CIS*6060 - Bioinformatics

Winter 2025 Course Outline
Section: 01
Credits: 0.50

Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

Calendar Description

Data mining and bioinformatics, molecular biology databases, taxonomic groupings, sequences, feature extraction, Bayesian inference, cluster analysis, information theory, machine learning, feature selection.
Department(s): School of Computer Science

Lecture Schedule

Wed 11:30am-2:20pm in REYN*1101 (1/6 to 4/21)

Note: **January 8th & January 22nd** lecture will be moved to **SSC 2315.**

Instructor Information

Yan Yan
Email: yyan15@uoguelph.ca

Learning Resources

There will be no required textbook for the class. Suggested readings are

1. Statistical Bioinformatics: For Biomedical and Life Science Researchers Jae K. Lee Wiley- Blackwell (2010).
2. Vince Buffalo, *Bioinformatics Data Skills -- Reproducible and Robust Research with Open Source Tools*, O'Reilly Media, March 2014.
3. Arthur M. Lesk, *Introduction to Bioinformatics*, 4th edition, Oxford University Press, 2014.
4. Concepts in Bioinformatics and Genomics, by Jamil Momand and Alison McCurdy, published by Oxford University Press (2017)
5. Bioinformatics and Functional Genomics, 3rd edition, by Jonathan Pevsner, published by Wiley- Blackwell (2015).

Course Resources

We will use PEAR for peer-evaluation activities in this class. https://peartool.opened.uoguelph.ca/

Cost of Textbooks and Learning Resources

No required textbook for this course.

Course Level Learning Outcomes

Upon successfully completing this course, students will be able to:

- Identify, select, and use a variety of algorithms for data analysis and pattern extraction.
- Critically assess experimental approaches used by authors to address programmatic questions.
- Build data analysis pipelines for structured, quantitative questions.
- Perform statistical analysis of computational results to assess significance.
- Collaborate effectively on project design.
- Assess and critique peer efforts in a collaborative framework.

Schedule of Topics and Assignments

Week of	Topic	Activities	Due
1/8	What is “Bioinformatics”? Review of Basic Math, Algorithms, and Complexity Theory Review of Molecular Biology		
1/15	The UNIX/LINUX Shell Genome-Wide Association Studies	Select Research Paper for Reading	
1/22	Sequence Alignment and Sequence Databases		Research Paper Selection
1/29	BLAST Phylogenetic Trees		Assignment 1
2/5	Hidden Markov Models		Research Paper Review Draft
2/12	Research Paper Presentation		Research Paper Peer Evaluation
2/19		Winter Break	
2/26	Gene expression analysis RNA-seq		Assignment 2 Research Paper Review Revision
3/5	Mass spectrometry and data analysis on peptide/protein sequencing		Project Proposal
3/12	Protein Structure Prediction	Project Pitch	
3/19	Wrap up of the course or special topics		
3/26	Project Support Q&A		Assignment 3
4/2	Project Presentation		All Quizzes Project Report

Assessment Breakdown

Description	Weighting (%)	Due Date
Assignment 1	10%	Jan. 29, 2025
Assignment 2	10%	Feb. 26, 2025
Assignment 3	10%	Mar. 26, 2025
Research Paper Reading Presentation	10%	Feb. 12, 2025
Research Paper Reading Reflective Review and Peer Evaluation	5%	Feb. 5/12, 2025
Research Paper Reading Reflective Review Revision	5%	Feb. 26, 2025
Project Proposal	5%	Mar. 5, 2025
Project Pitch	5%	Mar. 12, 2025
Project Presentation	15%	April 2, 2025

Project Report	15%	April 4, 2025
Quizzes	10%	April 4, 2025

Assessment Details

Project

Bioinformatics Project 40%

This course requires completion of an individual project which has several marked deliverables throughout the last a few weeks of the term.The goal is to provide students with practical experience in researching, designing, implementing, and evaluating research topics in the field of bioinformatics.The project topic must be relevant to bioinformatics, chosen by the student and approved by the instructor.

