

Introduction to Computational Genomics Syllabus

Micro 5161

Spring 2023

Course Information

- **Course times and location:** Mondays and Wednesdays, 12:40 pm – 01:35 pm in Mendenhall Laboratory – room 185; Fridays, 12:40 pm - 01:35 pm in Baker Systems Engineering – room 285
- **Credit hours:** 3
- **Mode of delivery:** In Person

Instructor

- **Name:** Igor Jouline
- **Email:** jouline.1@osu.edu
- **Office location:** 500 Aronoff Laboratory
- **Office hours:** by appointment (in person or via Zoom)
- **Preferred means of communication:**
 - My preferred method of communication for questions is **in class and during office hours**.
 - My class-wide communications will be sent through the Announcements tool in CarmenCanvas. Please check your [notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to be sure you receive these messages.

Course Prerequisites

Basic understanding of molecular biology (DNA, genes, proteins).



Course 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.

Learning Outcomes

By the end of this course, students should successfully be able to:

- Understand principles of computational genomics
- Know all major public databases of genomic information
- Use basic bioinformatics tools to search genomic databases and analyze protein sequences
- Understand basic evolutionary concepts and their use in genomics



How This Course Works

Mode of delivery: This course is 100% in person each week on Mondays, Wednesdays, and Fridays from 12:45 p.m. to 01:35 p.m. Assignments are found in Carmen and can be completed around your own schedule during the week.

Credit hours and work expectations: This is a 3 credit-hour course. According to [Ohio State bylaws on instruction](https://go.osu.edu/credithours) (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example).

Attendance and participation requirements: Research shows regular participation is one of the highest predictors of success. With that in mind, I have the following expectations for everyone's participation:

- **Attendance:** You are expected to be present during in-person lectures and to log into Carmen every week. All key lectures will be recorded and posted for those who cannot attend. If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible*.
- **Office hours:** **optional**



Course Materials, Fees and Technologies

Required Materials and/or Technologies

- Lecture slides containing all required material will be posted in Carmen

Recommended/Optional Materials and/or Technologies

- “Bioinformatics and Functional Genomics”, 3d edition. By Jonathan Pevsner, 2015. Wiley-Blackwell. ISBN: 978-1-118-58178-0

Required Equipment

- **Computer:** current Mac (MacOS) or PC (Windows 10) with high-speed internet connection
- **Webcam:** built-in or external webcam, fully installed and tested
- **Microphone:** built-in laptop or tablet mic or external microphone
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

If you do not have access to the technology you need to succeed in this class, review options for technology and internet access at go.osu.edu/student-tech-access.

Required Software

Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365. Visit the [installing Office 365](http://go.osu.edu/office365help) (go.osu.edu/office365help) help article for full instructions.

CarmenCanvas Access

You will need to use [BuckeyePass](http://buckeyepass.osu.edu) (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](http://go.osu.edu/add-device) (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- [Install the Duo Mobile application](http://go.osu.edu/install-duo) (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.



If none of these options will meet the needs of your situation, you can contact the IT Service Desk at [614-688-4357 \(HELP\)](tel:614-688-4357) and IT support staff will work out a solution with you.

Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- [Navigating CarmenCanvas](https://go.osu.edu/canvasstudent) (go.osu.edu/canvasstudent)
- [CarmenZoom virtual meetings](https://go.osu.edu/zoom-meetings) (go.osu.edu/zoom-meetings)
- [Recording a slide presentation with audio narration and recording, editing and uploading video](https://go.osu.edu/video-assignment-guide) (go.osu.edu/video-assignment-guide)

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat:** go.osu.edu/it
- **Phone:** [614-688-4357 \(HELP\)](tel:614-688-4357)
- **Email:** servicedesk@osu.edu



Grading and Faculty Response

How Your Grade is Calculated

Assignment Category	Points
Exam I	25%
Exam II	25%
Research project	25%
Final exam	25%

See [Course Schedule](#) for due dates.

Descriptions of Major Course Assignments

Written Assignments

Description: Describing the results of your research project will be your only written assignment. You will use a protein sequence annotated as a “hypothetical protein” and analyze it with bioinformatics tools that you have learned in this course. Results of this analysis will comprise the written assignment. Deadline for submitted your assignment is April 19, 2023.

Late Assignments

Assignments submitted after April 19 will not be considered, unless a valid excuse is provided in a timely manner.

Instructor Feedback and Response Time

I am providing the following list to give you an idea of my intended availability throughout the course. Remember that you can call [614-688-4357 \(HELP\)](tel:614-688-4357) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact me during the lecture or office hours. Email (through my Ohio State email address) is a less preferred contact message.
- **Class announcements:** I will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check [your notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Grading and feedback:** Exam and assignment results and feedback will be provided within **seven days**.

Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Other Course Policies

Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style:** When composing your written assignment, you should remember to write using good grammar, spelling, and punctuation.
- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.
- **Backing up your work:** Consider composing your written assignment in a word processor, where you can save your work, and then copying into the Carmen discussion.
- **Synchronous sessions:** During our Zoom sessions I ask you to use your real name and a clear photo of your face in your Carmen profile. During our full-group lecture time, you may turn your camera off if you choose. You are always welcome to use the [free, Ohio State-themed virtual backgrounds](https://go.osu.edu/zoom-backgrounds) (go.osu.edu/zoom-backgrounds). Remember that Zoom and the Zoom chat are our classroom space where respectful interactions are expected.

Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this online class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](https://studentconduct.osu.edu) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct,



so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct.

If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Office of Institutional Equity:

1. Online reporting form at equity.osu.edu,

2. Call 614-247-5838 or TTY 614-688-8605,
3. Or email equity@osu.edu

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Office of Institutional Equity to ensure the university can take appropriate action:

- All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.
- The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member.

Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, [on-demand mental health resources](https://go.osu.edu/ccsondemand) (go.osu.edu/ccsondemand) are available. You can reach an on-call counselor when CCS is closed at [614- 292-5766](tel:6142925766). **24-hour emergency help** is available through the [National Suicide Prevention Lifeline website](https://www.suicidepreventionlifeline.org) (suicidepreventionlifeline.org) or by calling [1-800-273-8255\(TALK\)](tel:18002738255). [The Ohio State Wellness app](https://go.osu.edu/wellnessapp) (go.osu.edu/wellnessapp) is also a great resource.

Accessibility Accommodations for Students with Disabilities

Requesting Accommodations

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 \(SLDS\)](#). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services.

Disability Services Contact Information

- Phone: [614-292-3307](tel:614-292-3307)
- Website: slds.osu.edu
- Email: slds@osu.edu
- In person: [Baker Hall 098, 113 W. 12th Avenue](#)

Accessibility of Course Technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations as early as possible.

- [CarmenCanvas accessibility](http://go.osu.edu/canvas-accessibility) (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- [CarmenZoom accessibility](http://go.osu.edu/zoom-accessibility) (go.osu.edu/zoom-accessibility)

Lecture schedule

This is a tentative schedule and is subject to change.

Date	Day	Week	Topic	Module
Jan 9	M	1	Introduction to Genomics, part I	1. Databases
Jan 11	W		Introduction to Genomics, part II	
Jan 13	F		Comprehensive genomics resources	
Jan 16	M	2	No classes (MLK day)	
Jan 18	W		Secondary & specialized databases	
Jan 20	F		Lab: NCBI & EMBL database collections	
Jan 23	M	3	Computational gene finding	2. Protein sequence analysis
Jan 25	W		Proteins, part I	
Jan 26	F		Lab: <i>FramePlot</i> and <i>GeneMark</i>	
Jan 30	M	4	Proteins, part II	
Feb 1	W		Domains, regions, and motifs	
Feb 3	F		Lab: <i>Quick2D</i>	
Feb 6	M	5	Membrane topology analysis	3. Basic sequence similarity search & multiple sequence alignment
Feb 8	W		Sequence similarity	
Feb 10	F		Lab: <i>TMHMM</i> , <i>DAS</i> , <i>Phobius</i>	
Feb 13	M	6	Exam 1	
Feb 15	W		Sequence similarity search by <i>BLAST</i>	
Feb 17	F		Lab: <i>BLAST</i>	
Feb 20	M	7	Multiple sequence analysis (MSA)	4. Advanced sequence similarity search
Feb 22	W		MSA interpretation	
Feb 24	F		Lab: <i>Clustal</i> and <i>MAFFT</i>	
Feb 27	M	8	Sequence profiles: HMMs and PSSMs	
Mar 1	W		Dynamic sequence profiles	
Mar 3	F		Lab: <i>Pfam</i> , <i>SMART</i> , and <i>CDD</i>	
Mar 6	M	9	Profile-profile search: <i>HHpred</i>	5. Protein structure
Mar 8	W		Summary Modules 3 and 4	
Mar 10	F		Lab: <i>PSI-BLAST</i>	
Mar 13	M	11	No classes (Spring Break)	
Mar 15	W		No classes (Spring Break)	
Mar 17	F		No classes (Spring Break)	
Mar 20	M	12	Protein folds and their evolution	6. Evolutionary genomics
Mar 22	W		Evolutionary concepts in genomics	
Mar 24	F		Lab: <i>HHpred</i> and <i>AlphaFold</i>	
Mar 27	M	13	Exam 2	
Mar 29	W		Phylogenetic trees	
March 31	F		Lab: Phylogenetic tree building, <i>MEGA</i>	
April 3	M	14	Whole genome analysis, genome context	7. Whole genome analysis
April 5	W		Metabolic reconstruction	
April 7	F		Lab: <i>KEGG</i> , <i>MiST</i>	

April 10	M	15	The Human Genome	8. Genomics in medicine
April 12	W		Genome medicine	
April 14	F		Lab: Genome browsers	
April 17	M	16	Consequences of missense mutations	
April 19	W		Polyphen and other predictors	
April 19	W		Written assignment due	
April 21	F		COURSE SUMMARY	
April 24	M		Final exam preparation: Q&A	

May 2	Tue		Final Exam: 12:00PM – 1:45PM	
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