AFNS 508 APPLIED BIOINFORMATICS

Fall 2025

College of Natural and Applied Sciences • Faculty of Agricultural, Life & Environmental Sciences • Department of Agricultural, Food & Nutritional Science • University of Alberta

Course at a Glance

Instructor	Dr. Paul Stothard (stothard@ualberta.ca, 2-31 GSB)
Office Hours	By appointment (send email)
Lectures	Tue, Thu, 12:30–13:50 in GSB 8-59
Course Site	Canvas (assignments, readings, announcements)

Calendar Description: *Introduction to databases, software tools, and analysis methods used to characterize DNA and protein sequences. Topics include information retrieval from sequence databases, protein function prediction, assessing sequence similarity, measuring gene expression, and the analysis of high-throughput sequencing data.*

Course Materials: Lecture materials and associated readings will be made available through Canvas. There is no required textbook for the course.

Learning Outcomes

Upon successful completion of this course, students will be able to:

- Apply their knowledge of gene structure and function to predict the impacts of known and hypothetical DNA changes on phenotype.
- Extract and interpret sequence information using popular web-based databases and tools from NCBI, EBI, and UCSC.
- Use command-line-interface software to perform routine bioinformatics operations and analyses.
- Use R and Bioconductor to perform statistical analyses of data produced by high-throughput instruments.
- Process short-read and long-read sequence data to identify sequence variation, assemble genomes, and measure gene expression.
- Organize bioinformatics projects, and plan and document data transformations and analyses using Markdown, R Markdown, and Jupyter Notebooks.
- Execute Snakemake and Nextflow workflows.
- Analyze data using interactive and batch jobs on a computer cluster.

Course Overview

Lectures will explore a variety of topics related to bioinformatics and will cover well-established as well as emerging technologies and techniques. Assignments and tutorials will be worked on in class and will give students the opportunity to apply a variety of software tools to genomics datasets. Students will be given access to a Linux-based server with bioinformatics software pre-installed.

Topics to be covered:

- Sequence data formats
- Biological databases
- Command-line software tools
- R and Bioconductor
- High-throughput sequencing methods and associated data formats
- Bacterial genome assembly and annotation
- Gene expression analysis
- Data management strategies
- Bioinformatics workflows
- High-performance computing
- Python and JupyterLab

Assessment & Grading

Assessment Type	Date	Marks
Assignment 1	Sep 16	10
Assignment 2	Oct 2	10
Assignment 3	Oct 14	10
Assignment 4	Oct 28	10
Assignment 5	Nov 18	10
Assignment 6	Dec 2	10
Bioinformatics software review and protocol	Dec 16	40
Course Total		**100**

Short-Answer Assignments: Students will complete short-answer questions designed to provide hands-on experience with web-based or command-line software tools.

Bioinformatics Software Review and Protocol Assignment: Students will write a review of a bioinformatics software tool of their choosing that includes a detailed analysis of a data set (a protocol). The document should explain the overall purpose of the software and why it is useful (i.e., what kinds of research questions can it address), and then guide the reader through a sample analysis using a publicly available data set (downloaded from NCBI for example) or simulated data. The analysis steps should be described such that another person could reproduce the analysis and obtain the same results. Relevant program output in the form of text excerpts, tables, and figures should be provided. The document should assist the reader with the interpretation of the results and should highlight particularly meaningful findings. Students are encouraged to choose or create a data set that highlights the program's capabilities and that produces an easily interpreted result. Small data sets (less than 1 GB in size) that can be processed in a short period of time on a standard laptop computer are preferred. Software tool/data set combinations already covered elsewhere (for example, on

the software's website or in an existing review or tutorial) should be avoided. Sample reviews and a grading rubric will be available through Canvas.

Key Policies

Assignment due time	11:00 pm on the specified date (unless otherwise noted)
Late penalty	-50% per day (or portion thereof)
Submission	Upload to Canvas

Grading and Course Materials

Final Grade Assessment: Final grade assessment is the responsibility of the instructors. Letter grades will be assigned only to the final distribution of aggregate raw scores. There will be no predetermined "curving" to assign final grades; instead, cut-offs for different grades will be based on real breakpoints in the overall distribution of raw marks within the class for the current academic year.

Access to Representative Evaluative Material: Students will be given access to representative evaluative materials through Canvas.

Academic Integrity and Student Conduct

The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect.

Students are particularly urged to familiarize themselves with the provisions of the Student Academic Integrity Policy and the Student Conduct Policy, and avoid any behaviour that could potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts, participation in an offence) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the Academic Integrity website for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Unfamiliarity of the rules, procrastination or personal pressures are not acceptable excuses for committing an offence. Listen to your instructor, be a good person, ask for help when you need it, and do your own work—this will lead you toward a path to success.

Any academic integrity concern in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the Student Academic Integrity Policy and the Student Conduct Policy.

The College of Natural and Applied Sciences (CNAS) has created an Academic Integrity for CNAS Students Canvas site. Students can self enroll and review the various resources

provided, including the importance of academic integrity, examples of academic misconduct & possible sanctions, and the academic misconduct & appeal process.

"Integrity is doing the right thing, even when no one is watching." — C.S. Lewis

Additional Information

Policy about course outlines can be found in Course Requirements, Evaluation Procedures and Grading of the University Calendar.

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).