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San José State University
Computer Science Department
Computer Science / Biology 123A: Bioinformatics I, Fall 2021

Course and Contact Information

Instructor:	Philip Heller
Office Location:	211 MacQuarrie Hall
Email:	philip.heller@sjsu.edu
Office Hours:	Tues 10:30-11:30, Weds 1:30-2:30
Class Days/Time:	T/Th 9:00 – 10:15
Classroom:	415 Duncan Hall
Prerequisites:	For CS 123A: CS 46B. For Biol 123A: Biol 31.

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.

Required 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 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.

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.

Quizzes: There will be a short in-person quiz at the start of most lectures, covering material from the previous lecture. The 3 lowest quiz grades will be dropped.

Final Exam: Friday Dec 10, 1:15 AM. Makeup final exams will be only be given in cases of verifiable emergencies or, if the instructor is notified at least 3 weeks before the last class meeting, to students with at least 2 other finals in a 24-hour period.

Grading:

Homework: 15%
Quizzes: 15%
Midterm 1: 15%
Midterm 2: 15%
Project: 20%
Final Exam: 20%

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

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.

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 Fall 2021 Course Schedule

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	8/19	Course mechanics. Bioinformatics: historical development, current challenges.
2	8/24	Molecular biology, the central dogma, and Bioinformatics.
2	8/26	Molecular biology, the central dogma, and Bioinformatics.
3	8/31	Molecular biology, the central dogma, and Bioinformatics.
3	9/2	Lab 1: Molecular Biology
4	9/7	Pairwise sequence alignment.
4	9/9	Pairwise sequence alignment.
5	9/14	Lab 2: Alignment.
5	9/16	Sequence databases. Projects and scientific writing.
6	9/21	Blast
6	9/23	Review for Midterm 1.
7	9/28	Midterm 1.
7	9/30	Midterm 1 answers.
8	10/5	Multiple sequence alignment. Lab 3.
8	10/7	Phylogenetics: UPGMA and WPGMA.
9	10/12	Phylogenetics: UPGMA and WPGMA
9	10/14	Phylogenetics: Neighbor Joining and bootstrapping.
10	10/19	Lab 4: BRCA
10	10/21	Lab 5: Phylogenetics
11	10/26	Epigenetics.
11	10/28	Review for Midterm 2.
12	11/2	Midterm 2
12	11/4	Midterm 2 answers.
13	11/9	Project presentations.
13	11/11	Holiday: Veteran's Day.
14	11/16	Project presentations.

Week	Date	Topics, Readings, Assignments, Deadlines
14	11/18	Project presentations.
15	11/23	Project presentations.
15	11/25	Holiday: Thanksgiving.
16	11/30	Project presentations.
16	12/2	Review for final exam.
Final Exam	12/10	7:15 AM.