The University of Nottingham Ningbo China

SCHOOL OF COMPUTER SCIENCE

A LEVEL 1 MODULE, SPRING SEMESTER 2016-2017

FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

Time allowed: Ninety (90) Minutes (1.5 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 THREE questions

The exam accounts for 75% (75 marks) of the module. Each of the three questions contributes to 25 marks

Only silent, self-contained calculators with a Single-Line Display or Dual-Line Display are

permitted in this examination.

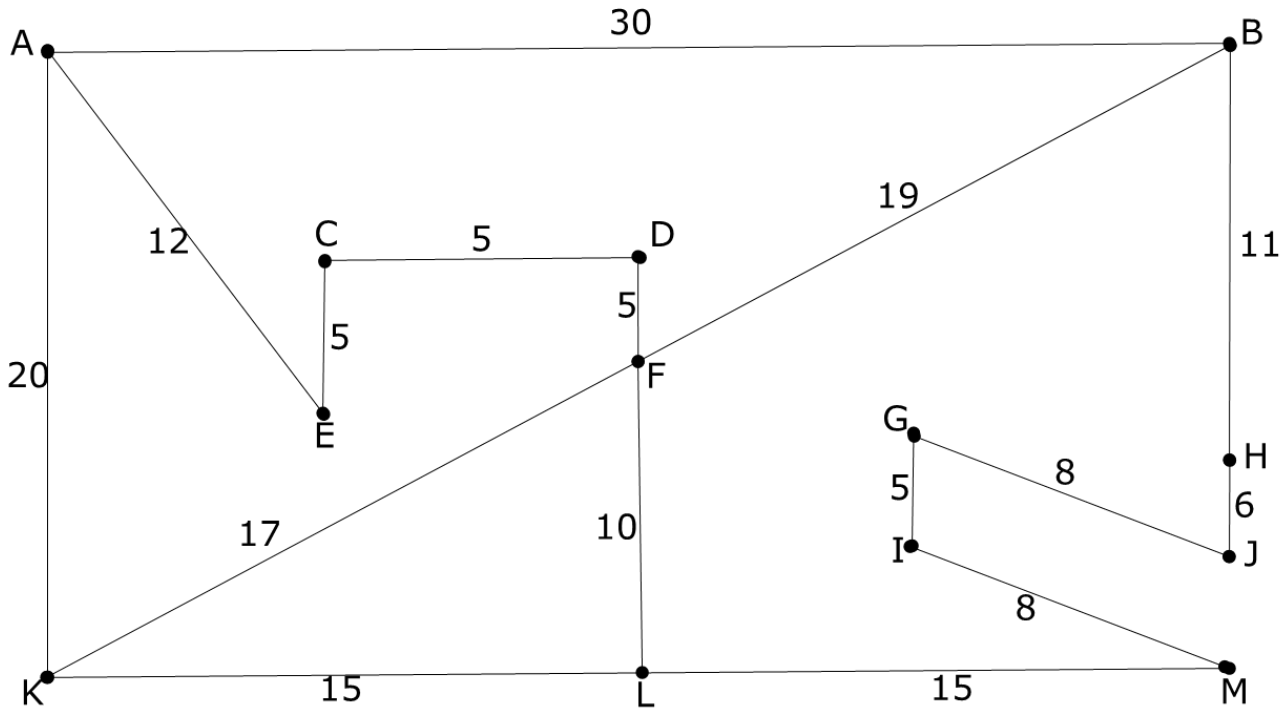
Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

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

DO NOT turn examination paper over until instructed to do so

Question 1: Search and AI basics

a. Use A* algorithm to find the shortest route starting from city A to city M in the figure below (not drawn to scale).



Straight line from A … L to M

A	36
B	22
C	30
D	29

E	24
F	23
G	12
H	10

I	7
J	5
K	29
L	14

M	0

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 a city that you have just come from.

[12 Marks]

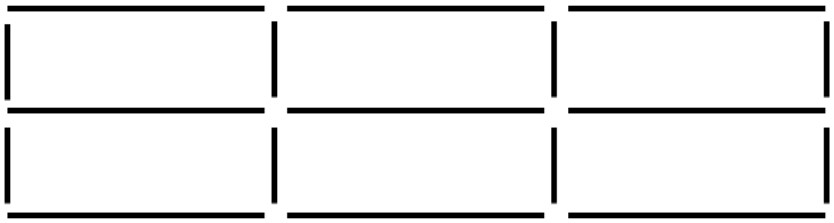
b. What does admissible mean? Why is it important that the heuristic used be admissible? How to evaluate two heuristic functions if both of them are admissible?

[5 Marks]

c. Describe the Chinese Room experiment. What view is the Chinese Room argument attempting to rebut?

[4 Marks]

d. Given the layout of 17 sticks shown in the figure, you are required to remove exactly 5 sticks in such a way that the remaining configuration forms exactly 3 squares. Given two different operators as shown below, calculate the corresponding size of the state space.
   i) Operator A: remove five sticks at a time.
   ii) Operator B: remove three squares at a time.



[4 Marks]

End of Question 1: Total 25 marks

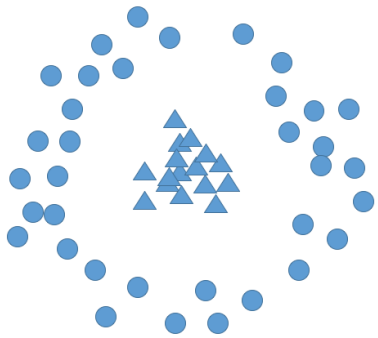
Question 2: Machine Learning

a. In data mining, describe the differences between clustering and classification.

[4 Marks]

b. For the following two classes of points (class triangle and class circle), state and explain whether it is possible for a single-layer perceptron to learn the required output. Design and draw the structure of neural network that could be used to classify the two classes (with minimal number of neurons). Explain the reason behind your design by showing how many lines can be learned together to shape the 2D space. (hint: the number of hidden layers, number of neurons, as well as their usage).

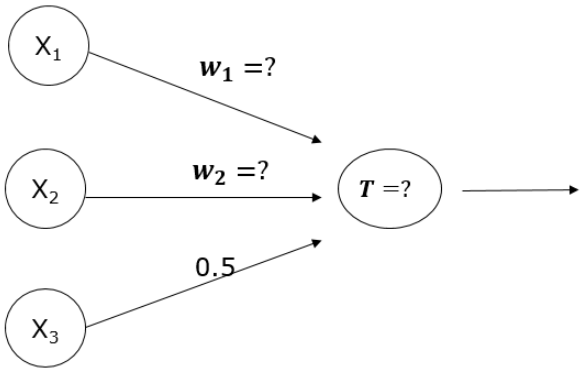
[9 Marks]



c. The truth table of a function is given in the table below. Based on the partial perceptron given below, complete the weights for X_1, X_2 and threshold T (assuming step function is used as the activation function) to implement the required function.

[6 Marks]

X_1	X_2	X_3	OUTPUT
0	0	1	0
0	1	1	0
1	0	1	1
1	1	1	1



d. In neural networks, in the context of error back propagation learning, define learning rate and explain its effect on the learning process.

[6 Marks]

End of Question 2: Total 25 mark

Question 3: Game Playing

a. Nim is a two player game in which players alternate making moves. Initially the players are given several piles of sticks. Each pile can have any number of sticks in it. On each turn a player can remove any number of sticks from one pile. The player must remove a minimum of one stick from the pile or may remove the whole pile. The player who picks up the last stick **loses**.

i) Initially there are three piles with number of sticks equal to (1, 2, 2). Draw the complete search tree for this game. Note, piles of (a, b, c) and (a, c, b) are treated as the **same** states, e.g. (1, 2, 1) is the same as (1, 1, 2).

[10 Marks]

ii) Assume two players, min and max, play this stone game. Max plays first. With a utility function values:
= 0 if min wins the game
= 1 if max wins the game
Apply the minimax algorithm to the search tree to assign utility functions to all states in the search tree

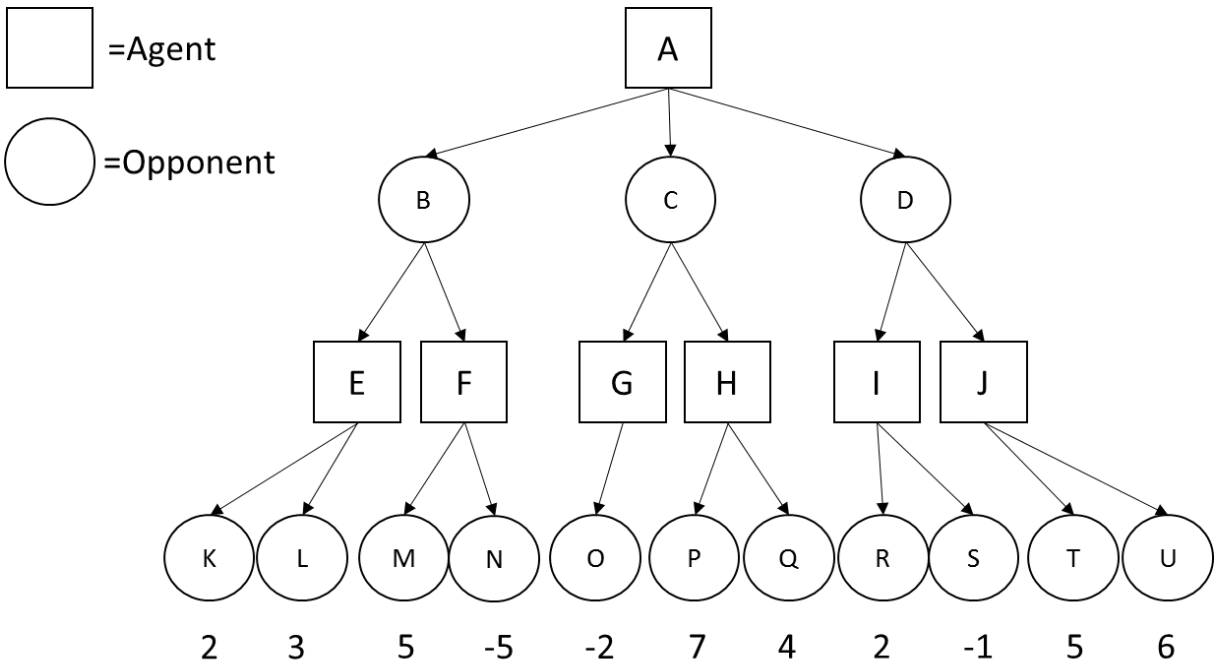
[5 Marks]

iii) If both min and max play a perfect game, who will win? Explain your answer.

[2 Marks]

b. 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. 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.

[8 Marks]



End of Question 3: Total 25 marks

End