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CS 670-003: Artificial Intelligence

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Department of Computer Science

CS670 - Artificial Intelligence

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Course Description

This course introduces the fundamentals of artificial intelligence. It contains a theory component about the concepts and principles that underlie modern AI algorithms, and a practice component to relate theoretical principles with practical implementation.

Skills Required: Students are expected to have Strong foundation in mathematics, particularly in calculus, linear algebra, and probability theory. Proficiency in programming languages such as Python or MATLAB, Knowledge of computer science fundamentals, including data structures and algorithms, basic knowledge of statistics is often beneficial for understanding and interpreting the results of AI algorithms. These concepts are fundamental for understanding algorithms and models used in AI.

Course Objective

The objective of this course is to gain understanding of artificial intelligence, formalization of knowledge, reasoning under uncertainty and without it, machine learning, and its applications. The focus will be to learn about major disciplines in artificial intelligence, their fundamental differences and applicability.

Learning Outcomes

1. Identify the foundational concepts, theories, and historical developments in artificial intelligence.
2. Apply various search algorithms and heuristic design techniques independently to solve complex AI problems.
3. Analyze, design, and implement probabilistic models, such as Bayesian networks, for effective decision-making in uncertain environments.
4. Demonstrate proficiency in data preparation and visualization skills while effectively developing practical AI solutions to address real-world problems.
5. Apply machine learning algorithms effectively to analyze and derive insights from real-world datasets.
6. Evaluate ethical considerations and societal impacts associated with the deployment of AI technologies.

7	Critically assess emerging trends and advancements in AI research.
8	Effectively address complex AI-related problems by integrating insights from different disciplines.

Course Contents

Introduction: What is AI, agent, environment and its applications.

Problem solving by Search: principles of search, uninformed ("blind") search, informed ("heuristic") search, constraint satisfaction problems, adversarial search and games.

Knowledge representation and reasoning: rule-based representations, declarative or logical formalisms, Logic Programing and logic network.

Reasoning with Uncertainty: Uncertainty, Probabilistic Models.

Learning: Supervised learning, unsupervised learning, reinforcement learning. Generative discriminative models.

Security: AI Content Authentication

Applications: Discussion of practical cases from various domains.

Conclusions & Review: Final opinion and inference of methods discussed.

Textbook & References

- Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th edition, Prentice Hall, 2020.
- N. Vapnik, The Nature of Statistical Learning Theory, 2nd edition, Springer, 2000.
- Selected papers and handouts.

Grading Policy

- Assignments 30%
- Midterm exam 15%
- Project 30%
- Class participation 5%
- Final exam/ Research Paper 20%

Class Participation	Actively participating in class discussions, asking questions, and contributing insights demonstrate engagement and a deeper understanding of the material.

Mid-Term Exam	The midterm exam serves as a midpoint assessment, focusing on evaluating students' grasp of theoretical understanding and problem-solving skills. It provides insights into individual understanding.
Assignments	Assignments in this course are meticulously designed to assess various dimensions of AI knowledge. They challenge students to demonstrate theoretical understanding, critical thinking, and problem-solving skills. While assignments may involve programming tasks, the emphasis is on applying a broad range of AI concepts to real-world scenarios. Students will showcase their ability to analyze and address complex challenges, fostering a deeper understanding of both theoretical principles and practical applications.
Project	The project component plays a crucial role in assessing individual proficiency in applying AI concepts to real-world scenarios. Each student will independently contribute to addressing significant AI challenges. This showcases their ability to apply learned concepts in practical contexts and highlights their individual skills in problem-solving, critical thinking, and the effective application of AI knowledge.
Final Exam / Research Paper	The **final exam** serves as a comprehensive evaluation encompassing the breadth of the course. It is meticulously crafted to assess students across multiple dimensions of artificial intelligence, ensuring a thorough examination of their knowledge, skills, and critical thinking abilities. **Research Paper** assess students ability to conduct in-depth research, critically analyze AI-related topics, and communicate findings effectively through a research paper. the final submission or publication of research paper is subject to the instructor's approval, ensuring alignment with the desired standards for scholarly work. A student have the flexibility to choose between two assessment options: a Final Exam or a Research Paper.

Guidelines & Policies

Attendance: Attendance will be taken in class. Students are expected to attend the lectures in the section that they are registered in. Lectures are a sequence. If you skip one you will not be able to understand the lecture that follows, if you don't catch up with the one you missed. Catching up lectures is your responsibility and is done in your own time. Instructor has the right to modify the grading criteria to include attendance and class participation when necessary. Cell phones must be turned off during class. During class time you may not play games, text, email, browse the web or engage in other activities that are not part of the class.

Course Communication: Canvas (canvas.njit.edu) will be the platform for posting lecture notes, submitting assignments and engaging in course discussions. **All communication with the instructor and TA should be conducted through NJIT Canvas** or using your NJIT email address. Emails sent from external servers may not be responded to.

Recitation: Attending recitation is an important checkpoint in assuring your grasp of the material being covered and correctly solving assigned problems.

Remake Exams:

- A student can remake either Mid-term Exam or Final Exam.
- Under any circumstances, student will not be allowed to remake both exams.
- *Eligibility:* If a student misses a Mid-term exam/ Final Exam due to a valid, documented reason determined by the dean of students and has informed the instructor beforehand may be eligible for a makeup mid-term exam or Final Exam.
- Requests for remake exams must be submitted before the exam.
- Please note that if remake request is received during or after the Mid-term or Final Exam then there are no makeup Mid-term or Final exams.

Grade Corrections: Check the grades in course work and report errors promptly.

- **Prompt Reporting**: Students who have concerns about their grades should contact both the TA and instructor via NJIT Canvas within three days of receiving the grade.
- **Initial Review:** The TA or instructor will review the student's concerns and provide feedback or clarification as needed.
- **Meeting with the TA**: If the issue is resolved or remains unresolved, the student should schedule a meeting with the TA during their immediate next available office hours for discussion and final review.
- **Timely Resolution:** Grade disputes must be addressed within the specified timeframes. Requests received after these deadlines may not be considered.

Late submission: Homework assignments or projects or any other course related work assigned are expected to be submitted by the specified due date and time. Late submissions will only be considered within a specific window of time, which is up to 5 days after the original due date. For each day an assignment is submitted late, a penalty of 10% of the total possible grade for that assignment will be deducted. This deduction will accumulate for each additional day of late submission. The maximum penalty for late submissions is 50% of the total possible grade for the assignment. After the 5-day late submission window has passed, no further submissions will be accepted. It is the responsibility of the student to manage their time effectively and submit assignments within the specified timeframe.

Exam and Proctoring Policy: All exams will be closed book and closed notes. Each midterm is held during regular class meeting times. The final exam will be given during the time slot assigned by the NJIT Registrar. See the NJIT Online Course Exam Proctoring page for information on proctoring tools and requirements. **You must bring ID to all exams.**

Final Exam/ Research Paper: The final exam will cover a range of topics discussed throughout the course. Alternatively, you have the option to submit a research paper on a relevant AI topic of your choice after approval of the instructor. The research paper should demonstrate in-depth research,

critical analysis, and effective communication of findings. If you choose to submit a Research Paper, you are required to be part of weekly meetings other than lectures, contact your instructor for scheduling. These meetings will provide an opportunity for guidance, feedback, and progress updates. Ensure that your research paper is submitted to a conference or journal at least 2 weeks before the last day of the semester. This is a crucial component of the assessment, and adherence to the deadline is mandatory.

- You will be graded based on the assessment option you choose. The grading criteria for the Final Exam and the Research Paper will be equivalent, ensuring fairness and equity.
- The assessment you choose (either the Final Exam or the Research Paper) will contribute to your final course grade.

Collaboration and External Resources for Assignments: Some homework problems will be challenging. You are advised to first try and solve all the problems on your own. For problems that persist you are welcome to talk to the course assistant or the instructor. You may consult online resources or collaborate with classmates for problem-solving. However, ensure you fully understand the concepts and solutions before submitting your work. Also make sure to give the appropriate credit and citation.

- **Proper Citation:** Always give credit to any external sources or collaborators as reference in your assignments/ project or any homework submitted for evaluation for this course.
- **Original Work:** Assignments should primarily represent your own work and understanding.
- **Plagiarism:** Any instances of plagiarism or academic dishonesty will be taken seriously and may result in disciplinary action.
- **Student Identification:** All submitted assignments must clearly indicate the names and student IDs of all collaborators involved. Failure to do so may be considered academic dishonesty.

Use of Generative AI: This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, **AI usage is not permitted throughout this course under any circumstances.**

Eating and Drinking inside Classroom: To maintain a conducive learning environment, eating and drinking are not permitted in the classroom, except for clear water. Please refrain from consuming food or beverages that may create distractions. You will be given appropriate breaks during the lectures.

Requesting Accommodations: If you need an accommodation due to a disability please contact Scott Janz, Associate Director of the Office of Accessibility Resources and Services, Kupfrian Hall 201 to discuss your specific needs. A Letter of Accommodation Eligibility from the office authorizing student accommodation is required.

NJIT Services for Students, Including Technical Support: Please follow this link.

Canvas Accessibility Statement: Please follow this link.

Academic Integrity: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity CodeLinks to an external site.. Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

Additional Notes:

- The instructor reserves the right to make changes to the course syllabus or policies as needed.
- Students are expected to adhere to the university's guidelines for academic conduct and behavior.