Conclusion

Based on what we discussed in this report, we can conclude that Graph Theory can be applied to the problem of Traffic Management System in the following way :-

- Modelling system traffic flow at crossroads into the compatible graph .

- Dividing the set vertices of the compatible graph into several sections complete graph such that many parts as possible or the number of dots in each graph section complete as much as possible.

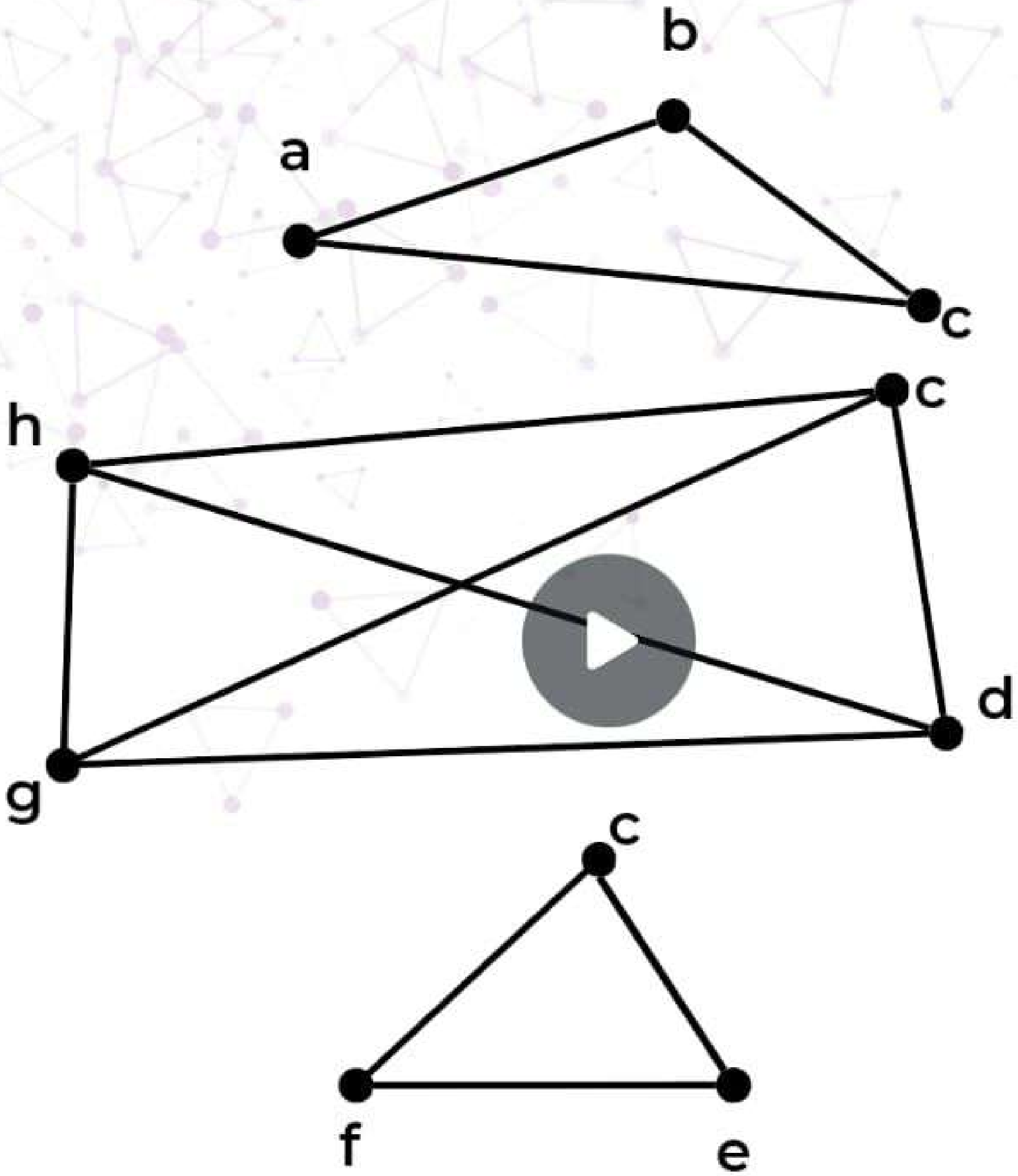
IMPACT

Without making Sections :-

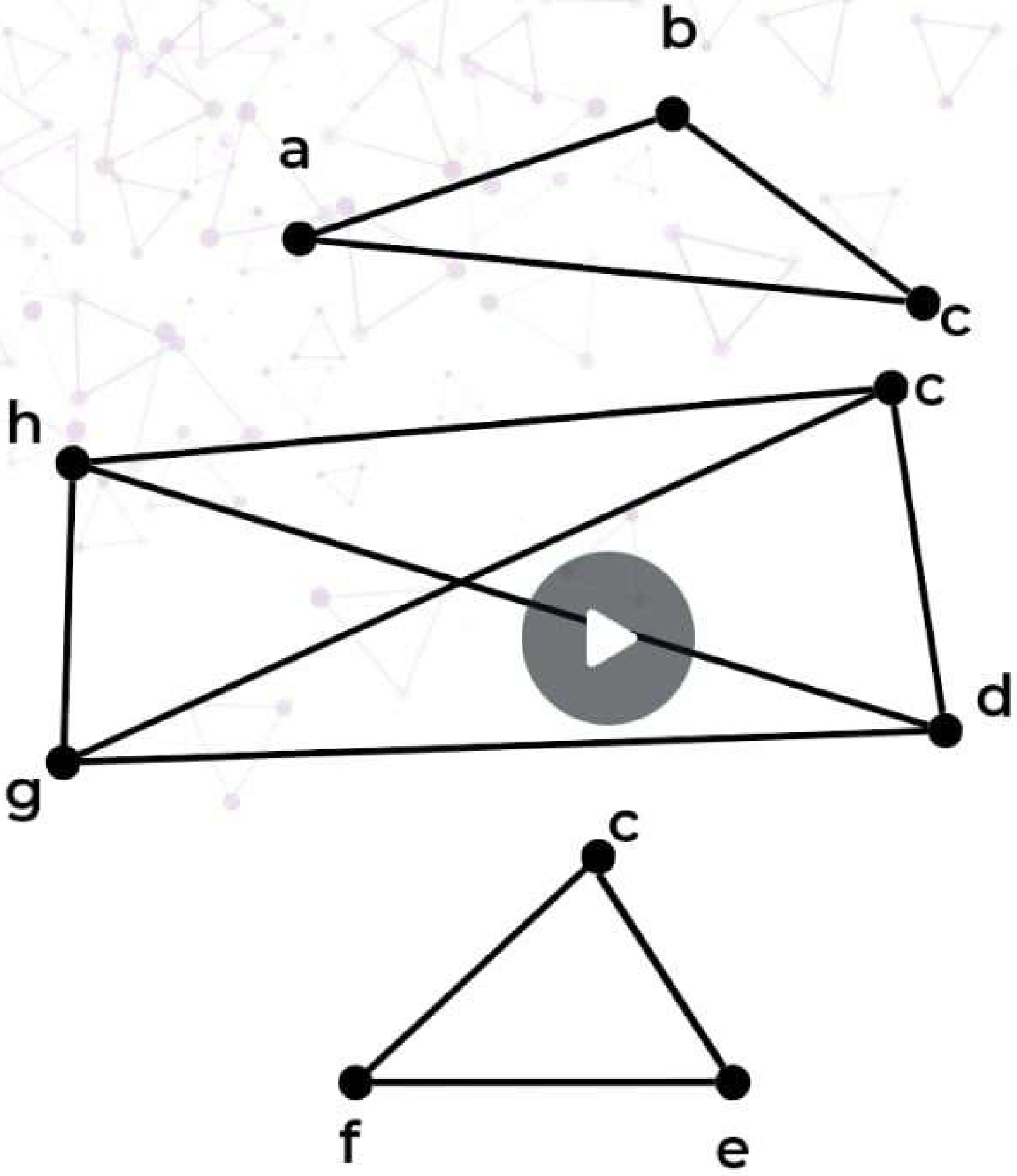
Waiting time	Flowing time	Total
420s	60s	480s

