The University of Calgary
Bachelor of Health Sciences
Cumming School of Medicine

Academic Year 2023-2024

MDSC 301
Introduction to Bioinformatics

Instructor:

Tatiana Maroilley, PhD
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Office Hours/Policy on Answering Student Emails

Please note that all course communications must occur through your @ucalgary email. Students can expect a response to their emails sent via their @ucalgary emails within 48 hours.

Office hours: Tuesdays and Wednesdays 3-5pm

Teaching Assistants:

Suzanne Ferris (suzanne.ferris@ucalgary.ca)
Shreya Tomar (shreya.tomar@ucalgary.ca)

Graduate Assistant:
Rumika Mascarenhas (rumika.mascarenhas@ucalgary.ca)

Time and Location:
2024/01/08 - 2024/04/08
For location please see D2L
Monday, Wednesday: 10:30am-11:45am

Prerequisite/Co-Requisite:
6 units (1.0 full-course equivalent) in Computer Science at the 300 level; or Medical Science 341; or 6 units (1.0 full-course equivalent) in Biological Sciences at the 300 level; or consent of the instructor.

Course Description:
This introductory course will familiarize students with bioinformatics in a research setting. Topics to be covered include analysis of multi-omics datasets, design of a bioinformatics analysis, interpretation of biological data, implementation of a bioinformatics pipeline of different platforms, and dissemination of scientific discoveries.

Overarching Theme
Bioinformatics is a field defined by process; that is, part of called Applied Bioinformatics involves the practical application of computational analyses, tools, and algorithms, to answer questions about biology. This course will cover some of the major streams in contemporary bioinformatics wit a particular focus on high-throuput sequencing analyses. The curriculum is structured to provide a research experience in bioinformatics in a classroom setting on published and original data, emphasizing the integration of students into the practical aspects of bioinformatics projects and the interpretation of bioinformatics

data. The class is scheduled for two 1.15-hour sessions per week, incorporating both lecture and assignment components. Attendance is critical to effectively completing the course.

Global Objectives

- To prepare students to participate in active research programs involving Bioinformatics analyses of omics datasets.

Course Learning Outcomes

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

- Design and implement a Bioinformatics analysis for genomics and transcriptomics data
- Run an analysis on Galaxy
- Be familiar with R
- Write a proposal, a manuscript and an abstract
- Design and present a poster regarding a scientific project
- Understand principles and biases of genome and transcriptome sequencing
- Be familiar with structural genomic variations

Transferable Skill Development:

Many of the skills and abilities that you are developing in your coursework are transferable to the workforce, graduate and professional studies and other facets of life. Employers seek applicants with transferable skills because they can be an asset in the workplace, regardless of industry or sector. Transferable skills are core skills for your success in building your future career.

The work that you will do in MDSC 301 will help you build the following transferable skills:

- **Collaboration**: Work respectfully with others from different backgrounds, cultures, and countries.
- **Verbal Communication**: Learn and share information by presenting, listening, and interacting with others.
- **Creativity and Innovation**: Find different and better ways to do things, being curious, thinking imaginatively.
- **Critical Thinking**: Actively and skillfully conceptualize, apply, analyze, synthesize, and/or evaluate information (data, facts, observable phenomena, and research findings) to make a reasoned judgement or draw a reasonable conclusion.
- **Digital Skills**: Use digital technologies like computers, social media, virtual meeting platforms, and the internet.
- **Information Literacy**: Find, understand, and use information presented through words, symbols, and images
- **Numeracy**: Use mathematical information such as numbers, symbols, words, and graphics to do tasks.
- **Problem solving**: Identify an issue, find and implement a solution, and assess whether the situation has improved.
- **Project Management:** Conceptualize, initiate, plan and execute a plan to achieve a predetermined goal (project) by effectively prioritizing activities and meeting deadlines.
- **Written Communication**: Share ideas and information by using words, images, and symbols.

Learning Resources
You will receive a lab book containing all necessary information to succeed in that class (templates, tutorials, background information, detailed schedule, readings, assignments, rubrics…). A link will be provided in the course D2L site.

