

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
Department of Computer Science

Computer Science 6980
Special Topics in Artificial Intelligence

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Course Website: <https://www.cs.mun.ca/~dchurchill/courses/3200>
(most course activity will take place on D2L)

Course Objectives:

This course is an introduction to Artificial Intelligence (AI), covering algorithmic techniques and data structures used in modern problem-solving environments. Each topic will have a related assignment where the learned techniques are applied to simple games.

Course Outline:

- Introduction to Artificial Intelligence
 - What is AI? What can Modern AI do?
 - Games as a Testing Environment for AI
 - Agents, Environments, and Problems
- Search Algorithms
 - Exhaustive Search (BFS / DFS)
 - Heuristic Functions / Incorporating Knowledge
 - Heuristic Search (Best-First Search / A*)
 - Introduction to Game Theory / Nash Equilibrium
 - Adversarial Search (Minimax / Alpha-Beta)
 - Data Structures / Optimizations for Search
- Genetic Algorithms (GA)
 - Introduction to Evolutionary Algorithms
 - GA Representations: (Genotype, Phenotype)
 - GA Implementation: Mutation, Crossover, Selection, Reproduction
- Reinforcement Learning (RL)
 - Introduction to RL: Agent, Environment, Actions, Policies, Rewards
 - Bandit Problems (Exploration vs. Exploitation)
 - Markov Decision Processes
 - Generalized Policy Iteration
 - Monte-Carlo Methods
 - Temporal Difference Learning (SARSA / Q-Learning)
- Neural Networks (NN)
 - Artificial Neurons / NN Structure / Training
 - Brief Introduction to Deep Learning

Textbook: Artificial Intelligence: A Modern Approach (Optional)
Russel & Norvig

Reinforcement Learning: An Introduction (Free Online)
Sutton & Barto
<http://incompleteideas.net/book/the-book.html>

Format: 2 lectures per week on Tuesday / Thursday (80 minutes each)

Evaluation:

The evaluation structure of the course is as follows:

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|--------------------------|---------------|---------------------|
| • Assignments | | 50% (≤ 2 Per Group) |
| ○ Intro to JS + BFS/ DFS | (Programming) | |
| ○ A* Search Pathfinding | (Programming) | |
| ○ Minimax + Alpha-Beta | (Programming) | |
| ○ Genetic Algorithm | (Programming) | |
| ○ Reinforcement Learning | (Programming) | |
| • Midterm Exam | (Written) | 10% (Solo) |
| • Final Exam | (Written) | 20% (Solo) |
| • Final Project | (Programming) | 20% (Solo) |

Note: Due the group work nature of this course, to effectively show that you have individually learned the material, you must pass the final exam to pass the course. If your grade on the final exam is less than 50%, then your overall course grade will be equal to the mark that you received on the final exam. If your final exam grade is greater than or equal to 50%, your course grade is determined by the scheme above.

Memorial University Policies:

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www.mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.

Differences from COMP 3200 (undergrad):

This course will be taught along with the undergraduate course COMP 3200, and therefore will cover many of the same topics as that course. In order to differentiate it from COMP 3200, there will be several differences which assign extra reading / work to graduate students, in order to further their learning beyond that of the undergraduate course.

- Graduate students will be assigned extra reading for advanced topics
- This course will have a project requirement, unlike 3200
- This course will have a more difficult final exam from 3200
- Assignments will have bonus material for graduate students