COSC1125/1127 Artificial Intelligence

Week 12: AI research at RMIT, Revision tips

Topics covered so far …

- Introduction (week 1)
- Search Strategies (week 2)
- Adversarial Search (week 3)
- Knowledge Representation (week 4 & 5)
- Automated Planning (week 6)
- Decision Making Under Uncertainty (week 7)
- Reinforcement Learning (week 8)
- Probability (week 9)
- Bayesian Networks (week 10)
- Intelligent Agents (week 11)
- AI at RMIT & Course Review (week 12)

Assessments

- Assignment#1: Search (10%; Due Week 3)
- Assignment#2: Connect4 game (15%; Due Week 6)
- Assignment#3: Reinforcement Learning (15%; Due Week 12)
- Class Test Component (Week 9): 10%
- Final Exam: 50%

Research in CS and IT

- Four main groups:
  - Distributed Systems and Networks
  - Information Storage, Analysis and Retrieval
  - Software Engineering
  - **Intelligent Systems**
    - **Intelligent agents**:
      - Agent reasoning
      - Agent-oriented software engineering
      - Agent-based simulation
    - **Evolutionary Computing and Machine Learning**:
      - Nature-inspired computational models and algorithms
      - Large-scale optimization; engineering optimization
      - Data mining/analytics
      - Application to real-world problems

Revision tips

- The exam will be 2 hours; 15 minutes of reading time.
- Questions are similar to those of past exams. However, there will be questions on Markov Decision Process (MDP) and Reinforcement Learning (RL).
- Do easy questions first.
- Read questions carefully, and make sure you answer what is being asked.
- Be concise and answer to the points. You don't get more marks simply because you write more.
- Use examples for illustration when needed.
- Calculator is unnecessary. It is more important for you to show how to plug in the numbers into the right places of a formula (ie., show the *process*, rather than just the "final product").
- It is highly recommended that you do a mock exam using one past exam, so as to familiarize yourself with exam questions and style, and identify the topic areas that you should spend more time in revision. This will help you to do the best you can in the real final exam!
- Make sure you go through tutorial exercises again (first work out your own solutions, and then study and compare with the sample solutions). It is likely some exam questions are similar to them.

Topics to be examined

- **Introduction** + **Search**: Definitions of Artificial Intelligence; Turing test; Search strategies; Different types of search problems; State space representation; Uninformed search – BFS, DFS, Iterative-Deepening Search, Uniform Cost Search, Bi-directional Search; Informed Search; Greedy Search (or Best-First Search); Heuristic; Admissibility; Heuristic informedness; A* Search; Open and Closed lists; Completeness, Time/Space complexity, Optimality.

- **Adversarial Search**: Utility; Evaluation function; Minimax search; Alpha-Beta pruning.

- **Propositional Logic**: Entailment; implication; logical equivalence; truth table; using truth table to determine validity of a sentence, e.g., a sentence being valid (tautology), satisfiable/unsatisfiable; Inference rules – Modus Ponens, And-Elimination, Universal Elimination, etc; Resolution; Horn clauses; AND/OR graph; Limitations of Propositional Logic.

- **Predicate Calculus (First Order Logic)**: Translation of plain English sentences into predicate calculus expressions; Universal and Existential quantifiers; applying inference rules; instantiation; unification; Generalized Modus Ponens; Proof by forward and backward chaining; Drawbacks of logic.

… to be continued on next slide

Topics to be examined

- **Planning**: Planning using predicate calculus expressions; Frame axioms; STRIPS operators; Search tree; Search strategies for producing a plan.
- **Markov Decision Process (MDP)**: Sequential decision making; Uncertainty; Definition of MDP; Values/Utilities; Policy; Transition function; Reward Function; Q-values; Value iteration; Policy Iteration; Policy evaluation, policy improvement; Maximum Expected Utility (MEU) Principle; Bellman equations.
- **Reinforcement Learning (RL)**: What are in common between RL and MDP, and how they are different? Model-based learning; Model-free learning; Temporal Difference Learning; Q-Learning.
- **Probability**: Prior (or unconditional) probability and conditional probability; joint-probability distribution; Independence; Conditional Independence; Product rule; Bayes' theorem.
- **Bayesian networks**: Conditional Independence; Inferencing using a Bayesian network; Calculating probability of a certain event using a Bayesian network; constructing a Bayesian network.
- **Intelligent Agents**: Characteristics of an intelligent agent; Design considerations of intelligent agents; Different types of intelligent agents.

Sample past exam

- **AI exam paper for 2014 (total 6 questions), with sample solutions provided.**

- It is highly recommended that you attempt this past exam without reading the sample solutions first. You should time yourself (see if you could complete it in 2 hours), and perhaps find a quiet place to do this, almost as a mock exam (simulating the real exam venue in some way).

- Identify gaps in understanding, so that you shall spend more time on those topics during the revision;

- Note that new topics in the 2019 exam may include MDP and RL.

- **Good luck!**

Two focus sessions

- We will run two sessions next week.

- **Session 1 (on topics: Search, Logic, probability, Bayesian Nets)**
  - Date/Time: Wednesday 5 June, 13:00 – 14:30
  - Venue: 56.03.93
  - Covered by Angus Kenny

- **Session 2 (on topics: MDP, RL, planning, general questions)**
  - Date/Time: Thursday 6 June, 13:00 –14:30
  - Venue: 12.12.02
  - Covered by Xiaodong Li