IST 719: INFORMATION VISUALIZATION
School of Information Studies, Syracuse University
Syllabus for the Summer 2019 Maymester

Instructor: Frank Marullo
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Email: fmarullo@syr.edu
Class Hours: 9:00am – 5:00pm, Mon-Fri (May 13th – May 17th)
Class Room: Hinds Hall 010
Office Hours: By Appointment

COURSE DESCRIPTION

This course will introduce students to skills and techniques related to information visualization. In this skills-based course, students will be introduced to the R programming language, Adobe Illustrator, simple data cleaning techniques, simple design concepts, different visualization tools and the ethics of visualizing data. The focus is on developing static data visualizations to visually explore and communicate findings using data from a variety of sources. Conceptual themes will be presented alongside technical aspects of data visualization. As this is an introductory class, there are no prerequisites but students will be programming on day 1!

COURSE OBJECTIVES & LEARNING OUTCOMES

By the end of this course, students will be able to

1. Use R to do basic data cleaning and preparation on a wide range of data sets
   a. Includes using functions to summarize and compare fields
   b. Find missing values
   c. Subset or filter data
   d. Retype data into correct format
2. Identify stories in data sets through exploration
   a. Use R to create appropriate rough plots to identify distributions and relationships in the data
   b. Use data sub setting and filtering to narrow in on questions of interest
3. Create rich visual artefacts that communicate data stories
   a. Identify the optimal type of visualization to minimize viewer cognitive overload and maximize image interpretability
   b. Enhance viewer cognition through context cues
   c. Use basic design principles to enhance viewer receptivity and convey meaning
   d. Use Adobe Illustrator to combine R data visualizations, design elements and context cues into a single artifact
4. Critically assess visualizations
   a. Interpret and analyze the meanings of data visualizations
   b. Identify appropriate audience
   c. Bring an ethics based perspective to development and interpretation of visualizations

REQUIRED TEXTS

*Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*

*Data Points: Visualization That Means Something*

*An Introduction to Data Science*
By Jeff Stanton. Free iTunes download

Additional readings will be provided as PDFs and posted on BlackBoard

COURSE STRUCTURE

In order to meet the goals of the class, we will use a combination of lectures to introduce topics and concepts, hands-on-labs to introduce skills, group exercises, possibly student presentations to enable peer-to-peer learning and homework assignments to practice skills to gain deeper knowledge of course content.

ASSIGNMENTS AND GRADING

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Class Lab Work (5 Labs 4pts each)</td>
<td>20</td>
</tr>
<tr>
<td>Home Exercises (5 HW’s 4pts each)</td>
<td>20</td>
</tr>
<tr>
<td>Class participation and possible presentations</td>
<td>20</td>
</tr>
<tr>
<td>Quizzes (4 Quizzes 2pts each)</td>
<td>8</td>
</tr>
<tr>
<td>Final project</td>
<td>32</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>100</strong></td>
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Please note that the above table identifies general point allocation to assignments- which means points may be allocated differently depending on the actual workload.

IN-CLASS LABS: In the real world of data visualization people work both alone and in teams to meet near and far deadlines. In this class we work in a lab setting to learn R, Adobe Illustrator and general visualization skills. Students are encouraged to work together to solve problems. Because of the nature of this work, I do not allow for makeups of labs.
HOMEWORK: These will be extensions of what we did in class or assignments out of the book. Homework may be in the form of quizzes on Blackboard, visualizations you create or some of the other assignments listed below. These are usually due by beginning of the next class. You cannot turn in assignments late.

Important: you may not receive credit if you do not follow the file naming convention specified on the assignment sheet. You may not receive credit if your file is of the wrong type. Unless otherwise specified, you will always turn in plots as .pdf files and R scripts as .R files.

ATTENDANCE AND PARTICIPATION: Labs and lab quizzes serve the function of taking attendance. Labs and Quizzes will not be announced in advance, and, as noted above, cannot be made up and cannot be late.

PRESENTATIONS: There are many other options available for creating visualizations. Examples of other visualization environments include (but are not limited to) D3, Processing, Tableau, GapMinder, and Sense.Us. In order to give you a taste of these other options, each of you may be presenting an “advanced topic” to the class.

FINAL PROJECT: You will begin working on your final project on the first day of class, with key deliverables being due throughout the course. These assignments will be graded as part of your final deliverable and will include:

1. Picking and preparing a dataset with R
2. Defining an audience and requirements for your visualizations
3. Experimenting with different visual encoding and graphic design choices
4. Executing your visualization
5. Presenting your final product

Throughout the semester, you are encouraged to use class discussions and exercises to explore topics or questions that you find compelling.