After making Sections :-

Waiting time	Flowing time	Total
120s	60s	180s

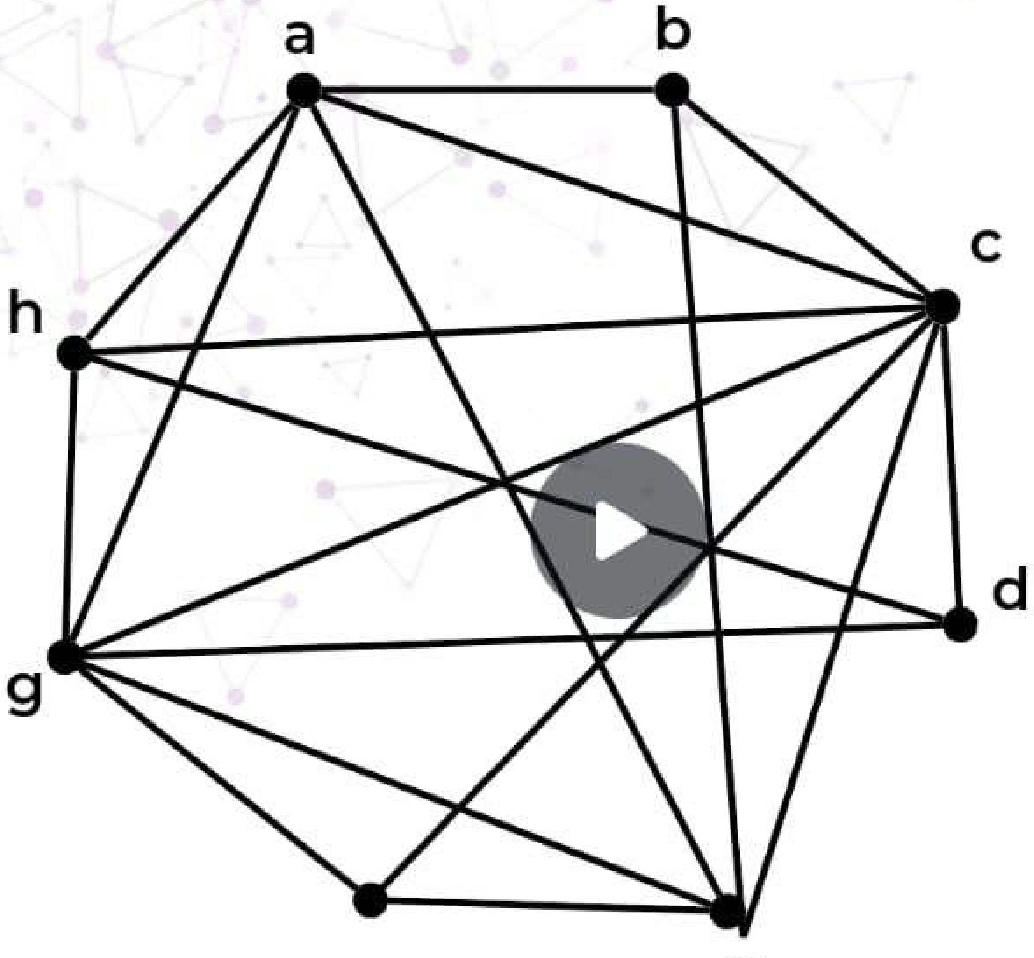


Alternate representation of the sectioned graph. Here we can see that all the sections of the graph are complete graphs, which states that they will not interfere with each other while moving.



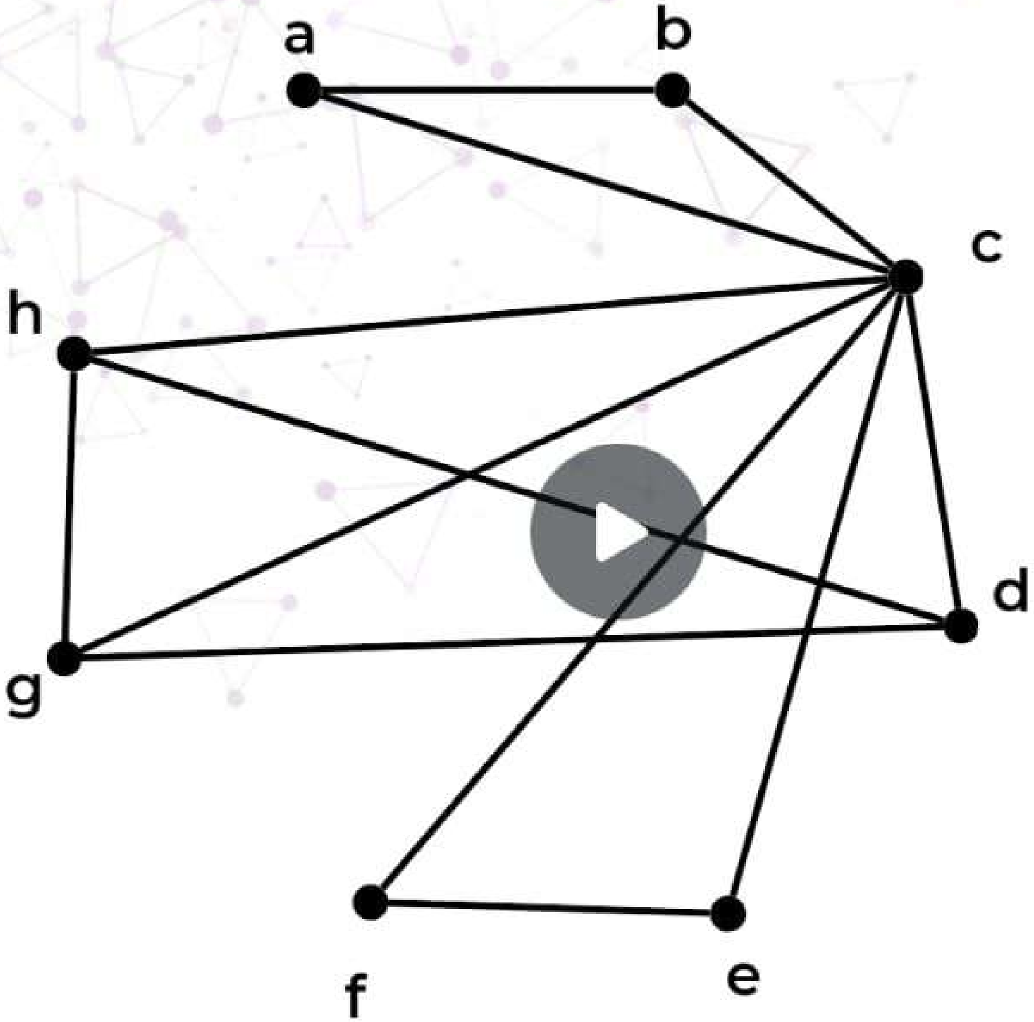
Alternate representation of the sectioned graph. Here we can see that all the sections of the graph are complete graphs, which states that they will not interfere with each other while moving.

