

IST719  
**INFORMATION VISUALIZATION**

Section 1: Wednesdays, 9:30am-12:15pm  
Hinds Hall, Room 010

Section 2: Tuesdays, 9:30am-12:15pm  
Hinds Hall, Room 010

**Instructor**  
Jeff Hemsley

**Contact**  
[jhemsle@syr.edu](mailto:jhemsle@syr.edu)

**Office hours**  
By appointment

**Course website**  
<https://blackboard.syr.edu>

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**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 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

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

**REQUIRED TEXTS**

*Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*  
By Nathan Yau. Wiley Publishing, 2011. [VT in schedule]

*Data Points: Visualization That Means Something*  
By Nathan Yau. Wiley Publishing, 2013. [DP in schedule]

*An Introduction to Data Science*

By Jeff Stanton. Free iTunes download. [DS in schedule]

### **ADDITIONAL READING**

*Additional readings will be provided as PDFs*

### **COURSE STRUCTURE**

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

### **ASSIGNMENTS AND GRADING**

Assignment	Points
In-Class Lab Work & Lab Quizzes	40
Home Exercises & Quizzes	50
Group reports and feedback	15
Advanced topic presentation	15
Final project	30
Total	150

*Because of the dynamic nature of the labs, the total points possible may be a few points higher or lower.*

**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 and Adobe Illustrator skills and students are encouraged to work together to solve problems. Most labs are between 3 and 6 points. Labs are also dynamic. The nature of what we turn in at the end of the lab will depend on how fast we go and what questions students ask. Because of the nature of this work, I do not allow for makeups of labs.

**LAB QUIZZES:** These are typically one or two question quizzes that are intended to reinforce something I talked about in the last class. These won't be announced in advance.

**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 9:00 AM at the start of the next class. You can turn in assignments late, but there are consequences. First, 1 point will be automatically deducted. Second, late assignments may not be graded till the end of the semester.

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:** I do not directly grade on attendance or participation. Labs and lab quizzes serve the function of taking attendance. Labs and Lab Quizzes will not be announced in advance, and, as noted above, cannot made up and cannot be late.

**ADVANCED TOPIC 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.U.S. In order to give you a taste of these other options, each of you will be selecting and presenting an “advanced topic” to the class, highlighting a product or application of your choosing.

**FINAL PROJECT:** The final project, including poster session, is worth 30% of your final grade. You will begin working on your final project on the first day of class, with key deliverables being due throughout the semester. These assignments will be graded separately from your final deliverable and will involve:

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, use class discussions and exercises to explore topics or questions that you find compelling. Details about requirements for each stage of the final project will be provided at least one week before due dates.

**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

A	96% - 100%
A-	93% - 95.9%
B+	90% - 92.9%
B	87% - 89.9%
B-	84% - 86.9%
C+	81% - 83.9%
C	78% - 80.9%
C-	75% - 77.9%

### 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.

Week	Theme; Learning Outcomes; Assignments
1	<p><b>What is data visualization? What is R?</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Differentiate between Information Visualization and other prominent forms of visualization</li> <li>• Describe the two main purposes of Information Visualization: exploration and communication</li> <li>• Describe the seven basic steps of visualization</li> </ul>

