CS 6965: Advanced Data Visualization
Combine Data Analysis and Machine Learning with Visualization
Course Syllabus, Fall 2019

Instructor: Dr. Bei Wang Phillips
beiwang@sci.utah.edu

Course Information

Meeting Time: Tuesdays, Thursdays, 9:10am - 10:30am
Classroom: FASB 101
Textbook: None
Web page: `http://www.sci.utah.edu/~beiwang/teaching/cs6965-fall-2019.html`

Contact Information:
 Instructor: Bei Wang Phillips
 Office: WEB 4608
 Email: beiwang@sci.utah.edu
 Office Hours: See course webpage for details.

1 Course Description

Data visualization is an integral part of data analysis; think about wine and cheese, they just go hand in hand. In this course, we would discover how new and advanced data visualization tools offer analytics capabilities that can help us understand large and complex data. Large and complex data arise from networks, high-dimensional point clouds, multivariate functions, heterogeneous personal data and ensembles; as such, this course is very much data-driven, as our topics are divided into modules which focus on particular data modality. The objective of this class is to enable the students to become familiar with innovative techniques that combine data analysis with data visualization, from algorithmic and implementation perspectives.

This course in going to focus on using existing libraries and developing new tools to study large complex data, in particular, network data such as social and biological networks, heterogeneous personal data, high-dimensional and multivariate data that arise from science, social studies and business intelligence. The course is heavily project based, with multiple mini-projects and a collaborative final project.

For Fall 2019, the course focuses on **combining data analysis and machine learning with data visualization** to obtain insights.

Suggested Topics: The course will cover (but is not limited to) the following topics:

- High-dimensional data: machine learning and visualization.
- Visualizing large graphs and networks.

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- Topological abstraction and summarization for data visualization.
- Personalized visualization: humanistic approach to data.

2   Learning Outcomes

Successful completion of the course will enable the students to pursue new research directions in data analysis and data visualization; and apply emerging and innovative techniques to data in various application domains.

Upon completion of CS 6965, students will be able to:

- Use data analysis and machine learning to aid the development of visualization.
- Implement prototypes that use visualization to explain machine learning models.
- Apply visualization solutions to real-world data.
- Appreciate the innovative nature of research in visualization.

3   Prerequisites

There are no formal prerequisites for this class. Students, however, will be expected to have basic knowledge of data structures and algorithmic techniques, bachelor-level knowledge in mathematics or computer science, and working knowledge of programming, ideally with Python and/or C++.

The targeted audience for the class includes PhD students, master students and very-motivated upper level undergraduate students. The students are not required to be majoring in Computer Science, but it is preferable that the students have some background in algorithms and/or other data science related courses, and have working knowledge of programming, ideally with Python and/or C++. If you are not sure whether you are qualified to take this class, please email/talk to the instructor.

4   Course Grading

- 4 assignments in the form of mini-projects (60 points, 60%; each project is worth 15 points). These projects are labeled as **Project 1, 2, 3 and 4** respectively in the course schedule.

- 1 final project (40 points, 40%). This is labeled as the **Final Project** in the course schedule.

    - Project proposal (10 points, 10%)
    - Project report (20 points, 20%), including the progress report (5 points) and the final report (15 points)
    - Project presentation (10 points, 10%)

- Additional 10 bonus points may be available in the form of bonus assignment questions.

Scale for assigning letter grades is as follows (based on points). This scale might be curved based on overall class performance, while ensuring fairness to all.
A 100-93 **A-** 93-90
B+ 90-87 **B** 87-83 **B-** 83-80
C+ 80-77 **C** 77-73 **C-** 73-70
D+ 70-67 **D** 67-63 **D-** 63-60
E 60-0

Assignment Policies:

- Assignments are required to be done individually. Final projects can be done in groups. In general, discussing topics is allowed. However, the copying of each others' work is considered cheating and will result in a failing grade.

- There will be a call for assignments to be submitted (see course schedule for details). Assignments must be turned in at the beginning of class (i.e. at the time requested) on the day in which they are due.

- Most assignments should be submitted via Canvas. Each submission typically requires the following components (see each assignment description for details):

  - A PDF file (for project report)

  - A ZIP file for source code (if the assignment includes programming)

  - A URL that allows access to the deployed online software, or a URL that contains a link to a video that captures the software in action (these URLs are to be included in the submitted PDF file)

- Students are expected to submit completed assignments by the due date and time. To get full credit for an assignment, it must be turned in through Canvas by the start of class, specifically 9:10 am. Once the deadline is missed, those turned in late will lose 10% of its total points for each subsequent hour until it is turned in. Therefore, assignments will not be accepted more than 10 hours late, and will be given 0.

- For the portion of an assignment involving programming, if the programs do not execute, no partial points will be given. To demonstrate the execution of the program, a URL that allows access to the deployed online software, or a URL that contains a link to a video that captures the software in action should be provided.

- Please allocate sufficient time for completing the class assignments.

- For assignments (not including the final project), students can have a one-time two-day extension without penalty; please use this exception wisely.

- For assignments, typesetting (Latex, MS Word, ... even a typewriter if you can find one) is required. Assignments deemed unreadable will be rejected at the time of collection; they can be resubmitted, but with the late penalty applied per the previously mentioned policy.

5 Final Project

5.1 Project Description

Your final project can be designed from the perspective of an expert user or from the perspective of a developer. As an expert user, you could use interesting and nontrivial datasets in various application domains (e.g. marketing, scientific simulation, transportation, business intelligence, etc.), and apply emerging and innovative techniques. As a developer, you could develop new software tools or extend existing ones that combine machine learning with visualization. You are responsible to pitch your project idea at a level that is appropriate for your background. Try to challenge yourself, at the same time, be realistic. In the case when you underestimate the difficulty of your project, please make sure that you have something to submit by the due date; choosing a project that is too difficult is not a valid reason for an incomplete.

5.2 Project Team

You will work in a team with two members (forming a team with one member, or a team with more than two members will require the permission from the instructor). You can form the team on your own; or the instructor could make some suggestions based on your submitted CV. Please try to form your project team as early as possible.

5.3 Important Dates

You could submit reports based on various project milestones on or before (as early as possible) the due dates. Each milestone report is due at 9:10 a.m. on its due date; the usual late submission policy applies. The milestones include project team creation, project proposal description, project progress report, project final report and project presentation. Please see course webpage for details.

6 Policies and Guidelines

Please read carefully the School of Computing (SoC) policies and guidelines at:
https://handbook.cs.utah.edu/2019-2020/Academics/policies.php.
This document represents SoC policies and guidelines that the students should be aware of. In addition, graduate students should read policies on Academic Misconduct under http://www.cs.utah.edu/graduate/resources/.

See also the College of Engineering Semester Guidelines at: https://www.coe.utah.edu/students/current/semester-guidelines/. These guidelines contain important dates regarding adding, dropping and withdrawing from classes as well as the College Policy regarding repeating courses.

The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin

Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

University Safety Statement. The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit `https://safeu.utah.edu/`.

Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Undocumented Student Support Statement. Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit `https://dream.utah.edu/`.