**** To take this course, you must access a Chrome browser. (Other browsers should work, but they are occasionally unstable for our programming environment, JupyterLab.)**
**** The JupyterLab address for the course is https://mcdb170.lsit.ucsb.edu Please check if you can access it with your UCSB ID.**

** UCSB COVID-19 policy applies to the class. Wearing a mask in class is not required but recommended.

Programming in Biology (MCDB 170, Fall/2022)

Course description

Studying complex biological systems can be significantly facilitated by modern computing technologies. This course introduces essential computer programming concepts and algorithms to biology major students. Students will learn the logic of programming and apply it to gene sequence analysis (bioinformatics), simulation of dynamic systems (systems biology), and data analysis (statistics in biology).

Time & Place

Main lectures:

MWF: 4:00 pm – 4:50 pm Bioengineering 1001

TA sessions: Friday

9:00-9:50 am HSSB 3201
10:00-10:50 am HSSB 3202
11:00-11:50 am HSSB 3202
12:00-12:50 pm HSSB 2201
1:00-1:50 pm HSSB 2201

Instructor

Sung Soo Kim (sungsoo@lifesci.ucsb.edu: Reply may take 1–2 days)
Office hours: Thursdays 11 am – 12 pm beginning Sep. 29th
Office hours are remote

Zoom: https://ucsb.zoom.us/j/81290105163?pwd=NWZOM1JNeE42MlI3WjI5YTkvTXZwUT09

TA

Shichang Liu < shichang@ucsb.edu >
Harshavardhan Miryala < harshavardhan@ucsb.edu >

Office hours: Remote
Shichang: Mon 2:30 pm-3:30 pm,

zoom: https://ucsb.zoom.us/j/83721031567?pwd=cy8yRnBkVFdTRDdjUUpEWU1KZlpRZz09

Harsha: Wed 2:30 pm- 3:30 pm,

zoom: https://ucsb.zoom.us/j/2254679266

Resources

No textbook is required. Followings are valuable resources.

Think Python: How to Think Like a Computer Scientist 2nd Ed, by Allen B. Downey, https://greenteapress.com/wp/think-python-2e/

Computing for Biologists: Python Programming and Principles 1st Ed, by Libeskind-Hadas, ISBN: 1107642183

Bioinformatics Algorithms 3rd Ed, by Compeau and Pevzner, ISBN: 0990374637, http://compeau.cbd.cmu.edu/home/online-education/bioinformatics-algorithms-an-active-learning-approach/

Biopython Tutorial and Cookbook (http://biopython.org/DIST/docs/tutorial/Tutorial.html)

Numpy tutorial: https://numpy.org/doc/stable/user/quickstart.html

Pandas tutorial: https://pandas.pydata.org/docs/user_guide/index.html
https://pandas.pydata.org/pandas-docs/stable/getting_started/tutorials.html
https://pandas.pydata.org/pandas-docs/version/0.15/tutorials.html

Scipy.integrate, https://docs.scipy.org/doc/scipy/reference/tutorial/integrate.html

Scipy.stats, https://docs.scipy.org/doc/scipy/reference/tutorial/stats.html

Scikit-image, https://scikit-image.org/docs/stable/user_guide.html

Weekly topics (subject to change)

Week	Date	Topic
	F, Sep 23	Course objectives, Introduction
	M, Sep 26	**Python syntax**
	W, Sep 28	Statement, variables, types, operators
	F, Sep 30	Conditionals, loops
	M, Oct 3	Functions, parameters
	W, Oct 5	Lists, tuples, dictionaries, sets
	F, Oct 7	Class, libraries, packages, and modules. Intro to libraries for the course
	M, Oct 10	**Sequence analysis**
	W, Oct 12	Introduction to data structures and algorithms
	F, Oct 14	String manipulation with DNA sequences
	M, Oct 17	Finding the DNA replication origin
	W, Oct 19	Introduction to Biopython: FASTA, SeqIO
	F, Oct 21	Alignments, BLAST
	M, Oct 24	**More on Python**
	W, Oct 26	Python object
	F, Oct 28	Review: Comprehension, control flow, package, learning strategy
	M, Oct 31	Midterm exam from 4 pm to 4:50 pm (range: Week 1 – 5)
	W, Nov 2	**Mathematical Operations**
	F, Nov 4	Numpy
	M, Nov 7	1D array operation
		Matrix operation

	W, Nov 9	**Ordinary Differential Equations** Scipy `solve_ivp()` Example: Ring attractor model
	M, Nov 14	
	W, Nov 16	
	F, Nov 18	
	M, Nov 21	**Dealing with real world data** Pandas
	W, Nov 23	
	M, Nov 28	TBD: (if we have time) Statistical analysis (statsmodels)
	W, Nov 30	TBD: (if we have time) Biological image analysis (Scikit-image)
	F, Dec 2	Course summary
	Dec 9	Final Exam: Dec 9th, 4–7 pm

Schedule for homework assignments:

Unlike Quizzes and Exams that are strictly about lecture materials, homework is for you to use the knowledge you learned from the class and solve challenging problems. Even though detailed instructions will be given to each problem, the nature of the homework is to *go beyond what you learned and explore new things*. Therefore, it can be occasionally quite challenging and may require your own research on the internet.

