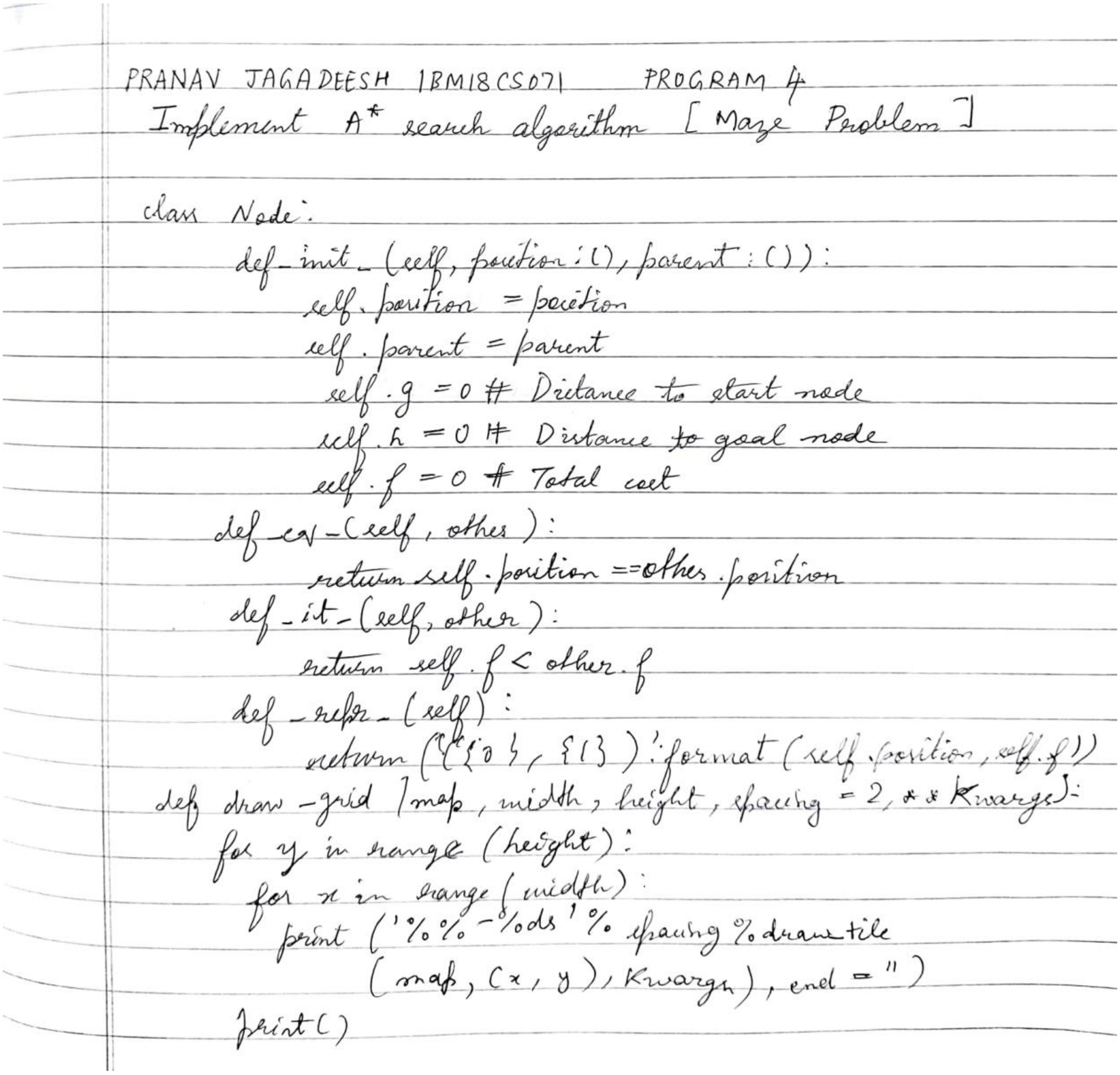
Program 4: Implement A* search algorithm.