Major milestone tasks include

- project proposal
- project pitch
- written report, and
- project presentation.

Reflective Activities

Research Paper Reading and Reflection 20%

Paper reading and reflective review provides students the opportunity to strengthen readings in scientific articles, practice critical thinking, and compose constructive feedback to others. It aims to help with the selection of course project as well.

In this exercise, each student selects a recently published scientific article in the filed of bioinformatics and perform a series of tasks on it. The article can be chosen by the students or given by the instructor.

Main tasks include:

- Present the paper to the class summarizing the key ideas
- Write a reflective review draft (500-700 words) of the paper .
- The draft is read by peer students in the class (typically 3 or 4 students) and provide feedback. The PEAR platform will be used for this activity.
- Student revise the reflective review based on peer feedback and submit the final version.

Assignment

Individual Assignment 30%

There will be three assignments in this course. Submission instructions will be included with each assignment description. Generally, you will upload your solutions as files and upload them to the CourseLink Dropbox, unless you are instructed otherwise. Assignments questions will be a combination of programming and long answer questions.

Quizzes

CourseLink Quiz 10%

There are 8 quizzes related to the course content which will be posted on CourseLink. They are used to evaluate the students' understanding of the course materials. Students are required to complete the quizzes and the highest 5 scores will be taken to calculate the grade for quizzes.

Last Day to Drop Course

The final day to drop Winter 2025 courses without academic penalty is the last day of classes: April 04

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

Course Grading Policies

Submission of Assignments

Submission information is posted on the CourseLink course page.

Late Assignment

No late assignment is accepted.

Course Standard Statements

All submitted coursework **must be your own efforts**, and using Generative AI (such as ChatGPT) in submitted assignments and assessments is **prohibited** in this course.

Anti-plagiarism Tools

Note that all materials submitted for grading will be evaluated using "MOSS" (Measure of Software Similarity) and "TurnItIn" tools, which detect plagiarism, illicit collaboration, and reuse of materials, all of which constitute academic misconduct.

If you are unsure whether some activity is academic misconduct just ask!

University of Guelph Statement on Artificial Intelligence Systems, ChatGPT, Academic Integrity

(source: https://news.uoguelph.ca/2023/03/university-of-guelph-statement-on-artificial-intelligence-systems-chatgpt-academic-integrity/)

The University is committed to ensuring that the use of AI in teaching and learning complies with existing policies and regulations that govern academic and scholarly integrity. We continue to engage the University community, including students, as we work to refine academic integrity policiesand their intersection with AI tools. We affirm the following:

1. Students' work **must reflect their unique intellectual capacity** and demonstrate the application of **critical thinking and problem solving.** Unauthorized use of AI to complete assessments violates the fundamental intellectual purposes of the University and does not demonstrate student achievement of course learning outcomes.

2. Submission of materials completed by AI, without permission of the instructor, constitutes an offence under the University's academic misconduct policies, either as a form of plagiarism or the use of unauthorized aids.

Course Technology Requirements

PEAR will be used for peer-evaluation activities https://peartool.opened.uoguelph.ca/.

Digital Research Alliance of Canada may be used for programming activities (https://www.alliancecan.ca/en).

Standard Statements for Graduate Courses

Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/academic-misconduct/) is outlined in the Graduate Calendar.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Use of the SAS Exam Centre requires students to make a booking at least 10 business days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (https://www.uoguelph.ca/sas/)

Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/academic-accommodation-religious-obligations/)

Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Drop Date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/registration/) dropping courses are available in the Graduate Calendar (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/registration/).

Email Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (https://wellness.uoguelph.ca/). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (https://wellness.uoguelph.ca/navigators/) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources. (https://wellness.uoguelph.ca/shine-this-year/) The Student Wellness team are here to help and welcome the opportunity to connect with you.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Recording of Materials

Presentations that are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars (http://www.uoguelph.ca/registrar/calendars/?index) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Graduate Calendar for information on regulations and procedures for Academic Consideration (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/grounds-academic-consideration/).