test

March 1, 2020

[11]:
```
!pip3 install pandas
!pip3 install matplotlib
!pip3 install networkx
!pip3 install locationiq
```

```
Requirement already satisfied: pandas in ./venv/lib/python3.6/site-packages
(1.0.1)
Requirement already satisfied: numpy>=1.13.3 in ./venv/lib/python3.6/site-
packages (from pandas) (1.18.1)
Requirement already satisfied: python-dateutil>=2.6.1 in
./venv/lib/python3.6/site-packages (from pandas) (2.8.1)
Requirement already satisfied: pytz>=2017.2 in ./venv/lib/python3.6/site-
packages (from pandas) (2019.3)
Requirement already satisfied: six>=1.5 in ./venv/lib/python3.6/site-packages
(from python-dateutil>=2.6.1->pandas) (1.14.0)
Requirement already satisfied: matplotlib in ./venv/lib/python3.6/site-packages
(3.1.3)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
./venv/lib/python3.6/site-packages (from matplotlib) (2.4.6)
Requirement already satisfied: numpy>=1.11 in ./venv/lib/python3.6/site-packages
(from matplotlib) (1.18.1)
Requirement already satisfied: cycler>=0.10 in ./venv/lib/python3.6/site-
packages (from matplotlib) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in ./venv/lib/python3.6/site-
packages (from matplotlib) (1.1.0)
Requirement already satisfied: python-dateutil>=2.1 in
./venv/lib/python3.6/site-packages (from matplotlib) (2.8.1)
Requirement already satisfied: six in ./venv/lib/python3.6/site-packages (from
cycler>=0.10->matplotlib) (1.14.0)
Requirement already satisfied: setuptools in ./venv/lib/python3.6/site-packages
(from kiwisolver>=1.0.1->matplotlib) (45.2.0)
Requirement already satisfied: networkx in ./venv/lib/python3.6/site-packages
(2.4)
Requirement already satisfied: decorator>=4.3.0 in ./venv/lib/python3.6/site-
packages (from networkx) (4.4.1)
Requirement already satisfied: locationiq in ./venv/lib/python3.6/site-packages
(0.0.2)
Requirement already satisfied: requests>=2.11.1 in ./venv/lib/python3.6/site-
```

```
packages (from locationiq) (2.23.0)
Requirement already satisfied: certifi>=2017.4.17 in ./venv/lib/python3.6/site-
packages (from requests>=2.11.1->locationiq) (2019.11.28)
Requirement already satisfied: idna<3,>=2.5 in ./venv/lib/python3.6/site-
packages (from requests>=2.11.1->locationiq) (2.9)
Requirement already satisfied: chardet<4,>=3.0.2 in ./venv/lib/python3.6/site-
packages (from requests>=2.11.1->locationiq) (3.0.4)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in
./venv/lib/python3.6/site-packages (from requests>=2.11.1->locationiq) (1.25.8)
```

[12]:

```
import pandas as pd
import matplotlib.pyplot as plt
import networkx as nx
from prsvagent import res_dct
from collections import deque
from locationiq.geocoder import LocationIQ
from math import sin, cos, radians, acos
import json
from queue import PriorityQueue

df = pd.read_csv("Indian_capitals2.csv",header = None,names␣
↪=["city1","city2","distance"])
node_list = []
G = nx.Graph()
lst = []
for i,row in df.iterrows():
    G.add_edge(row['city1'], row['city2'], weight=row['distance'])
    node_list.append(row['city1'])
    node_list.append(row['city2'])

node_list = list(set(node_list))
res_dct = {node_list[i]:dict(G[node_list[i]]) for i in range(len(node_list))}
print("resulting adjacency list =\n")
# for key,value in res_dct.items():
#     print("{}:{}".format(key,value),sep="\n")

elarge = [(u, v) for (u, v, d) in G.edges(data=True) if d['weight'] > 10]
pos = nx.spring_layout(G,k = 0.99,iterations = 50)  # positions for all nodes
# nodes
nx.draw_networkx_nodes(G, pos, node_size=300)
# edges
nx.draw_networkx_edges(G, pos, edgelist=elarge,width=2)
# labels
nx.draw_networkx_labels(G, pos, font_size=3, font_family='sans-serif')

plt.axis('off')
print("mygraph = ")
```

