COMP30024 Artificial Intelligence - Tutorial Problems (Part 1)

Questions based on exercises from Russell and Norvig (3rd edition) have the original question numbers shown in brackets. Many of these questions are designed to provoke discussion in tutorials, rather than having a simple, closed-form answer.

1. *What is AI? / Intelligent Agents*

1.1 (RN1.2) Turing's 1950 paper proposed the Turing Test for intelligence. He predicted that by 2000 a computer will have a 30% chance of passing the Turing Test with an unskilled interrogator.

Try the winner of the 2013 Loebner Prize: www.mitsuku.com – In your opinion, how successful is this Chatbot in passing the Turing Test? Can you find some conversations when it fails?

1.2 (RN1.11) "Surely computers cannot be intelligent - they can only do what their programmers tell them." Is the latter statement true, and does it imply the former?

1.3 (RN1.12) "Surely animals cannot be intelligent - they can only do what their genes tell them." Is the latter statement true, and does it imply the former?

1.4 (RN2.4) For each of the following activities, characterize the task environment in terms of its characteristics (i.e., is it observable, deterministic, etc):

a. Playing soccer.
b. Shopping for used books on the Internet.
c. Bidding on an item at an auction.

1.5 (RN2.2, 1st ed) For each of the environments in the following table, determine what type of agent architecture is most appropriate (i.e., simple reflex, model-based reflex, goal-based or utility-based).

Agent type	Medical diagnosis system
Percepts	Symptoms, test results, patient's answers
Actions	Questions, tests, treatments
Performance measure	Healthy patient, minimise costs, avoid lawsuits
Environment	Patient, hospital

Agent type	Satellite image analysis system
Percepts	Pixels of varying intensity and colour
Actions	Categorise image
Performance measure	Correct categorisation
Environment	Images from orbiting satellite

Agent type	Part-picking robot
Percepts	Pixels of varying intensity

Actions	Pick up parts and sort into bins
Performance measure	Place parts in correct bins
Environment	Conveyor belt with parts

Agent type	Refinery controller
Percepts	Temperature and pressure measurements
Actions	Open and close valves, adjust temperature
Performance measure	Maximise purity, yield and safety
Environment	Refinery

Agent type	Interactive English tutor
Percepts	Typed words
Actions	Print exercises, suggestions, corrections
Performance measure	Maximise student's score on test
Environment	Set of students

1.6 (RN1.8, 1st ed) Some authors have claimed that perception and motor skills are the most important part of intelligence, and that "higher-level" capacities are necessarily parasitic – simple add-ons to these underlying facilities. Certainly, most of evolution and a large part of the brain have been devoted to perception and motor skills, whereas AI has found tasks such as game playing and logical inference to be easier, in many ways, than perceiving and acting in the real world. Which do you think is the more important focus for AI – lower-level perception or higher-level reasoning?

2. *Solving Problems by Searching*

2.1 (RN3.9) Missionaries and cannibals is a classical formal problem, and is generally stated as follows.

> Three missionaries and three cannibals are on one side of the river. They all need to cross in a boat that only holds two people at once. There must never be a situation where there is a group of missionaries in one place who are outnumbered by cannibals.
>
> a. Formalise the missionaries and cannibals problem in terms of its goal, states, operators and path cost.
> b. Use depth first search to solve the problem.
> c. Is it necessary to avoid repeated states for this problem? Why?

2.2 (RN3.18) Can you think of a search space in which iterative deepening search performs much worse than depth-first search?

2.3 Derive the time complexity of the iterative deepening search.

2.4 At least one direction of bidirectional search must store all the nodes that are generated (e.g., by using breadth first search). Why is this necessary? What would be a good choice of search strategy for the other direction (e.g., breadth first search or depth first search), and can you explain why?

3. *Informed Search Methods*

3.1 (RN4.2) Come up with *heuristics* for the following problems. Explain whether they are admissible, and whether the state spaces contain local maxima with your heuristic

a. Path planning in the plane with rectangular obstacles.
b. Maze problems.
c. Algebraic equation solving
   (e.g., "solve for x: $x^2 * y^3 = 3 - xy$").
   Hint: Think of how you would solve for x if you were doing this by hand. Then think what would be the problem states leading to the solution when solving for x. Then think of some features of those states that could be used in a heuristic function.

3.2 (RN4.1) Suppose that we run a greedy search algorithm with $h(n) = -g(n)$. What sort of search will the greedy search emulate?

3.3 Generate the search graph for an A* search from Lugoj to Pitesti from the map of Romania. Use the following straight line distances to Pitesti: Craiova 130, Arad 360, Rimnicu Vilcea 210, Timosara 320, Mehadia 280, Dobreta 240