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# San José State University Computer Science Department Computer Science / Biology 123A: Bioinformatics I sec 02, Fall 2024

## Course and Contact Information

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| Instructor: | Philip Heller |
| Office Location: | 211 MacQuarrie Hall |
| Email: | philip.heller@sjsu.edu |
| Office Hours: | Tues 1:30-2:30 (in person); Weds 3:30-4:30 (Zoom link: [https://sjsu.zoom.us/j/81013855253](https://www.google.com/url?q=https://sjsu.zoom.us/j/81013855253&sa=D&source=calendar&ust=1724211541383851&usg=AOvVaw1T83YHNQAPYa2rhQkJ4SMg)) |
| Class Days/Time: | Tu/Th 10:30-11:45 |
| Classroom: | ISB876 (sweet!) |
| Prerequisites: | For CS 123A: CS 46B. For Biol 123A: Biol 31. |
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## Course Description

Introduction to algorithms, tools, and databases of Bioinformatics. Biological foundations: central dogma; sequence databases; pairwise alignment algorithms and tools; Blast; phylogenetics.

Possible additional topics: protein structure, multiple sequence alignment, next-gen sequencing, epigenetics, CRISPR.

Project applying these approaches to real-world problems.

## Course Format

## Sessions will be either lecture format, hands-on exercises, or a combination.

**Course Learning Outcomes**

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

* List the processes of the central dogma of molecular biology.
* Align 2 or more nucleotide or protein sequences, and explain how the underlying algorithms generate the results from the data.
* Use public databases and associated tools to retrieve information about nucleotide and protein sequences.
* Predict homology relationships using the Blast family of tools, and determine the reliability of predictions based on understanding the underlying algorithms.
* Create phylogenetic trees from nucleotide and protein sequences using standard software tools, and interpret the results based on understanding the underlying algorithms.

## Recommended Texts/Readings

### Textbook

“Understanding Bioinformatics” by Marketa Zvelebil and Jeremy Baum, 1st edition, Garland Science, 2008, ISBN 0-815-34024-9.

### Other technology requirements / equipment / material

## Students must bring a charged wifi-enabled laptop computer to all in-person sessions.

## Course Requirements and Assignments

**Homework Assignments:** Homework assignments and lab reports must be uploaded to Canvas by the due date/time. No late homework will be accepted except by prior arrangement with the instructor or in cases of documented emergency.

**Quizzes:** A quiz might be given at any time. Quizzes will be given in class, on paper. The lowest 2 quiz scores will be dropped.

**Term Project:** Students will do a term project individually or in teams of 2. Students in CS 123A must do a project that includes programming, in the language of their choice. Students in Biology 123A may do the same, or may do a project involving acquiring published data and then analyzing the data using 3rd-party bioinformatics tools. Projects include a written report and an oral presentation.

**Midterm Exams:** There will be 2 midterm exams. Note that the exam dates given in the schedule below are approximate and are subject to change.

**No Final Exam:** There will be no final exam. The final exam time slot will be used for project presentations. Attendance is required.

**Labs:** Some sessions will be used for hands-on software labs. Lab reports will count toward the homework grade.

**Grading:**

Homework: 30%

Midterm 1: 20%

Midterm 2: 20%

Project: 20%

Quizzes: 10%

|  |  |
| --- | --- |
| At least | Letter Grade |
| 97% | A plus |
| 93% | A |
| 90% | A minus |
| 87% | B plus |
| 83% | B |
| 80% | B minus |
| 77% | C plus |
| 72% | C |
| 70% | C minus |
| 67% | D plus |
| 62% | D |
| 60% | D minus |
| <60% | F |

## Office Hours

## Many students are shy about coming to office hours. Please don’t be! They are for you! It’s a great chance for you and the professor to get to know each other. You can ask specific questions about homework, labs, or your project. Or you can just hang out and talk about whatever is on your mind. Ask me about using AI to improve coral reef conservation. Cool stickers will be provided.

If you want to meet, it’s best to meet during office hours if you can, but don’t cut another class. You are welcome to email [Philip.heller@sjsu.edu](mailto:Philip.heller@sjsu.edu) to arrange a different time.

For the Wednesday zoom sessions, you have to have your camera on.

## Academic Integrity

## Students are expected to be familiar with the University’s Student Conduct Code (<https://www.sjsu.edu/studentconduct/docs/SJSU-Student-Conduct-Code-2016.pdf>). Cheating, plagiarism, and other forms of misconduct will not be tolerated and will have severe consequences. All prose submitted must be in the student’s own words. Text composed by anyone other than the student will not be accepted, *even if it is quoted and cited*.