Graphical Representation of our traffic flow :-



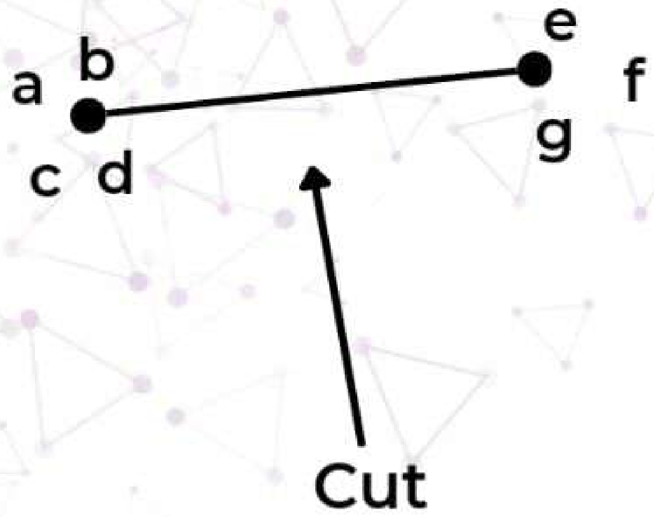
Now we need to make two or more sections of our graph such that it can be used to maintain traffic flow.

The Graph we got after the partition :-



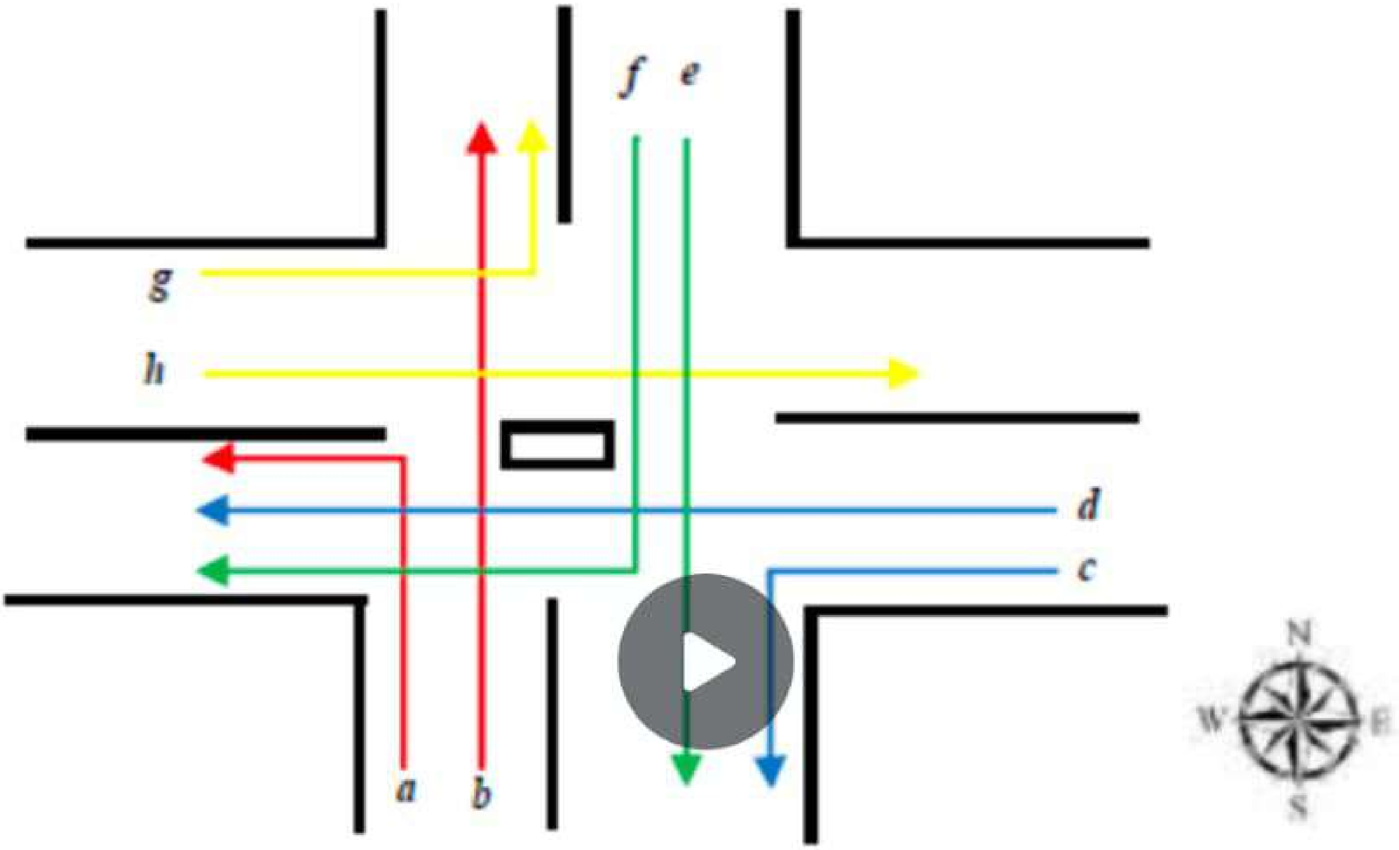
Here, we can see that the graph is partitioned into three parts namely {a,b,c}, {c,e,f} and {c,d,g,h}. Here, "c" is present in all the three sections beacuse as it is clearly visible that c can flow all the time and will not interact with any other traffic.

