INF 454: Data Visualization and User Interface Design

Spring 2016 Syllabus
Day/Times: TBD (4 Units)
Location: TBD

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IT Support: TBD
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Office Hours: TBD

Instructor's Office Hours: TBD; other hours by appointment only. Students are advised to make appointments ahead of time in any event and be specific with the subject matter to be discussed. Students should also be prepared for their appointment by bringing all applicable materials and information.

Catalogue Description

One of the cornerstones of analytics is presenting the data to customers in a usable fashion. When considering the design of systems that will perform data analytic functions, both the interface for the user and the graphical depictions of data are of utmost importance, as it allows for more efficient and effective processing, leading to faster and more accurate results. To foster the best tools possible, it is important for designers to understand the principles of user interfaces and data visualization as the tools they build are used by many people - with technical and non-technical background - to perform their work. In this course, students will apply the fundamentals and techniques in a semester-long group project where they design, build and test a responsive application that runs on mobile devices and desktops and that includes graphical depictions of data for communication, analysis, and decision support.

Short description: Foundational course focusing on the design, creation, understanding, application, and evaluation of data visualization and user interface design for communicating, interacting and exploring data.

Prerequisites:

INF 250 Introduction to Data Informatics

Course Objective

Students will learn:
- The theory and practice of creating effective user interfaces for modern devices ranging from mobile phones to large screen displays.
- To design guidelines for effective human computer interaction and the cognitive science theory that support the guidelines.
- Usability testing techniques to inform the design process and implementation techniques for building responsive user interfaces that adapt to different devices.
- Learn the theory and practice of creating good visualizations.
- In the theory part students will learn how our brains process visual data, and how the way our brains work affects how we perceive visualizations and how we should design visualizations to make them easy to understand.
- Students will get an understanding of which colors and shapes stand out clearly, how to organize visualizations and when images convey ideas more clearly than words.
- Learn guidelines and methods to design effective visualizations and how to implement interactive visualizations for the Web.
- To work in groups.

Class Communication

Blackboard at USC will be used for class communication.

Books and Readings

All books, papers or reports will be available to students online, at the USC bookstore and/or via the USC libraries at http://www.usc.edu/libraries/.

Required Readings:

About Face 3: The Essentials of Interaction Design, by Alan Cooper, Robert Reimann and David Cronin. ISBN: 978-0470084113.

Rocket Surgery Made Easy: The Do-It-Yourself Guide to Finding and Fixing Usability Problems, by Steve Krug. ISBN: 978-0321657299.

The Functional Art: An Introduction to Information Graphics and Visualization, by Alberto Cairo. ISBN: 978-0321834737.

Optional Readings:

The Design of Everyday Things, by Donald A. Norman. ISBN: 978-0465067107

Grading Schema

Quizzes: 20%
Homework Assignments: 30%
Class Project: 30%
Final: 20%

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Total   100%

Grades will range from A through F. The following is the breakdown for grading:

94 - 100 = A	74 - 76 = C
90 - 93 = A -	70 - 73 = C-
87 - 89 = B+	67 - 69 = D+
84 - 86 = B	64 - 66 = D
80 - 83 = B-	60 - 63 = D-
77 - 79 = C+	Below 60 is an F

The graded coursework will consist of four major components:

Quizzes
There will be a quiz most weeks at the beginning of the lecture. The quiz will be 10 minutes and consist of two parts:
1. Questions testing understanding of the material from the previous week.
2. Questions about the readings for the class. The questions are suitable for students who read the required readings.

The worst quiz score will not count towards the grade. There will be no make-ups or rescheduling for any reason (this is why one quiz does not count).

Homeworks
Homeworks will require 1-4 hours to complete. Each student is expected to submit the completed assignment each week. Homeworks are submitted individually and students will receive individual scores. However students may work in groups to complete the tasks. For the last four weeks of the course there will be no homeworks as students are expected to work on the class projects exclusively. Students are expected to attend class having completed the assignments for the period, and be prepared to engage in informed discussions on those materials.

