SJSU SAN JOSÉ STATE UNIVERSITY

College of Science · Computer Science

Advanced Practical Computing Topics Section 03

CS 185C

Fall 2024 3 Unit(s) 08/21/2024 to 12/09/2024 Modified 08/30/2024

Contact Information

Instructor: Mike Wood

Email: mike.wood@sjsu.edu

In addition to the office hours listed below, I am also happy to schedule a one-on-one office hour outside in the case that students have scheduling conflicts - please don't hesitate to reach out.

Office Hours

Monday, 2:00 PM to 3:00 PM, Virtual on Zoom

Friday, 2:00 PM to 3:00 PM, Virtual on Zoom

Course Information

Overview

This upper-division undergraduate course is designed for students interested in exploring how ocean simulations are developed, run, and analyzed for applications in science and beyond. Students will gain hands-on experience using code to construct and run models, and visualize model results. Particular focus will be placed on the numerical algorithms underlying ocean models including their limitations and stability criteria. In addition, students will become familiar with deploying code on a high-performance computing cluster. In the final project of this course, students will create and run a model using parallelized code and generate a visualization of model results to examine an oceanographic process. Skills developed through this course are applicable to many other fields that use large quantities of data on remote machines, including weather forecasting.

Prerequisities

A grade of C- or better in Math 32 and

Either:

Computer Science, Applied and Computational Math, or Software Engineering majors

Or:

Marine Science, Geology, Meteorology, or Climate Science majors with a grade of C or better in CS 22A and CS 22B

Or:

Instructor Consent.

In-Person Lecture

1:30 PM to 2:45 PM, ISB 876

Virtual Lecture

Thursday, 1:30 AM to 2:45 AM

See Zoom links on Canvas

Course Description and Requisites

Computing topics of current interest in industrial practice. Emphasis on effective use and integration of software/hardware. Different topics may be offered at different times in a short-course lecture/lab format and may be repeated for credit.

Prerequisite: Varies with topic; Allowed Majors: Computer Science or Data Science.

Letter Graded

Program Information

Diversity Statement - At SJSU, it is important to create a safe learning environment where we can explore, learn, and grow together. We strive to build a diverse, equitable, inclusive culture that values, encourages, and supports students from all backgrounds and experiences.

Course Learning Outcomes (CLOs)

Upon successful completion of this course, students will be able to:

1. Describe how numerical ocean models are used in research and forecasting (PLO 6)
2. Explain the physical concepts underlying ocean models and how they are represented with numerical algorithms (PLO 1)

3. Visualize and analyze data from ocean models (PLO 1)
4. Develop code to obtain and construct pertinent files for an ocean model and run a simulation using a common model framework (PLO 2)
5. Navigate, organize files, and submit jobs on a high-performance computing cluster (PLO 2)
6. Work in teams to present complex computational ideas for non-expert audiences (PLO 3, 5)

The above CLOs are aligned with the Computer Science Program Learning Outcomes (PLOs) listed HERE and copied below for reference

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Course Materials

For this course, will you will need a laptop with at least 5 GB of storage as well as a flash drive or external hard drive with at least 100 GB of storage (1 TB recommended).

All readings for this course will be selected from open source materials.

In addition, course notes will be updated in a Jupyter Book hosted on Github, accessible HERE (https://profmikewood.github.io/ocean_modeling_book/intro.html).

Grading Information

The grading of this course will be split evenly between homework assignments and the course project

Criteria

Type	Weight	Topic	Notes
Weekly Assignment	50	Homework	Homework is due before before Tuesday class meetings. Homework is posted on Canvas and will typically be turned in via a Github repository. Students should reference Canvas for pertinent files and instructions.

Type	Weight	Topic	Notes
Final Project	50	Project	In the final project of this course, students will create and run an ocean model using parallelized code and generate a visualization of model results to examine an oceanographic process. The model will be run on a high-performance computing cluster at San José State University. Students will be responsible for writing code to generate the model domain; constructing the initial, external forcing, and boundary conditions; and running the model from scratch. Projects will be summarized for the class in a final presentation and model code will be organized in a well-documented Github repository.

University Policies

Per [University Policy S16-9 (PDF) (http://www.sjsu.edu/senate/docs/S16-9.pdf)](http://www.sjsu.edu/senate/docs/S16-9.pdf), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on the [Syllabus Information (https://www.sjsu.edu/curriculum/courses/syllabus-info.php)](https://www.sjsu.edu/curriculum/courses/syllabus-info.php) web page. Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

Week	Date(s)	Lecture Topic
1	8/22	Introduction to Ocean Modeling
2	8/27, 8/29	Descriptive Oceanography
3	9/3, 9/5	Visualizing Model Results
4	9/10, 9/12	Analyzing Model Results
5	9/17, 9/19	Overview of Numerical Algorithms
6	9/24, 9/26	Momentum Algorithms in Ocean Models
7	10/1, 10/3	Thermodynamics Algorithms in Ocean Models
8	10/8, 10/10	The MIT General Circulation Model
9	10/15, 10/17	Developing a model experiment to investigate a hypothesis
10	10/22, 10/24	Where to begin? Generating initial conditions for a simulation

11	10/19, 10/31	What does the ocean "feel"? Generating external forcing conditions for simulations
12	11/5, 11/7	What's on the edge? Generating boundary conditions for simulations
13	11/12, 11/14	Working on a high-performance computing cluster (HPC)
14	11/19, 11/21	Running jobs on an HPC
15	11/26	Debugging model errors
16	12/3, 12/5	Projects and Presentations

The following schedule is tentative and subject to change. Please see Canvas for updates.