- **keep on repeating the process until you are left with only two nodes. Removing all the edges connecting those two nodes will give a cut.**



- Keep on repeating the above steps for a very large number of times(theoretically infinity, practically any large number you wish).
- The Cut you get for the maximum number of times is "**The Min-Cut**".

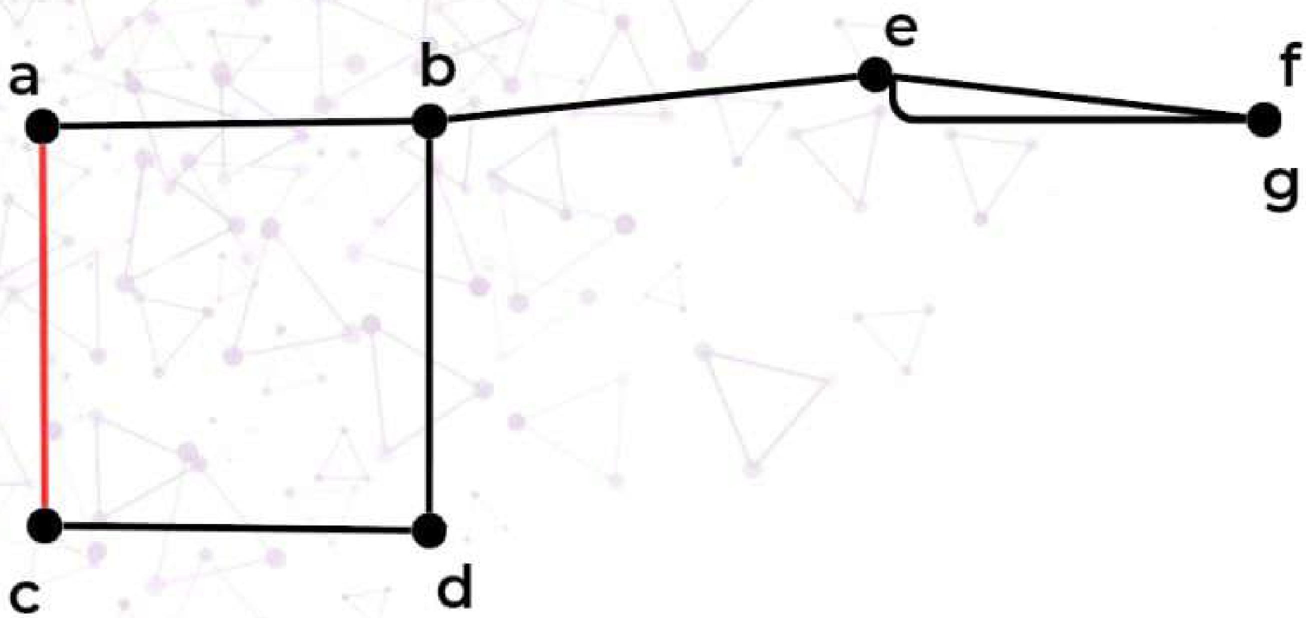
Traffic Lights Solution

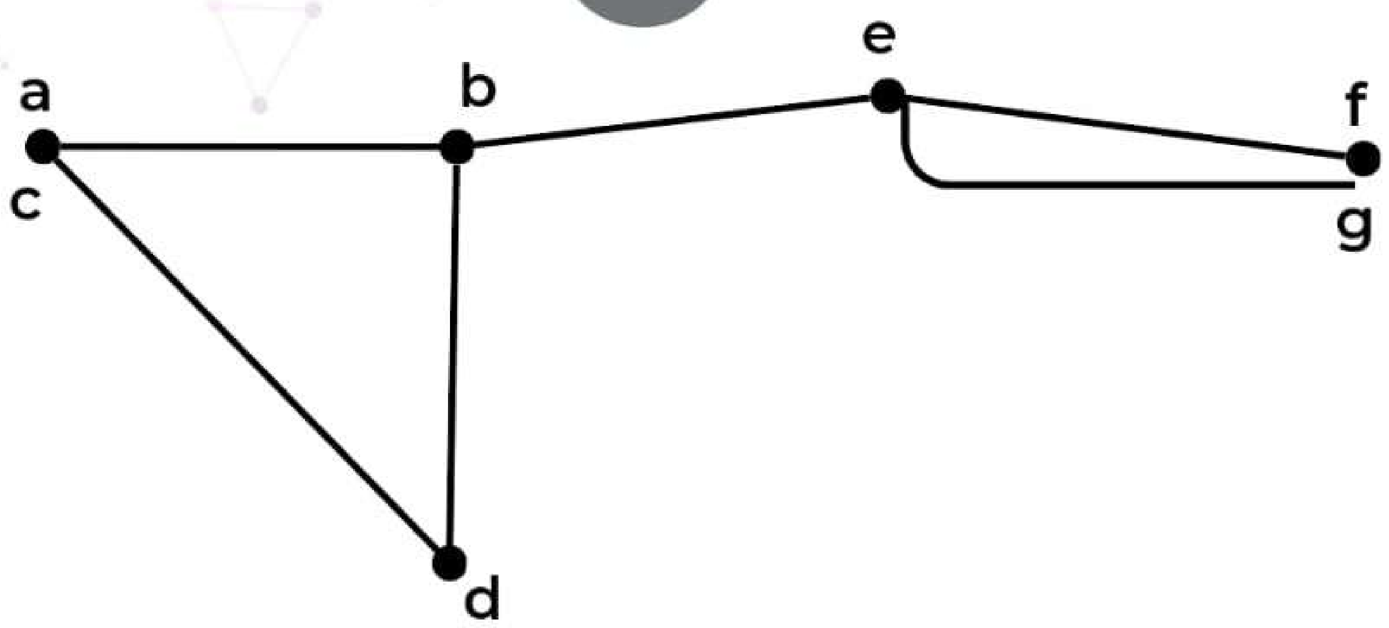


