Use of Greedy Method in Google Maps

Group 1

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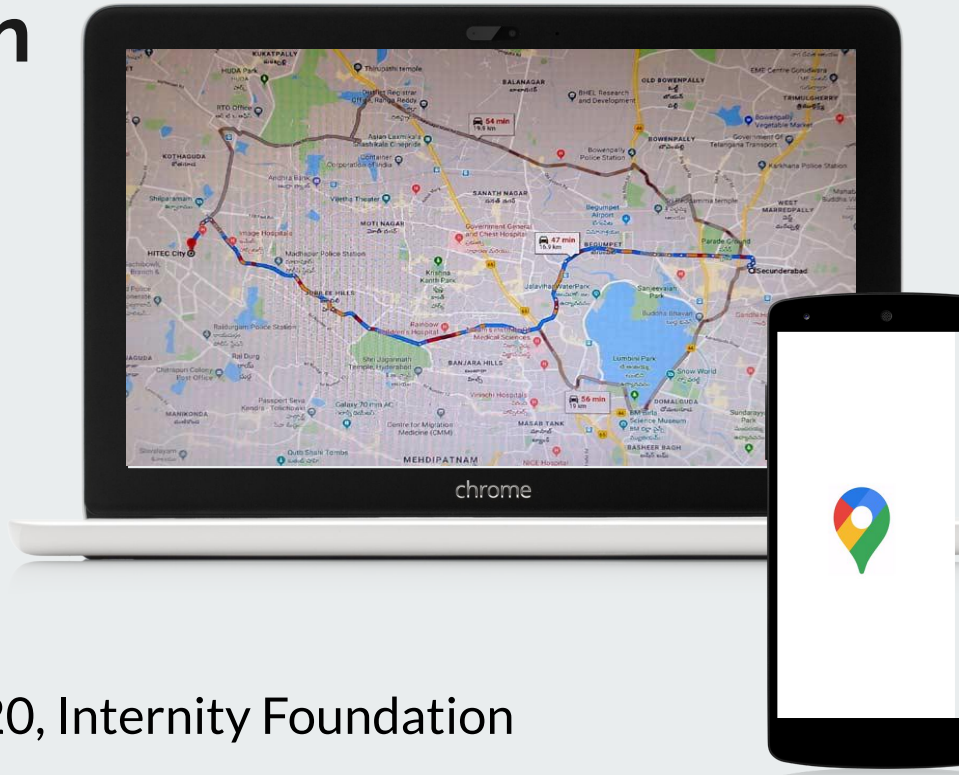

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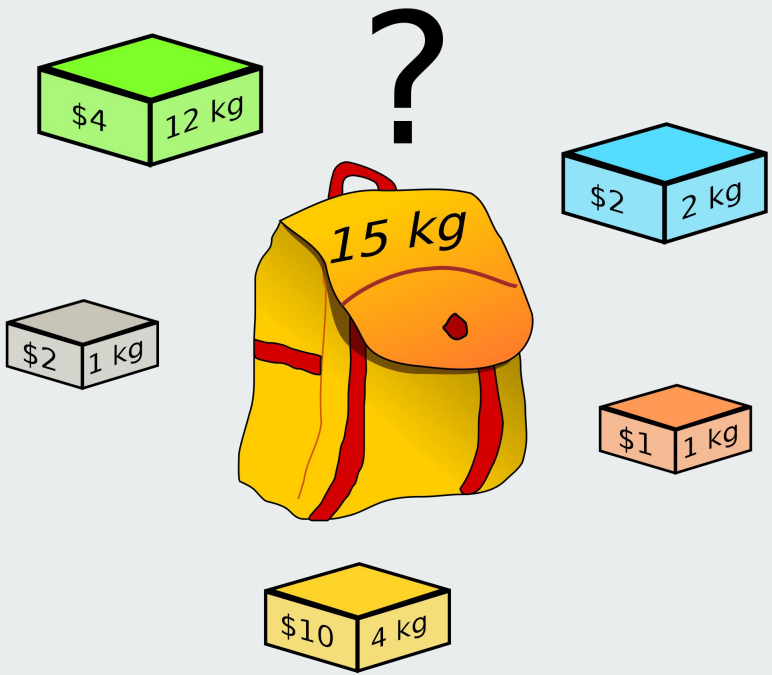
What is Greedy Method ?

- Technique that makes a choice that looks best at the moment
- The intuition behind it is that the local optimal can be used to build an optimal solution
- It may or may not lead to an optimal solution for all the problems
- They take decisions on the basis of information at hand without worrying about the effect these decisions might have in the future
- They are easy to implement and quite efficient.

Examples of Greedy Method

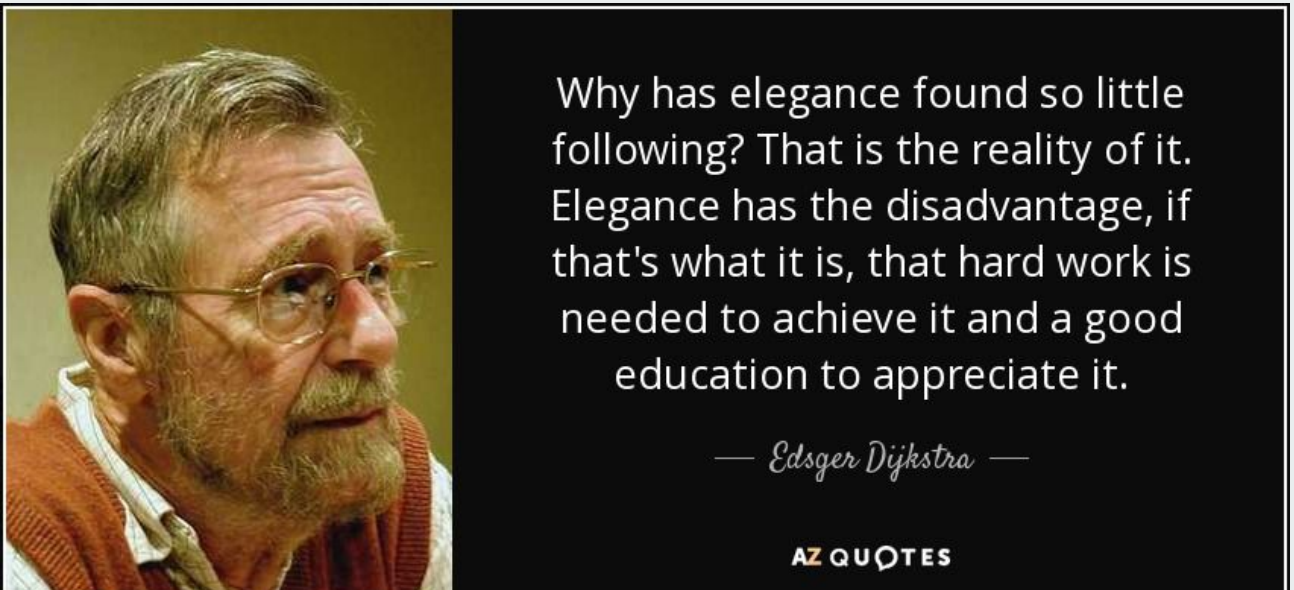
- Kruksal's Minimum Spanning Tree
- Prim's Minimum Spanning Tree
- Huffman Codes (data - compression codes)
- Dijkstra's Shortest Path Algorithm
- Dial's Algorithm
- Reverse delete Algorithm for MST

