IST719 Information Visualization

Section M002 Thurs. 2:00 to 4:45 PM, HH 013

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Office Hours	By arrangement via email, or right before and after the class		

Course Description:

A broad introduction to data visualization through various programming and illustration tools, data cleaning techniques, design concepts and ethics. Students will develop a portfolio of resources, demonstrations, recipes, and examples of various data visualization techniques to explore and communicate findings.

Additional Course Description

Introduction to skills and techniques related to information visualization, through the R programming language, and Adobe Illustrator. These skills include data cleaning techniques, control of the R graphics environment, developing custom plots, visually exploring data, using design concepts to visually communicate the story in the data, and discuss issues related to the ethics of data visualization. Conceptual themes will be presented alongside technical aspects of data visualization. Additional work and higher grading expected of graduate students.

Prerequisite / Co-requisite:

IST 387/687 or equivalent programming courses (R, Python, Java, SQL, C, C++, etc.). Please talk with the instructor if you don't meet the prerequisite requirements.

Audience:

Students interested in data analytics and data science, with a focus on data/information visualization.

Credits:

3

Course Fees and/or Costs

Only costs are for the books listed below if print copy is preferred, and for printing out the final poster project (~$12). Students may also choose to purchase a one-month subscription to Adobe Illustrator.

Learning Objectives:

1. Perform basic data cleaning and preparation on a wide range of data sets using R
2. Identify stories in data sets through visual data exploration
3. Create rich visual artefacts that communicate data stories

After taking this course, students will be able to:

1. Have basic proficiency with R programming language and Adobe Illustrator
2. Use functions and plots in R to explore a dataset and find simple relationships, distributions, and exceptional cases
3. Use R and Adobe Illustrator to create publish-quality data visualizations that communicate the story of the data

Required Texts / Supplies:

Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics, by Nathan Yau. Wiley Publishing, 2011. *[abbr. VT in course schedule]*

[Link to VT at SU Library](#)

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

[Link to DP at SU Library](#)

Note that both texts are available online from the SU Libraries!

Texts / Supplies – Additional:

Additional readings will be supplied as PDFs

Following are two additional textbooks we'll be using, both available online:

· R for Data Science *[abbr. R4DS in course schedule]*; by Hadley Wickham and Garrett Grolemund. Available online here https://r4ds.had.co.nz/index.html

· Joshua F. Willey and Larry A. Pace, 2015. Beginning R: An Introduction to Statistical Programming, 2nd Edition. *[abbr. BR in course schedule]*; This is a hands-on book showing how to use the R Language, write and save R scripts, read in data files, and write custom statistical functions as well as use built in functions. Chapter 9: Working with Graphics and Chapter 17: Data Visualization Cookbook are specifically relevant. Here's [permanent link for Beginning R at SU library](#)

Course Requirements and Expectations:

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 and student presentations to enable peer-to-peer learning, and homework assignments to practice skills and gain deeper knowledge of course content. These are detailed below.

Each week will introduce new content. During the first part of the course, there will be a brief lecture followed by a lab session. As the semester progresses, the lecture will eventually disappear, and we will devote the entire week to a lab. On some weeks, there will be a take home quiz (indicated in the schedule). At the end of the Thursday's class, lab work is due, to be submitted on Blackboard. There will also be homework for some of the weeks which will be due before the following week's class unless otherwise noted.

Grading:
Your final grade is determined by your performance on the items in the table below. An overview of each item is provided in the remainder of this section. Note that because of the dynamic nature of the labs, the total points possible may be a few points higher or lower, thus the ranges.

Assignment	Point Range
In-Class Labs	10 to 15
Quizzes	40
Homework	30 to 35
Group Reports and Feedback	5 to 10
Viz-a-thon	5 to 10
Final Project	25
Total Range	115 to 135

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. Lab work for each week is worth between 1 and 3 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. In order to receive points for in-class labs, you need to be in the class doing the work yourself. If you are going to be absent, you need to have a legitimate reason and provide proof for it. You also need to let me know ahead of time through email (at least two hours before the class), and describe the situation so that I can work with you to accommodate as best as I can. The lab sessions are in-person and they won't be recorded or streamed. Only in case of an emergency or a conference travel, a class may be streamed, or recordings may be shared.

