Master of Business Analytics

Data Visualization Fall 2018 Syllabus

Course Information

Instructor Information

Instructor: Nicolas Garcia Belmonte. **Class Time:** Fridays 1:10-3 pm **E-mail:** nico@uber.com

Course Description

Course topics include an overview of vocabulary, theory and principles as well as the algorithms and methods for (structured and unstructured) data visualization. The course will teach students how to present information in an understandable and efficient way for the purposes of data analysis and effective communication of results. The course also empowers students to critically analyze good and bad visualizations, and develop ways to improve on them.

Prerequisite

Basic programming / JavaScript/Web preferred.

Textbook & Course Materials

Required Text

• Information Visualization, Perception for Design, Colin Ware Recommended Texts & Other Readings (via handouts)

- The Visual Display of Quantitative Information
- Visualizing Data
- How Maps Work
- Semiology of Graphics

Course Software Requirements

Web browser, JavaScript editor (Sublime)

Course Structure

This course will be interactive and focuses on hands-on experience, therefore each session will have both theory lecture led by instructor, and a practical lecture consists of lab, discussion, students presentation etc. This course has <u>five sessions</u> and each session emphasizes on a key topic in data visualization.

Class Courtesy:

- Attendance will be taken every class. If you miss 4 hours or more during the quarter, you won't receive a grade higher than B for the class
- No make-up quiz, assignment or project will be organized
- Arrive on time
- It is expected that all class members will treat each other with respect and dignity

Part 2: Student Learning Outcomes

In this course, instructor will lay out theories in the field of data visualization to build a good foundation of data visualization. Practical techniques and tools then are added to the class to ensure students gain hands-on experience. Finally, instructor will teach two most commonly used skills in industry: dashboarding and story-telling. Students will be equipped with both theories and skills to create effective visualizations after completing this course.

You will meet the objectives listed above through a combination of the following activities in this course:

- Attend all sessions
- Complete project assignments
- Participate in-class discussion and student projects

Part 3: Topic Outline/Schedule

Module 1: 9/28

Topic: Introduction to Data Visualization

Reading: Information Visualization, Perception for Design - Colin Ware

Theory lecture: We'll cover principles of Information Visualization, including how to model human perception in Information Visualization, visual illusions, stephen's power law, visual cues for depth, dangers of 3D visualization, mapping from data types to

visual marks and channels, and review a taxonomy of visualizations to lay out the fundamentals for the rest of the course.

Practical Lecture: Introduction to ObservableHQ and D3.

Module 2: 10/5

Topic: Temporal Data Visualization

Reading: TBA

Theory lecture: We'll look at the many ways to represent time in visualizations, plotting time on different axes, working with seasonal data, filtering/brushing, temporal annotations, animation, timelines, progressively working our way towards more advanced techniques such as small multiples, and connected scatterplots. **Practical Lecture**: Time series with ObservableHQ and D3

Module 3: 10/12

Topic: Hierarchical Data Visualization **Reading:**

Theory lecture: In this module, we will be reviewing examples of hierarchical data visualizations along with different visual metaphors to represent hierarchies; the connection between tree and graph visualizations; the data structures behind it; popular layout algorithms, their pros and cons; and recent applications.

Practical Lecture: Radial and treemap drawing w/ Observable and D3.

Module 4: 10/19

Topic: Graphs & Networks

Reading:

Theory lecture: This module is designed to provide students with the foundations necessary for understanding and leveraging the state of the art in graph visualization. We will cover the fundamental concepts of graph, in addition to several graph representations, and the real world applications. We will also study the principle of making effective graph visualization with consideration of visual design and cognitive science. In addition to participating in class discussions, students will have to complete a short programming and data analysis through a graph visualization.

Practical Lecture:

• A sample force-directed graph will be given to the students. Students will need to find insights from the graph by changing the visual mapping through a set of accessors.

Module 5: 10/26

Topic: Storytelling with Data / Data Journalism

Reading: Data-Driven Storytelling (AK Peters Visualization Series): Nathalie Henry Riche, Christophe Hurter, Nicholas Diakopoulos, Sheelagh Carpendale NPR guide to hypothesis-driven design, <u>n.pr/hdd</u>

Theory lecture:

In this part of the lecture we will *understand* the general principles between data-driven stories. What is exploration versus explanation, what is an audience, how does attention and engagement work.

Practical Lecture:

We will then see how one *implements* a data-driven story. We'll present various narrative patterns for different purposes and explore a gallery of examples.

Group Assignment 1:

From a given dataset, design a story and sketch ways to deliver it.

Module 6: 11/2

Topic: Geospatial Visualization

Reading: TBA

Theory lecture:

In this lecture, we will take a look at the theory and practice of visualizing geospatial data with maps. Starting by discussing the theory behind how we understand maps, we will review several common types of mapping visualizations.

Practical Lecture:

We will introduce open softwares to create maps: QGIS and kepler.gl.

Group Assignment 1:

Based a given geospatial dataset, explore insights within the data, build a map visualization with the libraries introduced above.

Module 7: 11/9

Topic: Visualization for Business Intelligence **Reading:**

- The Big Book of Dashboards (<u>http://bigbookofdashboards.com/</u>)
- Information Dashboard Design / Stephen Few
- Now You See It / Stephen Few

Theory lecture:

The theory part of this class is centered around the concept of dashboard, that is: a set of interconnected charts which are organized to support a specific task. We'll see:

- What are the types of questions that business intelligence?
- What are the building blocks of a dashboard?
- How do relationships among charts in a dashboard, or among elements within each charts work?

Practical Lecture:

In this part we'll focus on how to build a dashboard and, specifically, a system of interconnected charts as opposed to a series of independent charts. We'll see how we can build an application that fetches data, represents it, then takes into account user interaction *anywhere* and reflects it *everywhere*.

Module 8: 11/16

Topic: Visualization for Data Science

Reading: Visualizing Data (optional) - Cleveland; Machine Learning for Hackers (chapter 2, 3) - John Myles White & Drew Conway

Theory lecture: The theory class will cover the techniques for using visualization to facilitate statistical analysis and solve data science problems. We will introduce several archetypical charts often used in visual analytics, and how to choose them based on the dataset in question (univariate, bivariate, trivariate, multi-dimensional data). We will also look at examples of advanced usage of these archetypes and real-word applications. **Practical Lecture**: We will be using the techniques introduced in the theory class to analyze a dataset from a real-world data science problem. We will practise using visualizations to answer a series of questions concerning the dataset, and coming up with further questions to delve into.

Module 9: 11/30

Topic: "*Beyond mouse, keyboard and 2d screens*": new mediums for visualization **Reading:**

Theory lecture: In this module, we will go beyond mouse, keyboard and 2D screens, and examine what new forms of computing devices, such as touch, speech, AR and VR, have in store for data visualizations. We will explore the opportunities and challenges of each of these new platforms, identify new product opportunities they open up, and discuss the latest research in these areas.

Practical Lecture: We will rebuild a visualization from an earlier module, but replace the target input from a mouse to multi-touch. We will deconstruct the vis to remove or redesign components that do not translate well to touch, and leverage multitouch gestures to introduce additional features.

Module 10: 12/7

Topic: Building and managing a Visualization team in the industry **Theory lecture**: We will cover how to set a vision and direction for a visualization team in the industry, cover org structure, operating model for the team, set up of success metrics, team building for specialized roles, coaching and calibration, product thinking, how visualization interfaces with product, design and engineering, management skills transferable to visualization and common, practical challenges with building a Visualization team in the industry.

Grading

- 1. Class participation: 15%
- 2. Individual project 20%
- 3. Individual project 20%
- 4. Group assignment 15%
- 5. Final project 30%