

QBIO 401 Introduction to Computational Analysis of Biological Data

Instructor Peter Calabrese

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Time and Place

Mondays and Wednesdays, 2:00-3:20, RRI 421 (lecture)

Thursdays, 3:30-4:20, RRI 221 (discussion)

Office hours Tuesdays, 3:00-5:00, RRI 403F, or by appointment

Course Description This projects-based 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. Some of these datasets will be publically available, and others will be collected and sequenced specifically for this course.

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 weekly computing assignments 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, machine learning, and human disease databases. Doing the assignments and the project are important. I believe that students will learn the most from this course while working on the assignments and the project.

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 weekly computing assignments 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 a project. Students will write the results of their project in a 3 to 5 page written report due at the end of the semester. Students have freedom in choosing their project (I can suggest topics, graduate students can use their thesis data if they wish). Students should discuss the topic of their project with me by week 10.

Grades

Assignment	Points	Percentage of Grade
Weekly computing assignments	10 each, 140 total	80
End-of-semester project and written report	35	20

Course Schedule

	Topic	Reading
Week 1	Discussion of course-specific sequencing experiments/ Introduction to Python	Posted on Blackboard
Week 2	Gene Prediction	Posted on Blackboard
Week 3	Sequence Alignment	Posted on Blackboard
Week 4	Phylogenetic Trees	Posted on Blackboard
Week 5	Next Generation Sequencing Data	Posted on Blackboard
Week 6	Meta-Genomics	Posted on Blackboard
Week 7	Introduction to R	Posted on Blackboard
Week 8	Population Genetics	Posted on Blackboard
Week 9	Structural Biology	Posted on Blackboard
Week 10	Systems Biology	Posted on Blackboard
Week 11	Machine Learning - Regression	Posted on Blackboard
Week 12	Machine Learning - Classification	Posted on Blackboard
Week 13	Machine Learning - Neural Networks	Posted on Blackboard
Week 14	Machine Learning - Applications to Biology	Posted on Blackboard
Week 15	Human Disease Databases	Posted on Blackboard
Week 16	Final Project and written report due	

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.