Final Exam
The final exam is cumulative, and will be done on the last day of the program. Students should look at the schedule of finals before planning their vacations, as there is no option for rescheduling.

The class project gives students the opportunity to put into practice the theory and techniques covered in class. The projects are about designing and implementing a complex interactive infographic or data visualization application.

The project is a group project of two/three students. An important objective of the class is to teach students to work in groups, so students cannot work on projects individually.

In addition, groups will be organized into clusters of 3 or 4 groups. The purpose of clusters is to provide a way for groups to critique each others' designs.

Project deliverables will consist of the following artifacts:

1. **Working demo:** students should produce a working demonstration of the system.
2. **Presentation**: students will present their projects to the class using the PechaKucha presentation format (see http://www.pechakucha.org). PechaKucha is a simple presentation format where you show 20 images, each for 20 seconds. One talks along as the images advance automatically. One cannot use bullets in any of the slides.

Course Topics and Schedule

User Interface Design Principles (Textbook: Cooper)
The Functional Art (Textbook: Cairo)

Week	Lecture	Readings	Homework	Exam
1	Introduction to UI design and visualization; why it is important, what are it's uses, examples, course overview, overview of homework/projects.	Cooper chapter 1 and 2 Cairo chapter 1 and 2	**Assignment 1:** Follow Cairo Part I, Ch.1 example on UN Data: find fertility rates with different trends for 3 countries, use Google Sheets to create 2 different charts to show different aspects of this data.	

2	Understanding goal-oriented design; focusing on users not the software; user goals and mental models; implementation models; design process. User categories and their needs, beginners, intermediates, experts; understanding users, qualitative research; stakeholder, subject matter expert, customer and user interviews; conducting interviews, what to ask. Personas, definition, steps to construct them; user goals, experience, end and life goals. Survey of visualization techniques.	Cooper chapters 3, 4 and 5 Cairo chapters 3	**Assignment 2:** Conduct interviews for an example application (e.g., purchasing music), define personas and goals. **Assignment 3:** Prototype and create bubble cloud and slope graphs visualizations of UN fertility rates for 3 years and 9 countries of your choice.	Quiz 1
3	Foundations of design, scenarios and personas; steps to define requirements using personas; from requirements to design, defining sketches; validating designs with scenarios. Introduction to responsive design. Design space of visualizations; the visualization wheel; design trade-offs.	Cooper chapters 6 and 7 Cairo chapters 4	**Assignment 4:** Critiquing visualizations in news media. Find 5 different infographics on the same subject and compare them using the visualization wheel. What do they do well, what do they do poorly?	Quiz 2

4	Principles of interaction design, design values; interaction design patterns; platforms and postures; designing for the desktop; designing for the Web, informational vs transactional Web sites, Web applications. Orchestration and flow, transparent interaction, modeless interaction; examples of good and bad designs; identifying GUI features that slow down use (excise), in navigation, error messages and alerts. Balancing function and esthetics; minimalism; making visualizations memorable.	Cooper chapters 10 and 11. Cairo chapter 5	**Assignment 5:** identify 3 examples of excise in applications you use and propose better alternatives. **Assignment 6:** Design two infographics to show data of your choice. Use different trade-offs in the visualization wheel. One must be a minimalist visualization.	Quiz 3
5	Designing good behavior; addressing excise: putting idle cycles to work, remembering user actions; metaphors, idioms and affordances; problems with metaphors. Visual interface design; relationships, hierarchy, alignment, grid, consistency, visual noise and clutter, simplicity, text, color, standards. The eye and the visual brain; visual queries; implications for design.	Cooper chapter 14 Cairo chapter 6 and 9	**Assignment 7:** identify 3 examples of excise and 3 examples of inappropriate visual design in applications you use and propose solutions. **Assignment 8:** Create a list of queries pertinent to a public transportation system. Answer these queries using a map for a region of the world you are not familiar with. Does the map you chose support answering the questions well? Explain your answers.	Quiz 4

