CS-561 Assignment Lab-4

Optimality:

Hill climbing with heuristics is not guaranteed to find the optimal solution, especially in complex problem spaces. It tends to find local maxima (states that are better than their neighbours) but may miss the global maximum (the optimal solution).

Completeness:

Hill climbing is generally not a complete search algorithm, meaning it may fail to find a solution even if one exists. This lack of completeness is due to its local search nature, as it only explores neighbouring states. Adding multiple heuristics (tiles displaced and Manhattan distance) can improve completeness to some extent by allowing the algorithm to explore a broader search space. However, it does not guarantee completeness.

Output:

Case 1: Where Both **Tiles Displaced** and **manhattan Distance** finds the path.

```
Source:
['T8', 'T6', 'T5']
['T7', 'T2', 'T4']
['T1', 'T3', 'B']
Target:
['B', 'T6', 'T5']
['T8', 'T2', 'T4']
['T7', 'T1', 'T3']
--------------
```

```
Target state reached using tilesdisplaced
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Optimal Path:
Move 0:
(('T8', 'T6', 'T5'), ('T7', 'T2', 'T4'), ('T1', 'T3', 'B'))
Move 1:
(('T8', 'T6', 'T5'), ('T7', 'T2', 'T4'), ('T1', 'B', 'T3'))
Move 2:
(('T8', 'T6', 'T5'), ('T7', 'T2', 'T4'), ('B', 'T1', 'T3'))
Move 3:
(('T8', 'T6', 'T5'), ('B', 'T2', 'T4'), ('T7', 'T1', 'T3'))
Move 4:
(('B', 'T6', 'T5'), ('T8', 'T2', 'T4'), ('T7', 'T1', 'T3'))
Total states explored: 4
Total number of states in the optimal path: 4
Time taken for execution: 0.00023674964904785156
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Target state reached using manhatt_distance
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Optimal Path:
Move 0:
(('T8', 'T6', 'T5'), ('T7', 'T2', 'T4'), ('T1', 'T3', 'B'))
Move 1:
(('T8', 'T6', 'T5'), ('T7', 'T2', 'T4'), ('T1', 'B', 'T3'))
Move 2:
(('T8', 'T6', 'T5'), ('T7', 'T2', 'T4'), ('B', 'T1', 'T3'))
Move 3:
(('T8', 'T6', 'T5'), ('B', 'T2', 'T4'), ('T7', 'T1', 'T3'))
Move 4:
(('B', 'T6', 'T5'), ('T8', 'T2', 'T4'), ('T7', 'T1', 'T3'))
Total states explored: 4
Total number of states in the optimal path: 4
Time taken for execution: 0.00017714500427246094
```

Case2: In both heuristic functions, it is impossible to establish a viable path from the source to the target.

1)

```
Source:
['T8', 'T5', 'T3']
['T4', 'T6', 'T1']
['B', 'T7', 'T2']
Target:
['T1', 'T2', 'T3']
['T4', 'T5', 'T6']
['T7', 'T8', 'B']
--------------
```

```
Total states visited = 2
Target state not reached using tilesdisplaced
Time taken for execution: 0.00010919570922851562
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Total states visited = 3
Target state not reached using manhatt_distance
Time taken for execution: 0.00017452239990234375
```

2)

```
Source:
['B', 'T4', 'T1']
['T5', 'T6', 'T2']
['T3', 'T7', 'T8']
Target:
['T1', 'T2', 'T3']
['T4', 'T5', 'T6']
['T7', 'T8', 'B']
--------------

Total states visited = 1
Target state not reached using tilesdisplaced
Time taken for execution: 8.344650268554688e-05
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Total states visited = 9
Target state not reached using manhatt_distance
Time taken for execution: 0.00047087669372558594
```

Case 3: Manhattan distance can find a path, but using **tiles displaced function** , a path cannot be found.

```
Source:
['T2', 'T8', 'T3']
['T1', 'T6', 'T4']
['T7', 'B', 'T5']
Target:
['T1', 'T2', 'T3']
['T8', 'B', 'T4']
['T7', 'T6', 'T5']
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Total states visited = 2
Target state not reached using tilesdisplaced
Time taken for execution: 0.00010776519775390625
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Target state reached using manhatt_distance
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Optimal Path:
Move 0:
(('T2', 'T8', 'T3'), ('T1', 'T6', 'T4'), ('T7', 'B', 'T5'))
Move 1:
(('T2', 'T8', 'T3'), ('T1', 'B', 'T4'), ('T7', 'T6', 'T5'))
Move 2:
(('T2', 'B', 'T3'), ('T1', 'T8', 'T4'), ('T7', 'T6', 'T5'))
Move 3:
(('B', 'T2', 'T3'), ('T1', 'T8', 'T4'), ('T7', 'T6', 'T5'))
Move 4:
(('T1', 'T2', 'T3'), ('B', 'T8', 'T4'), ('T7', 'T6', 'T5'))
Move 5:
(('T1', 'T2', 'T3'), ('T8', 'B', 'T4'), ('T7', 'T6', 'T5'))
Total states explored: 5
Total number of states in the optimal path: 5
Time taken for execution: 0.00021076202392578125
```

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