# AI Project 3

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## Introduction:

For this assignment, we are asked to solve the traveling salesman problem using the closest edge insertion heuristic implementing a greedy algorithm. For this problem, we insert the vertex that is closest to an edge already in tour.

## Approach:

The data sets given to test our code had an extra 6 lines that needed to be removed and stripped. My solution prompted the user for the tsp file then striped the file and sorted the information that was needed for the solution by storing that data in an array (list in python.) Once the data was sorted the program calls a function to find the closest two vertex’s in the problem. I chose the closest two vertex’s because it seemed more logical than Prim’s algorithm of randomly selecting a starting point. After the first two vertex’s are selected the program then finds the closest edge to that path and adds it to the tour. I originally had an if statement that was producing the incorrect path causing the traveling tour to have many crossing paths, but after sitting down and re-stepping through the paths and the logic I was able to correct this error. Although I used the closest points in the tour I believe that the best solution would result in finding the furthest points and calculating the original tour as an oval encompassing all of the possible node coordinates then modify this tour to collapse on itself and form the shortest tour by selecting the inner paths. I was not able to code this model in the time frame for the project.

After the tour is selected and calculated it is passed into a nested loop to plug the coordinates back into the vertex nodes. These values are then used and passed to a function that generates a GUI interface. I was having some trouble with the GUI being tiny due to the points being so close together. I tried to clean up the vertex’s by doing a light color modification, but it was overwriting the points so I just used a x2 magnification on the points and left the ovals clear. The GUI is not as clean as I would like, but I can improve it for future projects.

# 3. Results:

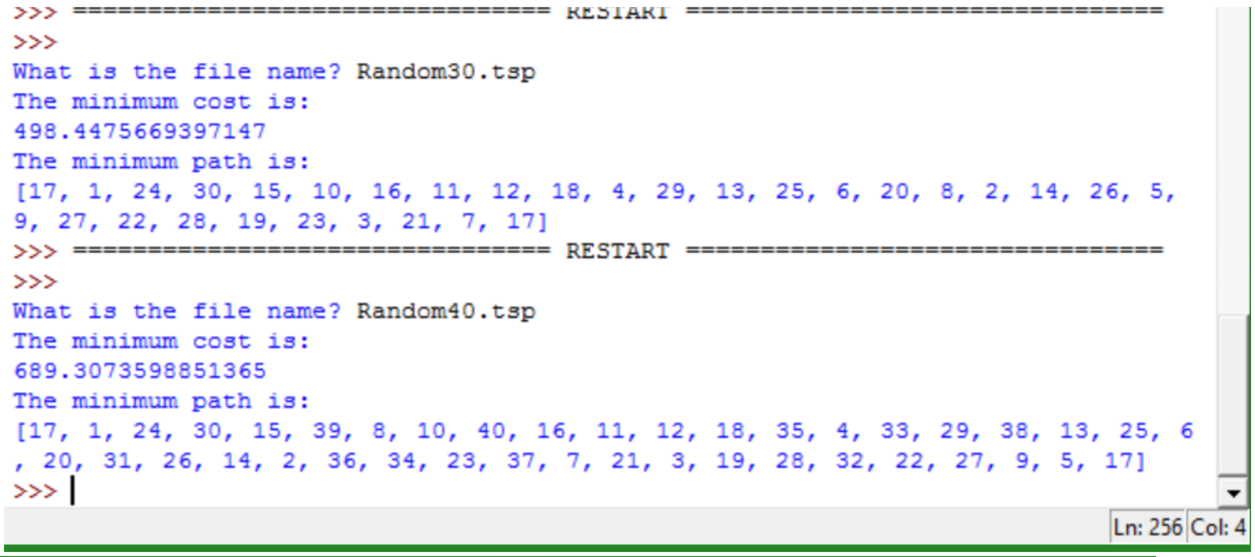
## 3.1 Data:

