UC SANTA BARBARA
Bren School of Environmental Science & Management

EDS 214: Analytical Workflows and Scientific Reproducibility

Quarter: Summer 2025
Units: 2
Grading: Letter
Prerequisites: None

Instructor information, meeting times, & materials

Instructor: Max Czapanskiy
Email: maxczap@ucsb.edu
TA: Alessandra Vidal Meza
The best way to contact us is by Slack

Class meets:

Dates: Monday August 25 - Friday August 29
Time: 10am - 5pm
Location: NCEAS 1st Floor Classroom

Course website: https://eds-214-workflows-reproducibility.github.io/

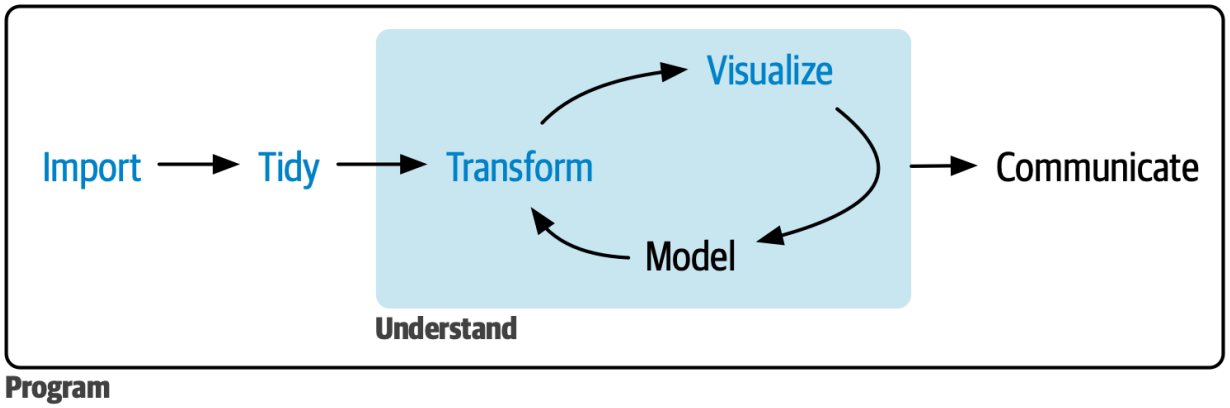
Computing requirements:

- **MEDS Computing Requirements & Software Installation Guide**
- R version 4.4.0 (or higher)
- RStudio version 2024.04.2+764 (or higher)

Basic course information

The generation and analysis of environmental data is often a complex, multi-step process that may involve the collaboration of many people. Increasingly, data scientists use tools that document and help to organize workflows to ensure reproducibility, shareability, and transparency of the results. This course will introduce students to the conceptual organization of workflows (including code, documents, and data) as a way to conduct reproducible analyses.

These concepts will be combined with the practice of various software tools and collaborative coding techniques to develop and manage multi-step analytical workflows as a team.



Conceptual model of an analytical workflow. *Source: R for Data Science* https://r4ds.hadley.nz

Learning objectives: The goal of this course is to enable MEDS students to collaboratively create reproducible analyses. Essential skills and concepts are:

- **Automate** the steps in an analytical workflow using scripts
- **Organize** workflow components modularly
- **Document** individual components and their relationships
- **Scale** workflows for computational performance and large datasets
- **Collaborate** in a team to develop a workflow

Course details

Course components: All lecture slides and assignment details will be posted to the course website. There is no homework for this course - all activities can be

completed in class. Class will combine lectures, learning activities, and a group project.

Daily schedule:
Each day will (approximately) follow this format.

Time	Activity
10:00-10:50	Lecture 1
10:50-11:00	Break
11:00-12:30	Interactive session 1
12:30-1:30	Lunch
1:30-2:00	Lecture 2
2:00-3:00	Interactive session 2
3:00-3:10	Break
3:10-4:00	Flex time
4:00-4:50	Q&A with instructors (as needed)

Topics:
Course topics will be taught in this order.

Time	Topics	Interactive sessions
Monday AM	Reproducible workflows	Plan an analysis
Monday PM	Workflow organization	Make spaghetti
Tuesday AM	Command line and remote server	Navigate the server
Tuesday PM	Documentation	READMEs, comments, and style
Wednesday AM	Version control with git	git branching
Wednesday PM	Collaboration with GitHub	Refactor a function

Thursday AM	Draft Quarto analysis	Self assessment
Thursday PM	Peer feedback and contributions	Open work time
Friday AM	Meet your next instructor	Final project submission
Friday PM	Instructor feedback	Project wrap-up

Slack: We will have an #eds-214-workflows-reproducibility channel in the MEDS workspace. Please feel free to use this as a space to communicate with each other about the content of the course. I will monitor the Slack channel regularly and send relevant links and other information. If you have a question about the course, someone else probably shares it! So posting questions to Slack is a service to your cohort. If you have a private question, please email the instructors directly.

Grading

Specifications: The grading for 214 uses *specification-based* grading. Specification-based grading is different from the traditional grading systems you've probably encountered in past courses. In traditional grading, each assignment earns you points and the total number of points you earn determines your grade. With specification-based grading, you will demonstrate your competency in learning objectives by meeting assessment specifications. For example, one specification corresponding to the *Automate* learning objective is "The analysis runs without errors."

Instead of giving you points out of 100, I will assess your work on each spec as *Not yet* or *Meets spec*. Critically, *you will have opportunities for feedback and revisions* to improve your spec assessment. Your grade will depend on the number of specs you meet. To get an A, you will need to *Exceed spec* for two specs in different learning objectives. There are 17 specs organized into 5 learning objectives.

The specifications will apply to your final project. On Thursday and Friday, you will have opportunities for self-feedback, peer feedback, and instructor feedback. Each stage will be accompanied by a chance for revisions.

Participation: During the summer session, you will be expected to attend all classes for the full period. I don't take or grade attendance. Instead, each interactive session will have a brief, ungraded reflection. Completing these reflections counts towards the participation component of your grade.

Letter grades: Specifications and participation translate to latter grades according to the table below.

Letter grade	Specifications	Participation
A	2 Exceeds spec 16 Meets spec	9 reflections
B	16 Meets spec	7 reflections
C	13 Meets spec	5 reflections

AI Policy

Large language models: I use ChatGPT and other Large Language Models (LLMs) regularly in my work as a data scientist. Invariably, the solutions proposed by LLMs are *at best* 70-90% accurate, and it remains my responsibility to interpret and revise them. By the end of the MEDS program, we expect you will be able to use LLMs critically and responsibly, if you choose to do so.

No LLMs in 214: LLMs impair cognitive development and can be a major obstacle to your learning and growth as data scientists. At this stage in your training, we expect you to avoid using them entirely. That expectation will be relaxed over the next three quarters. In 214, I do not want you to use any LLMs for any purpose. If you have a question or an obstacle, please do the following instead.

1. Think about it
2. Ask a peer about it
3. Ask an instructor about it

LLM-generated code policy: If you submit code for a specification that smells like an LLM (and trust me, it's usually obvious), I will ask you to explain the purpose and function of the code verbally. If you cannot explain it, you will not receive credit for

that specification. If it happens a second time, that will constitute a violation of the academic code of conduct.

I hope to never enforce the LLM-generated code policy. It's here to ensure all students are on equal footing regarding LLMs and that good faith efforts to learn the material are rewarded.

Access, accommodations and conduct

Course conduct: All students are expected to read and comply with the UCSB Code of Conduct. We are committed to making this course a welcoming and inclusive environment for everyone, regardless of gender, gender identity and expression, race, age, sexual orientation, disability, physical appearance, or religion (or lack thereof). We expect all students to help ensure this environment of inclusivity and will not tolerate harassment of any form.

Access and Accommodations: Please submit requests for accommodations often and early. It is never too late to apply for DSP accommodations. If you have any kind of disability, whether apparent or non-apparent, learning, emotional, physical, or cognitive you may be eligible to use formal accessibility services on campus. To arrange class-related accommodations, please contact DSP. DSP will initiate communication about accommodations with faculty. By making a plan through DSP, appropriate accommodations can be implemented without disclosing your specific condition or diagnosis to course instructors.

Additional student resources

The text below is provided by the UCSB Disabled Students Program.

Counseling and Psychological Services (CAPS). As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce your ability to participate in daily

activities. CAPS is available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus. They can be reached by phone at 805.893.4411, or online at http://caps.sa.ucsb.edu. The CAPS building is the pink building next to the Humanities and Social Science building (HSSB)

Food insecurity: http://food.ucsb.edu/ includes the Cal Fresh Program http://food.ucsb.edu/calfresh and the Associated Students food bank https://foodbank.as.ucsb.edu

Resource Center for Sexual and Gender Diversity (RCSGD) in the SRB, offers a host of services for LGBTQI+ students including a library and many events throughout the year. http://rcsgd.sa.ucsb.edu/

Dream Scholars/Undocumented Student Services Program offers workshops, helps students find scholarships and financial support as well as providing community for our undocumented students. http://www.sa.ucsb.edu/dreamscholars/home

Campus Learning Assistance Services (CLAS) helps students grow academically by offering workshops, walk-in and pre-scheduled tutoring, and writing help both for native and non-native (ESL) English as a second language speakers. Over 50% of students will stop by CLAS at one time or another. http://clas.sa.ucsb.edu

Student Resource Building (SRB) houses many campus resources offices, including the African Diasporic Cultural resource Center, the American Indian Resource Center, the Asian Resource Center, the Middle Eastern Resource Center, the Non-Traditional and Re-Entry Student Resource Center.
http://www.sa.ucsb.edu/student-resource-building/home

Multicultural Center (MCC), located in UCEN, hosts a wide variety of cultural events and educational programming throughout the year, including film showings, lectures, musical performances, and more: http://mcc.sa.ucsb.edu/

Campus Advocacy, Resources, & Education (CARE) offers 24/7 confidential support and advocacy in situations of sexual assault, dating and domestic violence, and stalking. Located in the SRB, they can be reached at 805.893.4613 or http://wgse.sa.ucsb.edu/care/home

Financial Crisis Response Team: If you are experiencing issues of housing insecurity contact the Financial Crisis Response Team at financialcrisis@sa.ucsb.edu to begin application for assistance.

Health and Wellness: Student well-being is integral to academic success, student development, and life satisfaction. On this website, students will find links to a range of services related to well-being such as: assistance with basic needs (food, housing, finances); counseling and physical health resources, daily wellness centers and programs; social connection, and personal safety. https://wellbeing.ucsb.edu/