

CSCI-561 Foundations of Artificial Intelligence – USC – Spring 2023 Syllabus and Schedule

Lectures: Prof. Laurent Itti, Bovard auditorium, dates/times vary (usually 9:00 – 12:20pm Tuesdays).

Textbook: Artificial Intelligence: A Modern Approach, 4th Ed. (AIMA)
Optional Reading: Autonomous Learning from the Environment (ALFE)

Date	Topic	Reading
Tues Jan 10	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 measure. Autonomy. Environment and agent design. Structure of agents. Agent types.	AIMA 1, 2 (ALFE 1)
Tues Jan 10	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)
Tues Jan 17	3. Uninformed Search - Depth-first. Breadth-first. Uniform-cost. Depth-limited. Iterative deepening. Examples. Properties.	AIMA 3 HW1 out
Tues Jan 17	4. Informed search – Best-first. A* search. Heuristics. Hill climbing. Problem of local extrema. Simulated annealing. Genetic Algorithms.	AIMA 3, 4 (ALFE 6)
Tues Jan 24	5. Continue informed search – Best-first. A* search. Heuristics. Hill climbing. Problem of local extrema. Simulated annealing. Genetic Algorithms.	AIMA 3, 4
Tues Jan 24	6. Game Playing - The minimax algorithm. Resource limitations. Alpha-beta pruning. Chance and non-deterministic games.	AIMA 5
Tues Jan 31	7. Continue game Playing - The minimax algorithm. Resource limitations. Alpha-beta pruning. Chance and non-deterministic games.	AIMA 5
Tues Jan 31	8. Constraint satisfaction. Node, arc, path, and k-consistency. Backtracking search. Local search using min-conflicts.	AIMA 6 (ALFE 6)
Tues Feb 7 ZOOM	9. Agents that reason logically 1 – Knowledge-based agents. Logic and representation. Propositional (boolean) logic.	AIMA 7 (ALFE 3) HW1 due
Tues Feb 7 ZOOM	10. Agents that reason logically 2 – Inference in propositional logic. Syntax. Semantics. Examples.	AIMA 7 HW2 out
Fri Feb 17	Midterm exam 1 – 9:00am-11:00am	
Thurs Feb 23	11. First-order logic 1 – Syntax. Semantics. Atomic sentences. Complex sentences. Quantifiers. Examples. FOL knowledge base. Situation calculus.	AIMA 8, AIMA 10
Thurs Feb 23	12. First-order logic 2 – Describing actions. Planning. Action sequences.	AIMA 8
Tues Feb 28	13. Inference in first-order logic – Proofs. Unification. Generalized modus ponens. Forward and backward chaining.	AIMA 9
Tues Feb 28	14. Continue Inference in first-order logic. Resolution. Proof by contradiction.	AIMA 9

Tues Mar 7	15. Logical reasoning systems – Indexing, retrieval and unification. The Prolog language. Theorem provers. Frame systems and semantic networks.	AIMA 9 HW2 due
Tues Mar 7	16. Planning – Definition and goals. Basic representations for planning. Situation space and plan space. Examples.	AIMA 11 (ALFE 6) HW3 out
Tues Mar 14	Spring recess – NO CLASS	
Tues Mar 21	17. Fuzzy logic – concepts, fuzzy inference, aggregation, defuzzification.	Handout
Tues Mar 21	18. Learning from examples – supervised learning, learning decision trees, support vector machines.	AIMA 19 + handout (ALFE 4)
Thurs Mar 30	Midterm exam 2 – 9:00am-11:00am	
Tues Apr 4	19. Learning with neural networks – perceptrons, Hopfield networks. How to size a network? What can neural networks achieve?	Handout + AIMA 21
Tues Apr 4	20. Advanced concepts in neural networks – convnets, deep learning, stochastic gradient descent, dropout learning, autoencoders, applications and state of the art.	Handout
Tues Apr 11	21. Reasoning under uncertainty – probabilities, conditional independence, Markov blanket, Bayes nets.	AIMA 12, 13
Tues Apr 11	22. Continue Reasoning under uncertainty – Probabilistic inference, enumeration, variable elimination, approximate inference by stochastic simulation, Markov chain Monte Carlo, Gibbs sampling.	AIMA 13, 14 (ALFE 5)
Tues Apr 18	23. Probabilistic decision making – utility theory, decision networks, value iteration, policy iteration, Markov decision processes (MDP), partially observable MDP (POMDP).	AIMA 17, 18 (ALFE 5)
Tues Apr 18	24. Probabilistic Reasoning over time: Temporal models, Hidden Markov Models, Kalman filters, Dynamic Bayesian Networks, Automata theory.	AIMA 14 HW3 due
Tues Apr 25	25. Probability-Based Learning: Probabilistic Models, Naïve Bayes Models, EM algorithm, Reinforcement Learning.	AIMA 20, 22 (ALFE 5.10, 6.1)
Tues Apr 25	26. General outlook and conclusions.	AIMA 27, 28

Midterm 1: Friday February 17, 9:00am – 11:00am, Bovard Auditorium

Midterm 2: Thursday March 30, 9:00am – 11:00am, Bovard Auditorium

Final exam: Tuesday May 9, 8:00am – 10:00am, room TBA

Grades: 20% for midterm 1, 20% for midterm 2, 30% for final, 10% for each of the 3 homeworks.

Homeworks: These are programming assignments, you will program some A.I. agents for search, game playing, logic inference (subject to change) from scratch. Good programming knowledge is necessary. We will use vocareum.com where you can edit, compile, and test your code in the cloud. Supported languages include C, C++, C++11, Java, and Python.

Tentative homework topics (subject to change):

HW1 search

HW2 game playing or constraint satisfaction problems

HW3 logic inference or neural networks

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.