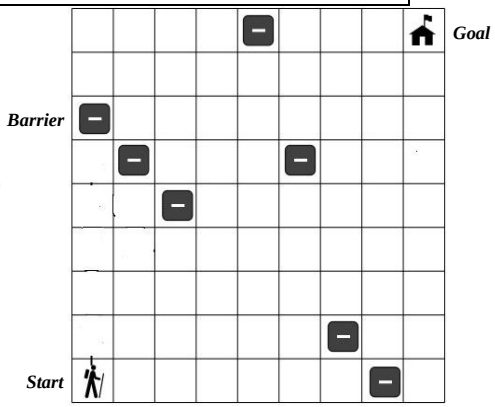
National University of Computer & Emerging Sciences, Karachi
Spring-2022 CS-Department
Midterm I Solution
March 8, 2022 Slot: 10 AM – 11 AM

Course Code: CS AI2002	**Course Name: Artificial Intelligence**
Instructor Name:	**Dr Fahad / Saeeda Kanwal / Waheed Ahmed/ Sohail Afzal/ Dr Muhammad Farrukh**
Student Roll No:	**Section No:**

- Return the question paper.
- Read each question completely before answering it. There are **4 questions and 2 pages.**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict with any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- Be specific, to the point while coding, logic should be properly commented, and illustrate with diagram where necessary.

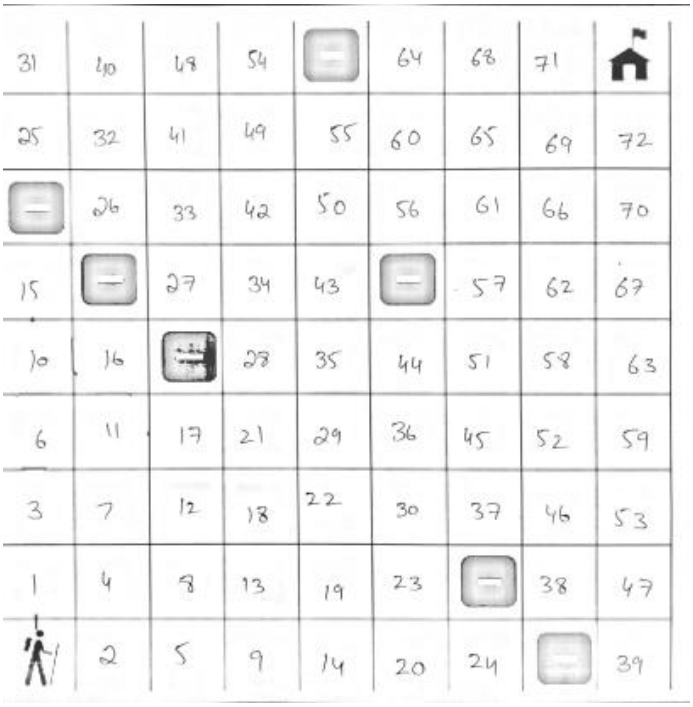
Time: 60 minutes. **Max Marks**: **50 points**

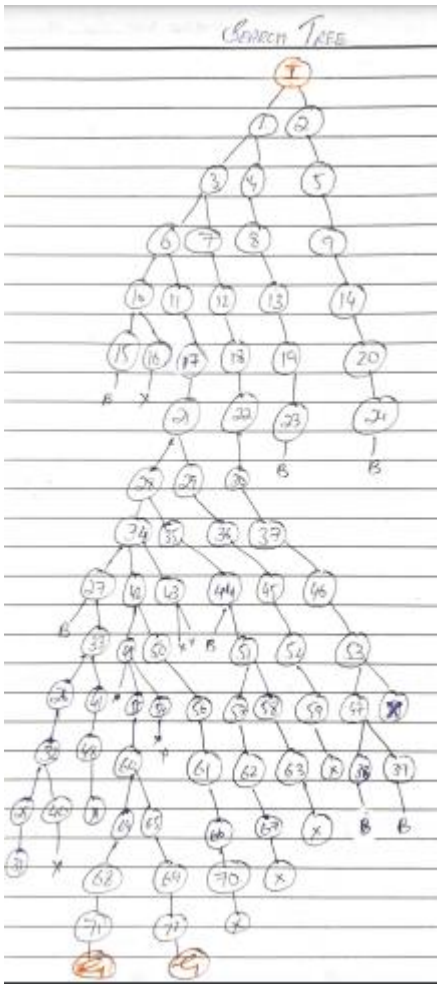
Question No. 1 **[Time: 20 Min] [Marks: (15)]**



You are on an Annual Kashmir trip with Fastians and according to the day-wise planning you must stay for a night at the peaks of Arang Kel but due congestion on a road, you must hike towards the hotel with your friends. In your group luckily you are more intelligent who could implement BFS and DFS algorithms under described scenario above and will inform them which algorithm is better to reach at the destination. Tell the search nodes first and then tell the pathway followed using both the strategies. You are required to carry out following tasks: Draw the Search Tree, *2.* Successor / Transition States: Represent with Digits, *3.* Avoid blocked paths, *4.* Actions: vertical and horizontal, not diagonal, *5.* Apply blind search algorithms (*BFS* and *DFS)* and avoid visiting same nodes (graph search).

Solution:





BFS = 1→2→3→4→5→6→7→8→9→10→11→12→13→14→15→16→17

→18→19→20→21→22→23→24→25→29→30→34→

→35→36→39→27→42→43→44→45→46→33→49→50

51→52→53→26→41→55→54→56→57→58→59→47

32→48→60→61→62→63→38→39→25→40

→64→65→66→67→31→68→69→70→71→72→G.

Path Cost 73

DFS = 28

I→3→6→10→15→16→11→17→21→28→34→27→33

26→32→25→31→40→41→48→42→49→55→60

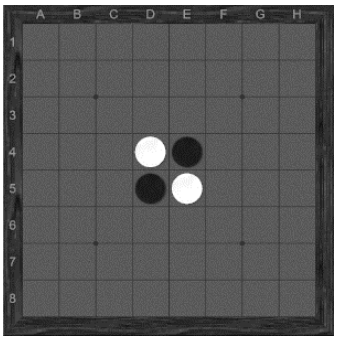
64→68→71→G

DFS Best

Question No. 2	**[Time: 10 Min] [Marks: (10)]**

For A game of Othello in *8 x 8* board. Each player takes 32 discs and chooses one colour to use throughout the game. Black places two black discs and white places two white discs as shown below.

A move consists of "outflanking" your opponent's disc(s), then flipping the outflanked disc(s) to your colour. To outflank means to place a disc on the board so that your opponent's row (or rows) of disc(s) is bordered at each end by a disc of your colour. (A "row" may be made up of one or more discs).



Othello rules:

1.Black always moves first.
2. If on your turn you cannot outflank and flip at least one opposing disc, your turn is forfeited and your opponent moves again. However, if a move is available to you, you may not forfeit your turn.

3: A disc may out flank any number of discs in one or more rows in any number of directions at the same time- horizontally, vertically, or diagonally.

4: Players may not skip over their own colour disc(s) to outflank an opposing disk.

Perform the followings:

A) Classify the characteristics of the environment for Othello according to the following properties and explain the analyzed reason for each of your four choices

1) Fully observable/partially observable 2) Deterministic/stochastic 3) Episodic/sequential

4) Static/dynamic/semi-dynamic 5) Discrete/continuous

B) Specify the task environment *(PEAS)* of Othello puzzle?

Solution:

Q2: Fully Observable, Deterministic, Static, Discrete, Sequential

PEAS ⇒ Performance Measure = Rules Followed, Successful

Environment = 8×8 Board

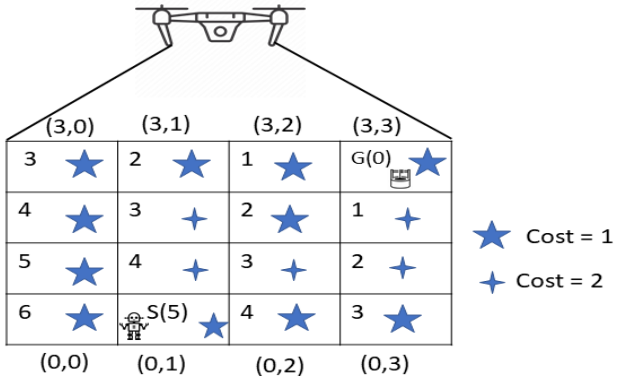
Actuator = keyboard, Touch Screen

Sensor = Screen (I), Mouse

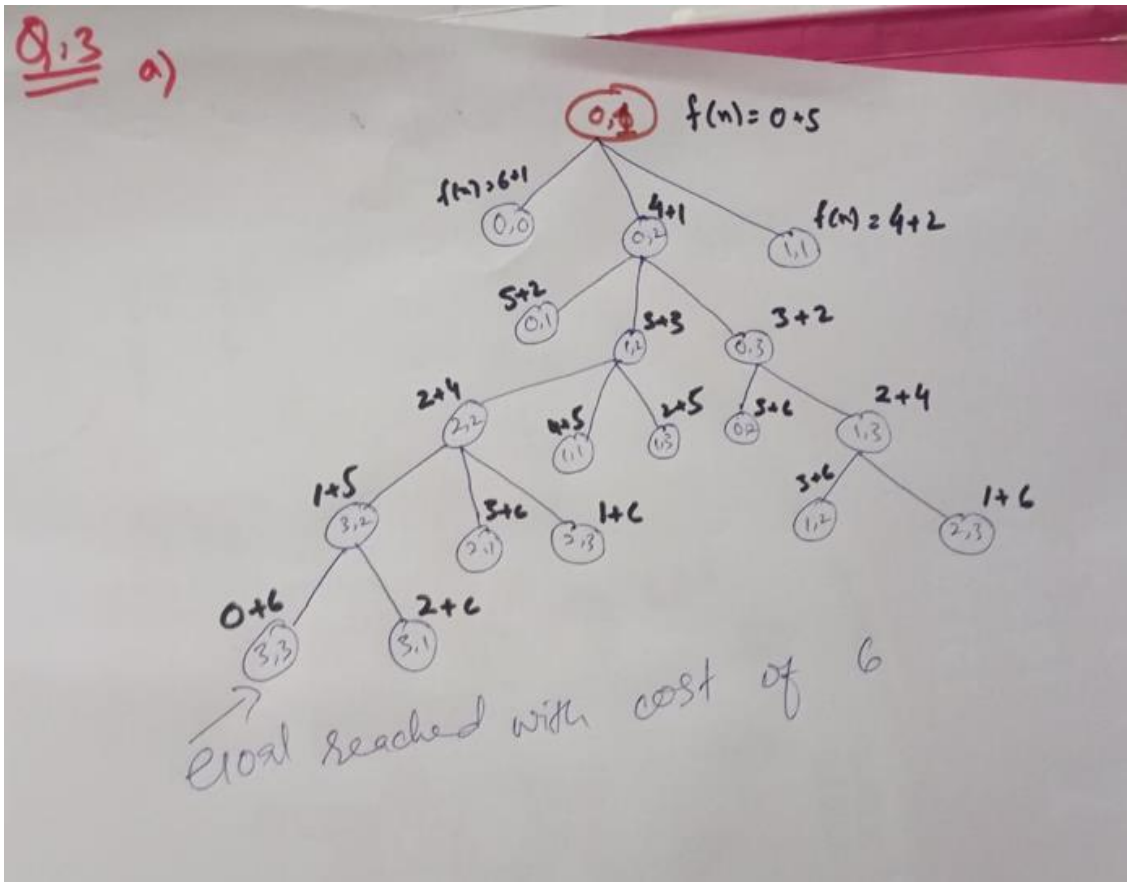
Question No. 3 **[Time: 20 Min] [Marks: (15)]**

