Syllabus

Course description

INFO 526 - This course provides an overview of the various concepts and skills required for effective data visualization. It presents principles of graphic design, programming skills, and statistical knowledge required to build compelling visualizations that communicate effectively to target audiences. Visualization skills addressed in this course include choosing appropriate colors, shapes, variable mappings, and interactivity based on principles of color perception, pre-attentive processing, and accessibility.

Introduction

Data Visualization is a blend of art and science. Throughout this course, we'll focus on three aspects: what, why, and how. 'What' relates to choosing appropriate visualizations and tools for specific purposes, such as maps for spatial data or R packages for tooling. 'How' involves the process from design to execution, starting with a rough sketch and pseudocode, data pre-processing, aesthetic mapping, strategic decision-making, and ending with post-processing for visual appeal. 'Why' delves into the theory linking 'what' and 'how', often emphasizing the grammar of graphics. We encourage an iterative approach, learning through critique and repeated trials. Additional modules will cover statistical graphics, data-based art, and non-visual data representation.

Prerequisites

Strong quantitative, statistical, and analytical reasoning abilities are needed to succeed in this course.

This course assumes that this is not your first interaction with working with data in R, using RStudio, and along with version control with Git, and collaboration on GitHub. The course will start with a quick review of the relevant technologies.

Learning goals

- Understand the principles of designing and creating effective data visualizations.
- Evaluate, critique, and improve upon one's own and others' data visualizations based on how good a job the visualization does for communicating a message clearly and correctly.
- Post-process and refine plots for effective communication.
- Use visualizations for evaluating statistical models and for statistical inference.
- Master using R and a variety of modern data visualization packages to create data visualizations.
- Work reproducibly individually and collaboratively using Git and GitHub.

Textbooks

Readings for the course will come from the following textbooks. All of them are **freely available online** and you do not need to purchase a physical copy of either book to succeed in this class.

1. `[ggplot2-book]` Hadley Wickham, Danielle Navarro, and Thomas Lin Pedersen. ggplot2: Elegant Graphics for Data Analysis. (in progress) 3rd edition. Springer, 2022.
2. `[socviz]` Kieran Healy. Data Visualization: A Practical Introduction. Princeton University Press, 2018.
3. `[fdv]` Claus O. Wilke. Fundamentals of Data Visualization. O'Reilly Media, 2019.
4. `[r4ds]` Hadley Wickham, Mine Çetinkaya-Rundel, and Garrett Grolemund. R for Data Science. 2nd edition. O'Reilly, 2022.

Course community

UArizona Community Standard

All students must adhere to the UArizona Student Rights & Responsibilities: The University of Arizona is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, and accountability. Citizens of this community commit to reflect upon these principles in all academic and non-academic endeavors, and to protect and promote a culture of integrity.

To uphold the UArizona Community Standard, students agree:

- I will not lie, cheat, or steal in my academic endeavors;
- I will conduct myself honorably in all my endeavors; and
- I will act if the Standard is compromised.

Inclusive community

It is my intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity and in alignment with UArizona's Commitment to Diversity and Inclusion. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally, or for other students or student groups.

Furthermore, I would like to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honors your identities. To help accomplish this:

- If you have a name that differs from those that appear in your official UArizona records, please let me know! You'll be able to note this in the Getting to know you survey.
- If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. If you prefer to speak with someone outside of the course, your academic dean is an excellent resource.
- I (like many people) am still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please let me or a member of the teaching team know.

Preferred Name & Pronoun

This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. Feel free to correct instructors on your preferred gender pronoun. If you have any questions or concerns, please do not hesitate to contact me directly in class or via email (instructor email). If you wish to change your preferred name or pronoun in the UAccess system, please use the following guidelines:

Preferred name: University of Arizona students may choose to identify themselves within the University community using a preferred first name that differs from their official/legal name. A student's preferred name will appear instead of the person's official/legal first name in select University-related systems and documents, provided that the name is not being used for the purpose of misrepresentation. Students are able to update their preferred names in UAccess.

Pronouns: Students may designate pronouns they use to identify themselves. Instructors and staff are encouraged to use pronouns for people that they use for themselves as a sign of respect and inclusion. Students are able to update and edit their pronouns in UAccess.

More information on updating your preferred name and pronouns is available on the Office of the Registrar site at https://www.registrar.arizona.edu/records-enrollment/personal-information/updating-personal-information(link is external).

Accessibility

If there is any portion of the course that is not accessible to you due to challenges with technology or the course format, please let me know so we can make appropriate accommodations.

