



# ANSC\*6100 Special Project

## Machine Learning Modelling

Winter 2022

Section(s): C01

Department of Animal Biosciences

Credit Weight: 0.50

Version 1.00 - December 13, 2021

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## 1 Course Details

### 1.1 Calendar Description

Supervised program of study in some aspect of animal and poultry science that can involve an experimental project and/or detailed analysis of the literature.

### 1.2 Course Description

The course will cover major topics in machine learning with applications to animal biosciences and related areas. The topics include: data types, problem types (e.g. classification, regression, clustering, dimensionality reduction), models (e.g. decision trees, artificial neural networks, k-nearest neighbour, k-means), quality measures (e.g. accuracy, precision, recall, errors, correlations), data (re)sampling procedures (e.g. k-fold cross validation, fixed percentage splits), Python implementations using various libraries (e.g. pandas, scipy, numpy, scikit-learn). This is a project-based course and it will have a computational component and a lab component focused on Python programming.

*Note: While the course is currently offered in-person, due to the continuously volatile Covid-19 situation, the course might have to move online (synchronously).*

### 1.3 Timetable

#### **Current timetable:**

Lectures: Fridays from 2:30 PM to 5:30 PM, ANNU 002

Labs: Fridays from 9:30 AM to 11:30 AM, ANNU 002

First class: Friday, January 14, 2022

## 1.4 Final Exam

There is no final exam for this course. There is a final project report and presentation.

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# 2 Instructional Support

## 2.1 Instructional Support Team

<b>Instructor:</b>	Dan Tulpan
<b>Email:</b>	dtulpan@uoguelph.ca
<b>Telephone:</b>	+1-519-824-4120 x52482
<b>Office Hours:</b>	By appointment: in-person or online (Zoom, WebEx, MSTeams, Skype, etc.).

## 2.2 Additional information

The instructor will facilitate discussions, present lecture notes in an interactive and hands-on fashion, provide feedback to students, help with project direction and oversee/prepare the lab activities.

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# 3 Learning Resources

## 3.1 Recommended Resources

**C.M. Bishop (2006): Pattern Recognition and Machine Learning (Textbook)**

**S. Marsland (2015): Machine Learning: An Algorithmic Perspective (Textbook)**

**T. P. Trappenberg, Fundamentals of Machine Learning (Textbook)**

<https://global.oup.com/academic/product/fundamentals-of-machine-learning-9780198828044?cc=ca&lang=en&>

## 3.2 Complementary resources

Course notes will be used during the course (both available in the course's webpage).

Extra pertinent information, such as papers, chapters of books, etc. will be accordingly recommended.

Students are advised to take their own notes during lectures.

Potentially useful/interesting Python programming resources:

**Online book: How to Code in Python:**

- <https://assets.digitalocean.com/books/python/how-to-code-in-python.pdf>

**Online book: Introduction to Scientific Programming with Python:**

- [https://library.oapen.org/bitstream/handle/20.500.12657/39979/2020\\_Book\\_IntroductionToSci](https://library.oapen.org/bitstream/handle/20.500.12657/39979/2020_Book_IntroductionToSci)

**Online python and machine learning courses courses:**

- <https://python-course.eu/>
- <https://machinelearningmastery.com/>

## 3.2 Course technology and technical support

### Course Technologies and Technical Support

#### ***System and Software Requirements***

*This course may / will use a variety of technologies including;*

- *CourseLink (main classroom)*
- <https://replit.com/>
- *Linux*
- *Webex*
- *Zoom*
- *Teams (via Office 365)*

To help ensure you have the best learning experience possible, please review the list of system and software requirements.

<https://opened.uoguelph.ca/student-resources/system-and-software-requirements>

#### **CourseLink System Requirements**

You are responsible for ensuring that your computer system meets the necessary system requirements. Use the browser check tool to ensure your browser settings are compatible and up to date. (Results will be displayed in a new browser window).

<http://spaces.uoguelph.ca/ed/system-requirements/>  
<https://courselink.uoguelph.ca/d2l/systemCheck>

### **Course Technologies**

#### **CourseLink**

*This course is being offered using CourseLink (powered by D2L's Brightspace), the University of Guelph's online learning management system (LMS). By using this service, you agree to comply with the University of Guelph's Access and Privacy Guidelines. Please visit the D2L website to review the Brightspace privacy statement and Brightspace Learning Environment web accessibility standards.*

*<http://www.uoguelph.ca/web/privacy/> <https://www.d2l.com/legal/privacy/>  
<https://www.d2l.com/accessibility/standards/>*

#### **Technical Support**

*If you need any assistance with the software tools or the CourseLink website, contact CourseLink Support.*

*Email: [courselink@uoguelph.ca](mailto:courselink@uoguelph.ca)*

*Tel: 519-824-4120 ext. 56939 Toll-Free (CAN/USA): 1-866-275-1478*

#### **Support Hours (Eastern Time):**

*Monday thru Friday: 8:30 am–8:30 pm*

*Saturday: 10:00 am–4:00 pm*

*Sunday: 12:00 pm–6:00 pm*

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## **4 Learning Outcomes**

### **4.1 Course Learning Outcomes**

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

1. Understand machine learning data processing and data types and be able to manipulate

them using computer programming.

