Computer Science 5093 — Visual Analytics
Instructor: Chris Weaver
Fall 2024

Overview

Coverage. This course focuses on theory and methods of visualization and the many ways that visualization is used for data exploration and analysis by researchers and practitioners in a wide variety of fields. The first half of the course includes a history of visualization design and application, an introduction to current popular software tools and libraries, a solid grounding in the theory of effective ways to represent and interact with data visually, practical experience with visualization design, and a survey of visualization in practice within the broader context of visual analysis processes. The second half of the course dives into the increasingly wide and deep assortment of known visualization techniques for representing and interacting with space, time, text, graphs, trees, and other kinds of data in science, industry, government, and even personal use. Studying these techniques, we will learn how to design, implement, and evaluate effective visualizations that account for the abilities (and limitations) of people and computers working together for data analysis.

Goals. The primary goals of this course are for students to (1) develop a thorough understanding of visualization theory, methods, and data analysis processes, and (2) apply that understanding to a practical project on a topic of professional or personal interest. The projects are semester-long team efforts and may involve implementation of a new visualization application using existing tools and techniques, evaluation of an existing application's utility and usability, or even development of a entirely new visualization technique.

Format. The seminar format centers on reading, reviewing, presenting, and discussing papers on visualization and related topics. The first half consists of instructor-led presentation and discussion interspersed with demonstrations and tutorials. In the second half, each day will start with a student presentation followed by instructor-guided discussion of the day's readings. Active participation in discussion is expected. A writing assignment will accompany each day's readings to progressively develop peer reviewing skills over the semester. Teams of 2–3 students will carry out a term project focused on building, applying, or assessing visual analytics methods and tools. Teams will present their results at the end of the course and submit a short paper in a format typical of current visualization conference proceedings.

Prerequisites: Permission of instructor. *(The course is designed to be accessible to graduate students outside as well as inside Computer Science. It may also be accessible to undergraduates in Computer Science who are well advanced in their program and self-disciplined enough to take on a reading-heavy and discussion-centric seminar format. To get permission to enroll, contact me to arrange for a brief chat that will help me make sure you have sufficient background and preparation to succeed in the course.)*

General Information

Place: P0207 Sarkeys Energy Center (SEC)
Days: Tuesday+Thursday
Time: 4:30pm–5:45pm (Important: Due to travel, there may be irregularly scheduled meeting times.)

Instructor: Chris Weaver
Office: 241 Devon Energy Hall
Email: cweaver {at} ou {dot} edu
Phone: 405.325.3380 (OU or Canvas email strongly preferred)
Office Hours: Tuesday 3:15pm–4:15pm, Friday 11:00am–12:00pm, and by appointment.

Materials

Class Web Pages:

- Canvas [5093]
- http://www.cs.ou.edu/~weaver/academic/teaching/2024-B-Fall-CS5093/ (basic information only)

Class Schedule: Refer to the *File/Schedule* folder in Canvas for the current version of the schedule. The schedule may change occasionally due to campus closures or other unforeseen circumstances.

Required Textbooks:

James J. Thomas and Kristin A. Cook. *Illuminating the Path: The Research and Development Agenda for Visual Analytics*. IEEE Computer Society, 2005. ISBN: 0-7695-2323-4. **[Available online as a free PDF at https://www.hsdl.org/c/abstract/?docid=485291]**

Required Papers:

We will read a mix of theory, system, and application papers from visualization and related fields. We will also read a couple of interesting meta papers, one on writing good information visualization papers and one on teaching visualization. Each student will also be asked to suggest additional papers from their areas of interest for contribution to the reading schedule. We will cover roughly 50–60 papers in total.