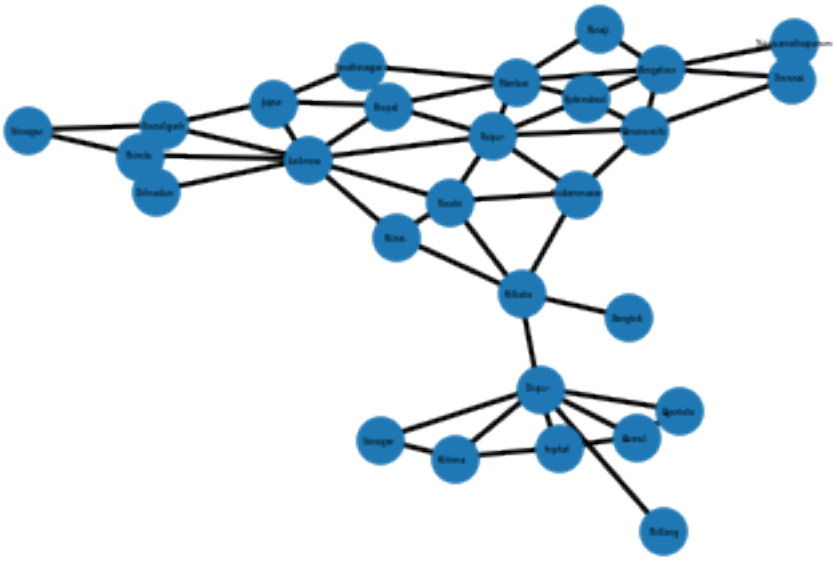
```
plt.figure(figsize=(10,40), dpi=100)
# plt.show()

lis = []
for key, value in res_dct.items():
    lis.append(key)
    l = []
    for key, value in value.items():
        l.append(key)
        for key, value in value.items():
            l.append(value)
    r = {l[i]: l[i + 1] for i in range(0, len(l), 2)}

    lis.append(r)
GRAPH = {lis[i]: lis[i + 1] for i in range(0, len(lis), 2)}
print(GRAPH)
```