	<ul style="list-style-type: none"> <li>• Describe the purpose of the 4 windows of RStudio</li> <li>• Create variables in R</li> <li>• Create simple single variable plots in R, such as pie and bar charts, histograms</li> <li>• Use R's help system to lookup the available parameters for plotting functions</li> </ul> <p><u>Lab 1:</u> R and Basic plots</p> <p><u>Reading:</u></p> <ul style="list-style-type: none"> <li>• VT: Chapters 1 and 2</li> <li>• DS: Chapters 1 and 2</li> <li>• Ben Fry, Visualizing Data</li> </ul> <p><u>Quiz 1:</u> covers readings and lecture</p>
<b>2</b>	<p><b>Data and R</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• List sources of freely available data</li> <li>• Describe the process of data exploration</li> <li>• Discuss the role of context markers in visualization</li> <li>• Differentiate between common data types</li> <li>• Open data files</li> <li>• Use R functions to explore and clean data</li> <li>• Use R to retype, subset and filter data</li> <li>• Create rough data exploration plots</li> </ul> <p><u>Lab 2:</u> Exploring Data in R</p> <p><u>Reading:</u></p> <ul style="list-style-type: none"> <li>• DP: Chapter 1</li> <li>• DS: Chapter 3</li> <li>• VT: Chapters 3 and 4</li> </ul> <p><u>Homework 1:</u> Reproduce Figures in VT Chapter 4</p>
<b>3</b>	<p><b>Using Data Libraries and visualizing multi-dimensional data</b> Guest Lecture: Paul H. Bern, Ph.D. Research Data Services Librarian</p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Find datasets from online data libraries such as Data Planet</li> <li>• Describe ways to make comparisons with visualizations</li> <li>• Describe ways to identify and show relationships in data</li> <li>• Differentiate between single and multi dimension plots</li> <li>• Use R make simple multi-dimensional plots</li> <li>• Identify the appropriate plot type for a given set of data</li> </ul> <p><u>Lab 3:</u> Visualizing multi-dimensional data</p> <p><u>Assignment:</u> Find a dataset and be prepared to describe / discuss it in class</p>

4	<p><b>Beginning to find and tell the story in the data &amp; Illustrator Intro</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe a dataset</li> <li>• Identify questions that might be answered with the data</li> <li>• Identify elements of a visual artifact that make it compelling</li> <li>• Interpret the meaning(s) of a data visualization</li> <li>• Use Illustrator to modify R plots</li> <li>• Add context elements to a data visualization</li> <li>• Use Illustrator to modify plot colors, type face and layout</li> <li>• Explain the difference between raster and vector graphics</li> </ul> <p><u>Lab 4:</u> Illustrator Intro <u>Quiz 2:</u> Optimal visual encoding of data <u>Reading:</u></p> <ul style="list-style-type: none"> <li>• DP: Chapter 2 &amp; 3</li> <li>• Few: Chapter 3</li> <li>• VT: Chapter 4 (Illustrator parts)</li> </ul> <p><u>Homework 2:</u> Illustrator portions of VT Ch 4 plots</p>
5	<p><b>Graphic Design Principles: Color, tools and R color functions</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe the use of contrasting and harmonious color in visualization</li> <li>• Describe how hue, saturation and value combine to make a color</li> <li>• Use online tools to choose and create color schemes</li> <li>• Use R's color setting and transformation functions</li> <li>• Use color to provide visual cues in visualizations</li> </ul> <p><u>Lab 5:</u> Working with color <u>Reading:</u></p> <ul style="list-style-type: none"> <li>• DP: Chapter 4</li> </ul> <p><u>Homework 3:</u> Visualize your data: creating a visual report of your dataset</p>
6	<p><b>Graphic Design Principles: Type Face &amp; Layout, R plot area control</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe how type face and layout work together to create a visual hierarchy</li> <li>• Describe how visual hierarchies direct viewers attention</li> <li>• Explain how lines, gutters, grids and colors can be used to highlight visual elements</li> <li>• Critically assess example posters and discuss useful and detracting design elements</li> </ul> <p><u>Reading:</u></p> <ul style="list-style-type: none"> <li>• DS: Chapter 5</li> </ul>

