MSIS 2629: Dashboards, Scorecard, and Visualization

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Motivation

This course enables you to transform data into **persuasive and evidence-based visualizations**. Visualizations are persuasive if they provide reasons that motivate actions of an intended audience. Visualizations are evidence-based if they are reproducible, functional, and truthful.

To this end, this course introduces the theoretical fundamentals, design principles, and visualization techniques that enable you to create persuasive and evidence-based visualizations. In a data-rich environment, were

decision-makers often drown in data but thirst for insight [1], mastering this course will equip you with a moderate level of data literacy.

Data literacy is the ability to interpret, construct, and convey arguments through the functional and truthful visual presentation of data. You will practice your data literacy by creating data visualizations using data-wrangling frameworks and visualization software.

Data literacy is a **vital skill** in our data-driven world. The chances are high that you will be interpreting and designing data visualizations throughout your career. The level of data literacy offered through this course allows you to establish a **competitive advantage in Silicon Valley and the global marketplace**.

Learning objectives

You will learn to create persuasive and evidence-based visualizations. Upon successful completion of this course you will:

- Understand the conceptual and technical fundamentals of data visualization.
- Analyze the persuasiveness and evidence of existing data visualizations.
- Develop a critical perspective on data visualizations.
- Create persuasive and evidence-based visualizations.

Course Logistics

Textbooks

- Cairo (2012): The Functional Art: An Introduction to Information Graphics and Visualization, New Riders.
  - This book provides you with the conceptual background of data visualization.
  - This book is available online in the SCU library.
- Cairo (2016): The Truthful Art: Data, Charts, and Maps for Communication, New Riders.
  - This book is the sequel to the first one and focuses on the 'truthful' part.
  - This book is available online in the SCU library.

I list the following books as additional helpful resources. Together, these books resemble the 'current common core' of contemporary data visualization:

- Munzner (2014): Visualization Analysis and Design, CRC Press.
  - This book offers a technical introduction into the elements of effective data visualization.
  - This book is available online in the SCU library.
- Tufte (2001): The Visual Display of Quantitative Information, Graphics Press.
  - This is often considered the groundbreaking book of data visualization
- Wexler, Shaffer, Cotgrave (2017): The Big Book of Dashboards, Wiley.
  - This is an excellent collection of dashboards and the reasoning behind them.

Technology

The hands-on elements in this course use **Tableau Desktop** and **Jupyter/Python**. Tableau Desktop is an analytics platforms for enterprise data. We use Jupyter/Python to gather, clean, and wrangle data. You are free to use other technologies (e.g., R) in the lab sessions and for your assignments. Please discuss such plans with the instructor prior to using other technologies.

[1] Loosely based on Naisbitt, J. 1982: Megatrends, Warner Books

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PLEASE NOTE: I expect you to have Tableau Desktop and Jupyter/Python installed on your laptop. If you run into any issues, please let me know.

It is my goal to spend the classroom time on conceptual and hands-on issues of data visualization. Therefore, we will only spend a minimal amount of time explaining how to use Tableau and Python.

The following resources will help you to get up to speed with Tableau:

- https://www.tableau.com/learn/training - This is a great resource to get answers on "how-to" questions.
- Stirrup et al. (2016): Tableau: Creating Interactive Data Visualizations, Packt. - This book is available online in the SCU library.

The following resources will help you to get up to speed with Python/Jupyter:

- https://jakevdp.github.io/WhirlwindTourOfPython - A great introduction into Python
- https://jakevdp.github.io/PythonDataScienceHandbook/ - A great book on Python in a data-intense environment
- https://wiki.python.org/moin/BeginnersGuide/Programmers - An extensive list of how to program in Python
- https://www.crummy.com/software/BeautifulSoup/bs4/doc/ - A library for pulling data from HTML and XML files.
- McKinney, W (2012): Python for Data Analysis, O'Reilly. - This book is available online in the SCU library.
- Rossant, C (2015): Learning IPython for interactive computing and data visualization, Packt. This book is available online in the SCU library.

Communication

I am committed to your learning success. Please feel free to contact me with any questions regarding this course. If I am not able to help you myself, I will forward your request to someone who can.

