



QBIO 401 Introduction to Computational Analysis of Biological Data

Units: 4

Fall 2024 Semester

Lecture: Mondays and Wednesdays, 2:00 – 3:20pm

Location: DMC 150

Discussion: Thursdays 3:00 – 3:50pm (SOS B48)
or Thursdays 4:00 – 4:50 (WPH 101)

Instructor: Peter Calabrese

Office: RRI 404B

Office Hours: Mondays 3:40 – 4:30,

Tuesdays 12:40 – 1:30,

Wednesdays 3:40 – 4:30,

Thursdays 12:40 – 1:30,

Immediately after lecture, or by appointment

Contact Info: petercal@usc.edu, 213-740-2434

For office hours, I will be in my office and I will also be on Zoom (<https://usc.zoom.us/j/4898518195>). It is up to you if you want to meet in person or online.

Teaching Assistant: TBD

Course Description

This course is intended for students who are interested in computational biology. This course will integrate the biology, computer science, and statistics training in the QBIO major. We will do this by analyzing genomic datasets.

Learning Objectives

In lecture, students will be introduced to the general programming language Python (no prior knowledge of this language is required). Students will use Python when doing weekly computing assignments and two take-home exams. There will be an emphasis on writing original code and not using off-the-shelf programs. Students will “get their hands dirty” by analyzing genomic datasets. The assignments and exams will be based on topics covered in lecture. Topics will include: next generation sequencing, hidden Markov models, sequence alignment, phylogenetic trees, RNA-seq, multiple testing, dimension reduction, population genetics, GWAS, meta-genomics, structural biology, systems biology, and machine learning.

Prerequisite(s): none

Co-Requisite(s): none

Concurrent Enrollment: none

Recommended Preparation: There are no prerequisites or co-requisites for this course. Experience writing computer code (or a willingness to learn) will be helpful.

Course Notes

This course can be taken either for a letter grade or for credit/no credit. Lecture slides will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

Students will need access to a computer. It will be helpful (but not required) if students have a laptop that they can bring to class.

Required Readings and Supplementary Materials

There is no textbook for this course. Lectures will be supplemented by readings posted on Blackboard.

Assignments

Most weeks there will be a computing assignment. Assignments will both be posted and submitted on Blackboard. The assignments will be due before midnight (California time) on Wednesday. The next day (Thursday) in discussion, the TA will review the solutions. The TA will grade the assignments for accuracy.

Exams

There will be a take-home midterm exam and a take-home final exam.

Grading Breakdown

Assessment Tool (assignments)	% of Grade	
Weekly computing assignments	75	
Mid-term take-home exam	10	
Final take-home exam	15	

Grading Timeline

Assignments will be graded within one to two weeks of submission. Grades will be entered on Blackboard.

Additional Policies

Late assignments will not be accepted without prior approval. You can work together on the assignments (every student must submit their own assignment). You **cannot** work together on the exams.

The professor reserves the right to make changes to the syllabus; these changes will be announced as early as possible so that students can adjust their schedules.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1 8/26-8/30	Next Generation Sequencing Introduction to Python	Posted on Blackboard	(none)
Week 2 9/2-9/6	Labor Day (no lecture on Monday) Python Continued	Posted on Blackboard	(none)
Week 3 9/9-9/13	Python Continued Hidden Markov Models	Posted on Blackboard	Assignment #1
Week 4 9/16-9/20	Sequence Alignment E-scores	Posted on Blackboard	Assignment #2
Week 5 9/23-9/27	Phylogenetic Trees More Advanced Python	Posted on Blackboard	Assignment #3
Week 6 9/30-10/4	More Advanced Python More Advanced Python	Posted on Blackboard	Assignment #4
Week 7 10/7-10/11	RNA-Seq Multiple Testing Fall Recess (no discussion on Thursday)	Posted on Blackboard	Assignment #5
Week 8 10/14-10/18	Dimension Reduction Population Genetics	Posted on Blackboard	Mid-term take-home exam due Wed., Oct. 16
Week 9 10/21-10/25	GWAS Meta-genomics	Posted on Blackboard	Assignment #6
Week 10 10/28-11/1	Machine Learning: Regression Machine Learning: Regression	Posted on Blackboard	Assignment #7
Week 11 11/4-11/8	Machine Learning: Classification Machine Learning: Classification	Posted on Blackboard	Assignment #8
Week 12 11/11-11/15	Veteran's Day (no lecture on Monday) Machine Learning: Neural Networks	Posted on Blackboard	Assignment #9
Week 13 11/18-11/22	Machine Learning: Neural Networks Machine Learning: Trees	Posted on Blackboard	Assignment #10
Week 14 11/25-11/29	Machine Learning: Unbalanced Data Thanksgiving (no lecture on Wednesday and no discussion on Thursday)	Posted on Blackboard	(none)
Week 15 12/2-12/6	Structural Biology (guest lecturer) Systems Biology (guest lecturer)	Posted on Blackboard	Assignment #11
FINAL	Final take-home exam due Friday, Dec. 13		

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.