

MDSC 519 Advanced Bioinformatics

Instructors:

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Office Hours/Policy on Answering Student Emails

Office Hours: Immediately after end of class, meet Dr. Bieda at end of class. Please arrange in advance to meet.

Emails: answered within 3 business days

Teaching Assistants:

There is no TA for this course.

Time and Location:

Thursday 5-8 pm at room O'Brien 1501

Prerequisite/Co-Requisite:

Medical Science 401 and at least one of Computer Science 217, 219, 231 or 233; or consent of the instructor.

Course Description:

Designed to develop student ability to perform bioinformatics analyses of datasets and develop their knowledge of the current literature. The course will emphasize careful study of recent methodologies for chromatin immunoprecipitation followed by sequencing (ChIP-seq) dataset analysis. The course will include lectures, literature review sessions and a self-directed bioinformatics research project.

Overarching Theme

This is an advanced course in bioinformatics, suitable as a second course on this topic.

This course is designed to allow motivated students with a foundation in basic bioinformatics to develop conceptual knowledge and concrete skills to allow them to understand bioinformatics analyses of genomic data at an advanced level and to engage the scientific literature in bioinformatics. This course is critical for students wishing to develop the ability to actually perform bioinformatics analyses in laboratory or other settings, or for students wishing to be

able to read and understand the bioinformatics scientific reports.

The course will focus each year on a single topic of current developing interest in bioinformatics, as a case study for understanding different conceptual approaches to bioinformatics data analysis and the dynamics of the bioinformatics scientific literature. For 2018, this course will focus on chromatin immunoprecipitation followed by sequencing (ChIP-seq) data analysis. The initial classes will introduce the topic (ChIP-seq data analysis) with an emphasis on understanding the fundamental biological importance of the topic. Following classes are a combination of a lecture focusing on theory and methods followed by a linked computer exercise performed in class with faculty supervision. After the initial sequence of classes, the students will choose and begin a research project with close faculty contact. In subsequent classes, the students will focus on critical papers from the bioinformatics literature. These classes will consist of a student presentation of a paper with detailed analysis of computational and statistical methods. There will be active input from the instructor and active discussion from other students.

Global Objectives

By the end of this course, students will have:

1. Developed an intermediate level capacity to read the bioinformatics literature and comprehend the mathematical and computational models that are commonly used.
2. Developed the ability to critically analyze and appropriately present in a group setting research papers focused on bioinformatics methods creation and evaluation.
3. Developed the ability to use modern large-scale databases of sequence information and to analyze the data held in these resources.
4. Developed a clear understanding of ChIP-seq experiments and their relation to general biological questions and specific other types of genome scale data.

Learning Objectives

By the end of this course, students will have:

1. Developed a much-enhanced ability to professionally present a scientific paper to peers and an ability to comprehend scientific publications in bioinformatics.
2. Developed an understanding of the importance of transcriptional regulation in biology and applications of this area of study.
3. Developed an understanding of the basic methodology and importance of chromatin immunoprecipitation and next-generation sequencing and an understanding of the detailed conceptual and technical issues surrounding chromatin immunoprecipitation followed by sequencing (ChIP-seq) data analysis.
4. Developed an understanding of the importance of "epigenetic marks" (histone modifications and DNA methylation) and transcription factor binding patterns.
5. Developed an understanding and basic familiarity with usage of the major resources and tools (UCSC Genome Browser, stand-alone packages, sets of packages (e.g. R/Bioconductor), web sites and services) employed in this area.

6. Developed a basic understanding of use of R/BioConductor for data analysis and simple programming in this environment.
7. Developed an understanding of different computational and statistical approaches to ChIP-seq analysis, including hidden markov models, classical statistical modeling (e.g. Poisson distributions), and empirical (Monte Carlo) methods and applicable “downstream” analyses such as gene ontology and pathway analyses.
8. Actually performed full ChIP-seq analysis using well-established approaches.

