New York University Tandon School of Engineering
Computer Science and Engineering
Course Outline CS-GY 6313 Information Visualization
SPRING 2020
Professor Enrico Bertini
Mon 12:25-2:55pm
Dibner (5MT), Rm LC400

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Office hours: right after class or by appointment on Fri

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Course Prerequisites

The coursework includes projects that require some programming using JavaScript and web technologies. While previous knowledge of JavaScript and web technologies is not required, being proficient and comfortable with extensive programming is a fundamental prerequisite for this course. Previous experience with data manipulation and analysis can also help but it is not required.

Course Description

Being able to analyze and present data visually has become one of the most important skills for students who want to work in data science and related fields. Information Visualization teaches you how to design effective interactive visualizations of complex data for data understanding discovery, and presentation.

The course is a blend of theoretical knowledge and practical work aimed at developing a well-rounded set of skills to ideate, design, implement, and evaluate sophisticated data visualization projects. The theoretical part aims at providing a mental model to think about the visualization design space in a principled manner. This includes the theory of *visual encoding*, *human perception* and *visualization techniques*.

The practical part aims at teaching the skills needed to develop effective interactive data visualizations for analysis and presentation. This includes teaching the D3 javascript library and practical labs on *exploratory data analysis*, *sketching*, *design* and *critique*.

The course also includes a series of small practical projects which enable students to gain experience with the development of fully-working interactive visualizations to solve an assigned problem. The work is organized in a way to simulate conditions happening in real-world data analysis and communication projects and includes activities to gain feedback from the instructor and the teaching assistants.

Course Objectives

- Identify what kind of problems visualization can solve
- Explain why and when visualization works
- Develop analytical questions for a data analysis problem and develop appropriate data manipulations and graphs to answer them
- Describe how to evaluate a visualization project: identify the elements of a project that need to be evaluated and strategies to carry out effective evaluations

- Identify the right type of graph for a data analysis and presentation problem based on tabular data
- Identify the appropriate graph for a given problem
- Describe what the limitations of a visualization method are and how they can be overcome
- Recall the set of marks and channels visualization methods can use and describe their advantages and disadvantages
- Describe a visualization in terms of its encoding strategy (marks and channels used) and identify its potential limitations
- Describe the concepts of channel *effectiveness* and *expressiveness* and demonstrate how to apply them in the design and evaluation of data visualizations
- Use appropriate visual representations for problem with geographical, time-oriented and network data
- Develop simple interactive visualizations with D3.js and be able to argue for their effectiveness

Course Structure

The course includes recorded lectures, practical work in class and at home (for in-class section), readings, exercises, and visualization design and development projects.

Textbooks

There is no required texts. However, the following books are those that contain most of the information taught in the course:

- Visualization Analysis and Design, Tamara Munzner, CRC Press 2014.
- Interactive Data Visualization for the Web, 2nd Ed., Scott Murray, O'Reilly Media 2017 (for the D3.js tutorials). A digital version of the D3 book is freely available online at: http://shop.oreilly.com/product/0636920037316.do?cmp=af-strata-books-video-product_cj_0636920037316_6754088

Other recommended texts are:

- Readings in Information Visualization, Stuart K. Card, Jock Mackinlay, Ben Shneiderman, Morgan Kaufmann, 1999.
- The Visual Display of Quantitative Information, Edward Tufte, Graphics Press, 2001.
- Information Visualization: Perception for Design, Colin Ware, Morgan Kaufmann, 2012.

You can find the books on Amazon, at the NYU bookstore, and at the Dibner Library.

Course requirements

The course requires:

- Attendance: full attendance of weekly classes;
- Homework: submission of all homework (see details below);
- Mini-Projects: development and submission of assigned projects;
- Midterm: graded test for midterm.

Grading breakdown:

- Attendance: 10%
- Homework: 30%
- Mini-Projects: 40%
- Midterm: 20%

Attendance

The course requires full attendance of classes for the face to face section of the course and of the weekly online meetings for the on-line section. Attendance counts as 10% of the final grade (10 points out of 100). Missed meetings result in reduction of attendance points as follows:

Missed Classes	Pt. reduction
1, 2	0
3, 4, 5	3, 4, 5
6 or more	10

For special situations such as sickness, religious festivities, problems with transport, no attendance points will be removed as long as you send your instructor and our TAs a note via email **before** the class starts and follow the procedures defined by our school regarding absence. Please familiarize with them here:

https://engineering.nyu.edu/campus-and-community/student-life/office-student-affairs/policies

Attendance will be recorded at the beginning or end of each meeting every week.

Weekly Meetings for the Online Section

Students enrolled in the online section must attend the weekly meetings for online students (Time/Day TBD). During the meetings we will discuss the topic of the weeks and discuss the exercises assigned for homework.

Homework

The course includes three different types of homework:

- **Video lectures.** Video lectures to watch to learn the main concepts of the week.
- **Readings.** To deepen/expand the knowledge acquired in the lecture.
- **Exercises.** To develop visualization analysis and design skills.
- **Programming.** To train your programming skills on relevant data visualization problems.

Grading policy

Each assigned homework is evaluated on a 100 point scale. It is always possible to resubmit an assignment after receiving the grade. With the resubmission it possible to receive up to 50% of the missed points back.

Late and no submission policy:

Late	Pt. deducted from grade
1 day	5%
2-7 days	20%
Above 7 days	50%
No submission	100%

Important note on "due dates": it is your responsibility to check that you understand when a given assignment is due. It is never a good justification to say: "*I made a mistake and thought the submission was due ...*". Keep in mind that 12pm is actually noon in the afternoon, not midnight!

Mini Projects

A project consists of an assigned data set and a problem the visualization is supposed to solve. The solution requires designing a solution and implementing it in D3/javascript.

The students will have to submit for each assigned project the following material:

- Design sketches (developed before coding)
- Short description of the design and its rationale
- Working code showing the visualization implemented

(More details will be provided at the time the projects are assigned.)

All students are assigned the same projects so that we will be able to compare and discuss the solutions.

The projects will be easier at the beginning and will gradually increase in complexity as the course progresses.

Midterm Tests

The course includes one graded test administered halfway throughout the course. The test aims at evaluating the knowledge and skills acquired in the course and it will include only questions and exercises on material that has been presented and tested in the weeks before the test. The test is going to take place on March 9 (TO BE CONFIRMED). For the in-class section we are going to use the regular slot we have in class. For the on-line section I am going to send a poll to find a time that works for everyone.

Schedule

This is the tentative schedule for the course. Note that the schedule may change to adapt to specific needs of the class.

- Introduction and Evaluation
- Analytical Questions and Data Transformation
- Fundamental Graphs and Comparison
- Data Visualization Pitfalls
- Visual Encoding and Graphical Perception
- Color
- Midterm
- Geographic Data
- Temporal Data
- Network Data
- Multiple Views and Interaction

Quoting Policy and Collaboration

The work students submit for individual assignments and class projects must be their own original work. When ideas are borrowed from existing work it is necessary to provide citations and a clear statement that describes which part has been adopted and which is original. For homework students are NOT allowed to collaborate with their peers. The submitted homework must be produced and submitted individually.

Etiquette

Academic Dishonesty

It's always annoying having to explain that copying work or cheating is not allowed. I like to totally trust each and everyone of you. But bad things happen and I have to warn you that academic dishonesty is a very serious thing and you might get in very serious trouble if caught cheating. Students caught in dishonest behavior will be reported to the school.

Moses Center Statement of Disability

If you are a student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 2nd floor.