Bioinformatics
BIOL 4663 / COMP 4923

Instructor: Dr. Zoë Migicovsky (she/her)

Office: BIO 433
Office hours: Thursday 1:30-3:30 PM or by appointment
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Lecture: Tues/Thurs 9:30-10:50am
Location: Huggins 137

Evaluation	Percentage	Date
1. Hand-in Assignments (8) a. High Performance Computing b. R c. Data Visualization d. Genome Alignment e. Molecular Evolution f. Microbiome g. Bioinformatics for Cancer h. RNA-Seq *Late assignments are not permitted. The lowest grade for a hand-in will be dropped.	(21)* 3 3 3 3 3 3 3 3	 Jan 14 Jan 16 Jan 21 Jan 30 Feb 27 March 11 March 13 March 20
2. Research Project a. Part one b. Final project	(39) 14 25	 Feb 6 Feb 27
3. Infographic a. Topic selection b. References c. Final project d. Presentation	(39) 1 3 20 15	 Jan 23 March 6 March 25 March 27 or April 1 or April 3
4. Course survey	(1)	Jan 9 / April 4

Part 1: Course Information

Course Description

An introduction to the analysis of biological data using computational tools. Using a combination of high-performance computing and R software, students will apply and interpret bioinformatic techniques including alignment of genome sequence data, genetic mapping, microbiome analysis, and RNA-sequencing. This course will include examples of applications across biological fields such as human health, agriculture, and conservation.

Prerequisite(s):
BIOL 4663: Completion of the Biology Core, with each course completed with a minimum grade of C-.
COMP 4923: COMP 2113 and MATH 1253 completed with a minimum grade of C-.

Course Materials & Requirements

1. Access to Moodle. All slides by Dr. Migicovsky will be posted. Guest lectures will be posted with permission of the guest lecturer.
2. A laptop computer to participate during class. You will also need a phone or tablet for multi-factor authentication.

Course Structure

This course will include a combination of lecture/theory and hands-on practicals. In many instances, the practical will include a "hand-in" assignment associated with it. There will be two projects: 1) a hands-on research project with a written report using bioinformatic methods to analyze and interpret data 2) an infographic using literature review to research a bioinformatic method which will also be shared with the class in an oral presentation.

Student Learning Outcomes

Gain an understanding of and hands on experience with major topics and applications in bioinformatics including methods for genome sequence alignment, population genomics, genetic mapping, molecular evolution, microbiome analysis, and RNA-sequencing.

How to Meet the Learning Outcomes

1. Attend lectures
2. Participate in the course
3. Get started on class projects early

Part 2: Course Plan

The instructor reserves the right to amend the course plan with reasonable notice, and in consultation with the class. The timing described below is approximate. It will roughly follow the course plan of having background/introductions on Tuesdays and a hands-on practical on Thursdays with a main theme each week.

Date	Class	Topic	Deadline
January 7	1	Introduction to the Course	
January 9	2	Introduction to High-Performance Computing	Course Survey
January 14	3	Research Project Introduction / Guest Lecture: Dr. Peter Cousins (E. & J. Gallo Winery)	High-Performance Computing Hand-In
January 16	4	RStudio and the Tidyverse	R Hand-In
January 21	5	Data Visualization / Guest Lecture: Dr. Beatrice Amyotte (Agriculture and Agri-Food Canada)	Data Visualization Hand-In
January 23	6	Data Visualization Practical	Topic Selection for Infographic
January 28	7	Genome Sequencing and Alignment	
January 30	8	Genome Alignment Practical	Genome Alignment Hand-In
February 4	9	Population Genomics	
February 6	10	Population Genomics Practical	Research Project Part One
February 11	11	Genetic Mapping	
February 13	12	Genetic Mapping Practical	
February 17 - 21	N/A	No Class – Reading Break	
February 25	13	Molecular Evolution / Guest Lecture: Dr. Gavin Douglas (North Carolina State University)	