Required Readings

All readings will be scientific papers available via the University of Calgary library. Readings and the presenter will be assigned one week in advance.

A Note regarding readings (include this statement, if applicable)

A list of required readings for all course sections 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.

Evaluation

The University policy on grading and related matters is described in section F.2 of the 2017-2018 Calendar.

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

1. 50% Final Project (consisting of original analysis of data or methods analysis; five pages of written text followed by figures, in a typical scientific paper style (this will be covered in class in more detail); also submission of well-documented code used to generate the paper).
2. 35% class participation, including quality of presentation of materials.
3. 15% one assignment

A Note regarding Writing Assignments:

Writing skills are important to academic 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 2017-18 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). The University of Calgary offers a number of 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:

A+ 97-100%	B+ 80-84%	C+ 65-69%	D+ 54-56%
A 90-96%	B 75-79%	C 60-64%	D 50-53%
A- 85-89%	B- 70-74%	C- 57-59%	F 0-49%

Missed Components of Term Work:

Students will lose 25% per day late past the deadline for all assignments. In this case, assignments will NOT be accepted more than 72 hours after the posted deadline and students failing to submit any assignment within this time frame will receive a mark of zero. Students who miss a quiz will receive a mark of zero unless the instructor has been previously notified. There will be NO exceptions to this policy.

It is the agreement of all Faculty and Staff involved in MDSC519 that extensions will NOT be granted on any assignment or quizzes. The only exceptions to this are those in keeping with the University Calendar (illness, religious conviction, or domestic affliction) that are received in writing and with supporting documentation. Please be advised that students should notify the instructor before the assignment deadline to discuss.

Desire2Learn (D2L)

Desire 2 Learn 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 s/he gets all posted communications and documents and that s/he receives 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.

If you need help accessing or using D2L, please visit the Desire2Learn resource page for students: <http://elearn.ucalgary.ca/d2l-student/>.

Policies Governing the Course:

Attendance

Attendance at all lectures is required

Conduct During Lectures

Students are expected to conduct themselves in a mature and courteous manner during ALL lectures. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic.

Students are expected to take notes during each session and should not rely solely on handout material supplied by the instructors.

Electronic Devices

The Bachelor of Health Sciences program aims to create a supportive and respectful learning environment for all students. Research studies have found that student use of electronic devices (laptops, tablets, etc) in the classroom negatively affects the learning of both the user and those sitting nearby. Inappropriate use of laptops is also disruptive to your fellow classmates and disrespectful to the lecturer. The use of laptops and other electronic note-taking devices is permitted; however, their use in the classroom should be for course-related work/note-taking only. Please do **NOT be to surf the web, check email or do other unrelated work**. Students who use their laptops inappropriately or are otherwise disruptive during lectures will be asked to leave.

Cell phones (or similar devices) should **be turned off** (not merely silent) upon entering the classroom. Sending/receiving text messages or leaving the class to take calls is disruptive to the entire class and will not be tolerated unless absolutely necessary. Students who disregard this rule during lectures or tutorials will be asked to leave. These items are not permitted under any circumstance during exams/quizzes, etc.

Copyright

It is the responsibility of students and professors to ensure that materials they post or distribute to others comply with the Copyright Act and the University's Fair Dealing Guidance for Students (library.ucalgary.ca/files/library/guidance_for_students.pdf). Further information for students is available on the Copyright Office web page (<http://library.ucalgary.ca/copyright>)

A Note Regarding Instructor Intellectual Property

Generally speaking, course materials created by professor(s) (including course outlines, presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the professor(s). 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 Based on Disability or Medical Condition

It is the student's responsibility to register with Student Accessibility Services to be eligible for formal academic accommodation in accordance with the Procedure for Accommodations for Students with Disabilities (https://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf). If you are a student who may require academic accommodation and have not registered with Student Accessibility Services, please contact their office at (403) 220-8237; <http://www.ucalgary.ca/access/>. Students will be provided with all necessary accommodations to ensure equal opportunity to succeed in this course. Please provide the instructor your accommodation letter from Student Accessibility

Services within 14 days after the start of this course so that all needed arrangements for exams and assignments can be made.

