National University of Computer and Emerging Sciences, Lahore Campus

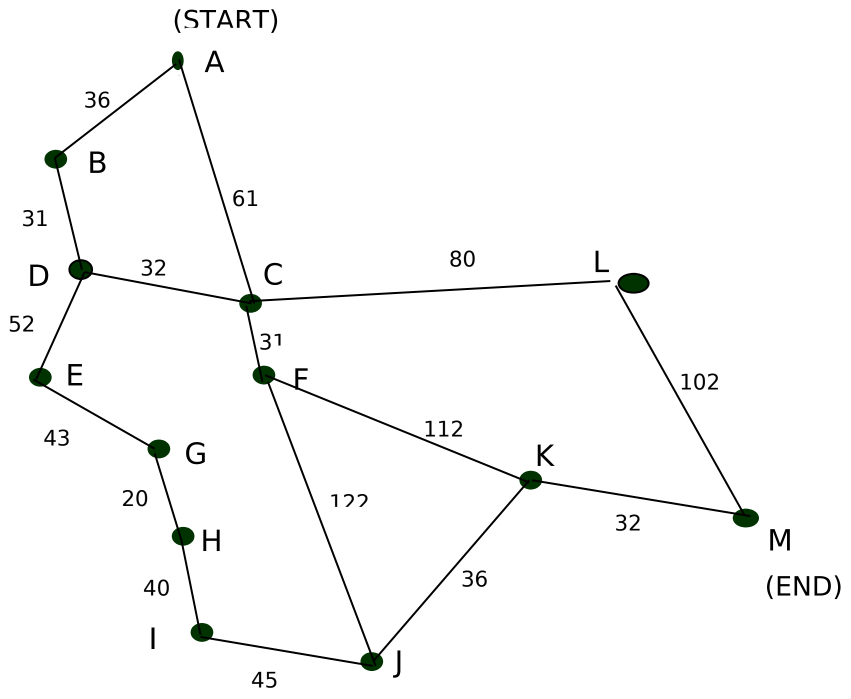
Course Name:	Artificial Intelligence	Course Code:	CS 401
Program:	BS (Computer Science)	Semester:	Spring 2020
Duration:	60 Minutes	Total Marks:	75
Paper Date:	25-2-2020	Weight	15
Section:	All	Page(s):	6
Exam Type:	Mid I		

Student Name:
Registration #: Section:

Instructions: No rough sheets needed.

Q1. A* Search Algorithm: (25)

Consider the following map.



Using the A* algorithm avoiding repeated states, work out a route from town A to town M.

Use the following cost functions.

- g (n) = The cost of each move as the distance between each town (shown on map).
- h (n) = The Straight Line Distance between any town and town M. These distances are given in the table below.

Provide the search tree for your solution and indicate the order in which you expanded the nodes. Finally, state the route you would take and the cost of that route.

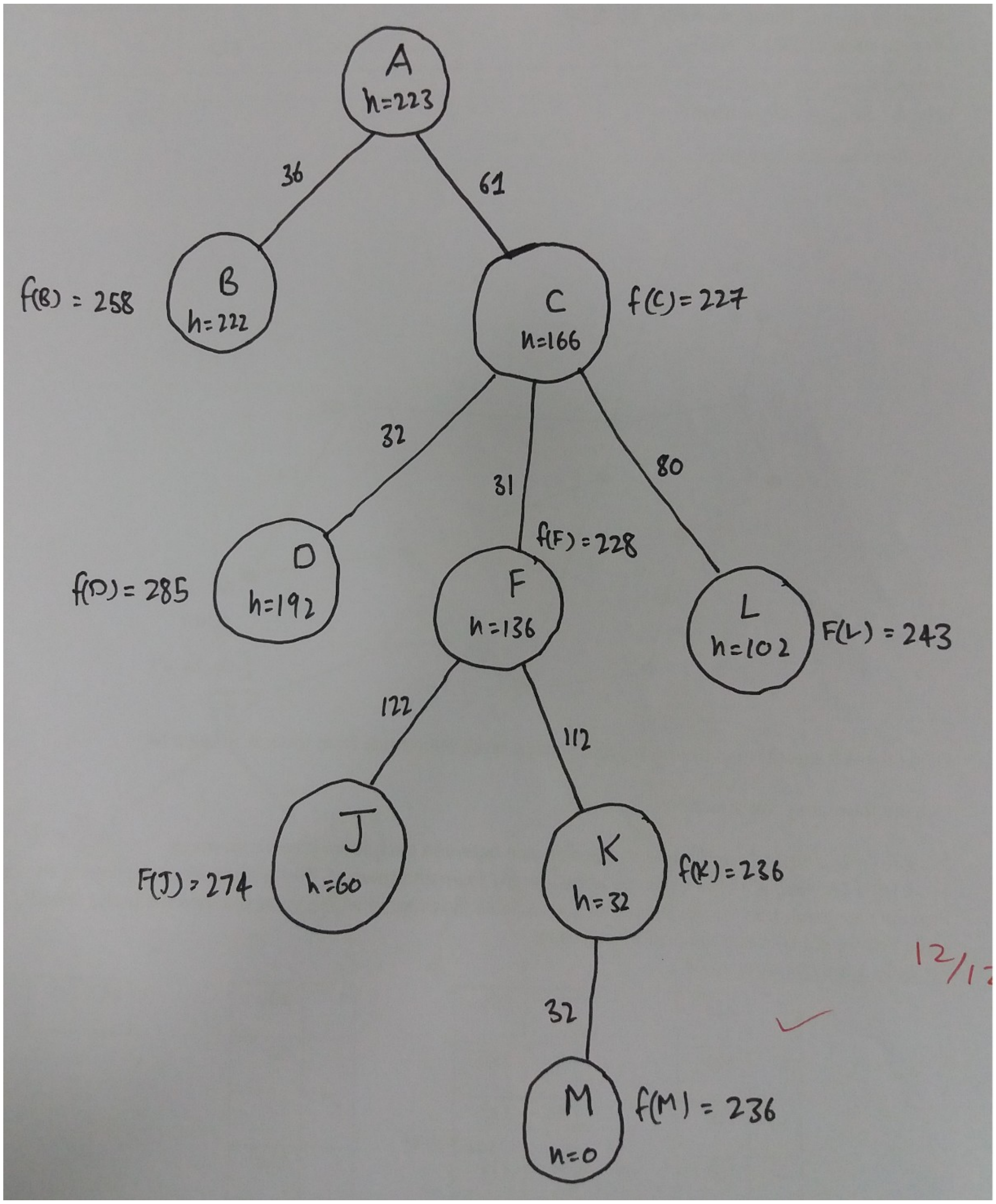
Straight Line Distance to M

A	223	E	165	I	100	M	0
B	222	F	136	J	60		
C	166	G	122	K	32		

D	192	H	111	L	102

In your answer provide the following:

i) The search tree that is produced, showing the cost function at each node (12 marks)



ii) State the order in which the nodes were expanded (5 marks)

ACFKM

State the route that is taken, and give the total cost (4 mark)

ACFKM

Explain the relationship between the A* algorithm and the Uniform Cost Search algorithm? (4 marks)

A*: f(n) = g(n) + h(n)
Uniform Cost Search = f(n) = g(n)

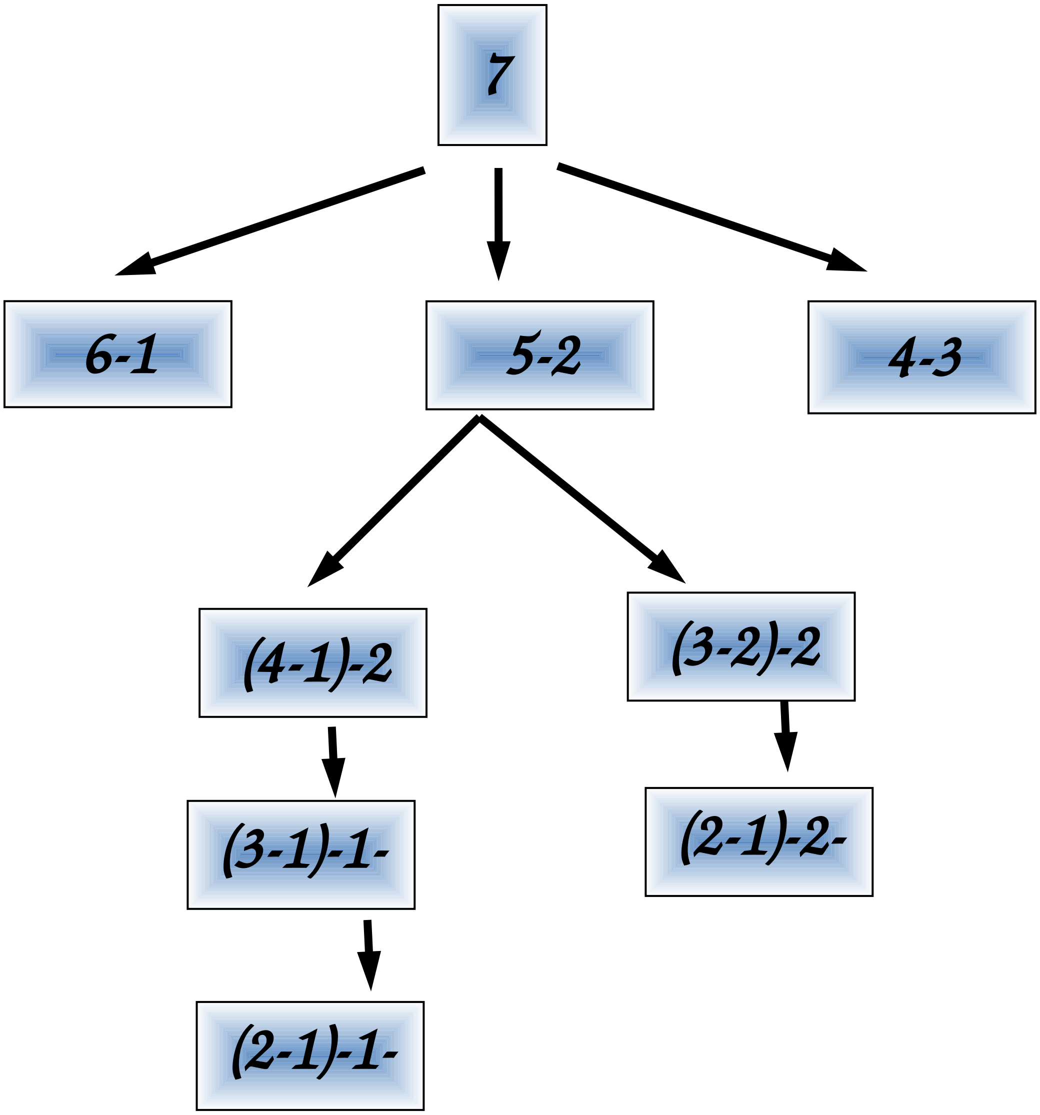
Reference:
When all step costs are equal, breadth-first search is optimal because it always expands the shallowest unexpanded node. By a simple extension, we can find an algorithm that is optimal with any step-cost function. Instead of expanding the shallowest node, uniform-cost search expands the node n with the lowest path cost g(n).

<u>Q2</u>: Nim is a two-player game The rules are as follows. (25)

The game starts with a single pile of 7 tokens. At each move a player selects one stack and divides it into two non-empty, non-equal piles. A player who is unable to move loses the game.

a. Moving first a human player chose to divide the pile of 7 tokens into a two piles of sizes 5 and 2 respectively as shown below. It is turn of auto-player. Draw the complete search tree for the auto-player.

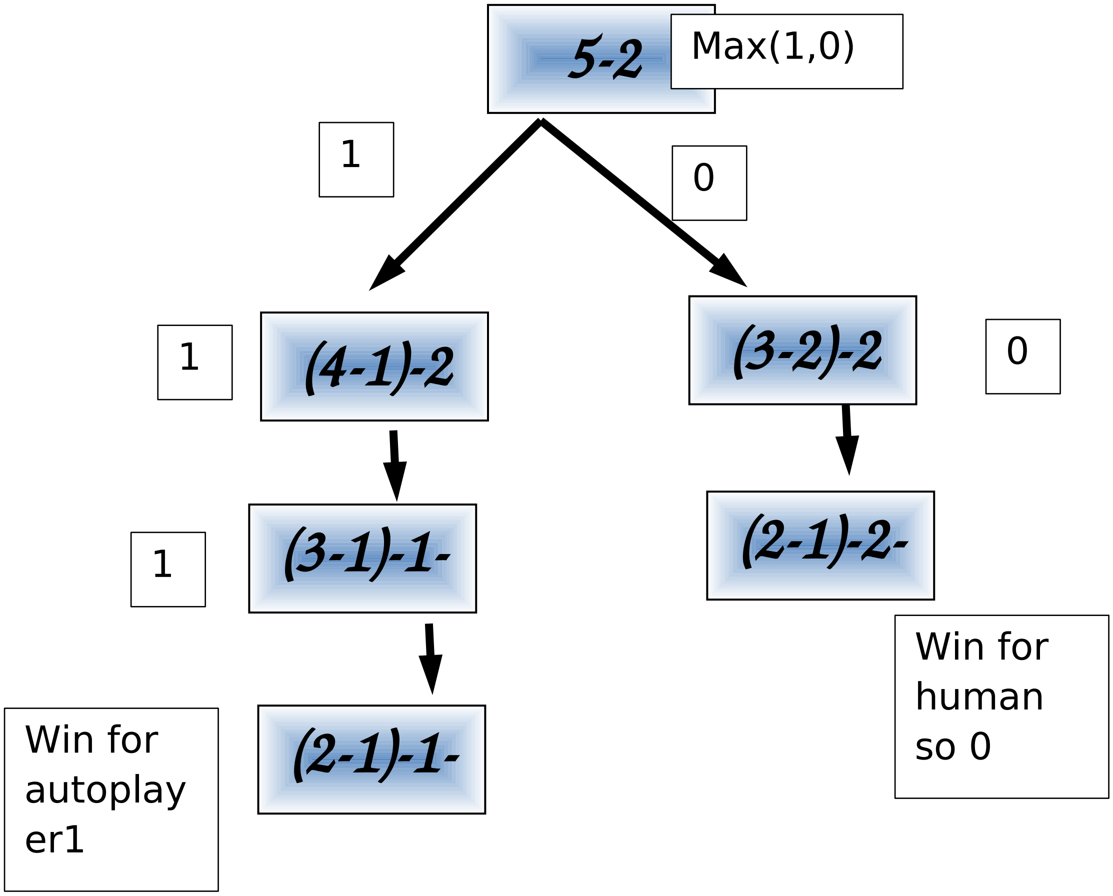
b.



(b) Assume two players, min and max, play nim (as described above). If a terminal state in the search tree developed above is a win for min, a utility function of zero is assigned to that state. A utility function of 1 is assigned to a state if max wins the game.

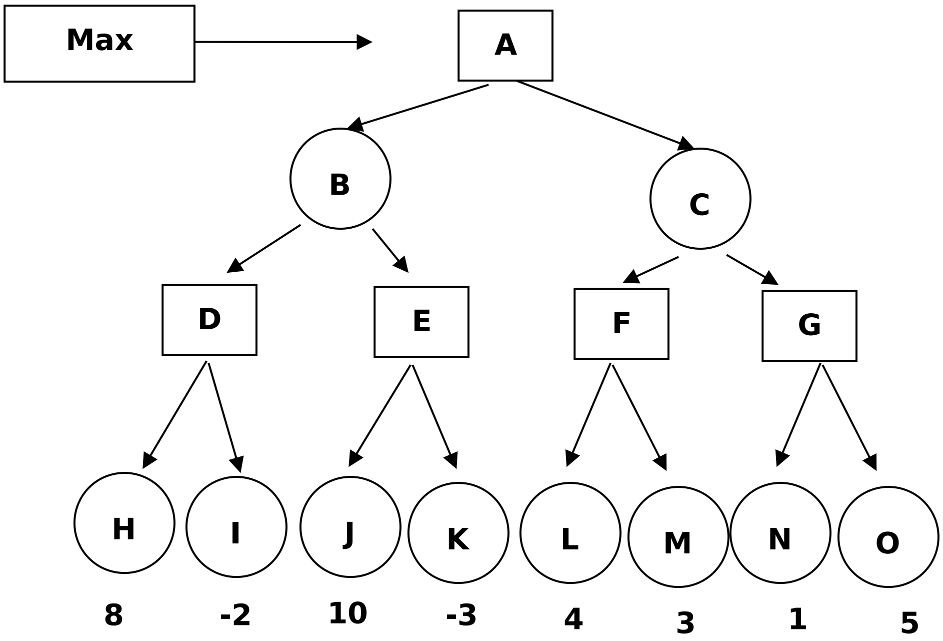
Apply the minimax algorithm to the tree drawn in pervious question and decide the move auto-player must make.

