



USC University of Southern California

MICB560: Recent Advances in Microbiology
Special Topic: Bioinformatics for Biomedical Research
(Theory + Hands-on Practical Applications)

Credit: 1 unit

Term: Spring 2023

Time: Wednesdays —12:00pm-12:50pm

Location: MCH156 (Hybrid)

Instructor: Ha Youn Lee, PhD

Office: NRT 5506

Office Hours: Thursday 4:00-5:00pm or by appointment

Contact Info: hayoun@usc.edu

Course Background

Contemporary biomedical and clinical research is undergoing constant development with the rapid advancement of various high throughput technologies at the DNA, RNA and protein levels. These technologies generate vast amounts of raw data, making bioinformatics methodologies essential in their use for basic biomedical and clinical applications. Basic understanding on computational skills to mine the variety and complexity of available datasets are required to advance cutting-edge biomedical and clinical research.

Course Description

This course is designed to introduce the basics of bioinformatics, accompanied by hands-on analysis of biomedical and genomic data. Students will acquire practical experience during class. Participants will learn how we analyze large-scale biomedical and genomic data sets. With step-by-step instructions, students will perform bioinformatics analysis during the class. Students will master methods and techniques of error filtering, alignment, mapping reads to transcript database and gene database, taxonomic annotation, differential expression, and functional pathway analysis. Upon completion of this course, students will be able to analyze biomedical sequence datasets from their own future studies or other professional projects including RNA sequencing and microbiome sequencing.

Learning Objectives

By the end of this course, students will be able to:

- Access raw sequencing data structures and filter out erroneous sequences.
- Learn Python language basics
- Work with command-line based bioinformatics codes and packages.
- Align and map next-generation sequencing reads to reference database.
- Perform basic statistical testing using R.
- Perform statistical tests to identify differentially expressed genes.
- Conduct microbiome taxonomic annotation.
- Perform functional pathway analysis.

Computational Resources

Students will use their own laptop and log into the computer server of this course. A computer account on the server computer will be provided to students. During class hours, students will perform bioinformatics analysis in this server.

Prerequisites

None, except that students will need to use their own laptop computers.

Assessment of Projects

Midterm Project

There will be one midterm project. Students will perform an assigned bioinformatics task and submit a report summarizing their procedures and results. Students may work in small groups. This assignment will be completed outside regular class meeting hours and will be uploaded to Blackboard by the specific deadline. Discussion of this project will take place during a regularly scheduled class meeting.

Final Project

There will be one final project. Students will perform an assigned bioinformatics project and submit a report (upload to Blackboard) summarizing their procedures and results. Students may work in small groups for the final project.

Grading

Assignment	% of Grade	Maximum Points
In-Class Participation	30	30
Midterm Project	30	30
Final Project	40	40
Total	100	100

Points	Grade
96 or greater	A
91 - 95	A-
86 - 90	B+
81 - 85	B
76 - 80	B-
71 - 75	C+
66 - 70	C
61 - 65	C-
51 - 60	D
0 - 50	F
Total	100

Late Policy

Both midterm project and final project carry a 5% mark-down in grade for each day they are turned in after their due date. If you have an unavoidable emergency, notify the instructor by email and discuss the situation with the instructor during office hours.

Attendance

Regular, consistent attendance (and on-time arrival) is necessary, as students are required to perform weekly in-class bioinformatics activities. Attendance will be graded in the category of In-Class Participation.

Course evaluation

Student feedback is welcome. Students will have an opportunity to submit comments on the mid-term evaluation and the standard USC course evaluation survey at the end of the semester.

Course policies

As per USC policies, recordings of lecture material require the express permission of the instructor and announcement to the class, and can only be used for individual or group study.

(see next page for Course Schedule)

Course Schedule (Spring 2023)

Week 1	Jan. 11	Introduction. What is Bioinformatics?
Week 2	Jan. 18	Unix commands
Week 3	Jan. 25	Python language basics (Part 1)
Week 4	Feb. 1	Python language basics (Part 2)
Week 5	Feb. 8	Next-generation sequencing data and quality filtering
Week 6	Feb. 15	Microbiome taxonomy annotation
Week 7	Feb. 22	R basics (Part 1)
Week 8	Mar. 1	R basics (Part 2)
Week 9	Mar. 8	Midterm exam
Week 10	Mar. 15	Statistical testing (Part 1)
Week 11	Mar. 22	Statistical testing (Part 2)
Week 12	Mar. 29	Principal component analysis
Week 13	Apr. 5	Clustering analysis
Week 14	Apr. 12	RNA sequencing data analysis
Week 15	Apr. 19	Differential gene expression analysis
Week 16	Apr. 26	Functional pathway analysis
Week 17	May 3	Final project

