

DS 3000B – Introduction to Machine Learning Course Outline

Cross listed with DS 9000B

1. Course Information

Course Information

Academic Term: Winter 2025/26

Lectures:

Tuesday 4:30pm to 6:30pm, UCC 146.

Thursday 4:30pm to 6:30pm, NCB 113.

List of 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.

Unless you have either the requisites for this course or written special permission from your Science Academic Advisors to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

List of Antirequisites

The former Computer Science 4414A/B, the former Statistical Sciences 3850F/G, the former Software Engineering 4460A/B

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Cristián Bravo (Course Coordinator)	cbravoro@uwo.ca	WSC 280	(519) 661-2098 x87565	Thursdays 3pm – 4pm
Xiangshi Li	xli3492@uwo.ca	Please check OWL	N/A	Please check OWL
Kaize Pan	kpan26@uwo.ca			

Mengqi Wang	mwan259@uwo.ca			
Zixuan Yang	zyang548@uwo.ca			
Raushan Zhumanova	rzhumano@uwo.ca			
Rika Fitriani	rfitrian@uwo.ca			

Students must use their Western (@uwo.ca) email addresses when contacting their instructors. The course will have an active Discord channel for fast communication. Students must use their real name as nicknames, or they will not be accepted/removed from the Discord. Important announcements will appear in OWL. Students are responsible for checking the course OWL site (<https://westernu.brightspace.com/>) or the Discord regularly for news and updates.

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

Office hours will be in person unless agreed-to by email.

3. Course Syllabus, Schedule, Delivery Mode

Introduces machine learning and statistical methods for data analysis through applied examples. The goal of this course to expose students to topics related to statistical learning such as Regularized 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
- Classification, evaluation, logistic regression regularization, multi-class problems.
- Test error, Cross-validation, Model Selection, Bias-Variance tradeoff, uncertainty and bootstrapping.
- Feature Selection and Regularization (L1 and L2)
- Trees, XGBoost, Random Forest
- Dimensionality reduction, PCA, NMF, tSNE, UMAP.
- Unsupervised learning: Clustering, K-means, hierarchical clustering, autoencoders.
- Fairness, Accountability, Explainability and Transparency.
- Neural networks and an introduction to deep learning.

Table of Contents and Schedule

Week	Week Starting	Lecture	Lab	Homework
1	Jan 05	Supervised Learning and Model Fitting	Pandas and Numpy	Linear regression, Loss function Squared error Mean absolute deviation

2	Jan 12	Probability and Maximum Likelihood	Polars	Regression
3	Jan 19	Introduce test set/out-of-sample idea, Test error. Classification, Evaluation, Logistic regression Regularization, Multi-class problems	Running a logistic model	Logistic regression, Classification, Evaluation
4	Jan 26	Model Selection, Cross-validation, Bias-Variance trade-off, Bootstrap	Uncertainty	Uncertainty and model selection
5	Feb 02	Feature Selection and Regularization (L1 and L2)	Regularization	Regularization and nested cross-validation
6	Feb 09	Trees, XGB, Random Forest	Tree Lab	Tree homework (deadline Feb 27 after midterm)
7	Feb 16	Reading Week	-	-
8	Feb 23	Midterm prep	Midterm	-
9	Mar 02	Dimensionality reduction, PCA, NMF, t-SNE, UMAP	Dimensionality reduction	Dimensionality reduction
10	Mar 09	Clustering, K-means, hierarchical clustering, autoencoders	Clustering	Clustering
11	Mar 16	FATE Machine Learning	FATE Machine Learning	FATE Machine Learning
12	Mar 23	Neural Networks, Gradients, learning	Dense Networks	Dense Networks
13	Mar 30	Deep Learning	Introduction to Deep Learning	No homework. Term project deadline Friday 5pm.

