PRACTICAL 3

Aim: To implement A* Algorithm using Romania Map.

Code:

```
import queue as Q
dict_hn={'Arad':336, 'Bucharest':0, 'Craiova':160, 'Drobeta':242,'Eforie':161,
'Fagaras':176, 'Giurgiu':77, 'Hirsova':151, 'Lasi':226,'Lugoj':244,
'Mehadia':241, 'Neamt':234,
        'Oradea':380, 'Pitesti':100, 'Rimnicu':193, 'Sibiu':253,
'Timisoara':329, 'Urziceni':80, 'Vaslui':199, 'Zerind':374}
dict_gn=dict(
Arad=dict(Zerind=75, Timisoara=118, Sibiu=140),
Bucharest=dict(Urziceni=85, Fagaras=211, Giurgiu=90, Pitesti=101),
Craiova=dict(Drobeta=120, Rimnicu=146, Pitesti=138),
Drobeta=dict(Mehadia=75, Craiova=120),
Eforie=dict(Hirsova=86),
Fagaras=dict(Sibiu=99, Bucharest=211),
Giurgiu=dict(Bucharest=90),
Hirsova=dict(Urziceni=98, Eforie=86),
Lasi=dict(Vaslui=92, Neamt=87),
Lughoj=dict(Timisoara=111, Mehadia=70),
Mehadia=dict(Lugoj=70, Drobeta=75),
Neamt=dict(Lasi=87),
Oradea=dict(Zerind=71, Sibiu=151),
Pitesti=dict(Rimnicu=97, Craiova=138, Bucharest=101),
Rimnicu=dict(Sibiu=80, Pitesti=97, Craiova=146),
Sibiu=dict(Fagaras=99, Rimnicu=80, Oradea=151, Arad=140),
Timisoara=dict(Arad=118, Lughoj=111),
Urziceni=dict(Hirsova=98, Bucharest=85, Vaslui=142),
Vaslui=dict(Lasi=92, Urziceni=142),
Zerind=dict(Arad=75, Oradea=71)
)
def get_fn(citystr):
    cities=citystr.split(',')
    hn=0
    gn=0
    ctr=0
    while ctr!=len(cities)-1:
        gn=gn+dict_gn[cities[ctr]][cities[ctr+1]]
        ctr=ctr+1
    print('-----------g(n) for ',citystr,' is ',gn)
    hn=dict_hn[cities[len(cities)-1]]
    print('-----------h(n) for ',citystr,' is ',hn)
    print('-----------f(n) for ',citystr,' is ',(hn+gn))
    print('-----------')
    return (hn+gn)
```

```
def expand(mycities, cityq, goal):
    tot,citystr=mycities
    cities=citystr.split(',')
    city2expand=cities[len(cities)-1]
    if city2expand==goal:
        ans='The A* path is '+citystr+' with the value as '+str(tot)
        while not cityq.empty():
            cityq.get()
        return ans
    print('Expanded city----------------------',city2expand)
    for cty in dict_gn[city2expand]:
        cityq.put((get_fn(citystr+","+cty),citystr+","+cty))
def main():
    start='Arad'
    goal='Bucharest'
    cityq=Q.PriorityQueue()
    cityq.put((get_fn(start),start))
    while not cityq.empty():
        mycities=cityq.get()
        ans=expand(mycities, cityq, goal)
    print('##########',ans)
main()
```

Output:

```
[Running] python -u "c:\Users\athar\Documents\Practicals\AI Practical\P3\A.py"
----------g(n) for  Arad  is  0
----------h(n) for  Arad  is  336
----------f(n) for  Arad  is  336
----------
Expanded city---------------------- Arad
----------g(n) for  Arad,Zerind  is  75
----------h(n) for  Arad,Zerind  is  374
----------f(n) for  Arad,Zerind  is  449
----------
----------g(n) for  Arad,Timisoara  is  118
----------h(n) for  Arad,Timisoara  is  329
----------f(n) for  Arad,Timisoara  is  447
----------
----------g(n) for  Arad,Sibiu  is  140
----------h(n) for  Arad,Sibiu  is  253
----------f(n) for  Arad,Sibiu  is  393
----------
Expanded city---------------------- Sibiu
----------g(n) for  Arad,Sibiu,Fagaras  is  239
----------h(n) for  Arad,Sibiu,Fagaras  is  176
----------f(n) for  Arad,Sibiu,Fagaras  is  415
----------
----------g(n) for  Arad,Sibiu,Rimnicu  is  220
----------h(n) for  Arad,Sibiu,Rimnicu  is  193
----------f(n) for  Arad,Sibiu,Rimnicu  is  413
----------
----------g(n) for  Arad,Sibiu,Oradea  is  291
----------h(n) for  Arad,Sibiu,Oradea  is  380
----------f(n) for  Arad,Sibiu,Oradea  is  671
----------
----------g(n) for  Arad,Sibiu,Arad  is  280
----------h(n) for  Arad,Sibiu,Arad  is  336
----------f(n) for  Arad,Sibiu,Arad  is  616
----------
Expanded city---------------------- Rimnicu
----------g(n) for  Arad,Sibiu,Rimnicu,Sibiu  is  300
----------h(n) for  Arad,Sibiu,Rimnicu,Sibiu  is  253
----------f(n) for  Arad,Sibiu,Rimnicu,Sibiu  is  553
----------
----------g(n) for  Arad,Sibiu,Rimnicu,Pitesti  is  317
----------h(n) for  Arad,Sibiu,Rimnicu,Pitesti  is  100
----------f(n) for  Arad,Sibiu,Rimnicu,Pitesti  is  417
----------
----------g(n) for  Arad,Sibiu,Rimnicu,Craiova  is  366
----------h(n) for  Arad,Sibiu,Rimnicu,Craiova  is  160
----------f(n) for  Arad,Sibiu,Rimnicu,Craiova  is  526
----------
Expanded city---------------------- Fagaras
----------g(n) for  Arad,Sibiu,Fagaras,Sibiu  is  338
----------h(n) for  Arad,Sibiu,Fagaras,Sibiu  is  253
----------f(n) for  Arad,Sibiu,Fagaras,Sibiu  is  591
----------
----------g(n) for  Arad,Sibiu,Fagaras,Bucharest  is  450
----------h(n) for  Arad,Sibiu,Fagaras,Bucharest  is  0
----------f(n) for  Arad,Sibiu,Fagaras,Bucharest  is  450
----------
Expanded city---------------------- Pitesti
----------g(n) for  Arad,Sibiu,Rimnicu,Pitesti,Rimnicu  is  414
----------h(n) for  Arad,Sibiu,Rimnicu,Pitesti,Rimnicu  is  193
----------f(n) for  Arad,Sibiu,Rimnicu,Pitesti,Rimnicu  is  607
----------
----------g(n) for  Arad,Sibiu,Rimnicu,Pitesti,Craiova  is  455
----------h(n) for  Arad,Sibiu,Rimnicu,Pitesti,Craiova  is  160
----------f(n) for  Arad,Sibiu,Rimnicu,Pitesti,Craiova  is  615
----------
----------g(n) for  Arad,Sibiu,Rimnicu,Pitesti,Bucharest  is  418
----------h(n) for  Arad,Sibiu,Rimnicu,Pitesti,Bucharest  is  0
----------f(n) for  Arad,Sibiu,Rimnicu,Pitesti,Bucharest  is  418
----------
######## The A* path is Arad,Sibiu,Rimnicu,Pitesti,Bucharest with the value as 418
```