The University of Nottingham

SCHOOL OF COMPUTER SCIENCE

A LEVEL 1 MODULE, SPRING SEMESTER 2013-2014

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Time allowed TWO hours

Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced

Answer ALL FOUR questions

No calculators are permitted in this examination

Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.

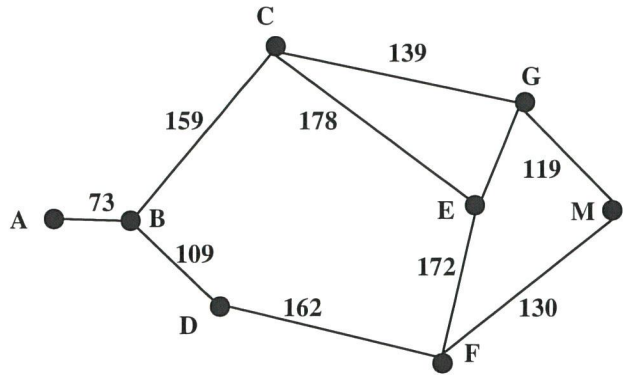
DO NOT turn your examination paper over until instructed to do so

ADDITIONAL MATERIAL: N/A

INFORMATION FOR INVIGILATORS:
To include any announcements or to indicate if the paper needs to be collected in at the end of the exam.

1. Heuristic Search

Consider the following map (not drawn to scale).



Use the A* algorithm to find a route from A to M in the map. In the cost function:
G(n) = cost of path from A to n based on the distance between towns (shown on map).
H(n) = Straight Line Distance between n and M, shown in the table below.

Straight Line Distance to M

A	223	D	192	G	122	J	60	M	0
B	222	E	165	H	111	K	32		
C	166	F	136	I	100	L	102		

(a) Provide the search tree for your solution, showing the order in which the nodes were expanded and the cost at each node. You should not re-visit the town that you just came from.

(15 marks)

(b) State the route you would take and the cost of that route.

(2 marks)

(c) Compare the cost function in A* search against that of the Uniform-Cost-Search and Greedy Search.

(3 marks)

(d) What does "admissible heuristic" mean? Why is it important that the heuristic used be admissible?

(3 marks)

(e) Explain the heuristic used in the above cost function. Is it admissible?

(2 marks)

2. Game Playing

Consider a **variation** of the two player game Nim. The game has the following rules:

The game starts with a single stack of 5 tokens. At each move a player removes one, two or three tokens from the pile, leaving the pile non-empty (unlike in Nim, where the player divides the pile). A player who has to remove the last token loses the game.

(a) Draw the complete search tree for this variation of Nim.

(8 marks)

(b) Assume two players, min and max, play the game described as above. **Max plays first**.

If a terminal state in the search tree developed above is a win for min, a utility function of -1 is assigned to that state. A utility function of 1 is assigned to a state if max wins the game.

Apply the minimax algorithm to the search tree to assign utility functions to all states in the search tree.

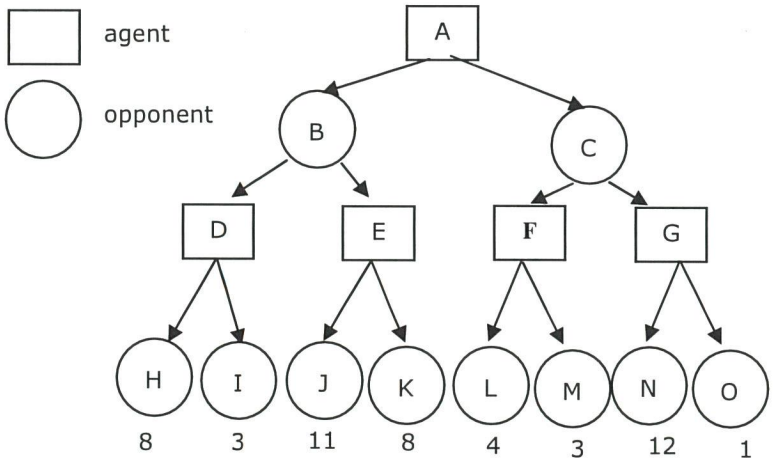
(5 marks)

(c) If both min and max play a perfect game above, who will win? Explain your answer, showing the path that the game would take in the tree.

(3 marks)

(d) Given the following search tree, apply the alpha-beta pruning algorithm to it and show the search tree that would be built by this algorithm. Show the order that the nodes are expanded. Make sure that you show where the alpha and beta cuts are applied and which parts of the search tree are pruned as a result. Explain why the alpha and beta cuts occur.

(9 marks)



3. Neural Networks

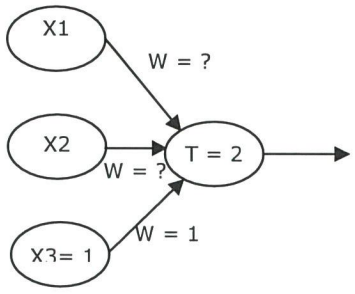
(a) Given the truth table below, is it possible for a perceptron to learn the required output? Explain the reason behind your decision.

Input X1	0	0	1	1
Input X2	0	1	0	1
Output Y	0	1	1	0

(7 marks)

(b) The truth table of a function is given in the table below. Based on the partial perceptron given below, complete the weights for X1, X2 and X3 to implement the required function. The threshold T of the perceptron is 2.

Input X1	0	0	1	1
Input X2	0	1	0	1
Input X3	1	1	1	1
Output Y	0	0	0	1



(6 marks)

(c) Write the pseudo-code of the learning algorithm in neural networks.

(6 marks)

Define learning rate, and its effect on the learning process.

(6 marks)

4. Miscellaneous

(a) Consider the following knowledge base in conjunctive normal form:

1) A V B V C
2) ¬B V ¬D
3) ¬C
4) D

Use proof by resolution to prove that the knowledge base entails A.

(7 marks)

(b) In data mining, what are the relationship and differences between clustering and classification?

(5 marks)

(c) Briefly describe the Turing Test and its objective. Provide an example of a Turing Test in real life. Criticize Turing test by providing an example of objection.

(7 marks)

(d) Match the following AI pioneers to the areas with which they are associated.

1. Samuel	a) Seminal work for checkers
2. Hebb	b) The term of AI
3. Schaeffer	c) First neural networks learning rule
4. John McCarthy	d) Chinese room experiment
5. Shannon	e) Chinook
6. John Searle	f) Seminar work on complexity of chess

(6 marks)

End