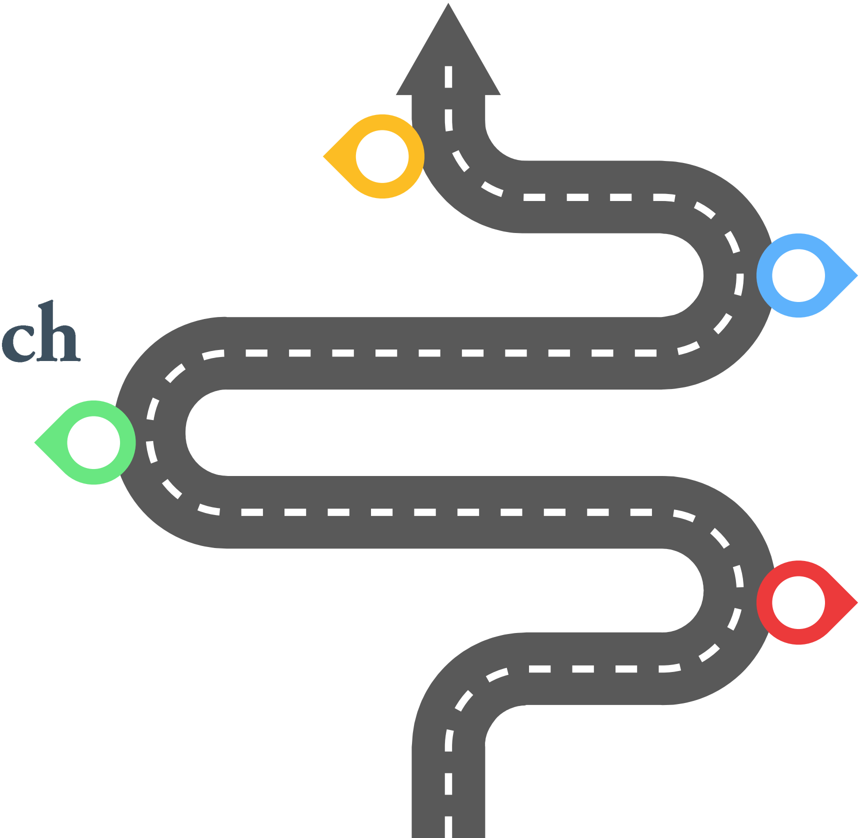
Artificial intelligence and Experts Systems Lab
CSE 404

Project-1

Implementation of a small address Map using A* Search Algorithm



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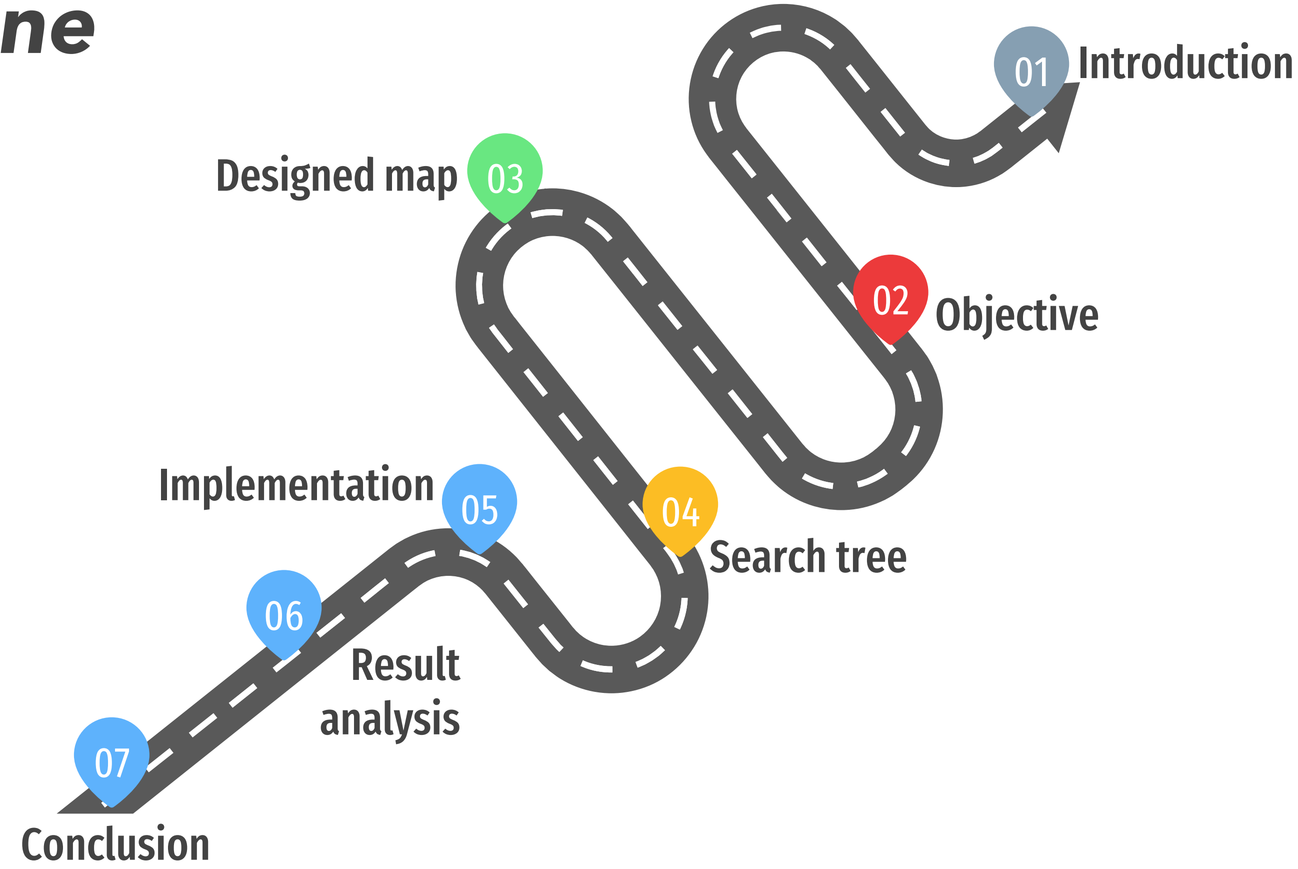
Outline



