San José State University
Computer Science Department
CS/BIOL 123A Bioinformatics I, Sec 01, Spring 2020

Course and Contact Information

Instructor:	Leonard Wesley
Office Location:	MH 212
Telephone:	408.924.5287
Email:	Leonard.Wesley@sjsu.edu
Office Hours:	Thursdays 2:00PM – 4:00PM, Except on 2/27, 3/9, 3/30 when office hours will be from 12noon to 1:30PM
Class Days/Time:	Tuesdays and Thursdays 10:30AM – 11:45AM
Classroom:	SCI 311
Prerequisites:	BIOL 30 and BIOL 31, or CS 46A and CS 46B

Catalog Course Description:

Introduction to the main public domain tools, databases and methods in bioinformatics. Analysis of algorithms behind the most successful tools, such as the local and global sequence alignment packages, and the underlying methods used in fragment assembly packages. Solution of complex biological questions requiring modification of standard code.

Learning Outcomes:

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

1. SLO-1 BIOINFORMATICS DBs: Describe the structure of bioinformatics-related DBs and how they function to analyze sequence and related biological data. Navigate through various DBs to research and answer questions of interest, identify genes, and analyze complex genomes.
2. SLO-2 ALIGNMENT: Describe and use pairwise and multiple sequence alignment algorithms to conduct local, global, and semiglobal alignments. Understand and use BLAST and advanced DB searching.
3. SLO-3 PHYLOGONY: Build, understand, and use molecular phylogenetic trees. Understand and answer questions about evolution using molecular phylogenetic trees.
4. SLO-4 PROTEINS & FUNCTIONAL GENOMICS: Understand protein analysis, proteomics, and functional genomics.

5. SLO-5 NGS: Describe, understand, and analyze state-of-the-art technologies such as next-generation-sequencing (NGS) and genome assembly.

Required Texts/Readings:

Textbook

Bioinformatics and Functional Genomics Edition: 3rd Year 2015
Author: Pevsner
ISBN 13: 978-1-118-58178-0 Price ranges from $39(Paperback) to $73(e-Book)

Other Readings

Introduction To Bioinformatics by Arthur M Lesk, 4th Edition, Oxford University Press, 2014, ISBN-13: 978-0-19-965156-6

Bioinformatics: A Practical Guide To The Analysis of Genes and Proteins by Andreas D. Baxevanisad B.F. Francis Oullette, 3rd Edition, Wiley Interscience, 2005, ISBN-10: 0-471-47878-4 (cloth)

Computational Resources:

Students are required to make sure that they have access to sufficient UNIX, Windows, or Mac based computational resources (e.g., computers and software) to carryout assignments in the course. An attempt to offer the course in a classroom with sufficient computation resources will be made by the department to support classroom instruction and demonstrations. However, students should be prepared to bring their portable laptops to class.

Course Requirements and Assignments:

Course Logistics

Students should expect to spend approximately nine (9) hours per week (on average) outside of the classroom preparing for and completing the assigned course work. This includes reading papers, viewing videos as appropriate, completing homework and programming exercises, and so forth. The amount of time that a student actually spends studying and completing course work will depend on individual skills and the time that the student actually allocates to the course. The nine (9) hours per week estimate is based on previous experiences of the instructor and students. So please plan and schedule accordingly.

Previously, some students have asked for special exceptions to policies and procedures for this course. An example includes asking the instructor for extra assignments or work to help improve a grade. Even if such a request is reasonable in the opinion of the

instructor, no exception will be given to a student unless the same opportunity can be made available to the entire class, and does not constitute significant extra work on the part of students, instructors, graders and so forth. Students should have no concern that other students will receive special exceptions that will not be made available to the entire class.

NOTE: University policy (F69-24) states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading." However, attendance will be required in order to complete and submit many in-class exercises, quizzes, and exams. Should students miss or leave early from one or more classes, students are responsible for knowing and understanding any and all course subject matter, assignments, exercises, instructions and so forth that are presented or discussed during official scheduled class time.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the Syllabus/Greensheet.

Quizzes and Exams:

There will be three quizzes, one midterm and a final exam all of which will count toward a student's final grade as specified in the "Grades" section below. During quizzes and exams, communication with other individuals via any means is strictly prohibited without the express permission of the instructor. Violations will be met with the full impact of SJSU's academic integrity policy and procedures.

Projects:

Several life-science related project topics will be described near the start of the course. Projects will involve applying the skills and knowledge learned in the course to the project. Projects in this course will be individual (not team) projects. Project scores will count toward the final grade as specified in the "Grades" section below.

In-Class Exercises

There will be four in-class exercises where groups of two to four will be formed to work on an assigned exercise. In-class participation is mandatory, and an attendance sign-up sheet will be passed around to verify participation. The assigned exercises are intended to reinforce learning and understanding of previous lecture, homework, and programming assignment subject matter by providing hands-on experience with completing the provided assignment. A supplement document named "In-Class Exercise Procedure.pdf" is available on Canvas in the same location as the course Syllabus/Greensheet. The "In-Class Exercise Procedure.pdf" document describes the general organization of all in-

class exercise assignments as well as the procedure for completing and submitting all in-class exercises. The “In-Class Exercise Procedure.pdf” document should be treated as part of the Greensheet for this course.

