

ANSC*6330 - Topics in Computational Biology and Bioinformatics

Fall 2024 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

Major topics and methods in bioinformatics and computational biology for animal sciences will be covered. Topics include alignments, phylogenetics, genomics, data mining, databases, DNA, RNA and protein structures, DNA sequence analysis, data curation, pipeline construction and data visualization.

Department(s): Department of Animal Biosciences

Lecture Schedule

Fri 11:30am-2:20pm in GRHM*2302 (9/5 to 12/13)

Lab / Seminar Schedule

Day	Time	Location
Wednesday	11:30 - 13:30	ANNU*204

Instructor Information

Dan Tulpan

Associate Professor

Email: dtulpan@uoguelph.ca

Office: ANNU*127

Additional Support

Office hours: In-person, by email or online (Zoom, MSTeams, Skype, etc.). Please book your appointment by email with the instructor.

Learning Resources

Recommended Course Resources

J. Xiong, *Essential Bioinformatics*, Cambridge University Press, 2012, ISBN: 9780511806087, <https://doi.org/10.1017/CBO9780511806087>

S. Alesina, M. Wilmes. *Computing Skills for Biologists*, Princeton University Press, 2019, ISBN: 9780691182759 (Textbook) (Textbook)

<https://press.princeton.edu/books/paperback/9780691182759/computing-skills-for-biologists> (<https://press.princeton.edu/books/paperback/9780691182759/computing-skills-for-biologists/>)

R. Libeskind-Hadas, E. Bush. *Computing for Biologists*, Cambridge University Press, 2014, ISBN: 9781107337510 (Textbook) (Textbook)

<https://www.cambridge.org/highereducation/books/computing-for-biologists/5B08EEEE2AE8A602113A8F225E89F5FD#overview> (<https://www.cambridge.org/highereducation/books/computing-for-biologists/5B08EEEE2AE8A602113A8F225E89F5FD/#overview>)

Other potentially useful/interesting Python programming resources

Online book: How to Code in Python: <https://assets.digitalocean.com/books/python/how-to-code-in-python.pdf>

Online book: Introduction to Scientific Programming with Python: https://library.oapen.org/bitstream/id/56d27e73-e92a-4398-8198-239be7aacc93/2020_Book_IntroductionToScientificProgra.pdf

Online Python course: <https://python-course.eu/>

Course notes will be used during the course (available on CourseLink).

Extra pertinent information, such as papers, chapters of books, etc. will be accordingly recommended. Students are advised to take their own notes during lectures.

Campus Resources

If you are concerned about any aspect of your academic program: make an appointment with a Program Counsellor (<https://www.uoguelph.ca/uaiic/programcounsellors/>) in your degree program. If you are struggling to succeed academically: there are numerous academic resources offered by the Learning Commons (<https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/>) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Course Learning Outcomes

1. Understand bioinformatics data formats and types and be able to manipulate them using computer programming.
2. Perform and understand sequence alignments, gene predictions, phylogenetics and omics analyses.
3. Appreciate differences among bioinformatics methods and algorithms for both data curation and data analyses.
4. Be able to integrate different biological data sets via programming.
5. Discuss the relative merits of methods and designs used in bioinformatics and computational biology.
6. Be able to contribute to a team project and perform various types of data analyses.
7. Accurately and effectively communicate scientific analyses in written form.
8. Have a proficient command terminology common in bioinformatics and computational biology.