February 27	14	Molecular Evolution Practical	Research Project Final Molecular Evolution Hand-In
March 4	15	Microbiome	
March 6	16	Microbiome Practical	References for Infographic
March 11	17	Microbiome Practical	Microbiome Hand-In
March 13	18	Bioinformatics for Cancer Biology / Guest Lecture: Dr. Wasu Fernando (Acadia University)	Bioinformatics for Cancer Hand-In
March 18	19	RNA-sequencing	
March 20	20	RNA-sequencing Practical	RNA-Seq Hand-In
March 25	21	Graduate Student Presentations	Infographic
March 27	22	Infographic Presentations	
April 1	23	Infographic Presentations	
April 3	24	Infographic Presentations	Course Survey (Due April 4)

Part 3: Assessment and Grading

There are 3 major components of assessment to this course: 1) hand-in assignments, 2) research project, 3) infographic. All assessments are due by midnight on the day of the deadline.

There are 8 hand-in assignments associated with the course and late assignments or make-ups are not permitted. The lowest hand-in grade will be dropped.

Infographic topic must have prior approval of instructor. To receive mark, topics must be submitted by deadline. All infographics are due on March 25, regardless of presentation date. The course survey for the beginning and end of term must both be completed by their deadlines to receive the mark; partial marks are not possible.

Bonus mark: If at least 85% of the class attends each of the 4 presentation dates (March 25/March 27/April 1/April 3) all students will receive a bonus mark of 1%.

Grades will be converted from numeric to letter grade using the following conversion table: https://registrar.acadiau.ca/grades.html

Part 4: Course Policies

Slides for lecture material will be posted to Moodle before class begins. The course will also include a practical component that will involve working through analyses together. **In-person attendance is strongly encouraged.**

Use of artificial intelligence tools by students to assist with their learning is allowed only if:

- prior permission has been given by the course professor/instructor, and
- the student properly credits/cites how the AI technology was used in their work.

AI must be used in an ethical and responsible manner as a positive learning tool. AI may not be used in ways that violate Acadia's Academic Integrity Policy. Students are reminded that plagiarism, or other forms of cheating, are both types of academic dishonesty.

Part 5: University Policies

University policies are available in the Acadia University Academic Calendar or through the Registrar's website: https://registrar.acadiau.ca/welcometotheregistrarsoffice.html

Equity, Diversity and Inclusion

Acadia University is committed to becoming a culturally safe and anti-oppressive community. This can only be achieved where there are simultaneous efforts to eliminate all forms of discrimination and harassment from our campus community, including the elimination of all discrimination, harassment and violence based on one's identity, including but not limited to, gender, race, class, ethnicity, sexual orientation, disability, gender identity, gender expression, and Indigeneity. The policy against harassment and discrimination, and resources for students who believe they may have experienced, or witnessed, discrimination or harassment, are available here: https://www2.acadiau.ca/student-life/equity-judicial/equity.html

Last Drop Day

Last day to drop a course and receive a "W". Please check the Acadia University calendar dates, which are available here: https://registrar.acadiau.ca/AcademicCalendars.html

Inform Your Instructor of Accommodations

Acadia University is dedicated to improving access to campus life for all students with disabilities. While we attempt to ensure that all courses are accessible, we recognize that there are barriers that need to be addressed on an individual basis. Students who require accommodations to complete coursework or otherwise fully participate in class should contact Accessible Learning Services directly as soon as possible. https://www2.acadiau.ca/student-life/accessiblelearning.html

The Use of Animals in Teaching and Research

The use of animals in teaching and research at Acadia University is done in accordance with guidelines on the care and use of animals published by the Canadian Council on Animal Care (CCAC). For more information on the CCAC, please visit their website at http://www.ccac.ca

Commitment to Integrity

It is standard practice in Biology to check exams and assignments for cheating and plagiarism. Cheating in the class and/or lab, including plagiarism, will not be tolerated. Please read the appropriate sections of the current Acadia University Academic Calendar: https://registrar.acadiau.ca/AcademicCalendars.html