Suggested Readings:

- Jacques Bertin. *Semiology of Graphics: Diagrams, Networks, Maps*. University of Wisconsin Press, Ltd., 1983. **[Quintessential classic. If you work at all with graphics, consider buying a copy.]**
- William Cleveland. *Visualizing Data*. Hobart Press, 1993.
- Richard J. Heuer. *Psychology of Intelligence Analysis*. Central Intelligence Agency: Center for the Study of Intelligence, 1999. **[We might read a chapter or two as part of our required readings, depending on availability of time in our schedule. Available online as free HTML or PDF at https://www.hsdl.org/c/abstract/?docid=2899]**
- Alan M. MacEachren. *How Maps Work: Representation, Visualization, And Design*. The Guilford Press, 2004.
- Tamara Munzner. *Visualization Analysis And Design*. CRC Press, 2014.
- Donna J. Peuquet. *Representations of Space and Time*. The Guilford Press, 2002.
- Ben Shneiderman and Catherine Plaisant. *Designing the User Interface: Strategies for Effective Human-Computer Interaction (6th Edition)*. Addison-Wesley, 2017.
- Edward Tufte. *The Visual Display of Quantitative Information*. Graphics Press, 1983.
- Colin Ware. *Information Visualization: Perception for Design (2nd Edition)*. Morgan Kaufmann, 2004.
- Leland Wilkinson. *The Grammar of Graphics*. Springer-Verlag, 1999.

Evaluation

This course will follow a small seminar format. Every student will be expected to participate **actively** in class, to keep up with the readings, and to make clear and steady progress on a team project. The interrelatedness of visual analysis topics makes keeping up even more essential. You will be required to give a 20 minute presentation of and lead discussion on 1–3 papers (exact number to be determined based on class size and the schedule). You will also be required to write a brief summary plus 2–3 discussion questions (starting around the middle of the semester) or a full review (at the end) of a paper for each class meeting. The contributions to your grade are as follows:

- Team project: 40%
- Individual paper presentations: 20%
- Individual paper summaries/reviews: 20%
- Class participation: 20%

Borderlines grades will be determined by class participation.

Slack Days: You will have 1–3 slack days (exact number to be determined based on class size and the schedule) for summaries/questions/reviews. Using a slack day will entitle you to skip the summaries/questions/reviews for the reading assignment for that day. The day(s) on which you present a paper also automatically count as slack days. *You need not notify me that you want to use a slack day. I set up Canvas to track the missing assignments automatically.* You are still responsible for the readings themselves, as ongoing discussion will draw from past readings.

Due Dates: All assigned materials are due at the beginning of the corresponding class meeting, or as otherwise noted in the assignment instructions and in Canvas. For summaries/questions/reviews there will be no leeway beyond your allowed slack days. Use them wisely.

Project: Teams of 2–3 students will carry out a term project focused on building, applying, or assessing visual analytics methods and tools. At the beginning of the semester, teams will be formed and projects chosen as a function of the development skills and domain analysis expertise of team members. Teams will present their results and submit a short paper with content and style typical of current conference proceedings. Your final project will be due on the day of the final exam.

Grade Summary: I will store all of your grades in the Canvas online grade book. It is your responsibility to verify that the grades on Canvas are correct. If an error is found, bring the graded item to me and I will correct the online entry.

Course Policies

The following set of rules will help keep us all on the same page all semester and help to ensure fair treatment for all students.

Course Web Page: Access the Canvas website using your 4+4 (first four letters of your last name followed by the last four digits of your student number) and your standard OU password. If you have general difficulty with Canvas, please read the online OU IT documentation or call them at 325-HELP. All handouts and assignments will be made available in Canvas. You should check the site regularly. When I update the site with something important, I will post an announcement telling you what has been added and where it is located. You are responsible for things posted on the site after a 24 hour delay or the end of the first following class meeting, whichever occurs first.

Course Announcements: Announcements will be posted in Canvas. It is your responsibility to:

- Set up Canvas to receive notification of course announcements, class and group forum messages, and updates to course content including posting of assignments.
- Make sure that your contact info in Canvas includes an email address that you read regularly. I'll send out at least one class-wide message during the first week of class. If you do not receive this message, it is your responsibility to get the problem resolved immediately.
- Have your email program set up properly so that replying to your email will work correctly the first time. You can send email to yourself and reply to yourself to test this.

If you need assistance in accomplishing any of these tasks, contact OU IT.