1. If you have general questions about course material, assignments, etc. please write them into this FAQ document (accessible only with SCU ID).
2. Before you write an email, please read and comment in the FAQ document (accessible only with SCU ID).
3. If you send me an email that contains questions of interest to the whole class, I will answer them in the FAQ document (accessible only with SCU ID).
4. My office hours are Mondays and Wednesdays from 4:30pm to 5:30pm. Please make an appointment here. I am also available after each class.
5. Please make an appointment whether you want to meet during office hours or outside of my office hours. A meeting request must have a specific agenda. I am available via phone, zoom, or face-to-face.
6. I post all course material, course information, announcements, and updates on Camino. On Camino, you will also find the class recordings. Please make sure that your correct email address is listed in Camino so that you do not miss important information.

Class Meetings

> *"One must learn by doing the thing, for though you think you know it, you have no certainty until you try it." (Sophocles)*

Class meetings are Saturdays, 8:30 AM to 11:15 AM in Lucas Hall 310.

This course is centered around a practical approach to data visualization. Each class meeting will have the same structure:

- 5 min Introduction
- 15 min Reading
- 45 min Discussion
- 75 min Lab Session
- 15 min Presentation
- 10 min Wrap up

Each class will focus on **one specific conceptual issue** and discusses solutions to this issue in data visualizations. During the lab session, you have to team up and work on a **data visualization case study** that allows you to practice the solution. At the end of each lab session, **two teams presents their results**.

Assignments

> *"What it boils down to is one per cent inspiration and ninety-nine per cent perspiration." (Thomas Edison)*

Your mastery of the learning objectives will be examined through classroom work in the lab sessions, two individual projects and one team team project. There will be **no exams**.

The following table links the learning objectives of this class with the assignments and shows the maximum number of points that you can achieve of each assignment in the final grade.

Learning Objective	Assignment	Max. Points
Understand the conceptual and technical fundamentals of data visualization.	Lab Sessions	25
Analyze the persuasiveness and evidence of existing data visualizations	"Data Visualization Redesign" Project	25
Develop a critical perspective on data visualizations.	"Deceptive Visualization" Project	25
Create persuasive and evidence-based visualizations	Team Project	25
Total		**100**

The final grade distribution is as follows.

Points	Letter Grade
100-94	A
>94-90	A-
>90-87	B+
>87-84	B
>84-80	B-
>80-77	C+
>77-74	C
>74-70	C-

Points	Letter Grade
>70-0	F

My grading criteria are as follows:

- **A grades** (4.0) reflect work that meets all assignment objectives at the highest possible level and sometimes goes beyond that. The submitted work is of superior quality and could be presented to the target audience with no or minimal revisions. Typically, no more than 40% of participants in a course receive an A grade.
- **B grades** (3.0) reflect work that meets all assignment objectives at a level that is above average but not exceptional. The submitted work shows high levels of competency and could be presented to the target audience with some editing.
- **C grades** (2.0) reflect work that meets all course objectives at an average level but is not exceeding expected standards. The submitted work lacks a clear in-depth understanding of the subject and could be presented to the target audience only with extensive editing. Typically, at least 5% of participants in a course receive a C grade.
- **F grades (0.0)** reflect work that does not meet course objectives and is below minimum standards. Submissions are late without prior consultation with the instructor, miss the assignment objectives, or show a clear lack of learning progress. Also, repeated violation of the academic integrity standards result in an overall F grade.

I reserve the right to change the grading to accommodate special circumstances and opportunities. Any changes, however, will be discussed and announced in class and on Camino.

Lab Sessions

The class meetings 1 to 9 will have a lab session to practice data visualization. In the lab session, you will work on a short data visualization case study that prepares, deepens, and extends the material of the class meeting. You will receive the case study on the Monday before the class meeting. This will give you the whole week to read, prepare, and ask questions. The purpose of the lab session is to complete final steps, resolve challenges, and fine-tune the submission.

You will submit your results at the end of the lab session. **I will choose individuals to shortly present an interesting aspect of their results.**

I will evaluate the submission for each lab sessions based on the following criteria:

- Max. 3 points for completion of case study objectives
- Max. 2 points for additional effort, originality, or creativity beyond case study objectives

Your **five** best submissions will count towards the final grade. The lab session of class meeting 1 does not count towards the grade.

Projects

The following table provides an overview of your project work:

Assignment	Deadline
Individual Project “Data Visualization Redesign”	October, 27, 2017, 23:59pm
Individual Project “Deceptive Visualization”	November, 17, 2017, 23:59pm
Team Project	December 1, 2017, 23:59pm

PLEASE NOTE: It is vital for you to start early and discuss intermediate results with me and the TA.

I will **not** accept late submission without prior notice or without a doctor's note. I am aware that sometimes life goes crazy but please notify me in advance and we will work it out.

Individual Project "Data Visualization Redesign"

The objective of this project is to redesign a data visualization (e.g., an infographic, a data visualization in a newspaper, a project report, or a sales report). This will allow you to learn from others, sharpen your critical perspective on data visualizations, reason about design decisions, and attempt to improve data visualizations.

You are **highly** encouraged to structure the project according to the following schedule:

Phase	Should be done by
Project setup	September, 29
Data wrangling and exploratory data visualizations	October, 6
Develop several data visualization prototyping	October, 13
Refinement & documentation	October, 20

The project is due on **October, 27, 2017, 23:59pm**.

Individual Project "Deceptive Visualization"

The objective of this project is to create a data visualization that purposefully distorts the data or deceives the reader. You start with an existing data visualization and develop a deceptive version of it. ***You may not alter the data.*** The purpose of this project is for you to experience and realize the ethical implications of design decisions during the development of data visualizations.

You are **highly** encouraged to structure the project according to the following schedule:

Phase	Should be done by
Project setup	October, 20
Data wrangling and exploratory data visualizations	October, 27
Develop several data visualization prototyping	November, 3
Refinement & documentation	November, 10

The project is due on **November, 17, 2017, 23:59pm**.

Team Project "Data Product"

The objective of this project is to jointly develop a data product (e.g. a dashboard). A data product tells a complex story using several data visualizations. You will work teams of up to five students. Each team is free to choose a topic of interest. The challenge of a team project is to organize your team, hold one another accountable, and complement your skills and interests. **At the end of the team project, your teammates will evaluate your contributions to the project. This will be part of your grade for the team project.**

You are **highly** encouraged to structure the project according to the following schedule:

Phase	Should be done by
Project setup	October, 7
Data wrangling and exploratory data visualizations	October, 21
Develop several data visualization prototyping	November, 4
Refinement & documentation	November, 18
Preparing presentation and video	November 24

The project is due on **December, 1, 2017, 23:59pm**.

Project Delieverables

The deliverable for each project (Individual projects and team project) must be a self-contained deliverable (e.g., a Jupyter notebook on github and a link to a Tableau Public project) that includes the following components:

1. Project statement (Motivation, objective, data, project plan)
2. "Making-of" documentation (Details of your development process, data wrangling steps, your reasoning, detours, literature, etc.)
3. Several intermediate visualization prototypes
4. Final data visualization
5. Road map with future features/enhancements/features
6. Showcase video (<90 sec)

Grading Rubric for Projects

The objective of this course it to enable you to transform data into **persuasive and evidence-based visualizations**. Naturally, the persuasiveness and the amount of evidence offered for your arguments are key drivers of your projects work.

I will evaluate project submissions based on the following criteria:

- **40%** Persuasiveness (Structure and strength of the visual argument)
- **30%** Evidence (Functionality, truthfulness, reproducibility)
- **20%** Presentation & Style (Professionality, publishability)
- **10%** Originality, creativity, & effort

How to get an A in this course

I firmly believe that mastery of data visualization requires constant practice. You will ace this course if you:

- Adhere to the academic integrity standards outlined below.
- Be ready for class meetings, which means you have read the material and prepared for the case study.
- Participate in the class discussions, ask questions, and share experiences.
- Support your teammates.
- **Show intermediate results early and often.**
- Start early on the assignments, **seek continuous feedback from me, the TA, and other sources**.
- Continuously think about **why** you are doing something in your assignments. This is far more important than **what** you are doing.
- Answer the **'boss question'** before submitting **any** deliverable: Would you send your submission **as is** to your boss or a recruiter?

Course Schedule

Week	Topic	Class Meeting
1	Introduction, Logistics, Setup, and Overview	September, 23
2	Data Visualization from 30,000 feet	September, 30
3	Data Wrangling in a Whirlwind	October, 7
4	Visual Arguments	October, 14
5	Audience	October, 21
6	Metrics, KPIs, Scorecards	October, 28
7	Dashboards	November, 4
8	Validation	November, 11
9	Aesthetics	November, 18
10	Wrap up & Final team presentations	December, 2

Academic Integrity

The Academic Integrity pledge is an expression of the University's commitment to fostering an understanding of and commitment to a culture of integrity at Santa Clara University. The Academic Integrity pledge, which applies to all students, states:

> *"I am committed to being a person of integrity. I pledge, as a member of the Santa Clara University community, to abide by and uphold the standards of academic integrity contained in the Student Conduct Code."*

You are expected to uphold the principles of this pledge for all work in this class. For more information about Santa Clara University's academic integrity pledge and resources about ensuring academic integrity in your work, see www.scu.edu/academic-integrity.

