Bio 156L Genomics and Bioinformatics Lab
Spring 2020

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TA: Sarah Halverson / shalverson@g.hmc.edu

Lecture: 11:00-12:15 (MW)
Lab: 12:45 – 4:45 (M)
Office hours: 8:00-9:00 ("Friday coffee") and 2:30-3:30 ("Friday Tea")
Slack workspace: *Genomics and Bioinformatics*

Overview

This course will provide you with the foundations of the exciting field of genomics. In the course, we will explore the cutting-edge methods used to produce genomic data, the powerful computational techniques for their analyses, and the biological insights that can be gained from performing experiments on a genome-scale. Ultimately, we will apply these skills towards addressing important biological questions. To do this, the course employs extensive experiential learning, mainly through hands-on computational labs.

Objectives

The main objective of this course is to learn to generate, analyze, interpret, and communicate genomic data. To this end, we will focus on developing the core competencies below[1]:

1. Explain the role of computation and data mining in addressing hypothesis-driven and hypothesis-generating questions within the life sciences.
2. Summarize key computational concepts, such as algorithms and relational databases, and their applications in the life sciences.
3. Apply statistical concepts used in bioinformatics.
4. Use bioinformatics tools to examine complex biological problems.
5. Generate, find, retrieve, and organize various types of biological data.
6. Explore and/or model biological interactions, networks, and data integration using bioinformatics.
7. Use command-line bioinformatics tools and write computer scripts.
8. Describe and manage biological data types, structures, and reproducibility.
9. Interpret the ethical, legal, medical, and social implications of biological data.
10. Recognize that science is a human endeavor and is greatly improved by working collaboratively with scientists from diverse backgrounds and expertise.

Course Sites: Sakai and Slack

We will use the course Sakai site for formal course communications (labs, readings, assignments, etc). Our Slack channel ("Genomics and Bioinformatics") will be for informal interactions including following up from lectures, sharing relevant links, working with study group members, and community building.

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[1] *Core competencies 1-9 were developed by the Network for Integrating Bioinformatics into Life Sciences Education*

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Readings

Readings will be taken primarily from review papers, book chapters, and original research publications. There is no course textbook, but the following books may be useful. **Strongly recommended.*

Bioinformatics Data Skills, Buffalo ($33 at Amazon)*
Introduction to Genomics, A. Lesk ($67 at Amazon)*
Primer to Analysis of Genomic Data Using R, Gondro ($35 at Amazon)
RNA-seq Data Analysis: A Practical Approach, Korpelainen et al. ($56 at Amazon)

Grading

Exams 1 and 2	30% total, 15% each*
Lab assignments	15%
Participation	5%
Journal club	10%
RNA-Seq project	20%
Population genomics project	20%

All **exams** will be take-home and will consist of a few short essay questions and exercises in bash or R. They test your ability to manipulate, analyze, and/or interpret genomic data. Exams are to be completed independently and no late or make-up exams will be accepted.

For each lab, you will turn in a **lab assignment** prior to leaving the class. Lab assignments have group and/or individual components. Some components of the lab assignment will needed to be completed prior to leaving lab, while others will take the form of weekly home work.

Most weeks, we will discuss a paper in a "**journal club**" on Wednesdays. For journal clubs, you (in groups) will be responsible for either completing Google slides on a particular topic about the paper and/or completing a short quiz on Sakai prior to the beginning of each class.

Students will work on an **two research projects** throughout the semester. Students will present their results in an oral presentation and/or research paper. Details on the assignment will be announced later in the semester.

Late work

Assignments are expected to be turned in on time, but I understand that situations beyond our control can sometimes cause delays. Each student is allowed two freebies, where you can turn assignments in up to three days late with no penalty. If you need to use a freebie, please alert me and I will mark it down. After your two freebies have been used, a grade penalty will apply for every 24 hours late (-10% day per day).

No late exams will be accepted. Also, because class participation is essential to keeping up in the course, students that miss more than 4 meetings will not pass the course.

