

AI 2022 Fall

Assignment 2 Search Submission

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November 2, 2022

1 Writing Component

1.1 Search with Heuristics

(a)

$$\mathcal{O}(n^3)$$

(b)

$$h_i(x_i, y_i) = |x_i - (n - i + 1)| + |y_i - n|$$

Of course, Manhattan distance is admissible.

May not with other cars, because hopping over cars get a jump of 2 with cost of 1.

(c)

(i) No.

(ii) Yes, because hopping only halves the cost needed to the goal.

(iii) No.

(iv) No.

(v) No.

1.2 Adjusted Heuristics

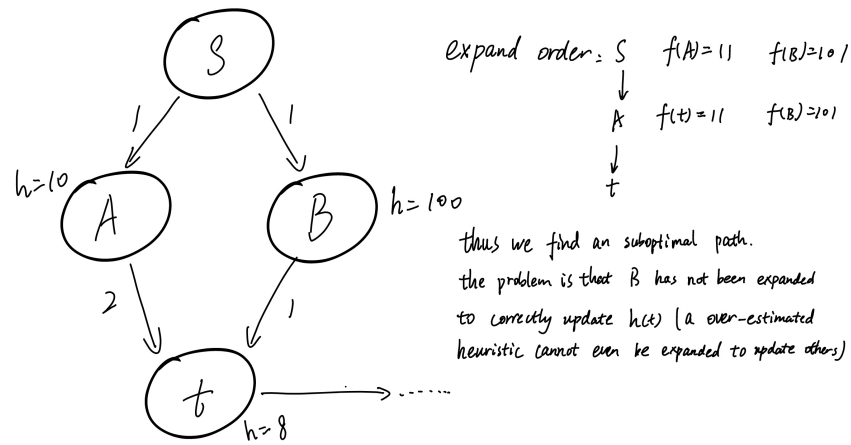
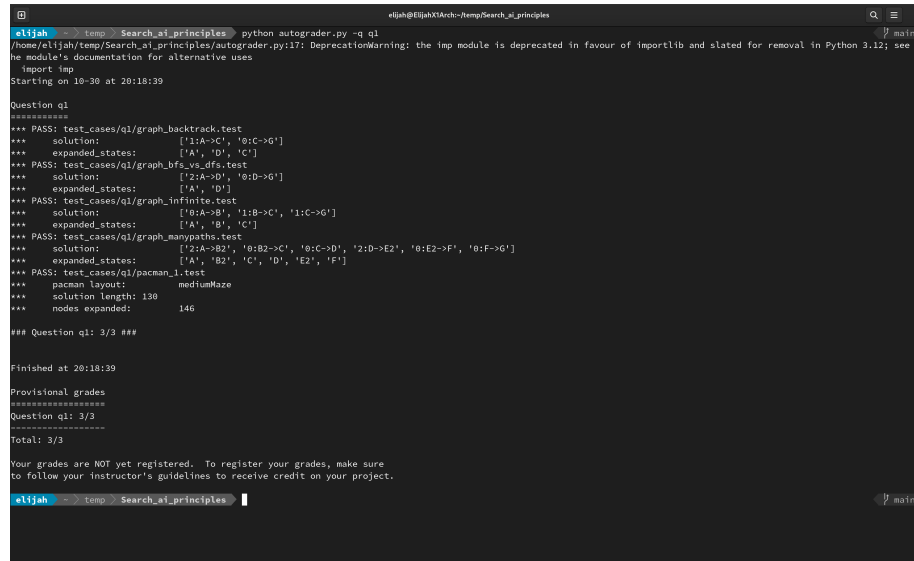