resulting adjacency list =

mygraph =

{'Gangtok': {'Kolkata': 675}, 'Dispur': {'Shillong': 91, 'Imphal': 482, 'Aizawl': 462, 'Agartala': 536, 'Itanagar': 323, 'Kohima': 350, 'Kolkata': 1035}, 'Gandhinagar': {'Bhopal': 599, 'Jaipur': 634, 'Mumbai': 553}, 'Bhubaneswar': {'Amaravathi': 819, 'Raipur': 544, 'Ranchi': 455, 'Kolkata': 441}, 'Chandigarh': {'Lucknow': 742, 'Jaipur': 528, 'Shimla': 113, 'Srinagar': 562}, 'Raipur': {'Amaravathi': 758, 'Bhubaneswar': 544, 'Hyderabad': 783, 'Mumbai': 1091, 'Bhopal': 614, 'Lucknow': 810, 'Ranchi': 580}, 'Bhopal': {'Gandhinagar': 599, 'Jaipur': 598, 'Lucknow': 615, 'Mumbai': 776, 'Raipur': 614}, 'Amaravathi': {'Bangalore': 663, 'Chennai': 448, 'Bhubaneswar': 819, 'Raipur': 758, 'Hyderabad': 271}, 'Ranchi': {'Bhubaneswar': 455, 'Kolkata': 395, 'Lucknow': 710, 'Patna': 327, 'Raipur': 580}, 'Aizawl': {'Agartala': 342, 'Imphal': 400, 'Dispur': 462}, 'Shimla': {'Chandigarh': 113, 'Dehradun': 227, 'Lucknow': 841, 'Srinagar': 620}, 'Jaipur': {'Chandigarh': 528, 'Gandhinagar': 634, 'Bhopal': 598, 'Lucknow': 574}, 'Bangalore': {'Amaravathi': 663, 'Panaji': 578, 'Chennai': 333, 'Thiruvanathapuram': 730, 'Mumbai': 980, 'Hyderabad': 569}, 'Panaji': {'Bangalore': 578, 'Mumbai': 542}, 'Srinagar': {'Shimla': 620, 'Chandigarh': 562}, 'Lucknow': {'Chandigarh': 742, 'Dehradun': 552, 'Jaipur': 574, 'Bhopal': 615, 'Ranchi': 710, 'Patna': 539, 'Raipur': 810, 'Shimla': 841}, 'Hyderabad': {'Amaravathi': 271, 'Bangalore': 569, 'Raipur': 783, 'Mumbai': 719}, 'Chennai': {'Amaravathi': 448, 'Bangalore': 333, 'Thiruvanathapuram': 771}, 'Dehradun': {'Lucknow': 552, 'Shimla': 227}, 'Mumbai': {'Bangalore': 980, 'Hyderabad': 719, 'Panaji': 542, 'Gandhinagar': 553, 'Bhopal': 776, 'Raipur': 1091}, 'Thiruvanathapuram': {'Bangalore': 730, 'Chennai': 771}, 'Imphal': {'Aizawl': 400, 'Dispur': 482, 'Kohima': 136}, 'Kolkata': {'Bhubaneswar': 441, 'Ranchi': 395, 'Patna': 583, 'Gangtok': 675, 'Dispur': 1035}, 'Itanagar': {'Dispur': 323, 'Kohima': 323}, 'Shillong': {'Dispur': 91}, 'Agartala': {'Aizawl': 342, 'Dispur': 536}, 'Kohima': {'Dispur': 350, 'Imphal': 136,

```
'Itanagar': 323}, 'Patna': {'Kolkata': 583, 'Lucknow': 539, 'Ranchi': 327}}
```



```
<Figure size 1000x4000 with 0 Axes>
```

[13]:
```python
class Node:
    def __init__(self,state,g,h,p,parent_dist):
        self.state = state
        self.g = g
        self.h = h
        self.p = p
        self.parent_dist = parent_dist
        self.f = 0
        self.visited = False
```

[14]:
```python
class Problem:
    def __init__(self,state,final):
        self.state = state
        self.final = final

    def goalTest(self,state1):
        if state1 == self.final:
            return  True
        else:
            return False
```

[15]:
```
class simpleProblemSolvingAgent:
    def __init__(self):
        self.seq = []
        self.state = None

    def problemStruct(self,state,goal):
        if not seq:
            state = self.formulateProblem(state,goal)
            goal= self.formulateGoal(state)

    def formulateProblem(self):
        raise NotImplementedError

    def formulateGoal(self):
        raise NotImplementedError


    def expandNode(self,node):
        for key,value in res_dct.items():
            if key == node:
                return [key for key,value in value.items()]

    def DFS(self,problem):
        self.seq = []
        frontier = deque()
        frontier.append(problem.state)
        explored = set()
        while frontier:
            # print(frontier)
            k = frontier.pop()
            self.seq.append(k)
            explored.add(k)
            child_list = self.expandNode(k)
            for child in child_list:
                if child not in explored and child not in frontier:
                    if problem.goalTest(child):
                        self.seq.append(child)
                        return self.seq
                    frontier.append(child)


    def BFS(self,problem):
        self.seq = []
        frontier = deque()
        frontier.append(problem.state)
        explored = set()
```

```
        while frontier:
            k = frontier.popleft()
            explored.add(k)
            self.seq.append(k)
            for child in self.expandNode(k):
                if child not in explored and child not in frontier:
                    if problem.goalTest(child):
                        self.seq.append(child)
                        return self.seq
                    frontier.append(child)


    def bidirectional_bfs(self,problem):
        path_left = []
        path_right = []
        frontier_left = deque()
        frontier_right = deque()
        frontier_left.append(problem.state)
        frontier_right.append(problem.final)
        explored = set()
        while frontier_right or frontier_left:
            if frontier_left:
                k  = frontier_left.popleft()
                explored.add(k)
                path_left.append(k)
                if k in frontier_right:
                    return [*path_left,*path_right[::-1]]
                for child in self.expandNode(k):
                    if child not in explored and child not in frontier_left:
                        if child in frontier_right:
                            path_left.append(child)
                            return [*path_left,*path_right[::-1]]
                        frontier_left.append(child)



            if frontier_right:
                k = frontier_right.popleft()
                explored.add(k)
                path_right.append(k)
                if k in frontier_left:
                    return [*path_left,*path_right[::-1]]
                for child in self.expandNode(k):
                    if child not in explored and child not in frontier_right:
                        if child in frontier_left:
                            path_right.append(child)
                            return [*path_left,*path_right[::-1]]
```

```
                frontier_right.append(child)
```