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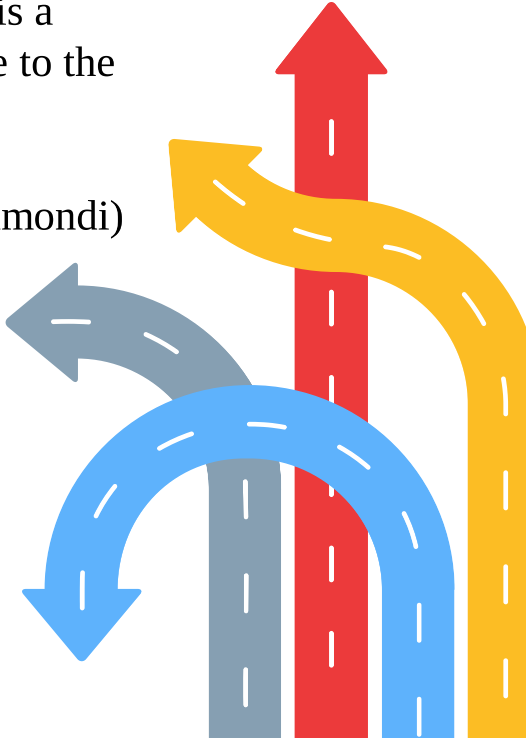
Introduction

The assigned problem is implementation of a small address map from my home to UAP, using A* search algorithm and find out the optimal path. A* algorithm is a searching algorithm that searches for the shortest path between the initial state to the final state.

