VEHICLE ROUTING PROBLEM

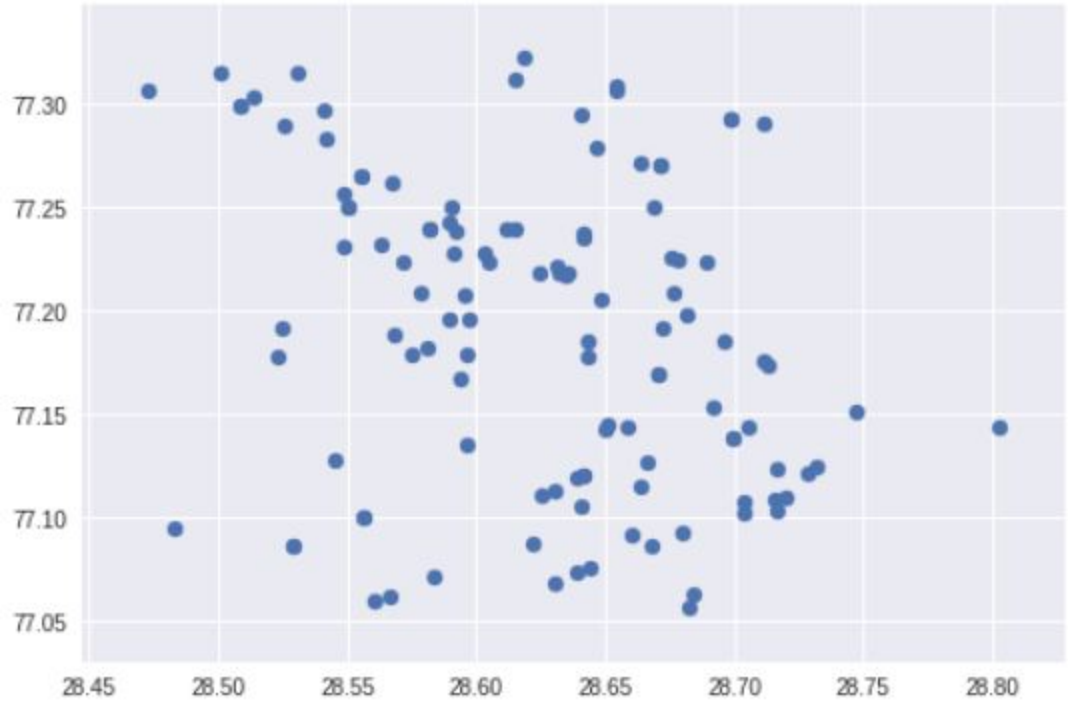
MAXIMIZING PROFITS WITH DISTANCE CONSTRAINTS

FITNESS -

Total Profit while travelling in a route

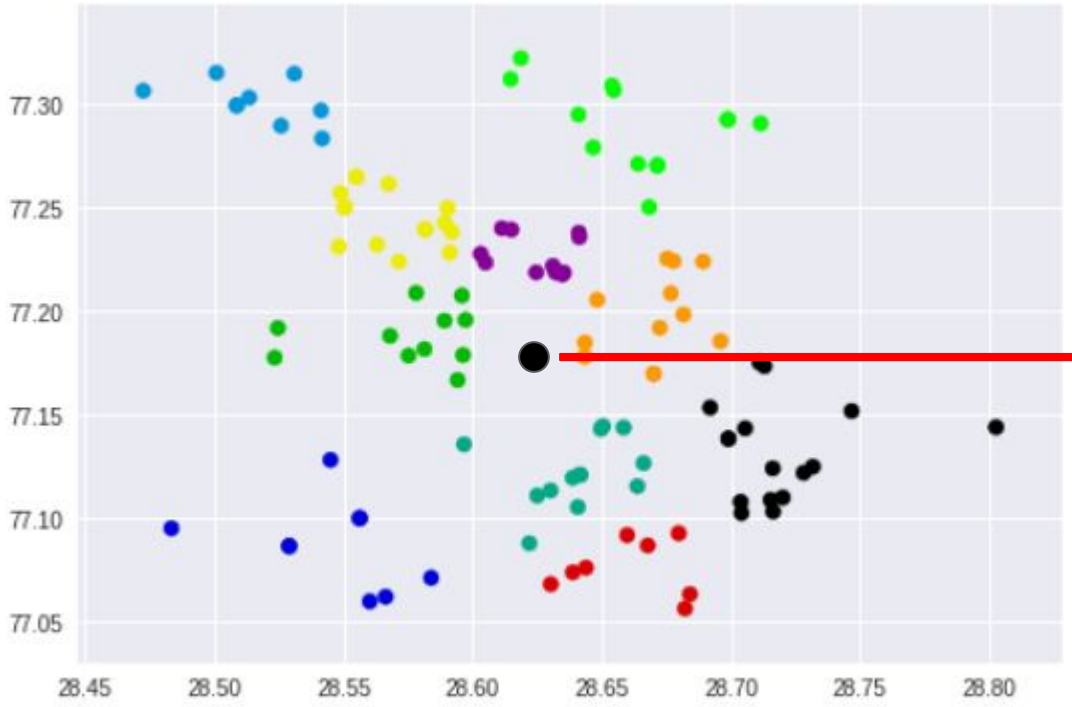
$$\text{FITNESS} = \left[\text{PROFIT COLLECTED AT EACH STORE}\right] - \left[2*(\text{DISTANCE TRAVELLED})\right]$$

