جـــامـــعـــة مـحـمـد بـــن زايـــد
لـلـــذكـــاء الاصـــطـــنـــاعـــي
MOHAMED BIN ZAYED UNIVERSITY
OF ARTIFICIAL INTELLIGENCE

Core Courses Syllabi

AI701 - Artificial Intelligence

Title	Artificial Intelligence
Code	AI701
Loading	4 Credit-hours
Prerequisites	• Understanding of concepts in Discrete Mathematics, and Probability and Statistics • Proficiency in Python and Pytorch or equivalent library
Catalog Description	This course provides the students a comprehensive introduction to modern artificial intelligence (AI), and some of its representative applications. The students will be familiarized with both the historical and recent AI techniques that have proven successful in building practical systems.
Goal	The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.
Contents	This course covers the following major modules: **(I)** machine learning **(II)** solving problems by searching **(III)** knowledge representation and reasoning **(IV)** Markov decision processes **(V)** Bayesian networks, and **(VI)** AI applications
Recommended Textbooks	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd Edition, Prentice Hall, 2010.
Recommended References & Supplemental Material	Relevant research papers, tech reports, and surveys for each topic, where needed, are identified in the teaching plan ahead. In addition, the following textbook may be useful: P. C. Jackson Jr., *Introduction to Artificial Intelligence, 3rd Edition*, Dover Publications, 2019.

Teaching Week	Topics
1	**Course Introduction** **Lecture** • Course overview (content, learning outcomes, evaluation methods, etc.) • The foundations & history of AI • Agents and environments • The structure of agents **Lab** • A quick refresher on Python • Review/discuss real-life AI systems from the agent-environment perspective
2	**Machine Learning - Part I** **Lecture** • Supervised learning • Linear models • Support vector machines (SVMs) • Artificial neural networks (ANNs) **Lab** • Practice using Decision Trees, ANNs, and SVMs to solve supervised learning problems on toy datasets by filling in the given code template
3	**Machine Learning - Part II** **Lecture** • Generalization • Unsupervised learning • K-means **Lab** • Instructor-led demonstration of topics discussed in the week
4	**Solving Problems by Searching - Part I** **Lecture** • Concept of computational problems • Searching as a problem-solving methodology • Uninformed search strategies **Lab** • Solve practical problems with uninformed search, A* search, and hill-climbing

Teaching Week	Topics
5	**Solving Problems by Searching - Part II** **Lecture** • Heuristic search strategies • Local search and optimization problems • Introduction to constraint satisfaction problems (CSPs) **Lab** • Review/discuss real-life problems from the perspective of games and CSPs • Assignment # 1 due
6	**Knowledge Representation and Reasoning - Part I** **Lecture** • Syntax vs semantics • Horn clauses • Propositional logic & theorem proving • First-order logic **Lab** • Describe and discuss real-life scenarios using propositional logic and first-order logic • Design and discuss knowledge-based agents for practical scenarios
7	**Knowledge Representation and Reasoning - Part II** **Lecture** • Introduction to propositional inference and first-order inference • Unification and lifting • Forward chaining • Backward chaining • Resolution **Lab** • Design propositional logic and first-order logic representations of given practical problems
8	**Game Playing and Adversarial Search** **Lecture** • Minimax search • Expectimax • Alpha-beta pruning • Game theory **Lab** • Assignment # 2 due

Teaching Week	Topics
9	**Uncertain Knowledge and Reasoning** **Lecture** • Introduction to uncertainty & recap on probability • Representing knowledge in an uncertain domain • Bayesian networks • Exact and approximate inference in Bayesian networks • Relational and first-order logic probability models **Lab** • Build and discuss Bayesian networks from real-life scenarios • Practice exact and approximate inference in Bayesian networks by writing functions in the given code skeleton
10	**Markov Decision Processes - Part I** **Lecture** • Introduction to Markov decision processes (MDP) • Policy evaluation • Value iteration • Monte Carlo methods **Lab** • Model a practical decision making problem as an MDP
11	**Markov Decision Processes - Part II** **Lecture** • Bootstrapping methods • Introduction to reinforcement learning (RL) • Passive RL • Active RL **Lab** • Practice exercises on reward design, optimality in RL, and policy iteration
12	**Bayesian Networks** **Lecture** • Bayesian inference • Hidden Markov models • Gibbs sampling • Particle filtering • Learning Bayesian networks • Laplace smoothing **Lab** • Implement object tracking using particle filtering

Teaching Week	Topics
13	**AI Applications: Natural Language Processing** **Lecture** • Language models • Text classification • Information retrieval and extraction • Phrase structure grammars • Syntactic analysis and semantic interpretation • Machine translation • Speech recognition **Lab** • Implement a text classification system in the given code skeleton
14	**AI Applications: Robotics** **Lecture** • Robotics hardware: sensors and effectors • Robotic perception • Planning certain and uncertain moves • Dynamics and control: reactive control and RL control • Robotic software architectures **Lab** • Assignment # 4 due
15	**Guest Lecture & Review** **Lecture** • Guest Lecture on Trending Topic **Lab** • Review and Exam Preparation