Computation and Visualization for Analytics (Spring 2021)

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Overview

This course covers the basics of data visualization. It introduces students to static and interactive visualization charts and techniques that reveal information, patterns, interactions, and comparisons by paying attention to details such as color encoding, shape selection, spatial layout, and annotation. Based on these fundamentals of analytical thinking, the course then focuses on data visualization techniques and the use of current software tools that support data exploration, analytics-based storytelling and knowledge discovery, and decision-making in engineering, healthcare operations, manufacturing, and related applications.

Course Objectives

To understand the principles and methodologies of visualization
To learn how to explore data using visualization tools
To design, validate and critique visualizations
To implement interactive data visualizations

Course Topics

Modern data structures
Data cleaning and data wrangling
Introduction to data visualization
Visual Encoding (Mapping of data variables using visual elements)
Visualizing amounts (comparison, part to whole)
Visualizing distributions and relationships
Visualizing trends (time component)
Map based visualizations (spatial component)
Working with colors
Network visualizations
Text visualizations
Interactive visualizations
Dashboards and storyboards

Reference Books

1. R for Everyone: Advanced Analytics and Graphics (2nd Edition) by Jared P. Lander
2. Wickham, H., & Grolemund, G. (2017). R for Data Science: Import, Tidy, Transform, Visualize, and Model Data (1 edition). O'Reilly Media
3. Wickham, H. (2016). ggplot2: Elegant Graphics for Data Analysis (2nd ed.). New York, NY:Springer
4. Healy, K. (2018). *Data visualization: a practical introduction*. Princeton University Press
5. Edward R. Tufte. The Visual Display of Quantitative Information. Graphics Press, 2 ed
6. Munzner, T. (2014). *Visualization analysis and design*. CRC press.
7. Few, S. (2009). *Now you see it: simple visualization techniques for quantitative analysis* (No. Sirsi) i9780970601988).
8. Tufte, E. R., Goeler, N. H., & Benson, R. (1990). *Envisioning information* (Vol. 126). Cheshire, CT: Graphics press.
9. Cairo, A. (2016). *The truthful art: Data, charts, and maps for communication*. New Riders.
10. Ware, C. (2010). *Visual thinking for design*. Elsevier.

Software

The course will use two main softwares for data visualization. 1) R (R studio) and, 2) Tableau. Below are the instructions to install the software

Tableau: https://www.tableau.com/academic/students

Following the link above students can obtain a free version of Tableau. They will ask you to fill out a form with proper institution email. They will also ask for a copy of the transcript. The student can provide a screenshot of their transcripts. Once the process is completed, they will provide a license which the students can use to activate the downloaded Tableau software. The students are urged to do this activity ASAP since it may take up to two weeks to verify all the student information

Install R and R Studio for Mac: Follow the instructions in the link below to install R and R Studio for Mac. All the steps remain the same as shown in the video except the R and R studio version.

https://www.youtube.com/watch?v=EmZqlcKkJMM&feature=emb_logo

Install R and R Studio for Windows: Follow the instructions in the link below to install R and R Studio for Windows. All the steps remain the same as shown in the video except the R and R studio version.

https://www.youtube.com/watch?v=8INfvKR4uqw&feature=emb_logo

Mode of Instruction

- The lecture will be synchronous and the instructor will deliver the lecture on ground/online
- The instructor will adopt a hybrid NUflex teaching model for spring 2021. To learn more about NUflex visit https://news.northeastern.edu/coronavirus/reopening/what-is-nuflex/
- For all resources related to on-campus life follow https://news.northeastern.edu/coronavirus/
- The weekly office hours will be conducted via Teams/Zoom by the instructor. The schedule for office hours will be notified later
- For personal interaction with the instructor schedule an appointment s.radhakrishnan@northeastern.edu
- The weekly interactions with TA will happen online via Teams/Zoom. The schedule for TA hours will be notified later
- The lecture and reading materials (if applicable) will be posted before each class
- All the materials will be posted in Canvas LMS

