

Spring 2023 Artificial Intelligence

Basic Info

Instructor: [Dr. Weitian Tong](#) Assistant Professor at Department of Computer Science

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Please refer to our **syllabus** on Folio for more details, such as prerequisites, textbook, topics, objectives, learning outcomes, assessment plan, course policies, etc.

Course Schedule (timely updated!)

CH: Coding homework; WH: written homework

Date	Topics	Useful Recourses
Week 1: 01/09 – 01/15	Class begins on 01/09! • Attendance Verification • Syllabus • Introduction: ◦ What is AI? ◦ History of AI ◦ What Can AI Do? ◦ AI Applications ◦ What is this course about? • Installation: Anaconda, Python 3.7 • Math Diagnostic	• AI Cheatsheet • Dive into Deep Learning • Deep Learning: An MIT Press book by Ian Goodfellow and Yoshua Bengio and Aaron Courville • Papers with Code: a free and open resource with Machine Learning papers, code, datasets, methods and evaluation tables • Google AI Blog • Google AI • DeepMind Lab • Serpent.AI

		Python and Command Line: • Command Line: Windows, OSX, Linux • Video: Command Line • Free Interactive Python Tutorial • Anaconda Cheatsheet Youtube: • What is Artificial Intelligence 1 • What is Artificial Intelligence 2 Latex: • Download Latex • Learn LaTeX in 30 minutes • Youtube: LaTeX Tutorial for Beginners Full Course
Week 2: 01/16 – 01/22	• Introduce CH1 and Python • Agents and environments ◦ Agents ◦ PEAS ◦ Environment types ◦ Agent types • Search Problem ◦ Definition of search problem ◦ World state vs Problem state	• Unity ML-Agents Tutorials Youtube: • Problem Formulation, State Space
Week 3: 01/23 – 01/29	• Search Problem: ◦ Problem formulation ◦ State space graphs vs search trees ◦ Graph Search vs Tree Search ◦ Uninformed Search: DFS	Youtube: • Search problems • Depth First Search • Breadth First Search Part 1; Part 2 • Uniform Cost Search • A* Search

	◦ Introduce CH2 (Search): Implementation demo for DFS	• Search Problems in AI • Search Algorithms in AI • Informed vs Uninformed Search • Visualgo: visualising data structures and algorithms through animation
CH1 (Unix/Python/Autograder Tutorial) Due; WH1 (AI, Agent, Search Problems) Due; Deadline: 11:59 pm on 01/29		
Week 4: 01/30 – 02/05	• Sol to CH1 and WH1 • Uninformed Search: BFS and UCS • Informed Search: ◦ Heuristic ◦ Greedy Search ◦ A-star Search	• Manhattan distance vs Euclidean distance • A* Search • Informed Search Algorithms Youtube: • A* Search and Heuristics Intuition in 2 minutes • Heuristic search • A* Search
Week 5: 02/06 – 02/12	• A-star Search: Admissibility vs Consistency	Youtube: • Finding Admissible Heuristics • Finding Heuristic function for 8-Puzzle Problem
Week 6: 02/13 – 02/19	Constraint Satisfaction Problems (CSPs) • Definition • Constraint Graphs • Solve CSPs ◦ Standard Search Formulation ◦ Backtracking Search ◦ Improving Backtracking: Filtering, Arc consistency, Ordering, k-Consistency	• CSP Backtracking Algorithms • Animations of Constraint Satisfaction Algorithms Youtube: • Constraint satisfaction problems • What is Constraint Satisfaction • What is Constraint Satisfaction • How Constraint Satisfaction Algorithm Works