Recommended Textbooks/Readings

1. WormBook - http://www.wormbook.org/chapters/www_celegansintro/celegansintro.html
2. WormBook - http://www.wormbook.org/chapters/www_geneticbalancers/geneticbalancers.html
3. Essential Bioinformatics, by Xiong J. (2006) - https://www-cambridge-org.ezproxy.lib.ucalgary.ca/core/books/essential-bioinformatics/D003E841CD01B2F71C96E64C0B25E089
4. Ernesto Picardi (eds) RNA Bioinformatics. 2021 (https://link.springer.com/book/10.1007/978-1-0716-1307-8)
5. Elementary Sequence Analysis, by Brian Golding, Dick Morton, and Wilfred Haerty. 2018. Available by download as .pdf at: http://helix.mcmaster.ca/3S03_2018.pdf

A Note regarding readings
A list of required readings will be outlined on D2L and links and documents will be made available, where possible. Required readings have been chosen carefully to inform you and enhance the lecture material**. Students are REQUIRED to complete assigned readings BEFORE each lecture.** Instructors will proceed in class on the assumption that students have read completely the assigned readings. Students should be aware that many of the readings they will be assigned may be of an unfamiliar nature and style. Students should allot sufficient time to allow for several reads of the assigned material.

Learning Technology Requirements
Brightspace (by D2L) is located on the University of Calgary server and will be used extensively for communication with students. **It is the student's responsibility to ensure that they receive all posted communications and documents and that they receive emails sent by instructors or fellow students through D2L.**

Only your @ucalgary.ca email address may be linked to D2L. Please ensure that you are regularly checking your @ucalgary.ca account.

A laptop, desktop, tablet or mobile device is required for D2L access. If you need help accessing or using D2L, please visit the Desire2Learn resource page for students: http://elearn.ucalgary.ca/d2l-student/.

Evaluation
The University policy on grading and related matters is described in section F of the 2023-2024 Calendar.

In determining the overall grade in the course, the following weights will be used:

Individual Assignments

Reflection Assignment 1 their	10%	Series of questions to help the students to reflect on perception of research and their visit to the research lab

Reflection Assignment 2 their	10%	Series of questions to help the students to reflect on experience of research in Bioinformatics in the class
Quizzes	10%	Quizzes through D2L assessing the necessary background knowledge for the student to be successful in this course
Abstract	10%	Abstract (conference-submission style) written with a template regarding the transcriptomics projects
Engagement	10%	Assessed by the teaching team based on attendance and engagement in Active Learning Activities and Analyses

Group Assignments – submitted with peer evaluation

Proposal	10%	Proposal written with a template for genomics project
Manuscript	20%	Manuscript written with a template regarding genomics project (experiments 1, 2, 3)
Poster	20%	Design of a scientific poster regarding the transcriptomics project

All written work (proposal, manuscript, abstract, poster) will be supported by templates provided by the teaching team at the beginning of the semester.

A student's final grade for the course is the sum of the separate assignments. It is not necessary to pass each assignment separately to pass the course.

Some notes regarding peer evaluation on Team assignments:

- Each student will be provided a Peer evaluation Rubric to provide an evaluation for each group member relating to Group assignments.
- Peer evaluations will be used to determine the percentage of the group assignment mark the student will recieve:
  - If a student's peer evaluation mark is > 10 (out of 20), they will receive 100% of the group assignment mark
  - If a student's peer evaluation mark is >5 and ≤10, they will receive 50% of the group assignment mark
  - If a student's peer evaluation mark is >2 and ≤5, they will receive 25% of the group assignment mark
  - If a student's peer evaluation mark is between 0 and ≤2, they will receive 0% of the group assignment mark
- Student who do not submit a peer evaluation will receive a grade of zero on this component, regardless of the viewpoints of their fellow group members.
- Students will receive only an average group rating (not including self-rating) and will not be aware how each team member rated them.

- A peer evaluation score of ≤5 will NOT be accepted unless concerns are expressed by the group to Dr. Maroilley no later than **February 18th**.

There is no final exam for this course.

A Note regarding Writing Assignments:

Writing skills are important to cademic study in all disciplines. In keeping with the University of Calgary's emphasis on the importance of academic writing in student assignments (section E.2 of 2023-24 Calendar), writing is emphasized, and the grading thereof in determining a student's mark in this course. The Bachelor of Health Sciences values excellence in writing. Competence in writing entails skills in crafting logical, clear, coherent, non-redundant sentences, paragraphs and broader arguments, as well as skills with the mechanics of writing (grammar, spelling, punctuation). Sources used in research papers must be properly documented. The University of Calgary offers instructional services through the Students' Success Centre's Writing Support Services (http://www.ucalgary.ca/writingsupport/) for students seeking feedback on assignments or seeking to improve their general writing skills. Students are **strongly encouraged** to take advantage of these programs.

