

ARTIFICIAL INTELLIGENCE (AI)

AI IDEA, LOWER DIVISION ED ABROAD, 1-16 Credits

This course is repeatable for 99 credits.

AI UDEA, UPPER DIVISION ED ABROAD, 1-16 Credits

This course is repeatable for 99 credits.

AI 100, AI FOR EVERYONE, 3 Credits

Explores the basics of artificial intelligence with a non-coding approach suitable for all majors and available to first-year students. Explores AI's history and its wide variety of applications. Examines current AI technologies (such as chatbots based on Generative AI) that are deployed across many fields by explaining how they work at a high level and discussing their limitations. Examines the potential future evolution of AI.

AI 433, INTRODUCTION TO REINFORCEMENT LEARNING, 4 Credits

Introduce key concepts in intelligent decision-making, specifically reinforcement learning. Topics include agent representation, Markov decision process, fundamentals of model-free and model-based decision-making under uncertainty, value iteration, policy iteration, temporal difference methods, actor-critic methods, and imitation learning.

Prerequisite: CS 325 with C or better or CS 325H with C or better

AI 501, RESEARCH, 1-16 Credits

This course is repeatable for 99 credits.

AI 503, THESIS, 1-16 Credits

This course is repeatable for 99 credits.

AI 505, READING AND CONFERENCE, 1-16 Credits

This course is repeatable for 99 credits.

AI 506, PROJECTS, 1-16 Credits

This course is repeatable for 99 credits.

AI 507, SEMINAR, 1-16 Credits

This course is repeatable for 99 credits.

AI 510, OCCUPATIONAL INTERNSHIP, 1-4 Credits

This course is repeatable for 99 credits.

AI 530, BIG IDEAS IN AI, 3 Credits

Introduces the major ideas and subtopics in the field of Artificial Intelligence (AI) including philosophical foundations, heuristic search, optimization, knowledge representation, reasoning under uncertainty, machine learning, computer vision, natural language processing, sequential decision making, and social and ethical issues. Covers the historical context as well as recent advances.

Recommended: Programming ability in a high-level language (such as C++ or Python)

Available via Ecampus

AI 531, AGENTS, SEARCH AND REASONING, 4 Credits

Introduces the topics in Artificial Intelligence through the framework of intelligent agents. Studies different search algorithms for solving combinatorial problems, puzzles and games through implementation and experimentation. Examines the foundations of propositional and first order logics and sound and complete proof procedures for them.

Equivalent to: CS 531

Available via Ecampus

AI 532, CAUSAL INFERENCE FOR AI, 4 Credits

Explores causal inference for Artificial Intelligence and is situated at the intersection of probability, AI, and statistics. Focuses on answering causal and counterfactual queries using causal Bayesian networks and applying causal inference techniques to problems in AI and Machine Learning. Includes causal effect identification, causal discovery algorithms, and addressing challenges such as missing data, selection bias, and interference.

Recommended: An introductory course to probability and statistics including random variables (e.g., ECE 351, ST 421)

AI 533, INTELLIGENT AGENTS AND DECISION MAKING, 4 Credits

Representations of agents, execution architectures. Planning: non-linear planning, graphplan, SATplan. Scheduling and resource management. Probabilistic agents. Dynamic belief networks. Dynamic programming (value iteration and policy iteration). Reinforcement learning: Prioritized sweeping, Q learning, value function approximation and SARSA (λ), policy gradient methods.

Equivalent to: CS 533

Recommended: CS 531 or AI 531

AI 534, MACHINE LEARNING, 4 Credits

Continuous representations. Bias-variance tradeoff. Computational learning theory. Gaussian probabilistic models. Linear discriminants. Support vector machines. Neural networks. Ensemble methods. Feature extraction and dimensionality reduction methods. Factor analysis. Principle component analysis. Independent component analysis. Cost-sensitive learning.

Equivalent to: CS 534

Available via Ecampus

AI 535, DEEP LEARNING, 4 Credits

An introduction to the concepts and algorithms in deep learning; basic feedforward neural networks, convolutional neural networks, recurrent neural networks including long short-term memory models, deep belief nets, autoencoders and deep networks applications in computer vision, natural language processing and reinforcement learning.

Prerequisite: CS 534 with C or better or AI 534 with C or better or ROB 537 with C or better

Equivalent to: CS 535

AI 536, PROBABILISTIC GRAPHICAL MODELS, 4 Credits

Representation of probabilistic graphical models, both directed (Bayesian networks) and undirected (Markov networks). Exact and approximate inference techniques. Parameter and structure learning from data.

Equivalent to: CS 536

Recommended: Strong programming skills

AI 537, COMPUTER VISION I, 3 Credits

An introduction to low-level computer vision and visual geometry. Topics of interest include the following: detection of interest points and edges, matching points and edges, color models, projective geometry, camera calibration, epipolar geometry, homography, image stitching, and multitarget tracking.

Equivalent to: CS 537

Recommended: Undergraduate-level statistics, probability, calculus, linear algebra, good programming skills, machine learning or AI

AI 538, STATISTICAL NATURAL LANGUAGE PROCESSING, 4 Credits

Explores computational methods to study human languages. Emphasizes statistical models of language (finite-state models, n-gram language models, noisy-channel models, Hidden Markov Models, Context Free Grammars), decoding algorithms (Viterbi, Forward-Backward, CKY), and machine learning methods (maximum likelihood and expectation-maximization).

Prerequisite: AI 534 with C or better or CS 534 with C or better

AI 539, SELECTED TOPICS IN ARTIFICIAL INTELLIGENCE, 0-5 Credits

This course is repeatable for 99 credits.

AI 541, MACHINE LEARNING CHALLENGES IN THE REAL WORLD, 4 Credits

Explores the challenges that machine learning systems face when they move from the laboratory into the real world. Topics include thorny (but common) obstacles such as missing values, correlated data, concept/domain shift, evaluation, explainability, and more. Provides the opportunity for students to apply these concepts and strategies on a data set of their choice.

Prerequisite: AI 534 with C or better or CS 534 with C or better

AI 542, INFORMATION RETRIEVAL, 4 Credits

Introduces the foundations and advanced techniques of Information Retrieval (IR). Emphasizes the design and implementation of text-based information systems such as search engines and recommender systems. Covers topics including text processing and indexing, query understanding, (large) language models, learning to rank, evaluation and user models, recommendation and personalization, conversational system, and neural models for IR.

Recommended: CS 434, AI 534, or equivalent machine learning courses

AI 543, FOUNDATIONS OF ONLINE MACHINE LEARNING, 4 Credits

Introduces the foundations of online learning algorithms. Explores algorithms for online convex optimization and bandits, theoretically analyzes their performance, and discusses their applications in real-world machine learning problems.

Prerequisite: AI 534 with C or better or CS 534 with C or better

AI 567, STATISTICAL MACHINE LEARNING THEORY, 4 Credits

Focuses on analyzing the performance of algorithms for solving machine learning problems based on the paradigm of learning from examples. Emphasizes topics in the area of statistical machine learning theory.

Recommended: ST 421 or any introductory course to probability and statistics including random variables

AI 586, APPLIED MATRIX ANALYSIS, 4 Credits

Focuses on the why and how advanced matrix analysis tools can solve signal processing (SP) and machine learning (ML) problems. Covers both the fundamental concepts of advanced linear algebra and their applications in the broad areas of signal processing and machine learning. Offers an in-depth close look at a series of core tasks in SP and ML that are enabled by analytical and computational tools in matrix analysis. Introduces frontier research in nonnegative matrix factorization and tensor analysis.

Equivalent to: ECE 586

Recommended: MTH 341

AI 601, RESEARCH, 1-16 Credits

This course is repeatable for 99 credits.

AI 603, THESIS, 1-16 Credits

This course is repeatable for 99 credits.

AI 605, READING AND CONFERENCE, 1-16 Credits

This course is repeatable for 99 credits.

AI 607, SEMINAR, 1-16 Credits

This course is repeatable for 99 credits.

AI 637, COMPUTER VISION II, 4 Credits

An introduction to recent advances in visual recognition, including object detection, semantic segmentation, multimodal parsing of images and text, image captioning, face recognition, and human activity recognition. Covers common formulations of these problems, including energy minimization on graphical models, and supervised machine learning approaches to low- and high-level recognition tasks.

Prerequisite: CS 535 with B+ or better or AI 535 with B+ or better or CS 537 with B- or better or AI 537 with B- or better

Equivalent to: CS 637

Recommended: CS 519