Write_up:



PRANAV JAGADEESH 1BM18CS071 PROGRAM 4

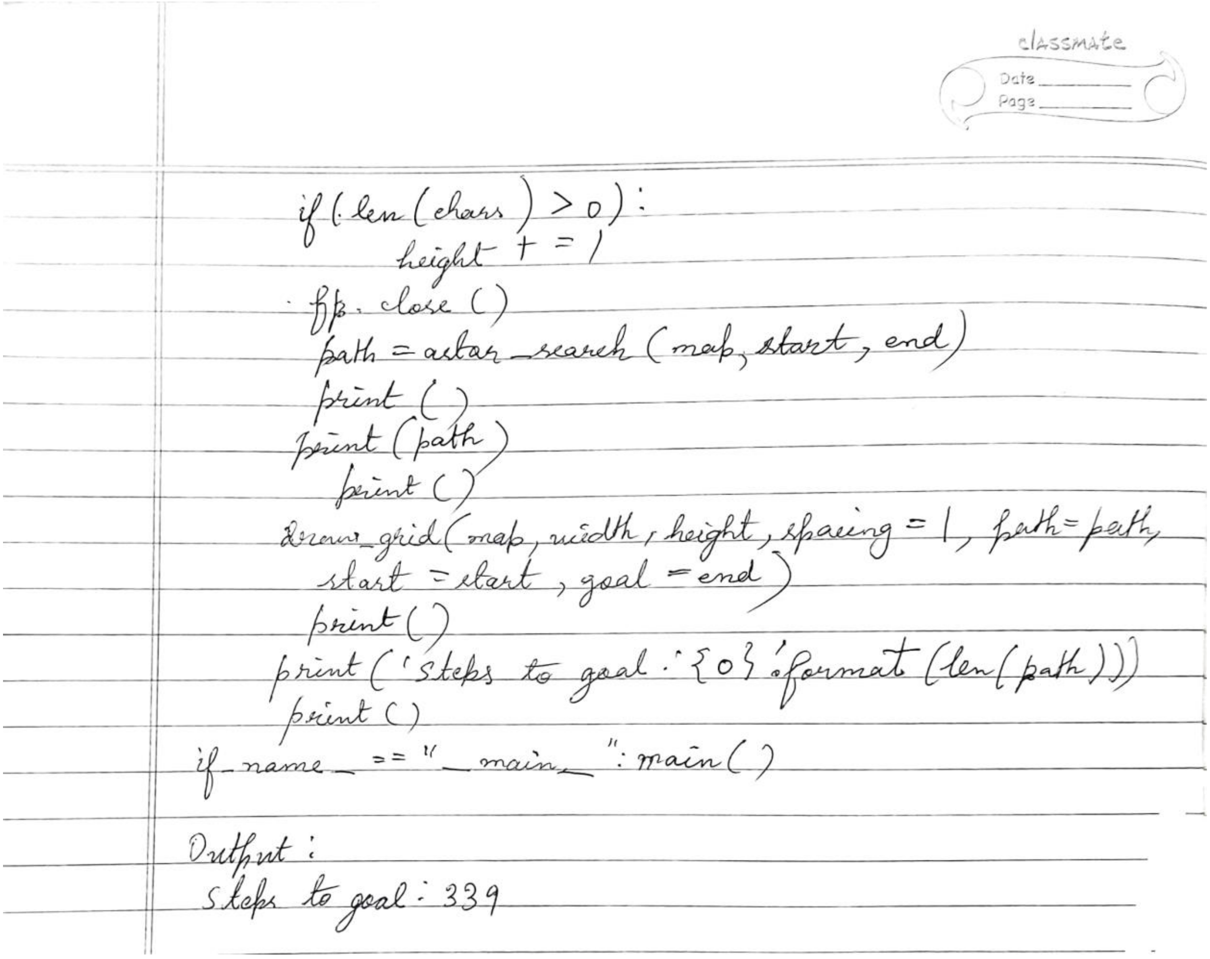
Implement A* search algorithm [Maze Problem]

```
class Node:
        def-init-(self, position:(), parent:()):
            self.position = position
            self.parent = parent
            self.g = 0 # Distance to start node
            self.h = 0 # Distance to goal node
            self.f = 0 # Total cost
        def-eq-(self, othes):
            return self.position ==othes.position
        def-it-(self, other):
            return self.f < other.f
        def-refr-(self):
            return ('({0}, {1})'.format(self.position, self.f))
def draw-grid(map, width, height, spacing = 2, **Kwargs):
    for y in range(height):
        for x in range(width):
            print('%%-%ds' % spacing % draw tile
                  (map, (x, y), Kwargs), end = '')
        print()
```

```
def draw_tile(map, position, Kwargs):
    value = map.get(position)
    if 'path' in Kwargs and position in Kwargs['path': value='+'
    if 'start' in Kwargs and position == Kwargs['start']: value='@'
    if 'goal' in Kwargs and position == Kwargs['goal']: value='$'
    return value

def astar_search(map, start, end):
    open=[]
    closed=[]
    start_node = Node(start, None)
    start_node = Node(End, None)
    open.append(start_node)
    while len(open) > 0:
      open.sort()
      current_node = open pop(0)
      closed.append(current_node)
      if current_node == goal_node:
         path = []
      while current_node != start_node:
       path.append(current_node.position)
       current_node=current_node.parent
      return path[::-1]
      (x, y) = current_node:position
