QBIO 401 Introduction to Computational Analysis of Biological Data

All classes and office hours will be online via Zoom. All classes will be recorded.

Instructor Peter Calabrese, petercal@usc.edu

Dates May 20 to June 30

Time Monday, Tuesday, Wednesday, and Thursday from 2:00PM to 4:05PM

Office hours Monday and Wednesday from 4:10PM to 5:00 PM, or by appointment

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

Learning Objectives and Outcomes In lecture, students will be introduced to the general programming language Python and the statistical programming language R (no prior knowledge of either language is required). Students will use these languages when doing one to two computing assignments per week and an end-of-the-semester project. There will be an emphasis on writing original code and not just using off-the-shelf programs. In both the weekly assignments and the end-of-the-semester project, students will "get their hands dirty" by analyzing genomic datasets. The assignments and project will be based on topics covered in lecture. Topics will include: gene prediction, sequence alignment, phylogenetic trees, next generation sequencing, meta-genomics, population genetics, structural biology, systems biology, and machine learning.

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

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

Assignments There will be one to two computing assignments per week in R or Python. These assignments are both to familiarize the students with writing computer code, and to teach the computational biology topics covered in lecture.
There will also be an end of the semester project. Students have freedom in choosing their project (I can suggest topics). Students should select a biological dataset (graduate students can use their thesis data if they wish), write some code to analyze it (it is fine to use existing computer programs, but I want students to write some original code too), and to write the results in a 3 to 5 page written report (code does not count towards the report's length).

Grades

Assignment	Points	Percentage of Grade
Computing assignments	8 assignments, 10 points each	80
End-of-semester project	20	20

Course Schedule

	Topic
Week 1 (half-week)	Introduction to Python
Week 2 (no class Monday for Memorial Day)	Next Generation Sequencing Data/ Gene Prediction
Week 3	Sequence Alignment/ Phylogenetic Trees
Week 4	Introduction to R/ Population Genetics/ Meta-Genomics
Week 5	Machine Learning – Regression/ Classification
Week 6	Machine Learning – Neural Networks/ Applications to Biology
Week 7 (half-week)	Systems Biology/ Structural Biology

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:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call
engemannshc.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) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) | Title IX - (213) 740-5086
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender

expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation 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 Support and Advocacy - (213) 821-4710
studentaffairs.usc.edu/ssa
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.