2. Perform and understand data modelling concepts and analytic approaches.
  3. Appreciate differences among machine learning methods and algorithms for both data curation and data analyses.
  4. Being able to manipulate data sets and apply machine learning models using Python programming in a Linux environment.
  5. Discuss the relative merits of machine learning methods and analytic results applied on various types of problems.
  6. Be able to contribute to a team project and perform various types of data analyses.
  7. Accurately and effectively communicate scientific analyses in written form.
  8. Have a proficient command terminology commonly used in machine learning modelling.
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## 5 Teaching and Learning Activities

### 5.1 Lecture

#### Topics

**Topics:** Topics covered in this course

- Python programming and Linux OS - overview
- Introduction to machine learning
- Data types (numeric, categorical, etc.)
- Data preparation and (pre)processing (test, validation, training, feature selection, feature engineering)
- Data (re)sampling (holdout sets, leave-one-out, fixed-percentage splits, k-fold cross validation, stratified sampling, etc.)
- Methods/model evaluation (confusion matrices, error measures, correlations, etc.)
- Model hyper-parameter optimization (learning and validation curves, parameter grid search)
- Classification methods (e.g. Decision Trees)
- Regression methods (e.g. Artificial Neural Networks)
- Clustering methods (e.g. K-Nearest Neighbour, K-Means)
- Ensemble methods (e.g. Random Forest)

- Other topics of interest (time permitting)

## 5.2 Additional information

### Lab component

Each lecture is followed by a lab, which will offer attendants the opportunity to practice the theoretical notions covered in the lecture using Python programs executed on a Linux platform (signal).

Please bring you own computer and make sure that you have 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: **Putty** -- <https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>
- SFTP/SCP: **WinScp** -- <https://winscp.net/eng/download.php>

#### *Mac OS X (Apple) users*

- SSH and SCP are typically pre-installed on Mac OS X and can be accessed via the *Terminal* application (Applications --> Utilities --> **Terminal.app**).
- **Note: For Mac users it is important to have XCode (from App Store) and the Homebrew package manager (<https://brew.sh/>) installed as well.**

#### *Linux users*

- SSH and SCP are typically pre-installed on a Linux OS and can be accessed using a *terminal*.

## 6 Assessments

The following information represents a list of assessment items for this course. The deadlines are approximate and may change based on the assimilation / teaching speed,

content and situations.

## 6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Assignment 1	6
Assignment 2	6
Assignment 3	6
Assignment 4	6
Assignment 5	6
Project presentation	30
Project report	40
Total	100

## 6.2 Assessment Details

### Assignment 1 (6%)

**Date:** Week 3

**Learning Outcome:** 1, 4, 7, 8

Data processing and sampling

### Assignment 2 (6%)

**Date:** Week 5

**Learning Outcome:** 1, 2, 4, 5, 7, 8

Classification problem: hands on exercises

### Assignment 3 (6%)

**Date:** Week 7

**Learning Outcome:** 1, 2, 4, 5, 7, 8

Regression problem: hands on exercises

### Assignment 4 (6%)

**Date:** Week 8

**Learning Outcome:** 1, 2, 4, 5, 7, 8

Clustering problem: hands on exercises

### Assignment 5 (6%)

**Date:** Week 10

**Learning Outcome:** 1, 2, 3, 4, 5, 6, 7, 8

Project proposal

### Project presentation (30%)

**Learning Outcome:** 1, 2, 3, 4, 5, 6, 7, 8

### Project Report (40%)

**Learning Outcome:** 1, 2, 3, 4, 5, 6, 7, 8

## 6.3 Notes

The project presentation will be 30 minutes long and will have a 5-10 minutes question period. Presentation slides will be made available to the instructor 24 hours in advance.

The project report will be structured as a journal article using the template of the **Journal of Animal Science** ([https://academic.oup.com/jas/pages/General\\_Instructions](https://academic.oup.com/jas/pages/General_Instructions)) and will be submitted approx. one week after the presentation (**April 20, 2022 before midnight**). This will allow students to integrate feedback from presentations into reports. While groups of up to 4 students can work on the same project, the reports will be written individually. The topic of each project will be decided between students and shared with the instructor before or on the week of March 7, 2022. Alternatively, the instructor can also provide project topics to students who cannot decide.

*Note: The exact dates for assignments, project presentation and project report are subject to change at the discretion of the instructor.*

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## 7 Course Statements

### 7.1 Grading Policies

All assignments, presentations and reports must be submitted by 11:59 pm of the due date. Late assignments will receive zero (0) marks.

### 7.2 Netiquette Expectations

#### **Online Behaviour:**

**Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:**

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student



- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

## 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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>

## 8.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

## 8.10 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).

## 8.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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