      neighbors = [(x-1, y), (x+1, y), (x, y-1), (x, y+1)]
      for next in neighbors:
        map_value = map.get(next)
         if (map_value == '#'):
           continue
        neighbor = Node(next, current_node)
         if (neighbor in closed):
            continue
```

```
neighbor.g = abs( neighbor.position[0]-start_node.position[0])
            + abs (neighbor.position[1]-start_node.position[1])
neighbor.h= abs ( neighbor.positon [0]-goal_node.position[0])
           + abs (neighbor.position [1]-goal_node.position[1])
neighbor.f = neighbor.g+ neighbor.h
 if (add_to_open (open, neighbor) == True):
     open.append (neighbor)
 # Return None, no path is found
 return None
def add_to_open(open, neighbor):
     for node in open:
         if (neighbor == node and neighbor.f >= node.f):
             return False
         return True
    def main():
        map = {}
        chars = ['c']
        start = None
        end = None
        width = 0
        height = 0
         fp = open('maze.txt', 'r')
   while len(chars) > 0:
       chars = [str(i) for i in fp.readline().strip()]
       width = len(chars) if width == 0 else width
       for x in range(len(chars)):
           map[(x, height)] = chars[x]
       if (chars[x] == '@'):
           start = (x, height)
         elif (chars[x] == '$'):
             end = (x, height)
```



```
if (len (chars) > 0):
        height += 1
fp.close()
path = astar_search (map, start, end)
print ( )
print (path)
  print ( )
draw_grid(map, width, height, spacing = 1, path=path,
  start = start, goal = end)
print()
print('steps to goal: {0}'.format(len(path)))
print ( )
if_name_ == "_main_": main()
```

