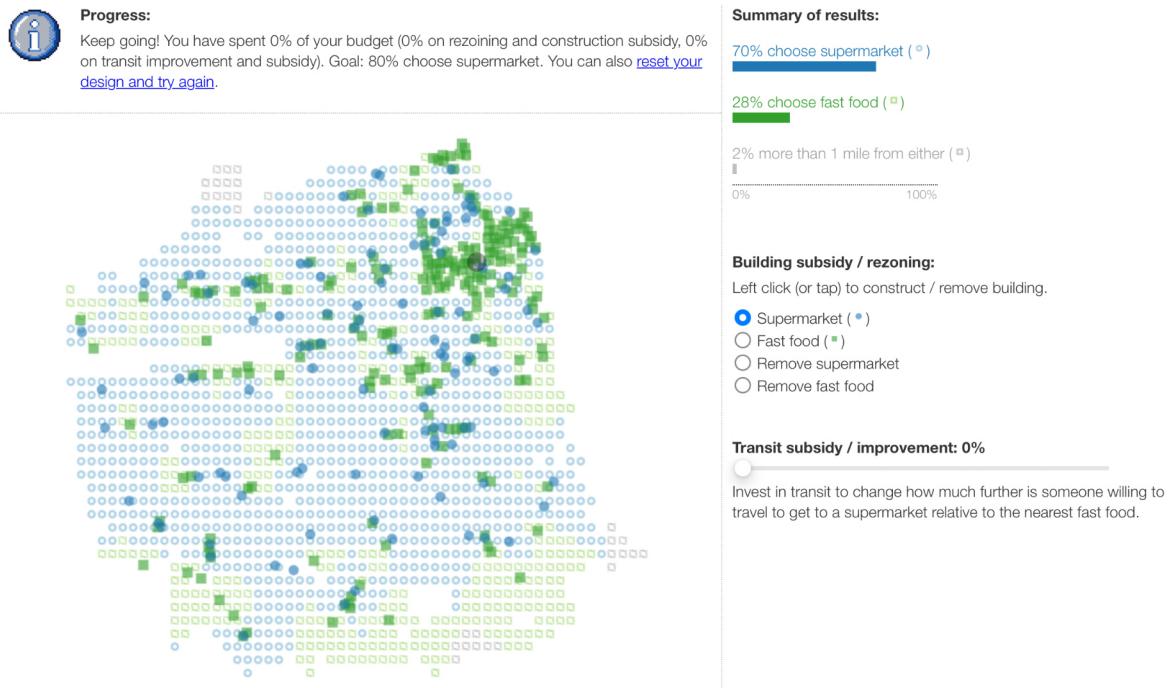


Interactive Data

Science and Visualization



Student Manual Spring 2025

Hello



Welcome!

I'm excited that you are joining us this semester as we explore interactive data science and visualization.

My name is Sam. Prior to UC Berkeley, I was at Google, Apple, IDEO, and various start ups. Here on campus, I'm a published researcher at the university's Schmidt Center for Data Science and Environment. Come say hi in Wellman Hall!

Most of my current focus is on crafting tools for policy makers to engage science in their work. This course is about building those kinds of digital environments that let us see the world around us in new ways through data. Specifically, we will construct "dialectic" experiences through which users can co-create narrative and build new knowledge in partnership with interactive "media for thought" (Victor 2011). We are going to journey through cognitive science, information design, game design, and more to explore how these ingredients come together within world-class tools for modern sense-making.

That's enough about me. Let's talk about you! I'm excited to have you here as future story-tellers, designers, scientists, and engineers. This hands-on course will help you build sophisticated interactive tools. Regardless of if you may be making those experiences for others or for yourself, our time together will focus on the ways we see information and construct knowledge. At the end of the course, you will be well versed in information design. We will use readings, short hands-on practice projects, a longer hands-on interactive experience, a capstone, and collaborative in-person discussion to get there.

This "student manual" gives you everything you need to navigate the course. While the syllabus offers an overview of the schedule with weekly lecture and assignments, this complements those materials with details on each reading and project. Also, to help you set time expectations, it outlines estimated duration for each activity.

I'll end this welcome letter with something a mentor told me once: design is an act of hope. When we do this work, we are engaging in optimism and practice of building a brighter, stronger, and more inclusive future.

Thank you for joining me!

Read

The take-home materials help you come into each in-person session with the right background knowledge to make our time together successful. Sometimes this will be reading and, other times, this will be video or audio. Regardless, these resources are often introductory but typically also point to more material if you want to dig in deeper.

There are 17 required readings, each taking about an hour. As documented later, there are also 5 additional readings for the capstone project. Additionally, some students with less Python familiarity are given access to an open textbook (A Byte of Python) but, for those already comfortable with the programming language, there are 4 optional replacement readings I ask you do instead (in light grey). Finally, 2 hours of “reading time” are allotted to explore articles for your interactive experience. In total, this comes to 28 hours across the semester.

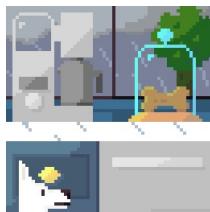
Due dates are on the left, corresponding with lecture materials. Citations in the syllabus. Access instructions sent by email. Readings do not have submissions but you are welcome to discuss with the rest of the class.



Remainder:
Readings for Final
and Interactive
Experience

Week	Monday	Wednesday
1		Jan 22
2	Jan 27 Media for Thinking the Unthinkable (Victor)	Jan 29 Dealing with Open Source Licenses (Winslow)
3	Feb 03	Feb 05 Review of Tufte (LeRoy)
4	Feb 10 Preattentive Attributes in Visualization (Kesavan)	Feb 12 Inventing on Principle (Victor)
5	Feb 17	Feb 19 OpenProcessing
6	Feb 24 Genuary	Feb 26
7	Mar 03 William Cleveland (Princeton)	Mar 05 From Data to Viz (Holtz 2018)
8	Mar 10 15 View on a Node Link Graph (Munzner)	Mar 12 Dear Data (Luipi and Posavec)
9	Mar 17 Designing for Realtime Spacecraft (Binx)	Mar 19 Bad Doors (Posner et al)
10	Mar 31 Explorable Explanations (Victor) Role of the Player (Portnow)	Apr 02 Last Guardian: Language of Games (Brown)
11	Apr 07 Super Mario Level 1-1 (Emmons and Portnow) Zelda Open World (Brown)	Apr 09 Storytelling with Verbs (Tremblay) Birth of a Game (Wright)
12	Apr 14 Games are for Everyone (Brown)	Apr 16 What Ethical AI Really Means (Thorne) Eyeo 2019 (Costanza- Chock)
13	Apr 21 World Design of Metroid (Brown)	Apr 23

Experience



We are going to look at a lot of short examples together. However, to learn how to create these interactive tools, it's important that go beyond looking and discussing... we have to actually play. In addition to video games having a lot of valuable lessons to share about creating dialectic digital spaces, they also teach us how to critically interrogate interactive designs as we experience them. Therefore, one of our activities ("interactive experience") is to play one of the games below. This will be further discussed in class. Please select one of these games and play with sound on if possible.

Ludic Elements / Ludonarrative

Pope (2013)

Papers Please



What message do the ludic elements convey?
What is gained by having the player take action to advance the narrative?

Thunder Lotus (2020)

Spiritfarer



How does the game build the player's investment in the characters?
How does food interact with the broader narrative and character building?

Dynamic Narrative / Design

Deconstructteam (2023)

Cosmic Wheel



How do the player and game respond to each other?
To what degree does the player have agency over the narrative?

Ma and Davis (2012)

FTL



How does the game build tension if you can pause?
What is the effect of limiting the player to a subset of content?

Environmental / Atmospheric Storytelling

Brier et al (2021)

Unpacking



Would the game be different with dialogue?
How does the game use solution validity to build its narrative?

Kice (2022)

Afterplace



How can dialogue / signage serve multiple roles?

How does the game build "vibe" of different areas outside of dialogue?

While going through these games, please identify the primary and secondary loops in addition to reflecting on the game-specific questions above. Depending on guest lecture schedule, we will plan to do a reflection on our experiences as a group around April 7 but please post when done! Depending on the guest lectures, these small group discussions may be during regular class or at alternative times to be scheduled later.

Some of these games have combat (🏃) and some deal with some heavier topics (❤️). I can give you a heads up if there are certain things you want to avoid. Also, many have non-subscription equivalent iOS / Android (📱) versions. Some games can (potentially) be completed within the 4 hours of homework time set aside for gameplay (⏳). We will also give 2 hours for reading reviews and articles about your game but you may convert those 2 reading hours to additional play time if desired. Regardless, all are chosen because you should be able to pick up on the key lessons (for the course) by the end of those 4 - 6 hours. Finally, an alternative assignment is available in which you can write two short essays about existing interactive visualizations. Please talk to me if this alternative is of interest.

Exercise

Short assignments foster active exploration of concepts discussed in each lecture. On average, each activity will take 2 hours to complete. Some assignments require coding but others may, for example, be drawing or short writings. Though we provide instruction in Sketchingpy, alternative technologies may be used if desired and pre-approved. The details of each assignment are provided below. These are due 2 days after lecture date below. There are 14 of these short assignments in total for 28 expected hours.



Jan 22

Async introductions

For getting warmed up, we will exchange short introductions online. Please write about 4 sentences introducing yourself and what you are hoping to gain from the course. Include an image describing yourself that isn't a photograph of yourself.

Jan 27

Example visualization 1

Find a visualization from your daily life. For example, this could include a graphic from the news or a textbook. What do you think the piece's intended message is? How does the author convey this message? Post 4 - 8 sentences with your answers and a link to the piece.

Jan 29

Example visualization 1 through 4 perspectives.

Revisit a visualization posted by someone else from last assignment. What might the 4 perspectives say about this visualization? Please post 4 - 8 sentences.

Feb 05

Example visualization 2

Find another visualization but, this time, limit yourself to just the sources types provided by Sam. What is the intended message? How does the visualization convey this message? What might the 4 perspectives say about this visualization? Please post 4 - 8 sentences with a link.

Feb 10 / Feb 12

Job satisfaction (Remix)

Plot job satisfaction from the Stack Overflow Developer Survey using your preferred software. This can be done in spreadsheet software. Please provide 2 - 4 sentences describing how this representation uses pre-attentive features. May be a heat map but other charts welcome. For follow up, re-use the variables from someone else's submission but choose a different representation. Describe how your plot uses pre-attentive features.

Feb 19

Creative Code 1

Build an art piece that is drawn using code. For this first submission, please do not make it interactive yet. Post your code and a screenshot.

Feb 26

Creative Code 2

In this next step, we will add interactivity. You can do this either by continuing the previous art piece or creating a new one. Post your code and a screenshot. Feel free to take a look around at other submissions for inspiration and remixing.

Mar 03

Census 1 / Income inequality with 4 variables

Visualize 4 variables of the income inequality dataset with a design guided by the recent course material. Please make this version without interactivity. Post your code and a screenshot!

Mar 05

Census 2 / Income inequality with 6 variables

Visualize 6 variables of the income inequality dataset with a design guided by the recent course material. This can be a continuation of the last assignment or a fresh attempt. Please make this without interactivity. Post your code and a screenshot!

Mar 10

Manual visualizations

Draw your last 5 years and your next 5 years by hand. Take a photo and post.

Mar 12

BART 1

Visualize the BART dataset with a minimum of 3 variables. You do not need to show everything. For example, you may choose to focus on a single station. Please do not make this version with interactivity. Post your code and a screenshot!

Mar 17

Think-Aloud of Pyafscgap

Record yourself on zoom or similar doing a Think Aloud of Pyafscgap's visualization. Post your walkthrough and listen to someone else's recording. What is this activity good at soliciting? What might this activity be poor at uncovering? Post 2 sentences as a reply.

Mar 19

BART 2

Visualize the BART dataset with a minimum of 4 variables. You do not need to show everything. For example, you may choose to focus on a single station. You may optionally make this with interactivity. Post your code and a screenshot!

Apr 09

Interactive Visualization

Revisit your BART or census visualization and add a single verb / single interaction. Post your code and screenshot.

Final



For the final project, we will build a visualization using what we learned throughout the course. This capstone affords additional time for a deeper exploration. You are welcome to share code and ideas with others as described in the “collaborate” section.

This visualization should be interactive, multi-dimensional, and reflect our discussion of ethics. You may use any licensed dataset but see below for some possible options which are well documented and formatted. As the “activity” for 9 lectures, we anticipate that this exercise will take about 18 hours. However, if you need more time, you may convert the 5 hours of final reading to additional project time. Sketchingpy is recommended but talk to Sam if you want to use a different technology.

StackOverflow Developers Survey

This resource provides an imperfect but multi-faceted look at working experiences within tech, spanning pay to technical preferences and satisfaction. It contains many interesting stories.

Amtrak Ridership Data

People travel for a lot of reasons. This look into mobility charts the path of those stories across America, winding through big cities and small towns along the way. What can you uncover?

US State Energy Data System

Electricity underpins our society. What consumes power and from what sources reflects climate priorities, economic forces, and social preferences. Each kilowatt adds to a bigger story.

Global Plastics AI Policy Tool

Plastics pollution sits in between ecological destruction and fossil fuels contributing to climate change. What can plastic tell us about our environmental future?

AFSC GAP

Climate change is impacting fisheries. What can fish stocks data tell us about climate and food?

California State Budget

Explore government through how it allocates its limited resources. The California State Budget provides another lens into our home and our representatives.

EPI Microdata (US ACS)

With a nearly overwhelming number of variables, the census ACS understands American life through rich socioeconomic data. It paints complex pictures of diverse experiences.

Armed Conflict Location and Event Data

Conflict shapes the course of human history and remains an ongoing force in our world today. What can a data perspective on these conflicts tell us about our species and our future?

Climate Driven Doubling of Maize Loss

Agriculture is under stress from climate change. What can exploring the future of corn in the US tell us about our challenges and our adaptation opportunities?

GitHut

What can programming language popularity tell us about shifting trends in tech?

The final class will be extended to two hours for a group in-person share of our work. During that time, we will provide peer feedback. Also, I will ask if you want to optionally post your work publicly on the course website. Updated links will be provided.

Discuss

Lectures: We will meet twice weekly in-person. These sessions will be a mixture of regular lectures and hands-on group or individual activities. Our time together is very valuable and will be focused on the dialogues that are best done live with each other.

Online discussion: The online community is run through the university's official bConnected service. This is where assignments will be submitted and discussions will take place. You can control your notification settings through Google Groups. You are welcome to help each other and have dialogue about assignments within this space.

Sensitive topics: We will be exploring visualizations and other materials which may deal with some heavy topics like gun violence or sexism. It is important to see how visualizations address these kinds of subjects. I will try to post notice about sensitive topics prior to each lecture and assignment as needed. Please let me know if there is anything I can do to ensure that the course is challenging but sensitive and inclusive.

Respectful discussion: The course will be talking about some big stuff from climate change to government. We will be sharing our work with each other and those pieces could include challenging viewpoints. We may disagree with each other sometimes. This space is meant to be respectful and inclusive. Mistakes happen but we will work to reduce bullying, threats, disrespectful language, and other non-constructive dialogue. In the event that disrespectful behavior is repetitive, you may be asked to complete the course with alternatives to certain course activities.

Licensing: We want to learn from each other's code and work. To support that activity, I ask that assignments be submitted under one of the following: CC-BY, CC-BY-NC, BSD 3-Clause, or GNU GPL. We will discuss this during class. If you are not willing to use these licenses, please talk with me for alternative accommodation.

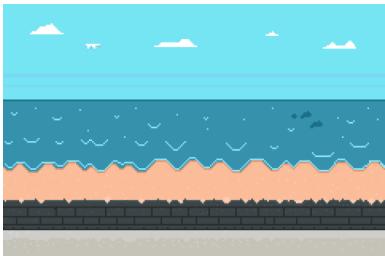
Recordings: Due to the sometimes sensitive topics discussed, lectures will not be recorded or streamed online to create space for safe reflection. However, time permitting, rehearsal recordings of lectures will be made available with captions. Note that there may be delay between the lecture and the recording.

Attendance: As mentioned in the syllabus, we will not take attendance during these sessions. Sometimes things happen where attending lecture is not the best use of your time and I want to ensure you have the flexibility as needed. However, our in-person meetings will be the space in which projects are discussed, assignments given, etc. If you miss a lecture, please reach out to me to ensure you have everything you need to complete the assignments.

Location: We will meet Monday and Wednesday at Shires Hall #211. 3 - 4 pm.



Collaborate



Internal Collaboration: Collaboration with other students is encouraged! However, to ensure fairness for everyone, please give credit to others if you are borrowing code or ideas. Work that builds on others can be excellent and inspiring. Joint submissions are welcome but please include a description of each person's contribution. This will be used to grade each person individually.

Open Source: Use of external open source resources is welcome. Please respect licenses of any code used. If no license is given, the code or resource should not be used even if public. If you are unsure, please ask for help. Finally, please be sure to mention the libraries used in your submission. Giving credit is often required for meeting license requirements.

How Zulip works: For this semester, we will be using Zulip for our online community. There are different channels for different types of students (#learner-audit, #learner-graded). There are also channels for office hours (#coffee-and-office-hours) as well as for lectures / rehearsal recordings (#lectures) and readings (#reading). Finally, all assignments get their own channel (#assign-*). You can interact with the course bot (CourseBot) to submit assignments, request peer review, and more. Details on how to interact with this software will be provided at the start of the course. Please note that you gain access to the Zulip after completing the welcome survey.

How waitlisting works: Unfortunately, to support collaboration between myself and the students, enrollment is capped. I will grade for everyone on the waitlist through lecture 5 (up to 50 students). After lecture 6 (Feb 10), the waitlist will be closed. At that time, students will be given the option to switch to auditing if they wish to continue.

How auditing works: You are very welcome to join us! Leave and join as you like but please register. Those auditing may participate in online discussions and submit assignments for peer feedback though they will not be graded. Students may use recorded rehearsal lectures or may attend in person. There will be 10 physical seats available to auditors but, if physical room runs out, for credit students will be prioritized. Only open to those in the UC Berkeley community (students, staff, faculty).



Dedication: Dedicated to my late grandmother, Barbara. Thank you for your wisdom and kindness. I hope I may continue your tradition of teaching creative computing. ❤️

License: This resource is released under the CC-BY-NC license. Please reach out if you have any questions.

Auditing

We have a fantastic auditing experience planned for this semester. The goal is that those who are taking the course for non-credit (“auditing”) can experience instruction and practice their skills like any other student with the exception that auditors will not receive formal grading or credit. This allows students to participate online without needing to attend lectures in person or be physically present on campus. This means that you do not need to be available during official class hours. Engaging in activities is optional and we invite you to join us in our online class Zulip community. Auditors are subject to UC code of conduct and other policies.

Rehearsal recordings will be posted online shortly after the lecture is delivered in class. These will have manually reviewed captions and will be publicly available. Please join us in the Zulip community to receive notifications when lectures and their corresponding reading assignments become accessible. Finally, those auditing are welcome to join in person. However, if space is limited, seats will be prioritized for those attending for credit. My apologies!

Beyond recordings, other activities are available to those registered within the **Zulip** community or who have been given an alternative accommodation (for which there may be limited resources). With access given after completing the welcome survey, this is only open to those in the UC Berkeley community (students, staff, faculty).

For non-credit students, **exercises** may optionally be completed online with peer feedback. This allows those participating as auditors to practice their skills and engage with others in the virtual community. Though subject to random spot-checks, please note that this feedback is not moderated. As part of our online community standards, all feedback must be kind, constructive, specific, and empathetic.

Auditors are also welcome to participate in the **final project** and **interactive experience**. These will be conducted through Zulip and Zoom with online discussion but, for those who are local, you are welcome to present your final project in person. Whether joining our final festival in person or online, it will be a lot of fun!

Everyone in the class including non-credit students are welcome to join **office hours**. These will be held virtually through Zoom with scheduling announced on Zulip. Note that, if you are unable to join during these times, you may still engage in discussion through our online community.

Those who register through **CalCentral** may receive some recognition of participation through their transcript but please reach out to me if you have questions. Note that some inquiries may require involving academic advisors. I cannot guarantee any formal recognition from the university for your participation.

Those who complete all assignments (with peer sign off for everything but the final) are invited to participate in the **showcase**. However, this is entirely optional. You may audit the course with any level of engagement so long as you follow university policies.

Showcase

At the end of the semester, we will do a showcase of final projects.

Objective: The goal is that this time together is a celebration of everything accomplished over the semester and an opportunity to try some skills one more time. You will have a chance to get non-graded feedback prior to the submission deadline. While optional, this is intended to help build confidence and reduce stress going into the final. The best outcome is that you are proud of this work and I hope that this is something you can be comfortable putting into your portfolio.

Guests: There will be a survey to students to see about the possibility of inviting guests such as friends and family but this will require consent from those attending. It is completely OK if you would like to skip this.

Due dates: It is recommended that you provide a copy of your draft final project for initial review by May 1. While feedback will be provided, this draft will not be graded. Projects may be refined ahead of final assessment based on initial feedback. Auditors must also let me know if they are participating by May 1. The actual final due date is the assigned day of your presentation (May 14 for most graded students). No late assignments will be accepted.

In-person: This will likely take place outside of our regular room. The details will be provided online as we get closer. Please expect to meet in Wellman Hall which has a larger space. This is scheduled during our final time which is 7 - 10pm on May 14.

Online: An online alternative will be made available if needed to those who cannot attend in person. Additional details will be provided online as we get closer.

Attendance: Note that for-credit students' final gradings will take place during the event so, if you are unable to attend, please reach out by May 1 to get an accommodation such as attending the online version instead.

Format: This will give us one last chance to practice skills taught in the course. We will do a rotation where one set of students will present while others offer thoughts before rotating. For graded students, the final grade is based only on the instructor's evaluation of their final project and the peer feedback they provided to others.

Publication: I would love to help you share your work! Upon completion of the final, you will be invited to optionally post your name and project to the course website. In order to participate, there are some logistics I unfortunately have to insist on in order to comply with university policy: the work needs to use properly licensed data, code must meet certain basic standards such as ability to run in the browser, your work must meet certain basic accessibility standards, your final project must have passed, and you will need to release your work under the BSD 3-Clause License. Participation is entirely optional. Inclusion subject to instructor discretion. Sketchingpy recommended.