Western University
Faculty of Engineering
Artificial Intelligence Systems Engineering Program

AISE 3020A – AI: Ethics, Bias, and Privacy

Course Outline Fall 2026

COURSE DESCRIPTION: This course explores fairness, bias, and privacy in machine learning. Students will examine how human bias and data quality affect model outcomes, and learn techniques for building ethical models that balance trade-offs between fairness, accuracy, and privacy. The course covers sources of bias, group fairness in supervised and unsupervised learning, and notions of individually fair predictions, as well as how context (such as decisions made based on predictions) determines. It also addresses privacy risks, differential privacy, federated learning, and the fairness and privacy of generative AI models, equipping students to design machine learning systems that are both effective and responsible.

ACADEMIC CALENDAR: AISE 3020A

https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_030388_1&SelectedCalendar=Live&ArchiveID=

This course explores the fundamental issues of fairness and bias in machine learning. In addition, the course explores many aspects of building ethical models while considering human bias and dataset awareness. Furthermore, the course will explore fundamental concepts involved in privacy and security of machine learning projects. Topics such as how to protect users from privacy violations while building useful transparent predictive models will be explored.

PREREQUISITE: DS 3000A/B

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record.

ANTIREQUISITES: n/a

CEAB ACADEMIC UNITS: n/a

INSTRUCTOR INFORMATION:

Instructor:
Office:
Office hours: TBA
Email:

CONTACT HOURS: Timetable information is available at https:/draftmyschedule.uwo.ca/.

LECTURE:	3 hours/week
LAB:	2hrs / 5 times during the term
TUTORIAL:	n/a

RECOMMENDED/ REQUIRED SOFTWARE: Python 3 installation, Jupyter Notebooks, Visual Studio Code

RECOMMENDED RESOURCES/REFERENCES:

Fairness and Machine Learning: Resources and Opportunities, *Solon Barocas, Moritz Hardt, Arvind Narayanan*. This textbook is available online at the link free of charge; if a hardcopy is desired it costs approximately $90.

Privacy-Preserving Machine Learning, *J. Morris Chang, Di Zhuang, and G. Dumindu Samaraweera*. The cost information for the ebook is available at the link. A used copy is sufficient if available.

Additional materials relevant to specific sections will be posted on OWL with that week's materials.

GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES)

Knowledge Base	D	Engineering Tools		Impact on Society	**I**
Problem Analysis		Individual & Teamwork		Ethics and Equity	**I**
Investigation	I	Communication		Economics and Project Mgmt.	
Design		Professionalism		Life-Long Learning	

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Rating: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e. g. no review).

COURSE MATERIALS: Weekly content will be available on the course OWL site.

UNITS: SI

COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES:

An important aspect of designing artificial intelligence systems is ensuring that bias is accounted for, and that systems are designed in a way that accounts for privacy, fairness, and ethics. This course will cover various topics related to bias, fairness, and privacy, as well as examine trade-offs where desirable objectives are incompatible. Students will develop skills that enable them to translate goals for privacy and fairness into technically-achievable objectives while understanding the limitations of this approach, as well as implement machine learning models that ensure desired objectives are met.

The following table summarizes the course learning outcomes along with CEAB GAIs where the GAIs in bold indicate ones to be measured and reported annually.

Course Topics and Specific Learning Outcomes	**CEAB Graduate Attribute Indicators**
1. Introduction to Fairness and Machine Learning By the end of this section students should be able to: a. Understand the different stages of machine learning modelling where bias can occur (data collection, pre-processing, model development) and where it can be mitigated (pre-processing, in-processing, post-processing). b. Describe the difference between allocative and representational fairness. c. Describe, in mathematical terms and in language, different concepts of group fairness and individual fairness and assess whether each conception of fairness is met by a given model. d. Identify incompatible notions of fairness and describe trade-offs between different definitions.	EE2, IESE1
2. Sources of Bias By the end of this section students should be able to: a. Identify sources of bias in data used to train machine learning models such as labelling bias, representation bias, and measurement bias. b. Identify how model choice affects fairness, and explain trade-offs of different models given particular classification tasks and data. c. Identify and describe feedback loops resulting from model outputs.	EE2, I3