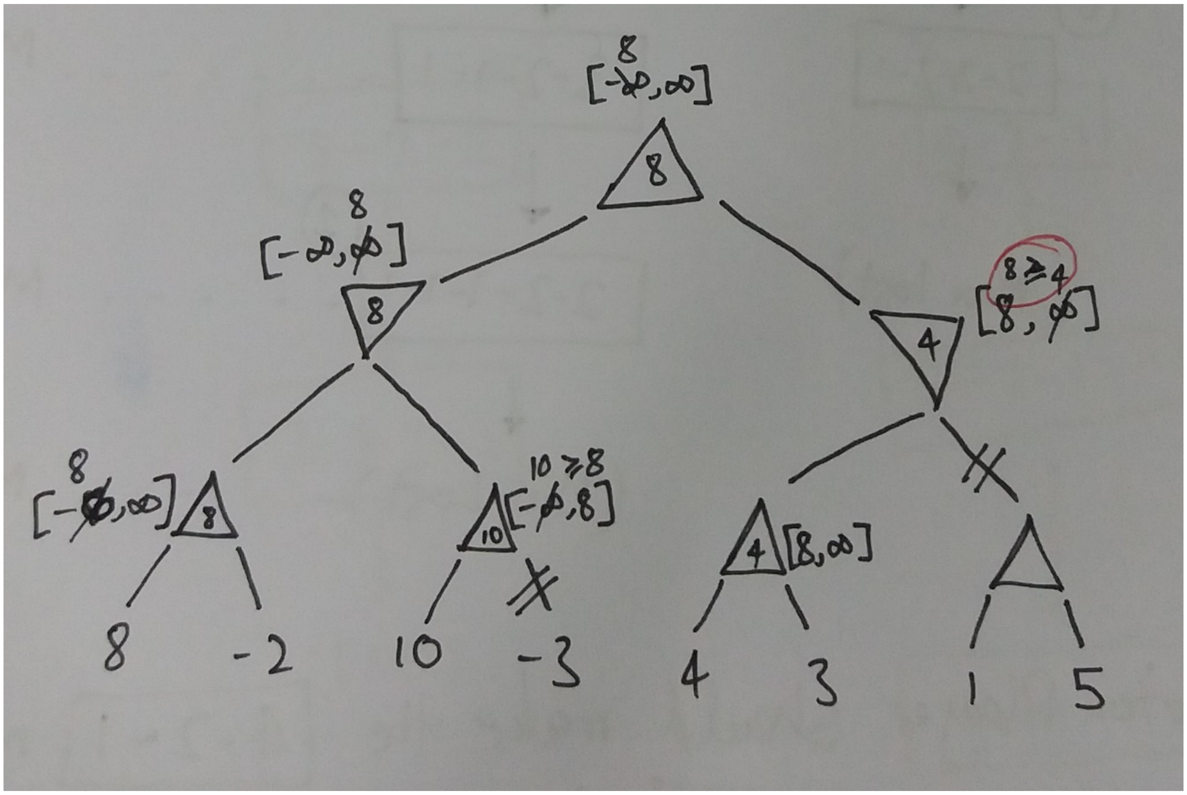
Assuming computer is max



Q3: Given the following search tree, apply the alpha-beta pruning algorithm to it and show the move 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. Assume the nodes are explored from **left to right**.

(25)





Should be 8>=8

Good Luck