POSTMEN DELIVERY PROBLEM

1. PROBLEM STATEMENT

- 100 letters need to be delivered by three postmen in a day.
- Company gets 10 INR on each delivery.
- Post office master receives 100 INR if all letters are delivered.
- Each postman has the same work hours daily.
- Solve the above problem by three methods.

2. ASSUMPTIONS

- 100 random points are generated with location (Latitude and Longitude) of each point. These correspond to the delivery addresses. An address for post office is also generated. From now onwards I will refer them as nodes.
- The path between two points is considered as the straight line joining them.
- No downtime (lunch break, road closures etc.) are assumed.

3A. STRATEGY1

- Cluster the nodes. I have assumed 3 clusters and have used K-Means algorithm to classify each node based on clusters, but other algorithms like DBSCAN can be tried. Mean-shift or OPTICS algorithm can also be used to find optimum number of clusters.
- Send a postman to each of the clusters.
- A distance matrix (101 x 101) is created which consists of distance between each individual node.
- Select a cluster.
- Write a code to choose sequentially the nearest node location for each present node without considering the previously visited nodes. For eg, first select the node nearest from the post office. Suppose this node is A1. Then select the nearest node withing the same cluster not considering the post office. Suppose we find the next nearest node as A5. Again, find the next nearest node in the same cluster without considering Post office and A1. Similarly continue for all nodes.
- Repeat the same process for each cluster.

3B.1. STRATEGY2

- ☐ Cluster the nodes. I have assumed 3 clusters and have used K-Means algorithm to classify each node based on clusters, but other algorithms like DBSCAN can be tried. Mean-shift or OPTICS algorithm can also be used to find optimum number of clusters.
- ☐ Send a postman to each of the clusters.
- ☐ A distance matrix (101 x 101) is created which consists of distance between each individual node.
- ☐ Select a cluster.
- ☐ Find the shortest path from each node to post office and assign a value to the same based on distance covered. Let's call this value "cost". Dijkstra's algorithm is used for the same and all nodes are considered since a postman can move to any node from current node. The same can be done with Q-learning also.
- ☐ Then sequentially select the nodes based on increasing cost value to find optimal path for that cluster covering all nodes.
- ☐ Repeat the above 2 steps for each cluster.

3B.2. STRATEGY2_MODIFIED

- ☐ The modification here is that each postman can move only to the nearest nodes form present node. This helps to create a directed graph for each cluster and also shortens the run time of Dijkstra's algorithm.
- ☐ Voronoi diagram is used to find the nearest nodes for each node and create a simpler graph network.

3C. STRATEGY3

- ☐ Combinatorial optimization algorithms are used. The current problem can be identified as Vehicle Routing Problem with Time window.
- ☐ The solution can be found by optimizing a linear equation consisting of summation of binary coefficients associated with each Euclidean distance between two nodes based on multiple constraints.
- ☐ Metaheuristic optimization techniques like PSO can be used to solve the same.

4. SUBMISSION

- ☐ Separate notebooks with codes are submitted for STRATEGY1, STRATEGY2 and STRATEGY2_MODIFIED.
- ☐ Multiple libraries are available for STRATEGY3, hence the same is not coded.