PPUA 5302: Information Design and Visual Analytics

Credit Hours: 4
Term: Spring 2018
Time and Location: Mondays, 5:15 pm - 7:45 pm, Richards Hall 155

Instructor: Dr. Dietmar Offenhuber
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Course Prerequisites

- PPUA 5301 Introduction to Computational Statistics; OR
- DA 5020 Collecting, Storing and Retrieving Data

Basic proficiency using the statistical software package R is required; basic experience with vector graphics editing software such as Adobe Illustrator is recommended.

Course Description

Introduces the systematic use of visualization techniques for supporting the discovery of new information as well as the effective presentation of known facts. Based on principles from art, graphic design, perceptual psychology, and rhetoric, offers students an opportunity to learn how to successfully choose appropriate visual languages for representing various kinds of data in order to support insights relevant to the user's goals. Topics include visual data mining techniques and algorithms for supporting the knowledge discovery process; principles of visual perception and color theory for revealing patterns in data, semiotics, and the epistemology of visual representation; narrative strategies for communicating and presenting information and evidence; and, finally, the critical evaluation and critique of data visualizations. The emphasis of this course is on fundamental representation theories and knowledge discovery techniques for design and analytics.

Course Outcomes

By the end of this course you will be able to:
- Create conceptually and visually consistent data visualizations by applying principles of graphic design and color theory
- Develop and employ a vocabulary of visualization techniques for the representation of quantitative, categorical, temporal, spatial and relational data structures in the context of a specific task
- Apply strategies for the systematic visual exploration of multidimensional and heterogeneous data sets
- Articulate the perceptual advantages and disadvantages of different chart types and mapping techniques
- Apply the relevant criteria for evaluating visualizations and identify common mistakes
- Synthesize, organize and communicate your findings in an easily understandable visual narrative

Course Format & Methodology

This course runs for a total of 15 weeks beginning Jan 8 2018, and ending on April 23 2018, and is delivered in a hybrid format with materials delivered online via the NU Online Blackboard (Bb) system accessible at: https://northeastern.blackboard.com. Each week (or module) contains one or more assignments that you begin on Monday and complete by Sunday of the same week. The modules are organized around specific course topics, and contain readings and multimedia presentations, practice activities that you complete individually or in small groups, and assessments.

Required Textbook & Materials

Meirelles, Isabel. Design for Information: An Introduction to the Histories, Theories, and Best Practices behind Effective Information Visualizations. Rockport Publishers: Beverly, Massachusetts. 2013

In addition, the course will be using the following tools:
- NUVUStudio (http://nuvustudio.com)
- R (https://www.r-project.org) and RStudio (https://www.rstudio.com)
- Adobe Illustrator (Available through your NU college or at a discount (http://www.northeastern.edu/its/student-perks). **Note** that if you are more proficient in an equivalent open-source tool such as Inkscape (https://inkscape.org), you can use that instead.

Participation and Engagement

Because this is course is partially online, your presence in peer-to-peer activities, and your performance on assignments, serve as indicators of your level of engagement and effort throughout the course. Those students who struggle with the material, but take advantage of opportunities provided for instructor help and peer-to-peer mentoring, can be successful in this course.

Communication/Submission of Work

Guidelines for completing and submitting each assignment are posted along with the assignment in Blackboard. Please note that if you are unable to complete an examination within the period it is assigned, a documented compelling excuse (such as hospitalization) is required. Make-up exams will be given during the final examination week.

Course Activities and Assignments

This course includes the following required activities and assignments:
- **Module readings/lessons:** Module readings and multimedia presentations provide the background knowledge, terminology, and practical examples you need in order to understand and correctly apply fundamental course concepts. You are responsible for completing the assigned textbook and other readings and for viewing the presentations and questions included in the lessons. All materials should be completed in the order in which they are presented, and by the due dates specified, within the weekly module.

