



PLNT*6500 Applied Bioinformatics

Fall 2019

Section(s): C01

Department of Plant Agriculture

Credit Weight: 0.50

Version 1.00 - September 04, 2019

1 Course Details

1.1 Calendar Description

The goal of this course is to provide an introductory understanding of the databases and methods used in computational molecular biology research. Topics include: reviewing major molecular databases and their structures, constructing sequence alignments, constructing phylogenics, and finding motifs and genes in biological sequences. Lab sessions include an introduction to Unix and Perl for the biologist and hands-on use of several molecular data analysis programs.

Pre-Requisites: Undergraduate level statistics class (such as STAT*2040 or STAT*2100) and undergraduate level molecular biology class (such as MBG*2020).

1.2 Timetable

Lecture: Monday, Wednesday, Friday 8:30AM-9:20AM MCKN232

Lab 01: Tuesday 2:30PM-4:30PM MINS Room 101.

Lab 02: Wednesday 2:30PM-4:30PM MINS Room 101.

1.3 Final Exam

To be determined

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructional Support Team

Instructor:	Lewis Lukens
Email:	llukens@uoguelph.ca
Telephone:	+1-519-824-4120 x52304
Office:	326 Crop Science
Office Hours:	Tuesday 1:30PM-2:30PM and by appointment

2.2 Teaching Assistants

Teaching Assistant:	Haiyang Chang
Email:	hchang02@uoguelph.ca
Office Hours:	By appointment only

3 Learning Resources

3.1 Required Resources

CourseLink (Website)

<https://courselink.uoguelph.ca>

Papers discussed in lecture and supporting literature will be available through CourseLink. Course notes will be available. I recommend taking notes in lecture and using course notes and readings as references.

Lab exercises are posted on CourseLink.

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. critique scientific journal articles to help understand specific instances in which bioinformatics has been used to test biological hypotheses. Students will learn skills for data processing using programming languages and a number of software analysis packages.
2. gain an understanding of how character information- the nucleotide composition of a gene, for example- can be analyzed quantitatively to draw inferences about the biological attributes of the characters- i.e. their biochemical function and their evolutionary history. Students will also learn to apply statistical tests in the context of bioinformatics and study different approaches for data analysis.

3. learn how a number of bioinformatics approaches have their antecedents in the fields of systematics and linguistics and the integration of mathematics and statistics into the analysis of molecular data.
 4. utilize concepts from disparate fields to solve problems. The course provides many examples of scientific discoveries that have integrated statistics and mathematics concepts with biological concepts.
 5. critique major, peer-reviewed discoveries using bioinformatics. Students will critique studies both in class participation and in written assignments.
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5 Teaching and Learning Activities

Lecture Content:

The lectures are divided into three topics. In each topic, lectures revolve around bioinformatics methods and the research that use them.

Topic 1: Identifying key genes important for biological variation in agriculture and medicine.

In this topic we discuss bioinformatics methods for the analysis genetic diversity. Research articles will describe relationships between molecular variation and trait variation. We will review genomics and genetic variation and learn how data from recent genotyping technologies assay molecular variation. Methods to associate genotypic variation with trait variation will be covered.

Topic 2: Identifying the molecular basis of cellular responses

In this topic, we discuss key research articles that have used genes' mRNA abundances to make biological insights. We will describe how to estimate a sample's RNA abundances using RNA Seq technologies and to compare gene transcript abundances between samples. We will discuss how summarizing the expression data of groups of genes can help elucidate the biological processes that differ between samples

Topic 3: Molecular evolution and its application

In this topic we discuss methods to explore factors driving population and evolutionary change. Approaches to evaluate diversity and relatedness among biological samples using single nucleotide polymorphism data are covered.

Labs:

Labs are computational only. They cover a number of analysis techniques including:

- genetic map construction and quantitative trait loci mapping.
- methods for pairwise and multiple sequence alignments
- RNASeq data analysis.
- software for diversity analyses and phylogeny generation and testing.
- beginning instruction on data processing using bash and a scripting language.

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Weekly Lab Completion	22
Three critical reviews	18

Name	Scheme A (%)
Quiz 1	15
Quiz 2	15
Final Exam	30
Total	100

6.2 Assessment Details

Weekly Lab Completion (22%)

Date: Labs begin Sept. 10

Learning Outcome: 1, 2

Critical reviews of 3 papers that use bioinformatics methods (18%)

Due: Sept. 30; Oct. 28; Nov 18th

Learning Outcome: 1, 3, 4, 5

Quiz 1 (15%)

Date: Fri, Oct 4

Learning Outcome: 1, 2, 4, 5

Quiz 2 (15%)

Date: Fri, Nov 8

Learning Outcome: 1, 2, 4, 5

Final Exam (30%)

Date: Sat, Dec 7, 2:30 PM - , 4:30 AM, TBD

Learning Outcome: 1, 2, 4, 5

6.3 Notes on Assignments and Tests

Notes on assignments and tests: For presentations, students will work in a group. Quiz 1 covers material up to Wed., Oct. 2. Quiz 2 covers material from Oct. 7- Nov. 6th. For the final exam, 1/3 to 1/2 of the exam will focus on material after Nov. 11th.

7 Course Statements

7.1 Grading Policies

All assignments are due in class on their due date unless we have made prior arrangements. Five points will be deducted from quizzes taken after the scheduled time. I will also deduct one point for every day after the scheduled quiz date. Make-ups are not possible later than five days after the quiz date. For written assignments, I will subtract two points per day of lateness.

7.2 Course Policy on Group Work

Individuals within a group are expected to contribute equally.

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 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. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

8.4 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.

8.5 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.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

8.6 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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

8.7 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.

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>