Without the use of Min-Cut algorithm, there was only one solution of the above problem.
That was to start one traffic flow while others will wait. Which was a very ineffective way to control traffic, as it consumed a lot of time.

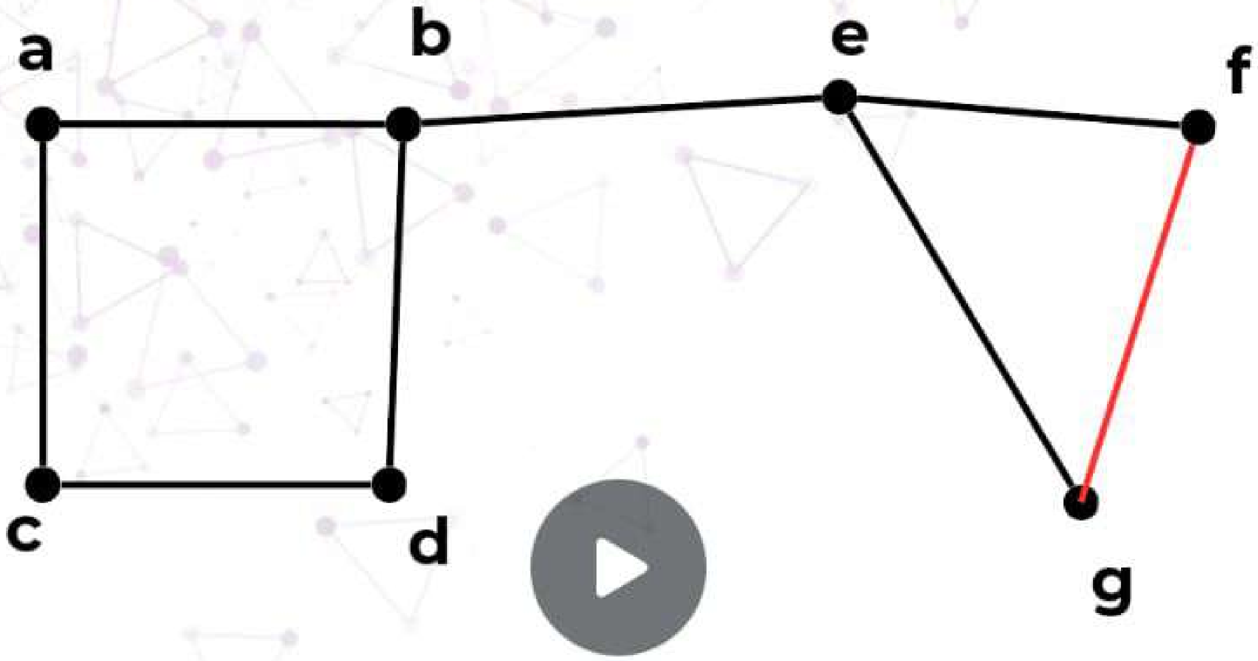
With the use of our Method, we can make various flows go on simultaneously, hence saving a lot of time and making the traffic flow fast and effective.

