



BISC/QBIO478 Computational Genome Analysis

Units: 4

Spring 2021 — T-Th — 9:30AM - 10:50AM

Location: This course will be taught remotely

Instructor: Andrew Smith

Office: RRI 408 E (Remote for Spring 2021)

Office Hours: 10AM-12PM, Fridays, or by appointment (subject to change before start of semester).

Contact Info: andrewds@usc.edu, replies within 24 hours.

Instructor: Peter Calabrese

Office: RRI 403 F (Remote for Spring 2021)

Office Hours: 10AM-12PM, Fridays, or by appointment (subject to change before start of semester).

Contact Info: petercal@usc.edu, replies within 24 hours.

Teaching Assistant: Amal Thomas

Office: Amal RRI 408 M (Remote for Spring 2021)

Office Hours: 9:30AM-10:50AM, Tuesday, Thursday (subject to change before start of semester).

Contact Info: amalthom@usc.edu

Short Description

Introduction to algorithms and statistics for genome analysis, and their applications. Topics include analysis of DNA sequencing, sequence comparison, genetic variation, gene expression, disease association, and evolution.

Course Description

Over the next decade, millions of genomes will be sequenced (likely including yours), and genetic analysis will be a cornerstone of medical care. The goals of this course are to provide students with (1) broad knowledge of computational genome analysis, (2) biological questions that motivate computational analysis, and (3) specific technical skills of immediate practical use. This course covers DNA sequencing technology, and computational methods to analyze: sequence data, individual genomes, disease studies, inter species comparison, functional genomics, and gene expression. The data analysis techniques covered in this course are founded in computer science and statistics and motivated by real examples from modern studies.

Learning Objectives

Students will learn:

Technology of modern sequencing methods, and the characteristics of the data produced by different technologies. Probability and statistics for sequence analysis. Algorithms for searching DNA databases and assembling genomes. Methods to discover genome variation, and application to discovering etiology of disease. How to use software for high-performance computing and sequence analysis. Models for sequence evolution. Algorithms for pairwise sequence alignment. Statistical methods for detecting differential gene expression and genomic regulatory regions.

Prerequisite(s): None

Co-Requisite(s): None

Concurrent Enrollment:

Recommended Preparation: BISC 305

Course Notes

Letter grade, 4 credits. If any lecture notes, slides or other materials are distributed, they will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

Assignments required access to a personal computer and network connection.

Required Readings and Supplementary Materials

Required reading: Computational Genome Analysis, an Introduction. e-book available from the USC library.

Description and Assessment of Assignments

Assignments may require: pencil/paper problem solving, and computational projects involving running online software, interacting with public biological databases, and writing a report with a summary of results.

Grading Breakdown

Assessment Tool (assignments)	Points	% of Grade
Homework (5)	6	30
Midterm	35	35
Final	35	35
TOTAL	100	100

Assignment Submission Policy

Written assignments are due at the beginning of lecture on the due date. Electronic reports are due by midnight on the due date and must be sent to the TA.

Grading Timeline

Homework and tests will be graded within one week of submission.

Additional Policies

Cell phone use is not allowed in class except in case of emergency or with prior permission.

Course Schedule

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1	Genomes and sequencing		
Week 2	Mapping reads: genome search engines		
Week 3	Genome assembly: sequence jigsaw puzzles		Homework 1
Week 4	Pairwise sequence alignment		
Week 5	Multiple sequence alignment		
Week 6	Regulatory sequence analysis		Homework 2
Week 7	Discovering patterns in sequences (1)		
Week 8	Discovering patterns in sequences (2)		Midterm (Thursday)
Week 9	Gene expression analysis with RNA-seq (1)		Homework 3
Week 10	Gene expression analysis with RNA-seq (2)		
Week 11	Dimension reduction: simplifying genome-scale data		
Week 12	Epigenomics		Homework 4
Week 13	Hidden Markov models		
Week 14	Genome-wide association studies (1)		
Week 15	Genome-wide association studies (1)		Homework 5
FINAL			Refer to the final exam schedule in the USC <i>Schedule of Classes</i> at classes.usc.edu .

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.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your con