3. Fair Classification By the end of this section, students should be able to: a. Recognize when data quality or balance results in biased models, and be able to apply pre-processing techniques such as resampling. b. Train classifiers that include group or individual fairness constraints and recognize any trade-offs with accuracy as well as computation time. c. Apply and recognize the advantages and disadvantages of post-processing techniques (such as group-specific thresholds) for group fairness.	KB4, I1
4. Fair Predictions vs Fair Decisions By the end of this section, students should be able to: a. Explain the difference between "learning to predict" and "learning to decide" and understand when ignoring the final use of a prediction can result in suboptimal outcomes (e.g., problems with missing labels). b. Explain how different types of decisions (such as ranking tasks) amplify errors in predictions.	KB4, I1
5. **Fair Unsupervised Learning** By the end of this section, students should be able to: a. Explain and implement a model for fair clustering. b. Describe and implement fairlets. c. Compare approaches to resolving biased representations (such as word embeddings) learned from large datasets.	EE2, KB4, I1
6. Causal Models and Counterfactual Fairness By the end of this section, students should be able to: a. Explain the limitations of observational fairness metrics in capturing individual-level discrimination. b. Construct simple causal models and identify paths that potentially represent unfair influence. c. Understand and apply the definition of counterfactual fairness and discuss limitations (such as contexts where it requires Pareto-dominated outcomes).	KB4
7. Privacy Implications of Machine Learning Models By the end of this section, students should be able to: a. Explain different types of privacy threats in machine learning models, including membership inference attacks, model inversion, and training data extraction. b. Evaluate the conditions under which ML models leak private information, considering factors such as model overfitting, black-box vs white-box	KB4, I1

models, and data distribution.	
8. Differential Privacy By the end of this section, students should be able to: a. Understand the (ε, δ)-differential privacy model. b. Be able to implement models with differentially private training methods (starting from appropriate libraries), and analyze the impact of privacy parameters on model performance. **c.** Understand trade-offs between privacy budgets and other desired outcomes (accuracy, fairness, transparency) and justify trade-offs for particular settings.	KB4
9. Federated Learning By the end of this section, students should be able to: a. Explain the how federated learning works, including the roles of clients, the central server, and the algorithm to combine models. b. Evaluate the advantages and limitations of federated learning in terms of privacy, model performance, and efficiency. **c.** Be able to run a basic federated learning setup (e.g., PySyft), and assess how the distribution of data between clients affects model training.	KB3, I1
10. Fairness and Privacy in Generative AI Models By the end of this section, students should be able to: a. Identify privacy risks such as training data memorization and prompt-based data leakage. b. Explain how generative AI models can amplify social biases in the training data. c. Critically evaluate common techniques for reducing bias and protecting privacy**.**	EE2, IESE1, KB4

EVALUATION:

Name	**% Worth**	**Assigned**	**Due Date**	**CEAB GAs ASSESSED**
Participation	5%	n/a	n/a	

Labs (Total = 5)	25%	Posted on OWL	Posted on OWL	KB3, KB4, I1, I3
Mid-Term Examination	30%		Oct 28	KB3, KB4, I3
Final Examination	40%		TBA	KB3, KB4, I3

Note that the dates listed above are **tentative** and may be adjusted if needed. Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness.

COURSE POLICIES:
All work submitted must be of professional quality in the requested format. Material that is handed in illegible, disorganized, or in an unapproved format will be returned to the student for resubmission and the late submission penalty will take effect. Any penalty of 10% may be deducted for poor grammar, incoherence, or lack of flow in any written questions.

PARTICIPATION: 5% of the course grade will come from iClicker questions/polls throughout lectures, and from in-class activities (marked only for completion). A full participation grade will be given to students who receive 85% of the available participation points. For individual absences, consideration will not be granted because of this flexibility. For longer illnesses or justified absences, please reach out to the instructor.

GENERATIVE AI POLICY: Generative AI may be used for the coding portions of assignments, but how it was used and any changes made must be documented (in the notebooks for labs). Written questions associated with lab should be answered in your own words.

LABORATORIES: There will be 5 lab assignments. Attendance at all laboratory sessions is mandatory. Absence from any session, or a portion of a session, without permission will result in a zero assigned to the corresponding assignment. Students who arrive 20 min after the scheduled lab time without a legitimate reason, leave the lab early without permission from the teaching assistant, or miss the lab without a legitimate reason will receive a zero for the corresponding laboratory assignment. Students who miss a lab with academic consideration are required to contact the course instructor within 3 days for further instructions. Failure to do so will result in a zero mark for that lab.