*Note - 2*Distance travelled is subtracted in order to compensate the travelling cost*



Latitudes and Longitudes of 130 Petrol Pumps in and around New Delhi

Number of Clusters - Customer
Generally number of clusters is equal to number of salesmen



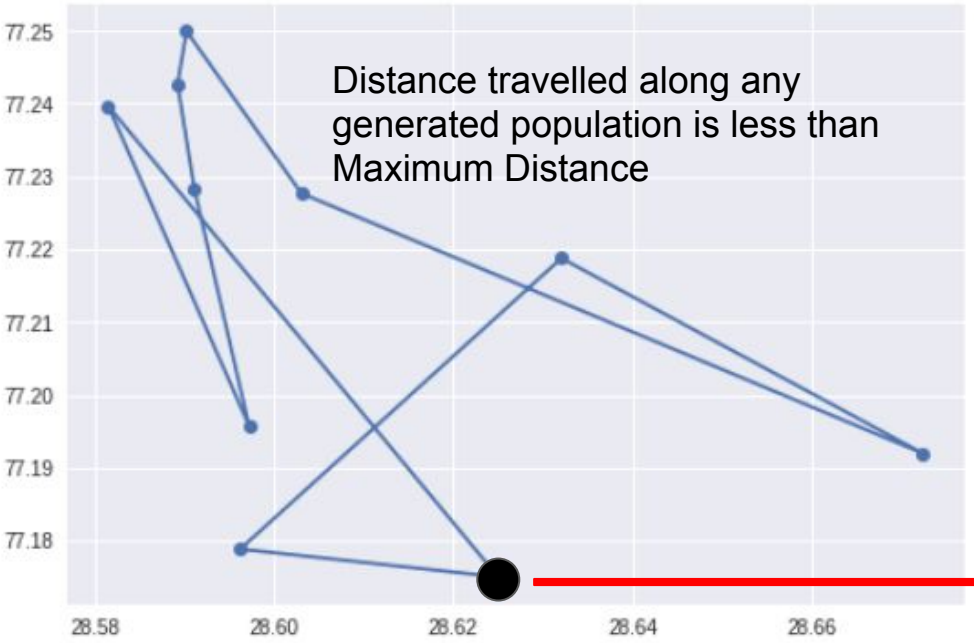
Starting Point
Every Salesman begins from this point and at the end of day has to return back to this point

K-Means Clustering to divide the Latitudes and Longitudes into 10 Clusters

Taking any Random Cluster to start with the Algorithm

POPULATION GENERATION(Not necessarily gives the fittest population)

Generate a random set of 1000 populations from the points inside the clusters.
These populations must have their total route distance less than the maximum distance a salesman is allowed to travel in one day

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[[28, 5, 6, 13, 20, 12, 7, 15, 11],
 [12, 11, 20, 15, 5, 6, 28, 13, 7],
 [13, 6, 12, 20, 28, 11, 5, 15, 7],
 [11, 13, 15, 5, 7, 12, 20, 28, 6],
 [13, 12, 15, 6, 7, 5, 20, 28, 11],
 [28, 6, 13, 20, 7, 11, 5, 15, 12],
 [7, 12, 15, 28, 13, 6, 20, 11, 5],
 [28, 11, 6, 12, 20, 7, 13, 5, 15],
 [20, 5, 12, 13, 28, 11, 15, 6, 7],
 [15, 20, 6, 5, 7, 12, 13, 28, 11]]
```

Randomly generated Populations with distance constraints

TOURNAMENT SELECTION

Specify a T_SIZE