Classes begin: January 5, 2026

Spring Reading Week: February 14 – 22, 2026
Classes end: April 9, 2026
Exam period: April 12 – 30, 2026

4. Course Materials

Core book:

The Elements of Statistical Learning by Hastie, Tibshirani and Friedman. [Available for Free Online at <https://web.stanford.edu/~hastie/ElemStatLearn/> or with a Western account at <https://link.springer.com/book/10.1007/978-0-387-84858-7>]

Recommended complementary book:

Machine Learning: A Probabilistic Perspective by P. Kevin Murphy [Free [online](#)]

Students are responsible for checking the course OWL site (<http://owl.uwo.ca>) on a regular basis 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: <http://owl.uwo.ca>.

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 at 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 in your own computer is possible, there is also the possibility of using online platforms. Two are available:

- Google Colab: <https://colab.research.google.com>
- Kaggle Kernels: <https://www.kaggle.com/code>

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 are recommended. If this were not available, we recommend using an online environment.

All lectures will be recorded and made available at the course's OWL site. Please note, your voice may be recorded when attending lectures.

5. Methods of Evaluation

Grading Scheme and Assessment Dates

The overall course grade will be calculated as listed below:

Homeworks	10%
Midterm Test	25%
Term Project	30%
Final Exam	35%

- Every week, a pass / fail **homework** will be provided. They will have a deadline on Mondays 5pm. No late submissions will be accepted. The assignments will come with a selection of multiple-choice questions (50%) and a code-based problem (50%) dealing with the class topics of the week. **These are the study guides of the course.** The mark for this activity will be calculated by the best 8 out of the 10 homework assignments of the semester, using the formula $(\# \text{ passed homework}) / (\# \text{ total homework}) * 100$.
- The midterm is a **closed-book test** with multiple choice and/or written problems, following the structure of the analysis and multiple-choice questions in the homework. The midterm is the designated examination that cannot be skipped using self-reported undocumented absences. It will include up to week 7. It will occur in the second slot of the class, after reading week. Grad students have an extra question they must complete in the given time. **This question is optional for UG students, providing up to 10% additive extra marks (max. 100%, total extra marks = score question / score max in question * 10%).** Note no extra time will be provided for PG students.
- The exam is a **closed-book test** that covers all topics of the semester following the same structure as the midterm. It will be scheduled by the registrar. Grad students have an extra question they must complete in the given time. **This question is optional for UG students, providing up to 10% additive extra marks (max. 100%, total extra marks = score question / score max in question * 10%).** Note no extra time will be provided for PG students.
- The course includes a term project. The project, **to be done in groups of up to 4 students**, will be released the week after the midterm with a deadline on **Friday April 9th, 5pm. Starting at 5:05pm** that day, a 10-point late penalty will be incurred, increasing by 10 points every 24 hours (i.e. if you submit at 5.05pm on Friday the 9th, and your mark is 70%, you will get 60%. If you submit at 5.05pm on Monday, you will get $70\% - 3 * 10\% = 40\%$).

Use of Generative AI Tools

Generative AI is **forbidden** for the purpose of writing any written content in the coursework, beyond simple spell and grammar checking. **If online detectors trigger an alarm, the group may be mandated to defend their results and how they come from their own analyses in an in-person meeting.** Use of GenAI for code generation is allowed but note the midterm and exam include code debugging and code writing that must be done with no aids, so its use is discouraged.

GENERAL INFORMATION ABOUT MISSED COURSEWORK

Graduate students:

You must provide valid documentation for medical-related absences or adequate supporting documentation for non-medical absences to the instructor as soon as possible and no later than 48 hours after the missed assessment.

Documentation for medical illness must include the completion of a Western Student Medical Certificate (SMC) or, where that is not possible, equivalent documentation, by a health care practitioner.

For other types of absences, proper documentation must be provided.

Undergraduate students:

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](#).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:

https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests normally must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- Examinations scheduled during official examination periods (Defined by policy)
- Midterm (designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration).

