AI phase 1 Report

Team Members:
Mohamed Tarek Mohamed Ali: s-mohamed-tarek@zewailcity.edu.eg :202201647
Ahmed Gamal Abdelfattah : s-ahmed.sharaf@zewailcity.edu.eg : 202201638
Abdalrahman Khaled : s-abdalrahman.abdalrahman@zewailcity.edu.eg : 202201655
Habiba Ayman Amin : s-habiba.ibrahim@zewailcity.edu.eg : 202202088

Problem Modeling:

- **Problem:** A puzzle consists of a 3x3 grid, consisting of 8 numbers from 1-8 and another outlier which is 0.
- **The goal:** is to write the numbers in increasing order from 1-8 in the grid.
- **State space:** all possible configurations that can be obtained by moving the (0) arround the buzzel. **n = (9!/2)= 181,440**

- **Initial state:** random arrangement of titles.
- **Goal state**: arranged titles from 1 to 8
- **Actions:** The only allowed actions are moving the blank title (0) in one of four directions (up, down, left, right).

Search algorithms

(1) Uninformed search

1-BFS: It explores state space level by level, it starts with the initial state and generates all possible states in this level and then moves to the next level and so on untill it explodes all levels.

-It uses **(FIFO) (queue)** to store tates.

2- DFS:it explores as far as possible down to reach the goal or deadend, it uses **“LIFO”** It starts at the initial state and explores as deeply as possible, generating new states from the current state until it reaches a goal or a dead-end.

3-UCS: it expands the least cost node to ensure the solution has the minimum cost, it uses a **“priority queue”** in 8 buzzle we can use the shortest path if the cost of each path is 1.

4-IDS: it performs DFS with increasing depth limit.

Analysis of all uninformed search algorithms

Criteria	BFS	Uniform-cost	DFS	Depth-limited	IDS	Bidirectional
Complete?	Yes[#]	Yes[#&]	No	No	Yes[#]	Yes[#+]
Time	$O(b^d)$	$O(b^{1+\lfloor C^*/e \rfloor})$	$O(b^m)$	$O(b^l)$	$O(b^d)$	$O(b^{d/2})$
Space	$O(b^d)$	$O(b^{1+\lfloor C^*/e \rfloor})$	$O(bm)$	$O(bl)$	$O(bd)$	$O(b^{d/2})$
Optimal?	Yes[$]	Yes	No	No	Yes[$]	Yes[$+]

b: Branching factor
d: Depth of the shallowest goal
l: Depth limit
m: Maximum depth of search tree
e: The lower bound of the step cost

[#]: Complete if *b* is finite
[&]: Complete if step cost >= *e*
[$]: Optimal if all step costs are identical
[+]: If both direction use BFS

Informed search: such as A* and Greedy Best-First Search, use a heuristic function to evaluate states.

(1) A*: A* uses the evaluation function **f(n) = g(n) + h(n)**

Goal: It aims to find optimal solutions, it explores the states with the lowest f(n) values.

g(n): the cost to reach the current state from the start state

h(n): the heuristic estimate of the cost to reach the goal from the current state (estimated cost to the goal).

(2)Greedy Best-First Search: focuses only on the heuristic estimate

Greedy Best-First Search uses the evaluation function **f(n) = h(n);** it expands the state with the lowest heuristic value.

The primary goal of Greedy Best-First Search: is to reach the goal as quickly as possible, using only the heuristic. It is focused on finding a path to the goal efficiently, not necessarily the optimal one.

Local search algorithm: Local search algorithms, such as Hill Climbing, Simulated Annealing, and Genetic Algorithms, operate by exploring the state space from a starting state and iteratively improving the current state based on local moves.

(1)Hill Climbing: Hill climbing is a fast and simple local search method. Given a state, it evaluates its neighboring states and always moves to the neighbor with the best evaluation.

In 8-puzzle, this means shifting the blank space to adjacent positions and selecting the configuration with the most favorable heuristic .

limitations:it focuses only on the current state and its neighbors

(2)Simulated Annealing:material is heated and then slowly cooled to reach the most stable state. It allows moves to worse states (increasing the temperature) to escape local optima.

(3) Genetic Algorithms (GAs): are suitable for the 8-puzzle problem because they have the ability to explore large, diverse search spaces efficiently. By combining solutions through crossover) and selecting the best candidates (by mutation).

Reflection:

-The document provides the performance and limitation of each algorithm to solve 8 buzzle problem

-Discuss the performance of heuristic-based searches like A* and Greedy Best-First.

-Highlight the differences between informed and uninformed searches.

- it also shows us the difference between local search algorithms.