Fractional Knapsack Problem



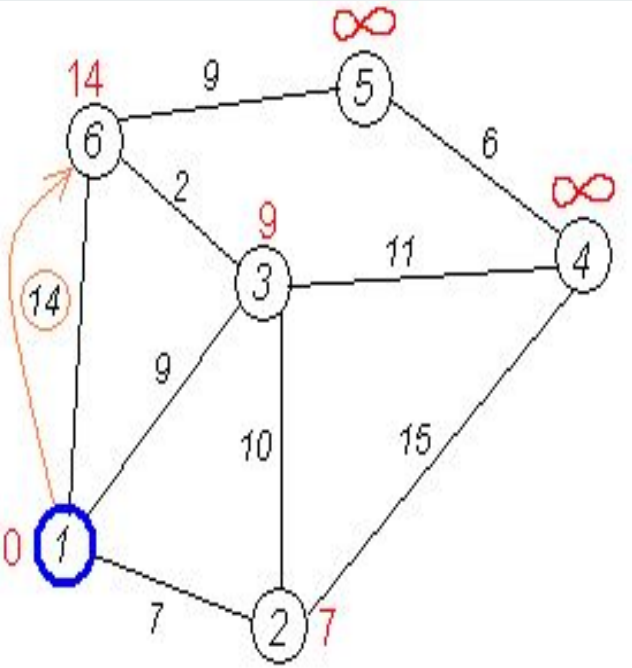
What is Dijkstra Algorithm?

- Dijkstra's Algorithm was delivered by a dutch scientist "**Edsger Wybe Dijkstra"** in 1956 and published in 1959.



Dijkstra's Algorithm

- It is the solution to shortest path problem of graphs
- It is a Dynamic Approach of finding a globally optimal solution by greedily choosing locally optimal solution
- Input : Weighted graph and source vertex s.t. all edge weights are positive
- Output : Length of shortest path from source vertex to all other vertices



Time Complexity

- Using **Array** or **Linked List** for storing vertices , time complexity will be :

$$O(|V|^2 + |E|)$$

- Using **adjacency list** through Heap or **Priority Queue** will take :

$$O(|E| + |V|) \log |V|$$

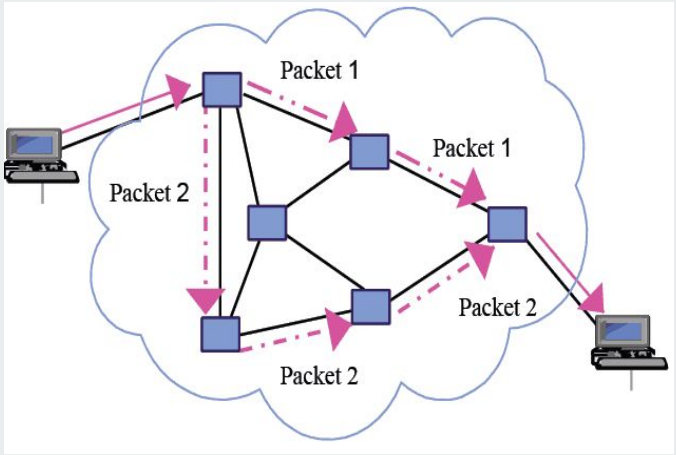
Social Networking Application

In many social networking applications, it is very common to suggest the lists of the friends that a particular user may know. The standard *Dijkstra algorithm* can be applied using shortest path between users measured in handshakes or connections between two users.

Telephone Network

In a telephone network, we want to route the phone call via the highest Bandwidth.

The bandwidth of a transmission line is the highest frequency that can be supported by the line. Generally, the higher the frequency of the signal the more the signal is attenuated by the line. If we are transmitted a digital signal then the BW represents the highest frequency or the fastest the signal can change from 0 to 0. Bandwidth represents the amount of information that can transmitted by the line.

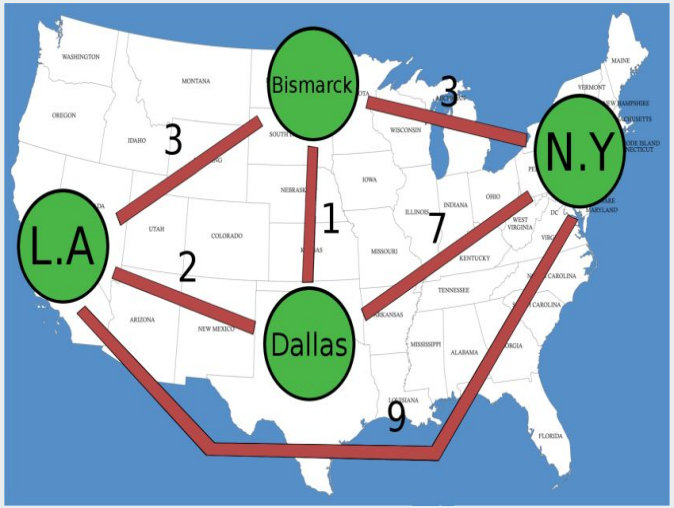


Flight Agenda

Flight scheduling application, allows users to find the shortest path to their preference destination, based on Dijkstra's algorithm and Data Structure model. It is basically used to determine the earliest arrival time for a particular destination, given an origin airport and start time.

Mapping

Dijkstra's algorithm (or **Dijkstra's** Shortest Path First algorithm) is an algorithm for finding the shortest paths between nodes in a graph, which may represent, for example, road networks.



Google Maps is a Web-based service that provides detailed information about geographical regions and sites around the world. In addition to conventional road maps, Google Maps offers aerial and satellite views of many places. In some cities, Google Maps offers street views comprising of photographs taken from vehicles.

Google Maps offers several services as part of the larger Web application, as follows.

- A route planner
- The Google Maps application program interface (API)
- Google Maps for Mobile.
- Google Street View
- Supplemental services

Like we have already mentioned that one of the most widely used application of Dijkstra's algorithm is it is used in Mapping. One of the universally used convention for the same is Google Maps. The aim of this presentation is to get a better understanding of how Dijkstra's algorithm plays a pivotal role in the working of Google Maps.

Working of Google Maps

Collect & Update data

Google collect data from following sources

- Map Partners
- Street View
- Location Service
- Google map maker(Local guides)
- Satellite
- Business owners
- sensors

