Northeastern
College of Engineering

INFO 7374 ST Data Visualization

Course Information

Course Title: Data Science Engineering Methods and Tools
Course Number: INFO 6105
Term and Year: Spring 2025
Credit Hour: 4
Course Format: On-Ground

Instructor Information

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Teaching Assistant Information

Full Name:
Email Address:
Office Hours:

Course Prerequisites

None

Course Description

Current information professionals are faced with an overwhelming amount of information every day. The information is typically unstructured, abstract, large-scale, and needs a more efficient and intuitive way to represent the relationships, reveal the patterns, and/or discover potential opportunities. Information visualization has thus recently gained increasing attention and begun to be widely applied to scientific, engineering, and social disciplines to help people understand and present their information better. Not everyone can intuitively understand the insights hidden in a dataset, which is why data visualization is such an invaluable skill in data science. Within the data science field, data visualization is recognized as the process of displaying data to provide insights that will support better decisions; that is, telling the story behind the data.

"A picture is worth a thousand words". We are all familiar with this expression. It especially applies when trying to explain the insights obtained from the analysis of increasingly large datasets. Data visualization plays an essential role in the representation of both small and large-scale data.

Data visualization is the graphical representation of data in order to interactively and effectively convey insights to stakeholders general. With ever increasing volume of data, it is impossible to tell stories without visualization. Data visualization is an art of how to turn numbers in to useful knowledge. The growing availability of informative datasets and software tools has led to increased reliance on data visualizations across many areas. Data visualization provides a powerful way to communicate data-driven findings, motivate analyses, and detect flaws. The fact that it can be difficult or impossible to notice a mistake within a dataset makes data visualization particularly important.

Data visualization helps to see analytics results presented visually, find relevance among the variables, communicate concepts and hypotheses to others, and even predict the future. Moreover, visualization helps in exploring and explaining patterns and trends. Patterns or anomalies in data can be detected by looking at the graphs. As well, the ability to create data visualizations that are compelling, accurate, and tell a story, is becoming a core skill of any job in the 21st Century. To grab audience's attention, you need to use intentional visuals that are:

- Appropriate
- Legible
- Not misleading

In this course, you'll learn how to use information design and data visualization to tell compelling stories**.** You will learn how to leverage a software tool to visualize data that will also enable you to extract information, better understand the data, and make more effective decisions and use data visualization for storytelling. This course provides a practical approach to learning the theories and techniques of data visualization for data analysis. Python programming lets you learn the art of visualization by offering a set of inbuilt functions and libraries to build visualizations and present data. In this course you will learn functionality for visualization and basics of data visualization and exploratory data analysis using Matplotib and seaborn, a data visualization packages for the statistical programming language Python.

The course will give you the skills you need to leverage data to reveal valuable insights and advance your career. You will study the application of primary drawing functions and advanced drawing functions and will focus on understanding the methods of data exploration by visualization.

The ultimate goal of this course is to provide students with an alternative powerful tool to process information in the specific domain of their own interests. By the end, you'll be able to transform raw data into actionable visualizations and communicate the findings and insights to various stakeholders.

Standard Learning Outcomes

Learning outcomes common to all College of Engineering Graduate programs:

1. *An ability to identify, formulate, and solve complex engineering problems.*
2. *An ability to explain and apply engineering design principles, as appropriate to the program's educational objectives.*
3. *An ability to produce solutions that meet specified end-user needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.*
4. how to take data that at first glance has little meaning and present that data in a form that makes sense to people.
5. how to use some data visualization libraries in Python, namely Matplotlib, Seaborn, and Folium/geopandas for presenting data.

The Information Systems Program accepts students of different engineering backgrounds with minimum programming skills and produces first class Information Systems engineers that operate at the intersection of real-world complexity, software development, and IT management. Graduating students will be able to construct end-to-end advanced software applications that meet business needs.

Specific Learning Outcomes for the Information Systems program:

1. *Create a strong technical foundation through diverse, high-level courses*
2. *Built crucial interpersonal skills needed to succeed in any industry*

3. *Foster a deep level of applied learning through project-based case studies*

Course Schedule/Topics Covered.

Introduction

Visualization vs. Descriptive Statistics

6 Principles of Analytical Design

3 questions to ask yourself next time you see a graph, chart or map

10 Simple Rules for Better Figures

The Art of Effective Visualizations of Multi-dimensional Data

Data/Ink Ratio

Example: Astronomical Companion Figures

Various libraries

- Matplotlib
- Seaborn
- Plotly
- Bokeh

Introduction to Visualization Tools

- Introduction to Data Visualization
- Introduction to Matplotlib
- Basic Plotting with Matplotlib
- Line Plots

Basic Visualization Tools

- Area Plots
- Histograms
- Density and Contour Plots
- Bar Charts

Specialized Visualization Tools

- Pie Charts
- Box Plots
- Scatter Plots
- Bubble Plots
- Correlogram

Advanced Visualization Tools

- 3D plots

- Waffle Charts
- Word Clouds
- Seaborn and Regression Plots

Creating Maps and Visualizing Geospatial Data

- Introduction to Folium/geopandas
- Maps with Markers
- Heat maps
- Choropleth Maps

Seaborn

Plotly API

Interactive features of Plotly graphs

Storytelling with Visualization

Introduction to Dashboard

Grading Scale. Please insert what is applicable for your class. See sample provided below. Additionally, please provide a breakdown of how students' grades will be weighted based on tests, projects, homework, etc.

95-100% A	87-89.9% B+	77-79.9% C+	69.9% or below F
	84-86.9% B	74-76.9% C	
90-94.9% A-	80-83.9%B-	70-73.9% C-	

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.

University Health and Counseling Services

As a student enrolled in this course, you are fully responsible for assignments, work, and course materials as outlined in this syllabus and in the classroom. Over the course of the semester if you experience any health issues, please contact UHCS.

For more information, visit https://www.northeastern.edu/uhcs.

Student Accommodations

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 https://drc.sites.northeastern.edu.

Library Services

The Northeastern University Library is at the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals.

For more information and for education specific resources, visit https://library.northeastern.edu.

24/7 Canvas Technical Help

For immediate technical support for Canvas, call 617-373-4357 or email help@northeastern.edu

Canvas Faculty Resources: https://canvas.northeastern.edu/faculty-resources/

Canvas Student Resources: https://canvas.northeastern.edu/student-resources/

For assistance with my Northeastern e-mail, and basic technical support:
Visit ITS at https://its.northeastern.edu
Email: help@northeastern.edu
ITS Customer Service Desk: 617-373-4357

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.

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 **https://www.northeastern.edu/ouec** for a complete list of reporting options and resources both on- and off-campus.*