Grading Scheme:

Letter Grade	Description	Percentage
A+	Outstanding performance	96-100
A	Excellent performance	90-95.99
A-	Approaching excellent performance	85-89
B+	Exceeding good performance	80-84
B	Good performance	75-79
B-	Approaching good performance	70-74
C+	Exceeding satisfactory performance	65-69
C	Satisfactory performance	60-64
C-	Approaching satisfactory performance	57-59
D+	Marginal pass	54-56
D	Minimal pass	50-53
F	Does not meet course requirements	0-49

Missed Components of Term Work:
As per University Calendar Section G.1.2, **students who are absent from an in-class assessment will receive a mark of zero on the missed component.** Students who are absent are responsible for contacting their instructor to discuss the impact of their missed assessment. The instructor may ask for supporting documentation to confirm an absence. Alternative opportunities for completing missed assessments or shifting of the assessment weight **may** be possible but are not guaranteed. Students who are identified as falsifying information related to missed assessments will be subject to investigation for academic misconduct.

Extensions will <u>NOT</u> be granted on any assignment or quizzes in MDSC 301. The only exceptions to this are those in keeping with the University Calendar (debilitating illness, religious conviction, or severe domestic affliction) that are received in writing and with supporting documentation. Traffic jams and late or full buses are common events in Calgary and are NOT acceptable reasons for late arrivals to class,

meetings and examinations. Please note that while absences are permitted for religious reasons, students are responsible for providing advance notice and adhering to other guidelines on this matter, as outlined in the University Calendar (https://www.ucalgary.ca/pubs/calendar/current/e-4.html).

Course Evaluations and Student Feedback

Student feedback will be sought at the end of the course through the UCalgary Course Experience Survey and a qualitative student evaluation. Students are welcome to discuss the process and content of the course at any time with the instructor. Students may also address any concerns they may have with Dr. Fabiola Aparicio-Ting, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (feaparic@ucalgary.ca).

Attendance

Attendance is primordial for success in MDSC301. – any absence should be justified and announced when possible. Groups that won't be attending the course will be disadvantaged, as the instructor, and TAs will prioritize groups coming in person. Attendence is part of the engagement grade component.

Conduct During Lectures

The classroom should be respected as a safe place to share ideas without judgement - a community in which we can all learn from one another. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic. Students, employees, and academic staff are also expected to demonstrate behaviour in class that promotes and maintains a positive and productive learning environment.

As members of the University community, students, employees and academic staff are expected to demonstrate conduct that is consistent with the University of Calgary Calendar, the Code of Conduct and Non-Academic Misconduct policy and procedures, which can be found at https://www.ucalgary.ca/student-services/student-conduct/policy .

Students are expected to take notes during class and should not rely solely on material supplied by the instructors. Instructors may or may not post lectures notes to D2L, at their individual discretion. Instructors may cover concepts or examples in class that may not be posted to D2L but may be assessed.

Use of Internet and Electronic Communication Devices in Class

The Bachelor of Health Sciences program aims to create a supportive and respectful learning environment for all students. The use of laptop and mobile devices is acceptable when used in a manner appropriate to the course and classroom activities. However, research studies have found that inappropriate/off-topic use of electronic devices in the classroom negatively affects the learning of others during class time.

Students are responsible for being aware of the University's Internet and email use policy, which can be found at https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Acceptable-Use-of-Electronic-Resources-and-Information-Policy.pdf.

Use of Artificial Intelligence Tools

Generative Artificial Intelligence (AI), and specifically foundational models that can create writing, computer code, and /or images using minimal human prompting includes not only GPT-4 (and its siblings ChatGPT and Bing), but many writing assistants that are built on this or similar AI technologies.

Students may use artificial intelligence tools, including generative AI, in **MDSC 301** as learning aids or to help produce assignments. **However, students are ultimately accountable for the work they submit.** Students may choose to use generative artificial intelligence tools as they work through the assignments in this course; this use must be documented in an appendix for each assignment. The documentation should include what tool(s) were used, how they were used, and how the results from the AI were incorporated into the submitted work. Failure to cite the use of AI generated content in an assignment/assessment will be considered a breach of academic integrity and subject to Academic Misconduct procedures.

UNIVERSITY OF CALGARY POLICIES AND SUPPORTS

Copyright

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy) and requirements of the Copyright Act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorized sharing of course materials (including instructor notes, electronic versions of textbooks, etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy https://www.ucalgary.ca/pubs/calendar/current/k.html.