All assignments are due at 11:59 pm each Sunday

HW1: due Oct 9, 11:59 pm
HW2: due Oct 16, 11:59 pm
HW3: due Oct 23, 11:59 pm
HW4: due Oct 30, 11:59 pm
HW5: due Nov 6, 11:59 pm
HW6: due Nov 13, 11:59 pm
HW7: due Nov 20, 11:59 pm
HW8: due Dec 2, 11:59 pm → This is Friday, not Sunday (after Thanksgiving)

Late submission policy

Up to 1-week late submission: 20% penalty

Submission over 1-week late will not be accepted because an answer to the assignment will be distributed.

Submission of Homework 8 won't be accepted after 11:59 pm December 2nd because the answer will be distributed on December 3rd.

Schedule for the quiz:

Each week (due 11:59 pm each Wednesday), the topics of the previous week will be subject to the quiz. The Gauchospace quiz engine is used. You can attempt three times before the deadline. The highest score will be used. There will be 9 sets of quizzes. The quizzes will not be accessible after each due date and no more attempts will be possible, *without exception*. (After the due date, quiz problems will be posted for the purpose of exam preparation, but not for points.)

Quiz 1: due Oct 5, 11:59 pm
Quiz 2: due Oct 12, 11:59 pm

Quiz 3: due Oct 19, 11:59 pm
Quiz 4: due Oct 26, 11:59 pm
Quiz 5: due Nov 2, 11:59 pm
Quiz 6: due Nov 9, 11:59 pm
Quiz 7: due Nov 16, 11:59 pm
Quiz 8: due Nov 30, 11:59 pm

Exams:

Midterm Exam: Friday, Oct 28 from 4:00 PM – 4:50 PM
Final Exam: Friday, Dec 9 from 4:00 PM – 7:00 PM
* Details of each exam will be provided 1 week before the exam.

TA Section attendance:

Each Friday. Attendance is required.

Gradings

Grading is based on the points earned via weighted sums of five categories.

- Exams (midterm:25% + final:35%): 60%
- Homework: 25%
- Quiz: 5%
- Class attendance (for MW in-person classes): 5%
- TA section attendance: 5%

Grade A: 90-100 (A-: 90-92.9, A: 93-96.9, A+: 97-100)
Grade B: 80-89.9 (B-: 80-82.9, B: 83-86.9, B+: 87-89.9)
Grade C: 70-79.9 (C-: 70-72.9, C: 73-76.9, C+: 77-79.9)
Grade D: 60-69.9 (D-: 60-62.9, D: 63-66.9, D+: 67-69.9)
Grade F: 0-59.9
(The point will be rounded up to the nearest first decimal after weighting.)

Advice on studying programming:

1) The best approach to programming is to actually program to solve problems, many times and frequently. Trials and errors are, therefore, an important part of this course. Spend enough time to try different methods to solve assignment problems.

2) Many exam questions, which will include multiple-choice problems and short programming problems, will be variations of (but not the same as) quizzes and assignment problems. Thus, it is important to fully understand the materials, covered in quizzes and assignment problems. Remember that you have only 50 minutes on the midterm. Without familiarizing with syntax and conventions, the time will not be enough to solve all questions.

3) Section attendance is required. You will learn various programming techniques, problem-solving techniques, and/or QnA for assignments/quizzes/exams. Section attendance will be noted.

University Policy:

The class, and the university, is an environment that must be free of harassment and discrimination. All students are expected to abide by the University of California policies on discrimination and harassment, which you can (and should) read the details about here and here. All policies of the University of California can be accessed here. If you look for *confidential* help regarding sexual violence or harassment, find experts with whom your confidentiality is protected by the University Policy here (all other personnel, including professors, are entitled to report all the details to the Title IX office of the university).

The class is committed to ensuring a safe, friendly, and accepting environment for everybody. We will not tolerate any verbal or physical harassment or discrimination on the basis of gender, gender identity and expression, sexual orientation, disability, physical appearance, body size, race, color, national origin, pregnancy and its related conditions, physical or mental disability, medical condition, citizenship, service in uniformed services, or religion. We will not tolerate intimidation, stalking, following, unwanted photography or video recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome sexual attention. Finally, it should go without saying that lewd language and behavior have no place in the class.