Batch: B2
Roll No.: 16014022050

Experiment No. 2

Title: To perform VLAB on Artificial Intelligence

Course Outcome:

CO1: Define and explain the fundamental concepts, scope, and types of Artificial Intelligence and Machine learning.

Vlab Links: https://ai1-iiith.vlabs.ac.in/List%20of%20experiments.html

Books/ Journals/ Websites referred:

1. **http://en.wikipedia.org/wiki/List_of_artificial_intelligence_projects**
2. **http://www.cs.cornell.edu/courses/cs478/2002sp/mllinks/interesting_ai_demos_and_project.htm**
3. **http://homepages.inf.ed.ac.uk/rbf/AIMOVIES/AImovai.htm**
4. **"Artificial Intelligence: a Modern Approach" by Russell and Norving, Pearson education Publications**
5. **"Artificial Intelligence" By Rich and knight, Tata McGraw Hill Publications**

Pre Lab/ Prior Concepts:
History and evolution of AI, Artificial intelligence: definitions and theories.

Historical Profile:

AI research is highly technical and specialized and is also divided by several multidisciplinary technical issues. So far there are many projects those have been developed and are in progress to work on those issues. Students must learn the applications of intelligent robots by studying various such projects to know the depth and complexity of the course.

Introduction:

Vlab On

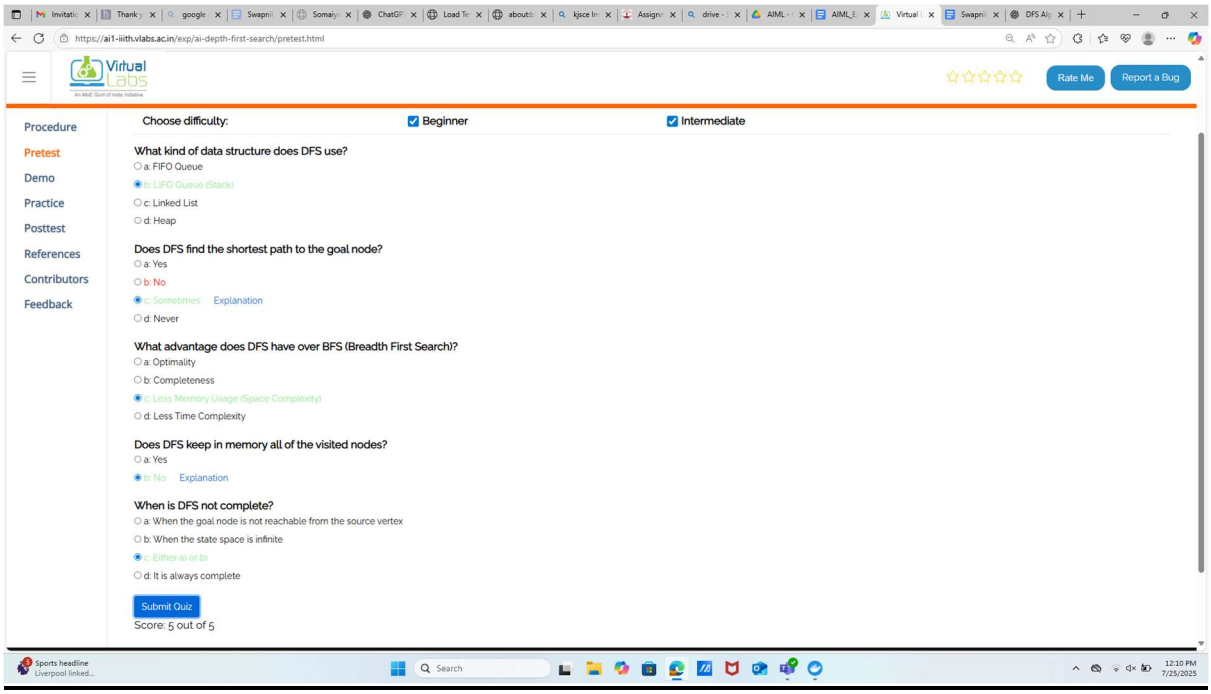
1. AI Depth First Search

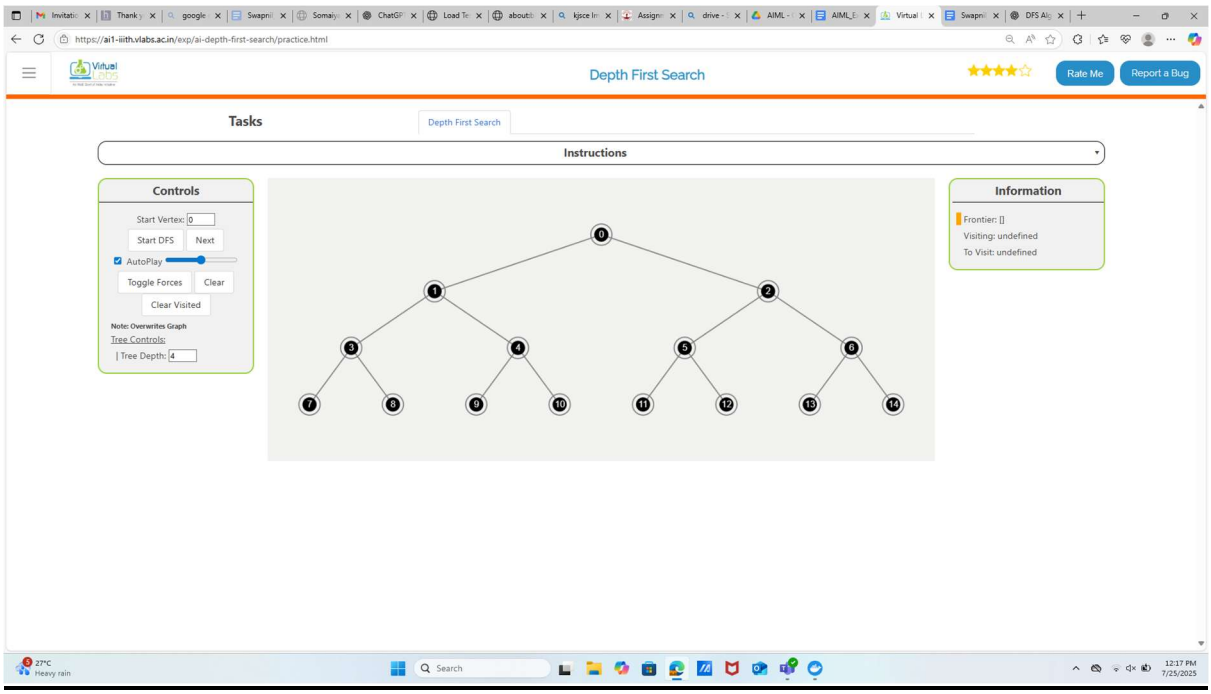
2.Greedy Best First Search

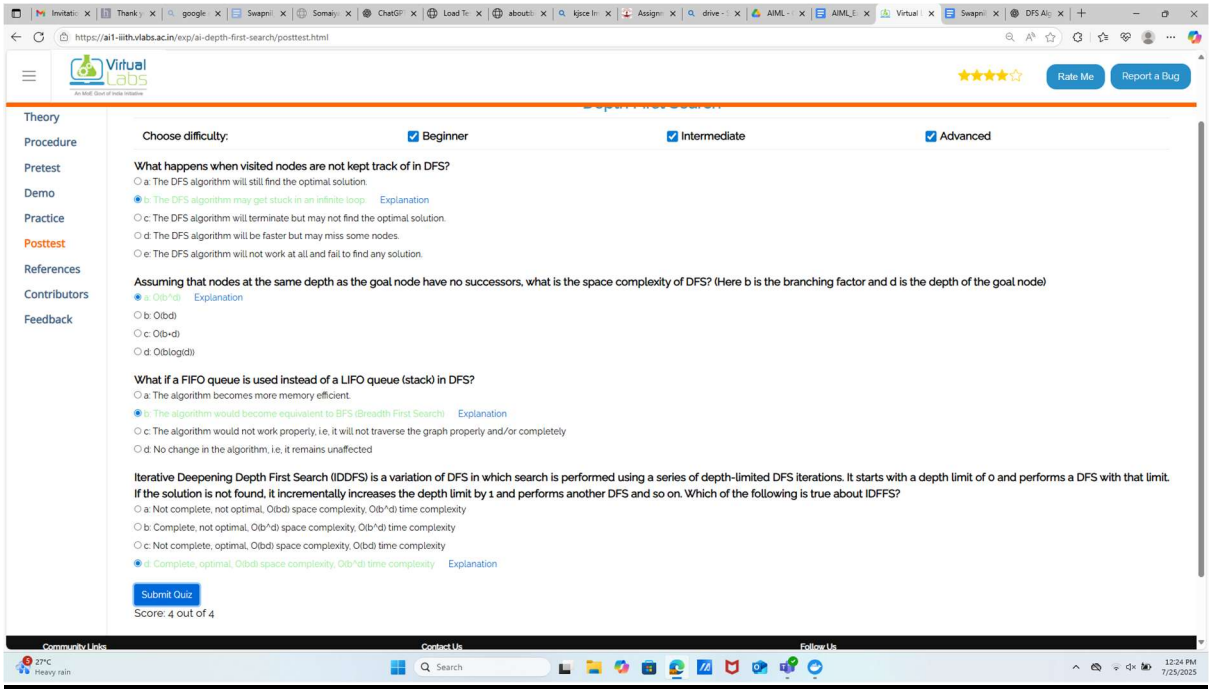
3.Min Max Search

Implementation:

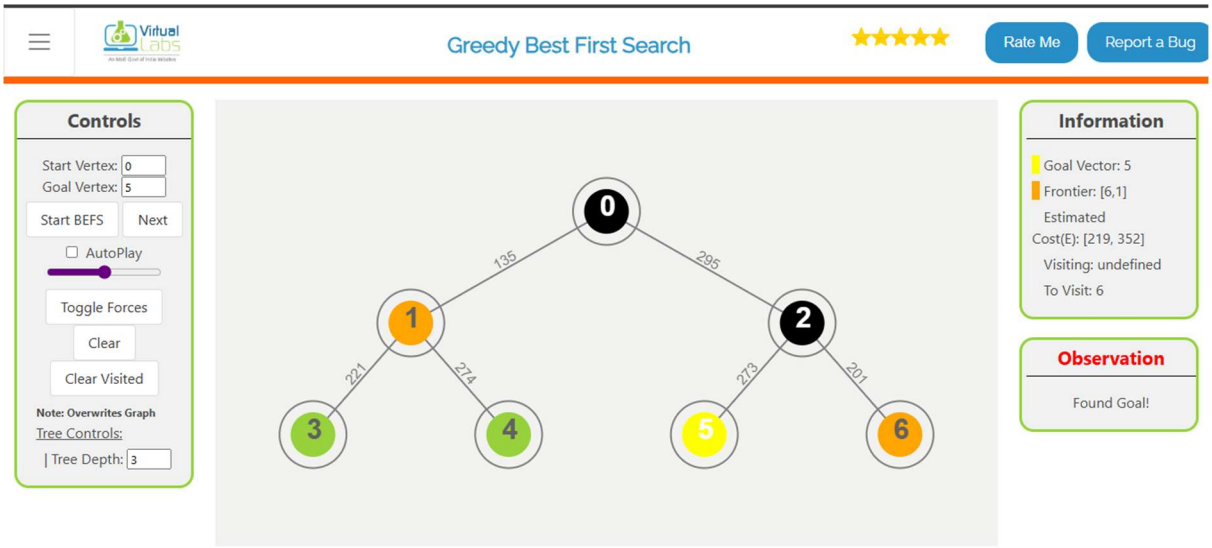
1. AI DEPTH FIRST SEARCH:

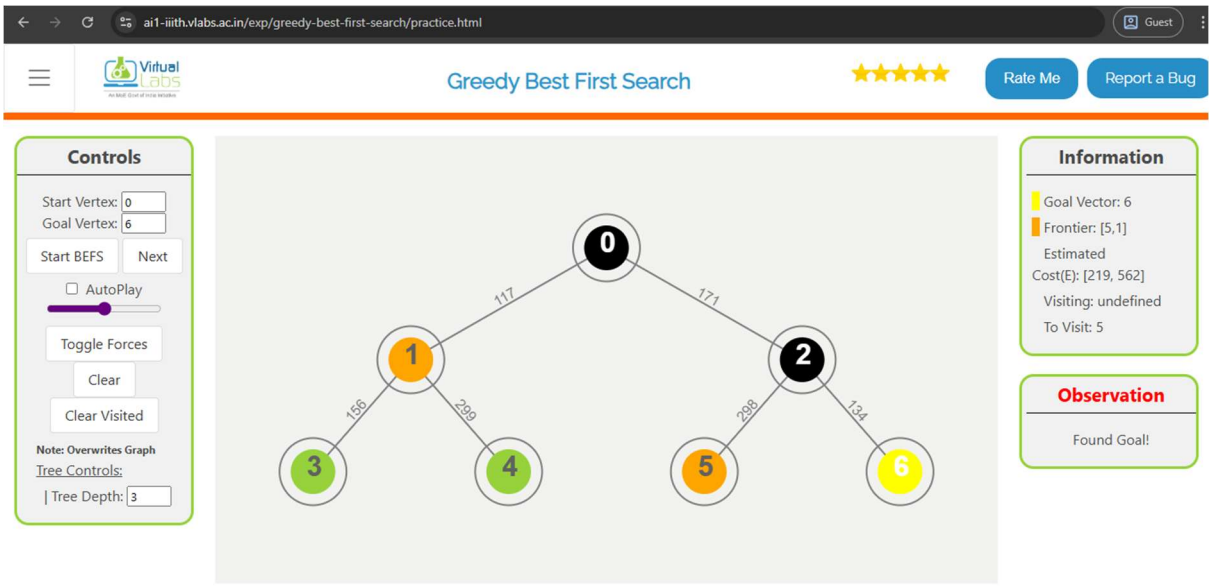


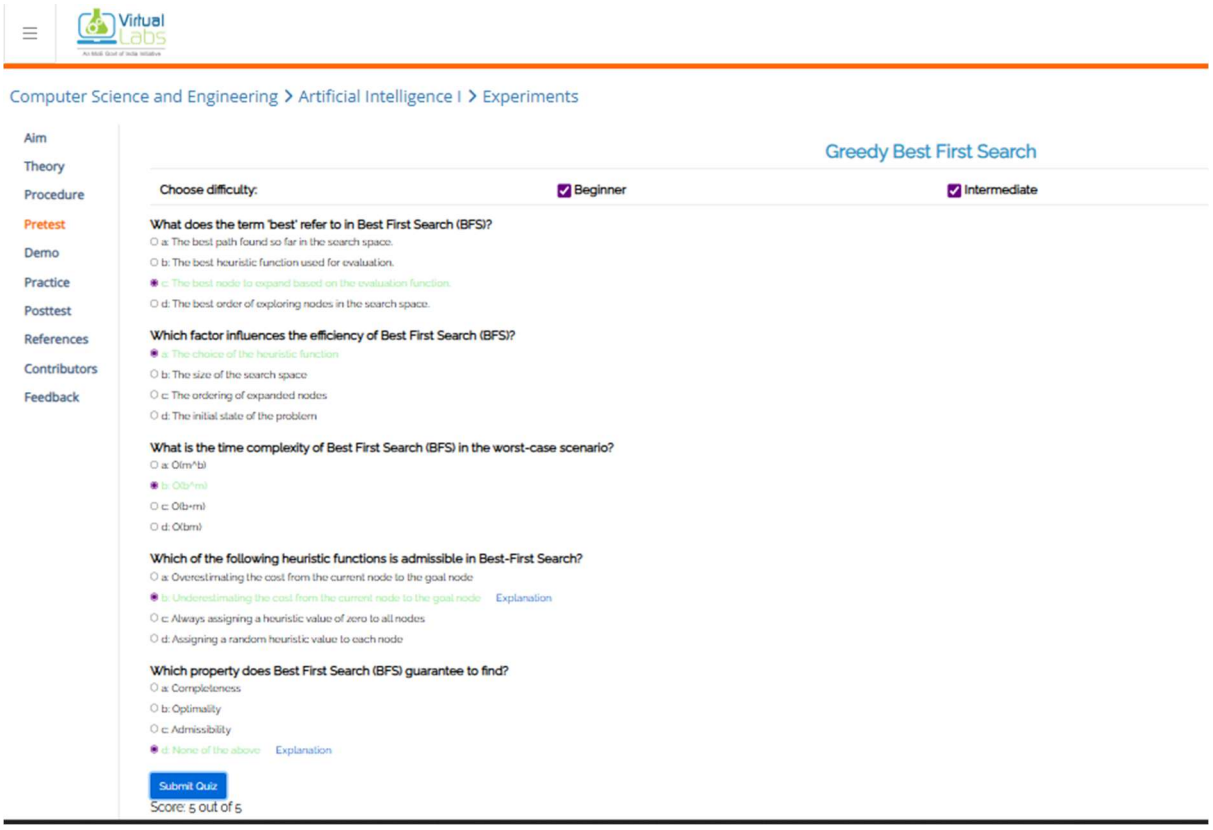


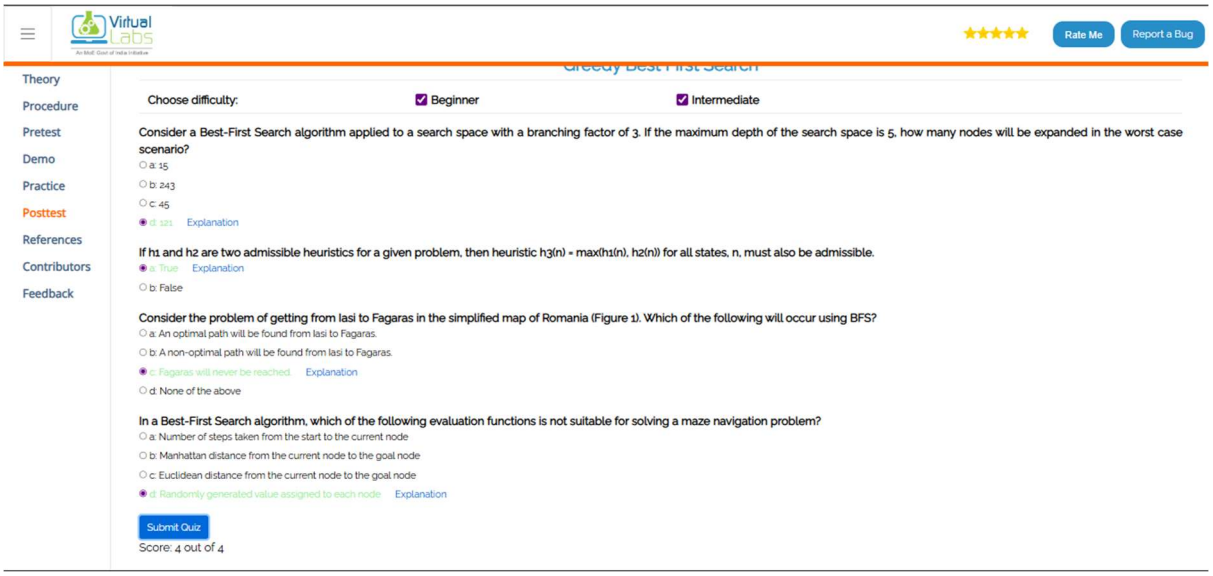


2. GREEDY BEST FIRST SEARCH

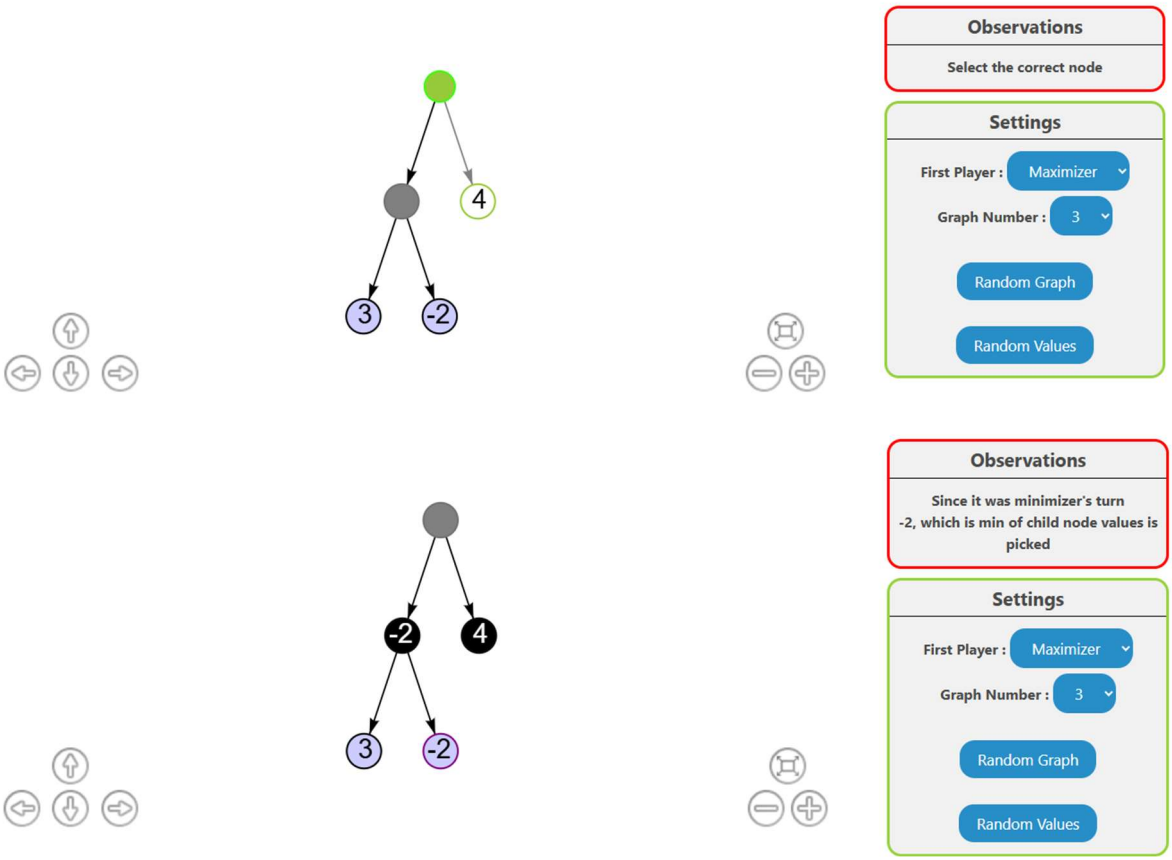


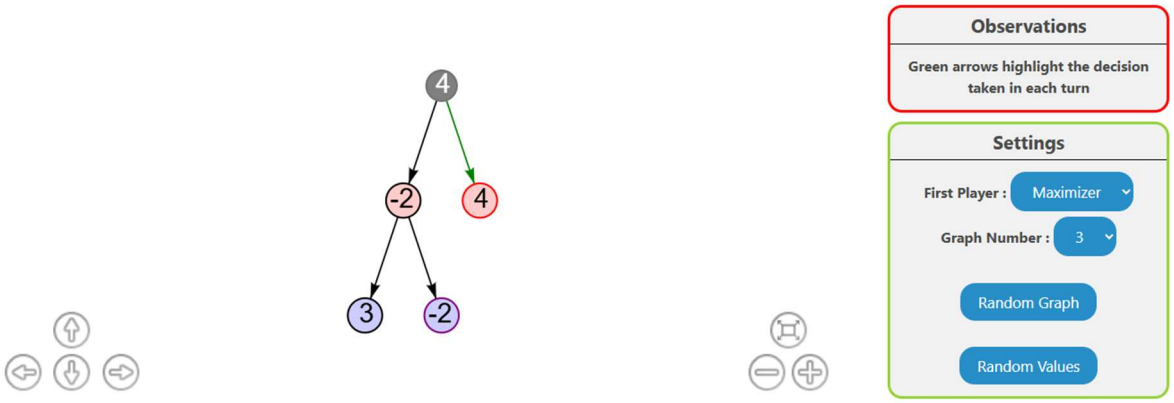

ai1-iiith.vlabs.ac.in/exp/greedy-best-first-search/practice.html
Guest
Virtual Labs
Greedy Best First Search
Rate Me
Report a Bug
Controls
Start Vertex: 0
Goal Vertex: 6
Start BEFS
Next
AutoPlay
Toggle Forces
Clear
Clear Visited
Note: Overwrites Graph
Tree Controls:
| Tree Depth: 3
0
1
2
3
4
5
6
117
171
156
299
298
134
Information
Goal Vector: 6
Frontier: [5,1]
Estimated
Cost(E): [219, 562]
Visiting: undefined
To Visit: 5
Observation
Found Goal!

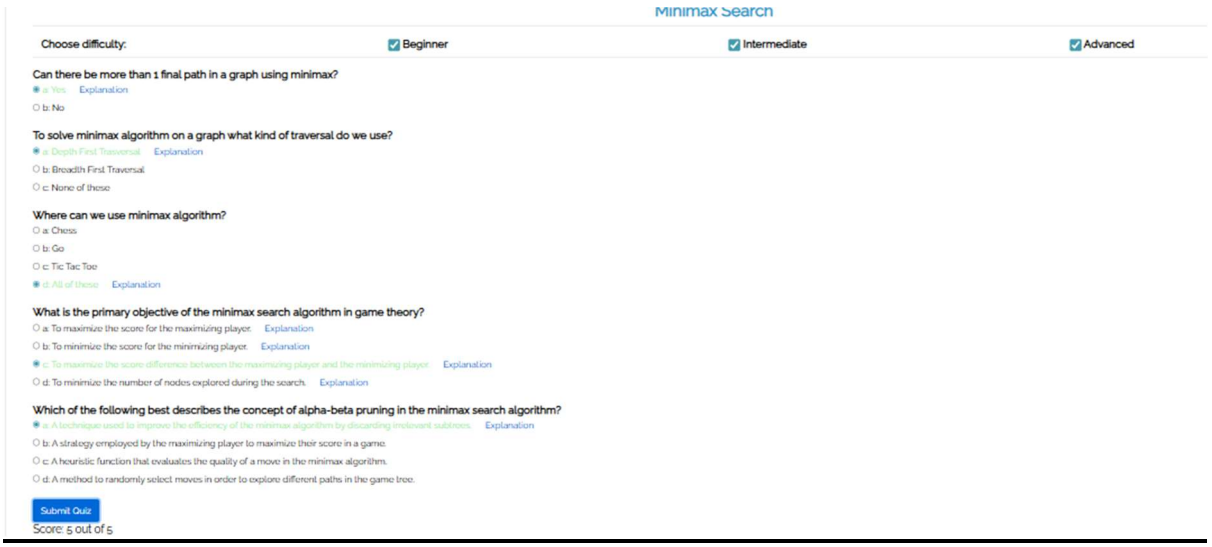

Virtual Labs
Computer Science and Engineering > Artificial Intelligence I > Experiments
Aim
Theory
Procedure
Pretest
Demo
Practice
Posttest
References
Contributors
Feedback
Greedy Best First Search
Choose difficulty:
Beginner
Intermediate
What does the term 'best' refer to in Best First Search (BFS)?
a: The best path found so far in the search space.
b: The best heuristic function used for evaluation.
c: The best node to expand based on the evaluation function.
d: The best order of exploring nodes in the search space.
Which factor influences the efficiency of Best First Search (BFS)?
a: The choice of the heuristic function
b: The size of the search space
c: The ordering of expanded nodes
d: The initial state of the problem
What is the time complexity of Best First Search (BFS) in the worst-case scenario?
a: O(m^b)
b: O(b^m)
c: O(b+m)
d: O(bm)
Which of the following heuristic functions is admissible in Best-First Search?
a: Overestimating the cost from the current node to the goal node
b: Underestimating the cost from the current node to the goal node
Explanation
c: Always assigning a heuristic value of zero to all nodes
d: Assigning a random heuristic value to each node
Which property does Best First Search (BFS) guarantee to find?
a: Completeness
b: Optimality
c: Admissibility
d: None of the above
Explanation
Submit Quiz
Score: 5 out of 5

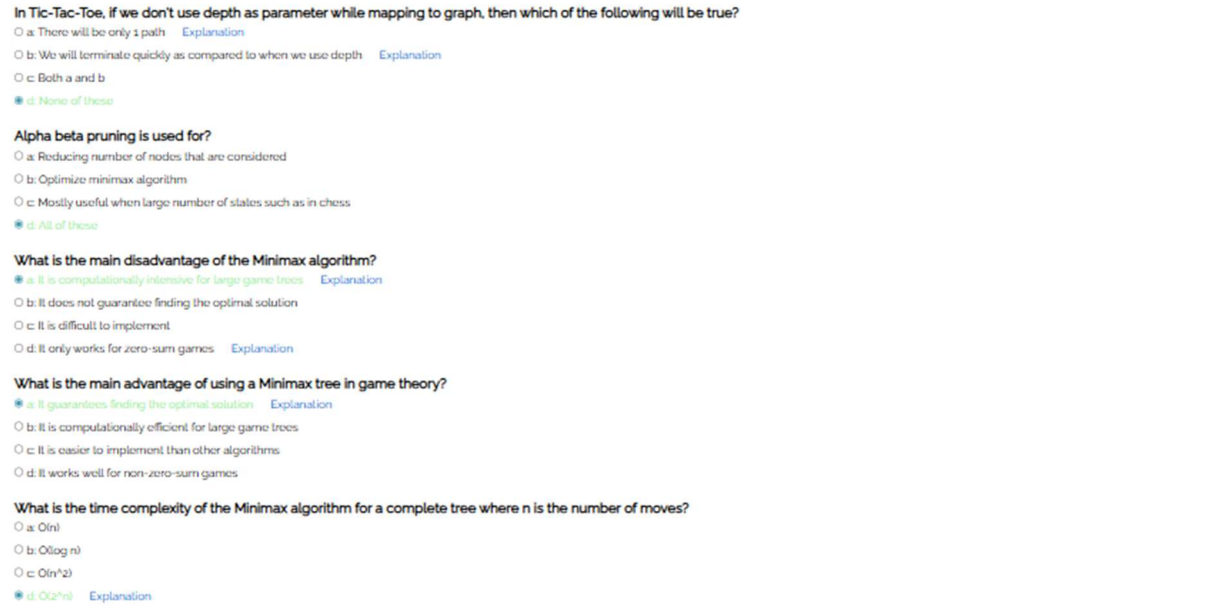


3. MIN MAX SEARCH

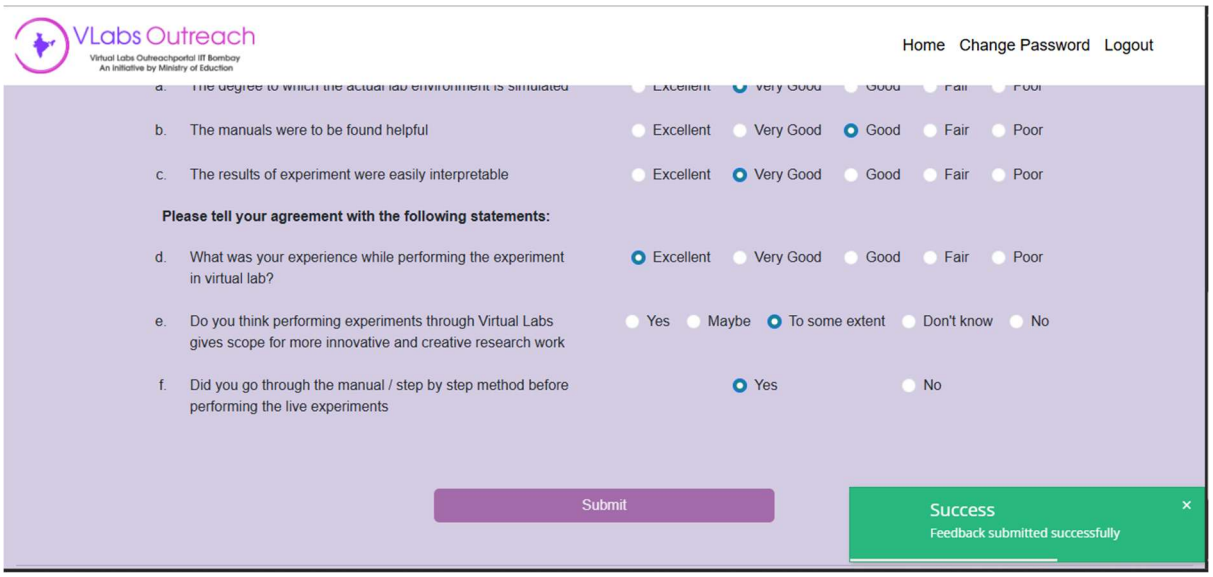



Observations
Green arrows highlight the decision taken in each turn
Settings
First Player : Maximizer
Graph Number : 3
Random Graph
Random Values
4
-2
4
3
-2


Minimax Search
Choose difficulty:
Beginner
Intermediate
Advanced
Can there be more than 1 final path in a graph using minimax?
a: Yes Explanation
b: No
To solve minimax algorithm on a graph what kind of traversal do we use?
a: Depth First Traversal Explanation
b: Breadth First Traversal
c: None of these
Where can we use minimax algorithm?
a: Chess
b: Go
c: Tic Tac Toe
d: All of these Explanation
What is the primary objective of the minimax search algorithm in game theory?
a: To maximize the score for the maximizing player. Explanation
b: To minimize the score for the minimizing player. Explanation
c: To maximize the score difference between the maximizing player and the minimizing player. Explanation
d: To minimize the number of nodes explored during the search. Explanation
Which of the following best describes the concept of alpha-beta pruning in the minimax search algorithm?
a: A technique used to improve the efficiency of the minimax algorithm by discarding irrelevant subtrees. Explanation
b: A strategy employed by the maximizing player to maximize their score in a game.
c: A heuristic function that evaluates the quality of a move in the minimax algorithm.
d: A method to randomly select moves in order to explore different paths in the game tree.
Submit Quiz
Score: 5 out of 5


In Tic-Tac-Toe, if we don't use depth as parameter while mapping to graph, then which of the following will be true?
a: There will be only 1 path Explanation
b: We will terminate quickly as compared to when we use depth Explanation
c: Both a and b
d: None of these
Alpha beta pruning is used for?
a: Reducing number of nodes that are considered
b: Optimize minimax algorithm
c: Mostly useful when large number of states such as in chess
d: All of these
What is the main disadvantage of the Minimax algorithm?
a: It is computationally intensive for large game trees. Explanation
b: It does not guarantee finding the optimal solution
c: It is difficult to implement
d: It only works for zero-sum games Explanation
What is the main advantage of using a Minimax tree in game theory?
a: It guarantees finding the optimal solution Explanation
b: It is computationally efficient for large game trees
c: It is easier to implement than other algorithms
d: It works well for non-zero-sum games
What is the time complexity of the Minimax algorithm for a complete tree where n is the number of moves?
a: O(n)
b: O(log n)
c: O(n^2)
d: O(2^n) Explanation