Accommodations on Protected Grounds other than Disability

Students who require an accommodation in relation to their coursework based on a protected ground other than disability, should communicate this need, preferably in writing, to the designated BHSc program contact, Mrs. Jennifer Logan (jljlogan@ucalgary), or to Dr. Ebba Kurz, Associate Dean, Undergraduate Health and Science Education, Cumming School of Medicine. Students who require an accommodation unrelated to their coursework or the requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Vice-Provost (Student Experience). For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/.

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. These rules are contained principally in Sections J to L of the *University of Calgary Calendar*. Students are expected to be familiar with these standards and to uphold the policies of the University in this respect. The Calendar also stipulates the penalties for violating these rules. Please know that the University and the Cumming School of Medicine take these rules seriously. **All incidences of academic dishonesty in this course, such as cheating and plagiarism, will be reported to the Associate Dean for investigation;** infractions will be noted on the record of a student found to be guilty.

Recording of Lectures

Audio or video recording of lectures is prohibited except where explicit permission has been received from the instructor.

Other Important Information

Freedom of Information and Protection of Privacy Act

This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIP); students should identify themselves on written assignments (exams and term work) by their name and ID number on the front page and ID on each subsequent page. Work assigned to you by your course instructor will remain confidential unless otherwise stated before submission. The assignment cannot be returned to anyone else without your expressed permission to the instructor. Grades will be made available on an individual basis and students will not have access to other students' grades without expressed consent. Similarly, any information about yourself that you share with your course instructor will not be given to anyone else without your permission. See <http://www.ucalgary.ca/policies/files/policies/privacy-policy-2011.pdf> for more information.

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/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 15 days** of first being notified of the grade.

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/
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 SU Wellness Centre (Room 370 MacEwan Student Centre, <https://www.ucalgary.ca/wellnesscentre/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/ombuds/ or email ombuds@ucalgary.ca

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 medrep2@su.ucalgary.ca.

Emergency Evacuation/Assembly Points

Assembly points for emergencies have been identified across campus. Assembly points are designed to establish a location for information updates from the emergency responders to the evacuees; and from the evacuated population to the emergency responders. The primary assembly point for the Health Sciences Centre is the Health Research Innovation Centre Atrium. For more information, see the University of Calgary's Emergency Management website: <http://www.ucalgary.ca/emergencyplan/assemblypoints>.

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 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.

Course Schedule (**Subject to alteration depending on student knowledge**):

1	Jan 11	Course introduction. Basics of transcriptional regulation. Introduction to reading scientific papers in this field.	Bieda
2	Jan 18	Chromatin immunoprecipitation and next-generation sequencing.	Bieda
3	Jan 25	Big data and introduction to unix tools for bioinformatics analysis. (computer exercise second half)	Bieda
4	Feb 1	R/Bioconductor for bioinformatics. (computer exercise second half)	Bieda
5	Feb 8	Guest lecture: Next Generation Sequencing (Dr. Quan Long)	Long
6	Feb 15	Advanced analysis pipeline design in bioinformatics with workflow systems. Assignment of student projects.	Bieda
7	Feb 22	No class – Reading Week	
8	Mar 1	Student presentation of paper. Assignment 1 will be made available	Bieda
9	Mar 8	Student presentation of paper. Student short presentations on project progress and plans.	Bieda
10	Mar 15	Student presentation of paper. Assignment 1 is due at start of class.	Bieda
11	Mar 22	Student presentation of paper.	Bieda
12	Mar 29	Student presentation of paper.	Bieda
13	Apr 5	Student presentation of paper.	Bieda
14	Apr 12	Summary lecture on ChIP-seq data analysis bioinformatics and future directions (Bieda) followed by class discussion. Project due by 12 noon EXACTLY in BHSC office	Bieda