EleNA system

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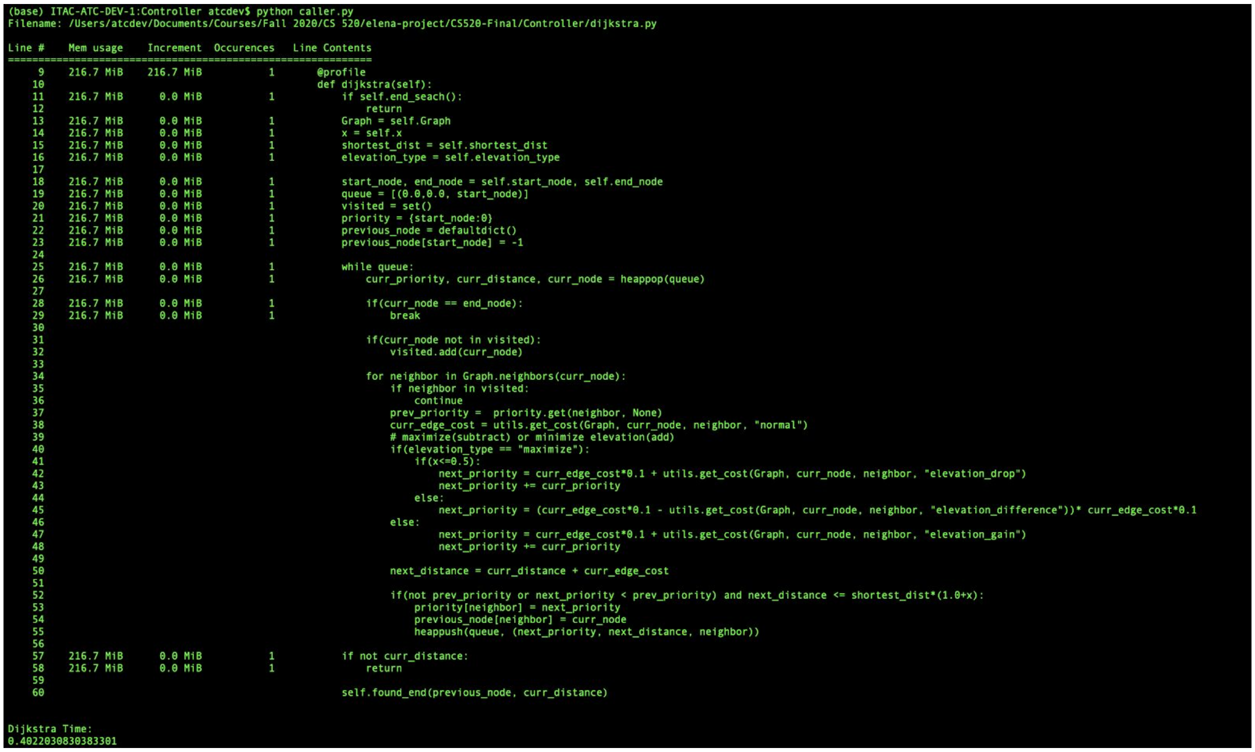
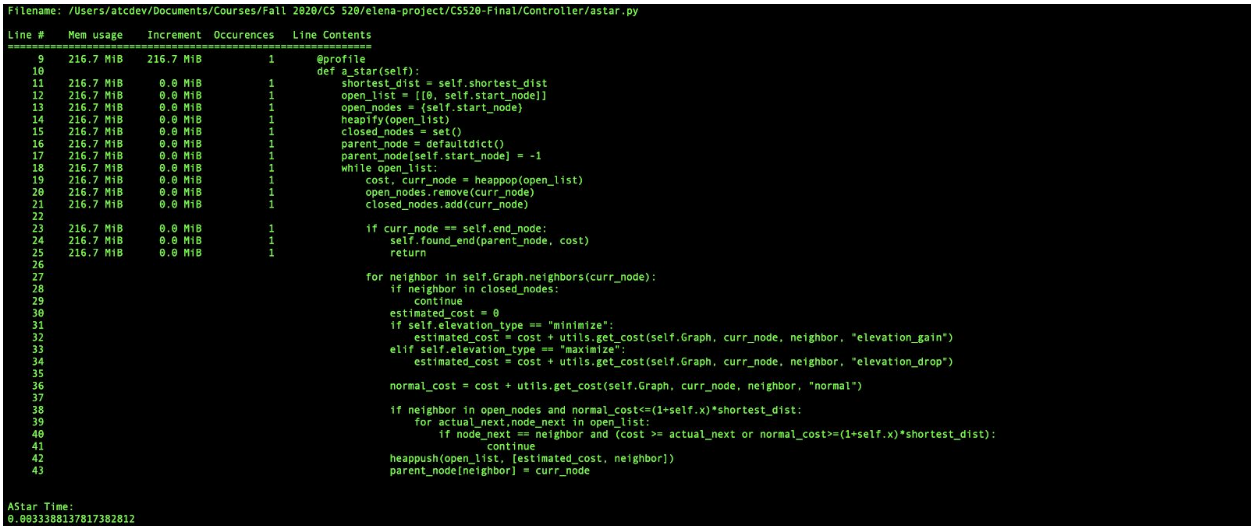
Test Cases and Performance



```
(base) ITAC-ATC-DEV-1:Controller atcdev$ python caller.py
Filename: /Users/atcdev/Documents/Courses/Fall 2020/CS 520/elena-project/CS520-Final/Controller/dijkstra.py

Line #    Mem usage    Increment  Occurences   Line Contents
============================================================
     9    216.7 MiB    216.7 MiB           1       @profile
    10                                             def dijkstra(self):
    11    216.7 MiB      0.0 MiB           1           if self.end_seach():
    12                                                     return
    13    216.7 MiB      0.0 MiB           1           Graph = self.Graph
    14    216.7 MiB      0.0 MiB           1           x = self.x
    15    216.7 MiB      0.0 MiB           1           shortest_dist = self.shortest_dist
    16    216.7 MiB      0.0 MiB           1           elevation_type = self.elevation_type
    17
    18    216.7 MiB      0.0 MiB           1           start_node, end_node = self.start_node, self.end_node
    19    216.7 MiB      0.0 MiB           1           queue = [(0.0,0.0, start_node)]
    20    216.7 MiB      0.0 MiB           1           visited = set()
    21    216.7 MiB      0.0 MiB           1           priority = {start_node:0}
    22    216.7 MiB      0.0 MiB           1           previous_node = defaultdict()
    23    216.7 MiB      0.0 MiB           1           previous_node[start_node] = -1
    24
    25    216.7 MiB      0.0 MiB           1           while queue:
    26    216.7 MiB      0.0 MiB           1               curr_priority, curr_distance, curr_node = heappop(queue)
    27
    28    216.7 MiB      0.0 MiB           1               if(curr_node == end_node):
    29    216.7 MiB      0.0 MiB           1                   break
    30
    31                                                     if(curr_node not in visited):
    32                                                         visited.add(curr_node)
    33
    34                                                     for neighbor in Graph.neighbors(curr_node):
    35                                                         if neighbor in visited:
    36                                                             continue
    37                                                         prev_priority =  priority.get(neighbor, None)
    38                                                         curr_edge_cost = utils.get_cost(Graph, curr_node, neighbor, "normal")
    39                                                         # maximize(subtract) or minimize elevation(add)
    40                                                         if(elevation_type == "maximize"):
    41                                                             if(x<=0.5):
    42                                                                 next_priority = curr_edge_cost*0.1 + utils.get_cost(Graph, curr_node, neighbor, "elevation_drop")
    43                                                                 next_priority += curr_priority
    44                                                             else:
    45                                                                 next_priority = (curr_edge_cost*0.1 - utils.get_cost(Graph, curr_node, neighbor, "elevation_difference"))* curr_edge_cost*0.1
    46                                                         else:
    47                                                                 next_priority = curr_edge_cost*0.1 + utils.get_cost(Graph, curr_node, neighbor, "elevation_gain")
    48                                                                 next_priority += curr_priority
    49
    50                                                         next_distance = curr_distance + curr_edge_cost
    51
    52                                                         if(not prev_priority or next_priority < prev_priority) and next_distance <= shortest_dist*(1.0+x):
    53                                                             priority[neighbor] = next_priority
    54                                                             previous_node[neighbor] = curr_node
    55                                                             heappush(queue, (next_priority, next_distance, neighbor))
    56
    57    216.7 MiB      0.0 MiB           1           if not curr_distance:
    58    216.7 MiB      0.0 MiB           1               return
    59
    60                                                 self.found_end(previous_node, curr_distance)


Dijkstra Time:
0.4022030830383301
```



