Exam 1 Review

From Cs470fall2011

Contents

Exam Logistics

- In the testing center from Oct 14 through Oct 16. The test is available during regular hours of the testing center.
- 3 hour timed.
- Closed book
- One 8.5" by 11" sheet of notes is allowed.
- Testing center calculator is required.
- Mix of true/false, short answer, matching, and "solve the following" problems.
- I will reuse questions from old exams that I have written, so **studying from my old exams is cheating**.

Frameworks for Decision Making

- Designer perspective: PEAS
  - Environment Types
    - Fully/Partially observable
    - Deterministic/stochastic
    - ~~Episodic/sequential~~
    - ~~Static/dynamic~~
    - ~~Discrete/continuous~~
    - Single agent/Multiple agent
    - ~~Known/Unknown~~
- Agent perspective: CSA
  - States
  - Actions
  - Consequences
  - Goals
  - Preferences
  - Utilities
  - Goodrich's definitions of *uncertainty* and *non-determinism*
- Agent types (from reading)

    - Simple reflex agents
    - Model-based reflex agents
    - Goal-based agents
    - Utility-based agents
    - Learning agents
    - How would you classify the following?
        - Agents that use potential fields
        - Agents that use PD controllers
        - Agents that use search
        - Agents that use probabilistic reasoning
- Relationship between CSA and PEAS perspectives
    - Actuators/Actions
    - Sensors/States
    - Performance Criteria/Utility
- Intelligence without representation
- Rationality and optimization

Control

- PD controllers
- Definition of a behavior (from Brooks)
- Potential fields: concepts and mathematical encoding
    - Attractive
    - Repelling
    - Tangential
    - Uniform
    - Random
    - Perpendicular
- Combining behaviors by combining potential fields
- Internal states with potential fields
    - Avoid the past (from reading)
- Lessons from lab

Search

- Nodes, states, goals, fringe, goal test, visited nodes
- Search strategy: definition
- Uninformed search strategies: algorithms, completeness, optimality, time complexity, space complexity
    - Breadth-First Search
    - Depth-First Search
    - Uniform-Cost Search
    - Depth-Limited Search
    - Iterative Deepening
    - ~~Bi-directional Search~~
- Informed search strategies: algorithms, completeness, optimality, time complexity, space complexity
    - Greedy Best-First Search
    - A*
    - IDA*
    - Recursive Best-First Search

    - ~~SMA*~~
    - Cost-to-arrive, cost-to-go, heuristics, admissible heuristics, consistent heuristics
    - Optimally efficient
- Graph versus tree implementations of search
- Goal-finding
    - hill-climbing
    - random restart
    - beam search
- Gradient ascent (continuous spaces)
    - partial derivatives
    - gradients
    - stepping in the direction of the gradient
- Genetic algorithms
    - chromosomes
    - fitness
    - mutation
    - crossover

Probabilistic Reasoning

- Probability spaces
    - Ω *possible* world states
    - σ "distinguishable" events (think set of subsets)
    - P and the axioms of probability – "size" of distinguishable events
        - $P : 2^{\Omega} \rightarrow [0, 1]$
        - For all $A \subseteq \Omega, P(A) \in [0, 1]$
        - $P(\Omega) = 1$
        - Any countable sequence of pairwise disjoint (synonymous with *mutually exclusive*) events $E_1, E_2, \ldots$ satisfies $P(E_1 \cup E_2 \cup \cdots) = \sum_{i=1}^{\infty} P(E_i)$. *(Quoted from wikipedia (http://en.wikipedia.org/wiki/Probability_axioms) .)*
    - Corollaries of the axioms.
- Random variables
    - "Measurable" states
    - $X : \omega \rightarrow S$ such that X satisfies a technical condition.
- Probability mass functions (pmfs)
    - Derived distribution: $P_X(x) = P(\{\omega : X(\omega) = x\})$
    - S is discrete so we can write $P_X(x)$ as a vector.
    - $\sum_{x_i} P_X(x_i) = 1$
    - $\forall x_i \in S, P_X(x_i) \in [0, 1]$
- Joint distributions
    - Multiple measures of same distinguishable space
    - Marginal distribution
    - Examples
- Conditional distributions
    - Definition

    - Properties
    - Examples
    -

$$\sum_x p_{X \mid Y}(x \mid y) = 1$$

    - $\sum_y p_{X|Y}(x|y) \neq 1$
- Bayes rule
    - States and observations
    - prior, posterior, likelihood, and normalizer
    - $p_{S|O} = \frac{p_{O|S} p_S}{p_O}$
    -

$$p_O(o) = \sum_s P_{S,O}(s,o) = \sum_s P_{O \mid S}(o \mid s) P_S(s)$$

    - Computing p_O
    - Examples: medicine, Monty Hall, 3 Prisoners (from homework)