	◦ Problem Structure ◦ Tree-Structured CSPs	
CH2 (Search) Due; WH2 (Uninformed Search, Informed Search) Due; Deadline: 11:59 pm on 02/19		
Please provide your rough ideas about your project!		
Week 7: 02/20 – 02/26	• Sol to CH2 and WH2 • Local Search: Hill Climbing, Beam Search, Simulated Annealing, Genetic Algorithms	• Local Search Algorithms • Iterated Local Search From Scratch in Python Youtube: • Local search algorithm in artificial intelligence
Week 8: 02/27 – 03/05	• Local Search (continue): ◦ Simulated Annealing ◦ Genetic Algorithm ◦ Demo: solve N-Queens problem by GA	• Simulated Annealing From Scratch in Python • Simple Genetic Algorithm From Scratch in Python
Week 9: 03/06 – 03/12	• Adversarial Search Algorithms: ◦ Definition ◦ Minimax search ◦ Alpha-Beta Pruning ◦ Depth-limited search ◦ Evaluation Functions ◦ Expectimax Search • Introduce CH3	• Simulator: minimax and alpha-beta pruning • Minimax with Alpha Beta Pruning Youtube: • Minimax and alpha-beta pruning • Minimax with Alpha Beta Pruning
Week 10: 03/13 – 03/19	Spring break for students – No classes	
CH3 (Adversarial Search) Due; WH3 (Adversarial Search) Due; Deadline: 11:59 pm on 03/19		
Week 11: 03/20 – 03/26	• Markov Decision Processes (MDP) ◦ MDP Search Trees ◦ Discounting • Solve MDP:	• Value Iteration Algorithm • Navigating in Gridworld using Policy and Value Iteration

	◦ Value Iteration ◦ Policy evaluation ◦ Policy iteration	Youtube: • Value Iteration • Policy Iteration • Policy and Value Iteration
Week 12: 03/27 – 04/02	• Sol to CH3 and WH3 • MDP: continue • Introduce CH4	
Week 13: 04/03 – 04/09	Reinforcement Learning (RL): • Model-based Learning • Model-Free Learning ◦ Passive (i.e. policy evaluation): ▪ Direct Evaluation ▪ Temporal Difference Learning ◦ Active (i.e. learn policy): Q-Learning • Approximate Q-Learning	• A (Long) Peek into Reinforcement Learning • Exploration Strategies in Deep Reinforcement Learning • REINFORCEjs: a Reinforcement Learning library • Exploration vs Exploitation • Multi-armed bandit • Wiki: Multi-armed bandit • Can you beat the bandit algorithms? Youtube: • Reinforcement Learning • Model Based Reinforcement Learning • Model Free Reinforcement Learning • Reinforcement Learning in 3 Hours using Python
CH4 (MDP and RL) Due; WH4 (MDP and RL) Due; Deadline: 11:59 pm on 04/09		
Week 14: 04/10 – 04/16	• Machine learning (ML) ◦ Machine learning concepts ◦ Parameter Estimation: Maximum Likelihood Estimation	• Difference Between a Parameter and a Hyperparameter Machine Learning Mastery: • How to Setup Your Python Environment for Machine Learning with Anaconda • 5 Step Life-Cycle for Neural Network Models in Keras

	◦ Classifier: Perceptron ◦ Gradient Descent	• Your First Deep Learning Project in Python with Keras Step-By-Step
Week 15: 04/17 – 04/23	• Sol to CH4 and WH4 • Introduce CH5	• Neural Net Demo • Paper: An overview of gradient descent optimization algorithms Youtube: • what is a Neural Network? • Gradient descent, how neural networks learn • What is backpropagation really doing? • Backpropagation calculus
Week 16: 04/24 – 04/30	• Machine learning (ML) ◦ Neural nets ◦ Decision trees	Decision tree: • A visual introduction to machine learning: apply decision tree to classification problem • Decision Trees model- Predicting Iowa house prices
CH5 (Machine Learning) Due; WH5 (Machine Learning) Due; Deadline: 11:59 pm on 04/30		
Project due; Deadline: 11:59 pm on 04/30		
Week 17: 05/01 – 05/07	The last day of classes is 05/01.	