This will be a short midterm (half a session time allotted). The point is just to make sure that everyone has the core material down. It will be multiple choice and short answer.

### Final Project

The plurality of the grade comes from the final project. You will build an interactive data visualization with a python back-end. Group sizes will vary and I will take size into account when grading, but I expect a multifaceted, interactive, well-designed view of some data you find interesting and an accompanying story of what you learned from your interactive vis.

The final project consists of both a presentation and a write-up. You will present your final project on the 10<sup>th</sup> week of class, and then you will have until the final exam date (one week later) to submit your final report.

### Group Composition

Groups are generally a mixture of in-class and online students, but these rules are crucial:

- There can be in-class-only and online-only groups.
- Online-only groups MUST have someone available to present for the last class.
- Groups that have a mix of online and in-class students MUST have at least 2 online students.
- In order to enforce these rules so this process runs smoothly, I reserve the right to edit group membership after you have formed them.

It can be difficult to keep online and in-class students working smoothly together. The skills practiced in doing this will be useful to your careers. I expect you all to handle this professionally, courteously and

respectfully. Deviations from this will adversely affect your grade in two ways: your participation score may be reduced, and your teammates may report their dissatisfaction on the peer evaluations.

### Non-performance of a team member

The final project in this course is very broad in its scope allowing your group to focus on a wide range of dataset types for visualization, and on a wide range of techniques for visualizing the data. Group members are expected to participate fully and equitably in the group, and part of the final project grading rubric will be a peer evaluation that will form part of the final project grade.

Usually, the peer evaluation and documentation, including the meeting minutes, in addition to an overall desire for excellence, is sufficient motivation for individuals to contribute a fair share to the team project. However, in extreme cases, individuals have been known to completely cease contributing to a team project. If this is the case, a team has the right to notify the instructor **unanimously (other than the individual being sanctioned)** that the individual is no longer contributing and the team no longer wants the individual on the team.

It is expected that a team will be able to show significant effort towards reconciling the issue prior to such an extreme action. Note also that this is not a decision to be made lightly, as expulsion from a team will result in **the loss of 40% of the of the final project grade**, i.e. the group portion of the grade, for the person expelled. Because this is such a serious decision, any team that makes this decision will also experience a deduction of **10% of the final project grade**.

## Policies

### Changes to Syllabus

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class, posted under Announcements in D2L.

### Online Course Evaluations

Evaluations are a way for students to provide valuable feedback regarding their instructor and the course. Detailed feedback will enable the instructor to continuously tailor teaching methods and course content to meet the learning goals of the course and the academic needs of the students. They are a requirement of the course and are key to continue to provide you with the highest quality of teaching. The evaluations are anonymous; the instructor and administration do not track who entered what responses. A program is used to check if the student completed the evaluations, but the evaluation is completely separate from the student's identity. Since 100% participation is our goal, students are sent periodic reminders over three weeks. Students do not receive reminders once they complete the evaluation. Students complete the evaluation online in [CampusConnect](#). I personally read these after each quarter, so while Administration will review them, I will be looking carefully for useful constructive criticism that I can use to improve the course. Please help me out.

### Academic Integrity and Plagiarism

This course will be subject to the University's academic integrity policy. More information can be found at <http://academicintegrity.depaul.edu/>. If you have any questions be sure to consult with your professor.

## **Academic Policies**

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing as indicated in the [University Academic Calendar](#). Information on enrollment, withdrawal, grading and incompletes can be found at: [cdm.depaul.edu/enrollment](http://cdm.depaul.edu/enrollment).

## **Students with Disabilities**

Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs or file appropriate paperwork with the University such that they notify me. All discussions will remain confidential.

To ensure that you receive the most appropriate accommodation based on your needs, make arrangements as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: [csd@depaul.edu](mailto:csd@depaul.edu).

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