The data that was used for this assignment was generated using Concorde. The format for the data was:

```
NAME: concorde30
TYPE: TSP
COMMENT: Generated by CCutil_writetsplib
COMMENT: Write called for by Concorde GUI
DIMENSION: 30
EDGE_WEIGHT_TYPE: EUC_2D
NODE_COORD_SECTION
1 87.951292 2.658162
2 33.466597 66.682943
3 91.778314 53.807184
4 20.526749 47.633290
5 9.006012 81.185339
6 20.032350 2.761925
7 77.181310 31.922361
8 41.059603 32.578509
9 18.692587 97.015290
10 51.658681 33.808405
11 44.563128 47.541734
12 37.806330 50.599689
13 9.961241 20.337535
```

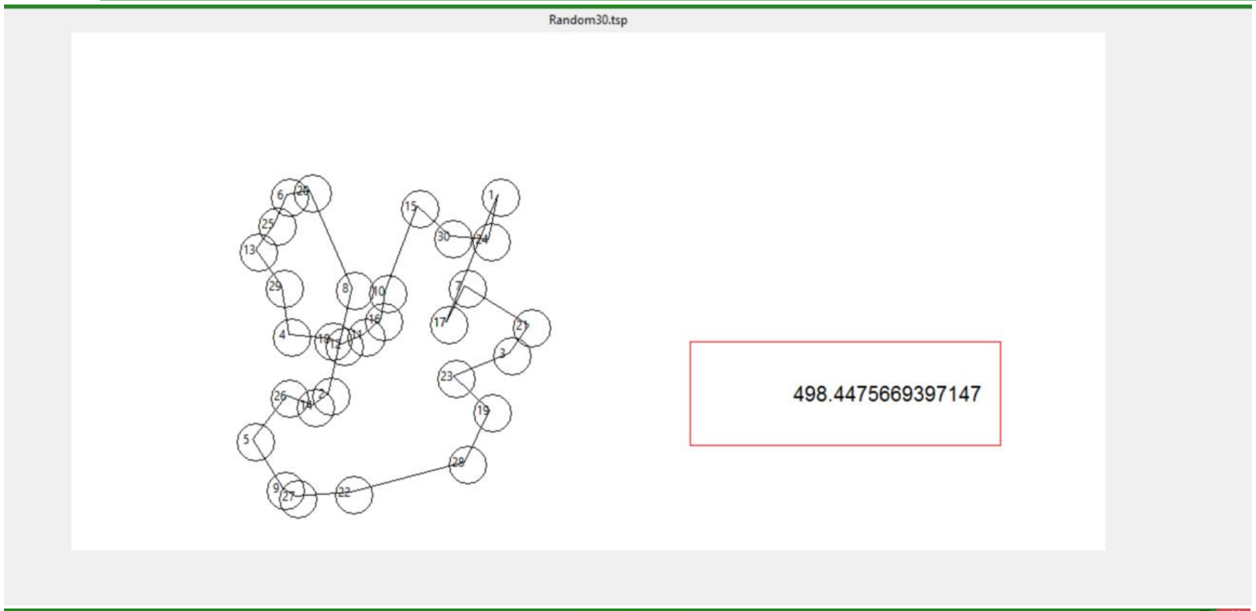
| | | |
|---|---|---|
| 14 | 28.186895 | 70.415357 |
| 15 | 62.129582 | 6.183050 |
| 16 | 50.376904 | 42.796106 |
| 17 | 71.285134 | 43.671987 |
| 18 | 34.156316 | 49.113437 |
| 19 | 85.201575 | 71.837519 |
| 20 | 27.466659 | 1.394696 |
| 21 | 97.985778 | 44.746239 |
| 22 | 40.730003 | 98.400830 |
| 23 | 73.799860 | 61.076693 |
| 24 | 85.076449 | 17.029328 |
| 25 | 16.052736 | 11.899167 |
| 26 | 20.160527 | 67.238380 |
| 27 | 22.730186 | 99.725333 |
| 28 | 77.196570 | 88.503677 |
| 29 | 18.494217 | 31.971191 |
| 30 | 72.743919 | 16.071047 |