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Reading, Homework, Programming, Participation Assignments

Graded reading, homework, programming, class participation and brief course feedback assignments will be given almost weekly. For non-CS majors, comparable non-programming tasks will be assigned for programming assignments. All graded assignments will count toward a student’s final course grade.

Tentative course calendar of assignment due dates & exam dates:

(Please note that course calendar below, and its content is "subject to change with fair notice")

Week and Class Mtg #	Thur	Tue	Module # & Name	TOPIC	Assignment See Canvas For Module & Weekly Assignment Details and Due Dates
Week 1 Class Mtgs 1 & 2	1/23	1/28	#1 Biology Basics	1/23: Intro To Course: -Topics, learning objectives, course logistics, Instructor background - Greensheet 1/28: - Intro to molecular biology, DNA, RNA, and the central dogma. - DNA Replication, Transcription, and Translation	Learning Module #1 Week #1
Week 2 Class Mtgs 3 & 4	1/30	2/4	#1 Bioinformatics DBs	1/30: - Entrez Gene 2/4: - Ensembl	Learning Module #1 Week #2 February 4th Last Day To Drop Classes
Week 3 Class Mtgs 5 & 6	2/6	2/11	#1 Biology Basics DBs	2/6 - UCSC 2/11: - **In-Class Exercise 1** Topics Covered Weeks 1 to 3	Learning Module #1 Week 3
Week 4 Class Mtgs 7 & 8	2/13	2/18	#2 Alignment	2/13: Pairwise Sequence - Alignment 2/18: Pairwise Sequence - Alignment	Learning Module #2 Week 4 Project Proposals Due 2/19

Week 5 Class Mtgs 9 & 10	2/20	2/25	#2 Alignment	2/20: - **Quiz 1 (~35 mins): Covers Topics Week 1 thru Week 4** - Multiple Alignment 2/25: - Multiple Alignment	Learning Module #2 Week 5
Week 6 Class Mtgs 11 & 12	2/27	3/3	#2 Alignment #3 Phylogenetic Trees	2/27: - Multiple Alignment 3/3: - Multiple Alignment - Molecular phylogenetic trees	Learning Module #2 & Learning Module #3 Week 6
Week 7 Class Mtgs 13 & 14	3/5	3/10	#3 Phylogenetic Trees	3/5: - **In-Class Exercise 2** Topics Covered 2/14 – 3/5 3/10: - Midterm review, finish Seq Alignment	Learning Module #3 Week 7
Week 8 Class Mtgs 15 & 16	3/12	3/17	#3 Phylogenetic Trees	3/12: - **Midterm (Full period): Covers Topics Week 1 thru Week 6** 3/17: - Molecular phylogenetic trees	Learning Module #3 Week 8
Week 9 Class Mtgs 17 & 18	3/19	3/24	#4 Proteins & Functional Genomics	3/19: - Proteins & Proteomics 3/24: - **Quiz 2 (~35 mins): Covers Topics Week 7 thru Week 8** - Proteins & Proteomics	Module #4 Week 9

Week 10 Class Mtgs 19	3/26	3/31	#4 Proteins & Functional Genomics	3/26: - Functional Genomics 3/31: - **SPRING BREAK**	Module #4 Week 10
Week 11 Class Mtgs 20	4/2	4/7	#4 Proteins & Functional Genomics	4/2: - **SPRING BREAK** 4/7: - **In-Class Exercise 3** Topics Covered Week 7 to Week 11	Module #4 Week 11
Week 12 Class Mtgs 21 & 22	4/9	4/14	#4 Proteins & Functional Genomics	4/9: -Phylogenetic Trees 4/14: - Phylogenetic Trees - Functional Genomics	Module #4 Week 12
Week 13 Class Mtgs 23 & 24	4/16	4/21	#5 NGS	4/16: - **Quiz 3 (~35 mins): Covers Topics Week 9 thru Week 12** - Intro to Sequencing Technologies 4/21: - **In-Class Exercise 4** (Work on Projects, Q&A)	Module #5 Week 13
Week 14 Class Mtgs 25 & 26	4/23	4/28	#5 NGS	4/23: Sequencing - Technologies 4/28: - Genome Assembly	Module #5 Week 14
Week 15 Class Mtgs 27 & 28	5/7	5/12	#5 NGS	5/7: - Finish Genome Assembly Review for Final Exam 5/12: - No Class Study/Conference Day	Module #5 Week 15

			Final Project Code and Project Report Due To Canvas **May 20, 2020 By 11:59PM** **Final Exam** **Monday May 18 from 9:45AM to 12:00noon in SCI 311**		

SCHEDULE FOOTNOTES:
NONE AS OF JANUARY 2020

Grades *

WRITTEN HOMEWORK (6 at 10 points each)	60 pts
QUIZZES (3 at 50pts each)	150 pts
MIDTERM	100 pts
IN-CLASS EXERCISES (4 at 50pts each)	200 pts
WEEKLY COURSE FEEDBACK (14 at 5pts each)	70 pts
PROGRAMMING ASSIGNMENTS (3 @ 40pts each)	120 pts
FINAL EXAM	200 pts
FINAL PROJECT REPORT & CODE	200 pts
Total Course Points	= 1,100 pts Total

* The total points for each category might change depending on the number of project teams and assignments. The instructor reserves the right to adjust, with sufficient advanced notice,

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

Classroom Protocol:

SCI 311is a dual purpose room. It can be a regular lecture room or a computer laboratory. Please note that "or" in the last sentence is exclusive. In other words, SCI 311is never a lecture room AND a computer lab at the same time.

