CSE 457A: Introduction to Visualization (Spring 2019)

Instructor  Alvitta Ottley (alvitta at wustl)
TAs         Xuanfan Wu (xuanfan.wu at wustl)
Meeting Time Tuesday and Thursday 2:30-4:00 pm
Location    Rudolph Hall, Room 203
Grades      Canvas
Questions   Piazza

Course Description.
Disciplines such as medicine, business, science, and government are producing enormous amounts of data with increasing volume and complexity. This course offers a rigorous introduction to the principles and techniques of data visualization. Topics include design, data mapping, visual perception, and interaction. We cover best practices for designing and building interactive visualization tools for the web, and we gain hands-on experience with designing and developing visualizations. We also learn how to critique visual designs and how to evaluate the systems we build.

Prerequisites: CSE 330S

Books.

<table>
<thead>
<tr>
<th>Visual Thinking for Design by Colin Ware</th>
</tr>
</thead>
<tbody>
<tr>
<td>“All the clanking gears are here: variable resolution image detection, eye movements, environmental information statistics, bottom-up/top-down control structures, working memory, the nexus of meaning, and specialized brain areas and pathways. By the time he’s done, Ware has reconstructed cognitive psychology, perception, information visualization, and design into an integrated modern form. This book is scary good.”</td>
</tr>
<tr>
<td>- Stuart Card, Senior Research Fellow, and manager of the User Interface Research group at the Palo Alto Research Center</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interactive Data Visualization for the Web by Scott Murray</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Explaining tricky technical topics with aplomb (and a little cheeky humor) is Scott Murray’s forte. If you want to dive into the world of dynamic visualization using web standards, even if you are new to programming, this book is the place to start.”</td>
</tr>
<tr>
<td>- Mike Bostock, creator of D3</td>
</tr>
</tbody>
</table>
Aims.

Aims of the course are:

- Design and develop visualization solutions for exploring real-world data
- Develop an appreciation for visualization research and practice
- Improve presentation skills
- Improve individual and collaborative problem-solving skills

Objectives.

Upon completing this course, you will be able to:

- Understand the basics of visualization design and research
- Gather and "wrangle" data from the wild
- Design and create professional and aesthetic web-based, interactive data visualizations using HTML5, CSS, JavaScript, SVG, and D3.js
- Produce high-quality visualization tools that aid data exploration and decision-making
- Prepare high-quality documentation and artifacts related to the design process
- Understand concepts of usability and evaluation

Technology.

This class will require the use of D3.js, JavaScript, HTML, CSS, GitHub, and Python (or any other scripting language). These programs will be used to manipulate data and build visualization tools. You may also use other tools such as database management tools, other visualization platforms, etc.

Course Work.

We will meet twice per week. During each class, the first portion will be a presentation and discussion. The second portion the will vary between studio work time and class activities. You should expect at least 5-10 hours per week to work on the various assignments, readings, and the particulars of each phase of the final project.
Assignments.

There will be three programming assignments at the start of the semester.

Studios.

There will be several short in-class studios throughout the semester.

Readings & Quizzes.

We will assign reading assignments to prepare you for the lectures and studios. We expect you to complete the readings before class. At the start of each class, there will be a short online quiz to test your understanding of the readings. Quizzes are 5% of the final grade.

Final Project.

The final project will be a significant focus of the course. The goal of the project is to design and implement a web-based interactive visualization. You will provide the dataset(s) and the questions you need to answer. You will work closely with other classmates in a 2- or 3-person project team.

Grading.

Final grades will be based on the following criteria:

35% Assignments
- 5% Assignment 0
- 10% Assignment 1
- 10% Assignment 2
- 10% Assignment 3

40% Final Project
10% Studios
5% Quizzes
10% In-Class Participation
Late Policy.

We will allow you to turn in your assignment up to 24 hours late with no penalty. After that, we will no longer accept submission under any circumstances.

Academic Integrity Policy

You are welcome to discuss the course’s ideas, material, and homework with others to understand it better, but the work you turn in must be your own (or for the project, yours and your teammate’s). For example, you must write your own code, design your own visualizations, and critically evaluate the results in your own words. You may not submit the same or similar work to this course that you have submitted or will submit to another. Nor may you provide or make available solutions to homework to individuals who take or may take this course in the future.

In homework, you must not use libraries or code provided on the Internet except when explicitly permitted in the instructions. You will be required to include one of the following statements in your README.txt:

- I did not use external resources.
- I used external resources. [followed by a citation list]

In your project, you may use limited parts of code found online, provided its license allows you to re-use it. You are free to use general purpose frameworks or libraries (e.g., Node.js, Bootstrap, JQuery, etc.) You may not use plotting libraries such as plot.ly. You must acknowledge any source code that was not written by you by a proper citation (author, year, title, time accessed, URL) directly in your source code (comment or header) and provide a link to the source. You should also acknowledge sources in a README.txt file if you used whole classes or libraries. You also must include these references visible on your project website.

We will use both manual and automatic methods to check your submissions for plagiarism and will also check against online sources and submissions from previous years. Each violation of the collaboration policy will result in a reduction of one letter grade for the course. You may not use extra credit to make up these lost points.