Instructor Intellectual Property

Course materials created by instructors (including course outlines, presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may **NOT** be reproduced, redistributed or copied without the explicit consent of the professor. **The posting of course materials to third party websites such as note-sharing sites without permission is prohibited**. Sharing of extracts of these course materials with other students enrolled in the course ***at the same time*** may be allowed under fair dealing.

Academic Accommodations

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The Student Accommodations policy is available at https://ucalgary.ca/student-services/access/prospective-students/academic-accommodations. Students needing an accommodation based on disability or medical concerns should contact Student Accessibility Services (SAS) in accordance with the Procedure for Accommodations for Students with Disabilities (https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf). SAS will process the request and issue letters of accommodations to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/ .

Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to Dr. Fabiola Aparicio-Ting (feaparic@ucalgary.ca), Associate Dean, Undergraduate Health and Science Education.

Academic Misconduct

The University of Calgary is committed to the highest standards of academic integrity and honesty. The University of Calgary has created rules to govern all its members regarding the creation of knowledge and the demonstration of knowledge having been learned.

Academic Misconduct refers to student behaviour that compromises proper assessment of a student's academic activities and includes (but is not limited to): cheating, fabrication, falsification, plagiarism, unauthorized assistance, failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses, and failure to comply with exam regulations applied by the Registrar. **It also includes using of third party websites/services to access past/current course material, essay/assignment writing services, or real-time assistance in completing assessments, seeking answers to assessment questions and similar, whether paid, bartered or unpaid.**

For information of the Student Academic Misconduct Policy and Procedures, please visit; https://www.ucalgary.ca/legal-services/university-policies-procedures/student-academic-misconduct-policy.

Additional information is available on the Academic Integrity website at: https://ucalgary.ca/student-services/student-success/learning/academic-integrity.

Recording of Lectures
Audio or video recording of lectures (or similar) is prohibited except where explicit permission has been received from the instructor.

Freedom of Information and Protection of Privacy Act
Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary

Appeals
If there is a concern with the course, academic matter or a grade, first communicate with the instructor. If these concerns cannot be resolved, students can proceed with an academic appeal, as per Section I of the University Calendar. Students must follow the official reappraisal/appeal process and may contact the Student Ombuds' Office (http://www.ucalgary.ca/student-services/ombuds) for assistance with this and with any other academic concerns, including academic and non-academic misconduct. Students should be aware that concerns about graded term work may only be initiated **within 10 business days** of first being notified of the grade. https://www.ucalgary.ca/pubs/calendar/current/i-2.html

Sexual and Gender-Based Violence Policy
The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Sexual-and-Gender-Based-Violence-Policy.pdf.

Resources for Support of Student Learning, Success, Safety and Wellness
Student Success Centre http://www.ucalgary.ca/ssc/
Student Wellness Centre http://www.ucalgary.ca/wellnesscentre/
Student Advocacy and Wellness Hub (CSM)
https://cumming.ucalgary.ca/mdprogram/current-students/student-advising-wellness
Distress Centre http://www.distresscentre.com/

Library Resources http://library.ucalgary.ca

Wellness and Mental Health Resources
The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the excellent mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the UCalgary Wellness Centre (https://www.ucalgary.ca/wellness-services/services/mental-health-services) and the Campus Mental Health Strategy (http://www.ucalgary.ca/mentalhealth/).

Student Ombuds' Office
The Student Ombuds' Office supports and provides a safe, neutral space for students. For more information, please visit www.ucalgary.ca/student-services/ombuds/ or email ombuds@ucalgary.ca

BHSc Student Faculty Liaison Committee (SFLC)
The BHSc SFLC, with elected representatives from all majors, serves to raise issues of interest to BHSc students to the program administration, including items pertaining to curriculum, scheduling and events. A list of current representatives can be found on the BHSc website.

Student Union (SU) Information
The SU Vice-President Academic can be reached at (403) 220-3911 or suvpaca@ucalgary.ca; the SU representatives for the Cumming School of Medicine can be reached at medrep1@su.ucalgary.ca or medrep2@su.ucalgary.ca.

