

# AGR\*3200 - Computing for Bioscientists

## Winter 2025 Course Outline

Section: 01

Credits: 0.50

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## Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

## Calendar Description

This course focuses on computational aspects of analytical techniques for biological data. Topics covered include, how to operate a computer efficiently when using biological data, types of biological data used in animal biosciences, how to prepare biological data for analysis, programming skills for bio-data organization, manipulation and problem solving, bio-data visualization, and computational aspects of data modelling.

**Prerequisite(s):** 9.50 credits

**Restriction(s):** Restricted to students in BSCH.ABIO, BSAG.AGRS, BSAG.ANSC, BBRM.EQM.

**Department(s):** Department of Animal Biosciences

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## Course Description

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## Lecture Schedule

Tu 8:30am-11:20am in ROZH\*108 (1/6 to 4/21)

## Lab / Seminar Schedule

| Day     | Time           | Location |
|---------|----------------|----------|
| Tuesday | 1:30 - 3:20 PM | ANNU*101 |

## Instructor Information

Dan Tulpan

Email: dtulpan@uoguelph.ca

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## Learning Resources

### Required Resources

Students will need access to a laptop computer. The laptop will be used in every lecture and lab. Materials will be made available on Course link (Website) (<https://courselink.uoguelph.ca/>).

## Course Resources

Course notes will be used during the course and available via the Course link (Website) (<https://courselink.uoguelph.ca/>). Extra pertinent information, such as websites, papers, chapters of books, etc., will be accordingly recommended.

Students are advised to take their own notes during lectures.

Potentially useful/interesting Python/R programming resources:

- Online book: How to Code in Python (<https://assets.digitalocean.com/books/python/how-to-code-in-python.pdf>)
- Online Python course: Python Course (<https://python-course.eu/>)
- Online R tutorial: R Tutorial (<https://www.r-tutor.com/r-introduction/>)

## Campus Resources

If you are concerned about any aspect of your academic program: make an appointment with a Program Counsellor (<https://www.uoguelph.ca/uaic/programcounsellors/>) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the Learning Commons (<https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/>) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

## Cost of Textbooks and Learning Resources

| Textbook / Learning Resource                                    | Required / Recommended | Cost |
|-----------------------------------------------------------------|------------------------|------|
| All text books and learning resources are free for this course. |                        | \$0  |

Students are advised that prices are often determined by the publisher or bookstore and may be subject to change.

## Course Learning Outcomes

1. Perform and understand basic computer operations.
2. Understand bio-data formats and standards used in bio sciences and be able to manipulate them using basic computer programming.
3. Be able to organize information in data files and visualize their content using appropriate visualization methods and graphs with the help of software.
4. Be able to perform basic statistical analyses of biological data using R.
5. Be able to operate a research computer running the Linux operating system and perform basic tasks such as creating, modifying and removing files, listing directory contents, searching in files, high throughput operations involving multiple files, etc.
6. Be able to create well-organized/structured data sets.

## Schedule of Topics and Assignments

| Day | Date: | Topic                                                                                                                              | Activities                                                       | Due |
|-----|-------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----|
| Tue | 1/7   | Intro to AGR*3200<br>Intro to data and computing                                                                                   |                                                                  |     |
| Tue | 1/14  | Linux - general info, file structure<br>Linux file operations                                                                      |                                                                  |     |
| Tue | 1/21  | Advanced Linux commands<br>Linux scripting and other commands                                                                      | Release Assignment 1 (Linux)                                     |     |
| Tue | 1/28  | Programming concepts, Python program structure, variables, operations, strings<br>Python data structures + printing and formatting | Due: Assignment 1<br>Quiz 1: Linux general notions               |     |
| Tue | 2/4   | Python command line input + decisions/branching<br>Python loops / repetitive structures                                            | Release Assignment 2: Python printing, decisions, loops          |     |
| Tue | 2/11  | Python functions and files<br>Python libraries: numpy, pandas                                                                      | Quiz 2: Python general notions and printing<br>Due: Assignment 2 |     |

|     |      |                                                                                                  |                                                                                                                 |
|-----|------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Tue | 2/18 | Winter Break                                                                                     |                                                                                                                 |
| Tue | 2/25 | Python: data organization concepts + data errors and cleaning<br>Python plotting + miscellaneous | Quiz 3: Python decision and loops<br>Release Assignment 3: Python loops, functions, file ops, data organization |
| Tue | 3/4  | R basics<br>R reading and writing data, subsetting, decisions/branching and loops                | Quiz 4: Data organization<br>Due - Assignment 3                                                                 |
| Tue | 3/11 | R functions and the apply function family<br>R exploratory data analysis                         | Due - Assignment 4<br>Release Assignment 5 - R data manipulation                                                |
| Tue | 3/18 | R plotting<br>ML modelling - general concepts and problem formulation                            | Quiz 5: R<br>Due - Assignment 5                                                                                 |
| Tue | 3/25 | ML pipeline development in 10 steps<br>ML decision trees + demo                                  |                                                                                                                 |
| Tue | 4/1  | Final lecture                                                                                    |                                                                                                                 |

## Teaching and Learning Activities

### Topics covered in lectures and labs

This course will provide you with solid notions of data wrangling and basic computing using three special tools: Linux OS, Python, and R. The following topics will be covered:

- Introduction to data and computing
- The Linux operating system:
  - Basic commands, file and directory structure, working with data
- The Python programming language:
  - Variables, data types, operations, input/output, decisions, loops, functions, special libraries
- The R language:
  - Variables, data types, operations, input/output, decisions, loops, functions, basic stats
- Working with bio data - use cases:
  - Tabular data commonly used in animal biosciences (e.g. RFID data, body weight, milk yield, etc.)
- Bonus topic:
  - Artificial Intelligence and Machine Learning (intelligent computing) or other interesting topic

### Technical details

Each theoretical aspect of a topic is immediately followed by hands-on exercises (thus lectures and labs are combined), offering students the opportunity to practice the theoretical notions covered in the lecture using Python programs executed on a Linux platform or on your laptops, and R programs executed on Linux or on individual laptops/computers using R (r-project.org (<https://www.r-project.org/>)) and RStudioDesktop (rstudio.com (<https://www.rstudio.com/>)), which must be installed prior to class.