```
[[28, 5, 6, 13, 20, 12, 7, 15, 11],
 [12, 11, 20, 15, 5, 6, 28, 13, 7],
 [13, 6, 12, 20, 28, 11, 5, 15, 7],
 [11, 13, 15, 5, 7, 12, 20, 28, 6],
 [13, 12, 15, 6, 7, 5, 20, 28, 11],
 [28, 6, 13, 20, 7, 11, 5, 15, 12],
 [7, 12, 15, 28, 13, 6, 20, 11, 5],
 [28, 11, 6, 12, 20, 7, 13, 5, 15],
 [20, 5, 12, 13, 28, 11, 15, 6, 7],
 [15, 20, 6, 5, 7, 12, 13, 28, 11]]
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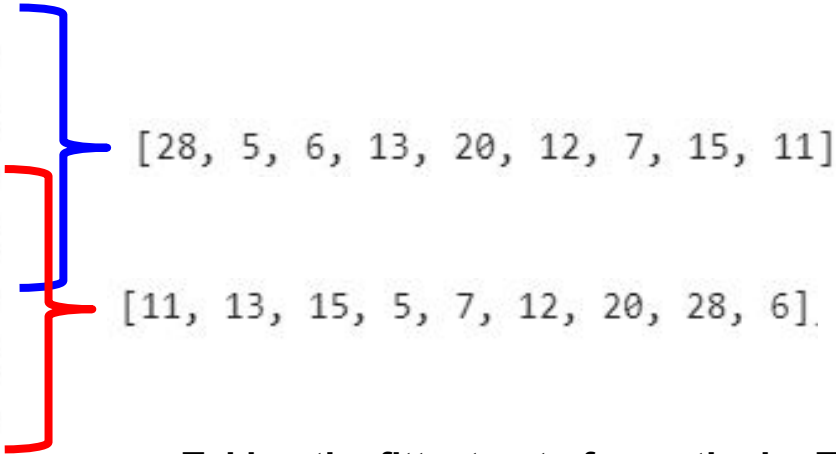


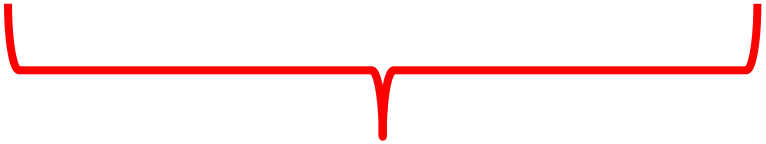
Taking the fittest out of a particular T_SIZE and forwarding it to a NEW POPULATION.

This will give rise to a Fitter Population than the previous one

CROSSOVER

[40, 51, 108, 63, 19, 36] [107, 14, 86, 112, 84, 19]

PARENT 1 **PARENT 2**



CROSSOVER

[107, 14, 86, 112, 84, 19] [107, 51, 108, 63, 19, 36]

CHILD 1 **CHILD 2**

Randomly select two Routes from the population generated after Tournament Selection and Replacing few Nodes in the Parent Nodes and Creating two Child Nodes.
After this, Forward the fittest of these Four Routes to get the Fittest Population

Repeat the Crossover for many iterations so that we get a Fitter Population with every step