Output:

```
Steps to goal: 339
```

Program:

```
class Node:
    def __init__(self, position: (), parent: ()):
        self.position = position
        self.parent = parent
        self.g = 0
        self.h = 0
        self.f = 0



    def __eq__(self, other):
        return self.position == other.position
    def __lt__(self, other):
        return self.f < other.f


    def __repr__(self):
        return ('({0},{1})'.format(self.position, self.f))


def draw_grid(map, width, height, spacing=2, **kwargs):
    for y in range(height):
        for x in range(width):
            print('%%-%ds' % spacing % draw_tile(map, (x, y), kwargs), end='')
        print()


def draw_tile(map, position, kwargs):

    value = map.get(position)

    if 'path' in kwargs and position in kwargs['path']: value = '+'

    if 'start' in kwargs and position == kwargs['start']: value = '@'

    if 'goal' in kwargs and position == kwargs['goal']: value = '$'

    return value
```

```
def astar_search(map, start, end):

    open = []
    closed = []

    start_node = Node(start, None)
    goal_node = Node(end, None)

    open.append(start_node)


    while len(open) > 0:

        open.sort()

        current_node = open.pop(0)

        closed.append(current_node)


        if current_node == goal_node:
            path = []
            while current_node != start_node:
                path.append(current_node.position)
                current_node = current_node.parent


            return path[::-1]
        (x, y) = current_node.position

        neighbors = [(x - 1, y), (x + 1, y), (x, y - 1), (x, y + 1)]

        for next in neighbors:

            map_value = map.get(next)

            if (map_value == '#'):
                continue

            neighbor = Node(next, current_node)

            if (neighbor in closed):
                continue

            neighbor.g = abs(neighbor.position[0] - start_node.position[0]) + abs(
                neighbor.position[1] - start_node.position[1])
            neighbor.h = abs(neighbor.position[0] - goal_node.position[0]) + abs(
                neighbor.position[1] - goal_node.position[1])
            neighbor.f = neighbor.g + neighbor.h

            if (add_to_open(open, neighbor) == True):

                open.append(neighbor)

    return None
```

```
def add_to_open(open, neighbor):
    for node in open:
        if (neighbor == node and neighbor.f >= node.f):
            return False
    return True




def main():

    map = {}
    chars = ['c']
    start = None
    end = None
    width = 0
    height = 0

    fp = open('maze.txt','r')



    while len(chars) > 0:

        chars = [str(i) for i in fp.readline().strip()]

        width = len(chars) if width == 0 else width

        for x in range(len(chars)):
            map[(x, height)] = chars[x]
            if (chars[x] == '@'):
                start = (x, height)
            elif (chars[x] == '$'):
                end = (x, height)



        if (len(chars) > 0):
            height += 1

    fp.close()

    path = astar_search(map, start, end)
    print()
    print(path)
    print()
    draw_grid(map, width, height, spacing=1, path=path, start=start, goal=end)
    print()
    print('Steps to goal: {0}'.format(len(path)))
    print()



if __name__ == "__main__": main()
```

Output:

```
[(39, 39), (38, 39), (37, 39), (36, 39), (35, 39), (34, 39), (33, 39), (33, 38), (33, 37), (32, 37),
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(17, 10), (17, 9), (16, 9), (15, 9), (15, 8), (15, 7), (14, 7), (13, 7), (13, 6), (13, 5), (13, 4), (13,
3), (12, 3), (11, 3), (11, 2), (11, 1)]
```

```
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+###.#.#.######.###.#.#.#.#.#.###.#.##########.######.#.#.###.######.##+#++++++++#+#.#++
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.###.#.########.###.#.#.###.#.#############.#.#.##+++#++++#+#+#...#++++++#.#.......#.#.#...#.
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#.#.########.#.#.#.######.#.##+#.#++++++++++++#.#.#.#.....#.#.....#...#.#.....#...#.#.#.#.#...#.#.
#.#.#.....#.##+###+##########+#.#.#.########.########.###.######.###.#.#.#.#.###.#.#.#.#.##
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+########.############.########.#.########.###.#.###.###.######.#.#.######.##.....#+#+#++
+#...#.#++++++++#.........#.#...#.......#.#.#...#...#.....#.#.#...#.#########+#+###+#.###.#+######+
#.######.###.#.#.#.########.#.######.###.######.#.###.#.##++++++++#+#++++#.....#+#...#+#...#
.#.....#.#.#.#.#.....#...#...#...#.....#...#.#.##+########+#+#.######.#+###.#+###.#.########.#.#.#.
#.########.#.###.#.###.######.#.#.##+#.#++++++#+#.#++++#.#++++#.#++++#...#.#...#.#...#.#.....#
.#...#...#...#.......#...##+#.#+######+#.#+#+######+#.###+###.#.#.#.#.######.######.#.######.##
###.##########.####+#..+#..+++#.#+#+#++++#++++#.#+#...#...#.#.#...#.....#...#.#...#...#.....#...#
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#+#.###.#.##########.#.#.#.#.#.#.#.######.#.#.#######...#++++++++#++++++++#++++++..#+++
#++++++++@..........#...#...#...#.......#.......#########################################
###############################################################################
```

Steps to goal: 339

Process finished with exit code 0