The City College of New York • Grove School of Engineering • Computer Science Department • Course Syllabus

Course number	**DSE I2700**	Course name	**Visual Analytics**
Credits & hours	3 cr. & 2:40 hours	Course coordinator	Ronak Etemadpour

Textbook, title, author, and year

- The required text book: visualization analysis and design, Tamara Munzner, 2014
- Other supplemental materials: IEEE VIS, EuroVis, ACM CHI
- Edward Tufte book

Specific course information

- Visualization organizes data in a way that the structure and relationships in the data that may not be so easily understood becomes easily understood and interpreted with the visualization. Visualizations of a data set give the reader a narrative that tells the story of the data. The purpose of data visualization is to convey information contained in data to clearly and efficiently communicate an accurate picture of what the data says through understandable and context appropriate visualizations.
- Today quantitative and symbolic data are easily collected in computer for- mat, from databases, websites, smart devices, and anything that has interconnect capabilities. When such large amounts of data are put in spreadsheets or tabular reports, it becomes difficult to see the patterns, structure, trends, or relationships inherent in the data. Effective data visualization exposes these inherent relationships, consolidating and illustrating them in graphics.

Course structure

- The course is online and on ZOOM one time a week. Students need to read the book, slides that are shared in blackboard, complete a practice exercise set in the class that need to be submitted on Slack channel, assignments at home, take an online quiz, take-home exams, and complete a group project.
- Grading is based on all the above-mentioned activities.
    - 3 different parts of a Final Project
        - 1) Data collection; task definition; hypothesis
        - 2) visualization and prototyping
        - 3) Finalization; Results, description, presentation, report.
        - A major part of this course is a group project, in which you will work in small teams on a web-based interactive visualization that allows you to answer questions you have about some topic of your own choosing or my examples. You will acquire the data, design your visualization, implement it using D3, and evaluate the results.
    - Class participation (Being active on Slack; tests and quizzes)
    - Assignments

Brief List of topics to be covered

Seq.	Topics
1	Why visualizations
2	Visualization Task taxonomies
3	Basics about visualizations (marks and channels)
4	Traditional Visualization Techniques
5	Modern Visualization Problems
6	Multidimensional Data Visualization
7	Visualization Issues
8	Vegalite, D3.js

Selection of course contents will be periodically reviewed. The coverage may be expanded or reduced based on the feedback gathered from course attendants.

Learning Goals: 1) Be able to describe the key design guidelines and techniques used for the visual display of information Understand how to best use the capabilities of visual perception in a graphic
display; 2) Understand the principles of interactive visualizations; 3) Understand how Machine Learning techniques can determine data structure and pattern; 4) Explore and critically evaluate a wide range of visualization techniques and applications

Ronak Etemadpour is inviting you to a scheduled Zoom meeting.

Topic: Ronak Etemadpour's Zoom Meeting DSE I2700
Time: Aug 31, 2021 04:50 PM Eastern Time (US and Canada)

Join Zoom Meeting
https://ccny.zoom.us/j/82571023767

Meeting ID: 825 7102 3767
One tap mobile
+13017158592,,82571023767# US (Washington DC)
+13126266799,,82571023767# US (Chicago)

Dial by your location
+1 301 715 8592 US (Washington DC)
+1 312 626 6799 US (Chicago)
+1 646 558 8656 US (New York)
+1 253 215 8782 US (Tacoma)
+1 346 248 7799 US (Houston)
+1 669 900 6833 US (San Jose)
Meeting ID: 825 7102 3767
Find your local number: https://ccny.zoom.us/u/kcXgbXt8kq

Detail Syllabus:

Reference Material (optional, but awesome):
Interactive Data Visualization for the Web by Scott Murray 2nd Edition (2017)
D3.js in Action by Elijah Meeks 2nd Edition (2017)
Semiology of Graphics by Jacques Bertin (2010)
The Grammar of Graphics by Leland Wilkinson
ggplot2 Elegant Graphics for Data Analysis by Hadley Wickham

The tools that we learn:
Vegalite
Some D3.js basics
Dash Plotly Samples

Prerequisites:
Some programming experience in any language. Ideally you have taken a course on computer graphics, but this is not strictly required.

Learning Outcomes:
By the completion of this course, learners will be able to:

- Design and create data visualizations.
- Conduct exploratory data analysis using visualization.
- Craft visual presentations of data for effective communication.
- Use knowledge of perception and cognition to evaluate visualization design alternatives.
- Design and evaluate color palettes for visualization based on principles of perception.
- Identify opportunities for application of data visualization in various domains.
- Critique existing visualizations based on data visualization theory and principles.
- Use Vega lite to develop interactive visualizations for the Web.

Communication:
Primary communication will be via Slack. Join this channel:
https://join.slack.com/t/visualdataana-jvh1958/shared_invite/zt-vdo0wxts-auj595it_BjSXwl5Qtq5Kg

See Introduce Yourself assignment for details on how to join.
You'll be expected to check this Slack for updates at least once every 24 hours.
If another student may be able to answer your question, please post it in Slack.
Direct message me in the Slack for quick communication.
If you have a question that only I can answer, and is not suitable for messaging in Slack, email me at retemadpour@ccny.cuny.edu. I will respond within 24 hours, weekdays.
We will have office hours on Weds at 12 pm-1 pm or by appointment that are sent to my email address retemadpour@ccny.cuny.edu.

