Syllabus

Artificial Intelligence Algorithms – Fall 2024

Scope

Representation and space search; heuristic search; predicate calculus; knowledge representation and knowledge engineering for expert systems; rule-based, hybrid, and O-O systems; semantic nets, frames, and natural language; theorem provers; planning, learning, neural nets; use of AI languages. Knowledge representation and reasoning, propositional logic and predicate calculus. Logic programming; search, game trees, backtracking; planning.

Prerequisites

4511: CSCI 3212
6511: CSCI 6212

Course Learning Outcomes

1. Demonstrate theoretical understanding of the design of decision-making software agents
2. Describe tractability of decision-making algorithms
3. Express decision problems as probability (Markov) models
4. Implement decision-making agents for solving problems in continuous and discrete state spaces

Required Textbook

Stuart J. Russell and Peter Norvig. *Artificial Intelligence : A Modern Approach.* 4th edition, Pearson, 2020.[1]

Supplemental Textbooks

Mykel J. Kochenderfer, Tim A. Wheeler, and Kyle H. Wray. *Algorithms for Decision Making* MIT Press, 2022

Richard S. Sutton and Andrew G. Barto. *Reinforcement Learning: An Introduction* MIT Press, 2018

[1] Several copes of this book will be on hold at the GWU Library. The international edition, which is much cheaper than the US edition, has the same contents.

Instructor

- Prof. Joseph Goldfrank joe.goldfrank@gwu.edu

Office Hours

M/W/F Afternoons: Detailed Schedule

Grading Server & Autograding

This course will use the GWU Computer Science grading and submission server. Coding assignments will be autograded with multiple submissions attmpts permitted for full credit. You will receive test cases to run your code against at home.

Schedule

Readings are from Russel & Norvig unless otherwise noted.

Date	Subject	Reading	Assessments
28 Aug	Rational Agents & State	Ch. 2	HW 0 (1 Sep)
4 Sep	Search & Heuristics	Ch. 3, 4	
11 Sep	Games	Ch. 5	HW 1 (15 Sep)
18 Sep	Logic	Ch. 6, 7	
25 Sep	Probability	Ch. 12	HW 2 (29 Sep)
2 Oct	Bayesian Networks	Ch. 13	
9 Oct	Markov Models & Exam Review	Ch. 14	
16 Oct	**Midterm Examination**		HW 3 (13 Oct)
23 Oct	Utility Theory & Decision Networks	Ch. 16	
30 Oct	Markov Decision Processes	Ch. 17	
6 Nov	Partially-Observable MDPs	Kochenderfer Ch. 20	HW 4 (3 Nov)
13 Nov	Reinforcement Learning	Ch. 22	
20 Nov	Deep Reinforcement Learning & Exam Review		Project Scope (24 Nov)
27 Nov	**Thanksgiving Break**		
4 Dec	**Final Examination**		
13 Dec			Final Project Due

- The final exam date is determined by the school.
- This schedule of topics is approximate and I may deviate from it. No homework assignment will be released with fewer than two weeks' time to complete it.

Examinations & Assessments

There will be four homework assignments, one project, one midterm exam, and one final exam. You must acknowledge the schedule of deliverables and agree to be present for both exams as part of the first homework assignment.

There may be extra credit opportunities in addition to what is listed here, some of which will be offered during class meetings. Any work you turn in for credit may be present on examinations.

Grading

> Grading in this course reflects that the only way to learn is by *doing*, and recognizes that this process includes many mistakes and errors. If you do the work and learn the material, you will earn a good grade at the end of the semester.

- The final exam grade replaces the midterm exam grade, if the final exam grade is higher
- The lowest homework is weighted 50% (i.e., it will be worth less than the other homework assignments).

Grading Scale

A numerical average will be calculated as follows:

- Homework: 35%
- Project: 15%
- Exams: 50%

The following grading scale will be applied at the end of the semester to calculate letter grades:

Numerical Average	Letter Grade
90-100	A
85-89	A-
80-84	B+
75-79	B
70-74	B-
65-69	C+
60-64	C
55-59	C-
45-54	D
0-44	F

Grades are rounded to the nearest integer, e.g., 0.4 rounds to 0 and 0.5 rounds to 1.

Conduct

Credit (up to 10% of your final grade) for can be lost for actions that disrespect other students, such as being disruptive in class, asking for complete solutions during office hours, or requesting grading accommodations other than those outlined in this syllabus.

The environment of this class will be respectful of age, race, ethnicity, country of origin, language, religion, spiritual practice, sexual orientation, gender identity or expression, introversion/extroversion personality dimensions, and socioeconomic and mental/physical status. I am committed to supporting all members of the class in fostering a respectful, charitable, and professional academic environment. You must also do your part to make this course inclusive.

Late Work

Late work is not accepted, with the following exceptions:

1. Each student will have eight "late days" to use on homework assignments. No more than three days can be used on any one assignment. These late days intentionally accommodate both time management difficulties and brief illnesses. We recommend saving a few late days for brief unexpected disruptions in your schedule.
2. Extensions will be granted should there arise circumstances beyond your control that substantially impede your ability to complete coursework. Notify me as soon as feasible in these cases. Examples of such circumstances include (but are not limited to) long-term illness and loss of housing. I will request documentation of such circumstances through your dean.

Attendance

I do not take attendance, but I strongly encourage you to attend. Lectures will not be videorecorded or audiorecorded, but lecture notes will be published. You are responsible for knowing the content of each lecture.

For long-term disruptions in schedule such as serious illness or loss of housing, I will make accommodations after being provided with documentation through the Office of Student Support or from your Dean. For illnesses impacting exams, I will also require such documentation.

Absence to represent GWU in an official capacity (such as at an athletic event) is always excused, however such excused absence will require confirmation from a faculty sponsor or athletic official, and must be arranged in advance.

Time Commitment

There is one 150-minute class meeting per week. Students are expected to spend at least 5 hours per week independently learning outside of class meetings for this course As preparation level for this course varies. It is possible that you will need to commit substantially more– or substantially less– than 5 hours per week.

Collaboration Policy

Write your own solutions to homework assignments by yourself. You must acknowledge any discussions you had with others in your writeup for each homework. Don't share your solutions with others, and don't copy solutions from other people, from websites, or from other sources.

The challenge from this course is largely in understanding how decision-making algorithms work and how/when to apply them to problems. Discussing these concepts with others is always permitted, and is strongly encouraged.

If you feel like a discussion with any person (including the professor) helped you answer a homework problem, include their name(s) in your comments at the start of that problem. In the event your collaboration exceeds what is permitted, penalties will be substantially reduced (or waived) if such a thing is an honest mistake as evidenced by these comments.

If I discover at any point during or after the semester that you have violated the collaboration policy, you will be formally referred to the Office of Student Rights and Responsibilities for Academic Dishonesty. Any assignment failed for reasons of Academic Dishonesty will be graded as *negative 100%* and cannot be dropped. This policy is not a game. Do not attempt to circumvent it.

Stress: If you feel like you are under pressure to violate this policy due to stress, deadlines, or some other situation, please reach out to me. I am committed to making this a course that any adequately-prepared student can pass with honest effort.

Generative Artificial Intelligence / Large Language Models

Copying solutions for homework assignments from an AI assistant or Large Language Model such as (but not limited to) ChatGPT, Copilot, or Claude will be treated the same as copying it from another person or from any other online resource. It is not permitted on any homework assignment, and it is considered cheating.

You Can Search Your Errors

Copying code snippets from Stack Overflow, language documentation, or similar is permitted, however please indicate when you have done this with a comment in your code citing the resource. If you have become accustomed to using LLMs for these searches, I expect you to verify the answers with language/library documentation and cite the documentation.

University Policies

Academic Integrity Code

Academic integrity is an essential part of the educational process, and all members of the GW community take these matters very seriously. As the instructor of record for this course, my role is to provide clear expectations and uphold them in all assessments. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, and otherwise violate the Code of Academic Integrity. If you have any questions about whether or not particular academic practices or resources are permitted, you should ask me for clarification. If you are reported for an academic integrity violation, you should contact the Office of Student Rights and Responsibilities (SRR) to learn more about your rights and options in the process. Consequences can range from failure of assignment to expulsion from the university and may include a transcript notation. For more information, please refer to the SRR website, email rights@gwu.edu, or call 202-994-6757.

University Policy on Observance of Religious Holidays

Students must notify faculty during the first week of the semester in which they are enrolled in the course, or as early as possible, but no later than three weeks prior to the absence, of their intention to be absent from class on their day(s) of religious observance. If the holiday falls within the first three weeks of class, the student must inform faculty in the first week of the semester. For details and policy, see "Religious Holidays" at Provost Policies, Procedures, and Guidelines.

Use of Electronic Course Materials and Class Recordings

Students are encouraged to use electronic course materials, including recorded class sessions, for private personal use in connection with their academic program of study. Electronic course materials and recorded class sessions should not be shared or used for non-course related purposes unless express permission has been granted by the instructor. Students who impermissibly share any electronic course materials are subject to discipline under the Student Code of Conduct. Please contact the instructor if you have questions regarding what constitutes permissible or impermissible use of electronic course materials and/or recorded class sessions. Please contact Disability Support Services at https://disabilitysupport.gwu.edu if you have questions or need assistance in accessing electronic course materials.

Academic Support

Writing Center

GW's Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process. Working alongside

peer mentors, writers develop strategies to write independently in academic and public settings. Appointments can be booked online at https://gwu.mywconline.

Academic Commons

Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions. Students may schedule an appointment, review the tutoring schedule, access other academic support resources, or obtain assistance at https://academiccommons.gwu.edu.

Support for Students Outside the Classroom

Disability Support Services (DSS)

Telephone: 202-994-8250

Any student who may need an accommodation based on the potential impact of a disability should contact Disability Support Services to establish eligibility and to coordinate reasonable accommodations.

Counseling and Psychological Services

Telephone: 202-994-5300

GW's Colonial Health Center offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success.

Safety and Security

- Monitor GW Alerts and Campus Advisories to Stay Informed before and during an emergency event or situation
- **In an emergency: call 911** or GWPD/EMeRG 202-994-6111
- For situation-specific actions: refer to GW's Emergency Response Handbook and Emergency Operations Plan
- In the event of an armed intruder: Run. Hide. Fight.