**Assignment No: 1**

**Problem Statement:**

Implement the following algorithms to solve 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 goal is to move the tiles using a series of valid moves (up, down, left, right) to reach a specific goal state. The problem can be approached as a state space search problem, where each state represents a unique arrangement of the tiles.

* Depth First Search (DFS) is an uninformed search strategy that explores as deeply as possible along each branch before backtracking.
* Breadth First Search (BFS) is an uninformed search strategy that explores all possible neighbor nodes (states) at the current depth level before moving to the next 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 arrangement of tiles and the blank space will define a state.
2. Goal State:
   * Define the goal state as follows:

1 2 3

4 5 6

7 8 \_

1. State Transitions:
   * Define valid moves (up, down, left, right) for the blank space, ensuring that moves stay within the grid boundaries.
2. DFS Implementation:
   * Use a stack (LIFO structure) to keep track of the current path.
   * Push the initial state onto the stack and explore new states by moving tiles.
   * Backtrack if a state has no further moves or reaches a dead-end.
   * Continue 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 until the goal state is found.

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

* DFS:
  + Advantages: DFS uses less memory than BFS since it only stores the current path.
  + Limitations: DFS may get stuck in an infinite loop in cyclic paths and does not guarantee the shortest solution.
* BFS:
  + Advantages: BFS guarantees the shortest path to the solution, assuming equal move costs.
  + Limitations: BFS requires significant memory as it must 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 algorithms have their strengths and weaknesses, and the choice of approach depends on factors like memory constraints and the need for optimal solutions.