Micro 5161
Bioinformatics and Genomics
Spring 2019

Instructor: **Dr. Igor Jouline**
Department of Microbiology
500 Aronoff Laboratory
Email: jouline.1 -at- osu.edu
Office hours: by appointment

Lecture: 3 units
MoWeFr, 12:40PM – 1:35PM, Jennings Hall 060

Description

In this course, you will learn how the genome sequencing technology has revolutionized biology and provided a foundation for new developments in science and medicine. You will become familiar with computational tools that are necessary to analyze genomic data and you will find out what biological questions can be answered by genomic approaches. We will use prokaryotes as the main material for genomic studies, but the core principles that you will learn are also applicable to eukaryotes including humans.

Prerequisites

Microbiology 4130 (Microbial Genetics), Biochemistry 4511

Format

Lectures and discussions (including working in small groups). **Graduate students** will also be required to make one in-class presentation and to carry out an individual research project.

Readings

There is no required textbook, but the following book is recommended for those who wish to have additional background and expanded information on some topics:

"Sequence - Evolution - Function: Computational Approaches in Comparative Genomics"
By E.V. Koonin and M.Y. Galperin, 2003. Boston: Kluwer Academic. ISBN-10: 1-40207-274-0

Assignments and grading

Undergraduate students

20%	Exam I
20%	Exam II
20%	Exam III
40%	Final exam

Graduate students

15%	Exam I
15%	Exam II
15%	Exam III
10%	Presentation
25%	Research project
20%	Final exam

Exams

The final exam will be ***cumulative***, but will **NOT** cover graduate student presentations from the final two weeks of class. All examinations are scheduled - missed exams will be scored zero. Make-up exams will only be allowed for students with medical emergencies or for those who obtained a prior approval from the instructor. To be eligible to take a make-up exam you must:

1. Email the instructor ***prior*** to the scheduled time of the exam **AND**

2. Provide a valid excuse with written, original documentation for your absence ***prior*** to taking the make-up exam. You may e-mail a digital copy of your excuse, but valid, original documentation will still be required.

If you qualify, you must take the re-scheduled exam within the 24-hour period following the time of the exam or the end of your excused leave. The make-up exam will be different from the regular exam. If you fail to follow these instructions, you will automatically receive a zero as the score for the missed exam. *Documentation that is suspected to be fraudulent will be reported to the Committee on Academic Misconduct (see below).*

Presentation

Graduate students will select, from a pre-approved list, a topic in genomics or bioinformatics and analyze the current literature to reveal significant developments on the subject. Students will share their findings during an in-class presentation (15 minutes plus 5 minutes for discussion and questions). Depending on the number of students enrolled in the class, presentations may be shortened or allocated extra time.

Presentations will be evaluated based on organization/visual appeal and subject knowledge.

Research Project

Each **graduate student** will be required to select a protein sequence for in-depth analysis using the tools and approaches discussed in the class. A written report (a digital copy submitted electronically) is required before the end of the semester. Projects will be evaluated based on the logic of analysis, the tool selection and use, and the interpretation of the results.

Learning Outcomes

Students that successfully complete this course will:

- Knowledgably describe the major developments in computational genomics and bioinformatics
- Knowledgeably describe the key elements of genomic database searches
- Knowledgably describe the basics of protein sequence analysis
- Understand current views on molecular evolution and its driving forces
- Understand common bioinformatics tools
- Understand the impact of genomics on microbiology and medicine
- Critically evaluate research papers on computational genomics and bioinformatics
- Interpret the quality of genomic data in research papers

Attendance policy

Students are expected to attend lectures. Exams will be based on material covered in class. Because class slides posted in Carmen do not contain much text, *you should attend every lecture and supplement them with your own notes*.

Classroom etiquette

Electronic devices should be silenced during lectures and exams. Computers can be used during lectures as long as they do not distract other students. The use of electronic devices during exams is prohibited and will be reported to the Committee on Academic Misconduct (see below).

E-mail policy

Questions about class material should ***not*** be submitted via e-mail and they will not be answered. Questions are welcome before, during and after class, as well as in office hours.

Academic misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487).

The Code of Student Conduct **http://studentlife.osu.edu/csc/**

Disability services

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Diversity statement

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color,

disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Student wellness and counseling services

OSU offers a range of services to assist students experiencing elevated stress levels. **Counseling and Consultation Service** (CCS; ccs.osu.edu) provides a range of confidential mental health services to students. 24-hour emergency help is also available through the National **24/7 Prevention Hotline** at 1-800-273-TALK or at suicidepreventionlifeline.org. **Wellness Coaching** (go.osu.edu/wellnesscoaching) is a free service provided by the Office of Student Life that takes an empowering, strength-based approach to building your capacity to face challenges and navigate transitions in order to create the life you want to live. In addition, the "**Student Advocacy Center** is committed to helping students navigate Ohio State's structure and to resolving issues. that they encounter at the university" (http://advocacy.osu.edu/).

Lecture schedule

This is a tentative schedule and is subject to change. The allotted time for graduate student presentations and the schedule of lecture topics will be adjusted depending on the number of graduate students enrolled in the class.

Date	Day	Week	Topic	Module
Jan 7	M	1	Introduction to Genomics & Bioinformatics	1. Databases & protein sequence analysis
Jan 9	W			
Jan 11	F			
Jan 14	M	2	DNA repositories & comprehensive genomics resources	
Jan 16	W			
Jan 18	F		Secondary & specialized databases	
Jan 21	M	3	No classes (MLK day)	
Jan 23	W		Computational gene finding	
Jan 25	**F**		**Exam 1**	
Jan 28	M	4	Proteins from the genomics point of view	
Jan 30	W		Domains, regions, and motifs	
Feb 1	F			
Feb 4	M	5	Membrane topology analysis	
Feb 6	W		SUMMARY: Module 1	
Feb 8	F		What is [sequence] similarity?	2. Basic sequence similarity search & multiple sequence alignment
Feb 11	M	6	BLAST, part I	
Feb 13	W		BLAST, part II	
Feb 15	F		Multiple sequence analysis (MSA) - Intro	
Feb 18	M	7	MSA building software	
Feb 20	W		MSA editing	
Feb 22	F		MSA interpretation	
Feb 25	M	8	SUMMARY: Module 2	3. Advanced sequence similarity search
Feb 27	W		Sequence profiles: HMMs and PSSMs	
Mar 1	F		Domain databases: Pfam and SMART	
Mar 4	M	9	Conserved Domain Database (CDD)	
Mar 6	W		Building dynamic profiles: PSI-BLAST	
Mar 8	F		Profile-profile search: HHpred	
Mar 11	M	11	No classes (Spring Break)	
Mar 13	W		No classes (Spring Break)	
Mar 15	F		No classes (Spring Break)	
Mar 18	M	12	SUMMARY: Module 3	
Mar 20	**W**		**Exam 2**	
Mar 22	F		Protein folds and their evolution Fold recognition: PHYRE	4. Protein structure
Mar 25	M	13	Evolutionary concepts in genomics	5. Evolutionary genomics & phylogenetics
Mar 27	W		Phylogenetic trees I	
Mar 29	F		Phylogenetic trees II	

April 1	M	14	Whole genome analysis and metabolic reconstruction	6. Whole genome analysis
April 3	W		Genomics in medicine	
April 5	F		SUMMARY: Modules 3 to 6	
April 8	**M**	15	**Exam 3**	
April 10	W		Graduate student presentations	
April 12	F		Graduate student presentations	
April 15	M	16	Graduate student presentations	
April 17	W		Graduate student presentations	
April 19	F		Graduate student presentations	

	TBD		**Final Exam**	