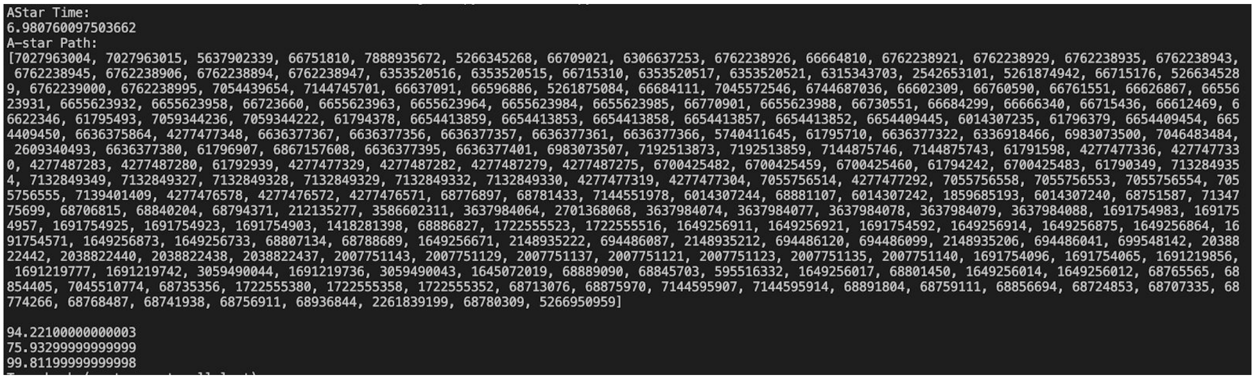
```
Filename: /Users/atcdev/Documents/Courses/Fall 2020/CS 520/elena-project/CS520-Final/Controller/astar.py

Line #    Mem usage    Increment  Occurences   Line Contents
============================================================
     9    216.7 MiB    216.7 MiB           1       @profile
    10                                             def a_star(self):
    11    216.7 MiB      0.0 MiB           1           shortest_dist = self.shortest_dist
    12    216.7 MiB      0.0 MiB           1           open_list = [[0, self.start_node]]
    13    216.7 MiB      0.0 MiB           1           open_nodes = {self.start_node}
    14    216.7 MiB      0.0 MiB           1           heapify(open_list)
    15    216.7 MiB      0.0 MiB           1           closed_nodes = set()
    16    216.7 MiB      0.0 MiB           1           parent_node = defaultdict()
    17    216.7 MiB      0.0 MiB           1           parent_node[self.start_node] = -1
    18    216.7 MiB      0.0 MiB           1           while open_list:
    19    216.7 MiB      0.0 MiB           1               cost, curr_node = heappop(open_list)
    20    216.7 MiB      0.0 MiB           1               open_nodes.remove(curr_node)
    21    216.7 MiB      0.0 MiB           1               closed_nodes.add(curr_node)
    22
    23    216.7 MiB      0.0 MiB           1               if curr_node == self.end_node:
    24    216.7 MiB      0.0 MiB           1                   self.found_end(parent_node, cost)
    25    216.7 MiB      0.0 MiB           1                   return
    26
    27                                                     for neighbor in self.Graph.neighbors(curr_node):
    28                                                         if neighbor in closed_nodes:
    29                                                             continue
    30                                                         estimated_cost = 0
    31                                                         if self.elevation_type == "minimize":
    32                                                             estimated_cost = cost + utils.get_cost(self.Graph, curr_node, neighbor, "elevation_gain")
    33                                                         elif self.elevation_type == "maximize":
    34                                                             estimated_cost = cost + utils.get_cost(self.Graph, curr_node, neighbor, "elevation_drop")
    35
    36                                                         normal_cost = cost + utils.get_cost(self.Graph, curr_node, neighbor, "normal")
    37
    38                                                         if neighbor in open_nodes and normal_cost<=(1+self.x)*shortest_dist:
    39                                                             for actual_next,node_next in open_list:
    40                                                                 if node_next == neighbor and (cost >= actual_next or normal_cost>=(1+self.x)*shortest_dist):
    41                                                                         continue
    42                                                         heappush(open_list, [estimated_cost, neighbor])
    43                                                         parent_node[neighbor] = curr_node


AStar Time:
0.0033388137817382812
```