Homeworks & Quizzes: 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. Quizzes often lean heavily on the readings and students who do not keep up with the readings, often do not do well on the quizzes. **Homeworks and quizzes are usually due by 12:30 pm in the following week's class, unless otherwise noted in the schedule.**

Important: You may not receive full credit if you do not follow the assignment submission instructions including file format and naming convention specified on the assignment. You may not receive credit if your file is of the wrong type. <u>Unless otherwise specified, you will always turn in</u> **plots as *.pdf* files and R scripts as *.R* files**.

Group Report and Feedback: During one of our weeks in class, we will have a "Work in Progress" report session where you will bring in a report of what you have so far for the poster to get feedback from a group. This requires submitting a PDF document of your report before the class and another version with the feedback notes, which is due the next day.

Ethics Assignment: This assignment will have you research what it means to think ethically when creating information visualizations. A portion of this assignment will require you to discuss your findings with the class with a group.

Viz-a-thon: You will be assigned to groups of two or three to work on a data visualization project. You will go through the process of finding and visualizing a story in the data (to be given). You will use visualization techniques you have learned so far, or feel free to use other techniques if needed. You will have a week to complete a mini poster. The groups may give feedback to each other in the class session. You must contribute to your group work, demonstrate it in the class session, and participate in the feedback discussion to earn full point.

Final Project & Poster Session: The final project culminates in a poster session that is worth a large percentage of your final grade. The poster project leverages skills developed throughout the semester, including cleaning data, exploring data with visualization techniques, data aggregation, simple design and information organization skills, and quality graphic presentation of data visualizations. **Your final project should reflect not only technical skills but also the ability to find a meaningful story from data (e.g. stories that can help improve lives, decision making, guide public-policy, or reveal a problem, ideally should serve for social good), and tell it compellingly through visualization.** Key deliverables leading up to the final project will be due throughout the semester (Poster Check-ins) to help the students stay on track for this major deliverable.

You **must be present at the iSchool Poster Day** (a school wide event scheduled by the iSchool) 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 that the requirements for posters change each semester. Past examples on Blackboard are provided for your reference.

<u>Grading Table</u>

Grades	Grade Points /Credit	Percentage Range
A	4.000	96%-100%
A-	3.667	93%-95.9%
B+	3.333	90%-92.9%
B	3.000	87%-89.9%
B-	2.667	84%-86.9%
C+	2.333	81%-83.9%
C	2.000	78%-80.9%
C-	1.667	75%-77.9%
F	0	Below 75%

Course Specific Policies on attendance, late work, make up work, examinations if outside normal class time, etc.:

In Class Labs: You are expected to be in class each day. There is no formal attendance policy, but you are expected to actively engage in the class session and be in the lab to complete lab exercises in the class. Labs are due at the end of the lab session. These sessions are where you exercise and learn R concepts, it is your effort that counts rather than submitting perfectly working code. There will be no late submissions or make-ups.

Late work: Late assignments and quizzes will be accepted, but there are consequences. First, 1 point will be automatically deducted, if it is later than one week, more points can be deducted. Second, late assignments may not be graded till the end of the semester.

Participation in Class Activities: You must be present for the Poster Session, and for in class activities such as Work in Progress Report and Ethics discussion to receive credit.

If there are extenuating circumstances that make it impossible for you to come to class or turn in an assignment, please contact me *in advance providing proof (at least two hours before the class)* and I will be happy to work with you.

APPENDIX

SYRACUSE UNIVERSITY STUDENT POLICIES & SERVICES
Effective August 2024

Syracuse University has a variety of policies designed to guarantee that students live and study in a community respectful of their needs and those of fellow students. **These statements are an official part of this course syllabus**.

University Attendance Policy

Attendance in classes is expected in all courses at Syracuse University. Students are expected to arrive on campus in time to attend the first meeting of all classes for which they are registered. Students who do not attend classes starting with the first scheduled meeting may be academically withdrawn as not making progress toward degree by failure to attend.

Academic Integrity Policy

As a pre-eminent and inclusive student-focused research institution, Syracuse University considers academic integrity at the forefront of learning, serving as a core value and guiding pillar of education. Syracuse University's Academic Integrity Policy provides students with the necessary guidelines to complete academic work with integrity throughout their studies. Students are required to uphold both course-specific and university-wide academic integrity expectations such as crediting your sources, doing your own work, communicating honestly, and supporting academic integrity. The full Syracuse University Academic Integrity Policy can be found by visiting class.syr.edu, selecting, "Academic Integrity," and "Expectations and Policy."