The Disability Resource Center is available to ensure that students are able to engage with their courses and related assignments. Students should be in touch with the Disability Resource Center to request or update accommodations under these circumstances.

Communication

All lecture notes, assignment instructions, an up-to-date schedule, and other course materials may be found on the course website: vizdata.org.

I will regularly send course announcements via email and D2L, make sure to check one or the other of these regularly. If an announcement is sent Monday through Thursday, I will assume that you have read the announcement by the next day. If an announcement is sent on a Friday or over the weekend, I will assume that you have read it by Monday.

Where to get help

- If you have a question during lecture, feel free to ask it! There are likely other students with the same question, so by asking you will create a learning opportunity for everyone.
- The teaching team is here to help you be successful in the course. You are encouraged to attend office hours to ask questions about the course content and assignments. Many questions are most effectively answered as you discuss them with others, so office hours are a valuable resource. Please use them!
- Outside of class and office hours, any general questions about course content or assignments should be posted on the course Slack. There is a chance another student has already asked a similar question, so please check the other posts on Slack before adding a new question. If you know the answer to a question posted on Slack, I encourage you to respond!

Check out the Support page for more resources.

I want to make sure that you learn everything you were hoping to learn from this class. If this requires flexibility, please don't hesitate to ask.

- You *never* owe me personal information about your health (mental or physical) but you're always welcome to talk to me. If I can't help, I likely know someone who can.
- I want you to learn lots of things from this class, but I primarily want you to stay healthy, balanced, and grounded during this crisis.

Lectures

The goal of the lectures is for them to be as interactive as possible. My role as instructor is to introduce you new tools and techniques, but it is up to you to take them and make use of them. A lot of what you do in this course will involve writing code, and coding is a skill that is best learned by doing. Therefore, as much as possible, you will be working on a variety of tasks and activities throughout each lecture and lab. Attendance will not be taken during class but you are expected to attend all lecture and lab sessions and meaningfully contribute to in-class exercises and discussion.

You are expected to bring a laptop to each class so that you can take part in the in-class exercises. Please make sure your laptop is fully charged before you come to class as the number of outlets in the classroom will not be sufficient to accommodate everyone. See the UArizona Libraries loaner technology if you need a loaner laptop.

Assessment

Assessment for the course is comprised of four components: attendance and participation, reading quizzes, homework assignments, and projects.

- **Attendance and participation** is required throughout the semester. Students who attend at least 80% of the lectures and participate regularly during lecture will receive full credit for this portion of their grade. Participation in labs as well as on Slack will also count towards this component.
- **Reading quizzes** (6), due every other week (roughly), completed individually. Each quiz is worth 2% of the grade. Lowest quiz score is dropped.

  Reading quizzes will be linked from the course schedule. They always cover reading that is due since the previous quiz and up to and including the deadline for the given quiz. They're due by 12pm ET (beginning of class) on the indicated day on the course schedule.
- **Homework assignments** (6), due every other week (roughly), completed individually. Each homework assignment is worth 8% of the course grade. Lowest homework assignment score is dropped.

  Homework assignments are due by 12pm ET (beginning of class) on the indicated day on the course schedule.

- **Projects** (2), mid-semester and end of semester, completed in teams.
  - Project 1: Teams will be given a dataset to visualize. Project 1 is worth 15% of the course grade.
  - Project 2: Teams will pick a dataset of interest to them and/or build an R package that implements a new type of data visualization in R. Project 2 is worth 25% of the course grade.

  The deliverables for each project will include a data visualization, a write up of the process and findings, and a presentation. For the second project, you will be encouraged to think beyond a traditional two-dimensional data visualization (e.g. interactive web apps/dashboards, data art, generative art, physical/tangible visualizations, **ggplot2** extensions, etc.).

  Each project will have a peer review component to provide at least one round of feedback during the process of development. Teams will provide periodic peer feedback to their teammates while working on the projects as well as upon completion. The scores from the peer evaluations, along with individual contributions tracked by commits on GitHub, will be used to ensure that each student has contributed to the teamwork.

  All team members must take part in the presentation. Presentations can be given in person in class, or via Zoom if the team prefers. My preference is that the team stick to one method of delivery (all presenters in person or all presenters on Zoom), but I realize a lot can change throughout this semester, and we'll adjust accordingly.

All work is expected to be submitted by the deadline and there are no make ups for any missed assessments. See [Late work policy] for policies on late work.

