QBIO 401 Introduction to Computational Analysis of Biological Data

Instructor Tsu-Pei Chiu
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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 413J, or by appointment

Course Description This course introduces a broad range of topics in quantitative and computational biology through hands-on learning experiences. This course integrates the multidisciplinary training of the QBIO major, touching on biology, computer science, and statistical concepts. Our class will cover fundamental techniques such as statistical analysis, machine learning, and algorithm design, and students will work directly with large-scale biological datasets.

Learning Objectives and Outcomes Topics covered in the course include principles and methods for sequence alignment, genome assembly, phylogenetic trees, next generation sequencing, meta-genomics, population genetics, system biology, structural biology, machine learning, as well as currently emerging research areas. The general programming language Python and the statistical programming language R will be introduced in the lecture as well (no prior knowledge of either language is required). Students will use these languages to analyze biological datasets and implement algorithms for their weekly computing assignments and an end-of-the-semester project. Students will be required to write their own code without solely using off-the-shelf programs. Students can expect to gain a broad understanding of the principles of computational biology and the skills to analyze and model biological data through the lecture and exercises.

Readings No textbook is required for this course. Reading materials will be posted on Blackboard.

Recommended Preparation No prerequisites or co-requisites are required for this course. Prior programming experience will be helpful but is not required.

Assignments The assignments include weekly computing assignment and an end-of-the-semester project. Computer-based problem sets in Python or R will be assigned every week. These assignments are designed to promote a deeper understanding of the principles discussed in lecture as well as provide hands-on experience with computing methods. The end-of-the-semester project will require students to design and carry out a research project. Students will write a report explaining their project and results in a 3 to 5 page due at the end of the semester. Students will have the freedom to choose their project topic related to the lectures. I can suggest topics to students if they need, and graduate students can use their thesis data if they wish. Students should discuss the topic of their research project with me by week 10.

Grades

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

Tentative Course Schedule

	Topic	Reading
Week 1	Introduction to Python	Posted on Blackboard
Week 2	Next Generation Sequencing Data	Posted on Blackboard
Week 3	Gene Prediction	Posted on Blackboard
Week 4	Sequence Alignment	Posted on Blackboard
Week 5	Phylogenetic Trees	Posted on Blackboard
Week 6	Introduction to R	Posted on Blackboard
Week 7	Population Genetics	Posted on Blackboard
Week 8	Meta-Genomics	Posted on Blackboard
Week 9	Structural Biology	Posted on Blackboard
Week 10	Machine Learning - Regression	Posted on Blackboard
Week 11	Machine Learning - Classification	Posted on Blackboard
Week 12	Machine Learning - Neural Networks	Posted on Blackboard
Week 13	Currently emerging research	Posted on Blackboard
Week 14	Final Project and written report due	Posted on Blackboard

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.