Effective learning, teaching, and research all depend upon the ability of members of the academic community to trust one another and to trust the integrity of work that is submitted for academic credit or conducted in the broader arena of scholarly research. Such an
atmosphere of mutual trust fosters the free exchange of ideas and enables all members of the community to achieve their highest potential. In all academic work, the ideas and contributions of others must be appropriately acknowledged, and work that is presented as original must be, in fact, original. Faculty, students, and administrative staff all share the responsibility of ensuring the honesty and fairness of the intellectual environment at Washington University. Please make sure you are familiar with the Washington University Academic Integrity Policy, as it will be strictly applied.

Rights and Responsibility.

Sexual Assault.

The University is committed to offering reasonable academic accommodations to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support services and accommodations. If you need to request such accommodations, please direct your request to Kim Webb (kim_webb@wustl.edu), Director of the Relationship and Sexual Violence Prevention Center. Ms. Webb is a confidential resource; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain as confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

If a student comes to me to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if I otherwise observe or become aware of such an allegation, I will keep the information as private as I can, but as a faculty member of Washington University, I am required to immediately report it to my Department Chair or Dean or directly to Ms. Jessica Kennedy, the University’s Title IX Director. If you would like to speak with directly Ms. Kennedy directly, she can be reached at (314) 935-3118, jwkennedy@wustl.edu, or by visiting the Title IX Office in Umrath Hall. Additionally, you can report incidents or complaints to the Office of Student Conduct and Community Standards or by contacting WUPD at (314) 935-5555 or your local law enforcement agency. See: Title IX

You can also speak confidentially and learn more about available resources at the Relationship and Sexual Violence Prevention Center by calling (314) 935-8761 or visiting the 4th floor of Seigle Hall. See: RSVP Center
Bias Reporting.

The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. See: brss.wustl.edu

Mental Health.

Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: shs.wustl.edu/MentalHealth
# Tentative Schedule.

<table>
<thead>
<tr>
<th>Week</th>
<th>Out</th>
<th>Due (Monday)</th>
<th>Lecture (Tuesday)</th>
<th>Studio (Thursday)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Jan 13 - Jan 19</td>
<td>Assignment 0 Design Critique</td>
<td><strong>Introduction</strong> Course Goals, Academic Integrity, Design Critique</td>
<td>Studio 1: Web Dev Tools Introduction to HTML, DOM, CSS, Selectors, and Bootstrap</td>
</tr>
<tr>
<td><strong>Foundations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Jan 20 - Jan 26</td>
<td>Assignment 1 Assignment 0 Design Critique</td>
<td>Design</td>
<td>Studio 2: Intro to Javascript</td>
</tr>
<tr>
<td>3</td>
<td>Jan 17 - Feb 2</td>
<td>Assignment 0 Design Critique</td>
<td>Data Mapping</td>
<td>Studio 3: Intro to SVG</td>
</tr>
<tr>
<td>4</td>
<td>Feb 3 - Feb 9</td>
<td>Assignment 2 Assignment 1</td>
<td>D3</td>
<td>Studio 4: Intro to D3</td>
</tr>
<tr>
<td>5</td>
<td>Feb 10 - Feb 16</td>
<td>Assignment 3 Assignment 2</td>
<td>Color</td>
<td>Studio 5: Enter, Update, Exit</td>
</tr>
<tr>
<td>6</td>
<td>Feb 17 - Feb 23</td>
<td>Assignment 3 Assignment 2</td>
<td>Perception</td>
<td>Studio 6: Linked Views</td>
</tr>
</tbody>
</table>

**Data Types**
<table>
<thead>
<tr>
<th>Date</th>
<th>Assignment</th>
<th>Topic</th>
<th>Studio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 24 - Mar 2</td>
<td></td>
<td>Graphs and Trees</td>
<td>Studio 7: Layouts</td>
</tr>
<tr>
<td>Mar 3 - Mar 9</td>
<td>Assignment 3</td>
<td>Text</td>
<td>Studio 8: Custom Visualizations</td>
</tr>
<tr>
<td>Mar 10 - Mar 16</td>
<td></td>
<td>SPRING BREAK</td>
<td>SPRING BREAK</td>
</tr>
<tr>
<td>Mar 17 - Mar 23</td>
<td>Project Proposal</td>
<td>High Dimensional Data and Sets</td>
<td>Studio 9: Advanced Javascript</td>
</tr>
<tr>
<td>Mar 24 - Mar 30</td>
<td></td>
<td>Storytelling</td>
<td>Studio 10: Javascript Frameworks</td>
</tr>
<tr>
<td>Mar 31 - Apr 6</td>
<td>Prototype 1</td>
<td>Individual Differences</td>
<td>Final Project: Design</td>
</tr>
<tr>
<td>Apr 7 - Apr 13</td>
<td></td>
<td>Visual Analytics</td>
<td>Final Project: Coding Session</td>
</tr>
<tr>
<td>Apr 14 - Apr 20</td>
<td>Prototype 2</td>
<td>User Studies and Evaluation</td>
<td>Final Project: User Studies</td>
</tr>
<tr>
<td>Apr 21 - Apr 27</td>
<td>Final Version, Evaluation, Video</td>
<td>Research</td>
<td>Presentations and Class Wrap-up</td>
</tr>
</tbody>
</table>