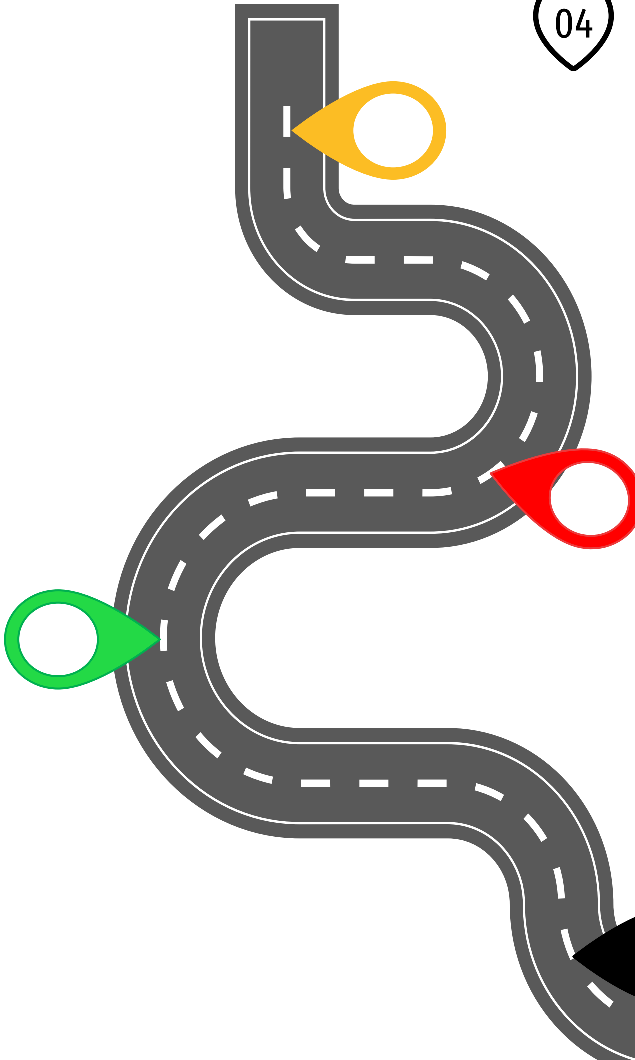
So, here in this project I will find the most optimal path from my home (Dhanmondi) to my university (UAP) using A* search algorithm.



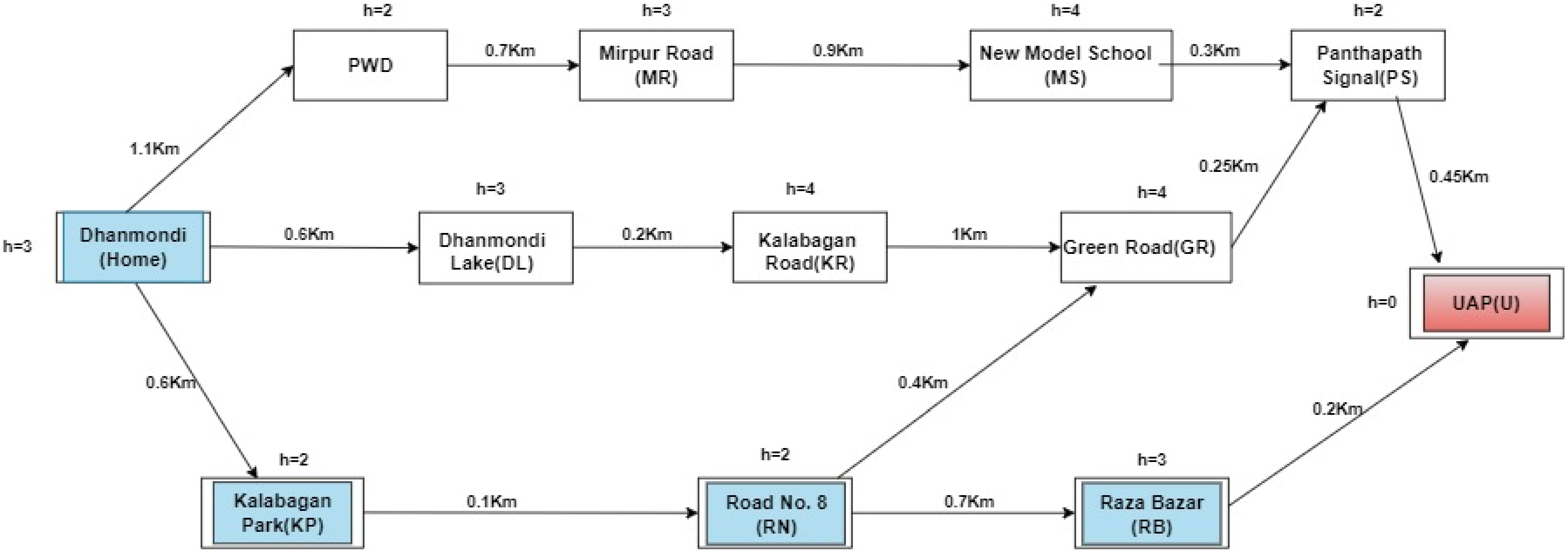
Objective

In this project, I have to reach UAP from my home Dhanmondi by using the shortest path.
There are several path between Dhanmondi to UAP. But not all of those path are optimal. So I need to find out the optimal path. For finding, I’ve used the A*(A-star) search algorithm.

