1. One approach to building intelligent computers is attempting to copy the way humans think and reason.

   a) Give TWO examples of how the history of ideas in psychology has informed the production of intelligent computers.

   (6 marks)

   b) Describe the **Turing Test** for identifying an intelligent computer and give TWO reasons why people have argued that it is not a true test of intelligence.

   (6 marks)

   c) Explain why Alan Turing's proof that the **Turing Machine** can program any intelligent system means that **physical symbol systems** can model intelligence.

   (8 marks)

   d) Explain FIVE reasons why the GRiST mental-health decision support system could be considered an example of computational intelligence (i.e. a system that has artificial intelligence within it).

   (10 marks)

2. Draw a suitable diagram of a search tree that can be used to illustrate how different search methods work. With reference to your tree diagram, describe the processes used by the following search methods:

   a) breadth-first search;                                    (4 marks)

   b) depth-first search;                                      (4 marks)

   c) best-first search;                                       (6 marks)

   d) A* search.                                               (6 marks)

3. Suppose you have been asked to run a society for your favourite sport or activity and want to encourage people to join it. Choose a sport or activity with which you are familiar and provide answers to the following tasks based on it.

a) Draw a **mind map** that represents what you think are the most important reasons why somebody should join your society. Your mind map should have at least FIVE concepts coming from the central node and a depth of THREE nodes (i.e. the path from the center node to the leaf node includes four nodes). *Your mind map will be used in other parts of the question so please read all parts of the question first to ensure your mind map is sufficiently detailed.*

(8 marks)

b) Based on your mind map, list the properties that people would be expected to possess if they are suitable members of your society and specify the range of values each property would have.

(6 marks)

c) Write a Lisp list that is a hierarchical list of **assocations lists** for representing an individual society member. It should be based on the structure of your mind map in Part (a) and the properties and values you specified for representing suitable members in Part (b). The properties can have any values you think a particular society member may possess but obviously they will need to lie in the range you defined for Part (b). *Hint: your list structure should represent knowledge about a society member in a similar way to how an individual house structure was represented in the intelligent knowledge-based system you developed in the lab classes for choosing somewhere to live.*

(6 marks)

d) Suppose you want a computer program to select people who would be suitable members of your society.

i) Specify in English (i.e. do not give the Lisp code) the steps a Lisp function called `rate-suitability` would need for rating the suitability of a potential member of your society. The input parameter to your function will be the list structure representing the person you want to rate, as represented in Part (c) of this question. The returned value will be the calculated rating based on the properties and values contained in the particular person's list.

(7 marks)

ii) Write the Lisp code for a function definition that would carry out the English steps you have specified in Part (i).

(8 marks)

4. The following set of rules, Rule 1 to Rule 3, is a simple **expert system** that defines relationships between facts represented as the single capital letters, X, Y, Z, A, B, C, and D:

```
Rule 1: If X AND Y THEN Z
Rule 2: If A THEN B
Rule 3: If C AND D THEN X
```

The starting facts that are already known about the system (i.e. the **working memory**) are: Y, C, and D.

A human user of the expert system wants to know whether the fact Z is TRUE. In other words, Z is a **goal**.

a) Explain how a **forward-chaining** reasoning process would use the rules and starting facts to determine whether the goal, Z, is TRUE. Your answer should show the sequence of rules leading to the goal, the consequent changes to the facts, and explain the following terms: **trigger**, **fire**, and **conflict resolution**.

(8 marks)

b) Explain how a **backward-chaining** reasoning process would use the rules and facts to find out whether the goal, Z, is true. Your answer should show the sequence of rules used to prove the goal and explain what happens at each step of the reasoning process.

(7 marks)

FORWARD

a) Try to match facts with rule conditions.

b) Rule 3 is the only match

c) Fire 3 and add X to facts

d) Match conditions again

e) Rule 1 and 3 match and are triggered

f) Conflict resolution: choose rule not fired.

g) Fire 1, Add Z to facts.

h) Z matches goal, so proved.

BACKWARDS

a) Goal is Z. See if it is in the fact base.

b) NO, so see if it is the conclusion of a rule.

c) Yes, R1.

d) Try to prove R1 and put both conditions on the proof list (X, Y).

e) Is X true? No, so find conclusion with X

f) R3 conditions on proof list instead of X (C, D, Y)

g) Is C true? Yes, matches facts. (D, Y)

h) Is D true? Yes, matches facts (Y).

i) Is Y ture? Yes, matches facts ()

j) Empty proof list so Z is proved.

END OF EXAMINATION PAPER