USC VITERBI SCHOOL OF ENGINEERING INFORMATICS PROGRAM
INF 554: Information Visualization

Fall 2017 Syllabus
02:00-5:20pm, Wednesday - VKC 150 (4 Units)

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Instructor's Office Hours: Monday from 12:00 p.m. to 2:00 p.m. – PHE 310. 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

Graphical depictions of data for communication, analysis, and decision support. Cognitive processing and perception of visual data and visualizations. Designing effective visualizations. Implementing interactive visualizations.

Course Objective

Visualizations are graphical depictions of data that help people communicate, understand and make decisions. In this course, students will learn the theory and practice of creating data 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. In the practical part of the course students will learn guidelines and methods to design effective visualizations and how to implement interactive visualizations for the Web. In addition students will learn how to read and discuss research papers from the visualization literature.

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:

Visual Thinking for Design, by Colin Ware. ISBN: 978-0123750303.

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

Interactive Data Visualization for the Web, by Scott Murray. ISBN: 978-1449339739. Online version available: http://chimera.labs.oreilly.com/books/1230000000345

Optional Readings

Envisioning Information, by Edward R. Tufte. ISBN: 978-0961392116.

Crockford, Douglas. JavaScript: The Good Parts: The Good Parts. O'Reilly Media, Inc., 2008. (videos https://www.youtube.com/playlist?list=PL7664379246A246CB)

Statistical Data Analysis: Chang, Winston. R graphics cookbook. O'Reilly Media, Inc., 2012. (http://www.cookbook-r.com)

Grading Schema

Quizzes:	20%
Homework Assignments:	30%
Class Project:	30%
Final:	20%
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. The quiz will be 10 to 20 minutes. Quizzes will include:

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).

Homework Assignments

Homework will be assigned in weeks 1 through 8. 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. Students may work in groups to complete the homeworks however it is expected that coding is done independently by each student. 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 arrive in class each week 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 day that USC schedules it. Students should look at the schedule of finals before planning their vacations, as there is no option for rescheduling.

Class Project

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 an interactive infographic or data visualization application.
The project is a group project of two students. An important objective of the class is to teach students to work in groups, so students cannot work on projects individually (there will be a group of 3 students if necessary).
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 4 items:
1. **Demo:** students should produce a working demonstration of the system and deploy it.
2. **Video:** students should produce a 5-minute (or less) video of their application and upload it to YouTube.
3. **Paper:** students should write a final paper about the project as if they were submitting it to a conference for publication. The papers should be written in the LNCS format (https://www.springer.com/gp/computer-science/lncs/conference-proceedings-guidelines also available on overleaf: https://www.overleaf.com/latex/templates/springer-lecture-notes-in-computer-science/kzwwpvhwnvfj#.WUxUe8aZPVo) and should be at most 5 pages long. The paper should be organized as a publication, stating the problem being addressed, the approach and description of the system, evaluation, related work and references.
4. **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. The images advance automatically and you talk along. You cannot use bullets in any of your slides.

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.

INF554 Course Schedule Fall 2017

Week	Topic	Readings	Homework	Exam
Aug. 23 **Week 1**	Introduction to information visualization; why it is important, what are it's uses, examples, course overview, overview of homework/projects; working with a versioning system.	Murray Chapter 1 & 2 Cairo Part I Chapter 1 & 2 Google charts online manual: https://developers.google.com/chart/	**Assignment 1.** Follow Cairo Part I, Ch.1 example on UN Data. For 10 countries select UN data of your choice. Import the data in Google Sheets. Create 3 different charts to show different aspects of the data. Create a web page with these interactive charts.	Quiz 0
Aug. 30 **Week 2**	Survey of visualization techniques; review of Web Technologies (Web Servers, Web Services, HTML5, DOM, SVG, Style sheets, Ajax, JavaScript, JSON, node.js and development tools).	A Tour through the Visualization Zoo, J. Heer, M. Bostock, V. Ogievetsky. Communications of the ACM, Jun 2010. Murray Chapter 3 & 4	**Assignment 2.** Use UN Data for the same 10 countries of Assignment 1 to create a bubble cloud with Inkscape (http://www.inkscape.org). Recreate the same bubble cloud using using SVG code (i.e., writing SVG yourself not the SVG created by Inkscape!) and using javascript (i.e., dynamically generating the SVG). Use node.js to develop and document your set-up in the README.md.	Quiz 1
Sep. 6 **Week 3**	Form project groups. Nomenclature of popular visualization tools; design space of visualizations; the visualization wheel; design trade-offs; developing interactive graphics; introduction to D3.js; handling data in D3.js; binding data to graphic elements; using callback functions; Javascript Frameworks introduction; tooling; responsive design. Statistics review and visualizing statistics.	Cairo Part I, Chapter 3 Murray Chapter 4 & 5 http://getbootstrap.com http://lesscss.org https://angular.io	**Assignment 3.** Critiquing visualizations in news media. Find 2 different infographics on the same subject and compare them using the visualization wheel. What do they do well, what do they do poorly? Suggest improvements for the things they do poorly. Document your analysis in Markdown.	Quiz 2

