

Course number and name: **Concepts in Artificial Intelligence (CS 07650)**

Credits and contact hours: 3 credits / 3 contact hours

Instructor's or course coordinator's name: John (Xiajun) Jiang

Instructional materials: Artificial Intelligence: Foundations of Computational Agents, 3rd Edition
David L. Poole and Alan K. Mackworth

Specific course information

Catalog description: This course surveys methods for programming computers to behave intelligently. Topics include knowledge representation methods, heuristic search, theorem-proving, puzzle-solving, game-playing, natural language processing, and expert systems.

About this course: Concepts of AI provides a foundational, systems-level understanding of how intelligent technologies perceive, reason, and learn. It takes a broader, structural approach and traces the core ideas that underlie modern AI systems, from classical decision-making frameworks to contemporary learning-based methods.

Prerequisites: Fluency expected in the following areas (below each area are potential learning resources:

1. Search fundamentals (i.e., depth-first search [DFS], breadth-first search [BFS])
 - a. BFS: [LinkedIn Learning](#), [Hacker Earth](#), [Code Academy](#)
 - b. DFS: [LinkedIn Learning](#), [Hacker Earth](#), [Code Academy](#)
2. Big O Notation: [LinkedIn Learning](#)
3. Graphs and Trees
4. Concepts from Mathematics
 - a. Linear Algebra – Matrices and Vectors
 - b. Probability – Joint distribution, Conditional distribution, Marginal distribution, Product rule, Chain rule, Bayes rule, Gaussian distribution, Expectation, Variance, Covariance, Maximum likelihood estimation, Maximum a posteriori
 - c. Calculus - Partial Derivatives

Specific Topics:

- Introduction: An overview of AI Tools for Problem Solving
 - Nomenclature and state of the field
 - What is Generative AI?
 - What is Agentic AI?
- State Space Search
 - Representing Problems as State Space Search Problems
 - States / Actions / Costs
 - Search Algorithms for State Space Search
 - A*, Greedy, Lowest-Cost First-Search (LCFS)
 - Heuristics: General, Admissible, Consistent
- Intro to Game Theory and Zero-Sum Games
 - Minimax
 - Alpha/Beta Pruning
 - Probabilistic Games: Expectimax
- Constraint Satisfaction Problems (CSP)
- Propositional Logic (optional)
- Introduction to ML
 - Regression
 - Classification
 - ML model accuracy: Gradient Descent
 - ML model generalization: Underfitting & Overfitting, Regularization
 - Unsupervised learning
- Introduction to Neural Networks
 - Feedforward NN & backpropagation
 - Neural network applications: vision tasks, sequential data, object detection, transformers
 - Advanced topics: generative AI, etc.