- **Discussions**: There are only optional discussions for questions only, as you will upload your peer reviews elsewhere. They are available for you to post questions on materials or visualizations. If you have the answer to a classmates' question, feel free to respond. The instructor will be monitoring the discussion as well and will answer any outstanding questions.
- **Visualization Exercises:** For these assignments, throughout the course, you will analyze existing visualization examples and propose ways how to improve them, or you will have to manipulate some data. These will be throughout the course.
- **My Digital Shadow Assignment:** In this assignment, you are asked to investigate and visualize your own "digital shadow" — the traces that you automatically generate by consuming media, communicating with other people via social networks or other tools. This assignment is a significant portion of your grade (25%) so you will work on it over multiple modules and have opportunities for both instructor and peer reviews. More information will be provided in Blackboard.
- **My City in Time and Space Assignment:** In this assignment, you will investigate the complexity of a city through data, its spatial and temporal processes. This assignment is a significant portion of your grade (25%) so you will work on it over multiple modules and have opportunities for both instructor and peer reviews. More information will be provided in Blackboard.
- **Final Project: Data Visualization:** Your final assignment is a free project using a more complex data set of your choosing. You must use course concepts and will integrate feedback you're your other assignments. In this you will use the steps of exploratory analysis, concept sketches, peer review, and iterative improvement for your final project. Final project is a significant portion of your grade (30%) so you will work on it over multiple modules and have opportunities for both instructor and peer reviews. More information will be provided in Blackboard.
- **Peer Reviews:** In addition to sharing your own visualizations, you will be commenting on each other's posts, providing feedback, what you like/dislike, and recommendations. Your peer review grade will be factored into your participation grade.

Course Grading Criteria

Participation (Peer reviews, posts discussions)	10%
Visualization Exercises (throughout the course)	10%
My Digital Shadow Assignment	25%
My City in Time and Space Assignment	25%
Final Project: Data Visualization	30%

Class Schedule / Topical Outline

Please note: for more information about specific assignments and due dates, see instructions within your course site.

Module	Topics	Readings	Assignments / Projects
1 Introduction to Data Visualization Week of Jan 8	Introduction External Cognition Visual Perception Visual Variables	Shneiderman, 1996 Cairo, 2012 Kosara, 2010	Data Variations Visualization critique
2 Perception and Design Principles Week of Jan 22	Perceptual theory Gestalt Laws Color theory Layout and typography	Ware, 2010 Brewer, 2002 Rogowitz, 1996	Project 1 - My Digital Shadow: Introduction
3 Uni- and multivariate data Week of Jan 29	Uni- and multivariate data	Heer, Jeffrey, 2010 Wickham, Hadley, 2010	My Digital Shadow: Concept Sketches Due
4 Animation and Interaction Week of Feb 5	Dynamic and interactive visualization	Yi, Stasko, 2007	My Digital Shadow: Peer Reviews Due
5 Hierarchies Week of Feb 12	Visualization strategies for hierarchical data	Meirelles, 2013 Wurman, 1996 Kosara, 2010	My Digital Shadow: Revision Due
6 Networks Week of Feb 19	Network visualization Constructing and encoding networks	Freeman, 2000 Meirelles, 2013 Barabasi, 2009	Exercise: Hubway data set Project 2 - My City in Time and Space: Introduction
7 Time Week of Feb 26	Time-oriented data Strategies for visualizing time	Aigner et al., 2008 Meirelles, 2013 Wolfram, 2014	My City in Time and Space: Concept Sketches Due
8 Maps Week of Mar 12	Spatial analysis Cartographic Design	Meirelles, 2013 Friendly, 2007	Exercise: Mapping in cartoDB My City in Time and Space: Peer Review Due
9 Spatiotemporal data Week of Mar 19	Strategies for dealing with complex data sets	Meirelles, 2013	My City in Time and Space: Revision Due

10 Text Week of Mar 26	Visualization of unstructured data and text	Meirelles, 2013 Friendly, 2008	Exercise: text analysis Project 3 - Free Project: Introduction
11 Evaluation Week of Apr 2	User-centered design Evaluation techniques	Norman, 2002 Lam et al. 2011	Free Project: Concept sketches Due
12 Rhetoric and Ethics Week of Apr 9	Narrative strategies Visual rhetorics	Drucker, 2011 Tufte, 2006 Segel, E., & J. Heer, 2010	Free Project: User study Due
13 Review Week of Apr 16	Instructor consultations		Time for revisions
14 Final Presentation Week of Apr 23	Final presentation		Free Project: Revision Due

Special Accommodations: If you have specific physical, psychiatric or learning disabilities that may require accommodations for this course, please contact Northeastern's Disabilities Resource Center (DRC) at (617) 373-2675. The DRC can provide you with information and assistance to help manage any challenges that could affect your performance in the course. The University requires that you provide documentation of your disabilities to the DRC so that they may identify what accommodations are required, and arrange with the instructor to provide those on your behalf, as needed.

Honor Code: All students must adhere to the Northeastern University honor code available on the Northeastern web site
(see http://www.northeastern.edu/osccr/academicintegrity/index.html) and the graduate student handbook.