Schedule of Topics and Assignments

Week of	Topic	Activities	Due
9/6	Introduction to Bioinformatics		
9/13	Module: Bioinformatics databases	> Assignment 1 - release	
9/20	Module: Sequence alignments	> Assignment 1 - due	
10/4		> Assignment 2: release	
10/11	Module: Sequence profiles and Hidden Markov Models	> Assignment 2: due > Assignment 3: release	
10/18	Module: Multiple sequence alignments and applications	> Assignment 3: due	
10/25	Module: Phylogenetic trees		
11/1		> Assignment 4: release	
11/8		> Assignment 4: due > Assignment 5: release	

11/15	Module: Structural bioinformatics Assignment 5: due
11/22	Module: Introduction to machine learning

Lab / Seminar Schedule

Lab 1: Python programming - introduction to programming + intro to Python

Lab 2: Python programming - data structures, printing, string formatting

Lab 3: Python programming - input, decisions, loops

Lab 4: Python programming - functions, files

Lab 5: Python programming - numpy, pandas

Lab 6: Python programming - data organization

Lab 7: Python programming - data cleaning

Lab 8: Python programming - plotting

Lab 9: Python programming - miscellanea

Assessment Breakdown

Description	Weighting (%)	Due Date
Assignment 1	10%	Week 3 (Sep. 20)
Assignment 2	10%	Week 6 (Oct. 11)
Assignment 3	10%	Week 7 (Oct. 18)
Assignment 4	10%	Week 10 (Nov. 8)
Assignment 5	10%	Week 11 (Nov. 15)
Project presentation	25%	Week 15 (Dec. 9)
Project report	25%	Week 15 (Dec. 11)

Assessment Details

Assignment

Assignment 1

Course Learning Outcomes Assessed: 1, 8

10%

Assignment 2

Course Learning Outcomes Assessed: 2, 3, 7

10%

Assignment 3

Course Learning Outcomes Assessed: 2, 3, 7

10%

Assignment 4

Course Learning Outcomes Assessed: 1, 2, 3, 5, 8

10%

Assignment 5

Course Learning Outcomes Assessed: 5, 6, 8

10%

Presentation

Project Presentation

Course Learning Outcomes Assessed: 1, 2, 3, 5, 6, 7, 8

25%

Project

Project Report

25%

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7, 8

Last Day to Drop Course

The final day to drop Fall 2024 courses without academic penalty is the last day of classes: November 29

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

All assignments and the project report must be submitted before 11:59 pm (EST) of the due date.

The submissions will be performed using the Dropbox functionality on CourseLink unless otherwise specified by the instructor.

Late Assignment

Late assignments and project reports will receive zero (0) marks.

Course Standard Statements

Presentation and project details

The project presentation will be up to 25 minutes long and will have a 5-10 minutes questions period. Presentation slides will be made available to the instructor and students two days in advance.

The project report will be structured as a journal article using the template of the IEEE/ACM Transactions on Computational Biology and Bioinformatics journal and will be submitted on or before December 11, 2024 (midnight). The presentation is scheduled on December 9, 2024. A copy of the presentation will be submitted on CourseLink on or before December 8, 2024 (midnight). This will allow students to integrate feedback from presentations into reports. Projects can consist of groups of up to 4 students. The topic of each project will be decided between students and shared with the instructor on the week of November 15, 2024. Alternatively, the instructor can also provide project topics to students who cannot decide.

Course Technology Requirements

Each lab will offer students the opportunity to learn Python and practice using Python programs executed on a Linux platform, on Windows, a Mac or on <https://replit.com/>.

Please bring your own computer for each lab and make sure that you have applications that support SSH (Secure Shell) and SFTP/SCP (Secure File Transfer Protocol/Secure Copy) installed on it. SSH allows connections to remote Linux/Unix servers, while SFTP/SCP allows file transfers to and from the Linux/Unix servers to your own computer.

Windows users

SSH: Putty – <https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>

SFTP/SCP: WinScp – <https://winscp.net/eng/download.php>

Mac OS X (Apple) users

SSH and SCP are typically pre-installed on Mac OS X and can be accessed via the Terminal application (Applications -> Utilities -> Terminal.app).

FTP/SFTP/SCP: FileZilla (<https://filezilla-project.org/download.php?platform=osx>)

Note: For Mac users it is important to have XCode (from App Store) and the Homebrew package manager (<https://brew.sh/>) installed as well.

Linux users

SSH and SCP are typically pre-installed on a Linux OS and can be accessed using a terminal.

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/>).