Western Science

Department of Statistical & Actuarial Sciences

DS 3000B / DS 9000B – Introduction to Machine Learning

1. Course Information

Course Information

Academic Term:	Winter 2022/23	
Undergrad Code:	DATASCI 3000B	
Grad Code:	DATASCI 9000B	
Lectures:	Tuesdays	4:30-6:20pm
Tutorials:	Thursdays	4:30-6:20pm
Classroom:	B&GS-0153	

Prerequisites

(Data Science 1200A/B or Computer Science 1026A/B or Computer Science 1027A/B or Computer Science 2120A/B or Digital Humanities 2220A/B or Engineering Science 1036A/B or Data Science 2000A/B or Integrated Science 2002B or Statistical Sciences 2864A/B); (Data Science 2000A/B or Integrated Science 2002B or Statistical Sciences 2857A/B or 0.5 course from the Introductory Statistics Course List); (Mathematics 1600A/B or Numerical and Mathematical Methods 1411A/B or the former Applied Mathematics 1411A/B or Data Science 2100A); (Calculus 1000A/B or Calculus 1500A/B or Numerical and Mathematical Methods 1412A/B or the former Applied Mathematics 1412A/B or Data Science 2100A). Note that Data Science 2000A/B, Integrated Science 2002B and Data Science 2100A can be used to fulfill multiple prerequisites.

Anti-requisites

The former Computer Science 4414A/B, the former Statistical Sciences 3850F/G, the former Software Engineering 4460A/B. Unless you have either the requisites for this course or written special permission from your dean to enroll, you may be removed from this course, and it will be deleted from your records. This decision may not be appealed. You will receive no adjustment to your fees in the event you are dropped for failing to have the necessary prerequisites.

2. Instructors' Information

Instructor	Email	Office Hours
Fazeli, Alireza	afazeli2@uwo.ca	Fridays 10:00-11:00AM

		Location: WSC 272

Teaching Assistants	Email	Office Hours
Guerrero Santaren, Daniel	dguerre4@uwo.ca	Wednesdays 3:00-4:30PM Location: WSC 250
Khadem Charvadeh, Yasin	ykhademc@uwo.ca	
Shi, Yu	yshi523@uwo.ca	

Students must use their "@uwo.ca" email accounts when contacting the instructor and teaching assistants. Emails sent from miscellaneous accounts will be ignored.

3. Course Syllabus, Schedule, Delivery Mode

Introduces machine learning and statistical methods for data analysis through applied examples. The goal of this course is to expose students to topics related to statistical learning such as Linear Regression, Logistic Regression, Discriminant Analysis, Model Selection and Regularization, Cross Validation, Tree Based Methods and Clustering. The course emphasizes the ability to apply techniques to real data sets and critically evaluate their performance. Topics include:

- Supervised Learning and Model Fitting
- Statistics, Prediction, and Maximum Likelihood
- Introduce test set/out-of-sample idea.
- Classification, Evaluation, Logistic regression Regularization, Multi-class problems
- Estimating Performance, Quantifying Uncertainty on parameter estimates and on model predictions
- Test Error, Cross-Validation, Model Selection, Bias-Variance Tradeoff
- Feature Selection and Regularization (L1 and L2)
- Trees, Random Forest
- Neural Networks, Gradients, Learning
- Autoencoders, Dimensionality Reduction, PCA, NMF, t-SNE
- Clustering, K-means, Hierarchical Clustering
- Model Limitations, Causality

Session format:
The attempt will be to allocate the first half of every session to delivering lectures and the second half to a hands-on lab with a five-minute break in between.

Schedule:

	Week	Topic
01	Jan. 09 – 15	Supervised Learning and Model Fitting
02	Jan. 16 – 22	Probability and Maximum Likelihood

03	Jan. 23 – 29	Test set/out-of-sample idea, Classification, Evaluation, Logistic regression
04	Jan. 30 – Feb. 5	Quantifying Uncertainty
05	Feb. 6 – 12	Test error, Cross-validation, Model Selection, Bias-Variance trade-off
06	Feb. 13 – 19	Feature Selection and Regularization (L1 and L2)
07	Feb. 20 – 26	Reading Week
08	Feb. 27 – Mar. 5	Tuesday: Summary Session, Thursday: Midterm Exam
09	Mar. 6 – 12	Tree-based Models
10	Mar. 13 – 19	Dimensionality reduction
11	Mar. 20 – 26	Clustering
12	Mar. 27 – Apr. 2	Fairness and Transparency
13	Apr. 3 – 9	Artificial Neural Networks

Classes begin: January 9, 2023

Spring Reading Week: February 18 – 26, 2023

Classes end: April 10, 2023

Final Exam* period: April 13 – 30, 2023
*University will announce the exact date of the final exam.

Contingency plan for an in-person class pivoting to 100% online learning
In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online as determined by the course instructor.

4. Course Materials

Books:
The Elements of Statistical Learning by Hastie, Tibshirani and Friedman. [online]
Machine Learning: A Probabilistic Perspective by P. Kevin Murphy [online]

Students are responsible for checking the course OWL site regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class. All course material will be posted to OWL.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone on 519-661-3800 or ext. 83800.

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click here.