Please bring your own computer/laptop to each class and ensure it can connect to the Internet and it has applications that support SSH (Secure Shell) and SFTP/SCP (Secure File Transfer Protocol/Secure Copy) installed on it. SSH allows connections to remote Linux/Unix servers, while SFTP/SCP allows file transfers to and from the Linux/Unix servers to your own computer.

Windows users:

- SSH tool that allows remote connections to servers: Putty (<https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>)
- SFTP/SCP file transfer tool: WinScp (<https://winscp.net/eng/download.php>)

Mac OS X (Apple) users:

- SSH and SCP are typically pre-installed and can be accessed via the Terminal application (Applications -> Utilities -> Terminal.app)
- FTP/SFTP/SCP: FileZilla (<https://filezilla-project.org/download.php?platform=osx>)
- Note: Mac users should also have XCode (from App Store) and the Homebrew package manager (<https://brew.sh/>) installed.

Linux users:

- SSH and SCP are typically pre-installed and can be accessed using a terminal.

## Assessment Breakdown

*The due dates for all evaluations are approximations and can be changed at the discretion of the instructor. The changes will only be performed if and when needed to account and compensate for the learning speed of the materials covered in class.*

| Description         | Weighting (%) | Due Date    |
|---------------------|---------------|-------------|
| Assignment 1        | 9%            | January 28  |
| Assignment 2        | 9%            | February 11 |
| Assignment 3        | 9%            | March 4     |
| Assignment 4        | 9%            | March 11    |
| Assignment 5        | 9%            | March 18    |
| Quiz 1              | 2%            | January 28  |
| Quiz 2              | 2%            | February 11 |
| Quiz 3              | 2%            | February 25 |
| Quiz 4              | 2%            | March 4     |
| Quiz 5              | 2%            | March 18    |
| Take-home exam      | 35%           | April 8     |
| In-person interview | 10%           | April 11    |

## Assessment Details

### Assignment

#### Assignment 1

Release date: January 21

Due date: January 28 @ 11:59 PM EST

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 5

9

#### Assignment 2

Release date: February 4

Due date: February 11 @ 11:59 PM EST

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 3, 5, 6

9

#### Assignment 3

Release date: February 25

Due date: March 4 @ 11:59 PM EST

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 3, 6

9

#### Assignment 4

Release date: March 4

9

Due date: March 11 @ 11:59 PM EST

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 4, 6

## Assignment 5

9

Release date: March 11

Due date: March 18 @ 11:59 PM EST

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 2, 3, 4

## Quizzes

### Quiz 1

2

Date: January 28 (in-class)

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 5

### Quiz 2

2

Date: February 11 (in-class)

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 2

### Quiz 3

2

Date: February 25 (in-class)

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 2, 6

### Quiz 4

2

Date: March 4 (in-class)

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 2, 3, 6

### Quiz 5

2

Date: March 18 (in-class)

*Note: Due date is subject to change at the discretion of the instructor.*

**Course Learning Outcomes Assessed:** 1, 3, 4

## Exam

### Take-home exam

35

The take-home exam will be released on March 25 and written individually. The estimated due date is April 8, subject to change at the discretion of the instructor.

**Course Learning Outcomes Assessed:** 1, 2, 3, 4, 5, 6

### Take-home Exam Interview

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The take-home exam interviews will be conducted in-person or virtually (to be decided) on April 11, subject to change at the discretion of the instructor.

You will be asked questions about your take-home exam submission to ensure the originality and origin of the answers.

**Course Learning Outcomes Assessed:** 1, 2, 3, 4, 5, 6

## Last Day to Drop Course

The final day to drop Winter 2025 courses without academic penalty is the last day of classes: April 04

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

## Course Grading Policies

All assignments, quizzes and take-home exams must be submitted before 11:59 pm (EST) of the due date. Late assignments will receive zero (0)marks.

The submissions will be performed using the Dropbox functionality on CourseLink unless otherwise specified by the instructor.

The answers for all assignments and for the take-home exam will be included in the document provided to you by the instructor, without altering its structure, which includes headers, problem definitions, etc.

The assignments and take-home exam will be submitted as Microsoft Word documents.

All quizzes will be delivered and taken in class (your presence is mandatory).

## Standard Statements for Undergraduate Courses

### 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 discourages misconduct. 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.

The Academic Misconduct Policy (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/>) is outlined in the Undergraduate Calendar.

### 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 make a booking at least 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (<https://www.uoguelph.ca/sas/>)

### Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/>).

### 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.

## 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 undergraduate students 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 the Undergraduate Calendar - Dropping Courses (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/>).

## Email Communication

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

## Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (<https://wellness.uoguelph.ca/>). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (<https://wellness.uoguelph.ca/navigators/>) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (<https://wellness.uoguelph.ca/shine-this-year/>). The Student Wellness team are here to help and welcome the opportunity to connect with you.

## Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

## 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.

## Resources

The Academic Calendars (<http://www.uoguelph.ca/registrar/calendars/?index>) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

## 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. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration. (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/>)