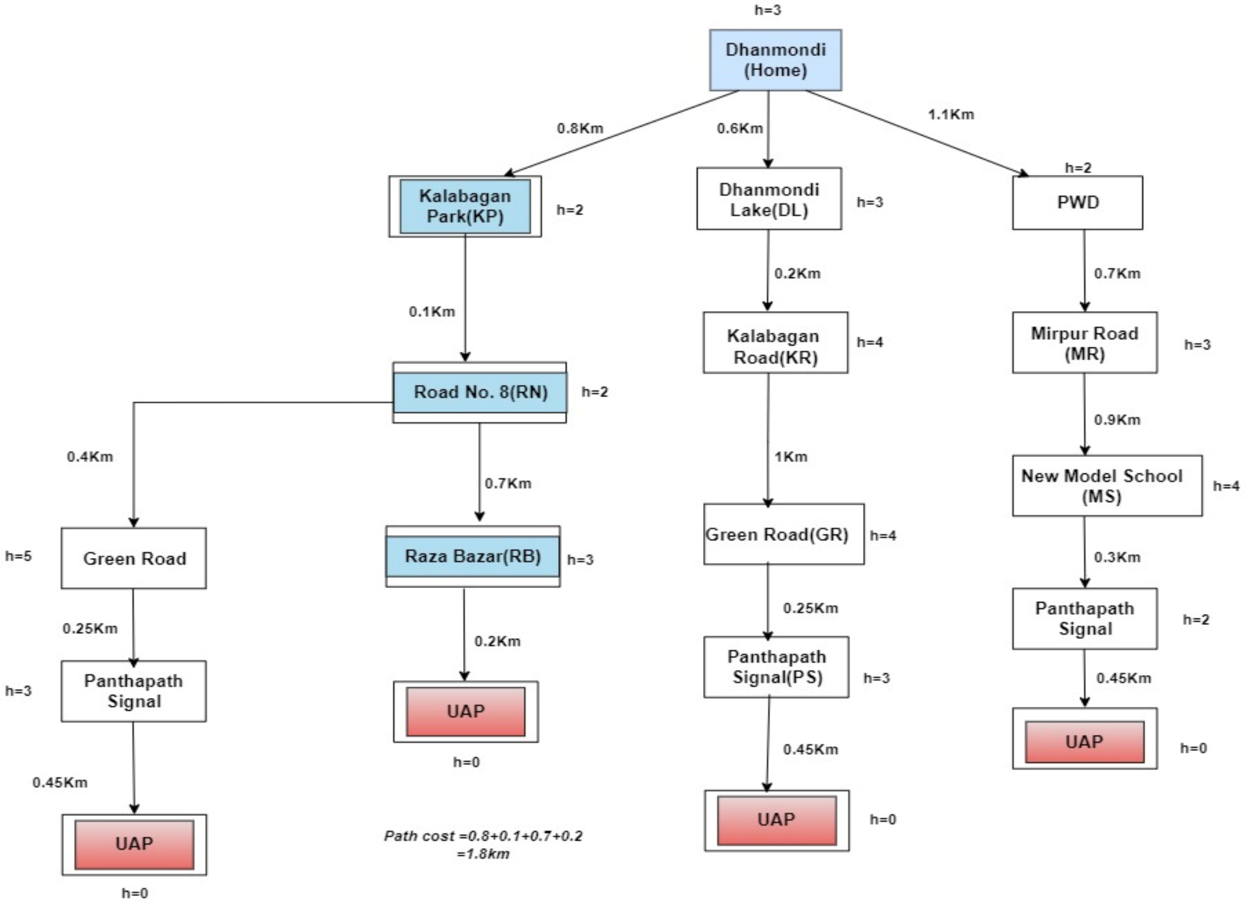
The objective of this project is to find an optimal path from my home (Dhanmondi) to my university (UAP).