While self-installation of the software on your own computer is possible, there is also the possibility of using online platforms. Two are available:

- Google Colab
- Kaggle Kernels

Technical Requirements
This is a mostly code-based course so a laptop with internet connection is required. If making your own local installation, a computer with a sufficiently powerful processor (at least two cores @2.2 GHz) with at least 8GB of RAM is recommended. If this were not available, we recommend using an online environment.

5. Methods of Evaluation

The final course grade will be calculated as listed below:

10 Assignments	36%
Midterm Exam	24%
Final Exam	40%

For undergrads to pass the course, a mark above 50% must be obtained in the written examination section of the course: ((0.24*Midterm + 0.40*Final) / 0.64) ≥ 50

For grads to pass the course, a mark above 60% must be obtained in the written examination section of the course: ((0.24*Midterm + 0.40*Final) / 0.64) ≥ 60

Weekly Assignment:
Assignments will be released each week, with due dates in the following week. There will be no make-up for missed weekly assignments.

Midterm:
The midterm will be a practical examination in the form of a timed assignment. Students will be given a data set and a set of practical data analytic problems to solve, like the structure of the weekly assignments. The exam is “open book” meaning students can access any offline and online contents. However, any sort of communication with people inside or outside the class is prohibited. Each student will need a laptop to complete the exam.

Final Exam:

The final exam will be scheduled by the Registrar. The exam is "open book" meaning students can access any offline and online contents. However, any sort of communication with people inside or outside the class is prohibited. The exam will cover concepts from the entire course and is in a structure like the midterm exam. It will be a practical examination and each student will need a laptop to complete the exam.

6. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Assessments worth less than 10% of the overall course grade:

- Late assignment submission will be subject to a late penalty discount of 10% a day (this means if your coursework gets an 80%, and you submit n days late, your final mark will be 80% minus $n \times 10\%$. The day late starts one minute after the deadline of the original assessment has passed. There is NO EXCEPTION to this policy unless the student informs the instructor of their circumstances at least 36 hours prior to deadline and the instructor deems the request justified and grants an exception.
- An assignment cannot be submitted after it has been returned to the class. In case of a missed assignment with justified cause determined by the instructor or Academic Counselling Office, the weight will be transferred to other assignments (or to the midterm/final exam).
- Note that in all cases, the instructor reserves the right to require supporting documentation (medical or otherwise) to be submitted by the student to their Dean's Office Academic Counselling unit before finalizing a decision.

Assessments worth 10% or more of the overall course grade:
For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy. The Student Medical Certificate is available here.

Students must note that instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds or else.

Absence from Midterm Examination
If you miss the Midterm Exam, please contact the Academic Counselling Office of your Faculty of Registration as soon as you can do so and shifting the weight to the final exam may be granted.

Absence from Final Examination

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you can do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

Note: missed work can *only* be excused through one of the mechanisms above. Being asked not to attend an in-person course requirement due to potential COVID-19 symptoms is **not** sufficient on its own.

7. Accommodation and Accessibility

Religious Accommodation
When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) here.

Accommodation Policies
Students with disabilities work with Accessible Education (formerly SSD), which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found here.

8. Academic Policies

The website for Registrarial Services is this.

In accordance with the policy, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

A laptop computer with internet connection is required for both the midterm and final exams.

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at this website.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.

In the event of health lock-down, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website.

9. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at (519) 661-2147 if you have any questions regarding accommodations.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being.

Learning-skills counsellors at the Student Development Centre are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western for a complete list of options about how to obtain help.

Additional student-run support services are offered by the USC.

10. Accreditation

University Accreditation Program – Canadian Institute of Actuaries (CIA)

Honours Specialization Program in Actuarial Science

If you are in 2nd or 3rd year

If you graduate from with an HSP in Actuarial Science, this course will be one of the courses that you will take in your program that will allow you to be exempt from the preliminary exams of the Society of Actuaries (SOA). This is under the new **CIA program accreditation program**. If your plan is to become a fully qualified actuary working in Canada, then all you would need to do is graduate from your HSP in actuarial science. You would then be eligible for the CIA Capstone Exam. Taking and passing this exam, along with an online module and a practice education course, would make you eligible to become an ACIA (associate of the Canadian Institute of Actuaries).

If you are in 4th year

This course is accredited under the Canadian Institute of Actuaries (CIA) University Course Accreditation Program (UAP) for the 2022-23 academic year. This course, along with Statistics 3859A (both need a minimum mark of 75%) can give you an exemption for the SRM exam. **This is the last year of the CIA course accreditation program**.

Major in Actuarial Science

If you are a student in a major in Actuarial Science, the CIA program accreditation program will not apply to you. If your plan is to become a fully qualified actuary, you will need to continue to write and pass the preliminary exams of the SOA. However, for 2022-23 this course is still accredited under the Canadian Institute of Actuaries (CIA) University Course Accreditation Program (UAP) for the 2022-23 academic year. Achievement of the established exemption grade in this course may qualify a student from exemptions from writing certain preliminary exams. **This is the last year of the CIA course accreditation program.**

Please see this link for full details.

In addition to the university's internal policies on conduct, including academic misconduct, candidates pursuing credits for writing professional examinations shall also be subject to the **Code of Conduct and Ethics for Candidates in the CIA Education System** and the associated **Policy on Conduct and Ethics for Candidates in the CIA Education System**.

For more information, please read this document.