[16]:
```
def h_sld(src, dest):

    geocoder = LocationIQ("5a04e85be375bb")
    bg = geocoder.geocode(src)[0]
    ch = geocoder.geocode(dest)[0]
    slat = radians(float(bg['lat']))
    slon = radians(float(bg['lon']))
    elat = radians(float(ch['lat']))
    elon = radians(float(ch['lon']))
    distance = 6371.01 * acos(sin(slat)*sin(elat) +
                              cos(slat)*cos(elat)*cos(slon-elon))
    return int(distance)
```

[17]:
```
def strld(dest):
    arr = []
    for i in node_list:
        arr.append(h_sld(i,dest))
    return arr
```

[18]:
```
def A_star_search(problem,lis,path = None):
    arr = []
    for i in range(len(node_list)):
        arr.append(node_list[i])
        arr.append(lis[i])
    straight_line = {arr[i]: arr[i + 1] for i in range(0, len(arr), 2)}

    source = problem.state
    destination = problem.final
    priority_queue, visited = PriorityQueue(), {}
    priority_queue.put((straight_line[source], 0, source, [source]))
    visited[source] = straight_line[source]
    while not priority_queue.empty():
        (heuristic, cost, vertex, path) = priority_queue.get()
        if vertex == destination:
            return heuristic, cost, path
        for next_node in GRAPH[vertex].keys():
            current_cost = cost + GRAPH[vertex][next_node]
            heuristic = current_cost + straight_line[next_node]
            if not next_node in visited or visited[next_node] >= heuristic:
                visited[next_node] = heuristic
                priority_queue.put(
                    (heuristic, current_cost, next_node, path + [next_node]))
```

[19]:
```
tes = []
print("Enter source,dest")
```

```
print(node_list)
source = input()
dest = input()
p = Problem(source, dest)
print("please wait.....")
tes = strld(p.final)
psa = simpleProblemSolvingAgent()
print("choices available:-")
print("1:DFS")
print("2:BFS")
print("3:Bidirectional bFS")
print("4:A star")
t = int(input())
if t == 1:
    l = psa.DFS(p)
    print("->".join(l))

if t == 2:
    l = psa.BFS(p)
    print("->".join(l))

if t == 3:
    l = psa.bidirectional_bfs(p)
    print("->".join(l))

if t == 4:
    heu,cost,path = A_star_search(p,tes)
    print("Path is\n")
    print("->".join(path))
    print("Total cost=",cost)
    print("Heuristic=",heu)
```

```
Enter source,dest
['Gangtok', 'Dispur', 'Gandhinagar', 'Bhubaneswar', 'Chandigarh', 'Raipur',
'Bhopal', 'Amaravathi', 'Ranchi', 'Aizawl', 'Shimla', 'Jaipur', 'Bangalore',
'Panaji', 'Srinagar', 'Lucknow', 'Hyderabad', 'Chennai', 'Dehradun', 'Mumbai',
'Thiruvanathapuram', 'Imphal', 'Kolkata', 'Itanagar', 'Shillong', 'Agartala',
'Kohima', 'Patna']
Agartala
Gangtok
please wait…
choices available:-
1:DFS
2:BFS
3:Bidirectional bFS
4:A star
4
```

```
Path is

Agartala->Dispur->Kolkata->Gangtok
Total cost= 2246
Heuristic= 2246
```