Lecture Mode: This is when SCI 311is used as a regular lecture room. Students are expected to listen and follow the Lecture. SCI 311can be a noisy room because of the large number of laptops/workstations and the server. Be considerate to your classmates and follow the Lecture. Do not use the computer (workstation) during lectures, and do not talk to your classmates during lectures. Do not open your laptops, or check email, web-chat, tweet, web-surf on the internet, and so forth. If you cannot follow these simple rules, please do not enroll in this class.

Lab Mode: This is when SCI 311 is used as a computer lab for in-class exercises, Canvas exams, and related assignments that involve the use of computers. Use the

computers and share your ideas and solutions with your classmates except during exams or when otherwise instructed. For in-class exercises, the results of your work for that class session will need to be uploaded to an appropriate Canvas assignment for review and possible grading. We shall alternate between the two modes. A typical class will begin with a short lecture (Lecture Mode) to describe the in-class exercise that will reinforce the assignment. This will be followed by a hands-on (Lab Mode). There will be a number of in-class exercises or hands-on-exercises. The purpose of the in-class exercises and hands-on exercises is to develop your understanding of the course lectures, homework assignments, videos, and e-materials.

Grading Percentage Breakdown (NOTE: Ranges might change if point totals change)

Grading Percentage Breakdown		
Percent of Total Points	**Points**	**Letter Grade**
96.66%	≥ 1063	A+
93.33%	≥ 1027	A
90.00%	≥ 990	A-
86.66%	≥ 953	B+
83.33%	≥ 917	B
80.00%	≥ 880	B-
76.66%	≥ 843	C+
73.33%	≥ 807	C
70.00%	≥ 770	C-
66.66%	≥ 733	D+
63.33%	≥ 697	D
60.00%	≥ 660	D-
59.99%	< 660	F

HOW TO CALCULATE/ESTIMATE YOUR GRADE:
If students would like to calculate their numeric grade percentage, the formula is as follows: Numeric CS 123A Grade Percentage =

$$\frac{Total\ points\ from\ assignments}{Total\ course\ points}\ x\ 100\%$$

There is no guarantee that grades will be curved. If so, it will be done at the end of the semester. The instructor is already aware that graduate students need to maintain an overall GPA of B or better. Just because a student NEEDS a particular grade doesn't mean that the instructor will automatically GIVE the student that grade. Students must EARN a passing grade based on submitted and evaluated course work.

Extra credit options, if available:

There are no pre-planned extra credit assignments in this course. However, homework assignments and exams might, on occasion, contain extra credit options/questions. At times, the instructor might announce the availability of extra exercises or assignments. There is no guarantee that such extra credit exercises or assignments will be offered to the class. If, in the opinion of the instructor, offering such extra credit options will be significantly advantageous to the learning process, they might be offered.

Late Assignment Submission

Late assignments will receive a 25% point deduction of a graded assignment for each 24hr period the submission is late. For example, if an assignment is worth 10 points, and the grade for the assignment is 8/10, and the assignment is submitted one day late, then the point deduction equals 2.5, and the final grade for the assignment is MAX(0, 8 – 2.5) = MAX(0, 5.5) = 5.5 .

Making Up Missed Assignments

An opportunity to makeup missed exams, homework, in-class exercises, programming assignments, and so forth will be provided if and only if verifiable documentation of a compelling reason (e.g., illness, accident, death in the immediate family) for missing the assignment is provided within one week from the student's ability to return to class. It is the student's responsibility to (1) contact the instructor if an assignment has or will be missed; (2) obtain verification from the instructor that the student will be allowed to make up the assignment, subject to acceptable and verified documentation; and (3) make arrangements with the instructor to submit all missing assignments by the end of the semester.

Receiving An Incomplete (I) Grade

Receiving a grade of Incomplete (I) is not automatic. Students must complete at least 80% of course assignments by the end of the semester to be eligible to receive a grade of incomplete. Students must also provide documentation to support the reason for the request to receive an Incomplete grade. The instructor has the final decision to give an Incomplete grade. If the instructor agrees to give a student an Incomplete grade, the instructor will enter the remaining work to be completed as part of the PeopleSoft grade submission process.

Grade Change Policy:

It is a university policy (S09-7) that "A change of grade request must be submitted by the department office directly to the Office of the Registrar in a timely fashion. Normally, such requests must be received by the drop deadline of the following Spring or Fall semester … Requests for exceptions to this policy must be accompanied with a documented and compelling reason. …"

University Policies:

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/. Make sure to review these policies and resources