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**Topics in Artificial Intelligence**

**COMP-4475 WA**

**Instructor Information:**

Instructor: Dr. Saad Bin Ahmed

Office Location: AT5020

E-mail: sbinahm@lakeheadu.ca

Office Hours: Thursday 11:00am - 1:00pm

**Teaching Assistant:** To be defined

**TA Email:** To be defined

**Course Identification:**

Course Number: COMP-4475 WA

Course Name: Topics in Artificial Intelligence

Course Delivery: Lectures, MyCourseLink/D2L

Room and Time: RB 1044, M/W 10:00 AM - 11:30 AM

Final Date to Withdraw (Drop): Friday, March 8, 2024

Final Day of Classes: Tuesday, April 9, 2024

Winter Study Week: February 19 to 23, 2024

**Attendance and participation lectures are highly recommended!**

**Description:**

"Topics in AI" is an advanced course designed to delve into cutting-edge areas within the field of Artificial Intelligence (AI). The course explores a diverse range of subjects, including but not limited to machine learning, natural language processing, computer vision, reinforcement learning, and ethics in AI. Students will gain a deep understanding of the latest advancements, emerging trends, and theoretical foundations that shape the landscape of AI research and development. Through a combination of lectures, hands-on projects, and discussions, participants will not only enhance their technical skills but also critically analyze the societal implications and ethical considerations associated with the rapid evolution of AI. This course provides a unique opportunity for students to engage with the forefront of AI knowledge, preparing them to contribute to and navigate the dynamic and multifaceted world of artificial intelligence.

**Course Learning Objectives:**

Upon successful completion of the "Topics in AI" course, students should demonstrate the following learning outcomes:

* Define and explain fundamental concepts in artificial intelligence, including machine learning, natural language processing, computer vision, and expert systems.
* Apply machine learning models to solve real-world problems, understand the principles behind model training and evaluation, and assess the suitability of different algorithms for specific tasks.
* Explore and discuss ethical considerations and implications associated with the development and deployment of AI technologies, including issues related to bias, transparency, and accountability.
* Analyze case studies and examples to understand how AI is being applied in various industries, and evaluate the potential impact on business processes and decision-making.
* Engage in hands-on projects or assignments that involve designing and implementing AI solutions, allowing students to apply theoretical knowledge to practical scenarios.
* Develop critical thinking skills to assess and solve complex problems using AI techniques, and understand the limitations and challenges associated with different approaches.
* Effectively communicate AI concepts, both in written and oral formats, demonstrating the ability to explain complex technical ideas to a non-technical audience.

**Suggested Text Resource:**

* **Artificial Intelligence A Modern Approach,** 4th edition, Stuart Russell & Peter Norvig, Published by Pearson (July 14, 2021) © 2012 Anany Levitin Villanova University

| **Weeks** | **Topics to cover** |
| --- | --- |
| Week 1 | Introduction to AI, The Foundations of AI, The History of AI and State of the art  |
| Week 2 | Intelligent Agents, Agents and Environment, The concept of Rationality, The nature of Environments, The Structure of Agents, Problem Solving  |
| Week 3 | Problem-Solving Agents, Example Problems, Search Algorithm, Uninformed Search Strategies, Informed (Heuristics) Search Strategies, Heuristic Functions,  |
| Week 4 | Search in Complex Environment, Local Search and Optimization Problems, Local Search in Continuous Spaces, Search with non-deterministic Actions, Search in Partially Observable Environment,  |
| Week 5  | Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems,  |
| Week 6 | Break (Fall Reading Week) |
| Week 7 | First Order Logic, Syntax and Semantics of First Order Logic, Knowledge Engineering in First Order Logic, Inference in First Order Logic, Proportional Vs First order inference, Unification and First order Inference, Forward Chaining and Backward Chaining, Resolution |
| Week 8 | Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic,  |
| Week 9 | Learning From Examples, Forms of Learning, Supervised Learning, Learning Decision Trees, Model Selection and Optimization, The Theory of Learning, Linear Regression and Classification, Non-Parametric Models, Ensemble Learning |
| Week 10 | Deep Learning, Simple Feed Forward Networks, Computation Graphs for DL, Convolutional Network, Learning Algorithms, Generalization, Recurrent Neural Networks, Unsupervised Learning and Transfer Learning  |
| Week 11 | Reinforcement Learning, Learning from Rewards, Passive Reinforcement Learning, Active Reinforcement Learning, Policy Search |
| Week 12 | Natural Language Processing, Language Models, Grammar, Parsing, Augmented Grammars, Complications of Real Natural Language, Natural Language Tasks |
| Week 13 | Computer Vision, Image Formation, Simple Image Features, Classifying Images, Detecting Objects  |

**Assignments and Evaluations:**

Students taking this course must understand and agree that:

(1) Unless otherwise allowed by the course instructor, students must complete the assignments in this course without the assistance of anyone else.

(2) Unless otherwise allowed by the course instructor, students must not access any sources or materials (in print, online, or in any other way) to complete any course exam.

**Academic Integrity:**

Students must further understand and agree that, if they violate either of these two rules, or if

they provide any false or misleading information about their completion of course assignments

or exams, they may be prosecuted under the Lakehead University Student Code of Conduct –

Academic Integrity, which requires students to act ethically and with integrity in academic

matters and to demonstrate behaviors that support the University’s academic values.

***Assignments:*** There is **Zero-Tolerance** for plagiarism cases. All such cases will be dealt with according to University prescribed rules. All assignments are individual. Students should understand that their assignments must go through a similarity check and if there is similarity detected then **ZERO** mark will be awarded to those students involved in copying.

***Late Assignments:*** Late assignments will automatically receive a **ZERO** however they will be

reviewed to provide formative evaluation feedback and must be submitted for course

Completion.

**Evaluation Map**

Following are the evaluation strategies and their percentage in their final Grades will be based on:

* 4 assignments (worth 5% each)
* 3 quizzes (each worth 5%, quiz day will be announced via D2L link one week ahead.)
* a midterm exam, worth 20% of the final mark
* a final exam, worth 45% of the final mark

***Important Note:***

**To be graded for this course each student is required to appear in the MidTerm and Final exam, otherwise your marks will be capped.**

**Mid-Term and Its Accommodation.**

* There will be **no makeup Midterm Exam**, except for students requesting a Special Midterm Exam for **religious reasons.** These students must have notified the course instructor and filed documentation with their Dean’s office at least 2 weeks prior to the Midterm Exam.
* If you miss the Midterm Exam for any other reason, and present valid documentation to the SAS, your Final Exam mark will be re-weighted to include the weight of the Midterm Exam.
* There is no negotiation on the prescribed rule for the Midterm exam.

**Schedule**(tentative, some of the dates might change) All assignments are due on D2L course link at 23:55 pm on the date indicated.

* Assignment 1 due on February 8.
* Assignment 2 due on February 27.
* Assignment 3 due on March 21.
* Assignment 4 due on April 5.

A 120 minutes midterm exam on February 28 from 10:00am to 12:00pm. (Tentative)

A 3-hour final exam will be scheduled by the Registrar’s Office.

**Course Policies:**

* Behavioral standards to follow: Student Code of Conduct - Academic Integrity
* Attendance and participation in class discussions is highly recommended.
* Students can communicate with the instructor through email using the **COMP-4475** - as a prefix in the subject line of their message.
* The course outline and schedule are not fixed and subject to change based on class flow.
* A passing mark is normally 50% of the total weight of all components.
* University’s attendance policy is followed.
* There will be 4 assignments. The late penalty for assignments is [2.5^i] (2.5 to the i-th power, rounded to the nearest integer), where i>0 is the number of days you are late. So, if you hand-in your assignment 1 day late, you will be penalized 3%, a delay of 2 days will decrease your grade by 6%, 3 days is penalized 16% and 4 days takes 39% off your grade. You cannot be more than 4 days late, Extensions will be granted only by the course instructor. If you have serious medical or compassionate grounds for an extension, you should take supporting documentation to the office of the Dean of your faculty, who will contact the instructor.
* Assignments and time will be posted on MyCourseLink/D2L and announced via emails to all registered students.
* There will be 3 quizzes. Quizzes’ date and time will be announced in advance.

**Copyright:**

Students should be aware that all instructional, reference, and administrative materials prepared for this course are protected in their entirety by copyright. Students are expected to comply with this copyright by only accessing and using the course materials for personal educational use related to the course, and that the materials cannot be shared in any way, without the written authorization of the course instructor. If this copyright is infringed in any way, students may be prosecuted under the Lakehead University Student Code of Conduct – Academic Integrity, which requires students to act ethically and with integrity in academic matters and to demonstrate behaviors that support the University’s academic values.

**Regulations:**

It is the responsibility of each student registered at Lakehead University to be familiar with, and comply with all the terms, requirements, regulations, policies and conditions in the Lakehead University Academic Calendar. This includes, but is not limited to, Academic Program Requirements, Academic Schedule of Dates, University and Faculty/School Policies and Regulations and the Fees and Refund Policies and Schedules (Lakehead University Regulations webpage, 2023-24).

**Academic Integrity:**

A breach of Academic Integrity is a serious offense. The principle of Academic Integrity, particularly of doing one’s own work, documenting properly (including use of quotation marks, appropriate paraphrasing and referencing/citation), collaborating appropriately, and avoiding misrepresentation, is a core principle in university study. Students should view the Student Code of Conduct - Academic Integrity for a full description of academic offenses, procedures when Academic Integrity breaches are suspected and sanctions for breaches of Academic Integrity.

**Support for Students:**

There are many resources available to support students. These include but are not limited to:

● [Health and Wellness](https://www.lakeheadu.ca/students)

● [Student Success Centre](https://www.lakeheadu.ca/students/academic-success/student-success-centre)

● [Student Accessibility Centre](https://www.lakeheadu.ca/students/student-life/student-services/accessibility/)

● [Library](https://library.lakeheadu.ca/)

● [Lakehead International](https://www.lakeheadu.ca/international)

● [Indigenous Initiatives](https://www.lakeheadu.ca/indigenous)

Lakehead University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities and/or medical conditions to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Accessibility Services (SAS)

and register as early as possible. For more information, please contact Student Accessibility Services (SC0003, 343-8047 or sas@lakeheadu.ca