Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: CS
Course and Section #: 3820-001
Course Title: Visualization Analytics for Data Science
Credits: 3

Course Description

Introduces visual analytics methods and techniques to support human reasoning and decision-making with data. Presents visualization as the primary tool for recognizing and communicating the significance, meaning and decision-making from massive, dynamic, often conflicting, data. Includes both theoretical foundations and application methods, which presents a comprehensive view of this emerging, multidisciplinary field beyond simply learning to use visualization tools. Includes choosing the right visualization for the questions being asked, the data and the target audience; translating numbers to images; showing data or statistics; showing uncertainty, time trends; presenting results of machine learning techniques; many variables; big data; and maps and networks. Covers pie charts, bar charts, histograms, simple metrics, scatterplots, maps.

Course Attributes

This course has the following attributes:
☐ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☒ Elective Core Requirements in Program
☐ Open Elective
Other: *Click here to enter text.*

Instructor Information

Instructor Name: Nathan Cordner

Student Learning Outcomes

Upon successful completion, students should be able to . . .
1 Choose the right visualization for the question being asked, the data given and the target audience, from among alternatives
2 Filter extraneous data from massive data sets
3 Filter extraneous visual information and interactions from a visualization
4 Create novel visualizations from scratch using a modern toolkit
5 Give a clear, science-based rationale for choices made in creating a visualization

Course Materials and Texts

Course Materials

Textbooks:

- Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks, by Jonathan Schwabish
- Fundamentals of Data Visualization, by Claus O. Wilke (available for free online)

Readings from other online textbooks, articles, or technical documentation may also be assigned.

Computing Resources:

We will primarily use Python to create data visualizations for this course, relying on built-in packages such as numpy, pandas, and matplotlib. We will also use additional Python packages such as seaborn and plotly. A good Python reference for this class is Python for Data Analysis, by Wes McKinney (available for free online).

Most of the coding tutorials will be presented using Jupyter Notebooks, which can be installed locally at https://jupyter.org/ or https://www.anaconda.com/download . Juptyer notebooks can also be run online using https://colab.google/ .

Tableau, another industry-standard visualization software, is available for free at https://www.tableau.com/products/public .

Course Requirements

Course Assignments, Assessments, and Grading Policy

Course Work

Attendance

Class attendance is the expectation for a face-to-face section. For full credit, you must attend at least **90%** of the lectures (no more than 3 classes missed). Your grade will be determined by the percentage of lectures that you do attend (total of 29 possible this semester) out of the total number required (26 this semester). Half-credit may be given for attending part of a class while missing significant portions of the class discussion. No credit will be given for attending without being engaged in class discussion.

Please come see me if there are extenuating circumstances that prevent your attendance for prolonged periods during the semester. **Students who are unable to come to campus at all during class time and are hoping to participate remotely need to make arrangements with me.**

Reading

Readings from the textbooks or other technical documentation will be assigned for each class. To help you prepare for the discussions, a short 2-question survey will accompany each reading assignment. These will be due **at the start of each class**, and must be submitted on Canvas for full credit.

Presentations

Each student will be expected to give two presentations in class during the semester (once during the first half, and once during the second half), limited to 5 minutes in length each. Students will find an existing data visualization or set of visualizations (from the news, from social media, from a blog, etc.) on a topic that interests them. The presentation should discuss what stories the visuals tell, what qualities (both good and bad) the visuals have, and any potential ways to amend or expand on what they found. A short summary of the presentation and sources for the visuals must be submitted on Canvas for full credit.

Good sources of visualizations include

- https://public.tableau.com/app/discover/viz-of-the-day
- https://pudding.cool/

Homework
There will be weekly homework assignments, consisting of written and programming problems. Working with other students is allowed, but you must turn in your own solutions.
Midterm
The midterm exam will be given out around week 6 of the course, and will project-based. You will be given a few data sets to visualize using the tools and principles discussed during the first part of the semester.
Final Project
The final project is an opportunity to apply your data visualizations skills to help solve real-world problems. This will involve a service-learning component. You will work in groups of 2 or 3 students, and either choose or be assigned to a community partner that to work with to identify organizational and community needs. Your group will work with the community partner to collect and prepare data for visualization, and create several visualizations to address real issues within the organization or community. Expect to spend at least 20 hours working on the final project.
To complete the final project (30% of the total grade), you will need to submit (one per group)

- A project proposal, which identifies your group, your community partner, and your initial ideas for collecting and visualizing data (5% of total grade)
- Two progress reports (Report 1 and Report 2), detailing data sets you've collected so far, preliminary visualizations, and how your collaboration with your group's community partner is going (5% of total grade each)
- A final project presentation, showing the rest of the class and any invited community partners the results of your group's work for the semester (10% of total grade)

In addition, each student in the class will submit an individual final project reflection report, stating what you've learned from completing the project and how the experience went working with the community partner (5% of total grade).
Extra Credit
There will be a few opportunities for extra credit during the semester, primarily from filling out mid-course feedback surveys and the end-of-semester SRI.

Time Commitment
You should expect to spend about 1 - 2 hours preparing for each lecture, and about 2 - 4 hours per week on the homework. This translates to a rough time commitment of 4 - 8 hours per week outside of class for 3820, depending on your level of preparation. More time will be needed for the midterm and final project. Please come talk to me if you find yourself regularly exceeding these estimates.