	<ul style="list-style-type: none"> <li>• VT: Chapters 6</li> <li>• Few: Chapter 4</li> </ul> <p><u>Homework 4:</u> Create plots in chapter VT, chapter 6</p> <p><u>Quiz: 3:</u> Design supported comparisons</p>
<b>7</b>	<p><b>Advanced Plots &amp; Posters in Illustrator</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Prepare geographic based data for plotting</li> <li>• Create national, regional and world map plots in R</li> <li>• Enhance cognitive apprehension of complex maps though the use of design elements</li> <li>• Use Illustrator to merge 2 or more plots and incorporate context text and design elements</li> <li>• Create poster sized, high quality vector graphic ready for printing</li> </ul> <p><u>Lab 6: Maps and Posters</u> <u>Reading:</u></p> <ul style="list-style-type: none"> <li>• DS: Chapter 7</li> <li>• VT: Chapters 7</li> </ul> <p><u>Quiz 4:</u> The right plot of the data</p>
<b>8</b>	<p><b>R's ggplot package and its graphical language</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Load packages that extend R</li> <li>• Create plots of 3 or more dimensions using ggplot</li> <li>• Create complex multi-plot layouts</li> <li>• Explain the concept of a graphical language as implemented by ggplot</li> </ul> <p><u>Quiz 5:</u> Sub-setting data in R and the graphical language of ggplot</p>
<b>9 &amp; 10</b>	<p><b>Advanced Topics Student Presentations &amp; Discussion</b> Students sign up to present or demo one of the many advanced visualization topics not otherwise covered in class. Slides are made available on Blackboard.</p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe advanced visualization tools used in the market place</li> <li>• Have knowledge of a range of additional R packages used in data cleaning and visualization not otherwise covered in class.</li> <li>• Apply design skills learned in class to slide deck creation</li> </ul> <p><u>Assignment:</u> Work in progress report for final poster project</p>
<b>11</b>	<p><b>Ethics and Project Group Feedback</b></p>

	<p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Critically assess visualizations</li> <li>• Identify the audience for a visual artifact</li> <li>• Identify visual credibility markers</li> <li>• Discuss the ethical concerns around visual artifacts</li> </ul> <p><u>Reading:</u></p> <ul style="list-style-type: none"> <li>• DS: Chapter 7</li> <li>• VT: Chapters 7</li> </ul> <p><u>Quiz 4:</u> The right plot for the data</p>
<b>12</b>	<p><b>Interactivity In R Plotting: Shiny</b></p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Create an online interactive visualization portfolio</li> </ul> <p><u>Lab 7: RStudio's Shiny extension</u></p>
<b>13</b>	<p><b>Viz-a-thon</b> Students are given a new dataset and must work together in small groups to explore the data to find the story, then create a mini-poster using R and Illustrator.</p> <p><u>Learning Outcomes</u> Students will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate knowledge of the process of creating a visual artifact</li> <li>• Work in a group to create a mini-poster from an unknown dataset</li> </ul>
<b>14</b>	<p><b>Final project poster session</b> Students present a poster they created themselves at the all-iSchool poster session.</p>

## POLICIES

### Office hours

My office hours are by appointment on *Monday or Wednesday afternoon*. 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.

### My Policy on Social Media & Letters of Reference

I encourage students to link with me on LinkedIn: <http://www.linkedin.com/in/jeffhemsley>

I do **not** accept friend requests from students on Facebook.

I do not write letters of reference for students unless I have worked with them for at least two semesters.

### 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 pilot policy in effect at the School of Information Studies 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 pilot 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 pilot 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 pilot 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. 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 and the pilot 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](http://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.

### **Diversity and Disability Syllabus Statement:**

Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. My goal 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, I invite any student to meet with me to discuss additional strategies beyond 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](http://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**

### **Student Academic Work Policy**

SU policy on student academic work may be found at:

[http://coursecatalog.syr.edu/content.php?catoid=3&navoid=270#Student\\_Academic\\_Work](http://coursecatalog.syr.edu/content.php?catoid=3&navoid=270#Student_Academic_Work)

Student work prepared for University courses in any media may be used for educational purposes, if the course syllabus makes clear that such use may occur. You grant permission to have your work used in this manner by registering for, and by continuing to be enrolled in, courses where such use of student work is announced in the course syllabus.

If you use students' work for educational purposes, University policy requires that you notify students in your syllabus (Academic Rules, Student Academic Work). The Curricula Committee suggests the following language: