Human-Centered Computing in Visualization: CMSC491/691
COMPUTER SCIENCE AND ELECTRICAL ENGINEERING, UMBC

Syllabus

Location: Room: Janet & Walter Sondheim 111
Time: M/W: 1:00 – 2:15 pm
Instructor: Dr. Jian Chen
E-mail: jichen@umbc.edu
Office Hours: W: 2:15-3:15 pm or Scheduled By Appointment

Faculty assistant (tentative): Guohao Zhang
E-mail: guohaozhang@umbc.edu

COURSE DESCRIPTION
As the world is flooded with increasing amounts of data, human perceptual and cognitive abilities remain relatively constant. Understanding design and human issues in visualization provides one means of using computer to augment and compensate the human limitations. Better visualization improves comprehension, memory, and decision-making.

The goal of this course is to prepare you for a career involving design of visualization and interactive experiences. Students in this course will learn about design in lectures, paper presentations, assignments, in addition to a final project that is related to solving some real-world problems. Do not mistake this for a course in only “computer” development. This course is focused on the rules and methods of visualization design, which remain fairly constant regardless of the technology used to develop a visualization technique. While technology will play a significant role in our studies, technological details will not be our focus. We will talk about technologies and implementations when we encounter them.

Topics include: visual encoding approaches, task analysis, trees and graphs, scalar, vector, and tensor field visualizations, validation approaches, multiple views, two-dimensional and three-dimensional interaction techniques, and tool designs in many application domains.

PREREQUISITES
There is no prerequisite for this class and the class is open to both graduate students as well as advanced undergraduates. Some working knowledge of or willingness to learn, graphics programming tools (technologies!) will be useful.

LEARNING GOALS
• An understanding of the key techniques and theory used in visualization, including graphical perception and techniques for visual encoding and interaction.
• Exposure to a number of common data domains and corresponding analysis tasks, including graphs, medical imaging, networks, multimedia (text, video) data etc.
• Practical experiences building and evaluating visualization techniques (including the most recent crowd-sourcing techniques).
• The ability to read and discuss research papers from the visualization literature.

REQUIRED TEXT

(Thanks Prof. Tamara Munzner for making the pre-print available to us. Access to PDF is password protected. The password will be distributed in class. You must register this class to use the PDF copy. Please do not re-distribute the password. University bookstore will have copies around mid-October.)

EXTRA READINGS
• Information Visualization: Perception for Design, Colin Ware.
  (This book includes many design principles, which are applicable to visualization, written by a leading researcher in the field.)
• Semiology of Graphics: Diagrams, Networks, Maps, Jacques Bertin.
  This is the very first book talking about design. It is still considered the most complete design book today.)
• Readings in Information Visualization: Using Vision to Think, Stuart K. Card, Jock D. Mackinlay, Ben Shneiderman.
  This book includes a set of highly influential papers in (information) visualization)
• OpenGL programming guide (free book)

Course notes will be posted periodically on the course website.

ONLINE RESOURCES
Home page: http://www.csee.umbc.edu/~jichen/courses/.
NOTE: if sending email about a homework, please state in the subject line which assignment and which question the email refers to (e.g., Subject: Hw3: Q1). If you have a technical or homework or general administrative question that is not confidential or personal, please post it on the Pizza forum instead, as that will get you a faster response.

COURSE STRUCTURE
This course includes a combination of lectures, exercises, projects, readings, group discussions and presentations. Participation in all aspects is imperative to your success in this course and will be an integral part of your final grade. At the conclusion of each project, there is a formal group critique in which the work will be discussed. Critiques will provide an opportunity to use formal design vocabulary, see mistakes and find solutions to them, and recognize effective strategies already present in the work.

HOMEWORKS AND GRADING
There will be four written homeworks, one midterm, and one major open-ended term project. Course grades will be based 30% on homeworks (10 % each), 15% on reading summaries, 15 % on the midterm, and 40% on the major term project. Up to 3% extra credit may be awarded for class participation, such as for helping classmates on the Piazza forum.

Your letter grade is mapped to the following category. A: > 90%, B: 80%, C: 70%, D: 60%, F: <60%.
The homework's will contain written questions and questions that may require some programming. In the term project, you will investigate some interesting aspect of human-centric design issues in visualization or apply design principles to a problem that interests you.

The instructor tries very hard to make questions unambiguous, but some ambiguities may remain. Ask if confused or state your assumptions explicitly. Reasonable assumptions will be accepted in case of ambiguous questions.

After you get back a graded homework, you may also be able to regain up to $\frac{1}{4}$ of lost points on the homework by submitting a corrected version of a solution. The corrected solution to homework N should be submitted together with homework N+1 and stapled on top of the N+1 homework.

The purpose of grading is to clearly and accurately pinpoint the strengths and weaknesses of your progress as a visualization designer. In this course you will earn your grade through hard work. An assignment description sheet will accompany each new assignment, detailing the specific requirements. Assignments are due at the beginning of the class period on the assigned due date. Please do not turn in an assignment longer than four days after the specific deadline. Only in the case of extreme situations that are called to our attention in advance can something be arranged. These excuses must be accompanied with proof.

**LATE POLICY**
The final project and the paper summary cannot be turned in late! No exceptions!

For the assignments, you are allowed 4 late days. You can use all 4 late days for one homework, or spread them out. That is up to you. To use a late day, you must inform the TA about it in advance. Late assignments (without informing the TA in advance in the use of the late days) will not receive any credit.

Always plan ahead.

**ATTENDANCE**
Since learning design principles means a lot of exercises and critiques, attendance is vital. There will be quizzes every week if not every class to help you grasp important concepts. Most time, there won’t be a correct or wrong answer. The purpose is to help you understand some concepts.

