GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

COMP 472
Artificial Intelligence
Department of Computer Science and Software Engineering
Winter 2024

Course Instructor: Dr. René Witte, Associate Professor
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Office Hours:
Every Thursday, 16:00-17:00, in ER 933 (starting Week 2).
Online meetings (via Zoom) can also be scheduled on-demand via Moodle.
You can also reach me on Moodle chat (works best for short, quick questions).

Labs: Please see your class schedule for details
Lab Demonstrators:
Ms. Alejandra Zambrano
Mr. Amin Karimi
Mr. Farzad Salajegheh

Course Calendar Description:
This course initially describes the scope and history of Artificial Intelligence. Then it covers knowledge representation, heuristic search, game playing and planning. Finally, it introduces the topics of machine learning, genetic algorithms and natural language processing. A project is required.

Component(s): Lecture 3 hours per week; Laboratory 2 hours per week

Prerequisites: COMP 352 or COEN 352
Co-requisites: n/a

Specific Knowledge and Skills Needed for this Course:
To succeed in this course, you will need specific skills and knowledge in the following areas:

Programming Skills:

- **Python**: Proficiency in general programming using Python is essential for lab sessions and the course project. A brief introduction to Python will be provided during the first lab session, but pre-existing familiarity is strongly recommended.

Mathematical Foundations:

- **Probability Theory**: A strong understanding of probability is needed, particularly for topics involving machine learning and decision-making algorithms.

- **Linear Algebra**: Concepts from linear algebra will be utilized frequently, especially in machine learning and neural network modules.

If you find yourself lacking in any of these areas, you are strongly encouraged to review these topics before the DNE (Did Not Enter) deadline.

Course materials

There is no single textbook that will be used for this course. For each lecture topic, required and recommended readings will be posted as part of the lecture information on Moodle. Generally, these readings will be available online or as an electronic resource through the Concordia Library.

Grading Scheme

Your grade will be based on exams and a team project (split into multiple submissions). The grading distribution of these deliverables is as follows:

35%	Course Project (team work, split into 3 submissions)
15%	Midterm Exam
50%	Final Exam

Letter grades for this course will be assigned based on a curve, which means they will be determined in relation to the overall class performance. There is no predetermined scale for converting percentages to letter grades, but the curve ensures that grading is fair and accounts for the performance of all students. To **pass the course**, you must achieve at least 50% of the total possible marks.

If your final exam grade (expressed as a percentage) is higher than your midterm exam grade, the midterm exam will be excluded from the calculation of your overall course grade. In this case, the final exam will make up 65% of your overall grade. However, this only applies if you have completed the midterm exam.

Should you fail to write the midterm exam ***and*** you have valid justification (e.g., doctor's note) then the weight of the missed midterm will be added to the final exam.

Note: It is your responsibility to adhere to the ***university's code of conduct*** as detailed in the calendar. All students must read and sign the Expectations of Originality form and submit the signed copy with their project deliverables.

Tentative Course Schedule

(Week 1) Introduction to AI: Overview & History
(Week 2) State-Space Search: Uninformed & Heuristic Search
(Week 3) Introduction to Machine Learning (ML), Naïve Bayes Classifier
(Week 4) ML: Decision Trees, Evaluation & Unsupervised Learning
(Week 5) Introduction to Artificial Neural Networks (ANN)
(Week 6) Introduction to Deep Learning, Convolutional Neural Networks (CNNs)
Mid-term break: February 25-March 2
(Week 7) *Midterm exam* (tentative!)
(Week 8) Knowledge Graphs & Intelligent Agents (I)
(Week 9) Knowledge Graphs & Intelligent Agents (II)

(Week 10) Introduction to Natural Language Processing (NLP)
(Week 11) Deep Learning for NLP
(Week 12) Transformers for NLP, Conclusions
Examination period: April 18-May 1 (date of final exam tbd)

A more detailed week-by-week breakdown, as well as additional information for each topic, will be available on the Moodle web site.

Lab Details
Beginning in Week 2, weekly lab sessions are an obligatory part of this course and will take place in-person and on campus. Make sure to attend the specific lab section for which you are registered.

Before each lab, it is essential that you review the previous week's lecture material, complete any assigned readings, and review the corresponding lecture worksheet. While the lectures focus on theoretical concepts and algorithms, the labs introduce new programming content not covered in the lectures. These sessions offer hands-on experience with practical applications through various AI libraries and toolkits, such as Python's *scikit-learn* and *PyTorch*.

In summary, the lectures and labs are designed to work in tandem, offering a comprehensive understanding of AI by merging theoretical foundations with practical coding skills.

Active Learning
Starting with the second lecture on *Search*, we will use *Active Learning* concepts in this course. Active Learning involves engaging with the material, classmates, and instructor in a more interactive way than simply listening to a lecture. In particular, worksheets will be distributed containing mini-exercises that you will solve in teams of two during practise sessions that last a few minutes each. The reasons for using active learning include:

- **Enhanced Retention**: Research shows you remember more when you actively engage with material.
- **Immediate Feedback**: Worksheets and pair discussions allow you to instantly clarify doubts and reinforce understanding.
- **Peer Learning**: Working with classmates exposes you to different perspectives and problem-solving approaches.

If you have never taken a class using active learning, you might have concerns like the following:

- **Feeling Shy?**: No worries! Active learning tasks are designed to be non-judgmental spaces for exploration. You won't be put "on the spot" in front of the class.
- **Don't Want to Interact?**: While collaboration is encouraged, the primary focus is on deepening your own understanding. Active learning can be a personal process too.

Course Learning Outcomes (CLOs):
By the end of this semester, students are expected to master the following skills and areas of knowledge:

Critical Analysis: Ability to critically analyze different AI algorithms, evaluating their appropriateness for various applications.

Data Interpretation: Develop skills in preprocessing and interpreting large datasets, making them suitable for AI and machine learning models.

Algorithm Implementation: Gain hands-on experience in implementing, testing, and debugging algorithms in a popular programming environment like Python.

Model Evaluation: Acquire the knowledge and skills to evaluate the performance of different AI and machine learning models using various metrics.

AI System Design: Ability to design simple AI systems that incorporate elements of machine learning, natural language processing, and/or deep learning algorithms.

Collaboration Skills: Gain experience in collaborative problem-solving and project development, through the team project and lab sessions.

Comparative Analysis: Learn to compare and contrast the strengths and weaknesses of various AI and machine learning approaches in different settings.

Application to Real-World Problems: Gain the ability to apply theoretical concepts in AI to real-world scenarios, appreciating the complexities and constraints of actual implementations.

Health and Safety Guidelines
General health and safety instructions and available health and safety trainings can be found at: Safety Programs - Concordia University (https://www.concordia.ca/campus-life/safety/general-safety.html)

On Campus Resources
Please visit Student services at Concordia University (https://www.concordia.ca/ginacody/students/services.html) for the services available to Gina Cody School students.