INST 760 - Data Visualization

Syllabus

- **Course hours:** Thursdays, 2:00pm-4:45pm
- **Room:** HBK 2119
- **Term:** Fall 2016
- **Instructor:** Dr. Niklas Elmqvist, Associate Professor of Information Studies
  - **E-mail:** elm@umd.edu
  - **Office:** HBK 2117H (second floor of the Hornbake building, South Wing)
  - **Office hours:** Thursdays 11am-12pm (or by appointment)

Introduction

*Data visualization* is the graphical representation of data to aid understanding, and is the key to analyzing massive amounts of data for fields such as science, engineering, medicine, and the humanities. In this graduate course, you will learn how to apply these exciting techniques to practical problems and work on state-of-the-art research and design projects. The course will serve as an introduction to the science, design, and technology of visualization. The course contents will include both theoretical foundations of this interdisciplinary science as well as practical applications of integrated visualization techniques on real-world problems.

Overview and Course Goals

The course will cover topics in data visualization such as perception and cognition, data representations and transformations, visual representations, and visualization techniques for specific data types. The format for the course will be group design activities and discussions, lectures by the instructor, and a semester-long class project. The grading will be based on participation in class, assignments, and class projects. Class projects may be done individually or in groups. Through readings, discussions, and activities, students will establish an understanding of scientific, societal, and commercial aspects of data visualization. Building on this understanding, upon successful completion of the course, students will be able to:

- Understand human, visual, and interactive design issues for creating effective visualizations.
Use existing commercial and open source visualization tools or APIs to analyze basic datasets.

Apply existing techniques from scalar, volume, multidimensional, textual, graph-based, tree-based, and temporal visualization to actual problems and data.

Evaluate a visualization solution based on quantitative metrics such as time and error, as well as more complex and qualitative metrics.

Read, analyze, and present technical visualization papers and systems.

Understand issues and techniques for applying visualization to domains such as medicine, finance, science, engineering, the humanities, and government.

**Grading**

The course outcomes will be assessed through the following mechanisms:

- **Visualization assignments (15%)** - practical assignments on data visualization, including visual and interactive design, cognition, and data transformation.

- **Paper reading and evaluation (15%)** - weekly research paper readings assigned from a list provided by the instructor. Readings will be summarized into a common annotated bibliography shared in the class.

- **Class participation (10%)** - in-class activities such as design sessions, quizzes, and presentations by students.

- **Class project (60%)**: a semester-long visualization project split into several stages, including literature survey, design, alpha release, beta release, final release, presentation, and report.

**Class Project**

The class project is a major part of the course. It is intended to emulate a complete research or design project, including the initial proposal and literature survey and all the way to the implementation, writeup, and presentation. It will have the following grade distribution for submissions throughout the entire semester (out of the 60% total for the project):

- **Project proposal (5%)** - initial ideas on problem and dataset for the project. Must be submitted and approved by the instructor.

- **Literature review (5%)** - studying existing work in the problem domain. Submitted as a literature review section for the final report.

- **Design (5%)** - design document for data transformations, visual representations, and/or interaction design. Submitted as sketches and text (possibly poster).

- **Alpha release (5%)** - initial visualization for the project. Should be a working prototype, i.e. not a mockup or sketch.

- **Beta release (5%)** - complete prototype of the project. Should be demonstrated to the instructor.

- **Paper (10%)** - academic paper on the project. Submitted in the IEEE VIS format [http://junctionpublishing.org/vgtc/Track/vis-menu.html](http://junctionpublishing.org/vgtc/Track/vis-menu.html). Draft can be submitted and given feedback by instructor approximately a week before deadline.

- **Final release (10%)** - final submission of the project, including all files and documentation.
- **Peer reviews (5%)** - conference-style single-blind reviewing of three papers by classmates.
- **Presentation (10%)** - final in-class presentation with slides (and possibly demo) during the last week of classes.