We experimentally compared the results for the two search algorithms we used (Dijkstra and A*). By using this comparison technique, we measured their performance in terms of both space and time. In the case below, we see that both Dijkstra and A* take up the same amount of space but A* performs better in terms of time.

We also get the optimal path for A* below:



```
AStar Time:
6.980760097503662
A-star Path:
[7027963004, 7027963015, 5637902339, 66751810, 7888935672, 5266345268, 66709021, 6306637253, 6762238926, 66664810, 6762238921, 6762238929, 6762238935, 6762238943,
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 2609340493, 6636377380, 61796907, 6867157608, 6636377395, 6636377401, 6983073507, 7192513873, 7192513859, 7144875746, 7144875743, 61791598, 4277477336, 427747733
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4, 7132849349, 7132849327, 7132849328, 7132849329, 7132849332, 7132849330, 4277477319, 4277477304, 7055756514, 4277477292, 7055756558, 7055756553, 7055756554, 705
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774266, 68768487, 68741938, 68756911, 68936844, 2261839199, 68780309, 5266950959]

94.22100000000003
75.93299999999999
99.81199999999998
```
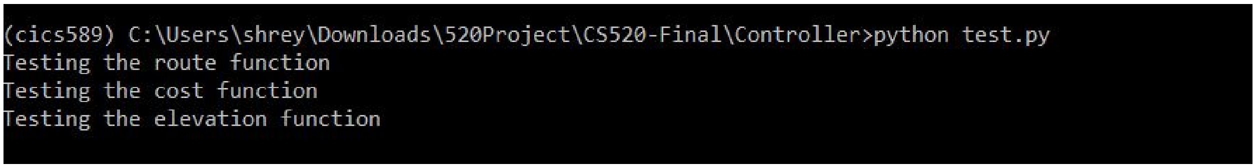

Finally, this is our testing performance using test.py



```
(cics589) C:\Users\shrey\Downloads\520Project\CS520-Final\Controller>python test.py
Testing the route function
Testing the cost function
Testing the elevation function
```