Figure 1: counter example

2 Programming Component: Search in Pacman

2.3 Question 1: Depth First Search



```
elijah@elijahX1Arch:~/temp/Search_ai_principles$ python autograder.py -q q1
/home/elijah/temp/Search_ai_principles/autograder.py:17: DeprecationWarning: the imp module is deprecated in favour of importlib and slated for removal in Python 3.12; see the module's documentation for alternative uses
  import imp
Starting on 10-30 at 20:18:39

Question q1
=====
*** PASS: test_cases/q1/graph_backtrack.test
***   solution:      ['1:A->C', '0:C->G']
***   expanded_states: ['A', 'D', 'C']
*** PASS: test_cases/q1/graph_bfs_vs_dfs.test
***   solution:      ['2:A->D', '0:D->G']
***   expanded_states: ['A', 'D']
*** PASS: test_cases/q1/graph_infinite.test
***   solution:      ['0:A->B', '1:B->C', '1:C->G']
***   expanded_states: ['A', 'B', 'C']
*** PASS: test_cases/q1/graph_many_paths.test
***   solution:      ['2:A->B2', '0:B2->C', '0:C->D', '2:D->E2', '0:E2->F', '0:F->G']
***   expanded_states: ['A', 'B2', 'C', 'D', 'E2', 'F']
*** PASS: test_cases/q1/pacman_1.test
***   pacman layout: mediumMaze
***   solution length: 130
***   nodes expanded: 146

### Question q1: 3/3 ###

Finished at 20:18:39

Provisional grades
=====
Question q1: 3/3
-----
Total: 3/3

Your grades are NOT yet registered. To register your grades, make sure
to follow your instructor's guidelines to receive credit on your project.

elijah@elijahX1Arch:~/temp/Search_ai_principles$
```

Figure 2: q1

2.4 Question 2: Breadth First Search

```
elijah@elijahXArch:~/temp/Search_at_principles$ python autograder.py -q q2
/home/elijah/temp/Search_at_principles/autograder.py:17: DeprecationWarning: the imp module is deprecated in favour of importlib and slated for removal in Python 3.12; see the module's documentation for alternative uses
  import imp
Starting on 10-30 at 20:18:46

Question q2
=====
*** PASS: test_cases/q2/graph_backtrack.test
***   solution:      ['1A->C', '0C->G']
***   expanded_states: ['A', 'B', 'C', 'D']
*** PASS: test_cases/q2/graph_bfs_vs_dfs.test
***   solution:      ['1A->G']
***   expanded_states: ['A', 'B']
*** PASS: test_cases/q2/graph_infinite.test
***   solution:      ['0A->B', '1B->C', '1C->G']
***   expanded_states: ['A', 'B', 'C']
*** PASS: test_cases/q2/graph_manypaths.test
***   solution:      ['1A->C', '0C->D', '1D->F', '0F->G']
***   expanded_states: ['A', 'B1', 'C', 'B2', 'D', 'E1', 'F', 'E2']
*** PASS: test_cases/q2/pacman_1.test
***   pacman layout: mediumMaze
***   solution length: 68
***   nodes expanded: 269

## Question q2: 3/3 ##

Finished at 20:18:46

Provisional grades
=====
Question q2: 3/3
-----
Total: 3/3

Your grades are NOT yet registered. To register your grades, make sure
to follow your instructor's guidelines to receive credit on your project.

elijah@elijahXArch:~/temp/Search_at_principles$
```

Figure 3: q2

2.5 Question 3: Uniform Cost Search

```
elijah@elijahXArch:~/temp/Search_at_principles$ python autograder.py -q q3
/home/elijah/temp/Search_at_principles/autograder.py:17: DeprecationWarning: the imp module is deprecated in favour of importlib and slated for removal in Python 3.12; see the module's documentation for alternative uses
  import imp
Starting on 10-30 at 20:25:59

Question q3
=====
*** PASS: test_cases/q3/graph_backtrack.test
***   solution:      ['1A->C', '0C->G']
***   expanded_states: ['A', 'B', 'C', 'D']
*** PASS: test_cases/q3/graph_bfs_vs_dfs.test
***   solution:      ['1A->G']
***   expanded_states: ['A', 'B']
*** PASS: test_cases/q3/graph_infinite.test
***   solution:      ['0A->B', '1B->C', '1C->G']
***   expanded_states: ['A', 'B', 'C']
*** PASS: test_cases/q3/graph_manypaths.test
***   solution:      ['1A->C', '0C->D', '1D->F', '0F->G']
***   expanded_states: ['A', 'B1', 'C', 'B2', 'D', 'E1', 'F', 'E2']
*** PASS: test_cases/q3/ucs_1.test
***   solution:      ['Up', 'Down', 'Down']
***   expanded_states: ['A', 'B', '0', 'C', 'D']
*** PASS: test_cases/q3/ucs_1_probMaze.test
***   pacman layout: mediumMaze
***   solution length: 68
***   nodes expanded: 269
*** PASS: test_cases/q3/ucs_2_probMaze.test
***   pacman layout: mediumMaze
***   solution length: 74
***   nodes expanded: 289
*** PASS: test_cases/q3/ucs_3_probMaze.test
***   pacman layout: mediumMaze
***   solution length: 132
***   nodes expanded: 173
*** PASS: test_cases/q3/ucs_4_testSearch.test
***   pacman layout: testSearch
***   solution length: 7
***   nodes expanded: 14
*** PASS: test_cases/q3/ucs_5_testBFSQueue.test
***   solution:      ['1A->B', '0B->C', '0C->G']
***   expanded_states: ['A', 'B', 'C']

## Question q3: 3/3 ##

Finished at 20:25:59

Provisional grades
=====
Question q3: 3/3
-----
Total: 3/3

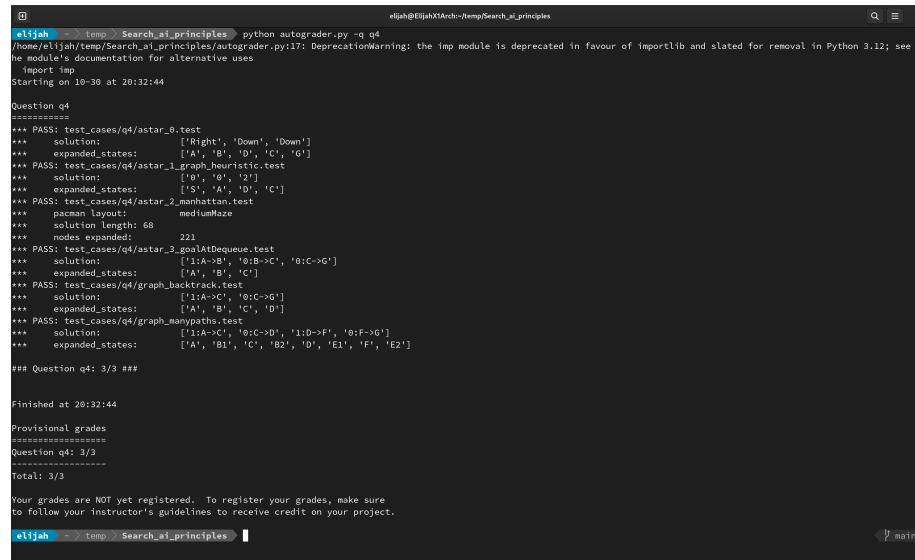
Your grades are NOT yet registered. To register your grades, make sure
to follow your instructor's guidelines to receive credit on your project.

elijah@elijahXArch:~/temp/Search_at_principles$
```

Figure 4: q3

2.6 Question 4: A Search

In this problem I implemented A search with null heuristic.



```
elijah@elijahXArch:~/temp/Search_at_principles$ python autograder.py -q q4
/home/elijah/temp/Search_at_principles/autograder.py:17: DeprecationWarning: the imp module is deprecated in favour of importlib and slated for removal in Python 3.12; see the module's documentation for alternative uses
  import imp
Starting on 10-30 at 20:32:44

Question q4
=====
*** PASS: test_cases/q4/astar_0.test
***   solution:      ['Right', 'Down', 'Down']
***   expanded_states: ['A', 'B', 'D', 'C', 'G']
*** PASS: test_cases/q4/astar_1_graph_heuristic.test
***   solution:      ['G', 'B', 'Z']
***   expanded_states: ['S', 'A', 'D', 'C']
*** PASS: test_cases/q4/astar_2_manhattan.test
***   pacman layout: mediumMaze
***   solution length: 68
***   nodes expanded: 221
*** PASS: test_cases/q4/astar_3_goalAIDequeue.test
***   solution:      ['1:A->B', '0:B->C', '0:C->G']
***   expanded_states: ['A', 'B', 'C']
*** PASS: test_cases/q4/graph_backtrack.test
***   solution:      ['1:A->C', '0:C->G']
***   expanded_states: ['A', 'B', 'C', 'D']
*** PASS: test_cases/q4/graph_manypaths.test
***   solution:      ['1:A->C', '0:C->D', '1:D->F', '0:F->G']
***   expanded_states: ['A', 'B1', 'C', 'B2', 'D', 'E1', 'F', 'E2']

### Question q4: 3/3 ###

Finished at 20:32:44

Provisional grades
=====
Question q4: 3/3
-----
Total: 3/3

Your grades are NOT yet registered. To register your grades, make sure
to follow your instructor's guidelines to receive credit on your project.

elijah -> temp - Search_at_principles |
```