In particular, I expect that you give credit to any material (including but not limited to journal articles, web article, blog posts, images, data sets, and any media) that you have used for completing any assignment in this class. Being able to give credit by referencing sources consistently and correctly is evidence of mastery of a topic. It shows that you are able to construct original arguments that are backed with verifiable evidence. Failing to give credit is a sign of an inadequate learning progress. It shows that you have not understood the topic well enough to formulate your own arguments in relation to already existing ideas.

During your work in this class, you will use, modify, or extend digital content that you have found online. You will also use libraries, APIs, code snippets, and data sets that have been created by others. In every piece of work (presentations, assignments, etc.), you must acknowledge work, source code, data sets, and any other content that was not produced by you. Acknowledgements must be easily identifiable, inseparable from your content, and must not violate licenses.

Failure to provide appropriate acknowledgements will result in an F grade for that assignment. Repeated failure to provide appropriate acknowledgements will result in an F grade for the entire course.

During the first class, we will discuss this digital content policy. After this class, I will strictly enforce this policy. If you have doubts, contact me.

Course Conduct

My responsibility

I will support you in your learning in this class and beyond to the best of my abilities. If I am not able to help you myself, I will identify someone who can. I will evaluate your contribution solely based on the standards set by this syllabus. Changes to the syllabus will be highlighted, discussed during class sessions, and will be published on Camino.

Your responsibility

By enrolling in this class, you agree to the requirements stated in this syllabus. You will operate with integrity in your dealings with me and your fellow students. You will engage the learning materials with appropriate attention and dedication and maintain their engagement when challenged by difficult learning activities. You will contribute to the learning of others and you will perform to standards set by this syllabus.

Mutual respect is the foundation of this course. No one will be criticized for being wrong. Appropriate conduct includes honesty, self-respect, respect for others, and compliance with university policies and standards. Computers in the classroom should be used only for completing course-related work and for taking notes; cell phones must be turned off or muted.

Attendance Policy

Please let me know via email during the first two weeks of the course if you have any conflicts between a course element (class meeting, assignment) and another vital commitment (another course, work, university-related extracurricular activities, religious commitments). At my discretion, I will you provide with alternative means to complete the course element.

I am aware that many of you have multiple commitments. You should attend at least 80 percent of all scheduled class meetings. If you miss more than 20 percent of scheduled classes, you will receive reduction by one letter grade.

University Policies

Disability Resources

If you have a disability for which accommodations may be required in this class, please contact Disabilities Resources (Benson Hall 216, 408-554-4109) as soon as possible to discuss your needs and register for accommodations with the University. If you have medical needs related to pregnancy, you may also be eligible for accommodations. If you have already arranged accommodations through Disabilities Resources, please discuss them with me during my office hours as soon as possible.

While I am happy to assist you, I am unable to provide accommodations until I have received verification from Disabilities Resources. If you are in doubt of whether you are eligible for accommodations, I encourage you to contact Disabilities Resources (Benson Hall 216, 408-554-4109). The Disabilities Resources office would be grateful for advance notice of at least two weeks.

Accommodations for Pregnancy and Parenting

In alignment with Title IX of the Education Amendments of 1972, and with the California Education Code, Section 66281.7, Santa Clara University provides reasonable accommodations to students who are pregnant,

have recently experienced childbirth, and/or have medically needs related to childbirth. Pregnant and parenting students can often arrange accommodations by working directly with their instructors, supervisors, or departments. Alternatively, a pregnant or parenting student experiencing related medical conditions may request accommodations through Disabilities Resources (Benson Hall 216, 408-554-4109).

Discrimination and Sexual Misconduct (Title IX)

Santa Clara University upholds a zero-tolerance policy for discrimination, harassment and sexual misconduct. If you (or someone you know) have experienced discrimination or harassment, including sexual assault, domestic/dating violence, or stalking, I encourage you to tell someone promptly. For more information, please consult the University's Gender-Based Discrimination and Sexual Misconduct Policy at http://bit.ly/2ce1hBb or contact the University's EEO and Title IX Coordinator, Belinda Guthrie, at 408-554-3043, bguthrie@scu.edu. Reports may be submitted online through https://www.scu.edu/osl/report/ or anonymously through Ethicspoint https://www.scu.edu/hr/quick-links/ethicspoint/

Acknowledgement

This syllabus was inspired by Aleszu Bajak's syllabus, Jeffrey Shaffer's data visualization with Tableau course, and earlier versions of CS171 at Harvard.