Upholding Academic Integrity includes the protection of faculty's intellectual property. Students should not upload, distribute, or share instructors' course materials, including presentations, assignments, exams, or other evaluative materials without permission. Using websites that charge fees or require uploading of course material (e.g., Chegg, Course Hero) to obtain exam solutions or assignments completed by others, which are then presented as your own violates academic integrity expectations in this course and may be classified as a Level 3 violation. All academic integrity expectations that apply to in-person assignments, quizzes, and exams also apply online.

Students found in violation of the policy 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. Students may not drop or withdraw from courses in which they face a suspected violation. Any established violation in this course may result in course failure regardless of violation level.

Use of Artificial Intelligence in Course

Based on the specific learning outcomes and assignments in this course, artificial intelligence is permitted on some projects and recitation assignments. See each assignment instructions for more information about what artificial intelligence tools are permitted and to what extent, as well as citation requirements. **If no instructions are provided for a specific assignment, then no**

use of any artificial intelligence tool is permitted. Any AI use beyond that which is detailed in course assignments is explicitly prohibited except when documented permission is granted.

Conduct of Online Assessments

All academic integrity expectations that apply to in-person quizzes and exams also apply to online quizzes and exams. In this course, all work submitted for quizzes and exams must be yours alone. Discussing quiz or exam questions with anyone during the quiz or exam period violates academic integrity expectations for this course.

Using websites that charge fees or require uploading of course material (e.g., Chegg, Course Hero) to obtain exam solutions or assignments completed by others and present the work as your own violates academic integrity expectations in this course and may be classified as a Level 3 violation, resulting in suspension or expulsion from Syracuse University.

Religious Observances Notification and Policy

[Syracuse University's Religious Observances Policy](#) 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 traditions. Under the policy, students are given 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 academic drop deadline. For observances occurring before the drop deadline, notification is required at least two academic days in advance. Students may enter their observances in MySlice under Student Services/Enrollment/My Religious Observances/Add a Notification.

Disability-Related Accommodations

Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. There may be aspects of the instruction or design of this course that result in barriers to your inclusion and full participation in this course. I invite any student to contact me to discuss strategies and/or accommodations (academic adjustments) that may be essential to your success and to collaborate with the Center for Disability Resources (CDR) in this process.

If you would like to discuss disability-accommodations or register with CDR, please visit [Center for Disability Resources](#). Please call (315) 443-4498 or email disabilityresources@syr.edu for more detailed information.

The CDR is responsible for coordinating disability-related academic accommodations and will work with the student to develop an access plan. Since academic accommodations may require early planning and generally are not provided retroactively, please contact CDR as soon as possible to begin this process.

Discrimination or Harassment

Federal and state law, and University policy prohibit discrimination and harassment based on sex or gender (including sexual harassment, sexual assault, domestic/dating violence, stalking, sexual exploitation, and retaliation). If a student has been harassed or assaulted, they can obtain confidential counseling support, 24-hours a day, 7 days a week, from the Sexual and Relationship Violence Response Team at the Counseling Center (315-443-8000, Barnes Center at The Arch, 150 Sims Drive, Syracuse, New York 13244). Incidents of sexual violence or harassment can be reported non-confidentially to the University's Title IX Officer (Sheila Johnson Willis, 315-443-0211, titleix@syr.edu, 005 Steele Hall). Reports to law enforcement can be made to the University's Department of Public Safety (315-443-2224, 005 Sims Hall), the Syracuse Police Department (511 South State Street, Syracuse, New York, 911 in case of emergency or 315-435-3016 to speak with the Abused Persons Unit), or the State Police (844-845-7269). I will seek to keep information you share with me private to the greatest extent possible, but as a professor I have mandatory reporting responsibilities to share information regarding sexual misconduct, harassment, and crimes I learn about with the University's Title IX Officer to help make our campus a safer place for all.

Health and Wellness

Mental health and overall well-being are significant predictors of academic success. As such it is essential that during your college experience you develop the skills and resources effectively to navigate stress, anxiety, depression, and other mental health concerns. Please familiarize yourself with the range of resources the Barnes Center provides (https://ese.syr.edu/bewell/) and seek out support for mental health concerns as needed. Counseling services are available 24/7, 365 days, at 315-443-8000.