Grading
The final grade is broken down into the following categories
Assignments -- 50% of the total

- Homework: 35% of the total
- Midterm: 15% of the total

Participation -- 20% of the total

- Attendance: 7.5% of the total
- Readings: 7.5% of the total
- Presentations: 5% of the total

Final Project -- 30% of the total

- Reports: 20% of the total
- Presentation: 10% of the total

Letter grades are assigned using the following table

Grade	Minimum Percent
A	93
A-	90
B+	87
B	83
B-	80
C+	77
C	73
C-	70
D+	67
D	63
D-	60
E	0

Late Submission

Homework assignments will be sent out by Wednesday each week, and will be due by the end of the following Tuesday. Assignments will remain open until the end of the Friday following the due date for a roughly 10% deduction per day late (divided into hourly increments). Those wishing to make up homework assignments after the close date will need to come see me.

No late submissions are allowed for missed reading surveys.

Extensions: One to two day extensions will usually be granted, if applied for *before* the due date. Send me a message, tell me your progress on the assignment so far, and let me know how much more time you need. No late penalty. Penalty-free extensions beyond the assignment close date will rarely be granted.
Redemption: I will allow you to earn back points on lost on homework assignments, up to half of what was missed (not including late penalties). For example, if you got 3 out of 5 on a homework then you can get a total of 1 point back. To qualify you must have attempted the problem and turned it in before the close date. You will need to show your understanding of the problem, why your solution was incorrect, how you fixed it, etc. Please do this within two weeks of receiving your grade for a particular assignment.

Required or Recommended Reading Assignments
Lecture Schedule
Subject to change as the semester progresses

Date	Topic	Readings	Assignments
7 January	Course Introduction	Schwabish: Introduction Wilke: Welcome, Preface	
9 January	Introductory Principles	Schwabish chapter 1, chapter 2 pages 29 – 41	
14 January	Additional Principles	Schwabish chapter 2 pages 41 to 52, chapter 3; Wilke chapter 4, chapters 19, 20	Homework 1 Due
16 January	Introduction to Visualization Tools: Matplotlib	Pyplot tutorial: https://matplotlib.org/stable/tutorials/pyplot.htmlLinks to an external site. and https://wesmckinney.com/book/plotting-and-visualizationLinks to an external site. (section 9.1)	
21 January	Introduction to Python Data Management: Pandas	Pandas introduction: https://wesmckinney.com/book/pandas-basicsLinks to an external site.	Homework 2 Due
23 January	Bar Charts	Schwabish chapter 4, pages 67 to 84; Wilke section 6.1	
28 January	Bar Charts with Multiple Data Sets	Schwabish chapter 4, pages 84 to 106; Wilke section 6.2	Homework 3 Due
30 January	Time Charts 1	Schwabish chapter 5, pages 133 to 149; Wilke chapters 13, 14	
4 February	Time Charts 2	Schwabish chapter 5, pages 150 to 178	Homework 4 Due
6 February	Distributions 1	Schwabish chapter 6, pages 179 to 187; Wilke chapter 7	
11 February	Distributions 2	Schwabish chapter 6, pages 187 to 200	Homework 5 Due

13 February	Part to Whole 1	TBD	
18 February	Midterm Review		Homework 6 Due
20 February	Tableau and Final Project Introduction		
25 February	Data Wrangling	TBD	Midterm Due
27 February	Comparing Categories: Beyond the Bar	TBD	
4 March	Geospatial Data 1	TBD	Homework 7 Due, Project Proposal Due
6 March	Geospatial Data 2	TBD	
11 March	**Spring Break**		
13 March	**Spring Break**		
18 March	Distributions 3	TBD	Homework 8 Due
20 March	Relationships 2	TBD	
25 March	Part to Whole 2	TBD	Homework 9, Project Report 1 Due
27 March	Additional Visualizations	TBD	
1 April	Additional Principles and Redesign	TBD	Homework 10 Due
3 April	Non-Static Visuals 1	TBD	
8 April	Non-Static Visuals 2	TBD	Homework 11, Project Report 2 Due
10 April	Data Dashboards 1	TBD	
15 April	Data Dashboards 2	TBD	Homework 12 Due
17 April	Fun Topic (TBD)	TBD	
22 April	Fun Topic (TBD)	TBD	
24 April	**Final Project Presentations**		Final Project Reflection Report Due

General Description of the Subject Matter of Each Lecture or Discussion

- Course Introduction – overview of data visualization and course policies
- Principles – introduces visualization principles such as perceptual accuracy, preattentive perception, general visualization techniques, small multiples, and ethical concerns
- Tools Introduction (Matplotlib, Pandas) – overview of basic Python tools for visualization and data management
- Bar Charts (1 and 2) – principles of designing bar charts, multiple bar charts, and tools for creating them
- Time Charts (1 and 2) – ways of visualizing time series data, including principles of line charts and tools for managing time data
- Distributions (1 and 2) – introduction to histograms and visualizing statistical distributions; covers visualizing error in data sets
- Part to Whole 1 – introduction to pie charts and related charts
- Midterm Review – overview of topics covered in the course so far
- Tableau Introduction, Data Wranging – covers additional tools for visualization for the final project, discusses how to deal with potential issues in real-world data
- Bar Charts 3 – advanced discussion of alternatives to the bar chart
- Geospatial data – visualizing data on maps and tools for doing so (folium, geopandas)
- Other advanced visualizations (Distributions 3, Relationships 2, Part to Whole 2) -- alternative visualizations for common charts like histograms, scatterplots, and pie charts
- Redesign principles – case studies of reworking visuals to improve them or highlight a new story
- Non-static visuals – creating online interactive visuals
- Data dashboards – creating visuals that incorporate real-time data updates
- Fun topics – additional class discussions based on student interest and needs for their final projects

Required Course Syllabus Statements

Generative AI
Students should use AI tools like ChatGPT as if it were a person. If asking another person to do task X is cheating, then asking ChatGPT and similar tools is cheating. If not, then not.

Using Remote Testing Software
☒ This course does not use remote testing software.

☐ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities

Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity

At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. 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, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX

Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation

UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.

To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.