Figure 5: q4

2.7 Question 5: Finding All the Corners

In this problem I defined state for the problem by supplying the state with a 4-tuple of bool to record which corner have been reached

```
elijah@elijahTAch-nemp:~/Search_ai_principles$ python autograder.py -q q5
/home/eli19b/comp/Search_ai_principles/autograder.py:17: DeprecationWarning: the 'imp' module is deprecated in favour of 'importlib' and slated for removal in Python 3.12; see the module's documentation for alternat
ive uses
  import imp
Note: due to dependencies, the following tests will be run: q2 q5
Starting on 10-30 at 21:01:45

Question q2
=====
*** PASS: test_cases/q2/graph_backtrack.test
***      solution:      ['1:A->C', '0:C->D']
***      expanded_states: ['A', 'B', 'C', 'D']
*** PASS: test_cases/q2/graph_bfs_walls.test
***      solution:      ['1:A->D']
***      expanded_states: ['A', 'B']
*** PASS: test_cases/q2/graph_infinite.test
***      solution:      ['0:A->B', '1:B->C', '1:C->D']
***      expanded_states: ['A', 'B', 'C']
*** PASS: test_cases/q2/graph_momompath.test
***      solution:      ['1:A->C', '0:C->D', '1:D->F', '0:F->D']
***      expanded_states: ['A', 'B1', 'C', 'B2', 'D', 'E1', 'F', 'E2']
*** PASS: test_cases/q2/pacman_1.test
***      pacman layout:  mediumMaze
***      solution length: 68
***      nodes expanded: 269

*** Question q2: 3/3 ***

Question q5
=====
*** PASS: test_cases/q5/corner_tiny_corner.test
***      pacman layout:  tinyCorner
***      solution length: 28

*** Question q5: 3/3 ***

Finished at 21:01:45

Provisional grades
=====
Question q2: 3/3
Question q5: 3/3
=====
Total: 6/6

Your grades are NOT yet registered. To register your grades, make sure
to follow your instructor's guidelines to receive credit on your project.

elijah@elijahTAch-nemp:~/Search_ai_principles$
```

Figure 6: q5

2.8 Question 6: Corners Problem: Heuristic

In this problem I designed a heuristic for 4 corner-search problem. The heuristic is the minimum cost to reach the goal in a relaxed problem, i.e. without walls, and I consider the four cases separately.

The proof is similar.

Figure 8: q7 (the heuristic used to test is 4)

2.10 Question 8: Suboptimal Search

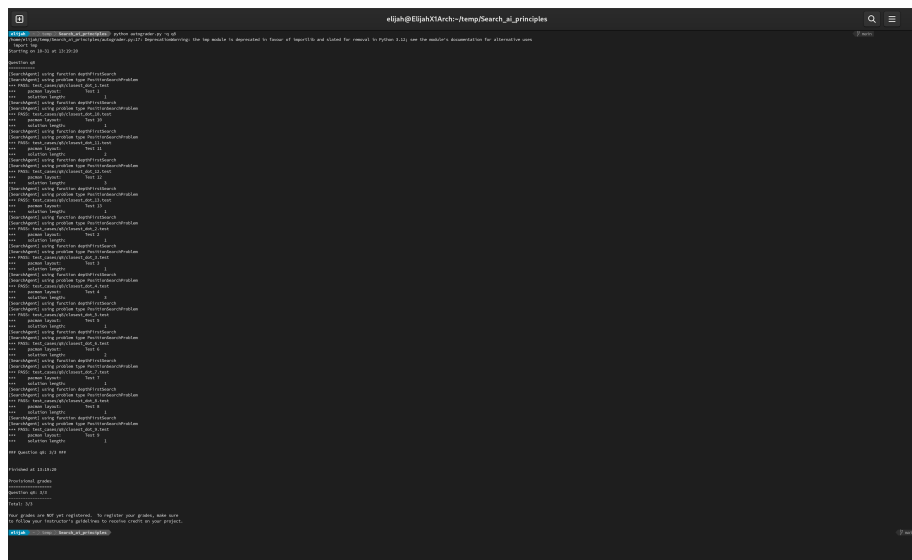


Figure 9: q8

The counterexample of closest dot search is inspired by the corners problem. The setting is three dots on the corner and starting point close to the dot in the middle.

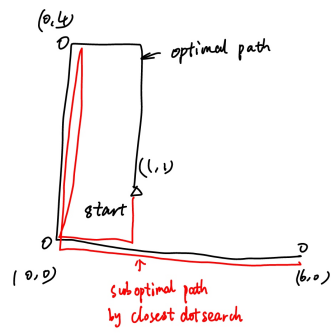


Figure 10: suboptimal