POSTER SESSION: You must go to the poster session at the end of the semester, with your poster, in order to get credit for your poster. The exact time and date of the poster session will be announced within the first few classes. Note the requirements for posters change each semester. Past examples on Blackboard are provided for your reference. All posters must state the tool used to create the plot. Any plot made on Tableau or Excel will not get full credit. Sketches do not have to be generated in R.

Grade Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>96% - 100%</td>
</tr>
<tr>
<td>A-</td>
<td>93% - 95.9%</td>
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<tr>
<td>B+</td>
<td>90% - 92.9%</td>
</tr>
<tr>
<td>B</td>
<td>87% - 89.9%</td>
</tr>
<tr>
<td>B-</td>
<td>84% - 86.9%</td>
</tr>
<tr>
<td>C+</td>
<td>81% - 83.9%</td>
</tr>
<tr>
<td>C</td>
<td>78% - 80.9%</td>
</tr>
<tr>
<td>C-</td>
<td>75% - 77.9%</td>
</tr>
</tbody>
</table>
TENTATIVE SCHEDULE

This schedule is intended to give you an idea of how the course will proceed, but may change depending on learning opportunities and class speed.

<table>
<thead>
<tr>
<th>Day</th>
<th>Theme; Learning Outcomes; Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>Morning Session</strong></td>
</tr>
</tbody>
</table>
| **9:00am – 10:05am** | Meet and Greet/Intro to course  
Review Syllabus and Schedule |

**What is data visualization? What is R?**

*Learning Outcomes*
Differentiate between Information Visualization and other prominent forms of visualization
- Describe the two main purposes of Information Visualization: exploration and communication
- Describe the seven basic steps of visualization
- Describe the purpose of the 4 windows of RStudio
- Create variables in R
- Create simple single variable plots in R, such as pie and bar charts, histograms
- Use R’s help system to lookup the available parameters for plotting Functions

*Reading:*
- VT: Chapters 1 and 2
- DS: Chapters 1 and 2
- Ben Fry, Visualizing Data

**10:05am – 10:15am**
Break

**10:15am – 11:15am**

*Data and R*

*Learning Outcomes*
List sources of freely available data
- Describe the process of data exploration
- Discuss the role of context markers in visualization
- Differentiate between common data types
• Open data files
• Use R functions to explore and clean data
• Use R to retype, subset and filter data
• Create rough data exploration plots

Reading:
• DP: Chapter 1
• DS: Chapter 3
• VT: Chapters 3 and 4

11:15am - Noon
Break and Quiz 1: covers readings and lecture

Afternoon Session

1:00pm – 2:00pm
Lab 1: Exploring Data in R Simple Plots

2:00pm – 2:50pm
Using Data Libraries and visualizing multi-dimensional data

Learning Outcomes
• Find datasets from online data libraries such as Data Planet
• Describe ways to make comparisons with visualizations
• Describe ways to identify and show relationships in data
• Differentiate between single and multi-dimension plots
• Use R to make simple multi-dimensional plots
• Identify the appropriate plot type for a given set of data

2:50pm – 3:00pm
Break

3:00pm – 4:00pm
Lab 2: Visualizing multi-dimensional data

4:00pm – 5:00pm
Review datasets and select your final project dataset before next class

Homework 1: Simple Plots (Day 1 Second Morning Session)
Homework 2: Muli Dimension Plots (Day 1 Afternoon Session)
Morning Session

9:00am – 10:05am
Beginning to find and tell the story in the data & Illustrator Intro

Learning Outcomes
- Describe a dataset
- Identify questions that might be answered with the data
- Identify elements of a visual artifact that make it compelling
- Interpret the meaning(s) of a data visualization
- Use Illustrator to modify R plots
- Add context elements to a data visualization
- Use Illustrator to modify plot colors, type face and layout
- Explain the difference between raster and vector graphics

Reading:
- DP: Chapter 2 & 3
- Few: Chapter 3
- VT: Chapter 4 (Illustrator parts)

10:05am – 10:15am
Break

10:15am – 11:30am
Lab 3: Illustrator Intro

Afternoon Session

12:30pm – 1:15pm
Quiz 2: Optimal visual encoding of data

1:15pm – 1:50pm
Graphic Design Principles: Color, tools and R color functions

Learning Outcomes
- Describe the use of contrasting and harmonious color in visualization
- Describe how hue, saturation and value combine to make a color
- Use online tools to choose and create color schemes
- Use R’s color setting and transformation functions
- Use color to provide visual cues in visualizations

Reading:
- DP: Chapter 4

1:50pm – 2:00pm
Break
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00pm – 3:00pm</td>
<td>Lab 4: Working with color</td>
</tr>
<tr>
<td>3:00pm – 4:00pm</td>
<td>Poster Session Working Groups</td>
</tr>
<tr>
<td></td>
<td>• Determine questions that can be answered</td>
</tr>
<tr>
<td></td>
<td>• Explore data set and beginning plotting data</td>
</tr>
<tr>
<td>4:00pm – 5:00pm</td>
<td>Homework 3: Illustrator portions of VT Ch 4 plots</td>
</tr>
<tr>
<td></td>
<td>Homework 4: Visualize your data: creating a visual report of your dataset</td>
</tr>
</tbody>
</table>

