

BIMM 185: Advanced Bioinformatics Laboratory

Course Staff:

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Class: Tuesdays and Thursdays, YORK 3010, 2 PM - 4:50 PM

Mike Office Hours: Mondays, CSE 4222, 12 PM - 1 PM

Niema Office Hours: Fridays, CSE 4252, 11 AM - 12 PM

Accommodations or special circumstances can be arranged by email.

This course emphasizes the hands-on applications of bioinformatics methods to biological problems. Students will gain experience in the application of existing software as well as in combining approaches to answer specific biological questions. This course is open to bioinformatics majors only.

Learning Objectives

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

- 1) Explain why bioinformatics approaches are important in understanding and interpreting results in many different areas of biological study.
- 2) Use various existing bioinformatics tools in combination to answer complex scientific questions.
- 3) Develop critical analysis and research skills that can be applied to understand and use new bioinformatics tools that are developed in the future.
- 4) Access publicly-available biological databases.
- 5) Develop software tools under good-practice guidelines.

Course Grading

Students will work on a weekly lab projects in class on Tuesday and Thursday. Reports for each week's project are due the following Monday 11.59 PM and will be returned within one week. Also, students will work on team projects and will present the results during Finals Week.

- In-class quizzes and participation questions - 10%
 - Three lowest will be dropped
- Weekly lab projects - 60%
 - One lowest will be dropped
- Final project - 30%

Attendance is mandatory, but in the case of valid excuses (which must be approved by the professor before the scheduled class), quizzes and participation points can be made up.

Teamwork vs. Individual Work

In the classroom, while you are working on coding and analysis for each week's project, you are encouraged to chat with your neighbors, form teams, look things up online, and ask the instructor and IA for help. However, when writing your lab reports, work independently, and make sure that the lab report is in your own words and reflects your own understanding.

You may use scientific literature, but you **must** cite it in the text. **Do not** directly copy/paste code to/from other students in the class or from the internet. **Do not** post questions about assignments on sites like SeqAnswers or Stack Overflow (you can research existing threads on these websites, just don't start new ones for the coursework of this class).

Academic Honesty

There is a **zero tolerance** policy regarding academic dishonesty. See the Academic Integrity Agreement (which you **must** sign to receive a passing grade in the class) for more details on the topic. Violators of these policies may be subject to UCSD rules for academic integrity.

Course Schedule (tentative)

Week 1 (Apr 4/6): “What causes antibiotic resistance?” Alignment to reference, variant calling. Introduction to AWS, software installation, working environment setup.

Week 2 (Apr 11/13): “I got vaccinated; why did I get the flu?!” Deep sequencing, error control.

Week 3 (Apr 18/20): “So where do all these reference sequences come from, anyway?” De novo bacterial genome assembly, error correction.

Week 4 (Apr 25/27): “Tardigrades: from gene stealers to space marines”. De novo eukaryotic genome assembly and annotation. Applying HMMs to gene prediction. Model training.

Week 5 (May 2/4): “Differential expression in bread”. RNA-seq analysis.

Week 6 (May 9/11): “Where Do We Come From? What Are We? Where Are We Going?” Introduction to human evolution analysis. 23andMe vs whole genome. Ancestry detection, DNA phenotyping.

Week 7 (May 16/18): “Build a tree, plant a house...” Molecular phylogenetics (NJ, ML, Bayesian). Ancestral reconstruction. Positive/negative selection, abundance, gene ontology.

Week 8 (May 23/25): “Dead Man's Teeth”. Introduction to metagenomics analysis. 16S vs whole metagenome, alignment, OTU clustering.

Week 9 (May 30/June 1): TBD (GWAS or structure-based phylogeny)

Week 10 (June 6/8): Independent projects.

Finals week (June 12): Final project presentations.

Getting Help

Questions are an integral part of science, and you should never be afraid to ask them! The preferred medium for asking course-related questions is via the Piazza discussion board. If you are confused, chances are that another student has

the same confusion, so by asking your questions there and having them answered publicly, everybody will benefit!