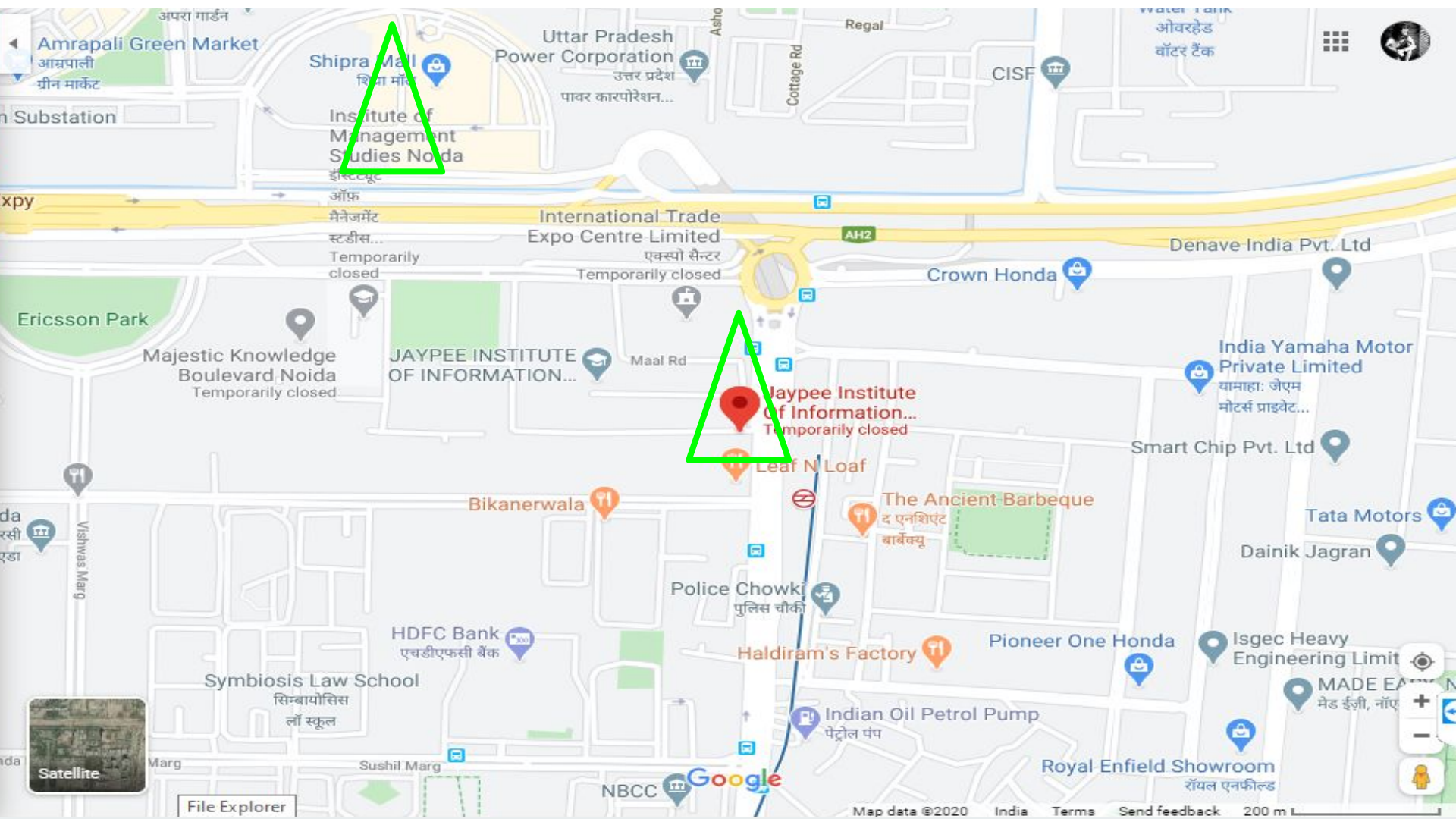
Check for current traffic status

Google shows red-green-orange lines on map according to the current traffic speed.
For this purpose it uses live data through-

- Crowdsourcing
- Sensors

Apply Dijkstra Algorithm

- Analyse Current traffic status.
- Apply dijkstra for shortest paths
- Apply time constraint as objective function
- Suggest best suited directions.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Pioneer One Honda
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Engineering Limit
Symbiosis Law School
सिम्बायोसिस
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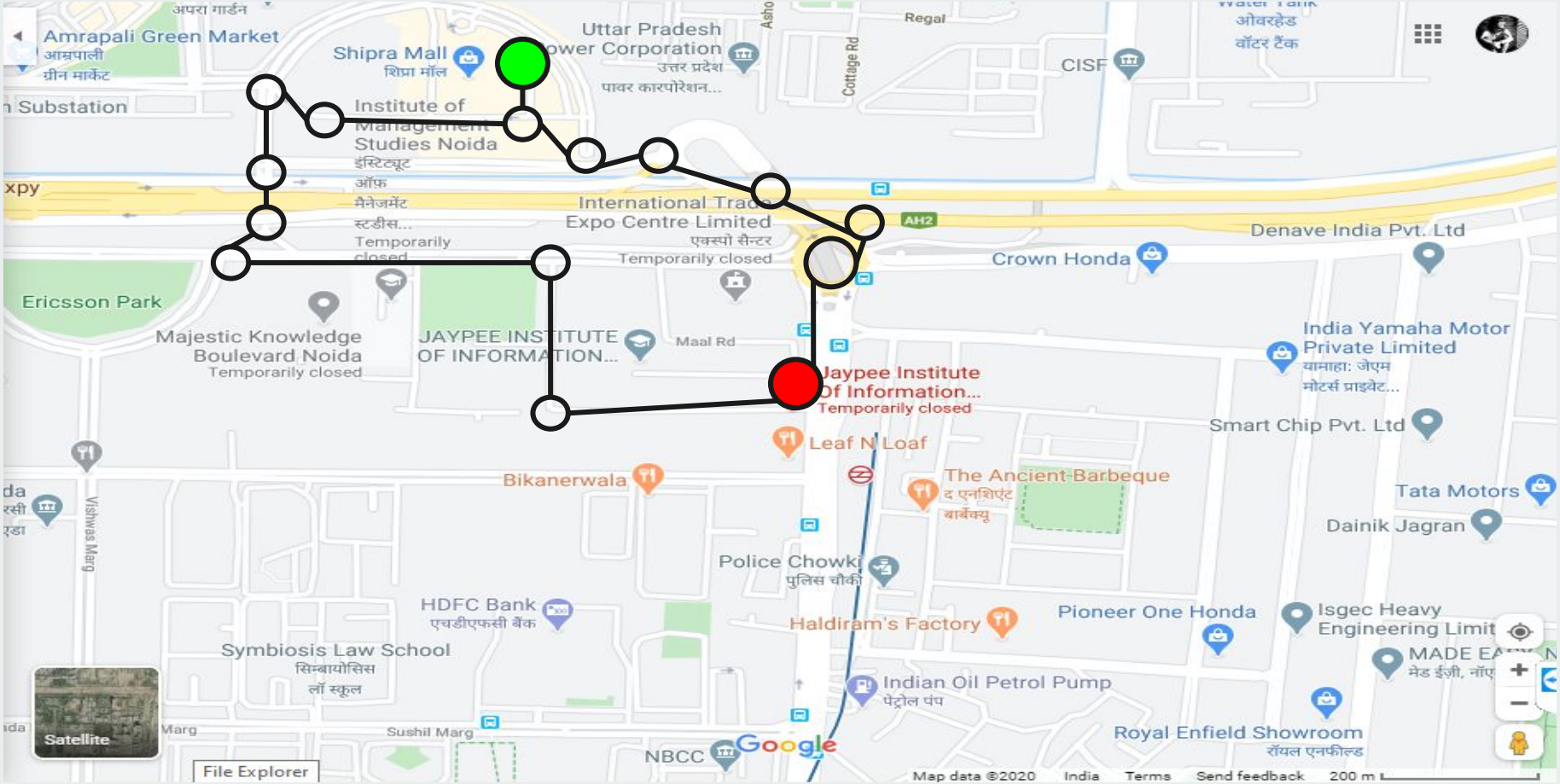
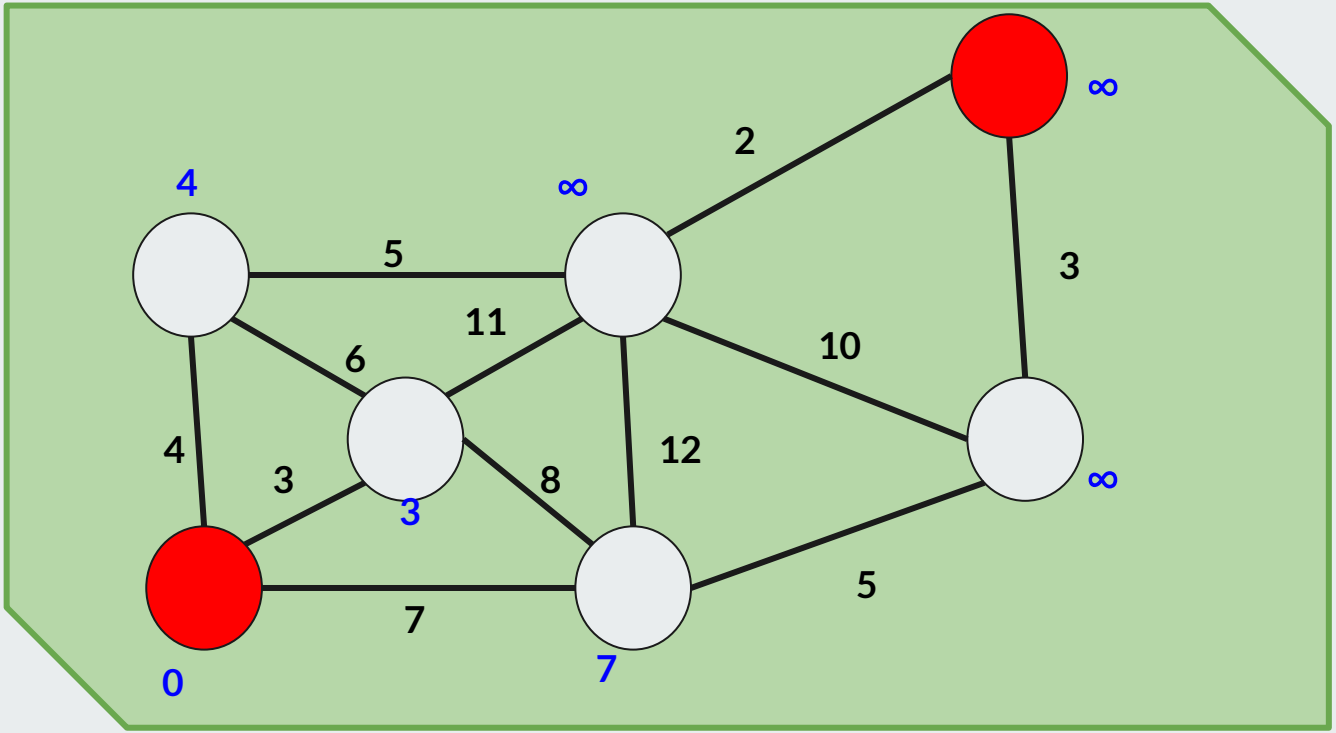
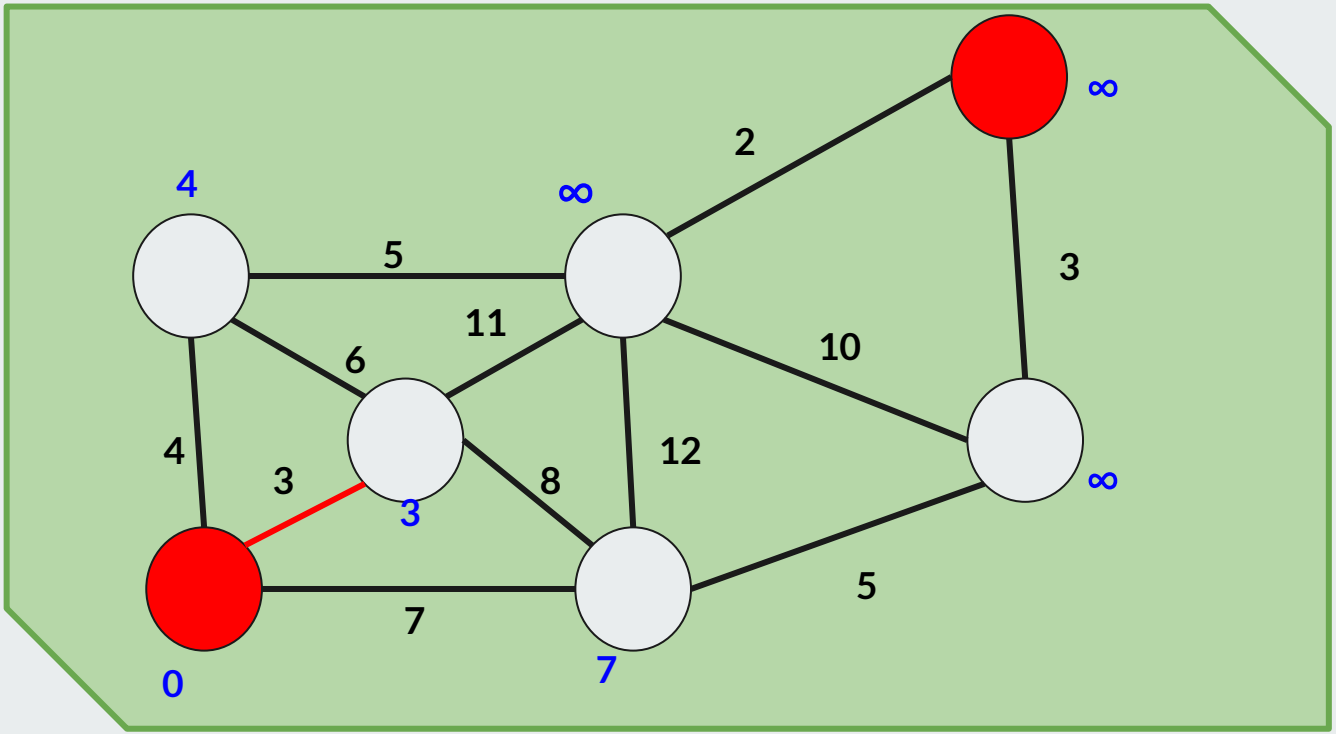
Step 2. Replace all circles/diversions with nodes and roads with edge



Step 3 . Apply weights on each route & apply Algorithm

Here weights are time required to cover the distance with respect to the current traffic situation.

