DOCUMENT ALGORITHM INTRODUCTION

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1-Part 1

In this part of the project we had to find the shortest possible route that visits a set of locations.

Our algorithm had to be 90% more efficient than greedy search. The greedy search algorithm computes at each step of the journey the best move and it does not take into account if it will be the best path in the long run,for that reason it does not find the optimal path, in this case, the shortest path to visit all houses.

In our approach we:
1- sort the list of house positions in ascending order
2- find the position that is closer to 0,
3- split the list of house positions in two list in the location found in step 2
4- revert the first list
5- concatenate the first and second lists and return the value

In the worst-case, greedy search is $O(n^m)$, where m is the maximum depth of the search.In our approach we use 2 times sort() function, in step 2 and step 4, this function uses timesort as sorting algorithm, an algorithm with an average complexity of O(n logn). And then we iterate in the list to find the value closer to 0, which brings a complexity of O(n). So the full completely of the algorithm will be O(n+ 2nlogn) which is a polynomial time complexity faster than the $O(n^m)$ *of* greedy search.

2- Part 2

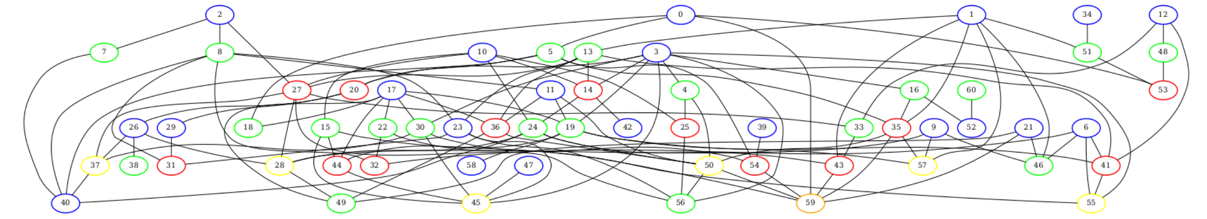

Figure 1-Graph Created with our coloring algorithm

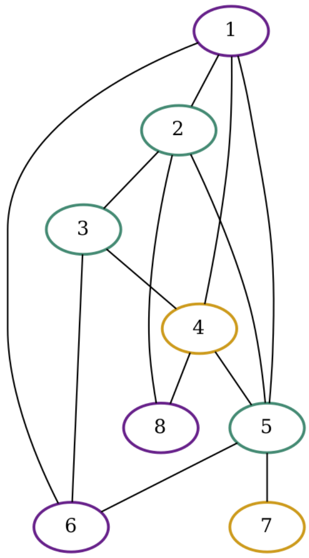

Figure 2-Graph Created with our coloring algorithm

3- Part 3

In this section we are going to speak about the connection between the Hamiltonian path problem, the Eulerian path problem and the line graph

A hamiltonian path is a path that visits each vertex in the graph exactly once. For instance, in the following Figure 3, the graph has a hamiltonian path with vertices 0-1-2-3

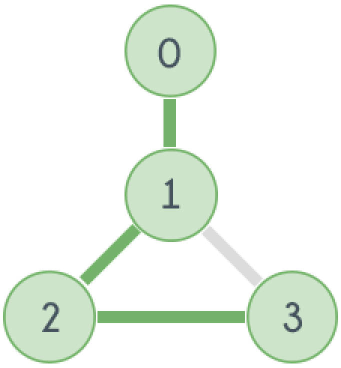

Figure 3-Hamiltonian path

If the hamiltonian path is closed, meaning the last node of the path can be connected to the initial node, it is called a hamiltonian cycle. This situation can be seen in figure 4.

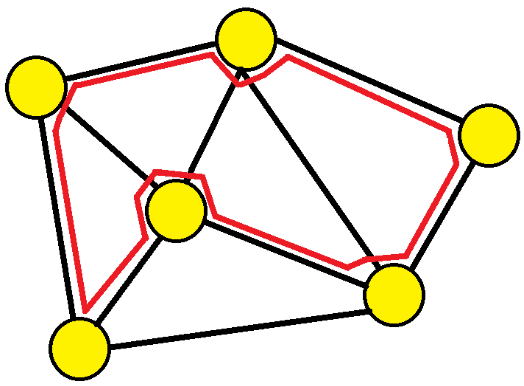
Figure 4-Hamiltonian cycle

An eulerian path is a path that visits every edge of the graph exactly once.

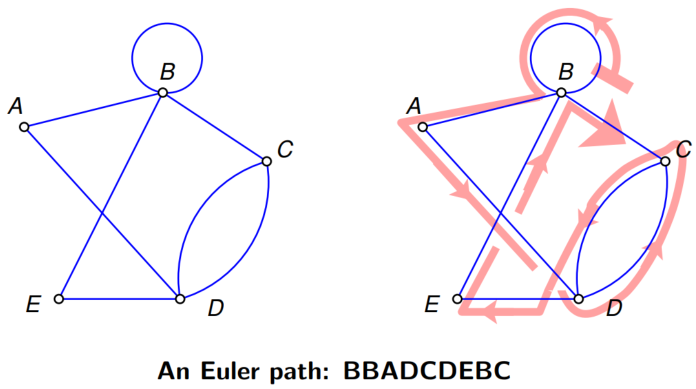

Figure 5-Euler path

The line graph of a graph G, denoted by L(G) is a graph that contains a vertex in the position of each edge of G and for every two edges in G that has a vertex in common, there will be an edge between the corresponding vertices of L(G)

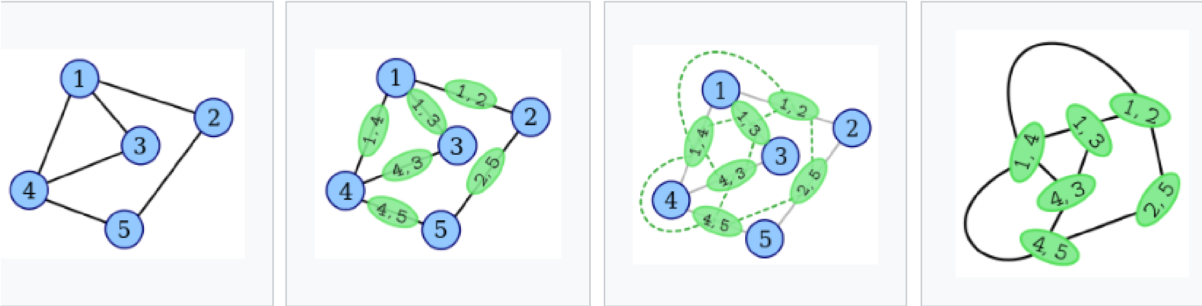

Figure 6-Line Graph Creation

We know that edges of G correspond to vertices of L(G) so the edge connectivity of G corresponds to the vertex connectivity of L(G). From this relation we can say that if L(G) has a hamiltonian cycle, a cycle containing every vertex exactly once, G will have a cycle containing every edge exactly once.