**CS4750-HW2**

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**References:** For *depth\_first\_graph\_search.py, interative\_deepening\_tree\_search.py, node.py, problem.py*, we implemented using the code from <https://github.com/aimacode/aima-python/blob/master/search.py> and modified it a bit to fit with the assignment requirement. For the A\* tree search using Manhattan distance heuristic (*a\_star-python.py*), we implemented our code based on the pseudo code from [https://en.wikipedia.org/wiki/A\*\_search\_algorithm](https://en.wikipedia.org/wiki/A*_search_algorithm).

**Description:** Our program used Python programming language to implement three search algorithms. We tested our program by

**Result:**

**Test case 1:**

1. Iterative deepening tree search (IDS)
2. First 5 search nodes that expanded:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 | 8 |
| 13 | 14 | 12 |  |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 | 8 |
| 13 | 14 | 12 |  |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 |  |
| 13 | 14 | 12 | 8 |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 | 8 |
| 13 | 14 |  | 12 |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 | 8 |
| 13 | 14 | 12 |  |

* 1. Solution Sequence
     1. 8 steps
     2. ['LEFT', 'UP', 'UP', 'UP', 'RIGHT', 'DOWN', 'DOWN', 'DOWN']
  2. Nodes Expanded
     1. 2705 Nodes
  3. Time Taken
     1. 37.142 ms

1. Depth-first graph search (DFGS)
2. First 5 search nodes that expanded:

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 | 8 |
| 13 | 14 | 12 |  |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 |  |
| 13 | 14 | 12 | 8 |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 | 4 |
| 9 | 10 | 15 | 8 |
| 13 | 14 |  | 12 |

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| 1 | 2 | 7 | 3 |
| 5 | 6 | 11 |  |
| 9 | 10 | 15 | 4 |
| 13 | 14 | 12 | 8 |

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| --- | --- | --- | --- |
| 1 | 2 | 7 | 3 |
| 5 | 6 |  | 11 |
| 9 | 10 | 15 | 4 |
| 13 | 14 | 12 | 8 |

1. Solution Sequence
   1. No solution found
2. Nodes Expanded
   1. 1,000,000 Nodes
3. Time Taken
   1. 18571.336 ms
4. A\* tree search
5. First 5 search nodes that expanded:

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| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
|  | 10 | 14 | 12 |

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1. Solution and total number of moves to reach the solution:
2. umber of node expanded:
3. CPU execution time:

**Test case 2:**

1. Iterative deepening tree search (IDS)
2. First 5 search nodes that expanded:

|  |  |  |  |
| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
|  | 10 | 14 | 12 |

|  |  |  |  |
| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
|  | 10 | 14 | 12 |

|  |  |  |  |
| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
|  | 6 | 15 | 8 |
| 13 | 10 | 14 | 12 |

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| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
| 10 |  | 14 | 12 |

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| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
|  | 10 | 14 | 12 |

* 1. Solution Sequence
     1. No solution found
  2. Nodes Expanded
     1. 1,000,000 Nodes
  3. Time Taken
     1. 12948.824 ms

1. Depth-first graph search (DFGS)
2. First 5 search nodes that expanded:

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| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
|  | 10 | 14 | 12 |

|  |  |  |  |
| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
|  | 6 | 15 | 8 |
| 13 | 10 | 14 | 12 |

|  |  |  |  |
| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
| 10 |  | 14 | 12 |

|  |  |  |  |
| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
|  | 2 | 11 | 4 |
| 9 | 6 | 15 | 8 |
| 13 | 10 | 14 | 12 |

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| --- | --- | --- | --- |
| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 6 |  | 15 | 8 |
| 13 | 10 | 14 | 12 |

* 1. Solution Sequence
     1. No solution found
  2. Nodes Expanded
     1. 1,000,000 Nodes
  3. Time Taken
     1. 18714.244 ms

1. A\* tree search
2. First 5 search nodes that expanded:

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| 5 | 1 | 7 | 3 |
| 9 | 2 | 11 | 4 |
| 13 | 6 | 15 | 8 |
|  | 10 | 14 | 12 |

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1. Solution and total number of moves to reach the solution:
2. umber of node expanded:
3. CPU execution time: