INF 385T – Visualization
Spring 2020

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Room: ACB 1.114
Time: Thursdays 15:00-18:00

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Office hours: by appointment

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1 Overview

Visualization is crucial for understanding data. The value of data is its potential to become information, and knowledge, and visualization plays a crucial role in this process. In today’s world, we are collecting vast amounts of data from myriad sources. We increasingly measure more variables about in every field of inquiry from economic, scientific and biological systems, to human behavior phenomena, to health, and to humanities. We collect and analyze data about local, national and global economy, weather and climate effects, traffic in our roads, infection rates and effectiveness of clinical treatments, and even LIDAR scans of archaeological sites. This is allowing us to increasingly move towards establishing better data-driven decision making processes and policies. However, in order to effectively capitalize on the benefits of this data, it is crucial that the users can understand it. Users need to be able to identify patterns and trends, identify interesting variations that allow us to differentiate signal from the noise, understand the phenomena, and infer the underlying processes, and potentially predict future phenomena. This course focuses on understanding the principles and practices for visualizing different large datasets, numeric and textual, structured and unstructured, using different approaches, ranging from 2-dimensional information visualizations, to 3-dimensional scientific visualizations, to visualizations using new platforms such as eXtended Reality (XR). We will explore new ways to use color to facilitate the discovery of interesting phenomena, and we will study alternative Web-based toolkits, desktop products, and headset displays.

2 Objectives

Through this course, students will develop:

- theoretical knowledge of the research areas of Visualization, including information visualization, scientific visualization, and eXtended Reality (XR)
- practical skills for designing, building, and evaluating interactive visualization applications for Visualization Environments that use multiple systems, including: 2D visualizations, 3D visualizations, XR, etc.

3 Course Structure and Organization

This course has three parallel narratives:

- Independent readings
- In-class discussions and presentations
- Mid-semester Project: interactive information visualization (2D)
- Final Project: interactive XR visualization (3D)

All students are expected to complete the weekly reading assignments before class time. Reading assignments include book chapters, research papers, and online tutorials.

ALL students are expected to read and understand ALL assignments, and participate actively in the class discussions
4 Group Work

This course includes both individual work, and collaborative work in groups. Students will form groups of 3-4 members, and complete two projects, producing an interactive visualization application for each of them. The first project will be an information visualization project, in which the students will create a 2D visualization of a dataset. The second project and final project requires students to create a 3D model that the users will be able to explore using XR devices (for example a heads up display for virtual reality, or an augmented reality application running on a phone. For each project, the instructor will provide each group with a dataset. The design and implementation of both projects will allow users to explore and understand the multiple dimensions of the data.

The final project requires considerable time to prepare

This course structure aims to create a learning environment where questions, concepts and skills are discussed, analyzed, and developed collaboratively. This format depends on the participation of all class members. Therefore, all students are expected to:

• Attend all class sessions; if a student misses a class, it is his or her responsibility to obtain all notes, handouts, and assignment sheets.
• Read all material prior to class; students are expected to complete the readings, and participate actively in all class discussions and group activities.
• Submit all assignments fully and on time. Late submissions will not be accepted (in the event of an emergency, students must contact the instructor).
• Educate themselves and their peers. The successful completion of this course and their participation in the information professions depend upon the students’ willingness to demonstrate initiative and creativity.
5 Academic Integrity

University of Texas Honor Code

The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Academic dishonesty, such as plagiarism, cheating, or academic fraud, will not be tolerated and will incur severe penalties, including failure for the course. If there is concern about behavior that may be academically dishonest, consult the instructor. Further information about plagiarism and its consequences can be found at:

http://deanofstudents.utexas.edu/conduct/standardsofconduct.php

6 Documented Disability Statement

Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities at 471-6259 (voice) or 1-866-329-3986 (Video Phone) as soon as possible to request an official letter outlining authorized accommodations.

Please notify me as quickly as possible if the material being presented in class is not accessible (for example, instructional videos need captioning, course packets are not readable for proper alternative text conversion, etc.).

7 Amendments to Syllabus

The instructor reserves the right to make amendments to the syllabus as the semester progresses in order to improve it, and to respond to unexpected events.

8 Reading Assignments

There are two types of reading assignments: papers and books. Most papers are available online. The books include:


The list of all paper assignments is provided at the end of this document
## 9 Important Dates

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Invited Talks</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan-21</td>
<td>Introduction</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Jan-28</td>
<td>General</td>
<td></td>
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<td>3</td>
<td>Feb-04</td>
<td>Best Papers</td>
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<tr>
<td>4</td>
<td>Feb-11</td>
<td>Conceptual Visualization</td>
<td>Jo Wozniak</td>
<td></td>
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<tr>
<td>5</td>
<td>Feb-18</td>
<td>Color, Gestalt</td>
<td>Stephanie Zeller</td>
<td>Interaction of Color: 50th Anniversary Ed.</td>
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<tr>
<td>6</td>
<td>Feb-25</td>
<td>D3 Tutorial</td>
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<td>D3 Tutorial</td>
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<td>7</td>
<td>Mar-4</td>
<td>Data Formats, Wrangling</td>
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<td>8</td>
<td>Mar-11</td>
<td><strong>Info Vis Project</strong></td>
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<td>9</td>
<td>Mar-18</td>
<td>SPRING BREAK</td>
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<td>10</td>
<td>Mar-25</td>
<td>Visualization and Accessibility</td>
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<tr>
<td>11</td>
<td>Apr-01</td>
<td>Scientific Visualization</td>
<td>Anne Bowen</td>
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<tr>
<td>12</td>
<td>Apr-08</td>
<td>Metaverse Chapters 1-9</td>
<td></td>
<td>Metaverse Part 1</td>
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<td>13</td>
<td>Apr-15</td>
<td>Babylon Tutorial</td>
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<td>14</td>
<td>Apr-22</td>
<td>Authoring XR Content</td>
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<tr>
<td>15</td>
<td>Apr-29</td>
<td>Metaverse Chapters 10-Conclusion</td>
<td></td>
<td>Metaverse Part 2</td>
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<tr>
<td>16</td>
<td>May-06</td>
<td><strong>Final Project Day</strong></td>
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10 Grading
The Letter Grade for the course is determined based on minimum grade requirements AND the final numeric score.

Minimum letter grade requirements

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Numeric Score</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>96 - 100%</td>
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</tr>
<tr>
<td>A-</td>
<td>90 - 95%</td>
<td>• Both Projects must be functional and meet all the specifications.</td>
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<tr>
<td>B+</td>
<td>87 - 89%</td>
<td></td>
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<tr>
<td>B</td>
<td>84 - 86%</td>
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</tr>
<tr>
<td>B-</td>
<td>80 - 83%</td>
<td>• Both Projects must function at least partially, meeting the most important specifications, and provide a proof of concept.</td>
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<tr>
<td>C+</td>
<td>77 - 79%</td>
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<tr>
<td>C</td>
<td>74 - 76%</td>
<td></td>
</tr>
<tr>
<td>C-</td>
<td>70 - 73%</td>
<td></td>
</tr>
<tr>
<td>D+</td>
<td>66 - 69%</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>60 - 65%</td>
<td></td>
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</tbody>
</table>

(higher grades must meet all the minimum requirements of lower grades)

Final Numeric Score
The final numeric score for the course is computed based on the following:

- 5% Class Participation (individual)
- 30% Reading Assignments (individual)
- 20% Presentations (individual)
- 20% First Project (group)
- 25% Final Project (group)
- 100% Final Numeric Score
10.1 Class Participation (Individual)
All students are expected to participate in class activities and discussions.

10.2 Reading Assignments (Individual)
The goal of the reading assignments is that every student develops an overarching view of the research areas that contribute to the field of Data and Information Visualization.

Every student is expected to read all the reading assignments, understand them, and participate actively in the class discussions.

Additionally, every student must prepare 3 reading points for every reading assignment. Reading points should identify the strengths and most important lessons learned from the reading.

The class instructor can ask for this points during the class. Failure to prepare this reading points will result in failing the reading assignment for that week.

10.3 Presentations (Individual)
Each student will be assigned to present at least 2 research papers (this will be modified depending on how many students register for the class). Students are expected to present the papers by conducting 3 roles:

1. Hunter-Gatherer – explain the paper’s background and discuss the context: who, where, when, what of authors, project, and research area
2. Reviewer – explain the paper. Specifically, the presenter must:
   a. Present a brief synopsis
   b. Discuss the strengths and weaknesses of work
   c. Identify the major contributions and the take home lessons
3. Lead discussant – guide the in-class discussion based on the discussion points that all the other class members submitted.

It is expected to have a visual presentation support for the hunter-gatherer and reviewer components of the presentation.

10.4 Projects (Group)
Early in the course, students will form groups of 3 or 4 to work in the both course projects. Both projects involve creating a system that visualize a dataset (provided by the instructor), and a short paper describing the system (see section 10.4.4 for details about the papers).

10.4.1 First Project: Information Visualization
In the first project will focus on designing and implementing a functional dashboard for a dataset, to create an interactive visualization system based on two-dimensional graphic representations. The system should be accessible online, using technologies such as D3.js. D3 stands for Data-Driven Documents, it is a JavaScript library for manipulating documents based on data. More information is available at https://d3js.org/

Each group will have a dataset assigned to them by the instructor. If a group wants to use a different dataset, they must first ask for the approval of the instructor.
10.4.2 Final Project: Visualization in XR

For the final project, groups will **design and implement a functional interactive visualization system** that illustrates how their interactive visualizations support the goals of the target users. It is also expected to conduct a basic system evaluation. This system must be created using an eXtended Reality (XR) technology such as Virtual Reality (VR), Augmented Reality (AR), or Mixed Reality (MR). The system can be implemented in platforms such as Babylon.js (https://www.babylonjs.com/) or Unity (https://learn.unity.com/).

Groups have the option to propose their own idea for their final project. However, this idea needs to be approved by the instructor. In case that the group cannot decide on an idea, they will be a dataset by the instructor.

10.4.3 Projects Presentation and Demonstration

The purpose of the presentations and demonstrations is to showcase the students’ capacity to communicate their work in a professional presentation and demonstration session. Each group will have 15 minutes total for both their presentation and demonstration. The demonstration can be a video of the system, or a live session using the system.

10.4.4 Project Papers

The purpose of a paper is to show the students’ capacity to communicate their work in writing. It must be scholarly structured, have a **coherent story and convincing argumentation**.

**Final papers are due on the day of the Project Presentation**

The papers must be written as if it was going to be submitted to a conference such as IEEE Vis, CHI, UIST, etc. As such, papers must follow the specifications set by the particular conference, including using the appropriate format.

Project paper must be 4 pages long, following the professional format of the conference (ACM, or IEEE). Papers must have an appropriate number of references (15+). Groups are encouraged to use the reading assignments as well as additional papers that were not covered in class.
11 Writing Guidelines for Papers and Reports

- **FOLLOW THE FORMATTING GUIDELINES.**
- **Proof read your paper.** Proper spelling and grammar is expected.
- **Write a good abstract.** The abstract should allow readers and reviewers to make a first assessment of the paper quickly. Some people recommend having four sentences in the abstract: The first states the problem. The second states why the problem is a problem. The third is the startling sentence (the discovery, solution, or contribution). The fourth states the implication of the startling sentence.
- **Papers should be self-contained.** All the contents and argumentation should be included in the paper without assuming the existence of appendices. If you wish to provide additional information, you can publish your appendices on the Web and provide a reference to the URL’s in the reference section or as a footnote.
- **Provide a convincing argumentation.** Authors have to present and argue for their ideas in a convincing and coherent manner.
- **Support your claims.** When making claims or presenting design decisions, it is not sufficient to just present them. It is necessary to support your claims, provide references and justify your design decisions.
- **Structure your paper properly.** It is expected that the papers are properly structured into sections and subsections.
- **Provide all required sections**, including Categories and Subject Descriptions, General Terms, and Keywords.
- **Encapsulate concepts into paragraphs.** Avoid having overly long paragraphs. Short paragraphs make the paper more accessible and give readers more places where to stop and think about the concepts and ideas expressed in the paper.
- **The reading should flow.** Do not write the paper as bullet list or telegraph.
- **Avoid having empty sections** between headings and subheadings (e.g., having the heading for section 5.1 immediately after the heading for section 5 with no text in between). This usually means that there is a missing introduction/overview of the whole section, or that the paper can be structured and organized better.
- **Respect the copyright notice space.** You can modify or delete the text of the copyright notice, but respect the space allocated for the notice. When publishing a paper, the copyright notice will be added, shifting the rest of the text, which in turn can cause annoying layout issues (e.g., figures out of place, etc.).
- **Respect the specified length of the papers.** The maximum number of pages is all you get. Documents longer than the maximum page limit are not appropriate. Shorter papers indicate a lack of content.
- **Check your references.** Format your references appropriately.

**Think about the communicative goals for your paper and your target audience**
12 Reading Assignments

General

2. Ben Shneiderman. "The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations."  
   https://ieeexplore-ieee-org.ezproxy.lib.utexas.edu/document/545307

   https://dl.acm.org/doi/abs/10.1145/22949.22950?casa_token=9XzxTbXZWAAAAA:0OK2vsX3zqiUvIIZ1ZPrxhImTvKmJbxR4YszTluP4vsSjxb4kvCU8qAd1PdQqEs0I1ViFGrwj0

Best Paper Awards
4. (Best VAST paper award)  
   https://virtual.ieeevis.org/paper_f-vast-1307.html

5. (Best InfoVis Paper Award)  

6. (Best SciVis Paper Award)  
   https://vcg.seas.harvard.edu/publications/observer-relative-flow

Conceptual Visualization
https://hbr.org/2016/06/visualizations-that-really-work


**Gestalt, Color**


11. Michael Yi. “How to Choose Colors for Your Data Visualizations”
https://medium.com/nightingale/how-to-choose-the-colors-for-your-data-visualizations-50b2557fa335

http://www.scholarpedia.org/article/Gestalt_principles

**D3**

13. Mike Bostock. “D3 Tutorial” (read the whole tutorial)
https://observablehq.com/@d3/learn-d3

**Data Formats, Wrangling**


17. W3Schools. “Jason Tutorial” (Read the 11 Web pages! Click on the “Next button”)  
https://www.w3schools.com/js/js_json_intro.asp

Scientific Visualization


Visualization and Accessibility


**Authoring XR**


