TASK:5

Implementation of **Ant Colony Optimization** to Optimize Ride-Sharing Trip Duration using Python by following constraints.

Aim: To Implement Ant Colony Optimization to Optimize Ride-Sharing Trip Duration using Python.

Algorithm:

Step 1:[Initialization]

t=0;NC=0;for each edge (I,j),initialize trail intensity.

Step 2:[starting node]

For each ant k:place ant k on a randomly chosen city and store this information in tablet.

Step 3: Build a tour for each ant.

Step 4:global update of trail.

Step 5: termination conditions,memorize the shortest tour found to this point.

Program:

```
import numpy as np
from numpy import inf

#given values for the problems

d = np.array([[0,10,12,11,14]
          ,[10,0,13,15,8]
          ,[12,13,0,9,14]
          ,[11,15,9,0,16]
          ,[14,8,14,16,0]])

iteration = 100
n_ants = 5
n_citys = 5

# intialization part

m = n_ants
```

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n = n_citys
e = .5          #evaporation rate
alpha = 1     #pheromone factor
beta = 2       #visibility factor

#calculating the visibility of the next city visibility(i,j)=1/d(i,j)

visibility = 1/d
visibility[visibility == inf ] = 0

#intializing pheromne present at the paths to the cities

pheromne = .1*np.ones((m,n))

#intializing the rute of the ants with size rute(n_ants,n_citys+1)
#note adding 1 because we want to come back to the source city

rute = np.ones((m,n+1))

for ite in range(iteration):

    rute[:,0] = 1          #initial starting and ending positon of every ants '1' i.e city '1'

    for i in range(m):

        temp_visibility = np.array(visibility)         #creating a copy of visibility

        for j in range(n-1):
            #print(rute)

            combine_feature = np.zeros(5)     #intializing combine_feature array to zero
            cum_prob = np.zeros(5)            #intializing cummulative probability array to zeros

            cur_loc = int(rute[i,j]-1)        #current city of the ant
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            temp_visibility[:,cur_loc] = 0     #making visibility of the current city as zero

            p_feature = np.power(pheromne[cur_loc,:],beta)         #calculating pheromne feature
            v_feature = np.power(temp_visibility[cur_loc,:],alpha)  #calculating visibility feature

            p_feature = p_feature[:,np.newaxis]                     #adding axis to make a size[5,1]
            v_feature = v_feature[:,np.newaxis]                     #adding axis to make a size[5,1]

            combine_feature = np.multiply(p_feature,v_feature)     #calculating the combine feature

            total = np.sum(combine_feature)                        #sum of all the feature

            probs = combine_feature/total       #finding probability of element probs(i) =
comine_feature(i)/total

            cum_prob = np.cumsum(probs)     #calculating cummulative sum
            #print(cum_prob)
            r = np.random.random_sample()   #randon no in [0,1)
            #print(r)
            city = np.nonzero(cum_prob>r)[0][0]+1       #finding the next city having probability
higher then random(r)
            #print(city)

            rute[i,j+1] = city              #adding city to route

        left = list(set([i for i in range(1,n+1)])-set(rute[i,:-2]))[0]     #finding the last untraversed
city to route

        rute[i,-2] = left                   #adding untraversed city to route

    rute_opt = np.array(rute)               #intializing optimal route

    dist_cost = np.zeros((m,1))             #intializing total_distance_of_tour with zero

    for i in range(m):
```

```
        s = 0
        for j in range(n-1):

            s = s + d[int(rute_opt[i,j])-1,int(rute_opt[i,j+1])-1]   #calcualting total tour distance

        dist_cost[i]=s                     #storing distance of tour for 'i'th ant at location 'i'

    dist_min_loc = np.argmin(dist_cost)            #finding location of minimum of dist_cost
    dist_min_cost = dist_cost[dist_min_loc]         #finging min of dist_cost

    best_route = rute[dist_min_loc,:]              #intializing current traversed as best route
    pheromne = (1-e)*pheromne                       #evaporation of pheromne with (1-e)

    for i in range(m):
        for j in range(n-1):
            dt = 1/dist_cost[i]
            pheromne[int(rute_opt[i,j])-1,int(rute_opt[i,j+1])-1]    =    pheromne[int(rute_opt[i,j])-
1,int(rute_opt[i,j+1])-1] + dt
            #updating the pheromne with delta_distance
            #delta_distance will be more with min_dist i.e adding more weight to that route
peromne

print('route of all the ants at the end :')
print(rute_opt)
print()
print('best path :',best_route)
print('cost of the best path',int(dist_min_cost[0]) + d[int(best_route[-2])-1,0])
```

Output:

Route of all ants at the end:

```
[[1.4.3.5.2.1]
 [1.4.3.5.2.1]
 [1.4.3.5.2.1]
 [1.4.3.5.2.1]
 [1.4.3.5.2.1]]
```

Best path: [1.4.3.5.2.1]

Cost of the best path=52.

Result:

Thus the Implementation of Ant Colony Optimization to Optimize Ride-Sharing Trip Duration using Python was successfully executed and output was verified.