SUPPORT FOR STUDENT NEEDS AND WELL-BEING

Students and Disability Accommodations

SC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. DSP is located in GFS-120 (University Park Campus) and is open 8:30 a.m. – 4:30 p.m., Monday through Friday. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Stress Management

Students are under a lot of pressure. If you start to feel overwhelmed, it is important that you reach out for help. A good place to start is the Eric Cohen Student Health Center on this campus (the Health Sciences Campus, HSC). The phone number is (323) 442-5631 and the website is <http://ecohenshc.usc.edu>. The service is confidential, and there is no charge.

Student Counseling Services

(213) 740-7711 – 24/7 on call

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

<https://engemannshc.usc.edu/counseling/>

National Suicide Prevention Lifeline

Tel: 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org/>

Beyond Academic Challenges

Balancing course work, midterms, finals, and laboratory research presents a challenge and at times can feel overwhelming. On top of that, many students are far away from home and family, perhaps even their country and their native language, which can feel quite depressing. Sometimes, relationship problems come up and make life miserable. But no matter the problem, USC offers resources to help students deal with depression, anxiety, and other types of distress. USC's services are not only geared toward helping students with academic challenges, but also with personal problems. Students in need

should not hesitate to take advantage of the services that are listed above (and on the next page); there is no need to feel embarrassed or ashamed. USC is offering these services and resources so that students are in the best position to meet their academic and personal goals.

ACADEMIC CONDUCT AND ACADEMIC INTEGRITY STANDARDS

- Members of the USC community are expected to be honest and forthright in their academic endeavors.
- To falsify the results of one's research, to present the words, ideas, data, or work of another as one's own, or to cheat on an examination corrupts the essential process by which knowledge is advanced.
- When students accept their offer to USC they are also accepting to abide by the Student Conduct Code.
- This is a higher standard of conduct than expected in the general community because we are TROJANS.
- When USC confers a degree, it is acknowledging students' academic success and their ability to be a positive, honest, and outstanding citizen within society.
- In failing to uphold academic standards students cheat themselves and others out of learning, degrade the value of their education, and diminish the prestige of the USC education.
- Ignorance of these expectations is not an acceptable justification for violating the Student Conduct Code.

The University prides itself in maintaining high academic integrity standards. The entire academic community benefits from the adherence to such standards. Among the violations of integrity standards is plagiarism. Plagiarism has to be avoided. It is a serious academic offense with serious consequences. When it occurs, the consequences for the student can be severe. For example, credit for a course may be denied and a grade of F is given, permanent notation on transcript, suspension or expulsion from the University, or revocation of admission or degree.

What is Plagiarism?

- Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.
- For example, if you use a sentence from somebody else's paper and insert it into your own paper without clearly marking the source, you are plagiarizing.

Further information, including a number of tutorials for students, can be found online at: <https://libraries.usc.edu/research/reference-tutorials>. This website has tutorials such as: how to avoid plagiarism, how to prevent academic dishonesty, how to manage your research, and other useful how-to tools and tutorials.

Understanding and Avoiding Plagiarism: Module 1 (What is plagiarism?)

<https://libraries.usc.edu/tutorial/understanding-and-avoiding-plagiarism-module-1-what-plagiarism-what-citation>

Understanding and Avoiding Plagiarism: Module 2 (Citing to avoid plagiarism)

<https://libraries.usc.edu/tutorial/understanding-and-avoiding-plagiarism-module-2-citing-avoid-plagiarism>

Students should expect that their work (such as term papers, research proposals, presentations, written theses, etc.) will be checked for plagiarism with the use of appropriate software (Turnitin; iThenticate; Copyscape; PaperRater; etc.).

DISCRIMINATION, HARASSMENT AND ASSAULT

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://dps.usc.edu/>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Relationship and Sexual Violence Prevention (RSVP) Services at <https://sites.google.com/usc.edu/rsvpclientservices/home?pli=1> provide 24/7 confidential support.

OTHER SUPPORT SYSTEMS

A number of USC schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
sites.google.com/usc.edu/counseling-mental-health

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

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
988lifeline.org

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining

custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355([WELL sites.google.com/usc.edu/rsvpclientservices/home](https://sites.google.com/usc.edu/rsvpclientservices/home))

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
eeotix.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.

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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 for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
campussupport.usc.edu

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

Diversity, Equity and Inclusion - (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
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) 442-1200 – 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 concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
chan.usc.edu/patient-care/faculty-practice

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.