Designed Map



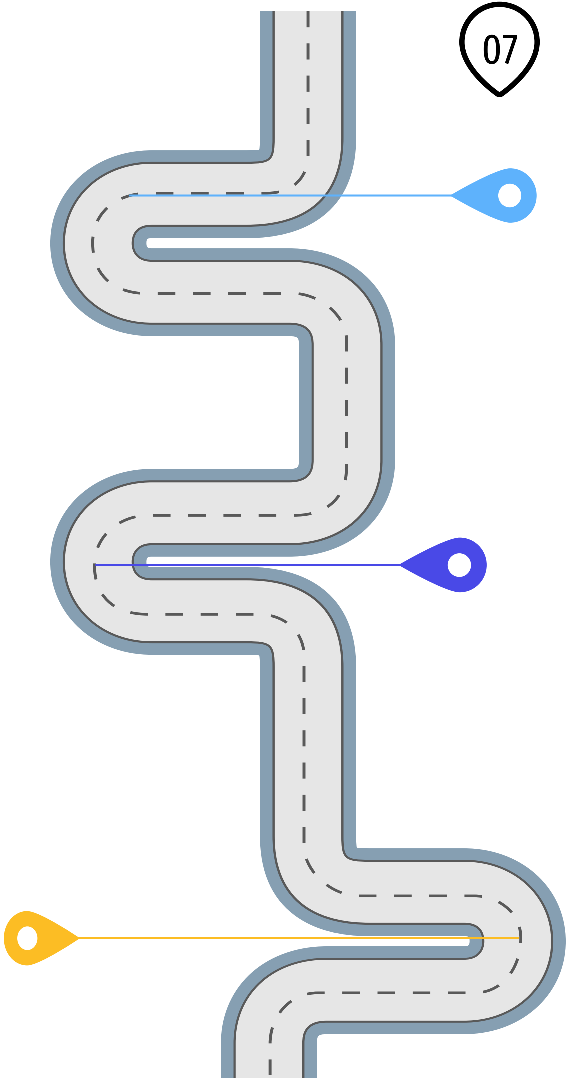
Search Tree


h=3
Dhanmondi (Home)
0.8Km
0.6Km
1.1Km
Kalabagan Park(KP)
h=2
Dhanmondi Lake(DL)
h=3
h=2
PWD
0.1Km
0.2Km
0.7Km
Kalabagan Road(KR)
h=4
Mirpur Road (MR)
h=3
Road No. 8(RN)
h=2
0.4Km
0.7Km
1Km
0.9Km
New Model School (MS)
h=4
h=5
Green Road
Raza Bazar(RB)
h=3
Green Road(GR)
h=4
0.3Km
0.25Km
0.2Km
0.25Km
Panthapath Signal
h=2
h=3
Panthapath Signal
Panthapath Signal(PS)
h=3
0.45Km
UAP
h=0
UAP
h=0
0.45Km
0.45Km
UAP
h=0
UAP
h=0
Path cost =0.8+0.1+0.7+0.2 =1.8km