More than three unexcused absences will result in the reduction of one letter grade from your final average for each additional day missed. Students are expected to arrive on time and remain until class is dismissed. Three tardy arrivals or early departures equal one absence. Attendance will be taken promptly at every class period. Attendance at critiques in several stages of project presentations is mandatory. Absence on critique day will result in a failing grade for the project; a doctor’s note will be required in order to excuse absence due to illness on critique days.

**ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**
If a student has a disability that qualifies under the Americans with Disabilities Act and requires accommodations, he/she should contact the Student Support Services for information on appropriate policies and procedures ([http://sss.umbc.edu](http://sss.umbc.edu)).
ETHICS

- Cell phones should be turned off or to silent mode during class time. If you must take a phone call please step into the hallway to minimize class disruption.
- Please be polite in group discussions.
- I strongly encourage students to form study groups. Students may discuss and work on homework problems in groups. However, each student must write down the solutions independently, and without refereeing to written notes from the joint session. In other words, each student must understand the solution well enough to reconstruct it independently. In addition, each student should write on the problem set the set of people with whom s/he collaborated or explicitly state that “This work is the sole contribution of my own.”
**TENTATIVE SCHEDULE**

*Foundation (1 week)*
*Introduction to evaluation (1 week, 9/3-8)*
*How data appear on the 2D plane or 3D space (2.5 weeks)*
*More design principles (1 week)*
*Interaction techniques (1 week)*
*Presentations (paper reading)*

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<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Assignments</th>
<th>Readings</th>
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<tbody>
<tr>
<td>1</td>
<td>8/27</td>
<td>Introduction</td>
<td>Asgn 1 out</td>
</tr>
<tr>
<td>2</td>
<td>9/1</td>
<td>Holiday</td>
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<td>3</td>
<td>9/3</td>
<td>Evaluation</td>
<td>Project group due</td>
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<td>4</td>
<td>9/8</td>
<td>Crowdsourcing</td>
<td>Asgn 1 due / 2 out</td>
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<td>5</td>
<td>9/10</td>
<td>Foundation on Data</td>
<td>Asgn 2 due / 3 out</td>
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<td>6</td>
<td>9/15</td>
<td>Foundation on Design</td>
<td>Asgn 3 due</td>
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<td>7</td>
<td>9/22</td>
<td>Trees</td>
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<td>8</td>
<td>9/29</td>
<td>Graphs</td>
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<td>9</td>
<td>10/1</td>
<td>Scalar, vector, and tensor</td>
<td>Asgn 1 due</td>
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<td>10</td>
<td>10/6</td>
<td>Color and other encodings</td>
<td>Asgn 2 due</td>
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<tr>
<td>11</td>
<td>10/8</td>
<td>Color and other encodings</td>
<td>Asgn 3 due</td>
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<td>12</td>
<td>10/13</td>
<td>Interaction in 2D</td>
<td>Asgn 4 due</td>
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<td>13</td>
<td>10/20</td>
<td><strong>Proposal presentation (10 min)</strong></td>
<td>Project Proposal due</td>
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<td>14</td>
<td>10/22</td>
<td>Presentation</td>
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<td>15</td>
<td>10/27</td>
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<tr>
<td>16</td>
<td>10/29</td>
<td>Presentation</td>
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<tr>
<td>17</td>
<td>11/3</td>
<td><strong>Project paper design presentation</strong></td>
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<td>18</td>
<td>11/5</td>
<td>Presentation</td>
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<td>19</td>
<td>11/10</td>
<td>Jian @ ieee vis in Paris</td>
<td>Guest presentation</td>
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<tr>
<td>20</td>
<td>11/12</td>
<td>Jian @ ieee vis in Paris</td>
<td>Project prototype due</td>
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<td>21</td>
<td>11/17</td>
<td><strong>Prototype presentation</strong></td>
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<tr>
<td>22</td>
<td>11/19</td>
<td>Presentation</td>
<td>Project pilot study due</td>
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<td>23</td>
<td>11/24</td>
<td>**Pilot result</td>
<td>improvement**</td>
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<tr>
<td>24</td>
<td>11/26</td>
<td>Presentation</td>
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<td>25</td>
<td>12/1</td>
<td>30min final project presentation</td>
<td>Project iteration due</td>
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<td>26</td>
<td>12/3</td>
<td>30min final project presentation</td>
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<tr>
<td>27</td>
<td>12/8</td>
<td>30min final project presentation</td>
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* Depending on the size of the class, there might be two presentations each day. You only need to write a summary from one paper for each class. The summary is due before class. No late submission will be accepted. The instructor will supplement the format of the summary.
DATES FOR ASSIGNMENTS

Experiment with different crowdsourcing models to generate an accurate database of professors in our department, including metadata like degrees, subfield, rank, numbers of papers published, numbers of paper published before tenure and after tenure. Report on patterns you find and plot the patterns to explain to your classmates about your findings. You will each be responsible for seven professors of your choice. You will draw three findings about professors in our department and use visualization approach to explain your findings. We will aggregate the data at the end to make the database public, and publish the lessons learned.

Assignment 2: Out 9/15. Due 9/26 (Experimental approach hunt)
Comb through six evaluation papers from the visualization conference and summarize the design guidelines, identify tasks, methods, interesting design and evaluation methods that we have not learned in class. We will aggregate this information. The instructor will supply these papers.

Assignment 3: Out 9/26. Due 10/10 (Redesign assignment)
Pick one paper published from visualization conference and using the design and evaluation approach learned in class to redesign the tools. For example, you may address different user tasks. You may supply a range of designs and try to implement one of them. The instructor will suggest a few papers and you can pick anything of your own.