When a student mistakenly submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

EVALUATION SCHEME FOR MISSED ASSESSMENTS (GRADUATE AND UNDERGRADUATE STUDENTS)

Exam and/or Midterm: When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write a makeup Final Exam after the date of the exam. This makeup exam **will test all topics of the semester, no matter if the exam or midterm was missed**. The mark in this examination will replace the mark of the missed assignment(s). The date of this makeup exam will be confirmed later in the term.

Term Project: If the deadline for the project is missed using Academic Considerations, a one-week extension will be provided. No further extensions will be allowed. Only one week can be claimed per group. If one member applies, then the whole group gets the extension.

Homework: This course has 10 homework assignments, and we will drop up to 2 failed or missed homework, using the rest to calculate your homework grade. Should extenuating circumstances arise, students do not need to request Academic Consideration or provide documentation for the first missed homework (both UG and PG). Academic consideration requests will be denied for this missed submission. You can use Academic Considerations (UG) or proper documentation (PG) for any extra homework, and in that case, we will not count that one for your homework grade.

TO PASS THE COURSE, A MARK ABOVE 50% (60% PG) MUST BE OBTAINED IN THE WRITTEN EXAMINATION SECTION OF THE COURSE (5/12 * MIDTERM + 7/12 * EXAM).

6. Additional Statements

6.1 Religious Accommodation

When a recognized religious holiday or observance conflicts with an examination, test, or other scheduled academic obligation, students must request accommodation via the University's Student Absence Portal (SAP). This request should identify the conflict and specify which course component(s) (e.g. test, midterm, exam) are affected.

Students are encouraged to submit the SAP request as early as possible, but no later than two weeks before any examination, or one week before any mid-term test or quiz, to allow sufficient time for adjustment. The SAP request serves as official notification to both the course instructor and the Academic Advising Office, in accordance with University policy:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

The Faculty of Science considers religious accommodations as scheduling conflicts. Instructors should provide either a make-up exam or an earlier sitting of the same exam to accommodate the student.

For more information on recognized religious holidays, please visit the Diversity Calendar posted on the Equity, Diversity & Inclusion website - <https://www.edi.uwo.ca>

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, 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 at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf.

6.3 General Academic Policies

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

Use of @uwo.ca email

In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as “appeals”)

Policy on Request for Relief from Academic Decision:

https://uwo.ca/univsec/pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Graduate):

https://uwo.ca/univsec/pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences:

https://uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Graduate):

https://uwo.ca/univsec/pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones. Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a scholastic offence, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

No electronic devices will be allowed in the exam, midterm, and special examination. If a student is found using an electronic device, it will be considered a Scholastic Offence.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is not permitted in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations. See the evaluation section for details.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a scholastic offence. If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

Electronic Verification

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.com (<http://www.turnitin.com>).

Computer-marked multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

Only in case of health lockdowns, 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 at: <https://remoteproctoring.uwo.ca>.

Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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 http://academicsupport.uwo.ca/accessible_education/index.html if you have any questions regarding accommodations.

Learning-skills counsellors at Learning Development and Success (<https://learning.uwo.ca>) 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.

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: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>.

University Accreditation Program – Canadian Institute of Actuaries (CIA)

Honours Specialization in Actuarial Science

If you graduate from Western 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). 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 and you would then be eligible for the CIA Capstone Exam. Taking and passing this exam, along with completing two online modules and a practice education course, would make you eligible to become an ACIA (Associate of the Canadian Institute of Actuaries).

Major in Actuarial Science

If you graduate from Western with a major in Actuarial Science, the CIA accreditation program will not apply to you. If your plan is to become a fully qualified actuary, then you will need to continue to write and pass the preliminary exams of the SOA.

Please see the following link for full details:

<https://www.cia-ica.ca/starting-your-journey/actuarial-education-in-canada/>

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.

<https://www.cia-ica.ca/publications/223159e/>