Course Evaluations

At the end of the term, the iSchool will ask you to share course feedback through EvaluationKIT [https://coursefeedback.syr.edu]. Log in to EvaluationKIT using your NetID and password. Please take the time to share your feedback about this course and your experience in it; all ratings and comments are completely anonymous. The iSchool carefully reviews your feedback. Our instructors use this feedback to fine tune course delivery and instruction; our professors of record use this feedback to fine tune course content and assignments. All feedback is factored into iSchool decisions about course, program, and instructor development.

Use of Blackboard

This class will use the Blackboard Learning Management to house the syllabus, course content, links to external course materials, assignments, quizzes, exams, feedback, and grades. Note

when submitting materials that the University's Blackboard Learning Management System is on Eastern Time.

Information about Blackboard is available on Answers Blackboard; alternatively, you can contact Information Technology Services by sending an email to help@syr.edu, calling 315.443.2677, or in-person at the ITS Service Center, located at 1-227 CST in the Life Sciences Complex. Business hours for the Service Center can be found on the ITS Website at http://its.syr.edu/its_service_center/

Course Schedule (subject to change):

Week	Date	Topic	Weekly readings (*optional/suggested) & Other coursework	Coursework due dates
1	**1/16**	**What is information visualization? What is R?** **Learning Outcomes** - Students will be able to: ● Differentiate between Information Visualization and other prominent forms of visualization ● Describe the two main purposes of Information Visualization: exploration and communication ● Describe the 7 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	**Lab 1**: R and Basic Plots **Readings**: ● VT: Chapters 1 and 2 ● DP: Chapters 1 and 2 ● Ben Fry, Visualizing Data Ch 1 ● *R4DS Intro and Ch4 **Quiz 1 posted**	**Lab 1**

| 2 | 1/23 | **Data and R: Dplyr&Data Wrangling**

Learning Outcomes – Students will be able to:
● 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 RBase and Dplyr to retype, subset and filter data
● Create rough data exploration plots | **Lab 2**: Exploring Data in R

Readings:
● DP: Chapter 3
● DP: Ch 4, pages 189 to 199
● VT: Chapters *3 and 4

HW-1: Reproduce Figures (in R) in VT Chapter 4 and answer questions given on the art.csv dataset

HW 2 (POSTER CHECK-IN) posted: Find a dataset, share the link, and write your data story idea to the discussion board. | ● **Lab 2**

● **Quiz 1** due (Th, 1/23 12:30pm) |
| 3 | 1/30 | **Using Data Libraries and visualizing multi-dimensional data**

Learning Outcomes - Students will be able to:
● Find datasets from online data libraries
● Describe ways to make comparisons with visualizations
● Describe ways to identify and show relationships in data
● Differentiate between single and multi-dimensional plots
● Use R to make a variety of multi-dimensional plots
● Identify the appropriate plot type for a given set of data | **Lab 3:** Visualizing multi-dimensional data

HW-3 posted: Answer questions given on Blackboard using the art.csv dataset | ● **Lab 3**

● **HW-1 due** (Th, 1/30, 12:30pm) |

| 4 | 2/6 | **Covering ggplot**

Learning Outcomes – Students will be able to:
Describe the elements of the grammar of graphics needed to build a ggplot plot Build simple and complicated plots using ggplot Describe the pros and cons of ggplot and when not to use it | **Lab 4:** ggplot 2

Readings:
•*Introduction and Data Visualization sections in R4DS | **Lab 4**

HW2 (POSTER CHECK-IN), due (Th, 2/6, 12:30 pm) |
| 5 | 2/13 | **Advanced ggplot**

Learning Outcomes – Students will be able to:
Build more advanced plots using ggplot Identify the appropriate plot type based on the data type | **Lab 5:** advanced graphs with ggplot2

Readings:
• Explore R Graph Gallery https://r-graph-gallery.com/
• *Ch 2 and 3 in R4DS

Quiz 2 posted

HW 4 (POSTER CHECK-IN) posted: Visualizing your data, creating a visual report of your dataset (1st draft of Work in Progress Report) | **Lab 5**