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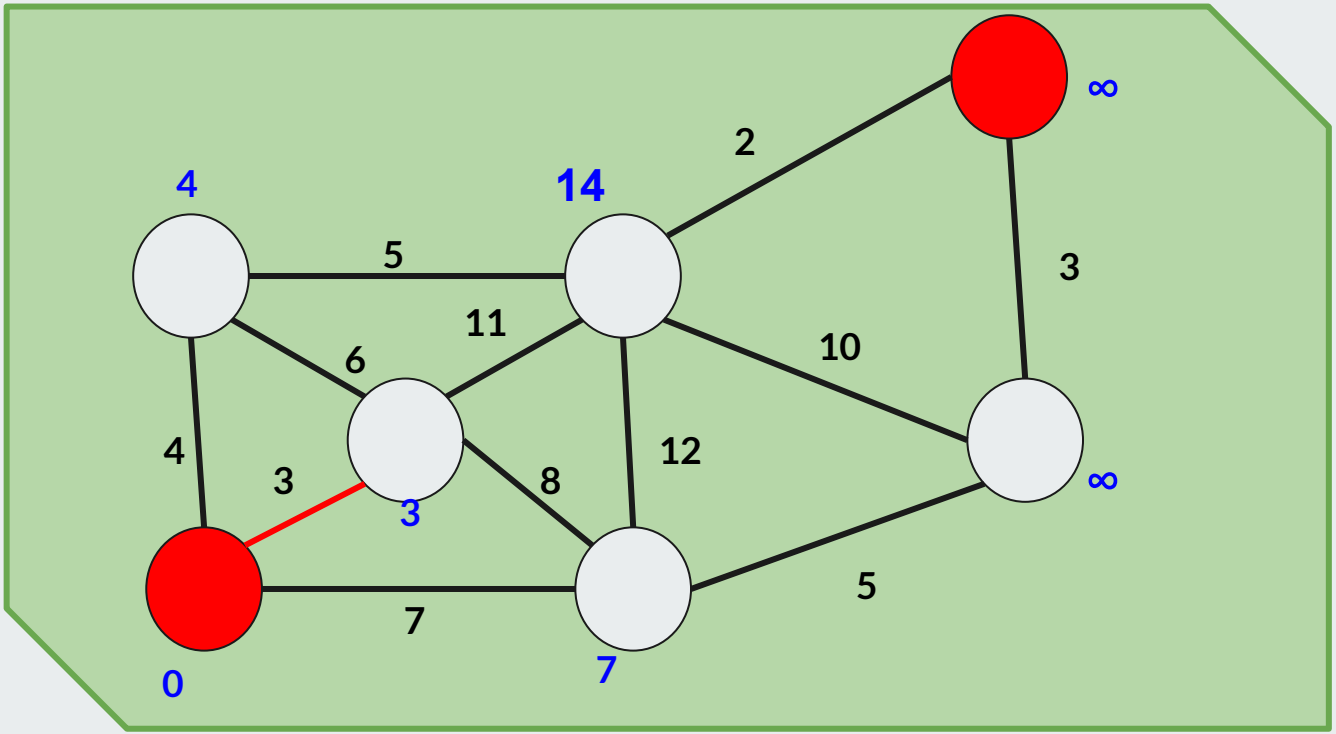
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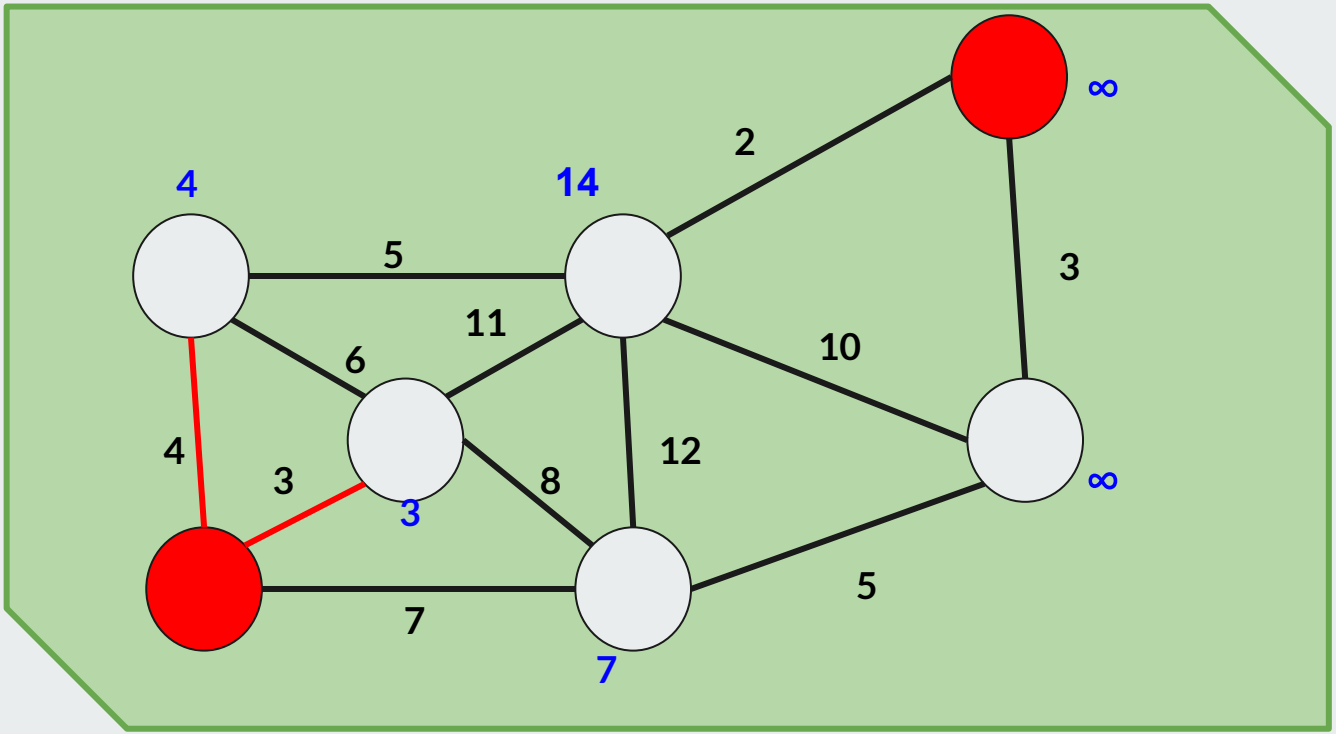
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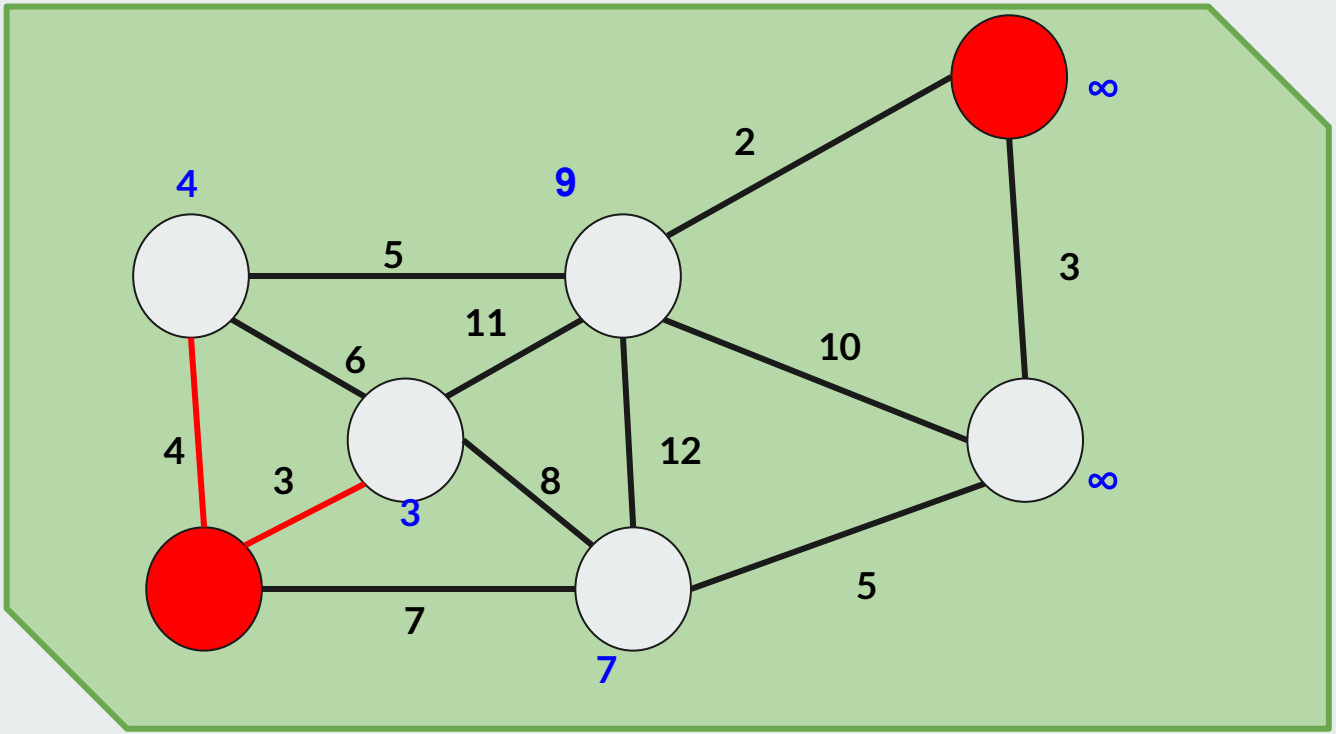
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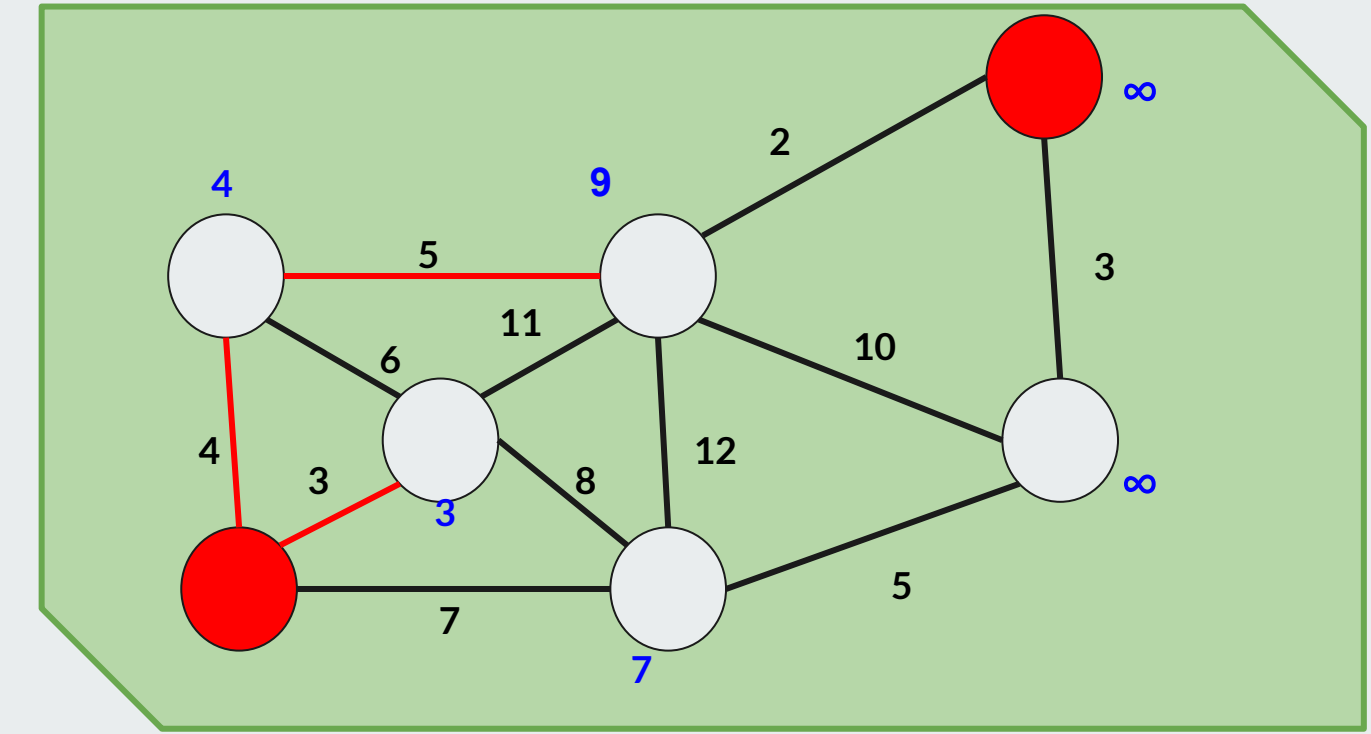
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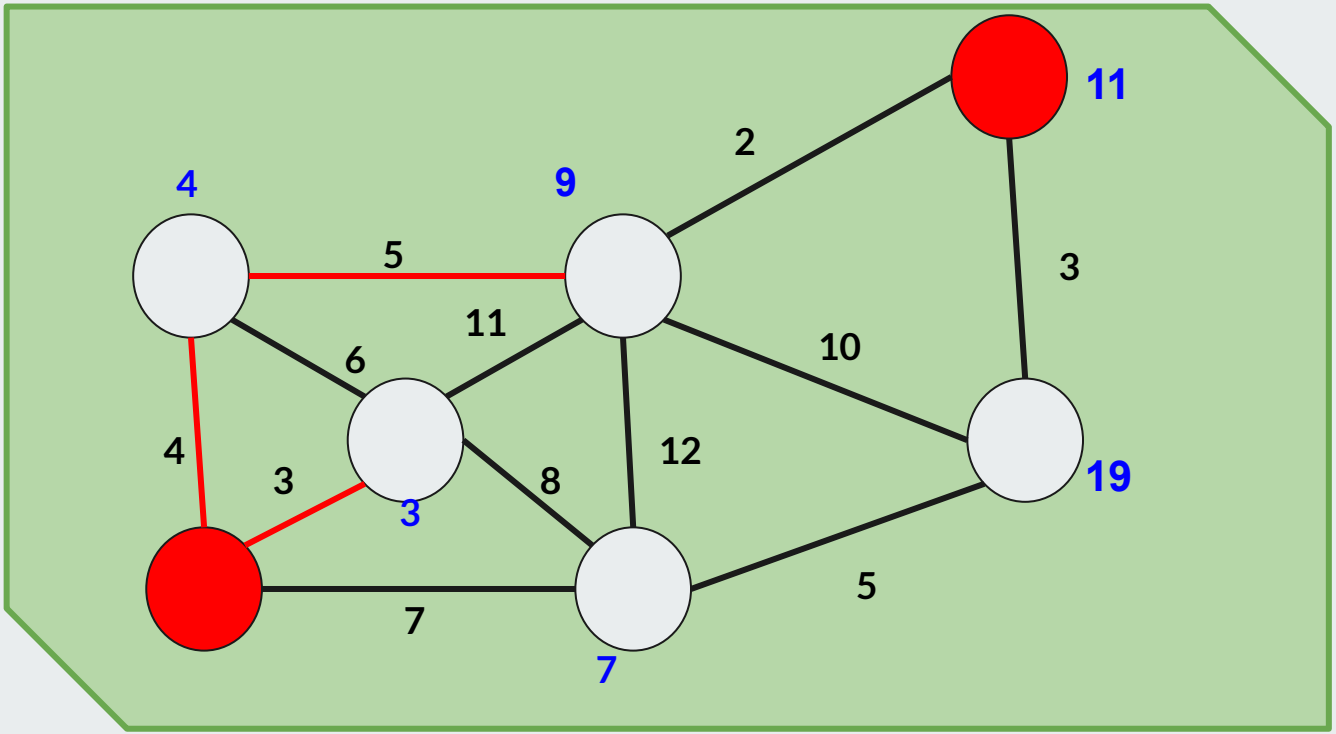
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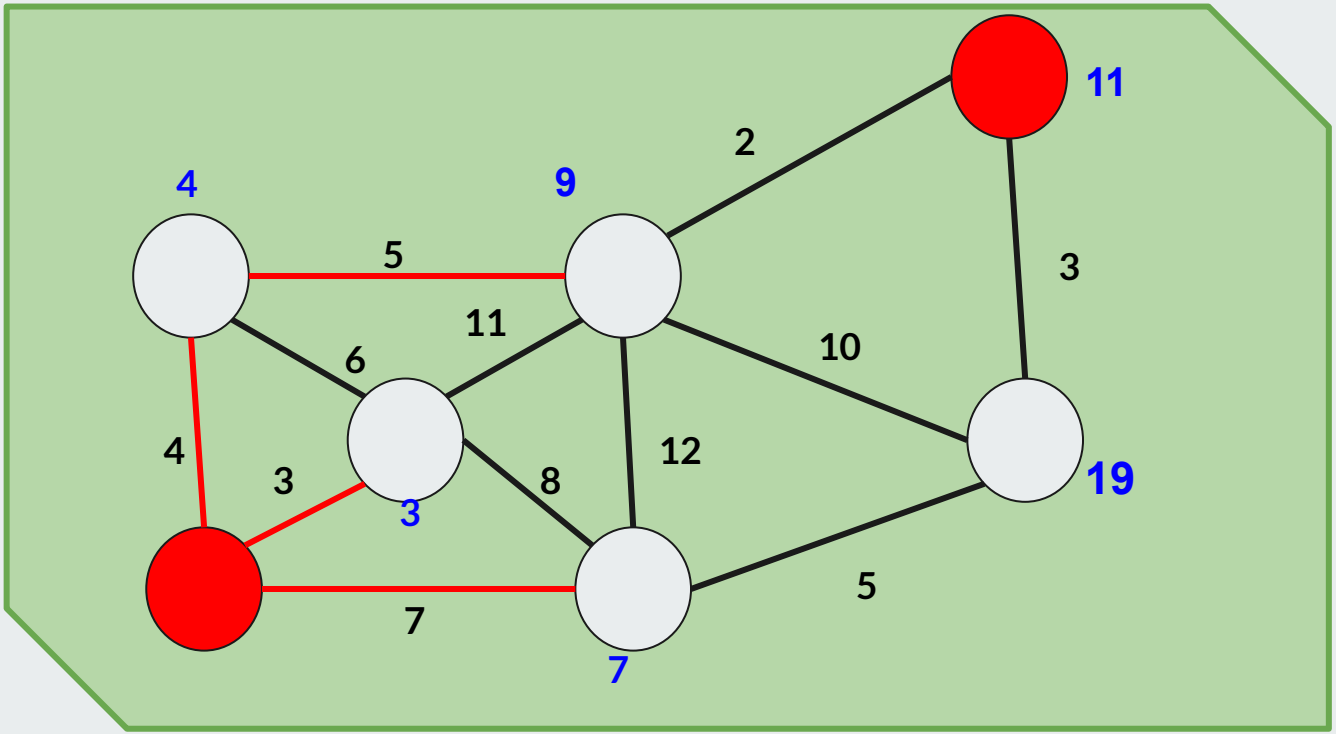
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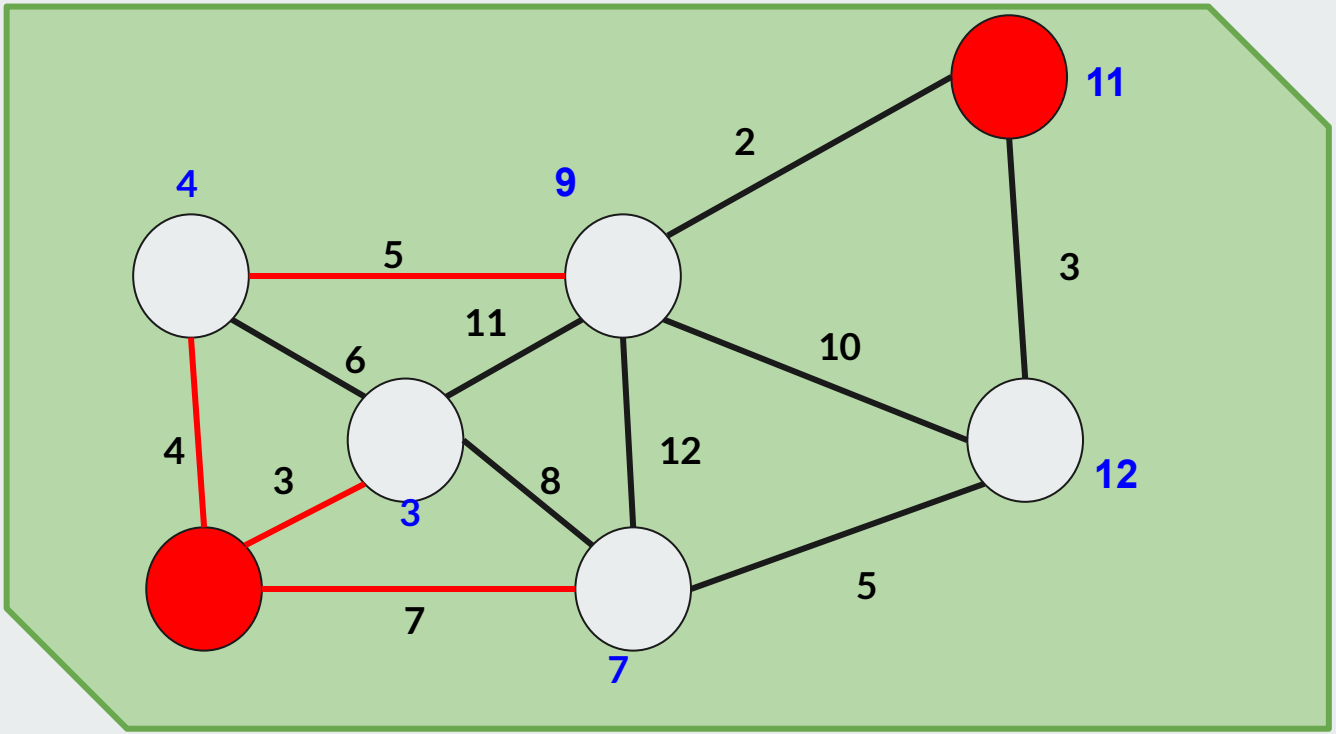
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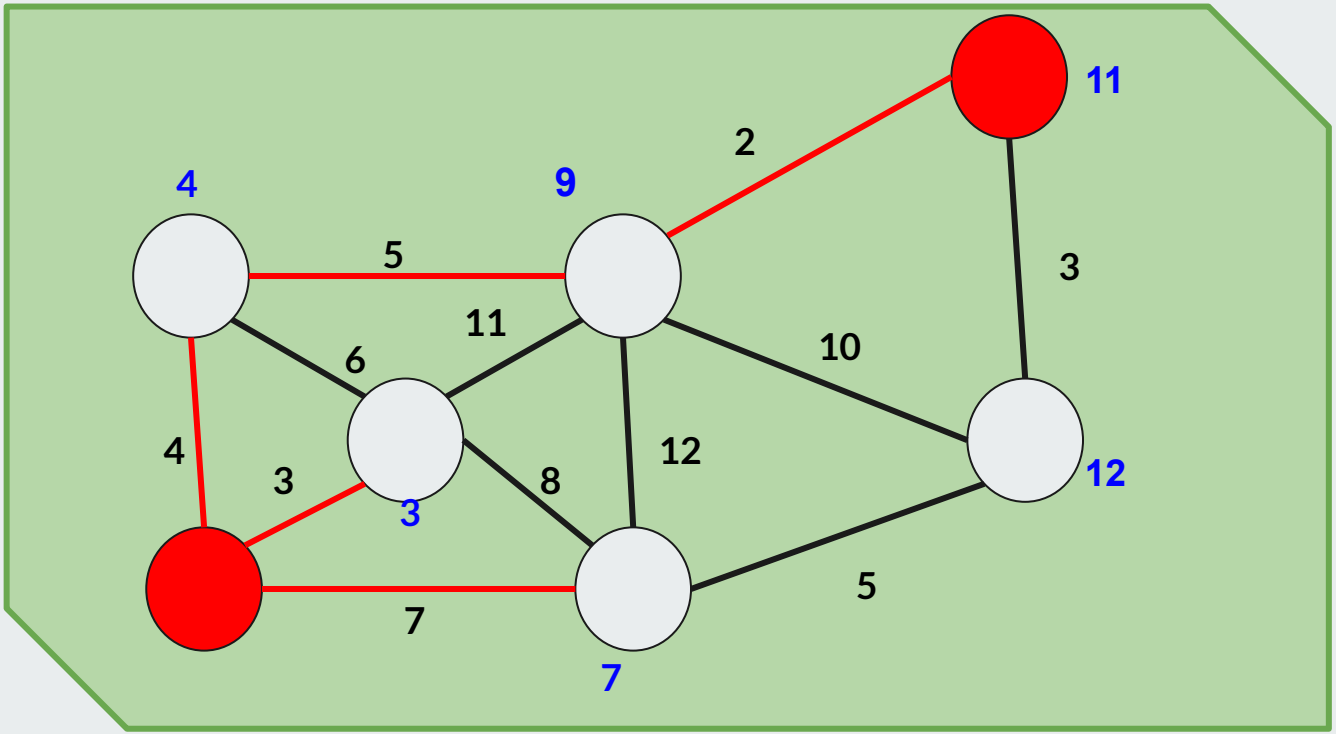
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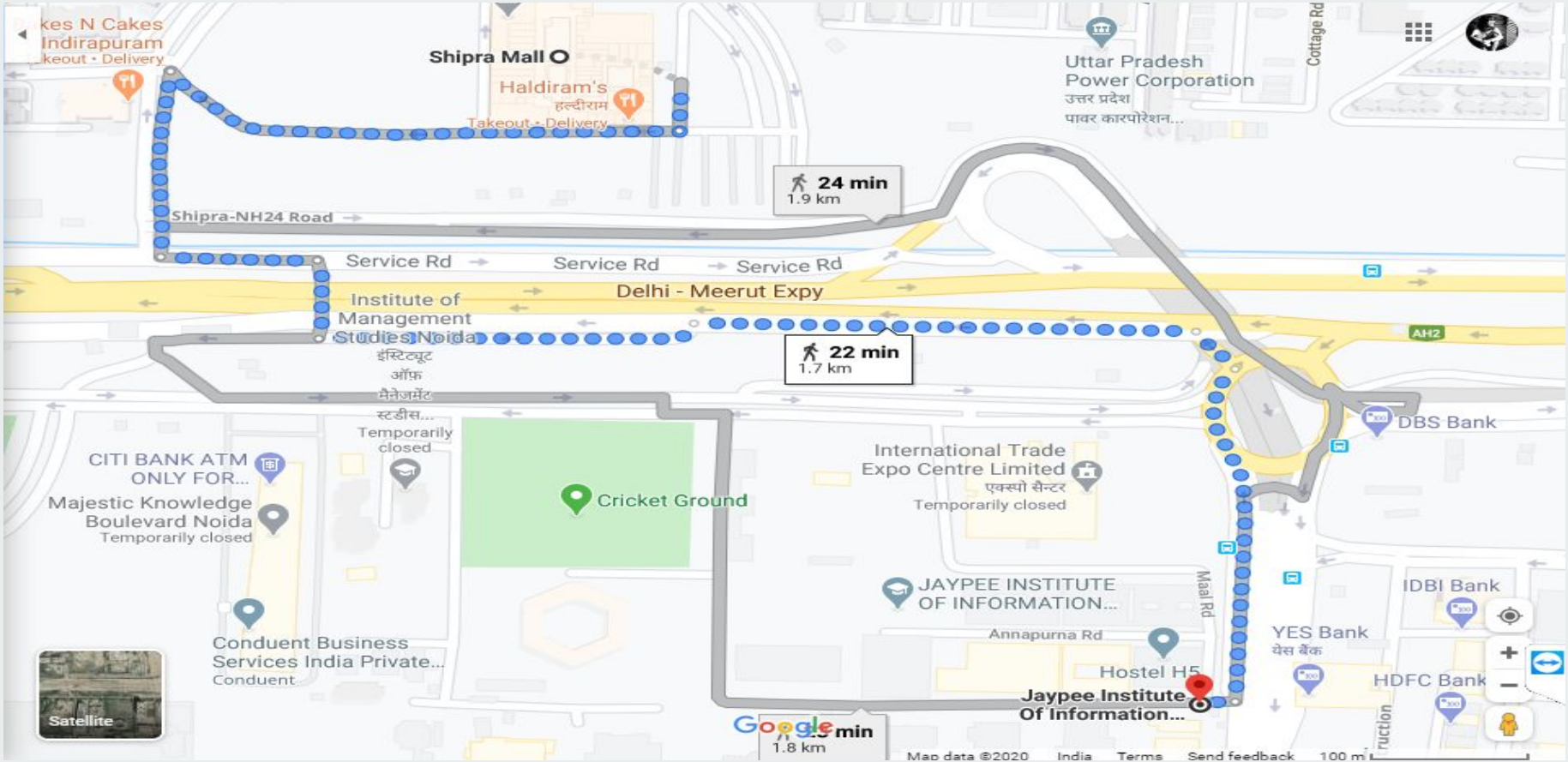
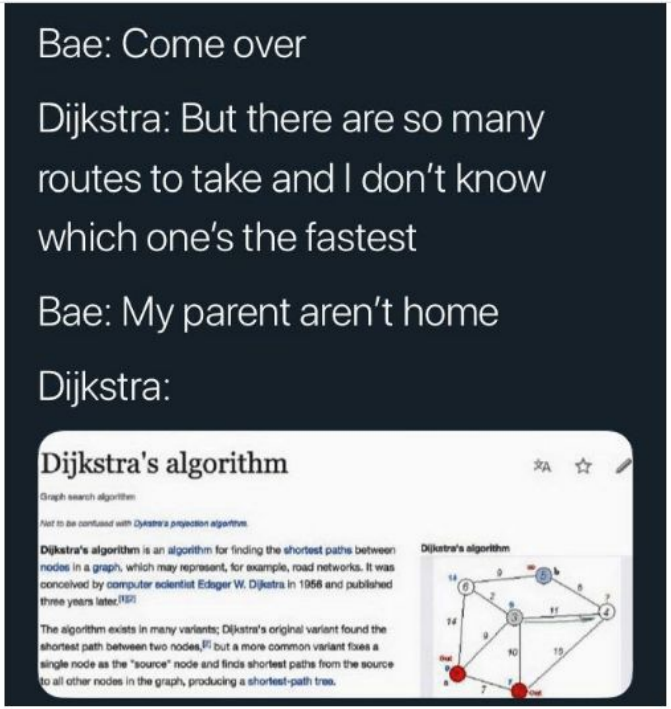
Final Optimal Solution along with other Feasible solutions



Some interesting Facts

- A C++ program(where 2 technologies) then purely a Web-based service(transformed & owned by google inc.) , later for Mobile 2.0. Finally Google Maps app had been released for its Android operating system
- In 2012, the Google Maps application was separately made available in the App Store, after Apple removed it from its default installation of the mobile operating system version iOS 6.
- Google maps automatically blurs face and license plate to protect people's privacy in Street View, and users can even request additional blurring.
- Street View camera system have 15 lenses and can produce images at about 65 Megapixels resolution.
- The Map app also has a dark mode theme for users in line with current trends
- Google maps show detailed view of North Korea, but doesn't work with South Korea
- Max Zoom in and zoom out limit is upto 20 times.
- There is an incognito mode in google maps which allowing users to enter destinations without saving entries to their Google accounts.

Now, Break the seriousness & concentrate here!




THANK
YOU!