Course Communications: The *General Discussion* in Canvas should be the primary method of communication outside of class. This allows everyone in the class to benefit from the answer to your question. If you email me a question of general interest, I may post your question and my answer to the discussion. Matters of personal interest should be directed to email instead of to the discussion, e.g. informing me of an extended personal illness.

Classroom Conduct: Disruptions of class are not permitted. No electronic devices may be used during class except to take notes or as a direct part of class exercises. Examples of disruptive behavior include:

- Allowing a cell phone or pager to repeatedly beep audibly.
- Browsing, listening to music, or playing computer games, regardless of whether they are visible or audible to other class members. (Such activities disrupt YOUR ability to pay attention and participate.)
- Exhibiting erratic or irrational behavior.
- Behavior that distracts the class from the subject matter or discussion.
- Making physical or verbal threats to a faculty member, teaching assistant, or class member.
- Refusal to comply with faculty direction.

In the case of disruptive behavior, I may ask that you leave the classroom and may charge you with a violation of the Student Rights and Responsibilities Code.

Project Code: Your project code and write ups must be written exclusively by you or your group. *Use of any downloaded code or code taken from a book (whether documented or undocumented) is considered academic misconduct and will be treated as such.* Exceptions to this policy (such as a course project that builds on an existing open-source project) may be granted but you **MUST** obtain approval from me first.

Generated Materials: All materials submitted or presented as a part of an assignment must be human generated exclusively by you or your group, except for materials either included with or explicitly required by the assignment instructions. *Use of any automatically generated text, images, code, or other materials (such as from GPT or DALL-E) is considered academic misconduct and will be treated as such.* Exceptions to this policy (such as a course project that builds on an artificial intelligence image generation algorithm) may be granted but you **MUST** obtain approval from me first.

Evaluating the Course: The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these forms are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty uses these forms to improve their own teaching effectiveness. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions.

Incompletes: The grade of *I* is intended for the rare circumstance when a student who has been successful in a course has an unexpected event occur shortly before the end of the course. I will not consider giving a student a grade of *I* unless all three of the following conditions have been met: (1) it is within two weeks of the end of the semester; (2) the student has a grade of *C* or better in the class; (3) the reason that the student cannot complete the class is properly documented and compelling.

University Policies

Reasonable Accommodation Policy: The University of Oklahoma (OU) is committed to the goal of achieving equal educational opportunity and full educational participation for students with disabilities. If you have already established reasonable accommodations with the Accessibility and Disability Resource Center (ADRC), please submit your semester accommodation request through the ADRC as soon as

possible and contact me privately, so that we have adequate time to arrange your approved academic accommodations.

If you have not yet established services through ADRC, but have a documented disability and require accommodations, please complete ADRC's pre-registration form to begin the registration process. ADRC facilitates the interactive process that establishes reasonable accommodations for students at OU. For more information on ADRC registration procedures, please review their Register with the ADRC web page. You may also contact them at (405)325-3852 or adrc@ou.edu, or visit https://www.ou.edu/adrc for more information.

Note: Disabilities may include, but are not limited to, mental health, chronic health, physical, vision, hearing, learning and attention disabilities, and pregnancy-related. ADRC can also support students experiencing temporary medical conditions.

Masking Protocols: The university welcomes masking on campus. See https://www.ou.edu/together for more information.

Copyright Syllabus Statement for In-Person or Online Courses: Sessions of this course may be recorded or live-streamed. These recordings are the intellectual property of the individual faculty member and may not be shared or reproduced without the explicit, written consent of the faculty member. In addition, privacy rights of others such as students, guest lecturers, and providers of copyrighted material displayed in the recording may be of concern. Students may not share any course recordings with individuals not enrolled in the class, or upload them to any other online environment.

Academic Integrity: Cheating is strictly prohibited at OU because it devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the *Student's Guide to Academic Integrity* at https://www.ou.edu/integrity/students.

All work submitted for an individual grade (or group grade), such as a homework or project assignment, should be the work of that single individual (or group), not their friends, a tutor, or other form of outside help. On examinations and quizzes you will never be permitted to use your notes, textbooks, calculators, or any other study aids. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree, but yours, too. Be aware that it is my professional obligation to report academic misconduct, which I will not hesitate to do. Sanctions for academic misconduct can include expulsion from the University and an F in this course, so don't cheat. It's simply not worth it.