Sep. 13 **Week 4**	Statistical graphics: introduction to R programming and ggplot2.	A (very) short introduction to R, Paul Torfs & Claudia Brauer https://cran.r-project.org/doc/contrib/Torfs+Brauer-Short-R-Intro.pdf Wickham, Hadley. "ggplot2." Wiley Interdisciplinary Reviews: Computational Statistics 3.2 (2011): 180-185. http://docs.ggplot2.org/current/	**Assignment 4.** Use R to load, tidy, analyze and visualize a dataset - (data provided).	Quiz 3
Sep. 20 **Week 5**	Balancing function and esthetics; minimalism; making visualizations memorable; drawing DIV elements and SVG shapes; Styling graphic elements; creating a bar chart; creating a scatter plot; adding labels. Introduction to Python, and statistical visualization tools in python.	Cairo Part I, Chapter 4 Murray Chapter 6	**Assignment 5.** From http://data.worldbank.org download Rural population (% of total population) for 20 countries and a year of your choice. In an HTML document, load the data as CSV then using D3 present the data in a table, draw a stem-and-leaf plot a bar chart and a scatterplot of the data. Publish to website.	Quiz 4
Sep. 27 **Week 6**	The eye and the visual brain; visual queries; implications for design; scales, mapping domains to ranges; normalizing scales; dynamic scales; using scales in scatter plot and bar charts; using scales to define axes; creating tick marks; formatting tick tables. Introduction to Raphael.js	Ware Chapter 1 Cairo Part II, Chapter 5 Murray Chapters 7 & 8 http://raphaeljs.com	**Assignment 6.** Using the contras and data from Assignment 1. Use JSON format and D3 to implement a slope graph with labels, a scatterplot and a bar chart complete with axes tick marks and labels.	Quiz 5

Oct. 4 **Week 7**	Preattentive features. Gestalt. updating D3 visualizations; changing data and updating the visuals; smooth transitions and animations. Updating the axes; adding and removing data values; joins. Introduction to Processing.js. Using D3 with a Javascript framework (Angular); re-usable charts.	Ware Chapter 2 Cairo Part II, Chapter 6 Murray Chapter 9 Cairo Part IV Profile 1 to 10 http://processingjs.org https://angular.io	**Assignment 7.** Create a proposal presentation using Sozi (http://sozi.baierouge.fr).	Quiz 6
Oct. 11 **Week 8**	**Project proposals presentations.** Lab & finalize project ideas.	http://sozi.baierouge.fr http://www.pechakucha.org https://bost.ocks.org/mike/selection/ https://bost.ocks.org/mike/nest/ https://github.com/d3/d3/blob/master/API.md#transitions-d3-transition	**Assignment 8.** Select 1 year from the dataset you created for Assignment 1. Load the data in JSON and implement a D3 bar chart complete with axes, tick marks and labels. Implement smooth transitions based on user input to reorder the bars: show all bars in alphabetic order (default), ascending order, descending order, top 5, bottom 5. Update the axes and legend as needed.	Quiz 7
Oct. 18 **Week 9**	Depth perception and cue theory: different ways to perceive depth. 2.5D design; linking perception and action; the “where” pathway in our brains; artificial interactive spaces and cognitive costs; showing data in maps; adding points and other graphics to maps; map projections; working with geospatial data. Introduction to WebGL and Three.js.	Ware Chapter 5 Murray Chapter 12 Murray Chapter 13 http://three.js	**Assignment 9.** Use data from Assignment 11 (one year 10 countries) to build a proportional symbol map and a choropleth map with D3.	Quiz 8

Oct. 25 **Week 10**	How the brain recognizes objects; the pattern-processing machinery; feature extraction, patterns, channels and attention; spatial layout; semantic pattern mappings; feature encoding; interactive visualizations; defining event listeners; behaviors and changing multiple elements on a visualization; grouping SVG elements; animated behaviors.	Ware Chapter 3 Cairo Part II, Chapter 7 Murray Chapter 10	**Work on Project**	Quiz 9
Nov. 1 **Week 11**	Colors and color vision; trichromatic theory; opponent process theory; color channels; color coding information. Emphasis and highlighting; color sequences, semantics of color. D3 color generators; D3 layouts. Principles of design, affordances, signifiers, strengths of verbal and visual media; dietic gestures, presentations & pointing; copycat cells; cartoons and narrative diagrams.	Ware Chapter 4 Murray Chapter 11	**Work on Project**	Quiz 10
Nov. 8 **Week 12**	Visualization papers presentations & discussions. Lab on projects.	Ware Chapter 6, 7 & 8 Cairo Part III, Chapter 8	**Work on Project**	Quiz 11
Nov. 15 **Week 13**	Course review Lab on projects.	Ware Chapter 9 Cairo Part III, Chapter 9	**Work on Project**	
Nov. 22-24	Thanksgiving			
Nov. 29 **Week 14**	**Project Presentations**			
Dec. 2-5	Study Days			
Dec. 8	**Final Examination Per University Schedule: 2-4 p.m.**			