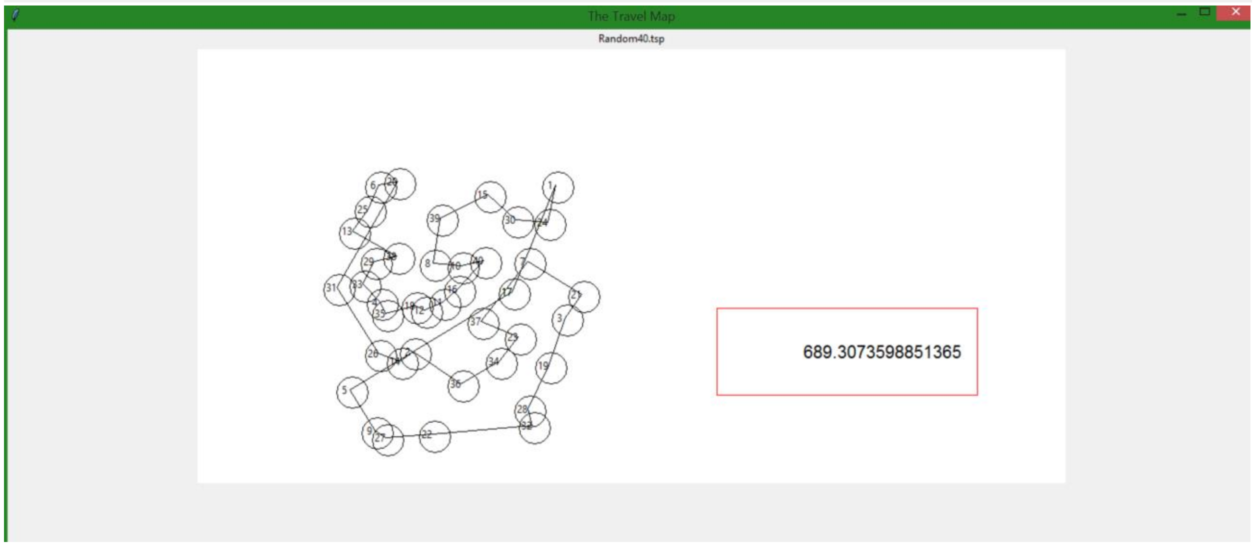
## 3.2 Results:



```
>>> ================================ RESTART ================================
>>>
What is the file name? Random30.tsp
The minimum cost is:
498.4475669397147
The minimum path is:
[17, 1, 24, 30, 15, 10, 16, 11, 12, 18, 4, 29, 13, 25, 6, 20, 8, 2, 14, 26, 5,
9, 27, 22, 28, 19, 23, 3, 21, 7, 17]
>>> ================================ RESTART ================================
>>>
What is the file name? Random40.tsp
The minimum cost is:
689.3073598851365
The minimum path is:
[17, 1, 24, 30, 15, 39, 8, 10, 40, 16, 11, 12, 18, 35, 4, 33, 29, 38, 13, 25, 6
, 20, 31, 26, 14, 2, 36, 34, 23, 37, 7, 21, 3, 19, 28, 32, 22, 27, 9, 5, 17]
>>> |
```

Ln: 256 Col: 4





## 4. Discussion:

.My program has a few intersecting lines, but the run time is very efficient. I don’t believe that my results are 100% correct but I do think that it is close to the optimal solution. I think that if the program took the furthest two nods and made an oval path encompassing the whole dataset, then modifying that path to collapse the oval to the nodes, then a better result would be generated. Unfortunately I was unable to define a logical response to this theory in the time frame for this project.

## 5. References:

http://web.tuke.sk/fei-cit/butka/hop/ConstructiveHeuristicsForTheTSP.pdf