3

**Morning Session**

**9:00am – 9:45am**

**Graphic Design Principles: Type Face & Layout, R plot area control**

*Learning Outcomes:*
- Describe how type face and layout work together to create a visual hierarchy
- Describe how visual hierarchies direct viewers’ attention
- Explain how lines, gutters, grids and colors can be used to highlight visual elements
- Critically assess example posters and discuss useful and detracting design elements

*Reading:*
- DS: Chapter 5
- VT: Chapters 6
- Few: Chapter 4

**9:45am – 10:05am**

**Ethics**

*Learning Outcomes:*
- Critically assess visualizations
- Identify the audience for a visual artifact
- Discuss the ethical concerns around visual artifacts

*Reading:*
- DS: Chapter 7
- VT: Chapters 7

**10:05am – 10:15am**

Break
10:15am – 11:00am
Quiz 3: The right plot of the data

11:00am – Noon
Tableau Intro and working session (Open Dataset)
Extra Credit for Tableau Live Data

Afternoon Session

1:00pm – 1:45pm
Tableau working session continued

1:45pm – 4:00pm
Poster Session Working Groups

4:00pm – 5:00pm
Homework 5: Create plots in chapter VT, chapter 6

Morning Session

9:00am – 10:15am
R’s ggplot package and its graphical language

Learning Outcomes:
- Load packages that extend R
- Create plots of 3 or more dimensions using ggplot
- Create complex multi-plot layouts
- Explain the concept of a graphical language as implemented by ggplot

10:15am – 10:25am
Break

10:30am – Noon
Lab 6: GG Plots Maps and Posters

Afternoon Session

1:00pm – 1:45pm
Quiz 4: Sub-setting data in R and the graphical language of ggplot

1:45pm – 2:15pm
Different Packages in R
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>2:15pm – 5:00pm</td>
<td>Poster Session Working Groups</td>
</tr>
<tr>
<td>5</td>
<td><strong>Morning Session</strong></td>
</tr>
<tr>
<td>9:00am – 2:00pm</td>
<td>Tableau Live Data workshop and print poster</td>
</tr>
<tr>
<td></td>
<td><strong>Extra Credit for Tableau Live Data submission</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Afternoon Session</strong></td>
</tr>
<tr>
<td>2:00pm – 5:00pm</td>
<td>Poster Session</td>
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**POLICIES**

**Office hours**
My office hours are by appointment. It is your responsibility to meet with me outside of class if you have any questions about grading, evaluation and/or any aspect of your performance.

**Future Use of Student Work**
This course may use course participation and documents created by students for educational purposes. In compliance with the Federal Family Educational Rights and Privacy Act, works in all media produced by students as part of their course participation at Syracuse University may be used for educational purposes, provided that the course syllabus makes clear that such use may occur. It is understood that registration for and continued enrollment in a course where such use of student works is announced constitutes permission by the student. After such a course has been completed, any further use of student works will meet one of the following conditions: (1) the work will be rendered anonymous through the removal of all personal identification of the work’s creator/originator(s); or (2) the creator/originator(s)’ written permission will be secured. As generally accepted practice, honors theses, graduate theses, graduate research projects, dissertations, or other exit projects submitted in partial fulfillment of degree requirements are placed in the library, University Archives, or academic departments for public reference.

**Academic Integrity Policy**
Syracuse University’s Academic Integrity Policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of
participation in class activities. The policy also prohibits students from submitting the same work in more than one class without receiving written authorization in advance from both instructors. Under the policy, students found in violation are subject to grade sanctions determined by the course instructor and non-grade sanctions determined by the School or College where the course is offered as described in the Violation and Sanction Classification Rubric. SU students are required to read an online summary of the University’s academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice. For more information about the policy, see http://academicintegrity.syr.edu.

Disability-Related Accommodations
Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. If you believe that you need accommodations for a disability, please contact the Office of Disability Services (ODS), disabilityservices.syr.edu, located at 804 University Avenue, room 309, or call 315.443.4498 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue “Accommodation Authorization Letters” to students as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible. Our goal at the iSchool is to create learning environments that are useable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please meet with me to discuss additional strategies beyond official accommodations that may be helpful to your success.

Religious Observances Notification and Policy
SU’s religious observances policy, found at supolicies.syr.edu/emp_ben/religious_observance.htm, recognizes the diversity of faiths represented in the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their tradition. Under the policy, students should have an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors no later than the end of the second week of classes through an online notification form in MySlice listed under Student Services/Enrollment/My Religious