- **Select another edge uniformly at random and fuse the two nodes connecting them.**

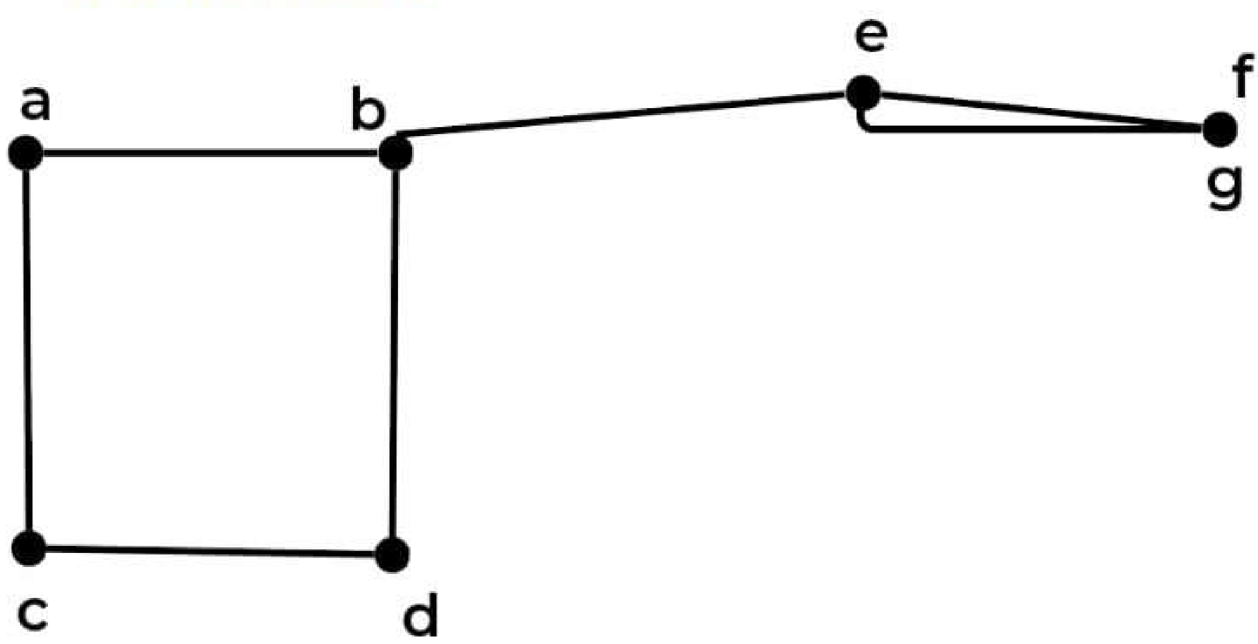




- Select an Edge from the Graph uniformly at random.



- Select the two Nodes connected by the Edge and fuse them.



