Fall 2020

CS 370-101: Intro to Artificial Intelligence

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Artificial Intelligence
Syllabus

Instructor

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Course Description

This course introduces concepts, approaches and techniques of artificial intelligence, and focuses on materials that are fundamental and have a broad scope of applications. Topics include Problem Solving, Search, Knowledge and Reasoning, Logical Agents, First-Order Logic and Inference, Uncertain Knowledge and Reasoning, Quantifying Uncertainty, Probabilistic Reasoning, Perception, Pictorial Knowledge Representation, and Search in Frequency and Spatial Domains. Additional topics include Machine Learning, Neural Computation, Evolutionary Computation, and Robotics.

Textbook


Grading Scheme

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Midterm</td>
<td>40%</td>
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<tr>
<td>Project I</td>
<td>10%</td>
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<tr>
<td>Project II</td>
<td>30%</td>
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<tr>
<td>Homework</td>
<td>20%</td>
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</tbody>
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Topics (Tentative)

1. Introduction
   ○ AI Fundamentals: Knowledge & Search, Cognitive Science, Turing Test, Ancient Philosophers (Logic)
   ○ Programming Languages: Lisp, Prolog, C/C++, Java, Matlab
   ○ Related Fields: Machine Learning, Neural Networks, Evolutionary Computation, Computer Vision
   ○ AI History: Symbolism (Expert Systems) vs. Connectionism (MP model, Perceptron, BP Algorithm)
2. Problem Solving
Intelligent Agent: Sensors, Actuators, Agent Program
Solving Problems by Searching: problem-solving agent
Blind Search Strategies: Breadth-first Search, Depth-first Search (completeness, optimality, complexity)
Informed Search Strategies: Greedy Best-first Search, A* Search (completeness, optimality, complexity)

3. Knowledge and Reasoning - Logical Agents
   Knowledge Base, Models, and Knowledge-Based Agents
   Propositional Logic Knowledge Representation Language, Syntax and Semantics
   Logical Reasoning: Entailment and Inference (soundness, completeness)
   Propositional Theorem Proving: Validity, Satisfiability, Reduction to Absurd
   MP Inference Rule, Resolution Inference Rule, Horn Form, CNF

4. Knowledge and Reasoning - First-Order Logic
   Propositional Logic vs. First-Order Logic: objects, relations (unary, n-ary), functions
   First-Order Logic: Syntax and Semantics (predicates, variables, quantifiers)
   First-Order Logic Knowledge Representation Language, Model, Interpretation
   First-Order Logic Knowledge Base

5. Knowledge and Reasoning - Inference in First-Order Logic
   Universal Instantiation, Existential Instantiation
   Substitution and Unification
   Generalized MP Rule, Soundness of GMP
   Resolution Inference Rule, CNF
   Logic Programming - Prolog

6. Uncertain Knowledge and Reasoning - Quantifying Uncertainty
   Acting under Uncertainty
   Probability (model, atomic event, conditional), Random Variables (propositional, discrete, continuous)
   Syntax and Semantics: probability distribution, joint probability distribution
   Inference by Enumeration, Normalization
   Independence, Conditional Independence, and Bayes’ Rule

7. Uncertain Knowledge and Reasoning - Probabilistic Reasoning
   Representing Knowledge in an Uncertain Domain
   Bayesian Networks
   Optimal Feature Representation Methods and Search
   Optimal Feature Classification Methods and Search

8. Perception - Pictorial Knowledge Representation
   Digital Image Fundamentals
   Image Formation
   Digital Image Formats/Protocols (JPEG, PNG, TIFF, PGM, PPM)
   Digital Video Fundamentals (CAV; NTSC/PAL/SECAM; S-Video)

9. Perception - Search in Frequency Domain
   FT/FFT
   Lowpass and Highpass Filtering
   Convolution, Correlation, and Autocorrelation Theorems
   Pictorial Information Search using FFT Features

10. Perception - Search in Spatial Domain
    Geometric Feature Representation
    Edge Detection (Canny, Zero-crossing, LOG, Prewitt, etc.)
    Line and Curve Detection (Hough Transform)
    Pictorial Information Search using Geometric Features

11. Learning - Machine Learning
- Inductive Learning
- Decision Tree Learning
- Unsupervised Learning
- Supervised Learning

12. Neural Computation (optional)
- Multilayer Perceptrons and BP Algorithm
- Radial-Basis Function Networks

13. Evolutionary Computation (optional)
- Genetic Algorithms (GA)
- Evolutionary Strategy (ES)
- Evolutionary Programming (EP)

14. Robotics (optional)
- Sensors and Vision
- Path Planning
- Moving and Control

Cheating Policy

Cheating on a programming assignment results in zero credit for all students involved. Programming assignments may **NOT** be solved in collaboration, unless specifically stated in the assignment. Cheating on an exam will result in an “F” in the course. You may discuss problems with each other. Where does discussion end and cheating start? You may **NOT** copy lines of code from anybody or anywhere. You may **NOT** use code in your assignments that you did not write. As a general rule: If you don't understand the code and can't explain the code, you can't use the code.

Please familiarize yourself with the [NJIT Honor Code](#). Violations of the honor code will be dealt with seriously and reported immediately to the Dean of Students.

Late Policy

To receive full credit all programming assignments must be handed in on time at the beginning of class. Assignments will not be accepted after the due date.

Prerequisites

CS 114 and (Math 226 or CS 241)