National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	Artificial Intelligence	Course Code:	AI2022
	Program:	BS(CS)	Semester:	Spring 2022
	Duration:	40 Minutes	Total Points:	20
	Paper Date:	Monday, 31st May 2022	Weight	3%
	Section:	G, H	Page(s):	
	Exam Type:	Review Quiz		

Student : Name:_____ Registration No._____

Problem 1:   [3,2,2,1,1,1 Points]

The eight puzzle can be solved by successively moving the empty space Up (U), Down (D), Left (L) or Right (R). Moving the empty space corresponds to moving a corresponding tile. This problem can be posed as a state-space graph search problem with each board position being represented by the state and each move {U, D, L, R} have a unit cost. The *total number of tiles out of place* can be a useful heuristic to guide the graph search function. Assume that the puzzle is to be solved using the following initial and final states and repeated states are to be avoided during the search

Initial State			Final State		
1		3	1	2	3
4	2	6	4	5	6
7	5	8	7	8	

   a) Show the working of A* algorithm for solving this eight puzzle in the form of a tree that clearly shows:

- Solution (sequence of moves) found by the algorithm.
- Nodes that are expanded by A*, and their expansion order (by numbering nodes as 1, 2, …)
- Nodes in the open queue when the goal is found

   b) While solving the above puzzle, what is the minimum and maximum number of nodes expanded by each of the following graph search algorithms? Provide a solid justification for your answer

- Breath First Search
- DFS
- Uniform Cost Search

Problem 2:   [3, 3 Points]

The tic-tac-toe game is played on a 3x3 board with players taking turns. Each player marks a single cell during the turn. To win the game a player has to mark three consecutive horizontal, vertical or diagonal cells.

a) Following is the state of a tic-tac-toe game and it is turn of the player marking X. Which move will be selected by the player if the player is using **minimax** algorithm for selecting the move. Show the working by making the complete game tree used by minimax for move selection and then use it to select the move.
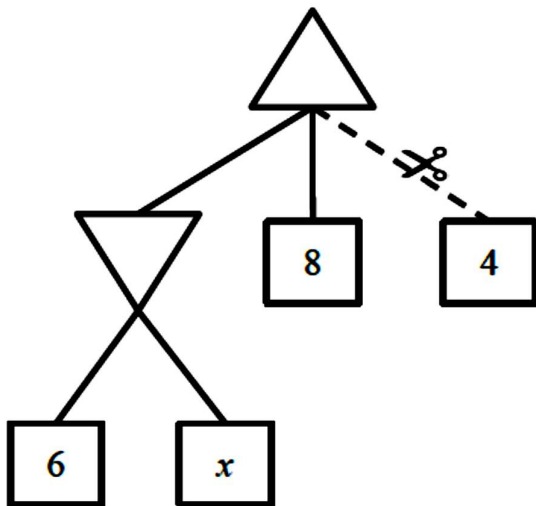
	X	O
X		O
O		X

b) Which parts of the tree will be pruned if the nodes are always expanded from left to right in your game tree?
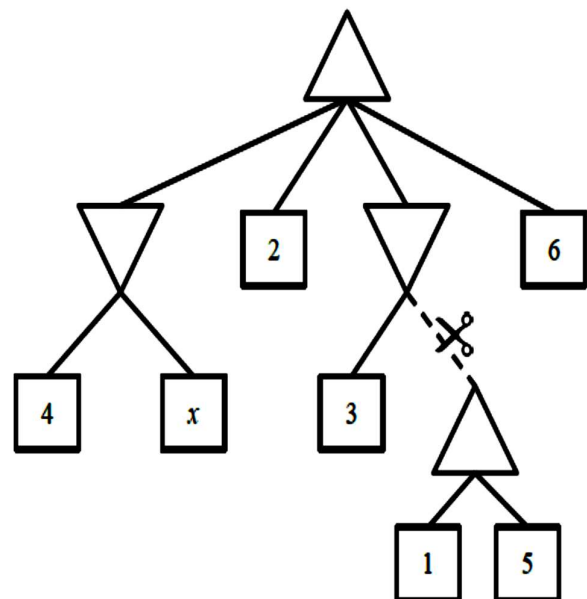
Problem 3   [2 + 2 Points]

For each of the game-trees shown below, state for **which values of x** the dashed branch with the scissors will be pruned. If the pruning will not happen for any value of **x write \none**". If pruning will happen for all values of **x write \all.**

X_____

X_____

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Problem 1:   [3,2,2,1,1,1 Points]

The eight puzzle can be solved by successively moving the empty space Up (U), Down (D), Left (L) or Right (R). Moving the empty space corresponds to moving a corresponding tile. This problem can be posed as a state-space graph search problem with each board position being represented by the state and each move {U, D, L, R} have a unit cost. The *total number of tiles out of place* can be a useful heuristic to guide the graph search function. Assume that the puzzle is to be solved using the following initial and final states and repeated states are to be avoided during the search

Initial State				Final State		
1		3		1	2	3
4	2	6		4	5	6
7	5	8		7	8	

c) Show the working of A* algorithm for solving this eight puzzle in the form of a tree that clearly shows:
- Solution (sequence of moves) found by the algorithm.
- Nodes that are expanded by A*, and their expansion order (by numbering nodes as 1, 2, …)
- Nodes in the open queue when the goal is found

d) While solving the above puzzle, what is the minimum and maximum number of nodes expanded by each of the following graph search algorithms? Provide a solid justification for your answer
- Breath First Search
- DFS
- Uniform Cost Search

Problem 2: [3, 3 Points]

The tic-tac-toe game is played on a 3x3 board with players taking turns. Each player marks a single cell during the turn. To win the game a player has to mark three consecutive horizontal, vertical or diagonal cells.

c) Following is the state of a tic-tac-toe game and it is turn of the player marking X. Which move will be selected by the player if the player is using **minimax** algorithm for selecting the move. Show the working by making the complete game tree used by minimax for move selection and then use it to select the move.
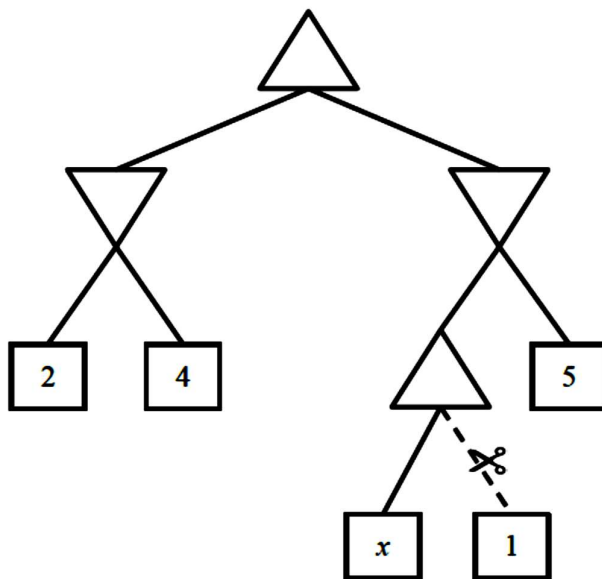
	X	O
X		O
O		X

d) Which parts of the tree will be pruned if the nodes are always expanded from left to right in your game tree?
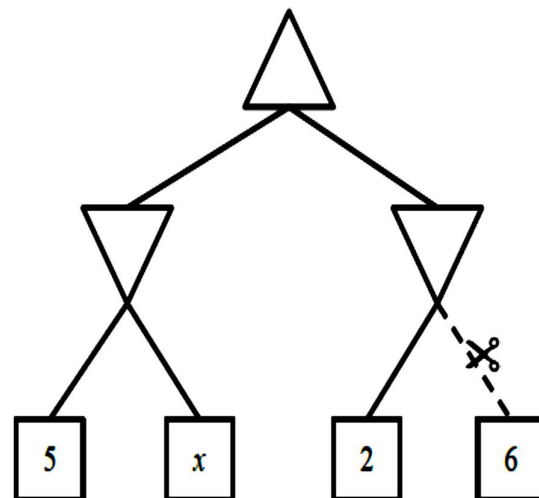
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For each of the game-trees shown below, state for **which values of x** the dashed branch with the scissors will be pruned. If the pruning will not happen for any value of **x write \none"**. If pruning will happen for all values of **x write \all.**

X_____

X_____