Asynchronous participation

Due to time zone differences, you may be a student who needs to participate asynchronously. Lectures and labs will be recorded and available via Box. Labs are computer-based and appropriate for asynchronous completion. Participation in journal clubs will also need to be completed asynchronously. *If you are an asynchronous student, let's make a plan!*

Expectations

Everyone is welcome in this course and I believe that everyone is capable of mastering the material. My goal is that we can build a climate of inclusion, respect and caring where we can feel comfortable wrestling with new and challenging concepts.

Genomics and computer programming is best learned by actually performing the tasks. This learning-by-doing approach is exciting, as one makes discoveries and experiments with knowledge firsthand. Yet, experiential learning like this requires a lot of dedication and effort from the learner (you). To gain the most from this course, you will need to be willing to be actively involved in the labs, take time to reflect on the material, and learn to be an independent problem-solver.

I hear and I forgot.
I see and I remember.
I do and I understand.
Confucius

Grade scale

Final course grades also will be based on a ten-point scale. I will send out a low-grade notice if your course grade is a C or below. I also may send a low-grade notice if I feel that you are at risk of losing a solid grade due to poor class attendance, lack of effort, or any other element of class participation

Conduct

I do not tolerate academic misconduct and will not hesitate to notify your Dean of Students if necessary.

Undergraduate research in the Keck Science Department

Scientific discoveries are made through research. Undergraduate researchers working in labs at Keck (as well as other colleges and universities) play key roles in asking questions, developing projects, carrying out those projects, analyzing and interpreting the data, and sharing the results widely. Many different students are successful researchers -- there is not just one "type." Successful researchers are often curious about a topic, creative in their thinking and approaches, collaborative in working with other students and faculty, persistent, and passionate. GPA does not define who will be successful in research or who will like doing research. Click here to learn more about undergraduate research at Keck (including funding) and for a list of research opportunities with Keck labs (tinyurl.com/2021KeckResearch).

Accommodations

The Claremont Colleges value diversity and inclusion. We are committed to a climate of mutual respect and full participation. As such, our goal is to create learning environments that are equitable, inclusive and welcoming. If you anticipate or experience any barriers to learning related to a disability or condition, please meet with me or reach out to the Office of Academic Resources and Services at your home college. ARS will work with you to discuss your experiences and a range of options to ensure your full participation in this course and others.

Please note that a student's home campus is responsible for establishing and providing accommodations. Below is a list of coordinators on the other campuses:

- *CMC: Kari Rood, kari.rood@claremontmckenna.edu*
- *HMC: Brandon Ice, bice@g.hmc.edu*
- *Pitzer: Gabriella Tempestoso gabriella_tempestoso@pitzer.edu*
- *Pomona: Mace Fuataina Mikaele, mace.mikaele@pomona.edu*
- *Claremont Graduate Institute: Madeline Kiuttu, madeleine.kiuttu@cgu.edu*
- *Keck Graduate Institute: Andrea Mozqueda, andrea_mozqueda@kgi.edu*

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Class meeting schedule (lecture/lab combined) *tentative, subject to change*:

Introduction

Week 1	1/25 – 1/29	Course introduction / Experimental design
Week 2	2/1 – 2/5	UNIX
Week 3	2/8 – 2/12	Writing simple scripts and parsing text
Exam 1 (take-home)		

Genome assembly and analysis

Week 4	2/15 – 2/19	Quality control / Genome assembly I
Week 5	2/22 – 2/26	Comparative genomics/gene discovery
Week 6	3/1 – 3/5	SPRING BREAK
Week 7	3/8 – 3/12	Introduction to R / Phylogenomics
Exam 2 (take-home)		

Population Genomics*

Week 8	3/15 – 3/19	SNPs & DNA extraction
Week 9	3/22 – 3/26	Population genomics I
Week 10	3/29 – 4/1	Population genomics II
Week 11	4/5 – 4/9	Student symposia I

Gene Expression*

Week 12	4/12 – 4/16	RNA-Seq introduction, RNA extraction
Week 13	4/19 – 4/23	Differential gene expression I
Week 14	4/26 – 4/30	Differential gene expression II
Week 15	5/3 – 5/7	Student symposia II

*The order of these modules may switch. We are generating the sequence data used in these modules in class and may need to be flexible with the arrival time of the data.