HW-3 due (Th 2/13, 12:30 pm) |

6	2/20	**Finding and telling the story in the data & Illustrator Introduction** **Learning Outcomes** - Students will be able to: ● 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	**Lab 6:** Illustrator Intro **Readings:** ● DP: Chapters 4 ● Few: Chapter 3 ● VT: Chapter 4 (Illustrator parts) **HW 5**: Illustrator portions of VT, Ch 4 plots	**Lab 6** **Quiz 2 due** (Th, 2/20, 12:30 pm)
7	2/27	**Advanced Plots: Maps** **Learning Outcomes** – Students will be able to: ● Prepare geographic based data for plotting ● Create national, regional and world map plots in R ● Enhance cognitive apprehension of complex maps through the use of design elements	**Lab 7**: Maps **Readings**: ● VT: Chapter 8 ● R graph gallery **Work on your HW 4 (POSTER CHECK-IN)**	**Lab 7** **HW5 due** (Th, 2/27, 12:30 pm)
8	3/6	**Graphic Design Principles: Color tools and R color functions** **Learning Outcomes** – Students will be able to: ● Describe the use of contrasting and harmonious color in visualization	**Lab 8**: Working with color tools and Illustrator. **Reading**: ● DP: Chapter 5 ● *DP: Chapter 4 ● *VT: Chapter 6	**Lab 8** **HW 4 (POSTER CHECK-IN)** due (Th, 3/6, 12:30 pm)

		- 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	***Exercise**: Create plots in VT Chapter 6 while reading **Homework:** Work on your work in progress report (WiP) for group feedback	
9	**3/9-3/16**	**SPRING BREAK - NO CLASS**		
10	**3/20**	**Graphic Design Principles: Type Face & Layout, R plot area control, Illustrator** **Learning Outcomes** – Students will be able to: - 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 - Use illustrator to create poster sized, high quality vector graphic ready for printing - Use Illustrator to merge 2 or more plots and incorporate context text and design elements	**Lab 10:** Layouts **Readings:** • DP: Chapter 6 • VT: Chapter 9 • Few: Chapter 4 **Quiz 3 posted** ·Viz-a-thon dataset posted (Fri, 3/28, 5pm)	**Lab 10**

11	3/27	**Viz-a-thon** 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 **Learning Outcomes** – Students will be able to: ● Demonstrate knowledge of the process of creating a visual artifact ● Work in a group to create a mini-poster from an unknown dataset	**Homework:** Work on your posters	● **Quiz 3 due** (Th, 4/3, 12:30 pm) ● **Viz-a-thon mini group posters due** (Fri, 4/4, 5pm)
12	4/3	**Data Scaling, Word Clouds and Ethics Discussion** **Learning Outcomes –** Students will be able to: ● Visualize data effectively using scaling ● Visualize non-numerical data using word clouds ● Critically assess visualizations ● Identify visual credibility markers ● Discuss the ethical concerns around visual artifacts	**Lab 12:** Scaling and word cloud **Groups work:** ● Ethics discussion ● Peer review of Viz-a-thon posters **Readings:** ● See Blackboard for readings and videos on ethics **Quiz 4 posted**	**Lab 12** **Ethics discussion write up due** (Th, 4/10)
13	4/10	**Work-in-Progress Group Feedback and Network Analysis** **Learning Outcomes –** Students will be able to: ● Critically assess visualizations ● Identify the audience for a visual artifact ● Identify visual credibility markers ● Create graphs using social network data	**Lab 13:** Social Network Analysis **Groups work:** **Work in Progress report (WiP) feedback discussion (POSTER CHECK-IN)** **Readings:** ● See Blackboard for instructions on WiP report **Homework:**	● **Lab 13** ● **WiP report (POSTER CHECK-IN) due** (Th, 4/17) ● **Quiz 4 due** (Th, 4/17, 12:30 pm)

			Implement feedback you received from WiP report discussion and work on your poster	
14	**4/17**	**Interactivity in R Plotting: Shiny** **Learning Outcomes** – Students will be able to: Create an online interactive visualization application	**Lab14**: RStudio's Shiny extension Completing course feedback survey	**Lab 14**
15	**4/24**	**Final Poster Work**	**Lab15:** • **Work on your final posters!** • **Complete and print your posters**	**Final Posters Due (4/25, 9 am)**
	4/25	**The iSchool Poster Day 11:00AM-1:00PM** Students present their posters at the iSchool Poster Day	**Present your posters**	