Advanced Bioinformatics

CS 223

Fall 2025   Section 01   In Person   3 Unit(s)   08/20/2025 to 12/08/2025   Modified 08/19/2025

👤 Contact Information

Instructor: Dr. Wendy Lee

Email: wendy.lee@sjsu.edu

Office: MH 413

Office Hours

- Wednesday 1:30 - 2:30 PM & Thursday 10:00 - 11:00 AM

Schedule appointment @ [https://calendly.com/wendy-lee-sjsu/fall-2025-office-hours (https://calendly.com/wendy-lee-sjsu/fall-2025-office-hours)](https://calendly.com/wendy-lee-sjsu/fall-2025-office-hours)

🕐 Course Information

The course investigates algorithms for solving computational problems in bioinformatics, and the life processes underlying those algorithms. Metagenomics, bioinformatic machine learning, single-cell RNA sequencing, variant discovery. Possible additional topics: genome assembly, advanced phylogenetics, long-read sequencing, and structural bioinformatics.

💻 Course Description and Requisites

Investigation of the main algorithms for solving computational problems in bioinformatics. Methods include Hidden Markov Models for gene prediction and protein profiling, and Genetic Algorithms for biological sequence analysis and structure prediction. Students complete programming projects.

Prerequisite(s): CS 123B/BIOL 123B/SE 123B. Allowed Declared Major: Computer Science, Bioinformatics, Data Science.

Letter Graded

✳ Classroom Protocols

This course is conducted in person. Each class session will begin with either a lecture, a quiz, or a student presentation to set the stage for the day's learning objectives. After this opening segment, students will participate in interactive, hands-on activities designed to reinforce key concepts and encourage collaborative problem-solving. To fully engage in these activities, students are required to bring a laptop with Wi-Fi capability to every class throughout the semester.

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)

Program Learning Outcomes (PLOs)

PLO 1 Students will demonstrate effective scientific written communication skills.
PLO 2 Students will demonstrate effective scientific oral communication skills.
PLO 3 Students will demonstrate the ability to independently answer complex biological questions using computational methods.
PLO 4 Students will demonstrate the ability to develop a research plan using information gained through critical analysis of primary literature

Course Materials

- Bioinformatics Algorithms: An Active Learning Approach by Phillip Compeau & Pavel Pevzner
- Additional reading assignments will be provided by the instructor

Course Requirements and Assignments

Course Requirements and Assignments

The course will consist of quizzes, hands-on lab reports, two midterms, and a group project.

1. Quizzes (10%): Quizzes will take place once a week to assess students' knowledge of the course materials.
2. Hands-on Lab Reports and Oral Presentations (20%): The purpose of the hands-on lab is to develop students' understanding of the material and problem-solving skills. While students may discuss the problems in groups, each student must write and submit independent lab reports. Students must submit lab reports on time to receive full credit. All work submitted on individual assignments must be your own. Infractions will be detected and will lead to an automatic failing grade for the course. If someone else copies your work, with or without your permission, you will be held responsible.

3. Midterms (20%):
   - Midterm 1 (10%): October 8th, 2025
   - Midterm 2 (10%): November 12th, 2025
4. Group Project & Presentation (50%): A semester-long group project and presentations will be used to assess students' understanding of the course materials throughout the semester instead of a final exam. Each team will be given a unique problem to solve for the project. Each team consists of 3 to 4 students. Here are the key deliverables and due dates:

   - Team Formation and Project Proposal: September 24th, 2025
   - Project Presentation I: October 15th, 2025
   - Project Presentation II: November 5th, 2025
   - Project Presentation III: December 1st & 3rd, 2025
   - Project Due: December 1st, 2025

Incomplete work

Points will be deducted for incomplete question responses and solutions that are partially functional. Consult individual assignments for details of point allocation for each problem.

Academic Honesty

All assignments submitted, including quizzes, hands-on activities, exams, and projects, are expected to be the student's own original work. The instructor may, at any time, ask a student to explain the meaning of any part of an answer they have submitted. If the student cannot adequately explain their answer, the penalty for the first incident will be the loss of all points on that question. The penalty for the second and subsequent incidents will be the loss of all points on the assignment, along with a report to the Office of Student and Ethical Conduct.

Makeup Exams

Makeup exams will only be given in cases of illness (documented by a physician) or in documentable, extreme emergency cases.

✔ Grading Information

Grading Information

- 10% Quizzes
- 20% Hands-on Assignments
- 20% Midterm I (10%) & Midterm II (10%)
- 50% Term Project

Grading Scale

Grade	Percentage

A plus	97.0 to 100%
A	93.0 to 96.99%
A minus	90.0 to 92.99%
B plus	87.0 to 89.99%
B	82.0 to 86.99%
B minus	80.0 to 81.99
C plus	77.0 to 79.99%
C	72.0 to 76.99%
C minus	70.0 to 71.99%
D plus	67.0 to 69.99%
D	62.0 to 66.99
D minus	60.0 to 61.99%
F	<60.0

🏛 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

Course Schedule

The course schedule is subject to change with fair notice. Changes will be announced on Canvas.

Week 0: (8/20) - Syllabus, Introductions, Course Expectations

Week 1: (8/25, 8/27) - Introduction to Algorithms and Big O Notation

Week 2: (9/1, 9/3) - Advanced Algorithm Analysis

Week 3: (9/8, 9/10) - DNA Sequencing Basics

Week 4: (9/15, 9/17) - Algorithms for Metagenomics

Week 5: (9/22, 9/24) - Algorithms for Read Mapping and Alignment

Week 6: (9/29, 10/1) - Sequence Similarity Searching with BLAST

Week 7: (10/6, 10/8) - Pairwise Alignment using Dynamic Programming

Week 8: (10/13, 10/15) - Advanced Alignment: Multiple Sequence Alignment (MSA)

Week 9: (10/20, 10/22) - Phylogenetic Algorithms: Building the Tree of Life

Week 10: (10/27, 10/29) - Probabilistic Algorithms for Sequence Analysis: Hidden Markov Models

Week 11: (11/3, 11/5) - Single-Cell RNA Sequencing Analysis Part 1: Pre-processing

Week 12: (11/10, 11/12) - Single-Cell RNA Sequencing Analysis Part 2: Dimensionality Reduction and Clustering

Week 13: (11/17, 11/19) - Single-Cell RNA Sequencing Analysis Part 3: Differential Gene Expression Analysis

Week 14: (11/24, 11/26) - Algorithms for Analyzing Genome Instability

Week 15: (12/1, 12/3) - Project Presentations

Week 16: (12/8) - Recap and Evaluation