[20]:
```python
def destIndex(dest):
    cop = [0 for x in range(len(dest)-1)]
    for i, x in enumerate(dest):
        if int(x):
            pl = dest.index(x)
            cop[int(x)-1] = (pl//3, pl % 3)
    return cop
```

[29]:
```python
def manhat(puz, dest):
    dist = 0
    cop = []
    b = destIndex(dest)
    cop.append([x for x in puz[0:3]])
    cop.append([x for x in puz[3:6]])
    cop.append([x for x in puz[6:9]])
    for i in range(len(cop)):
        for j in range(len(cop[0])):
            if int(cop[i][j]):
                dist += abs(i-b[int(cop[i][j])-1][0])
                dist += abs(j-b[int(cop[i][j])-1][1])
    return dist
```

[30]:
```python
def printpuz(path):
    for puz in path:
        print('\n')
        print(' '.join(element for element in puz[0:3]))
        print(' '.join(element for element in puz[3:6]))
        print(' '.join(element for element in puz[6:9]))
```

[31]:
```python
def swap(cop, i, j):
    cop[i], cop[j] = cop[j], cop[i]
```

[32]:
```python
def newStates(puz):
    pl = puz.index('0')
    value = [ele for ele in puz]

    if pl == 0:
        temp = []
        cop = value.copy()
        swap(cop, 0, 1)
        temp.append("".join(cop))
```

```
        cop = value.copy()
        swap(cop, 0, 3)
        temp.append("".join(cop))
        return temp
    if pl == 1:
        temp = []
        cop = value.copy()
        swap(cop, 1, 0)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 1, 2)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 1, 4)
        temp.append("".join(cop))
        return temp
    if pl == 2:
        temp = []
        cop = value.copy()
        swap(cop, 2, 1)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 2, 5)
        temp.append("".join(cop))
        return temp
    if pl == 3:
        temp = []
        cop = value.copy()
        swap(cop, 3, 0)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 3, 4)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 3, 6)
        temp.append("".join(cop))
        return temp
    if pl == 4:
        temp = []
        cop = value.copy()
        swap(cop, 4, 1)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 4, 3)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 4, 5)
```

```
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 4, 7)
        temp.append("".join(cop))
        return temp
    if pl == 5:
        temp = []
        cop = value.copy()
        swap(cop, 5, 2)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 5, 4)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 5, 8)
        temp.append("".join(cop))
        return temp
    if pl == 6:
        temp = []
        cop = value.copy()
        swap(cop, 6, 3)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 6, 7)
        temp.append("".join(cop))
        return temp
    if pl == 7:
        temp = []
        cop = value.copy()
        swap(cop, 7, 4)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 7, 6)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 7, 8)
        temp.append("".join(cop))
        return temp
    if pl == 8:
        temp = []
        cop = value.copy()
        swap(cop, 8, 5)
        temp.append("".join(cop))
        cop = value.copy()
        swap(cop, 8, 7)
        temp.append("".join(cop))
        return temp
```

[33]:
```
def getPathCost(src, dest, explored):
    crnt_node = [x for x in explored if x[0] == dest]
    crnt_node = crnt_node[0]
    cost = crnt_node[3]+crnt_node[1]

    path = []
    while crnt_node[0] != src:
        path.insert(0, crnt_node[0])
        crnt_node = [x for x in explored if x[0] == crnt_node[4]]
        crnt_node = crnt_node[0]
    path.insert(0, src)
    return path, cost
```

