CS610: Advanced Artificial Intelligence

Instructors Information

Ehsan Khosroshahi, PhD
Email:--

Sean Grimes, PhD
Email: spg63@drexel.edu

Department of Computer Science Drexel University
Office Hours: TBD

Student Learning Information

Course Description

This course aims to provide students with a comprehensive understanding of advanced concepts, methodologies, and applications in the field of Artificial Intelligence (AI), including representation, reasoning, and decision-making under uncertainty; probabilistic models; deep learning; generative models; natural language processing (NLP); AI ethics and societal impact; and emerging trends in AI.

College/Department: CCI, Department of Computer Science
Repeat Status: Not repeatable for credit
Prerequisites: (CS 510 [Min Grade: C])

Credits: 3 hours of lecture (3 credits total) ***Course Purpose within a Program of Study***

This graduate-level course is a foundation course for some degree programs (e.g., MS AI/ML) and an elective for other degree programs (e.g., MS CS).

Statement of Expected Learning

The course objectives are to:

- Develop a deep understanding of advanced AI Techniques, including probabilistic models, deep learning, reinforcement learning, and generative models.
- Understand the mathematical and algorithmic foundations underlying these techniques.
- Gain experience in AI tools and frameworks such as TensorFlow, PyTorch, and scikit-learn to implement and optimize AI models.
- Develop the ability to preprocess data, train models, and evaluate their performance effectively through a term group project.
- Assess the performance, limitations, and ethical implications of AI systems, including issues related to bias, fairness, and transparency.
- Engage with the latest research papers, industry trends, and technological advancements in AI.

As learning outcomes, students completing this course should be able to:

- Demonstrate a comprehensive understanding of advanced AI topics, including probabilistic models, deep learning, reinforcement learning, generative models, natural language processing, and AI ethics.
- Utilize state-of-the-art AI tools, frameworks, and libraries (e.g., TensorFlow, PyTorch) to develop scalable and efficient AI solutions.
- Analyze and compare the strengths and limitations of various AI algorithms and architectures.
- Formulate research questions and hypotheses related to emerging AI trends and challenges.
- Conduct literature reviews, design experiments, and present findings in a scholarly manner.
- Work collaboratively on a project to tackle AI-related projects and challenges.
- Communicate complex AI concepts and results effectively to the class through written reports, presentations, and visualizations.
- Stay informed about the latest advancements and trends in AI research and industry.

Course Materials

Required and Recommended Texts, Readings, and Resources

Artificial Intelligence: A Modern Approach, 4th edition (2020) Stuart Russell and Peter Norvig
Prentice-Hall, 2020
ISBN-10: 0134610997
ISBN-13: 978-0134610993
Textbook Website: http://aima.cs.berkeley.edu

We will follow the book fairly closely but not cover all of it. We will cover some topics not in the textbook, in which case supplemental readings will be assigned.

Required and Supplemental Materials and Technologies

None

Assignments, Assessments, and Evaluations

Graded Assignments and Learning Activities

The activities for this course will include active participation in class discussions, a class presentation, and a multi-stage project.

Each student will deliver a presentation, either in-class or online, and facilitate a discussion on one of the special topic readings. Presentations will be conducted individually, and you will be required to share slides that include your analysis and critique of the work, followed by leading a discussion about its context in the course.

The course will include a multi-week group project that combines all aspects of the learned material. The project involves implementing a system and writing a "conference-like" paper describing it. The final week includes a "mini-conference" in which everyone will present their projects and results to the class.

Work submitted after the specified deadline will incur a penalty of 20% per day late. Plagiarism and other academic misconducts will be dealt with seriously: in the case of a violation, the assignment or exam in

question will receive a grade of zero, the student may receive up to one letter grade penalty on their final course grade, and the violation will be reported to the department, college, and university.

Students are responsible for checking Blackboard Learn and Drexel's email daily for course announcements. If they have any questions about a project or assignment, they should email the instructor at least 24 hours before the deadline.

For more details, please refer to the Drexel University Student Handbook.

Grading Matrix

Grades will be assigned based on the following:

- Project: 60%
- Presentation: 30%
- Participation: 10%

Grading Scale

The following scale will be used to convert points to letter grades:

Points	Grade	Points	Grade	Points	Grade
Exceptional	A+	**83-86.99**	B	**70-72.99**	C-
93-100	A	**80-82.99**	B-	**67-69.99**	D+
90-92.99	A-	**77-79.99**	C+	**60-66.99**	D
87-89.99	B+	**73-76.99**	C	**0-59.99**	F

Course Schedule

[This schedule is tentative and may change during the course.]

Week	Notes
1	Introduction MDP
2	Probability Markov models
3	HMMs
4	Bayes Nets
5	Naive Bayes
6	ML -- Advanced Applications (NLP, Games, Cars, Computer Vision, Robotics)
7	ML -- Advanced Applications (NLP, Games, Cars, Computer Vision, Robotics)
8	Reinforcement Learning
9	LLMs – Invited Speaker
10	Bias, Fairness, and Transparency – Invited Speaker
11	Project Presentation

Academic Policies

This course follows university, college, and department policies, including but not limited to:

- Academic Integrity, Plagiarism, Dishonesty and Cheating Policy: https://drexel.edu/provost/policies-calendars/policies/academic-integrity/
- Students with Disability Statement: https://drexel.edu/disability-resources/support-accommodations/student- family-resources/
- Course Add-Drop Policy: https://drexel.edu/provost/policies-calendars/policies/course-add-drop/
- Course Withdrawal Policy: https://drexel.edu/provost/policies-calendars/policies/course-withdrawal/
- CCI Academic Affairs Policies: https://drexel.edu/cci/current-students/policies/
- Drexel Student Learning Priorities: http://drexel.edu/provost/assessment/outcomes/dslp/

The instructor(s) may, at his/her/their discretion, change any part of the course before or during the term, including assignments, grade breakdowns, due dates, and schedule. Such changes will be communicated to students via the course website. This website should be checked regularly and frequently for such changes and announcements.

Students requesting accommodations due to a disability at Drexel University need to request a current Accommodations Verification Letter (AVL) in the ClockWork database before accommodations can be made. These requests are received by Disability Resources (DR), who then issues the AVL to the appropriate contacts. For additional information, visit the DR website at http://drexel.edu/oed/disabilityResources/overview/, or contact DR for more information by phone at 215.895.1401, or by email at disability@drexel.edu.