Course Approach:
We will use the Blackboard system for content organization and submission of assignments. Course material will be delivered weekly as recorded video, assigned reading, and links to external resources such as fantastic lectures on YouTube, articles, examples and tutorials.

Class
Material to be Covered:

Homework Assignments/Projects: Some of the assignments will be done individually and some of them are group-based projects. The coding projects needs to be submitted via github.

1) Overview of Data Visualization, Introduction to Web Technologies

Reading: Chapter. 1 "What's Vis, and Why Do It?"

Lectures:
Why Visualize Data?
Introduction to D3.js.

Introduction to Vegalite.
Introduction to VizHub
Making a Face with D3.js: https://www.youtube.com/watch?v=-RQWC4I2I1s

Assignments:
Introduce yourself via video.
Find and describe a data visualization relating to current events.
Tweak a face with D3.js.

2) The Shapes of Data

Reading:

- Chapter 2 "What: Data Abstraction"
- Chapter 3 "Why: Task Abstraction"

Lectures:
Input for Visualization: Data and Tasks

Assignments:
Find and describe 3 datasets that you'd like to potentially visualize for your project.
Load and parse those 3 datasets using Vegalite, or D3.js or Python Plotly.

3) Marks and Channels

Reading: Chapter 5 "Marks and Channels"

Lectures:
Encoding Data with Marks and Channels
Rendering Marks and Channels with Vegalite or D3.js
Creating a Scatter Plot with Vegalite

Assignments:
Re-create one of the small graphics from Figure 5.1 (page 94)

4) Common Visualization Idioms

Reading: Chapter 7 "Arrange Tables"

Lectures:
Reusable Dynamic Components using the General Update Pattern
Reusable Scatter Plot
Common Visualization Idioms
Bar Chart, Vertical & Horizontal
Pie Chart and Coxcomb Plot
Line Chart
Area Chart

Assignment:
Create a visualization of the dataset you chose for your project, following one of the idioms discussed, including axes and legends.

5) Visualization of Spatial Data, Networks, and Trees

Reading:

- Chapter 8 “Arrange Spatial Data”
- Chapter 9 "Arrange Networks and Trees"

Lectures:
Making Maps
Visualizing Trees and Networks

Assignment:
If your project dataset has a spatial, network, or tree aspect, visualize it.

6) Using Color and Size in Visualization

Reading:
Ch. 10 “Map Color and Other Channels”

Lectures:
Encoding Data using Color
Encoding Data using Size
Stacked & Grouped Bar Chart
Stacked Area Chart & Streamgraph
Line Chart with Multiple Lines
Assignment (Project):
Add color to (or refine the palette of) your project using D3.js and one of the tools discussed.

7) Interaction Techniques

Reading:
Chapter 11 “Manipulate View”

Lectures:
Adding interaction with Unidirectional Data Flow
Using UI elements to control a scatter plot
Panning and Zooming on a Globe
Adding tooltips
Assignment (Project):
Add one of the interaction techniques discussed to your project using D3.js.

8) Multiple Linked Views

Reading:
Chapter 12 “Facet into Multiple Views”

Lectures:
Small Multiples
Linked Highlighting with Brushing
Linked Navigation: Bird's Eye Map
Assignment (Project):
Combine your 2 visualizations from week 4 with some form of linked interaction.

9) Data Reduction

Reading:
Chapter 13 “Reduce Items and Attributes”

Lectures:
Histograms
Aggregating Data with Group-By
Hexbin Mapping
Crossfiltering
Assignment (Project)
Create a histogram or aggregated bar chart of your project dataset.

10) Focus + Context

Reading:
Chapter 14 “Focus + Context”

Lectures:
Building a Migrant Deaths Dashboard: https://gmdac.iom.int/map-tracking-migrant-deaths-and-disappearances

Assignment (Project):
Use Focus + Context idiom in your project.

Note: Weekly assignments might be subject to change and will be given in detail week by week.

Grade Determination Breakdown
Percentage:
Assignments: 50%
Final Project, Presentation, paper preparation: 30%
Class Participation: 10%
Test and Quiz: 10%
Course incompletes may be granted if the major part of the course is completed; however, no additional credit can be given for missed class discussions or teamwork beyond the end of the course. In addition, in the case of an incomplete, the student is responsible for handing in the

final work within the CCNY required timeframe. After this time, an incomplete grade changes to a failing (F) grade.

Assignments

We will have weekly or biweekly assignments, due by the end of the week. Submission of the assignments will usually be inside the Blackboard online system.
Many assignments will involve submission of a link to your work in an external system such as GitHub.

Late Work Policy

Late work will be accepted, with a 10% grade penalty for each day that it is late.

Resubmissions based on initial grading and feedback will be re-graded if submitted before the deadline. You may re-submit as many times as you like before the deadline. After the deadline for an assignment, it will only be graded once and the grade will not be updated after subsequent resubmissions. Please submit a few days ahead of the deadline so you can get feedback, resubmit based on feedback, and maximize your grade.

Class Participation Expectations and Criteria

Our Slack channel will be used as participatory space for discussion, like a classroom. Students are encouraged and expected to actively participate in discussions there. Sometimes, assignments will be discussed on Slack. This may involve sharing your work with the class, posting your response to a specific question, or responding to the posts of others (peer feedback). Each assignment will include specific grading criteria regarding participation.