

CSCI 446 – ARTIFICIAL INTELLIGENCE EXAM 1 STUDY OUTLINE

Introduction to Artificial Intelligence

- I. Definitions of Artificial Intelligence
 - A. Acting Like Humans -- Turing Test
 - B. Thinking Like Humans -- Cognitive Modeling
 - C. Thinking Rationally -- Logicist Approach
 - D. Acting Rationally -- Rational Agents
- II. Foundations of Artificial Intelligence
 - A. Philosophy
 - B. Mathematics
 - C. Psychology
 - D. Computer Engineering
 - E. Linguistics
- III. History of Artificial Intelligence
 - A. Gestation
 - B. Early Enthusiasm, Great Expectations
 - C. Dose of Reality
 - D. Knowledge Based Systems
 - E. AI Becomes and Industry
 - F. Return of Neural Networks
 - G. Recent Events

Intelligent Agents

- I. Agents and Environments
 - A. Vacuum Cleaner World Environment
- II. Rationality
- III. PEAS – Performance Measure, Environment, Actuators, Sensors
- IV. Environment Types
 - A. Observable
 - B. Deterministic vs. Stochastic
 - C. Episodic vs. Sequential
 - D. Static vs. Dynamic
 - E. Discrete vs. Continuous
 - F. Single Agent vs. Multi-Agent
- V. Agent Types
 - A. Simple Reflex Agents
 - B. Reflex Agents with State
 - C. Goal-Based Agents
 - D. Utility Based Agents
 - E. Learning Agents

State Spaces, Uninformed Search

I. Problem Formulation

A. Problem Types

1. Deterministic, fully observable: Single-State Problem
2. Non-observable: Conformant Problem
3. Nondeterministic and/or partially observable: Contingency Problem
4. Unknown state space: Exploration Problem

B. Single State Problem Formulation

1. Initial State
2. Successor Function
3. Goal Test
4. Path Cost
5. Solution

II. State Space

III. Tree Search Algorithms

A. General Tree Search

1. Completeness
2. Time Complexity
3. Space Complexity
4. Optimality

B. Breadth First Search

C. Uniform Cost Search

D. Depth First Search

E. Depth Limited Search

F. Iterative Deepening Search

IV. Graph Search

Heuristic Search

I. Best-First Search

A. Heuristic Function $h(n)$

II. A* Search

A. Actual Cost to Current Node + Heuristic $g(n) + h(n)$

III. Heuristics

- A. Admissible Heuristic
- B. Consistency or Monotonicity
- C. Dominance
- D. Relaxed Problems

Local Search

I. Hill Climbing

- A. Gradient Ascent or Descent
- B. Local Maxima
- C. Global Maximum

II. Simulated Annealing

III. Genetic Algorithms

Constraint Satisfaction Problems (CSPs)

- I. Examples
- II. Backtracking Search
 - A. Order of Variable Assignment
 - 1. Degree Heuristic
 - B. Order of Value Assignment
 - 1. Least Constraining Value Heuristic
 - C. Early Detection of Inevitable Failure
 - 1. Forward Checking
 - 2. Arc Consistency
 - D. Problem Structure
- III. Problem Structure and Decomposition
- IV. Local Search for CSPs

Games (Adversarial Search)

- I. Overview
- II. Minimax (Perfect Play)
- III. $\alpha\beta$ Pruning
- IV. Nondeterministic Games
 - A. Chance Nodes

Logical Agents

- I. Knowledge Based Agents
 - A. Knowledge Base
 - B. Inference Engine
 - C. Separation of Knowledge and Process
- II. An Example
 - A. Wumpus World
- III. General Logic
 - A. Entailment
 - B. Models
 - C. Inference
- IV. Propositional Logic
 - A. Syntax
 - B. Truth Tables
- V. Equivalence, Validity, Satisfiability
- VI. Inference Rules / Theorem Proving
 - A. Forward Chaining
 - B. Backward Chaining
 - C. Resolution
 - 1. Conjunctive Normal Form (CNF)
 - 2. Conversion to CNF
 - 3. Resolution

First Order Logic

- I. Overview
- II. Syntax and Semantics
 - A. Basic Elements
 - B. Atomic Sentences
 - C. Complex Sentences
 - D. Models
 - E. Universal Quantification
 - F. Existential Quantification
- III. Fun with Sentences
 - A. Equality

Inference in First Order Logic

- I. Unification
 - A. Universal Instantiation
 - B. Existential Instantiation
 - C. Reduction to Propositional Inference
 - D. Unification
- II. Generalized Modus Ponens
- III. Forward and Backward Chaining
 - A. Forward Chaining
 - B. Backward Chaining
- IV. Logic Programming
- V. Resolution

Fuzzy Logic

- I. Membership Functions
- II. Linguistic Variables
- III. Fuzzy Set Operations
- IV. Fuzzy Inference
 - A. Fuzzification
 - B. Rule Inference
 - C. Rule Composition
 - D. Defuzzification

Planning

- I. Search vs. Planning
 - A. Actions, States, Goals, Plans
 - B. Situational Calculus
- II. STRIPS Operators
 - A. Initial and Final States
 - B. Operators
 - 1. Action
 - 2. Preconditions
 - 3. Effects (Postconditions)
- III. Partial-Order Planning

IV. The Real World

A. When Things go Wrong

1. Incomplete Information
2. Incorrect Information
3. Qualification Problem

V. Conditional Planning

VI. Monitoring and Replanning