Profit Converges to a saturated value giving us the route with maximum profit and constrained distance

```
777.686788187609
806.0547094301883
815.5642351902536
834.1120572497559
847.8010183375159
870.4175632144448
897.3780320606304
911.3196765195235
911.4673618304457
921.0585786566779
921.2081142382988
925.2196981695726
925.2196981695726
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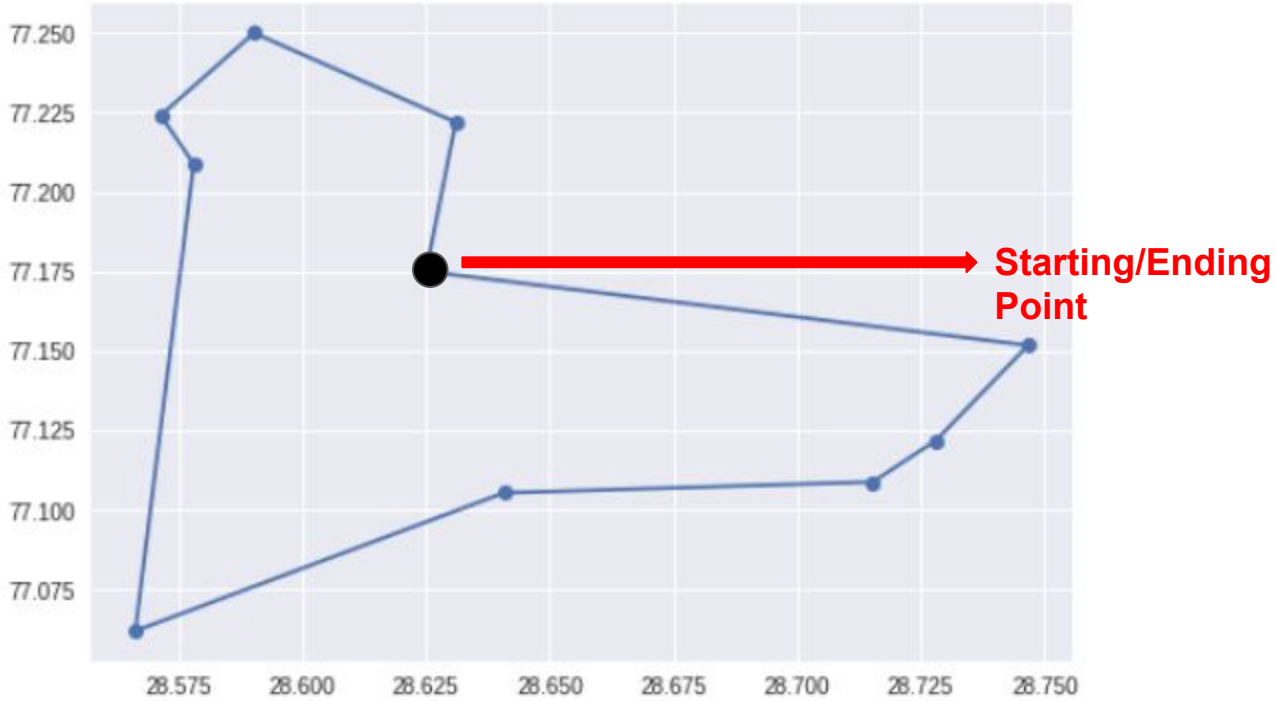
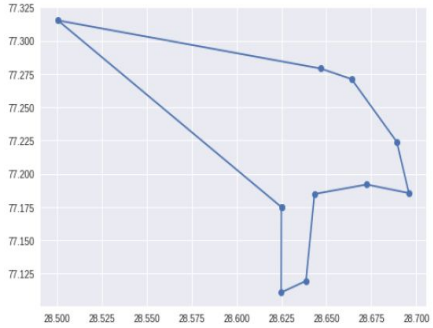
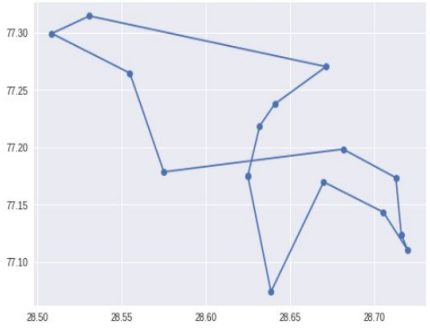
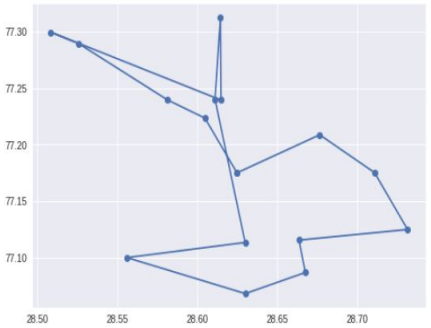
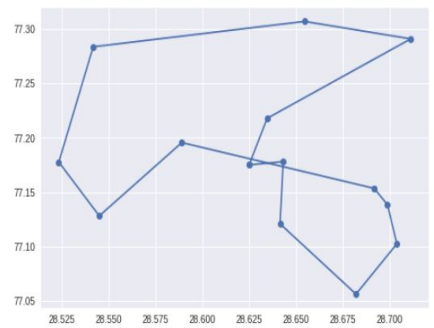


Route within a Cluster with maximum profit and constrained distance









Fittest Routes within every Cluster