[34]:
```
def search(src, dest, searchMethod):
    open_list = [(src, 0, manhat(src, dest), 0, None)]
    explored = set()
    while True:
        if searchMethod == "Greedy":
            open_list = sorted(open_list, key=lambda x: x[2])
        if searchMethod == "AStar":
            open_list = sorted(open_list, key=lambda x: x[1]+x[2]+x[3])
        if not open_list:
            return ("false", -1)
        if dest in [x[0] for x in explored]:
            return getPathCost(src, dest, explored)
        if searchMethod == "DFS":
            crnt_node = open_list.pop()
        else:
            crnt_node = open_list.pop(0)
        if crnt_node[0] not in [x[0] for x in explored]:
            explored.add(crnt_node)
        neighs = newStates(crnt_node[0])
        for neigh in neighs:
            if neigh not in [x[0] for x in explored]:
                child = (neigh, 1, manhat(neigh, dest),
                         crnt_node[1]+crnt_node[3], crnt_node[0])
                open_list.append(child)
```

[35]:
```
def Inv(puz):
    Count = 0
    for i in range(len(puz)):
        for j in range(i+1, len(puz)):
            if int(puz[j]) and int(puz[i]) and int(puz[i]) > int(puz[j]):
                Count += 1
    return Count
```

[36]:
```
def ifSolvable(src, dest):
    c1 = Inv(src)
    c2 = Inv(dest)
    return ((c1 % 2) == (c2 % 2))
```

[37]:
```
src = input("Enter source inform of single array(enter 0 as blank space)\n")
dest = input("Enter destination\n")
print("choices available:-")
print("1:DFS")
print("2:BFS")
print("3:Greedy BFS")
print("4:A star")
t = int(input())


if ifSolvable(src, dest):

    if t == 1:
        path_traversed, total_cost = search(src, dest, "DFS")

    if t == 2:
        path_traversed, total_cost = search(src, dest, "BFS")

    if t == 3:
        path_traversed, total_cost = search(src, dest, "Greedy")

    if t == 4:
        path_traversed, total_cost = search(src, dest, "AStar")


    print("path found=\n")
    printpuz(path_traversed)
    print("Total path cost = {}".format(total_cost))

else:
    print("Puzzle is not solvable")
```

```
Enter source inform of single array(enter 0 as blank space)
724506831
Enter destination
012345678
choices available:-
1:DFS
2:BFS
3:Greedy BFS
4:A star
4
```

```
path found=


7 2 4
5 0 6
8 3 1


7 2 4
0 5 6
8 3 1


0 2 4
7 5 6
8 3 1


2 0 4
7 5 6
8 3 1


2 5 4
7 0 6
8 3 1


2 5 4
7 3 6
8 0 1


2 5 4
7 3 6
0 8 1


2 5 4
0 3 6
7 8 1


2 5 4
3 0 6
7 8 1
```

```
2 5 4
3 6 0
7 8 1
```

```
2 5 0
3 6 4
7 8 1
```

```
2 0 5
3 6 4
7 8 1
```

```
0 2 5
3 6 4
7 8 1
```

```
3 2 5
0 6 4
7 8 1
```

```
3 2 5
6 0 4
7 8 1
```

```
3 2 5
6 4 0
7 8 1
```

```
3 2 5
6 4 1
7 8 0
```

```
3 2 5
6 4 1
7 0 8
```

```
3 2 5
6 4 1
```

```
0 7 8


3 2 5
0 4 1
6 7 8


3 2 5
4 0 1
6 7 8


3 2 5
4 1 0
6 7 8


3 2 0
4 1 5
6 7 8


3 0 2
4 1 5
6 7 8


3 1 2
4 0 5
6 7 8


3 1 2
0 4 5
6 7 8


0 1 2
3 4 5
6 7 8
Total path cost = 26
```

[ ]: