**Assignment No: 1**

**Problem Statement:-**

Implement the following algorithms for solving the 8-puzzle problem: a) Depth First Search (DFS) b) Breadth First Search (BFS)

**Theory:-**

The 8-puzzle problem consists of a 3x3 grid containing eight numbered tiles and one empty space. The objective is to move the tiles into a goal state using a series of valid moves (up, down, left, right) on the empty space. The problem can be viewed as a state space search problem, where each state represents a unique arrangement of tiles.

* **Depth First Search (DFS)** is an uninformed search strategy that explores as far as possible along each branch before backtracking.
* **Breadth First Search (BFS)** is also an uninformed search strategy that explores all possible neighbor nodes (states) at the present depth level before moving on to nodes at the next depth level.

**Methodology:-**

To implement DFS and BFS for the 8-puzzle problem, follow these steps:

1. **State Representation**: Represent the 3x3 grid as a list of lists or a single list (with 9 elements). The position of the tiles and the blank space will represent a state.
2. **Goal State**: The goal state will be defined as the arrangement of the tiles in order:

1 2 3

4 5 6

7 8 \_

1. **State Transitions**: Define valid moves that the blank space can make (up, down, left, right). Ensure that transitions are within the boundaries of the grid.
2. **DFS Implementation**:
   * Use a stack (LIFO structure) to keep track of the current path.
   * Push the initial state onto the stack and explore by moving tiles.
   * Backtrack when a state has no further moves or reaches a dead-end.
   * Repeat until the goal state is reached.
3. **BFS Implementation**:
   * Use a queue (FIFO structure) to explore each level of states.
   * Add the initial state to the queue and expand by exploring neighboring states.
   * Continue exploring until the goal state is found.

**Advantages and Limitations of DFS and BFS:**

* **DFS**:
  + Advantages: DFS requires less memory compared to BFS since it only needs to store the current path.
  + Limitations: DFS can get stuck in an infinite loop in cyclic paths and may not find the shortest solution.
* **BFS**:
  + Advantages: BFS guarantees the shortest path to the solution, provided all moves have the same cost.
  + Limitations: BFS can consume a large amount of memory as it needs to store all nodes at the current depth level.

**Conclusion:-**

In this assignment, we successfully implemented DFS and BFS to solve the 8-puzzle problem. Both methods have their pros and cons, and the choice of algorithm depends on the specific requirements (e.g., memory constraints or solution optimality)