Feedback:



Post Lab Descriptive Questions:

1. How can Depth First Search be applied to navigate a maze with multiple dead ends to find a possible escape path?

Depth First Search (DFS) is a fundamental graph traversal algorithm that can be applied effectively to navigate a maze with multiple dead ends. The algorithm explores as far as possible along each branch of the maze before backtracking. In the context of a maze, where the **nodes represent junctions or intersections**, and the **edges represent possible paths**, **DFS will systematically explore one path to its deepest point before retreating and trying another direction if a dead end is encountered**.

To apply DFS in navigating a maze, we typically **begin at the maze's entrance**, marking it as visited. Then, the algorithm **moves forward along an unvisited path until it reaches a dead end** or a junction where no further unvisited paths exist. **Once a dead end is reached, the algorithm backtracks to the last junction and explores an alternative path**, repeating the process until it finds an exit or exhausts all possible paths. If the maze contains multiple dead ends, DFS is particularly suited because it does not require knowledge of the maze's layout in advance. It is capable of exploring the entire structure and returning to previously explored areas. This exhaustive search ensures that if there is an escape route, DFS will eventually find it.

However, a potential downside of DFS is that it can be inefficient in mazes with large branching factors or dead ends scattered throughout, since it might explore long and non-optimal paths before backtracking. It can also get stuck in loops or revisit already explored areas if not properly managed, which is why modern implementations often use a stack to keep track of visited nodes or rely on marking cells to prevent revisiting.

2. In a GPS navigation system, how does Greedy Best First Search help in choosing the next city to visit based on straight-line distance to the destination?

Greedy Best First Search (GBFS) is an informed search algorithm used to find an optimal path based on a **heuristic that estimates the cost to reach the goal**. In the context of GPS navigation systems, GBFS **can help in choosing the next city or node to visit by evaluating the straight-line distance** (also known as the "heuristic") from the current city to the destination city. The primary goal of GBFS is to make decisions that seem the best in the short term, based solely on the heuristic, with the hope that this leads to a globally optimal path.

When a GPS system uses GBFS, **it starts at the current location and computes the straight-line distance from all neighboring cities to the destination**. The city with the smallest heuristic value (i.e., the one that appears to be closest to the goal) is selected as the next city to visit.

For instance, in a road network, **the GPS system would evaluate neighboring cities based on the straight-line distance to the destination, potentially choosing a city that seems close to the goal even if the actual roads make the path longer.** This approach works well when the heuristic is reliable, such as in cases where cities are spread out in a relatively predictable manner (like in a grid or planar network). However, if the heuristic is misleading (for example, due to road detours or traffic), GBFS can lead to suboptimal routes. While this makes GBFS an efficient algorithm for quick decisions, it may not always yield the most cost-effective path when compared to algorithms that consider both the distance and the cost to travel.

3. How is Min-Max Search used in a chess game to choose the best move while anticipating the opponent's counter moves?

Min-Max Search is a decision-making algorithm used extensively in two-player, zero-sum games like chess, where one player's gain is another player's loss. **The algorithm aims to choose the best possible move by simulating all possible future moves**, both for the player and the opponent, and **selecting the one that maximizes the player's chances of winning while minimizing the opponent's opportunities**.

In the context of a chess game, Min-Max works by constructing a game tree where **each node represents a state of the chessboard, and each edge represents a possible move**. Starting from the current game state (the root of the tree), the algorithm **recursively simulates all potential moves for both the player and the opponent**. At the terminal nodes (the leaves of the tree), the algorithm assigns a value that indicates the game's outcome (for example, +1 for a win, 0 for a draw, and -1 for a loss).

The "Min" part of the algorithm refers to the opponent's optimal strategy to minimize the player's advantage, while the "Max" part refers to the player's strategy to maximize their chances of winning. The algorithm evaluates the game tree by alternating between "Max" and "Min" levels, going from the leaves to the root. At each level, the player picks the

maximum value (best move), while the opponent picks the minimum value (to minimize the player's gain).

To choose the best move, Min-Max evaluates all possible moves and counter-moves, assuming that the opponent will always play optimally to counter the player's choices. For example, if it is the player's turn to move, Min-Max will evaluate all the moves that could be made, and for each of those moves, it will evaluate the subsequent moves the opponent might make. This evaluation continues recursively for all future moves and counter-moves, considering the depth of the game tree and the number of possible scenarios.

While Min-Max provides a robust strategy, it can be computationally expensive, as it may require evaluating a vast number of possible moves, especially in complex games like chess. To improve efficiency, techniques like Alpha-Beta Pruning are often used to eliminate branches of the game tree that don't need to be explored, significantly reducing the computational overhead.

Thus, Min-Max Search is crucial for making decisions in a chess game, as it takes into account both the current move and all subsequent moves, helping to anticipate the opponent's counter-moves and ensuring that the player selects the optimal strategy.