Grading

The final course grade will be calculated as follows:

Category	Percentage
Attendance and participation	5%
Reading quizzes	10%
Homework assignments	45%
Project 1	15%
Project 2	25%

The final letter grade will be determined based on the following thresholds:

Letter Grade	Final Course Grade
A	>= 93
A-	90 - 92.99
B+	87 - 89.99
B	83 - 86.99
B-	80 - 82.99
C+	77 - 79.99
C	73 - 76.99
C-	70 - 72.99
D+	67 - 69.99
D	63 - 66.99
D-	60 - 62.99
F	< 60

These are upper bounds for grade cutoffs, depending on the class performance the cutoffs may be lowered but they won't be increased.

Teams

You will be assigned to a different team for each of your two projects. You are encouraged to sit with your teammates in lecture and you will also work with them in the lab sessions. All team members are expected to contribute equally to the completion of each project and you will be asked to evaluate your team members after each assignment is due. Failure to adequately contribute to an assignment will result in a penalty to your mark relative to the team's overall mark.

You are expected to make use of the provided GitHub repository as their central collaborative platform. Commits to this repository will be used as a metric (one of several) of each team member's relative contribution for each project.

Course policies

Academic honesty

TL;DR: Don't cheat!

Students are expected to abide by The University of Arizona Code of Academic Integrity. 'The guiding principle of academic integrity is that a student's submitted work must be the student's own.' If you have any questions regarding what acceptable practice under this Code is, please ask an Instructor.

Please abide by the following as you work on assignments in this course:

- **Collaboration:** Only work that is clearly assigned as team work should be completed collaboratively.
- The reading quizzes must be completed individually with absolutely no communication with classmates.
- The homework assignments must also be completed individually and you are welcomed to discuss the assignment with classmates at a high level (e.g., discuss what's the best way for approaching a problem, what functions are useful for accomplishing a particular task, etc.). However you may not directly share answers to homework questions (including any code) with anyone other than myself and the teaching assistants.
- For the projects, collaboration within teams is not only allowed, but expected. Communication between teams at a high level is also allowed however you may not share code or components of the project across teams.
- **Sharing and reusing code:** I am well aware that a huge volume of code is available on the web to solve any number of problems. Unless I explicitly tell you not to use something, the course's policy is that you may make use of any online resources (e.g. RStudio Community, StackOverflow) but you must explicitly cite where you obtained any code you directly use (or use as inspiration). Any recycled code that is discovered and is not explicitly cited will be treated as plagiarism. On individual assignments you may not directly share code with another student in this class, and on team assignments you may not directly share code with another team in this class.
- **Generative AI (e.g., ChatGPT):** I am additionally aware of the potential code AI for coding (I taught a workshop on it…). While these tools are amazing, learners should be aware of the impacts that using such tools can have on core competency. David Humphrey, a computer science professor, **wrote about ChatGPT and its potentially negative impacts on core learning.** It is a good read about the pitfalls of using generative AI in an educational context. By using a generative AI, learners may miss the opportunity to discover how something works and why things are done that way. It is also important to note that the iSchool generally bans utilizing ChatGPT and generative AI in our Academic Integrity Policy.

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: https://deanofstudents.arizona.edu/policies/code-academic-integrity(link is external).

Late work & extensions

The due dates for assignments are there to help you keep up with the course material and to ensure the teaching team can provide feedback within a timely manner. We understand

that things come up periodically that could make it difficult to submit an assignment by the deadline.

Policy on late work depends on the particular course component:

- Reading quizzes: Late quizzes are not accepted and there are no make ups for missed quizzes.
- Homework assignments: GitHub repositories will be closed to contributions at the deadline. If you need to submit your work late, send a DM on Slack to me to reopen your repository.
  - Late, but same day (before midnight): -10% of available points
  - Late, but next day: -20% of available points
  - Two days late or later: No credit, and we will not provide written feedback
- Projects: The following three components contribute to your project score.
  - Presentation: Late presentations are not accepted and there are no make ups for missed presentations.
  - Write up: GitHub repositories will be closed to contributions at the deadline. If you need to submit your work late, Slack/email me to reopen your repository.
    * Late, but same day (before midnight): -10% of available points
    * Late, but next day: -20% of available points
    * Two days late or later: No credit, and we will not provide written feedback
  - Peer evaluation: Late peer evaluations are not accepted and there are no make ups for missed presentations. If you do not turn in your peer evaluation, you get 0 points for your own peer score as well, regardless of how your teammates have evaluated you.

Waiver for extenuating circumstances

If there are circumstances that prevent you from completing a lab or homework assignment by the stated due date, you may email me (mailto:gchism@arizona.edu) before the deadline to waive the late penalty. In your email, you only need to request the waiver; you do not need to provide explanation. This waiver may only be used for once in the semester, so only use it for a truly extenuating circumstance.

If there are circumstances that are having a longer-term impact on your academic performance, please let your academic dean know, as they can be a resource. Please let me know if you need help contacting your academic dean.

Regrade requests

Regrade requests must be made within one week of when the assignment is returned, and must be typed up and submitted via email to me. These will be considered if points were tallied incorrectly or if you feel your answer is correct but it was marked wrong. No regrade will be made to alter the number of points deducted for a mistake. There will be no grade changes after the second project presentations. Note that during the regrade process your score could go up or go down or not change.

No grades will be changed after the project presentations.

"Incomplete" grade

The grade of "I" may be awarded only at the end of a term, when all but a minor portion of the course work has been satisfactorily completed. The grade of I is not to be awarded in place of a failing grade or when the student is expected to repeat the course; in such a case, a grade other than I must be assigned. Students should make arrangements with the instructor to receive an incomplete grade before the end of the term, ..., If the incomplete is not removed by the instructor within one year the I grade will revert to a failing grade.

Attendance policy

Responsibility for class attendance rests with individual students. Since regular and punctual class attendance is expected, students must accept the consequences of failure to attend.

However, there may be many reasons why you cannot be in class on a given day, particularly with possible extra personal and academic stress and health concerns this semester. All course lectures will be recorded and available to enrolled students after class. If you miss a lecture, make sure to watch the recording and review the material before the next class session. Overall this policy is put in place to ensure communication between team members, respect for each others' time, and also to give you a safety net in the case of illness or other reasons that keep you away from attending class.

Note that attendance and participation is part of your grade as well.

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at https://catalog.arizona.edu/policy/class-attendance-and-participation

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable: http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences pre-approved by the UA Dean of Students (or dean's designee) will be honored. See https://deanofstudents.arizona.edu/policies/attendance-policies-and-practices

Attendance policy related to COVID symptoms, exposure, or infection

Student health, safety, and well-being are the university's top priorities. To help ensure your well-being and the well-being of those around you, please do not come to class if you have symptoms related to COVID-19, have had a known exposure to COVID-19, or have tested positive for COVID-19. If any of these situations apply to you, you must follow university guidance related to the ongoing COVID-19 pandemic and current health and safety protocols. If you are experiencing any COVID-19 symptoms, contact student health at (520) 621-9202. To keep the university community as safe and healthy as possible, you will be expected to follow these and the university guidelines on COVID-19 mitigation. Please reach out to me and your academic dean as soon as possible if you need to quarantine or isolate so that we can discuss arrangements for your continued participation in class.

Notify your instructor(s) if you will be missing up to one week of course meetings and/or assignment deadlines

If you must miss the equivalent of more than one week of class and have an emergency, the Dean of Students is the proper office to contact (DOS-deanofstudents@email.arizona.edu). The Dean of Students considers the following as qualified emergencies: the birth of a child, mental health hospitalization, domestic violence matter, house fire, hospitalization for physical health (concussion/emergency surgery/coma/COVID-19 complications/ICU), death of immediate family, Title IX matters, etc.

Please understand that there is no guarantee of an extension when you are absent from class and/or miss a deadline.

Inclement weather policy

In the event of inclement weather or other connectivity-related events that prohibit class attendance, I will notify you how we will make up missed course content and work. This might entail holding the class on Zoom synchronously or watching a recording of the class.

Accommodations

Academic accommodations

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu/(link is external)) to establish reasonable accommodations.

See http://drc.arizona.edu/instructors/syllabus-statement(link is external).

Religious accommodations

Students are permitted by university policy to be absent from class to observe a religious holiday. You can find the policy and relevant information here.

Nondiscrimination and Anti-Harassment Poilicy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy(link is external).

Safety on Campus and in the Classroom

For a list of emergency procedures for all types on incidents, please visit the website of the Critical Incident Response Team (CIRT): https://cirt.arizona.edu/case-emergency/overview(link is external).

Also watch the following video.

Note: If you've read this far in the syllabus, email me a picture of your pet if you have one or your favorite meme!

Important dates

- **Monday, August 21:** Classes begin, Monday schedule
- **Monday, August 28:** Drop/add ends
- **Monday, September 4:** Labor Day, no class
- **Sunday, September 17:** Last day to drop without a W (withdraw)
- **Sunday, October 29**: Last day to withdraw from a class online through UAccess
- **Friday, November 10**: Veteran's Day, limited support available
- **Thursday - Sunday, November 23 - 26**: Thanksgiving recess, no support available
- **Tuesday, December 12**: Project 2 presentations

For more important dates, see the full UArizona Academic Calendar.