Religious Observance: It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty.

Title IX Resources and Reporting Requirement: The University of Oklahoma faculty are committed to creating a safe learning environment for all members of our community, free from gender and sex-based discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking, in accordance with Title IX. There are resources available to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you have (or someone you know has) experienced any form of sex or gender-based discrimination or violence and wish to speak with someone confidentially, please contact OU Advocates (available 24/7 at 405-615-0013) or University Counseling Center (M-F 8 a.m. to 5 p.m. at 405-325-2911).

Because the University of Oklahoma is committed to the safety of you and other students, and because of our Title IX obligations, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are

mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. You may also choose to report directly to the Institutional Equity Office. After a report is filed, the Title IX Coordinator will reach out to provide resources, support, and information and the reported information will remain private. For more information regarding the University's Title IX Grievance procedures, reporting, or support measures, please visit Institutional Equity Office at 405-325-3546.

Adjustments for Pregnancy/Childbirth Related Issues: Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact the Accessibility and Disability Resource Center at 405/325-3852 and/or the Institutional Equity Office at 405/325-3546 as soon as possible. Also, see the Institutional Equity Office FAQ on Pregnant and Parenting Students' Rights for answers to commonly asked questions.

Mental Health Support Services: Support is available for any student experiencing mental health issues that are impacting their academic success. Students can either been seen at the University Counseling Center (UCC) located on the second floor of Goddard Health Center or receive 24/7/365 crisis support from a licensed mental health provider through TELUS Health. To schedule an appointment or receive more information about mental health resources at OU please call the UCC at 405-325-2911 or visit University Counseling Center. The UCC is located at 620 Elm Ave., Room 201, Norman, OK 73019.

Emergency Protocol: During an emergency, there are official university procedures that will maximize your safety. If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather:

1. Look for severe weather refuge location maps located inside most OU buildings near the entrances.
2. Seek refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building.
3. Go to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows.
4. Get in, Get Down, Cover Up
5. Wait for official notice to resume normal activities.

Additional Weather Safety Information is available through the Department of Campus Safety.

The University of Oklahoma Active Threat Guidance: The University of Oklahoma embraces a Run, Hide, Fight strategy for active threats on campus. This strategy is well known, widely accepted, and proven to save lives. To receive emergency campus alerts, be sure to update your contact information and preferences in the account settings section at https://one.ou.edu.

- RUN: Running away from the threat is usually the best option. If it is safe to run, run as far away from the threat as possible. Call 911 when you are in a safe location and let them know from which OU campus you're calling from and location of active threat.
- HIDE: If running is not practical, the next best option is to hide. Lock and barricade all doors; turn of all lights; turn down your phone's volume; search for improvised weapons; hide behind solid objects and walls; and hide yourself completely and stay quiet. Remain in place until law enforcement arrives. Be patient and remain hidden.
- FIGHT: If you are unable to run or hide, the last best option is to fight. Have one or more improvised weapons with you and be prepared to attack. Attack them when they are least expecting it and hit them where it hurts most: the face (specifically eyes, nose, and ears), the throat, the diaphragm (solar plexus), and the groin.

Please save OUPD's contact information in your phone. NORMAN campus: For non-emergencies call (405) 325-1717. For emergencies call (405) 325-1911 or dial 911. TULSA campus: For non-emergencies call (918) 660-3900. For emergencies call (918) 660-3333

Fire Alarm/General Emergency: OU Fire Safety on Campus. If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates:

1. LEAVE the building. Do not use the elevators.
2. KNOW at least two building exits
3. ASSIST those that may need help
4. PROCEED to the emergency assembly area
5. ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues.
6. WAIT for official notice before attempting to re-enter the building.

Final Exam Preparation Period: Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's Final Exam Preparation Period policy. Note the provision that "All University laboratory classes and graduate courses are exempt from this policy."

I reserve the right to add, remove, or change any element or policy of this course, including evaluation percentages, at any time and for any reason, within the limits of University policy.