6	Undo, single and multiple; saving the user's work; data entry, data errors, missing data, system responses. Direct manipulation; pointing and clicking; affordances; selection, command ordering and selection, multiple selection; drag and drop, insertion targets; modal tools; cursors, object manipulation Preattentive features and their use in visualizations; Uses of transitions and animations in visualizations. Interactive graphics.	Cooper chapters 19, (optional Cooper chapter 20) http://tableau.com https://www.r-project.org http://d3js.org http://raphaeljs.com http://processingjs.org	**Assignment 9:** identify 3 examples of inappropriate direct manipulation behavior in applications and propose solutions; identify 3 examples in applications where direct manipulation should have been used but wasn't and propose solutions. **Assignment 10:** Analyze three visualizations using the criteria discussed in Cairo chapter 6. Select the worst of these visualizations and suggest 2 redesigns to improve them.	Quiz 5
7	Controls, widgets and dialogue boxes; buttons, selection, checkboxes, radio buttons, list controls, combo boxes; data entry controls, dials, sliders, text boxes, validation; scrolling; menus, tooltips. dialogs, Modal and modeless; uses of dialog boxes; complex dialogs; errors, alerts and confirmations; preventing errors; feedback. Review of popular visualization tools (Tableau, R, Google charts, Raphaël, Processingjs, D3.js).	Cooper chapters 24 and 25 Cairo chapter 8	**Assignment 11:** research and identify 5 examples of inappropriate dialogs and alerts in applications and propose solutions.	Quiz 6

8	Perception, vision, Gestalt principle; visual structure. Reading; design to support reading; color vision; ability to distinguish colors, guidelines for using color; peripheral vision; making messages visible; Implications of color vision for visualizing data; trichromatic and opponent opponent process theory; color coding information. Emphasis and highlighting; color sequences, semantics of color.	Cairo Profiles 1-3	**Assignment 12:** Find 3 different types of visualizations on the Web where colors have been used inappropriately. Explain why and redesign them according to the color principles covered in the course.	
9	Memory, short-term and long-term; implications for interface design; attention, external aids; goal directed behavior; recognition vs recall, implications for interface design. How the brain recognizes complex objects; sets of primitives; scene characterization; visual and verbal thinking; visual and verbal working memory; implications for design;	Cairo Profiles 4-7	**Assignment 13:** Get a bus route with stops, schedule and assume current location of buses. Design a visualization that shows busses on, behind and ahead of schedule.	Quiz 7
10	Learning from experience; actions vs problem solving; implications for interface design; facilitating interface learning, consistency; avoiding user fear; Interface responsiveness; limitations of the human brain; implications for interface design. Depth perception and cue theory: different ways to perceive depth. 2.5D design; linking perception and action.	Cairo Profiles 8-10 Krug chapters 1, 2, 3 and 4	**Work on Project**	Quiz 8

11	Do-it-yourself testing; observing users; organizing your tests; what to test. recruiting users, how many; what to test; organizing your tests, checklists; test setup; conducting the tests. Introduction to maps and projections; using geospatial data. Showing data in maps; adding points and other graphics to maps;	Krug chapters 5, 6, 7 and 8	**Work on Project**	Quiz 9
12	Observing tests; what to record; debriefing users, what to ask; what to take away from tests; making decisions. Finding the main problems; making sure usability is improving; remote testing.	Krug chapters 9, 10 and 11.	**Work on Project**	Quiz 10
13	Course review.	Krug chapters 12, 13 and 14.	**Work on Project**	
14	Project Presentations.		**Project Presentations**	
15	Study Week			
16	**Final Examination**		Per University schedule	Final Exam

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standardshttps://scampus.usc.edu/1100- behavior- violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/ or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online- forms/contact-us. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American

Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information http://emergency.usc.edu/will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Statement on Diversity
The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. I encourage and support the efforts of all of our students to contribute freely and enthusiastically. We are members of an academic community where it is our shared responsibility to cultivate a climate where all students and individuals are valued and where both they and their ideas are treated with respect, regardless of their differences, visible or invisible.