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

**** For the first two weeks, the main lectures will be provided *ASYNCHRONOUSLY*. Lecture videos will be uploaded on the Gauchospace. For the first two weeks, TA sessions will be SYNCHRONOUS, and the zoom link is provided below.**

**** Because of the disruption caused by Omicron, this syllabus is being rewritten. More detailed information about the course will be updated as the COVID-19 situation is updated and the course progresses.**

Programming in Biology (MCDB 170, Winter/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:

Asynchronous lecture videos will be provided on the Gauchospace for the first two weeks.
From the third week: MWF: 4:00 pm – 4:50 pm Psych 1924

TA sessions:

Synchronous zoom meetings will be held for the first two weeks.
From the third week: F 1 pm Girv 1108, F 2 pm HSSB 3201, F 3 pm Girv 1108

Instructor

Sung Soo Kim (sungsoo@lifesci.ucsb.edu: Reply may take 1–2 days)
Office hours: Thursdays 11 am – 12 pm, Office hours are remote
Zoom: https://ucsb.zoom.us/j/81909770456?pwd=aDl1MHhZNUlFSW9NZllDeUlsUGw0QT09
Meeting ID: 819 0977 0456
Passcode: 602149)

TA

Jon Luntzel (luntzel@umail.ucsb.edu)
Office hours: 2-4 pm on Mondays
First two weeks: Remote. Zoom: https://ucsb.zoom.us/j/6677917824
From the third week: In room 4572 of the library. However, this may change depending on the availability of the library room.

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
1 Lecture videos	M, Jan 3	Course objectives, Why Python?, JupyterLab basics
	W, Jan 5	Statement, variables, types, operators
	F, Jan 7	Conditionals, loops
2 Lecture videos	M, Jan 10	Functions, parameters
	W, Jan 12	Lists, tuples, dictionaries, sets
	F, Jan 14	Class, libraries, packages, and modules. Intro to libraries for the course
3	W, Jan 19	Introduction to data structures and algorithms
	F, Jan 21	String manipulation with DNA sequences
4	M, Jan 24	Finding the DNA replication origin
	W, Jan 26	Introduction to Biopython: FASTA, SeqIO

	F, Jan 28	Alignments, BLAST
5	M, Jan 31	Python object 1
	W, Feb 2	Python object 2
	F, Feb 4	Review: Comprehension, control flow, package, learning strategy
6	M, Feb 7	Numpy, intro
	W, Feb 9	Midterm exam from 4 pm to 4:50 pm (range: Jan 3 – Feb 2)
	F, Feb 11	Numpy, 1D array
7	M, Feb 14	Numpy, Matrix 1
	W, Feb 16	Numpy, Matrix 2
	F, Feb 18	Ordinary Differential Equations
8	W, Feb 23	Scipy; `solve_ivp()` - an example
	F, Feb 25	More examples
9	M, Feb 28	Ring attractor model
	W, Mar 2	Dealing with real world data (Pandas)
	F, Mar 4	Pandas example
10	M, Mar 7	(Optional) Statistical analysis (statsmodels)
	W, Mar 9	(Optional) Biological image analysis (Scikit-image)
	F, Mar 11	Course summary
11	F, Mar 18	Final Exam (all materials from Week 1 – 9) 4:00 PM - 7:00 PM, Room: TBD

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 Jan 16, 11:59 pm
HW2: due Jan 23, 11:59 pm
HW3: due Jan 30, 11:59 pm
HW4: due Feb 6, 11:59 pm
HW5: due Feb 13, 11:59 pm
HW6: due Feb 20, 11:59 pm
HW7: due Feb 27, 11:59 pm
HW8: due March 6, 11:59 pm
HW9: due March 13, 11:59 pm

Late submission policy

Up to 1-week late submission: 20% penalty

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

Submission of Assignment 9 won't be accepted after 11:59 pm March 13th because the answer will be provided on March 14th.

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 as many times as you want 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 Jan 12, 11:59 pm
Quiz 2: due Jan 19, 11:59 pm
Quiz 3: due Jan 26, 11:59 pm
Quiz 4: due Feb 2, 11:59 pm
Quiz 5: due Feb 9, 11:59 pm
Quiz 6: due Feb 16, 11:59 pm
Quiz 7: due Feb 23, 11:59 pm
Quiz 8: due March 2, 11:59 pm
Quiz 9: due March 9, 11:59 pm

Exams:

Midterm Exam: Wednesday, Feb 9 at 4:00 PM – 4:50 PM
Final Exam: Friday, Mar 18, 2022 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 + final): 60%
- Homework: 25%
- Quiz: 5%
- Class attendance (for in-person classes and synchronous classes, if any): 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.