/***
 * Project Report Template
 * Project 3 (Map Routing), ECE368
 ***/

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/***
 * Explain your overall approach to the problem and a short
 * general summary of your solution and code.
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My implementation is based on Dijkstra Algorithm with priority queue (min heap). There are two functions, read_map and read_query, that read the given map and find shortest path between two nodes. Since I am given a map with nodes containing only coordinates, I calculate the distance between two nodes and store the data while I am adding edges in the map. The map in my implementation is constructed in the form of Adjacency List which allocates less memory space in contrast to Adjacency Matrix.

The time complexity of my implmentation is O(E log V). Since my program leverages the power of min heap and adjacency list, it beats implementation based on adjacency matrix.

/***
 * Known bugs / limitations of your program / assumptions made.
 ***/

The assumptions of my program are:

- The given maps are undirected graph.
- There isn't any negative cycles in the map.
- The index of nodes is always positive.

/***
 * List whatever help (if any) that you received.
 ***/

References:

- Binary Heap from Geeks for Geeks
- Dijkstra's algorithm from Wiki
- Finding The Shortest Path, With A Little Help From Dijkstra

/***
 * Describe any serious problems you encountered.

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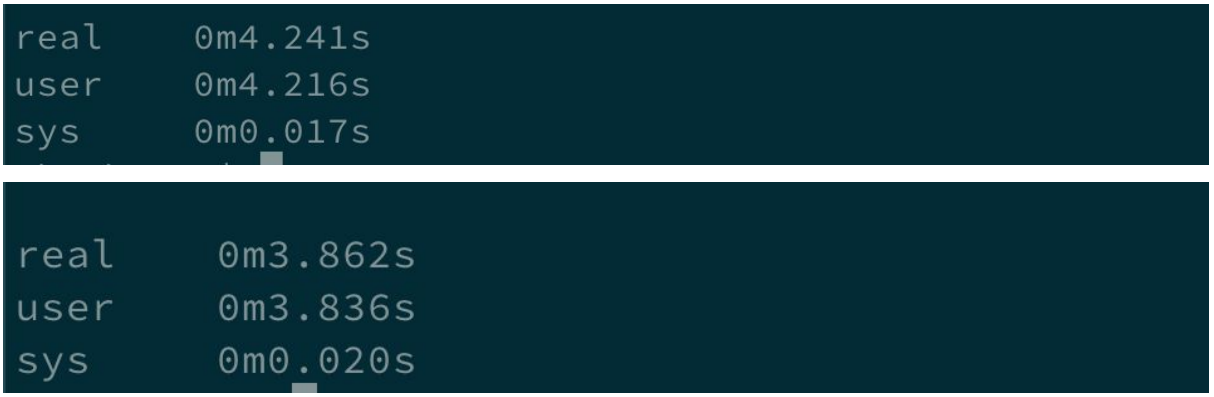
There were two problems, execution time and memory usage. Originally, I wanted to use cache to store the computation result for every starting point. So I can quickly lookup the shortest path between two nodes in cache, if I already have the computation result kept in cache. However, this approach allocates too much memory space if the graph is large. Therefore, I decided not to use cache but to compute the result for each query.

I tried to reduce some nested for loops in order to have better performance in time consumption. Eventually, my improved program runs 8% faster than original implementation.



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* List any other comments/feedback here (e.g., whether you
* enjoyed doing the exercise, it was too easy/tough, etc.).
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This project is pretty interesting and I enjoyed a lot while I was programming. It would be much fun if we can decide what algorithm we want to use to solve the given problem, for example Bellman-Ford Algorithm or Floyd-Warshall Algorithm.

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* How to run my program
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make compile
./**adjacent map.txt query.txt**