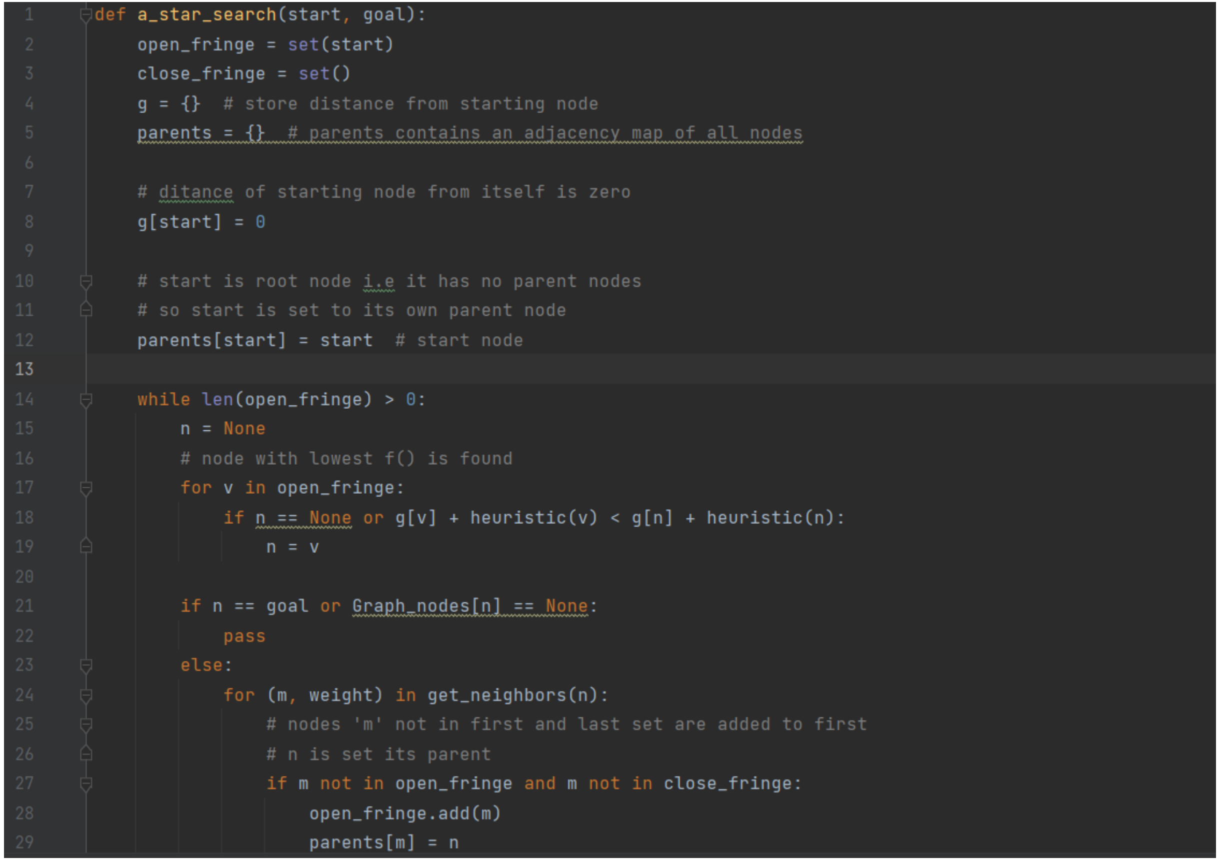
Implementation

Now I'll explain implementation part of this project.

I've used python for the programming language and implement it in PyCharm IDE.

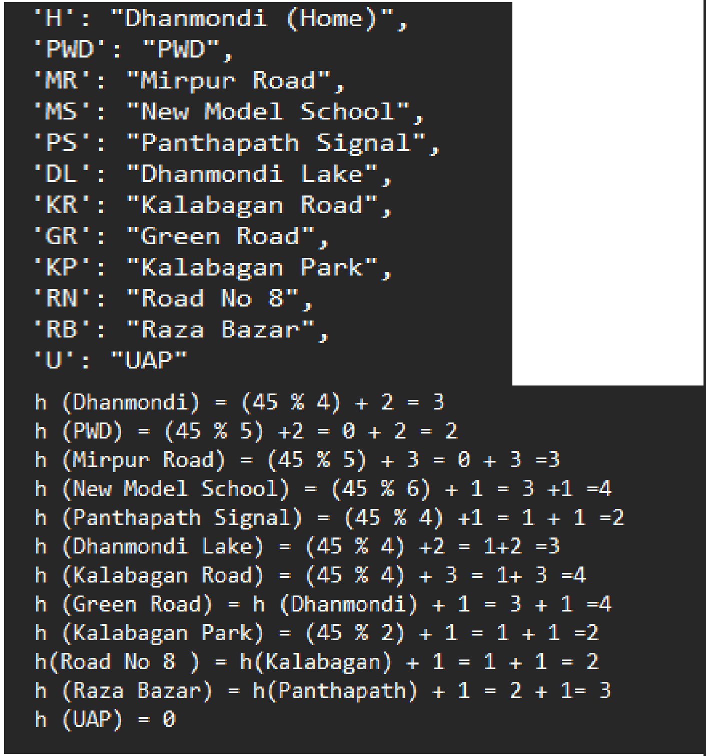


Implementation



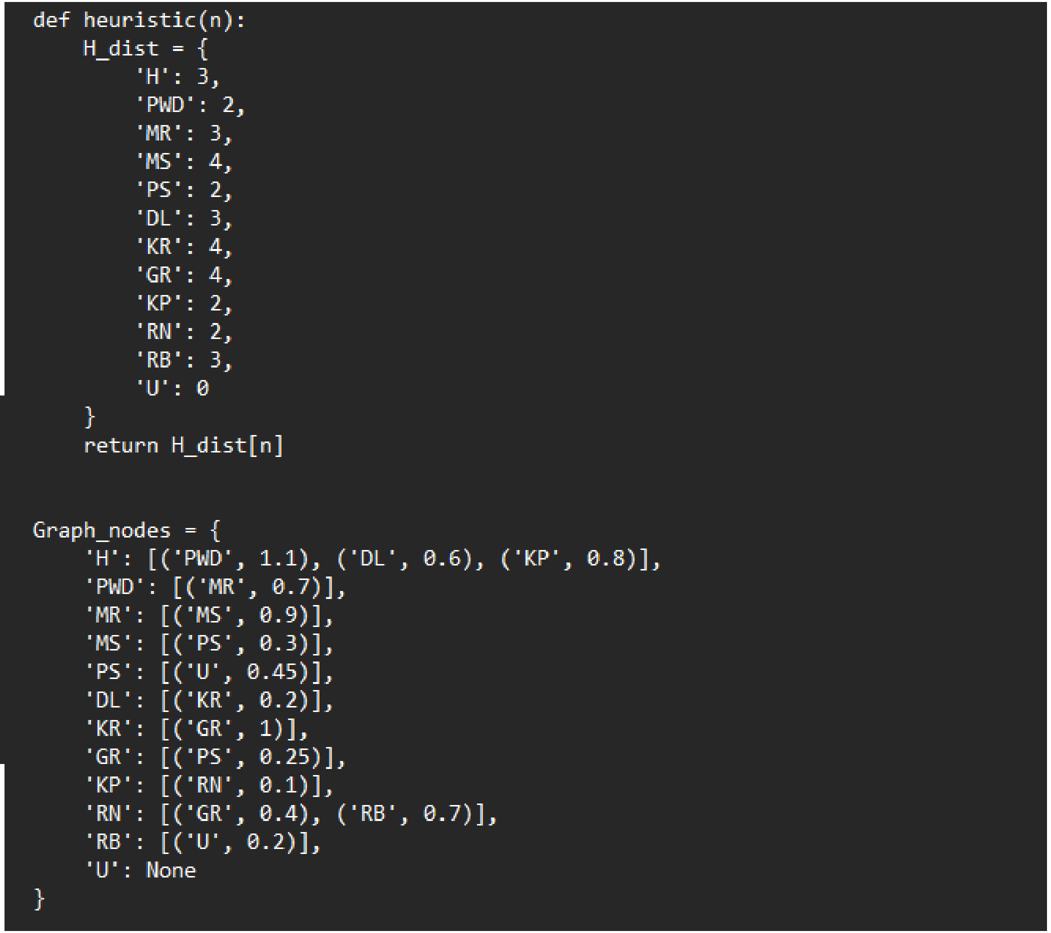
```python
def a_star_search(start, goal):
    open_fringe = set(start)
    close_fringe = set()
    g = {}  # store distance from starting node
    parents = {}  # parents contains an adjacency map of all nodes

    # ditance of starting node from itself is zero
    g[start] = 0

    # start is root node i.e it has no parent nodes
    # so start is set to its own parent node
    parents[start] = start  # start node

    while len(open_fringe) > 0:
        n = None
        # node with lowest f() is found
        for v in open_fringe:
            if n == None or g[v] + heuristic(v) < g[n] + heuristic(n):
                n = v

        if n == goal or Graph_nodes[n] == None:
            pass
        else:
            for (m, weight) in get_neighbors(n):
                # nodes 'm' not in first and last set are added to first
                # n is set its parent
                if m not in open_fringe and m not in close_fringe:
                    open_fringe.add(m)
                    parents[m] = n
```

Input



```
'H': "Dhanmondi (Home)",
'PWD': "PWD",
'MR': "Mirpur Road",
'MS': "New Model School",
'PS': "Panthapath Signal",
'DL': "Dhanmondi Lake",
'KR': "Kalabagan Road",
'GR': "Green Road",
'KP': "Kalabagan Park",
'RN': "Road No 8",
'RB': "Raza Bazar",
'U': "UAP"
```

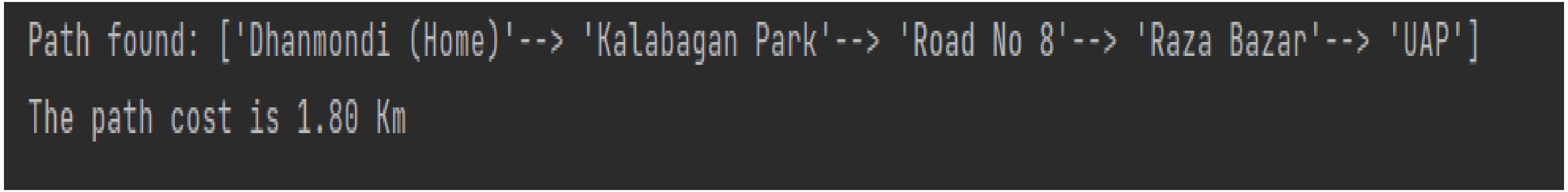
```
h (Dhanmondi) = (45 % 4) + 2 = 3
h (PWD) = (45 % 5) +2 = 0 + 2 = 2
h (Mirpur Road) = (45 % 5) + 3 = 0 + 3 =3
h (New Model School) = (45 % 6) + 1 = 3 +1 =4
h (Panthapath Signal) = (45 % 4) +1 = 1 + 1 =2
h (Dhanmondi Lake) = (45 % 4) +2 = 1+2 =3
h (Kalabagan Road) = (45 % 4) + 3 = 1+ 3 =4
h (Green Road) = h (Dhanmondi) + 1 = 3 + 1 =4
h (Kalabagan Park) = (45 % 2) + 1 = 1 + 1 =2
h(Road No 8 ) = h(Kalabagan) + 1 = 1 + 1 = 2
h (Raza Bazar) = h(Panthapath) + 1 = 2 + 1= 3
h (UAP) = 0
```



```
def heuristic(n):
    H_dist = {
        'H': 3,
        'PWD': 2,
        'MR': 3,
        'MS': 4,
        'PS': 2,
        'DL': 3,
        'KR': 4,
        'GR': 4,
        'KP': 2,
        'RN': 2,
        'RB': 3,
        'U': 0
    }
    return H_dist[n]


Graph_nodes = {
    'H': [('PWD', 1.1), ('DL', 0.6), ('KP', 0.8)],
    'PWD': [('MR', 0.7)],
    'MR': [('MS', 0.9)],
    'MS': [('PS', 0.3)],
    'PS': [('U', 0.45)],
    'DL': [('KR', 0.2)],
    'KR': [('GR', 1)],
    'GR': [('PS', 0.25)],
    'KP': [('RN', 0.1)],
    'RN': [('GR', 0.4), ('RB', 0.7)],
    'RB': [('U', 0.2)],
    'U': None
}
```

Result Analysis

After Using A Star Search Algorithm on this designed map, on output we can find the shortest path



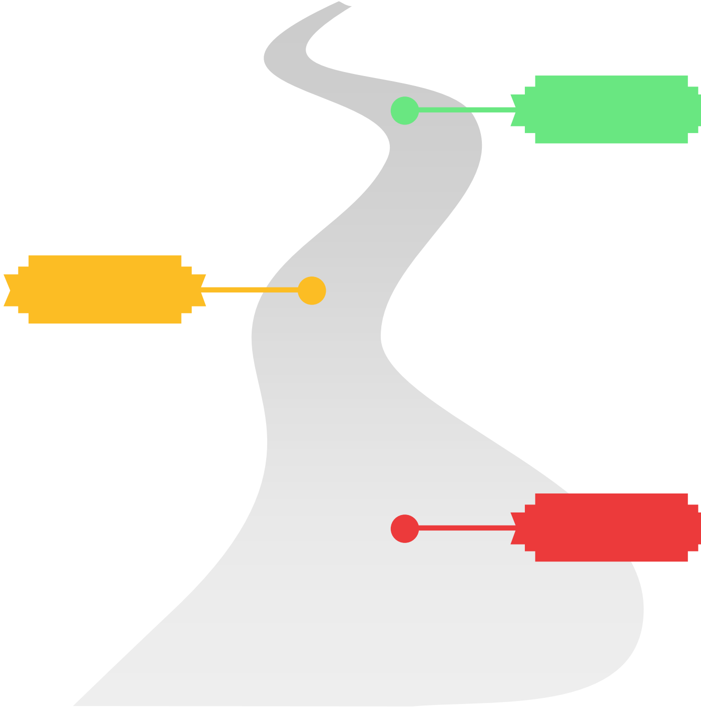
```
Path found: ['Dhanmondi (Home)'--> 'Kalabagan Park'--> 'Road No 8'--> 'Raza Bazar'--> 'UAP']

The path cost is 1.80 Km
```

So, we can say that that is the most optimal and shortest path.

Conclusion

- In this project, after successful implementation, A* search algorithm gives the most optimal path as output.

- In conclusion, A* search algorithm is a powerful and beneficial algorithm with all the potential. So we can use this algorithm for approximate the shortest path in real-life situation, like - in maps, games, robotics etc.



Thank You