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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)

DEPARTMENTOFINFORMATIONTECHNOLOGY

COURSECODE:DJS22ITL501 **DATE:16-8-24**

COURSENAME:Artificial Intelligence Laboratory **CLASS:TY-IT**

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<u>EXPERIMENTNO.03</u>

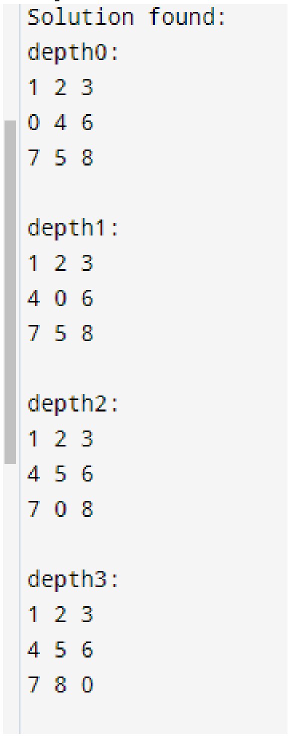
CO/LO: Apply various AI approaches to knowledge intensive problem solving, reasoning, planning and uncertainty.

AIM/OBJECTIVE: Implement DFID search algorithms to reach goal state

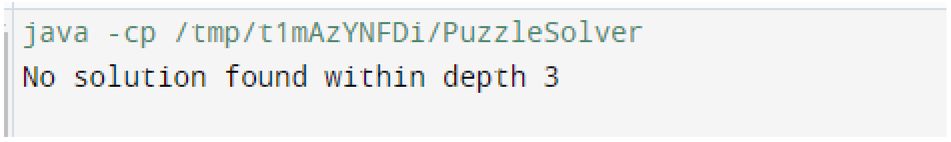
Code:

```
import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;

public class PuzzleSolver {
    // The goal state of the 8-puzzle
    static final int[][] goalState = {
        {1, 2, 3},
        {4, 5, 6},
        {7, 8, 0}
    };

    // Directions for moving the blank tile (0): up, down, left, right
    static final int[][] directions = {
        {-1, 0}, {1, 0}, {0, -1}, {0, 1}
    };

    public static void main(String[] args) {
        // Initial state of the puzzle
        int[][] initialState = {
            {1, 2, 3},
            {0, 4, 6},
            {7, 5, 8}
        };

        int maxDepth = 3;
        List<int[][]> solutionPath = iterativeDeepeningSearch(initialState, maxDepth);

        if (solutionPath != null) {
            System.out.println("Solution found:");
            for (int step = 0; step < solutionPath.size(); step++) {
                System.out.println("depth" + step + ":");
                printState(solutionPath.get(step));
                System.out.println();
            }
        } else {
            System.out.println("No solution found within depth " + maxDepth);
        }
    }

    static List<int[][]> iterativeDeepeningSearch(int[][] startState, int maxDepth) {
        for (int depth = 0; depth <= maxDepth; depth++) {
            List<int[][]> path = new ArrayList<>();
            path.add(startState);
            List<int[][]> result = dfs(startState, depth, path);
            if (result != null) {
                return result;
            }
        }
        return null;
    }

    static List<int[][]> dfs(int[][] state, int depth, List<int[][]> path) {
        if (depth > 0 && isGoal(state)) {
            return new ArrayList<>(path);
        }

        if (depth == 0) {
            return null;
        }

        for (int[][] neighbor : getNeighbors(state)) {
            if (!isInPath(neighbor, path)) { // Avoid revisiting the same state
                path.add(neighbor);
                List<int[][]> result = dfs(neighbor, depth - 1, path);
                if (result != null) {
                    return result;
                }
                path.remove(path.size() - 1); // Backtrack
            }
        }
        return null;
    }
    static boolean isGoal(int[][] state) {
        return Arrays.deepEquals(state, goalState);
    }

    static int[] getBlankPosition(int[][] state) {
        for (int i = 0; i < 3; i++) {
            for (int j = 0; j < 3; j++) {
                if (state[i][j] == 0) {
                    return new int[]{i, j};
                }
            }
        }
        return null;
    }

    static int[][] swap(int[][] state, int[] pos1, int[] pos2) {
        int[][] newState = new int[3][3];
        for (int i = 0; i < 3; i++) {
            newState[i] = state[i].clone();
        }
        int temp = newState[pos1[0]][pos1[1]];
        newState[pos1[0]][pos1[1]] = newState[pos2[0]][pos2[1]];
        newState[pos2[0]][pos2[1]] = temp;
        return newState;
    }

    static List<int[][]> getNeighbors(int[][] state) {
        List<int[][]> neighbors = new ArrayList<>();
        int[] blankPos = getBlankPosition(state);

        for (int[] direction : directions) {
            int newBlankRow = blankPos[0] + direction[0];
            int newBlankCol = blankPos[1] + direction[1];
            if (newBlankRow >= 0 && newBlankRow < 3 && newBlankCol >= 0 &&
newBlankCol < 3) {
                int[][] newState = swap(state, blankPos, new int[]{newBlankRow,
newBlankCol});
                neighbors.add(newState);
            }
        }
        return neighbors;
    }
    static boolean isInPath(int[][] state, List<int[][]> path) {
        for (int[][] pastState : path) {
            if (Arrays.deepEquals(state, pastState)) {
                return true;
            }
        }
        return false;
    }

    static void printState(int[][] state) {
        for (int[] row : state) {
            for (int num : row) {
                System.out.print(num + " ");
            }
            System.out.println();
        }
    }
}
```

output:



```
Solution found:
depth0:
1 2 3
0 4 6
7 5 8

depth1:
1 2 3
4 0 6
7 5 8

depth2:
1 2 3
4 5 6
7 0 8

depth3:
1 2 3
4 5 6
7 8 0
```



```
java -cp /tmp/t1mAzYNFDi/PuzzleSolver
No solution found within depth 3
```

Conclusion: In this experiment we learnt to implement DFID to reach the goal state.