The penalty for the first incident of cheating or plagiarizing is zero points on the assignment or exam, and a reduction of a full grade point from the final letter grade (e.g. A minus becomes C minus). The penalty for the second incident is an F in the course. All incidents will be reported to the Office of Student and Ethical Conduct.

All assignments submitted are expected to be the students’ own original work. The instructor may, at any time, ask a student to explain the meaning of any part of any answer that they submit. If the student can't explain the answer to a question, the penalty for the first incident will be loss of all points on the question. The penalty for the second and subsequent incidents will be loss of all points on the assignment and a report to the Office of Student and Ethical Conduct. A similar policy will apply to the project report and any related code; the policy will be explained in the project assignment doc later in the semester.

All course materials, including slides, homework assignments, lab assignments, exams, and instructor’s solutions, are the instructor’s intellectual property and may not be distributed without permission. Distribution includes posting to social media sites and Chegg. Distribution is grounds for failing the course, and all incidents will be reported to the university, which may impose further sanctions.

## Classroom Protocol

Students are expected to attend all class sessions for their assigned section unless they have a personal emergency. During lectures, students’ devices may only be used for course-related purposes such as taking notes. Disruptive behavior, including using devices for purposes unrelated to the course, is not allowed. The consequence for the first incident of disruption is a reduction of 1/3 grade point from the final letter grade (e.g. B minus becomes C plus). The consequence for the second incident is a reduction of 2/3 grade point from the final letter grade (e.g. B minus becomes C). The consequence for the third incident is an F in the course. All incidents will be reported to the university, which may impose further sanctions.

## University Policies

Per University Policy S16-9 (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 Syllabus Information web page (http://www.sjsu.edu/gup/syllabusinfo), which is hosted by the Office of Undergraduate Education. Make sure to visit this page to review and be aware of these university policies and resources.

# Computer Science / Biology 123A sec 02 Fall 2024 Course Schedule

## All dates and topics are estimates and are subject to change. Date changes for midterm exams will be announced 2 weeks in advance. Guest speakers often reschedule at the last minute!

| **Week** | **Date** | **Topics** |
| --- | --- | --- |
| 1 | 8/22 | Course mechanics. |
| 2 | 8/27 | Bioinformatics: historical development, current challenges. |
| 2 | 8/29 | Molecular biology, the central dogma, and Bioinformatics. |
| 3 | 9/3 | Molecular biology, the central dogma, and Bioinformatics. |
| 3 | 9/5 | Molecular biology, the central dogma, and Bioinformatics. |
| 4 | 9/10 | Lab 1: Molecular Biology |
| 4 | 9/12 | Pairwise sequence alignment. |
| 5 | 9/17 | Pairwise sequence alignment. |
| 5 | 9/19 | Lab 2: Alignment. |
| 6 | 9/24 | Sequence databases. Projects and scientific writing. |
| 6 | 9/26 | BLAST. |
| 7 | 10/1 | Review for Midterm 1. |
| 7 | 10/3 | Midterm 1. |
| 8 | 10/8 | Midterm 1 answers. |
| 8 | 10/10 | Multiple sequence alignment. Lab 3. |
| 9 | 10/15 | Phylogenetics: UPGMA and WPGMA. |
| 9 | 10/17 | Phylogenetics: UPGMA and WPGMA |
| 10 | 10/22 | Phylogenetics: Neighbor Joining and bootstrapping. |
| 10 | 10/24 | Work on project. |
| 11 | 10/29 | Bioinformatics of space exploration. |
| 11 | 10/31 | Guest speaker. |
| 12 | 11/5 | Lab 4: BRCA. |
| 12 | 11/7 | Lab 5: Phylogenetics. |
| 13 | 11/12 | Complete Labs 4 and 5. |
| 13 | 11/14 | Guest speaker. |
| 14 | 11/19 | Review for Midterm 2. |
| 14 | 11/21 | Midterm 2. |
| 15 | 11/26 | Midterm 2 answers. |
| 15 | 11/28 | Thanksgiving, no class. |
| 16 | 12/3 | Project presentations. |
| 16 | 12/5 | Project presentations. |
| FINAL EXAM SLOT (for project presen-tations) | 12/13  Fri | Project presentations: 9:45 AM – noon. |