ITCS 4122/5122 – Visual Analytics (Fall 2018)

Instructor:	Dr. Gabriel Terejanu (Dr. T)	Time:	W 2:30PM-5:15PM
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Course Objective

The course introduces key design principles and techniques for visual analytics. Visual analytics combines data analysis and interactive visualizations for an effective understanding and decision making when working with big data. The course introduces a unified framework to data visualization and a set of specific guidelines based on mechanisms of perception to facilitate the design of effective visualizations. The data visualization topics will be paired with data analytics tools such as unsupervised and supervised learning to improve knowledge discovery and decision making. After the completion of this course, students will be able to create effective visualizations using a structured approach, evaluate and improve data analysis and visualizations, create interactive web-based visualizations, and use storytelling principles for effective communications. This course has a significant project oriented component. Students will be divided in teams to develop visualization products based on real data.

Prerequisite

Students should have basic knowledge in linear algebra and probability theory, and be able to program using a high-level language such as Python and JavaScript to complete homework assignments.

Some Recommended Books – research papers and slides will be provided in the class

1. Tamara Munzner. *Visualization Analysis and Design*. CRC Press, 2014
2. Colin Ware. *Information Visualization: Perception for Design.* Morgan Kaufmann, 2013
3. Matthew O. Ward, Georges Grinstein, Daniel Keim. *Interactive Data Visualization: Foundations, Techniques, and Applications*. CRC Press, 2015, 2nd edition

Lecture Notes/Assignments/Readings

Students will spend approximately 150 minutes of instructional time during the 15 week session using CANVAS or other web technologies, where lecture notes, homework assignments and additional material will be available on CANVAS. You will be responsible for downloading them to prepare for class and complete assignments.

Student Work and Grading

1. (30%) Homework assignments (~ 5 assignments)
2. (15%) Announced quizzes (~ 3 quizzes)
3. (20%) Midterm project presentation – peer evaluation
4. (20%) Final project presentation – peer evaluation
5. (15%) Ad-hoc attendance and participation based on peer feedback

Difference between Undergraduate and Graduate Work

Graduate students are assigned additional work in homework assignments.

Grades

A (90-100%), B (80-90%), C (70-80%), D (60-70%), F (0-60%)

Tentative Schedule

Week 1	Foundations of Visual Analytics. Visualization Aspects (exploration, interactivity, effectiveness). Machine Learning Aspects (supervised and unsupervised learning, generalizations). Data Wrangling. Hands-on with Tableau and Open Refine.
Week 2	Project Description. Data Visualization Analysis Framework (what data, why use visualization, how to construct visual encodings and interactions). Data Abstraction. Task Abstraction. Hands-on with HTML.
Week 3	Data Visualization: Validation. Marks and Channels. Building blocks for analyzing visual encodings. Expressiveness and effectiveness principle. Relative versus absolute judgments. Rules of Thumb. Advice and guidelines for effective data visualization. Hands-on with JavaScript.
Week 4	Data Visualization: Tables. How to arrange tabular data spatially (scatterplots, bar charts, stream graphs, heat maps, parallel layouts, radial layouts). Networks (connection versus matrix view, hierarchy marks). Hands-on with SVG and VEGA.
Week 5	Data Visualization: Spatial Data (scalar fields, vector fields, tensor fields). Color (effective color maps). Hands-on with VEGA and D3.
Week 6	Examples and dashboards in D3. Introduction to Python and Scikit-learn.
Week 7	**Midterm Proposal Presentations**
Week 8	Supervised Learning: Decision Trees and Linear Models for Regression. Hands-on with Scikit-learn.
Week 9	Supervised Learning: Linear Models for Classification, Neural Networks for Regression and Classification. Convolutional NNs. Hands-on with Scikit-learn.
Week 10	Supervised Learning: Support Vector Machines. Combining Models. Hands-on with Scikit-learn.
Week 11	Visualizing High Dimensional Data. Dimensionality Reduction/Feature Extraction – PCA, CUR and Fisher Linear Discriminant. Hands-on with Scikit-learn.
Week 12	Unsupervised Learning: Clustering Algorithms – Hierarchical Clustering, K-mean, CURE, Gaussian Mixture Models, Spectral Clustering. Hands-on with Scikit-learn.
Week 13	Interactivity: Manipulate Views and Facet into Multiple Views. Embed: Focus+Context. Hands-on with D3 and VEGA.
Week 14	*Storytelling: The Next Step for Visualization* by Kosara and Mackinlay. Uncertainty and Data Visualization.
Week 15	**Final Presentations and Reports**

Team Policies and Expectations

If a team member refuses to cooperate on the project, his/her name should not be included on the completed work. If the non-cooperation continues, the team should meet with the instructor so that the problem can be resolved, if possible. If no resolution is achieved, the cooperating team members may notify the uncooperative member in writing that he/she is in danger of being fired, sending a copy of the memo to the instructor. If there is no subsequent improvement, they should notify the individual in writing (copy to the instructor) that he/she is no longer with the team. The fired student should meet with his/her instructor to discuss options. Similarly, students who are consistently doing all the work for their team may issue a warning memo that they will quit unless they start getting cooperation, and a second memo quitting the team if the cooperation is not forthcoming. Students who get fired or quit must find a team willing to accept them as member. As you will find out, group work isn't always easy – team members sometimes cannot prepare or attend group sessions because of other responsibilities, and conflicts often result from differing skill levels and work ethics. When teams work and communicate well the benefits more than compensate for the difficulties. One way to improve the chances that a team will work well is to agree beforehand on what everyone on the team expects from everyone else.

Academic Integrity

Homework assignments are expected to be the sole effort of the student submitting the work. Students are expected to follow the Code of Student Academic Responsibility. Every instance of a suspected violation will be reported. Students found guilty of violations of the Code will receive the grade of F for the course in addition to whatever disciplinary sanctions are applied. **Your source code submission will be checked against plagiarism.**