QBIO 578b: Computational Molecular Biology

Units: 3

Term—Day—Time: Fall, TuTh, 11:00 AM-12:20 PM

Location: RRI 301

Instructor: Fengzhu Sun, Liang Chen

Office: RRI 416H, RRI 416E

Office Hours: Tue: 3:00-5:00 PM (Sun), 1:45-3:45 PM (Chen)

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Course Description
Applications of mathematics and statistics to data from molecular biology. Statistics for genomic sequence data: DNA sequence assembly, significance of alignment scores, hidden Markov models, models of sequence evolution, genetic mapping, and high throughput sequencing analysis.

Learning Objectives
Through this course, students will obtain advanced understanding of the statistical and computational models in computational molecular biology.

Prerequisite(s): MATH 505A and MATH 541A

Course Notes
Letter grading is used. The copies of lecture slides and other class information will be posted on Brightspace.

Required Readings and Supplementary Materials

Textbooks
Waterman MS (1995) Introduction to Computational Biology: Maps, Sequences and Genomes. Chapman & Hall/CRC Interdisciplinary Statistics
Warren J. Ewens and Gregory Grant (2005) Statistical Methods in Bioinformatics: An Introduction, 2nd edition. Springer

Optional Textbooks
T. Koski (2002) Hidden Markov Models for Bioinformatics. Kluwer Academic Publishers.
R. Durbin et al. (1998) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.

Description and Assessment of Assignments
You are encouraged to seek help from others including your fellow classmates and the instructor for homework assignments. However, the final work must be done by yourself.

The exams will be on the honor system. You can use textbooks, lecture notes, and computers. *However, you are not allowed to seek help from others*. The submitted work must be done by yourself. If there are some evidences of violating USC scientific integrity rules, both the help provider and the recipient will receive zero credits for the relevant exams.

Grading Breakdown

Assessment Tool (assignments)	Points	% of Grade
Homework		40
Exam I		30
Exam II		30
TOTAL		100

Assignment Submission Policy

You can use Brightspace to turn in your assignments/exams. For every homework, a *turnitin* link will be made available. Please make sure you check the due dates for each assignment/exam. You can either do your homework on pen and paper and then upload its scanned version or if you have access to an iPad or a Microsoft Surface or anything equivalent, you can use any supported writing application to write your homework on the divide and then upload the PDF.

Brightspace

USC is making a change in our online learning platform, and we are now using Brightspace.

How to Log In

To access Brightspace, follow these steps:

1. Go to https://brightspace.usc.edu/d2l/login to login. You can also find Brightspace on myUSC.
2. Enter your USC Net ID to access
3. Begin navigating through Brightspace

We also encourage you to download the mobile app, Brightspace Pulse, available in both the Apple App Store and Google Play.

What to Expect

Brightspace provides an enhanced learning experience with detailed class progress reports. With Brightspace, you can easily see all assignment due dates in one place. Upon opening Brightspace, you will find the following:

- **The Qbio578B Course**: We will use this course to complete work for this course throughout the semester.

Support Resources

Do you want to learn more about Brightspace? Check out training and resources in the Brightspace Student Tutorials. Find technical support information below:

- **Student Guides:** Brightspace Student Guides
- **Brightspace Technical Support Line:** 888-895-2812

- **Brightspace Email Support:** usc@d2l.com

Grading Timeline

Grading and feedback are usually done within one week.

Course evaluation

Course evaluation occurs at the end of the semester university-wide. It is an important review of students' experience in the class. The process and intent of the end-of-semester evaluation should be provided.

Sharing of course materials outside of the learning environment is prohibited

USC has a policy that prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.
SCampus Section 11.12(B)

Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study is a violation of the USC Student Conduct Code. This includes, but is not limited to, providing materials for distribution by services publishing class notes. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the Internet or via any other media. (See Section C.1 Class Notes Policy).

Course Schedule

	QBIO 578b Lecture	Computational Molecular Biology Topic	Lecturer
Wk. 1	8/27	Introduction; Markov Chains I	FS
	8/29	Markov Chains II	FS
Wk. 2	9/03	Word Counts I	FS
	9/05	Word Counts II	FS
Wk. 3	9/10	EM algorithm	FS
	9/12	Monte Carlo Markov Chain (MCMC)	FS
Wk. 4	9/17	Sequencing Accuracy	FS
	9/19	Motif finding	FS
Wk. 5	9/24	Sequencing Progress I (Lander-Waterman Model)	FS
	9/26	Sequence Progress II (Next Generation Sequencing: Chip-Seq)	FS
Wk. 6	10/01	Global Alignment Statistics	FS
	10/03	Local Alignment Statistics I	FS
Wk. 7	10/08	Local Alignment Statistics II	FS
	10/10	**Fall Recess**	FS
Wk. 8	10/15	**First Midterm**	FS
	10/17	Evolution Models I	LC
Wk. 9	10/22	Evolution Models II	LC
	10/24	Evolution Models III	LC
Wk. 10	10/29	HMM I	LC
	10/31	HMM II	LC
Wk. 11	11/05	HMM III	LC
	11/07	Statistical Genetics I	LC
Wk. 12	11/12	Statistical Genetics II	LC
	11/14	Statistical Genetics III	LC

Wk. 13	11/19	Multiple Testing and FDR	LC
	11/21	Next Generation Sequencing I	LC
Wk. 14	11/26	Next Generation Sequencing II	LC
	11/28	**THANKSGIVING**	
Wk. 15	12/03	Next Generation Sequencing III	LC
	12/05	**Exam II**	LC

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.