# Assignment No:1

Practical Exercise: Artificial Intelligence - 8 Puzzle Problem

## 1) Problem Statement

Implement Depth-First Search (DFS) and Breadth-First Search (BFS) algorithms for the 8-puzzle problem.  
The 8-puzzle problem involves a 3x3 grid with 8 tiles, numbered from 1 to 8, and one empty space. The goal is to move the tiles using valid moves (up, down, left, right) to reach a specific target configuration from an initial scrambled configuration.

## 2) Libraries Used

Python:  
1. NumPy: For array manipulation and handling the grid structure of the puzzle.  
2. Collections: For using queues and stacks required for BFS and DFS algorithms.  
3. Matplotlib/Seaborn (Optional): For visualizing the grid state (optional).

## 3) Theory

The 8-puzzle problem is a classic example of a search problem in Artificial Intelligence. It can be solved using tree traversal algorithms such as DFS and BFS.  
- Breadth-First Search (BFS): A complete algorithm that explores all nodes at the present depth level before moving on to the nodes at the next depth level.  
- Depth-First Search (DFS): An algorithm that explores as far down a branch as possible before backtracking. It is not guaranteed to find the shortest solution.  
  
In this problem, BFS guarantees finding the shortest path (minimum moves) to the goal configuration, while DFS may find a solution faster but might take more steps.

## 4) Methods

The solution involves the following steps:  
1. **State Representation**: The puzzle is represented as a list or an array of 9 elements, with '0' representing the empty space.  
2. **BFS and DFS Implementation**: Both BFS and DFS algorithms are used to explore the possible states of the puzzle.  
3. **Move Generation**: Possible moves (up, down, left, right) are generated by shifting the tiles into the empty space.  
4. **Goal Test**: The algorithm terminates when the target state is achieved.

## 5) Advantages and Disadvantages

- **Advantages of BFS**: Guarantees the shortest path to the solution but requires more memory as it explores all nodes level by level.  
- **Advantages of DFS**: Uses less memory and may find a solution faster, but it might not be the optimal solution.  
- **Disadvantages of BFS**: Memory-intensive and may take longer to execute in cases with many possible states.  
- **Disadvantages of DFS**: May get stuck exploring deep branches and could miss the shortest solution.

## 6) Diagram

A diagram of a diagram

Description automatically generated

BFS Approach

A diagram of a diagram

Description automatically generated

DFS Approach

## 7) Conclusion

The 8-puzzle problem demonstrates the application of search algorithms like BFS and DFS. While BFS ensures finding the shortest solution, DFS might find solutions quicker with the trade-off of not always being optimal. Both algorithms are foundational in understanding search problems in AI and are widely applicable in various real-world problems.