Student Success Centre
The Student Success Centre provides services and programs to ensure students can make the most of their time at the University of Calgary. Our advisors, learning support staff, and writing support staff assist students in enhancing their skills and achieving their academic goals. They provide tailored learning support and advising programs, as well as one-on-one services, free of charge to all undergraduate and graduate students. For more information visit: https://www.ucalgary.ca/student-services/student-success

Emergency Evacuation/Assembly Points
As part of the University of Calgary Emergency Evacuation plan, students, faculty, and staff should locate the closest Assembly Point in case of Fire Alarm. Safety signage is posted throughout the campus showing the locations and the possible route to these locations. All students, faculty, and staff are expected to promptly make their way to the nearest Assembly Point if the Fire Alarm is activated. No one is to return into campus facilities until an all clear is given to the warden in charge of the Assembly Area. For more information, see https://www.ucalgary.ca/emergencyplan/building-evacuation/assembly-points

Safewalk
Campus security will escort individuals, day or night, anywhere on campus (including McMahon Stadium, Health Sciences Centre, Student Family Housing, the Alberta Children's Hospital and the University LRT station). Call 403-220-5333 or visit http://www.ucalgary.ca/security/safewalk. Use any campus phone, emergency phone or the yellow phone located at most parking lot pay booths. Please ensure your personal safety by taking advantage of this service.

Class Schedule

The following is a list of topics for class, associated readings, and assignment / exam due dates. Please note that unforeseen circumstances may cause changes to the schedule with respect to the timing of topics and readings. Students will be notified of all changes in a timely manner by way of email and D2L announcements.

P = Peer evaluation
Q = Quiz (about 10 min)
R = Report (about 5 one sentence-length-answer questions)
Grey: Individual assignment
White: Group assignment

Date	Module / Topics	Instructor	Readings	Assignments & Due Dates
Jan. 08, 2024	Introduction to *C. elegans*	T. Maroilley		Team Building Survey
Jan. 10, 2024		T. Maroilley	Lab Book Pg 16 -18	
Jan. 15, 2024	Genome Sequencing, Structural Variants	T. Maroilley	Refer to Lab Book	Quiz (C. elegans)
Jan. 17, 2024		T. Maroilley		Reflection Assignment due **January 15, 2024 @ 11:59 PM**
Jan. 22, 2024	Designing genome analysis for SV detection	T. Maroilley	PMIDs: 34521941, 36617680	Q1 (Genomics)
Jan. 24, 2024		T. Maroilley		Proposal + P1 due **January 26, 2024 @ 11:59 PM**
Jan. 29, 2024	Genome analysis on Galaxy	T. Maroilley	Refer to Lab Book	Q2 (Genome Analysis)
Jan. 31, 2024		T. Maroilley	Refer to Lab Book	R1 by **Feb. 02, 2024 @ 11.59 PM**
Feb. 05, 2024	Introduction to IGV and PCR	R. Mascarenhas	Refer to Lab Book	Q3 (Galaxy)
Feb. 07, 2024		S. Ferris		R2 by **Feb. 09, 2024 @ 11.59 PM**
Feb. 12, 2024	Introduction to RNA-Seq	T. Maroilley	Refer to Lab Book	Q4 (Validation)
Feb. 14, 2024		T. Maroilley		Manuscripts for feedback on **Feb. 14, 2024 @ 11:59 PM**
Feb. 18, 2024	Winter term break			
Feb. 24, 2024				
Feb. 26, 2024	Introduction to R	S. Tomar	Refer to Lab Book	Q5 (RNA-Seq)
Feb. 28, 2024		T. Maroilley		Manuscript + P2 due on **Feb. 28, 2024 @ 11:59 PM**

Date	Module / Topics	Instructor	Readings	Assignments & Due Dates
Mar. 04, 2024	Project Design	T. Maroilley		Q6 (R)
Mar. 06, 2024		T. Maroilley		
Mar. 11, 2024	Project	T. Maroilley		Proposal due **Mar. 11, 2024 @ 11:59 PM**
Mar. 13, 2024		T. Maroilley		R3 by **Mar. 15, 2024 @ 11.59 PM**
Mar. 18, 2024	Project	T. Maroilley		
Mar. 20, 2024		T. Maroilley		Abstracts due on **March 22, 2024 @ 11:59 PM**
Mar. 25, 2024	Poster design	T. Maroilley		
Mar. 27, 2024	Poster design	T. Maroilley		Poster + P3 due on **Mar. 27, 2024 @ noon**
Apr. 01, 2024	Easter Monday – no classes			
Apr. 03, 2024	Conference preparation	T. Maroilley		
Apr. 08, 2024	Conference with poster presentation	T. Maroilley		Reflection assignment due on **April 08, 2024 @ 11:59 PM**