MIDTERM EXAMINATION: There will be one midterm test, which will be a closed-book exam (no reference materials allowed) and will last for 120 minutes. Calculators are not permitted. If a student misses the midterm, the exam will not be rescheduled. Instead, the weight of the midterm will be added to the final exam, making the final exam worth 70% of the overall grade. If no valid justification is provided for missing the midterm, the student will receive a mark of zero for the test.

FINAL EXAMINATION: The final exam will take place during the regular examination period. The final exam will be three hours long, closed book. Only a basic, non-programmable calculator is allowed.

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark < 50% will result in a final course grade of 48% or less. If the above conditions are not met, your final grade cannot be greater than 48%. Students who have failed this course (i.e., final average < 50%) must repeat all components of the course.

LATE SUBMISSION POLICY:

All lab assignments will be penalized by 20% of the available marks per day for late submission. Assignments submitted more than 5 days late will not be accepted.

This course has 4 labs with only the best 4/5 labs counted towards your final grade. If students miss one lab, the remaining 4 labs will be used in the calculation of the final grade. If students miss greater than 1 lab, they will receive a grade of zero on each missed lab. Because of this, academic consideration will be granted in exceptional circumstances only. See https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html if more than one lab must be missed.

ATTENDANCE: Attendance is mandatory for all labs.

FACULTY OF ENGINEERING POLICIES:
Students must familiarize themselves with the policies of the Faculty of Engineering https://www.eng.uwo.ca/electrical/pdf/2024-UG-BOILERPLATE-OUTLINES.pdf

Faculty of Engineering Policies and Procedures-Undergraduate

Absence/Late Accommodation Policy

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.

Students missing a test/assignment/lab or examination will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.

- All requests for Academic Consideration must be made within 48 hours after the

assessment date or submission deadline. Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements.

- An instructor may deny academic consideration for any assessment that is not required in the calculation of the final grade (e.g., "8 of 10 quizzes"). Assessment flexibility must be indicated on the course outline.

- An instructor may deny academic consideration relating to the timeframe submission of work where there is already flexibility in the submission timeframe (e.g., 72-hour submission window). This assessment flexibility must be indicated on the course outline.

- All Academic Consideration requests 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 per course. Some assessments are excluded from this policy. Please refer to the course outline to determine if documentation isrequired.

- Requests without supporting documentation are limited to one per term per course.

- Please note that examinations scheduled during official examination periods always require official supporting documentation.

- If a student mistakenly submits their one allowed Academic Consideration request without supporting documentation for the assessments listed above that do not require academic consideration, the request cannot be recalled and reapplied. This privilege is forfeited.

An undocumented absence is only valid for a 24-hour period, from midnight on the day specified to midnight of the following day. An appropriate use of an undocumented absence would be for an in-class assessment that takes place that day. Where the time given to complete the assessment is longer than 24 hours, an undocumented absence will not cover a student for the full time given to complete the assessment, and flexibility considerations in submitting the assessment will override the undocumented absence.

NOTE: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

It is the student's responsibility to check the date, time and location of the Special Examination.

Religious Accommodation

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or
(b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

Academic Integrity

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

Academic Offences

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.
Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on 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). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Faculty of Engineering AI Policy

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. Please refer to the course outline for the GenAI policy related to each course.

GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

Accessibility

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-

related resources available at Western.
Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

Inclusivity, Diversity, and Respect

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

I. Health and Well-Being

Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
Gender-Based Violence and Survivor Support - "Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website:
https://www.uwo.ca/health/student_support/survivor_support/gethelp.html To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Important Contacts

Engineering Undergraduate Services
Department of Electrical and Computer Engineering
Office of the Registrar/Student Central

Important Links

- WESTERN ACADEMICCALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES
- ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS
- UNIVERSITY STUDENTS' COUNCIL (USC) - SERVICES
- IMPORTANT DATES AND DEADLINES
- ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS

- ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS
- SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS
- STUDENT FORMS
- OFFICE OF THE REGISTRAR
- RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES (SYLLABI)
- ACADEMIC APPEALS
- STUDENT ABSENCE PORTAL