National University of Computer and Emerging Sciences, Lahore Campus

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	Course Name:	Artificial Intelligence	Course Code:	CS 401
	Program:	BS(CS)	Semester:	Spring 2020
	Duration:	40 Minutes	Total Points:	15
	Paper Date:	Thursday, February 20, 2020	Weight	3%
	Section:	E, F	Page(s):	4
	Exam Type:	Quiz 1		

Student : Name:_____ Roll No._____ Section:_____

Problem. Adversarial Search   [1 + 1 + 1 + 2 +2 Points]

Consider the game tree picture below where A-F represent some real values. Assume the nodes are explored from left to right and standard alpha beta pruning is used.
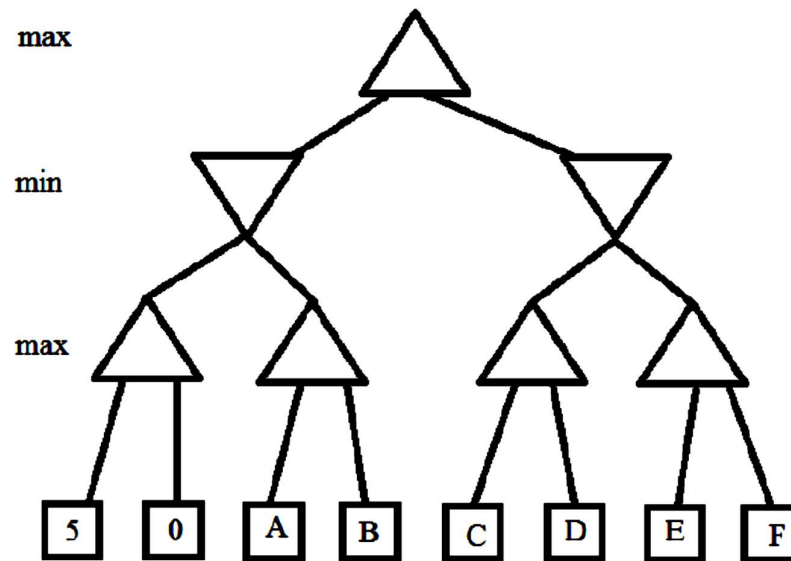
Part a) Give all values of **A** such that **B** is pruned.

Part b) [True or False] There are SOME values of A and B such that the sub-tree containing C and D is pruned? If true specify the values and if false give a reason

Part c) Assuming that B = 5 and A = 5, give a value of C and D such that the sub-tree containing E and F is pruned.

Part d) For what values of A, B, C, D, E, and F none of the nodes will be pruned by the alpha-beta pruning algorithm. **(More than one possible answers)**
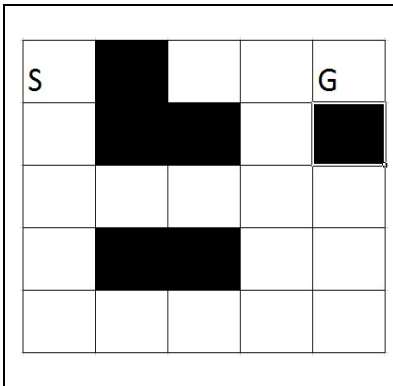
Part e) For what values of A, B, C, D, E, and F a maximum of the nodes will be pruned by the alpha-beta pruning algorithm Specify all pruned nodes for the values you specify and also mark all pruned nodes. **(More than one possible solution)**

Problem A* Search [3 + 5 Points]

Given the following maze with S marking the start state cell and G marking the goal cell. An intelligent agent can move in this maze either horizontally or vertically while moving along a diagonal is not allowed. Black Cells are blocked and hence an agent cannot move into these cells.

Part a) Define a suitable heuristic for this problem. Your heuristic must be accurate and easy to compute.

Part b) Show the order of cells expanded and the path returned by **A*** algorithm using your heuristic. Mark the start cell as 1 and the next cells as 2, 3, .. to show the order of expanded nodes and mark the path returned by the algorithm on the figure.

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Problem. Adversarial Search   [3 + 7 Points]

Connect Four is a two-player connection game in which the players first take turns dropping marked discs (**Marked X disc** for computer player and **Marked O disc** for human player) from the top into a **seven-column, six-row** vertically suspended grid. The pieces fall straight down, occupying the next available space within the column.

The objective of the game is to **connect four** discs of the **same mark** next to each other **vertically**, **horizontally**, or **diagonally** before your opponent.

After taking the exciting course of AI at FAST some of our students have implemented an auto-player of connect-4 that uses MINIMAX algorithm with alpha-beta pruning to play the game.

While playing the game the auto-player (marking **X**) reached the following board position and it is his turn to make a move.

Row Number	1	2	3	4	5	6
7	O	X	O	X		
6	X	O	X	X		
5	X	O	X	O	X	
4	X	X	X	O	O	O
3	O	X	O	X	O	O
2	O	O	X	X	O	O
1	X	O	O	O	X	X

Column No

Part a)   **[2 Points]**

Draw a complete game tree that will be used by the auto-player to make the move.

Part b)   **[5 Points]**
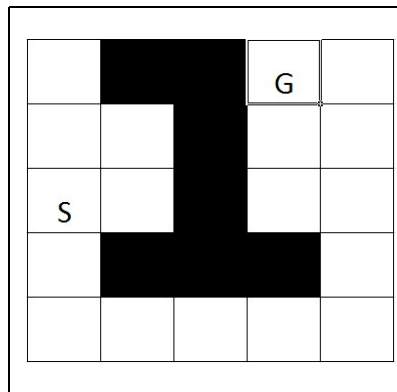
Use the MINIMAX algorithm to determine the move of auto-player. Which part of the tree will be pruned by the auto-player if he always expand the nodes from left to right in your game tree?

Problem A* Search   **[3 + 5 Points]**

Given the following maze with S marking the start state cell and G marking the goal cell. An intelligent agent can move in this maze either horizontally or vertically while moving along a diagonal is not allowed. Black Cells are blocked and hence an agent cannot move into these cells.

Part a) Define a suitable heuristic for this problem. Your heuristic must be accurate and easy to compute.

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Problem. Adversarial Search   [2 + 5 Points]

At some point in a two player game the possible actions for the two players are shown in the following tree.
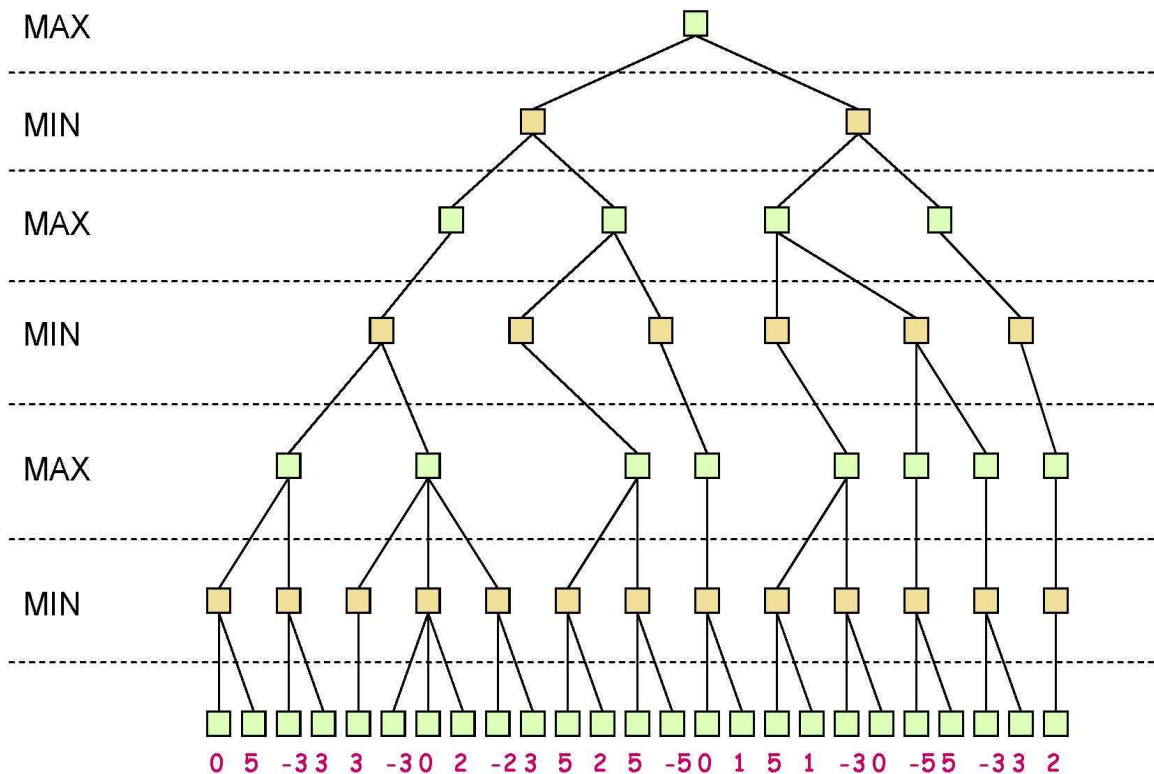
Assume that MINIMAX algorithm with alpha-beta pruning is used to determine the move for MAX at this point in the game.
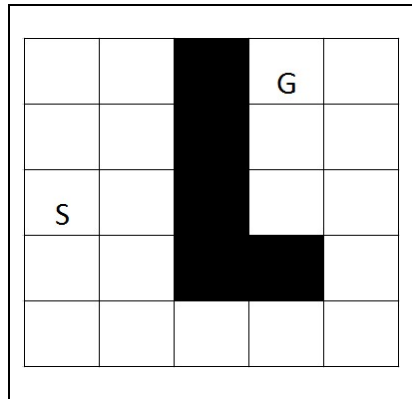
Determine
- the minimax value of each of the nodes in this tree

- the nodes that will be pruned and value of alpha and beta when the pruning decision was taken

Problem A* Search **[3 + 5 Points]**

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