Course Evaluation

- Assignments (**30%**) (6 assignments)
- Quiz (**20%**) (5 quizzes)
- Hackathon (**10%**)
- Final Project (**30%**) (project proposal = 30%, project progress presentation = 30%, final project presentation = 30%, project documentation = 10%)
- Class Participation (**10%**)

Schedule

Assignment = A, Project = P, Quiz = Q, Hackathon = H

Date	Topics Covered	Post Date	Due Date
01/19	Visual analytics, jobs, schedule, expectations		
01/22	Modern data structures using R		
01/26	Data cleaning and data wrangling		
01/29	**Lab:** Data wrangling using R - Part 1		
02/02	**Lab:** Data wrangling using R - Part 2	A1	
02/05	**Lab:** Tableau		
02/09	Introduction to data visualization		A1
02/12	Visual encoding	A2	
02/16	Visualizing amounts (comparison, part to whole)	Q1 (**Topic:** Introduction to data vis, visual encoding)	
02/19	**Lab:** Visualizing amounts (comparison, part to whole)	A3	A2
02/23	Visualizing distributions and relationships	Q2 (**Topic:** Visualizing amounts (comparison, part to whole))	P1 (Project proposal)
02/26	**Lab:** Visualizing distributions and relationships	A4	A3

03/02	Visualizing trends	Q3 (**Topic:** Visualizing distributions and relationships)	
03/05	**Lab:** Visualizing trends	A5	A4
03/09	Map based visualizations	Q4 (**Topic:** Visualizing trends)	
03/12	Map based visualizations		A5
03/16	**Lab:** Map based visualizations		
03/19			P2 (Project progress presentation)
03/23			P2 (Project progress presentation)
03/26	Network visualization	A6, Q5 (**Topic:** Map based visualizations)	
03/30	**Lab:** Network visualization		
04/02	Text visualization		A6
04/03		H	
04/04			H
04/06	Interactive visualizations		
04/09	**Lab:** Interactive visualizations		
04/13	Building dashboards and storyboards		
04/16	**Lab:** Building dashboards and		

	storyboards		
04/20			P3 (Final project presentation)
04/23			P3 (Final project presentation)
04/27			P4 (Project documentation)

Assignments and quizzes are individual submissions. Hackathon and final project are group endeavor (group of 3).

Assignments focus on improving the technical skills of the students. The assignments will help the students gain expertise in using the visualization tools and apply the visualization concepts to real world applications. Unless specified, all assignments are due for submission at 11:59pm on the day they are due. Late submission of homework will receive a penalty. For two-day delay, grades will be cut by 10%. Beyond two days past the deadline, the submission will not be accepted.

Quizzes test students' understanding of data visualization concepts. The first 15 minutes of the class will be devoted to answering the quiz questions.

Hackathon will test the ability of students to extract visual insights from real world datasets. The dataset and goals will be provided to the students on the day of hackathon. The data may need preprocessing and the insights from the data must be presented in the form of visualizations.

Final Project will require the students to create an interactive dashboard. The students are expected to select a topic of interest and collect the relevant data. The dashboard should contain the visual elements that allow the users to interact and gain insights from the data.

Recording of Classes
Classes will be recorded to enable all students to review material covered in synchronous classes. Please contact me if you have any concerns.

Rules of Engagement
1. Attendance is mandatory. Non-attendance will be penalized
2. Students must be camera ready for each lecture
3. Students are expected to sort out technology related issues before the lecture

Academic Integrity
A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to http://www.northeastern.edu/osccr/academic-integrity-policy/ to access the full academic integrity policy.

Student Accomodations
Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit
http://www.northeastern.edu/drc/getting-started-with-the-drc/.
Diversity and Inclusion
Northeastern University is committed to equal opportunity, affirmative action, diversity and social justice while building a climate of inclusion on and beyond campus. In the

classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration and an awareness of global perspectives on social justice. It is my intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity that students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic background, family education level, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.
Please visit http://www.northeastern.edu/oidi/ for complete information on Diversity and Inclusion.

Title IX
Title IX of the 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.
In case of an emergency, please call 911.
Please visit www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus