USC CSCI-561 Foundations of Artificial Intelligence — Fall 2021 Syllabus and Schedule

Prof. Wei-Min Shen, Wednesdays, Room SGM123, Lectures: 5:00–7:20pm, Discussions: 7:30-8:20pm

Textbook: Artificial Intelligence: A Modern Approach, 3rd Ed. (AIMA)
Optional Reading: Autonomous Learning from the Environment (ALFE)

Date	Topic	Reading
Week-1 8/25	1. Welcome – Introduction. Why study AI? What is AI? The Turing test. Rationality. Branches of AI. Brief history of AI. Challenges for the future. What is an intelligent agent? Doing the right thing (rational action)? Performance measures. Autonomy. Environment and agent. Types of agents.	AIMA 1, 2 (ALFE 1)
	2. Problem Solving & Search – Types of problems. Example problems. Basic idea behind search algorithms. Complexity. Combinatorial explosion and NP completeness. Polynomial hierarchy.	AIMA 3 (ALFE 2, 6)
Week-2 9/1	3. Uninformed Search - Depth-first. Breadth-first. Uniform-cost. Depth-limited. Iterative deepening. Examples. Properties.	AIMA 3 HW1 out
	4. Informed Search – Best-First, A* search, Heuristics, Hill climbing, Problem of local extrema, Simulated annealing, and Genetic Algorithms.	AIMA 3, 4 (ALFE 6)
Week-3 9/8 (9/6 L-Day)	5. Constraint satisfaction. Node, arc, path, and k-consistency. Backtracking search. Local search using min-conflicts.	AIMA 6
	6. Game Playing - The minimax algorithm. Resource limitations. Alpha-beta pruning. Chance and non-deterministic games.	AIMA 5
Week-4 9/15	7. Advanced Game Playing - Agent Interaction with environment and other agents. 8. Reinforcement Learning.	AIMA 21 ALFE 6.1
Week-5 9/22	9. Agents that reason logically 1 – Knowledge-based agents. Logic and representation. Propositional (Boolean) logic.	AIMA 7 (ALFE 3) HW1 due
	10. Agents that reason logically 2 – Inference in propositional logic. Syntax. Semantics. Examples.	AIMA 7 HW2 out
Week-6 9/29	Midterm exam 1	
Week-7 10/6	11. First-order logic 1 – Syntax. Semantics. Atomic sentences. Complex sentences. Quantifiers. Examples. FOL knowledge base. Situation calculus.	AIMA 8, AIMA 12
	12. First-order logic 2 – Describing actions. Planning. Action sequences.	AIMA 8
Week-8 10/13	13. Inference in first-order logic – Proofs. Unification. Generalized modus ponens. Forward and backward chaining.	AIMA 9
	14. Continue Inference in first-order logic. Resolution. Proof by contradiction.	AIMA 9
Week-9 10/20	15. Logical reasoning systems – Indexing, retrieval and unification. The Prolog language. Theorem provers. Frame systems and semantic networks.	AIMA 9
	16. Planning – Definition and goals. Basic representations for planning. Situation space and plan space. Examples.	AIMA 10 (ALFE 6)
Week-10 10/27	Midterm exam 2	HW2 due HW3 out

Week-11 11/3	17. Learning from examples – supervised learning, learning decision trees, support vector machines.	AIMA 18 Handout
	18. Learning with neural networks – Perceptron, Hopfield networks. How to size a network? What can neural networks achieve? Deep learning and state of the art.	AIMA 18 Handout
Week-12 11/10	19. Reasoning under uncertainty – probabilities, conditional independence, Markov blanket, Bayes nets.	AIMA 13, 14
	20. Reasoning under uncertainty – Probabilistic inference, enumeration, variable elimination, approximate inference by stochastic simulation, Markov chain Monte Carlo, Gibbs sampling.	AIMA 14, 15 (ALFE 5)
Week-13 11/17	21. Probabilistic decision making – utility theory, decision networks, value iteration, policy iteration, Markov decision processes (MDP), partially observable MDP (POMDP).	AIMA 16, 17 (ALFE 5)
	22. Probabilistic Reasoning over time: Temporal models, Hidden Markov Models, Kalman filters, Dynamic Bayesian Networks, Automata theory.	AIMA15 HW3 due
Thanksgiving	No Classes	
Week-14 12/1	23. Probability-Based Learning: Probabilistic Models, Naive Bayes Models, EM algorithm, Reinforcement Learning.	AIMA 20 (ALFE 5.10)
	24. Towards intelligent machines – The challenge of robots: with what we have learned, what hard problems remain to be solved? Different types and architectures of robots.	AIMA 24, 26, 27 (ALFE 13)
Week-15 12/8	Final Exam (set by the University/School)	

Midterm-1: September 29
Midterm-2: October 27
Final-Exam: December 8 (set by the university/school)

Grades: 20% for midterm-1; 20% for midterm-2; 30% for final; 10% for each of the 3 homework. Some of the exam questions will be on topics covered in the discussion sessions only and not in the main lectures.

Homework: There are 3 programming assignments in which you will program some AI agents for search, game playing, logic inference, or learning (subject to change) from scratch. Good programming knowledge is essential. We will use vocareum.com where you can edit, compile, and test your code in the cloud. Supported languages include Python (preferred), Java, C++, C++11, and C.

Tentative homework topics (subject to change):

HW1: Search
HW2: Game playing or constraint satisfaction problems
HW3: Neural networks or logic inference

Grading is absolute and according to the following scale: 90 or more: A+; 80 or more: A; 75 or more: A-; 70 or more: B+; 60 or more: B; 55 or more: B-; 50 or more: C+; 40 or more: C; 35 or more: C-; less than 35: F.