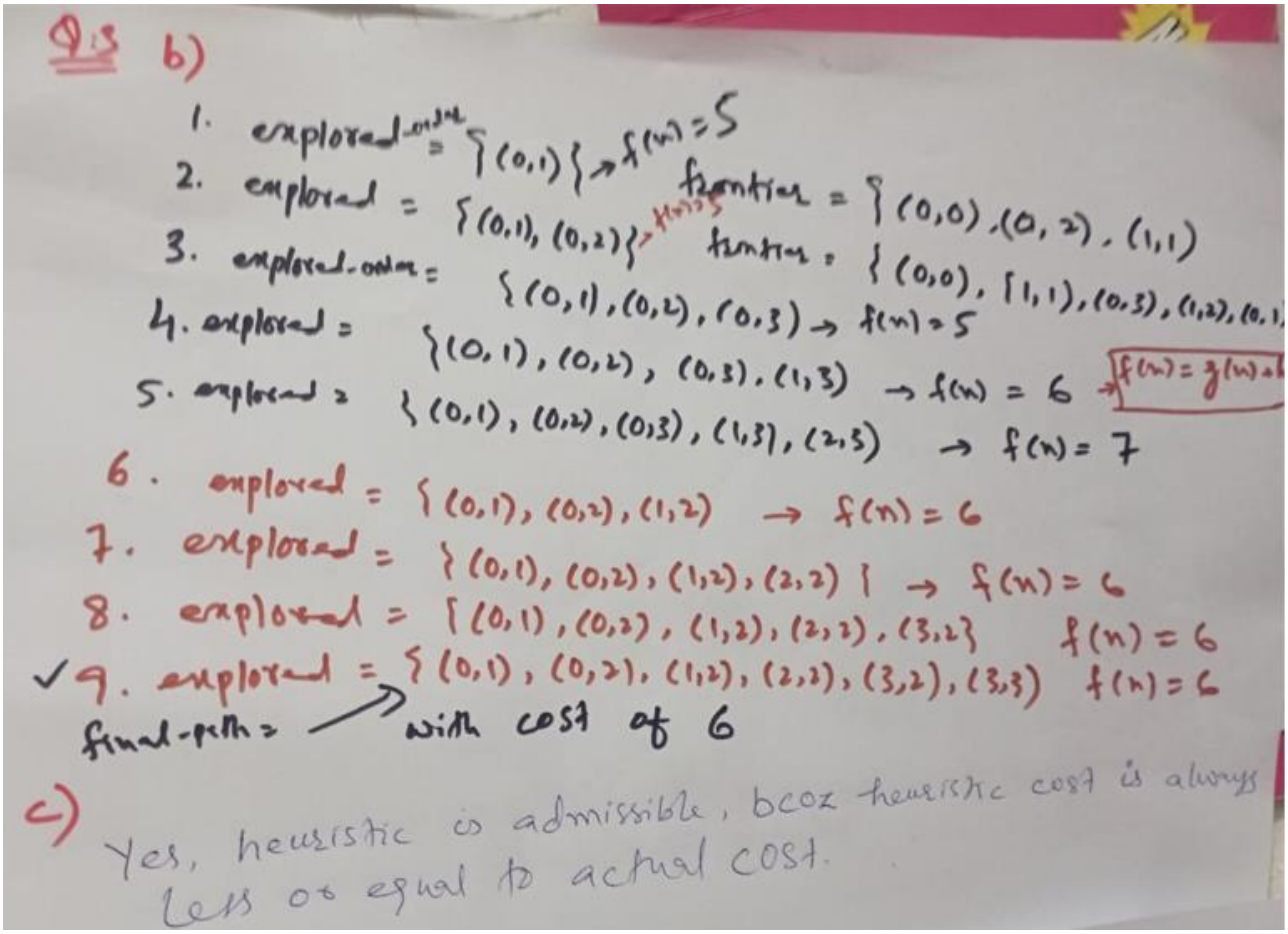
An *UAV* (unmanned aerial vehicle) is deployed to monitor the agriculture field that consists of several intelligent objects such AI-enabled tractor, sensors, robots and etc. Figure shows the footprint of the *UAV* in a certain region of the agriculture field in the form of 3 x 3 grid (Refer Fig below). On the console of the *UAV*, it shows an agent (robot) at the location S that must reach to the goal state G. Allowed movements are (*Left, Right, UP*) in one cell at a time. The agent is standing at some start state S cell index of (0, 1) and needs to find a path toward field G shown by index of (3, 3) and agent can traverse cells with cost of 1. However, there are some cells (denoted with 4-star points) which are hard to traverse and has traversal cost of 2. Perform the followings:

A) Give the search tree until optimal path to goal state is reached if our agent performs **A*** search in this scenario. Assume that the Manhattan distance can be used as the heuristic function-h(n) for any cell. Manhattan distance of each cell from goal cell is given in the figure (see box value of each cell).
B) Give order in which nodes or cell will be explored by the algorithm and provide optimal path cost from start state to goal state.
C) Explain if the provided / given heuristic is admissible or not?



Solution :





Question No. 4	**[Time: 10 Min] [Marks: 10]**

Define the followings:

a) Under which circumstances or applications do we perform local searching?

Answer : We use local search algorithms when there is more than one possible goal state but some outcomes are better than others and we need to discover the best. Used a lot in optimization of machine learning algorithms.

b) How you can differentiate local solution from global optimum solution?

Answer : Local optimization means to find optimal solution for a particular/specific region of search space while global optima is overall best solution.

c) What are the potential challenges that arise in the hill-climbing algorithm and discuss some methods to solve them?

Answer : Can stuck in local maxima, plateau and ridges. Random walk, simulated annealing, local beam are solutions.

d) What happens if we don't perform mutation operations in Genetic Algorithm?

Answer: The purpose of mutation in GAs is to introduce diversity into the sampled population. Mutation operators are used in an attempt to avoid local minima by preventing the population of chromosomes from becoming too similar to each other, thus slowing or even stopping convergence to the global optimum.

e) Can you differentiate between the two terms Self-awareness and Situation Awareness in the context of AI?

Answer: Self aware machines have human level consciousness. These machines are aware of themselves and perceive their internal states and others' emotions, behaviours, and acumen. In situation awareness, machines are aware of others and what's going on around them.

Good Luck!