Information on copy-write and course content from Acadia University is available through the Vaughan Memorial Library: http://libguides.acadiau.ca/c.php?g=433650&p=5027078

The spoken and written course content (including the syllabus, handouts, lectures, presentations, labs, assignments, quizzes, tests, and exams) are the intellectual property of the instructor and may only be copied for personal use. Sharing these materials or uploading them where they may be accessed by others is a violation of copyright. If you wish to make audio, video, or photographic recordings in class, you must first obtain the consent of the instructor and of any other persons (e.g., guest speakers, other students) who may be captured in such recordings. In the case of personal use by students with disabilities, the instructor's consent shall not be unreasonably withheld.

Acadia is a Scent-Free Campus

In consideration of the difficulties that exposure to scented products causes individuals with sensitivities and allergies, all students, faculty, staff, employees of any companies working on university property, visitors, and guests of Acadia University, or of members of the University community are asked to refrain from wearing scented personal care products such as perfumes / aftershave, lotions, hair spray and deodorant. In addition, users of tobacco and cannabis are asked to be aware that odours associated with product use may impact individuals with sensitivities and allergies. Acadia University in consultation with its contracted cleaning staff, have agreed to use products that do not leave residual odors that may cause difficulties for individuals with sensitivities and allergies.

Part 6: Program Learning Outcomes

Foundations of knowledge		**Course specific examples**	**Proficiency** 1-Introduction 2-Reinforcement 3-Proficient
Scientific method, inquiry and hypothesis testing	Find, understand and apply information from the literature; understand how to use the scientific method to examine problems from different perspectives	Analyze data and complete a research project using bioinformatics	3
Historical concepts and contributions by important figures	Explain foundational concepts in biology, Two-eyed Seeing, and ethical implications of scientific discoveries		N/A
Biodiversity and ecology	Understand the genetic, taxonomic and ecosystem levels of biodiversity; focus on SW Nova including the Acadian Forest and Bay of Fundy ecosystems	Use of bioinformatic tools to study genetic diversity, course examples related to conservation and ecology	2
Genetics and evolution	Understand the chemical basis of heredity, genetics and genomics; integrate concepts across disciplines to understand evolution	Theory and application of bioinformatic tools for use in the study of genetics and evolution	3
Human and environmental health	Understand form and function in health and disease within a One Health framework, integrating human and environmental health	Use of bioinformatic tools in the study of human health and disease including cancer biology	2
Lab and field skills			
Experimental design	Gain experience in applying the scientific method	Course research project, consideration of experimental design when analyzing data	2
Safety	Work safely and productively in lab and field settings		N/A
Lab skills	Gain experience with basic and advanced lab techniques and understand their application in research, health science and industry		N/A
Field skills	Gain experience in basic and advanced field skills and understand their application in ecology, conservation biology and environmental change		N/A
Data acquisition, analysis and interpretations	Collect data, present results both qualitatively and quantitatively, and interpret outcomes in light of the literature	Download of data, use of bioinformatic methods to analyze data, interpretation of results	3
Statistical analysis	Use R and or other programs to analyze biological data	Use of R and HPC to analyze genomic data	3
Professional skills			
Ethical practices	Demonstrate ethical conduct, apply principles of academic integrity, and understand the principles of EDI in science	Respectful participation in class, proper citation of sources, academic integrity throughout course	3
Collaboration and group work	Work effectively in groups within and across disciplines	Discussion, working others in a classroom setting, collaboration across biology and computer science	2
Critical thinking	Analyze and evaluate information to make science-based decisions	Evaluating data input and parameters in bioinformatics, analyzing and interpreting outputs	3
Computer proficiency	Use common and discipline- specific software	Extensive use of R and high-performance computing for data analytics and visualization	3
Scientific communication	Communicate science effectively to both scientific and general audiences	Written report summarizing research findings for a scientific audience, infographic and oral presentation for a general audience	3