Biology 526H: Computational Genetics

Fall 2018 Syllabus

Course description
Tools from computer science, applied mathematics, and statistics have become essential for research in genomics, both because of the scale of the data and the complex nature of the research questions. This interdisciplinary seminar provides an introduction to common algorithmic and statistical ideas in the field, rather than providing instructions on the use of specific software packages. The course is aimed at life science students who have an affinity for mathematical puzzles and programming. Seminar-style classes will be complemented by computer labs. The class will give students a rare opportunity to hone their scientific writing and oral presentation skills. The final project will also give students an opportunity for independent research. 4 credit hours.

When and where
- Lecture: Tue & Thu 12:30am-1:45am, Wilson 202
- Lab/recitation: Thu 2:00pm-3:15pm, Genome Sciences 1377

Instructor
- Todd Vision
- Email: tjv@bio.unc.edu
- Phone: 962.4479
- Office hours (tentatively): Tue 2:00-4:00pm or by appointment
- Office location: 3155 Genome Sciences

Teaching Assistant
- Nick Colaianni
- Email: ncolaian@live.unc.edu
- Office hours and location to be decided
Eligibility and prerequisites

This course is intended for advanced undergraduates and beginning graduate students in the life sciences. Enrollment is limited, and honors undergraduates are given priority. Enrollment of first year undergraduates and graduates requires permission of the instructor.

Prerequisites

- A similar college-level course covering introductory molecular genetics (e.g. BIOL202)
- A college-level statistics course (e.g. STOR155)
- A college-level programming-intensive course (e.g. BIOL226, COMP110). While Rstats will be used in the course, no specific prior experience with Rstats is assumed.

Courses may be satisfied as corequisites, and waivers to specific requirements may be granted on a case-by-case basis.

Additionally, the Honors Office requires undergraduates to have a grade point average of at least 3.0 to enroll.

Readings and videos

Readings or other materials for each session will be made available and linked from the Sakai site. You are expected to read or watch the assigned material before class.

We will be using a number of videos from the MOOC Bioinformatics Algorithms: An Active Learning Approach by Compeau and Pevzner (for which an accompanying book is also available).

There is no textbook, but a number of useful books are available through the library online and/or physically on reserve at the Undergrad Library (on 24 hr loan).

- Pavel Pevzner and Ron Shamir (2011) Bioinformatics for Biologists, QH324.2 .B5474, on reserve.
Computer labs
Eight computer labs will be held during the Thursday afternoon sessions in the first half of the class. Each lab introduces a problem set that includes both computational and pencil-and-paper exercises. These will be grouped by pairs into four problem set assignments. The assignments are expected to be completed after the lab session. They are due by 2pm on the Thursday after the second lab of the assignment. Late problem sets will receive up to half credit. Late penalties can be waived in special cases with sufficient notice. Many of the lab exercises will use R (sometimes called Rstats) a free, open-source statistical programming language widely used in research biology with a vast ecosystem of user-contributed packages.

Exams
There will be two exams during the first half of the course. Generally, the exams will ask you to synthesize, compare and apply the knowledge you’ve learned (rather than, say, just plug numbers into equations). Study guides will be provided to highlight key concepts in the class. The exams will be closed book, but a sheet with key formulae will be provided for use during the exams. There will be no final exam, instead that will be served by a final paper due at the same time as the final exam would start (see below).

Minilessons
The second half of the class will be more driven by student projects. To begin, students will be present a short (8 minute) mini-lesson on a topic of their choosing. Ideally, this will be related to the topic of the independent project (see below).

Independent projects
Students will do a more in-depth exploration of a topic chosen collaboratively with the instructor and TA. Typically, this will be literature-based, but can also involve re-analysis of results from a paper or an original research idea that requires some programming. Students will make brief (8 minute) presentations of their work-in-progress on the final day of class. The final assignment is a research report written in the style of a journal article, to be submitted by the scheduled time of, and in lieu of, the final exam.

Journal clubs
In the later part of the class, while students are researching and conducting their independent projects, the recitation sessions will be used for journal clubs, i.e. discussions of primary literature. Participation in these discussions will count toward the final grade.

Grading point breakdown
The relative weights of each component to the final grade will be as follows:
Problem sets (4): 8% each = 36% total
Midterms (2): 12% each = 24% total
Minilesson: 8%
Independent project oral presentation: 8%
Independent project final paper: 14%
Journal club participation: 10%

Electronic devices

Electronic devices in the classroom should only be used for legitimate class purposes (e.g. taking notes, carrying out computer labs) unless in the case of emergency.

Communication outside of class time

Reading materials, handouts, study guides, problem sets, answer keys, and all other resources will be available within the Resources Directory on Sakai. Assignments are to be turned in using the Sakai Dropbox feature. We will also use Sakai for broadcasting Announcements. You can contact the Instructor, TA, and/or any students through the Messages and we encourage you to send your message to All Participants if you have a general question or idea about the course structure or material. You can also use the Chat feature on Sakai as a more interactive forum. The Class Schedule is posted online and, like this Syllabus, is freely viewable to anyone with the link. It is also linked from the Resources directory on Sakai.

Final note

The Syllabus and Class Schedule (particularly assigned readings) are subject to change, but sufficient notice will always be provided. In particular, some of the special topics in the later half of the class will be scheduled after the semester has progressed and the students’ interests are more clear.