### Class Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Readings &amp; Assignments</th>
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</thead>
</table>
| 1    | 9/1  | **Introduction**  
Course organization  
Introduction to visualization  
The visualization pipeline | Chapter 1 |
| 2    | 9/8  | **Data, Tools, and Methods**  
Data types, models, and representations  
Tools, languages, and libraries  
Open research problems | Chapter 2  
Due: Visualization assignment |
| 3    | 9/15 | **Fundamentals**  
Marks and channels  
Color and color theory  
Human perception and cognition | Chapter 5 |
| 4    | 9/22 | **Multidimensional Data**  
Visual variables and grammars  
Multidimensional visualization  
Applications | Chapter 7  
Due: Project proposal |
| 5    | 9/29 | **Evaluation**  
Evaluation methods  
Nested model for evaluation  
Evaluation patterns | Chapter 4 |
| 6    | 10/6 | **Graphs and Trees**  
Trees and hierarchies  
Graphs and networks | Chapter 9 |
| 7    | 10/13| **Temporal Data**  
Continuous time-series visualization  
Discrete event visualization  
Applications | Chapter 8  
Due: Literature review |
| 8    | 10/20| **Textual Data**  
Words and text visualization |
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<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Due</th>
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<tbody>
<tr>
<td>9</td>
<td>10/27</td>
<td>NO CLASS (IEEE VIS 2016)</td>
<td>Due: Design</td>
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<td>10</td>
<td>11/3</td>
<td>Spatial Data</td>
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<td>Managing space</td>
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<td>Scrolling, panning, zooming</td>
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<td>Map-based and spatial data</td>
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<td>11</td>
<td>11/10</td>
<td>Interaction and Tasks</td>
<td>Chapter 3</td>
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<td>Science of interaction</td>
<td>Due: Alpha release</td>
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<td>Interaction techniques</td>
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<td>Fluid interaction</td>
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<td>12</td>
<td>11/17</td>
<td>Collaboration</td>
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<td>Collaborative visualization</td>
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<td>Co-located collaboration</td>
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<td>Distributed collaboration</td>
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<td>13</td>
<td>11/24</td>
<td>Animation and Storytelling</td>
<td>Chapter 11.3</td>
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<td>Animation</td>
<td>Due: Beta release</td>
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<td>Narrative visualization</td>
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<td>Storytelling methods and examples</td>
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<td>14</td>
<td>12/1</td>
<td>Advanced Topics</td>
<td>Chapter 11</td>
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<td>Visual analytics</td>
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<td>HCI &amp; User Experience (UX)</td>
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<td>Visualization (re)design and principles</td>
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<td>Novel platforms for visualization</td>
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<td>15</td>
<td>12/8</td>
<td>Project Presentations</td>
<td>Due: Final presentation</td>
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<td>Due: Final report</td>
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<td>Due: Final release</td>
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<td>16</td>
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<td>(Exam Week - no exam)</td>
<td>Due: Peer reviews</td>
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**Syllabus Change Policy**

This syllabus is a guide for the course and is subject to change with advance notice.

**Academic Integrity**

Academic dishonesty is a corrosive force in the academic life of a university. It jeopardizes the quality of education and depreciates the genuine achievements of others. Apathy or acquiescence in the presence of academic dishonesty is not a neutral act. All members of the University...
Community - students, faculty, and staff - share the responsibility to challenge and make known acts of apparent academic dishonesty.

Students have a responsibility to familiarize themselves with violations of the Code of Academic Integrity. Among these include:

- **Cheating**: "Intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise."
- **Fabrication**: "Intentional and unauthorized falsification or invention of any information or citation in an academic exercise."
- **Facilitating Academic Dishonesty**: "Intentionally or knowingly helping or attempting to help another to commit an act of academic dishonesty."
- **Plagiarism**: "Intentionally or knowingly representing the words or ideas of another as one's own in an academic exercise."

For more information on the Code of Academic Integrity or the Student Honor Council, please visit [http://www.shc.umd.edu](http://www.shc.umd.edu).

**Students with Disabilities**

The University is legally obligated to provide appropriate accommodations for students with disabilities. The campus' Disability Support Services Office (DSS) works with students and faculty to address a variety of issues ranging from test anxiety to physical and psychological disabilities. If a student or instructor believes that the student may have a disability, they should consult with DSS (4-7682, email dissup@umd.edu). Note that to receive accommodations, students must first have their disabilities documented by DSS. The office then prepares an Accommodation Letter for course instructors regarding needed accommodations. Students are responsible for presenting this letter to their instructors.

**Attendance Policy**

University policy excuses the absences of students for illness, religious observances, participation in University activities at the request of university authorities and compelling circumstances beyond the student's control. Students who miss a single class for a medical reason are not required to provide medical documentation, but students who are absent more than once are responsible for providing various forms of documentation, depending on the nature of the absence.

**Extensions**

If you have to miss a deadline, you should inform the instructor as soon as possible, indicating when you will submit your work. The instructor will try to accommodate your needs. You should use this clause only for extraordinary personal reasons (e.g., personal illness, death in the family, etc.). The general policy is that late work will be deducted 20% of its total grade per calendar day, starting on the same day it is due. It is at the instructor's discretion to accept late work and assign late penalties.
Emergency Preparedness
See the following URL: http://www.umd.edu/emergencypreparedness/

Course Evaluation
Course evaluations are a part of the process by which the University of Maryland seeks to improve teaching and learning. The University Senate approved the implementation of a standard, online, University-wide course evaluation instrument. Each course evaluation contains a set of universal questions, and some are supplemented by questions from specific colleges. Students who leave no "Pending" evaluations in their Evaluation Dashboard each semester can view the aggregate results of a sub-set of universal items online. Across the University, course evaluations are being administered through a web-based system dubbed CourseEvalUM. All information submitted to the Evaluation System is confidential. Instructors and academic administrators can only view summarized evaluation results after final grades have been submitted. Instructors and academic administrators cannot identify which submissions belong to which students. This standardized set of evaluation results provides the University with useful information on teaching and student learning across the campus.

For additional info see Student Fast Facts at https://www.irpa.umd.edu/Assessment/CourseEval/stdt_faq.shtml