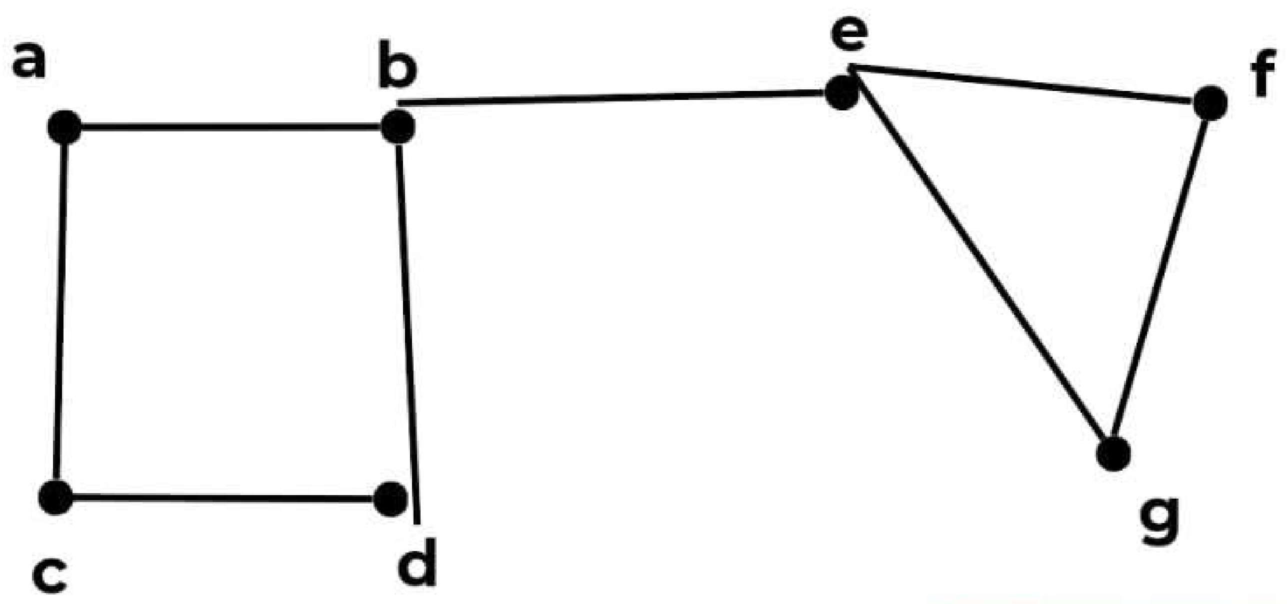
MIN-CUT ALGORITHM

A cut is defined between two nodes such that by removing all the edges between those two nodes, the graph can be divided into two separate sections independent of each other. A Min-Cut is a cut in which we need to remove minimum number of edges.

That is, such two nodes should be selected such that the graph is separated into two sections by eliminating minimum number of edges.

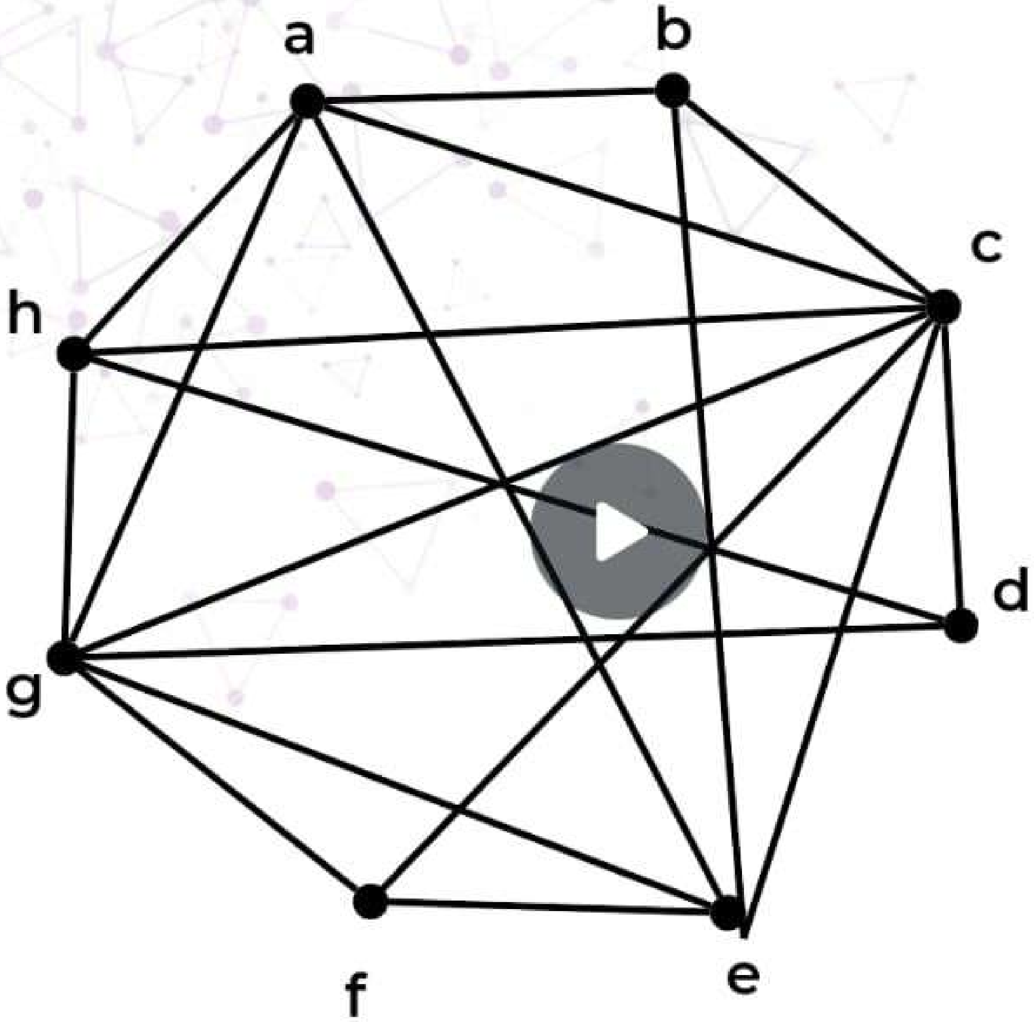
The Algorithm to find Min-Cut :-

Let us have a Graph G={V,E},
where, V = Nodes in the graph
E = Edges Connecting the Nodes.



COMPATIBLE GRAPH

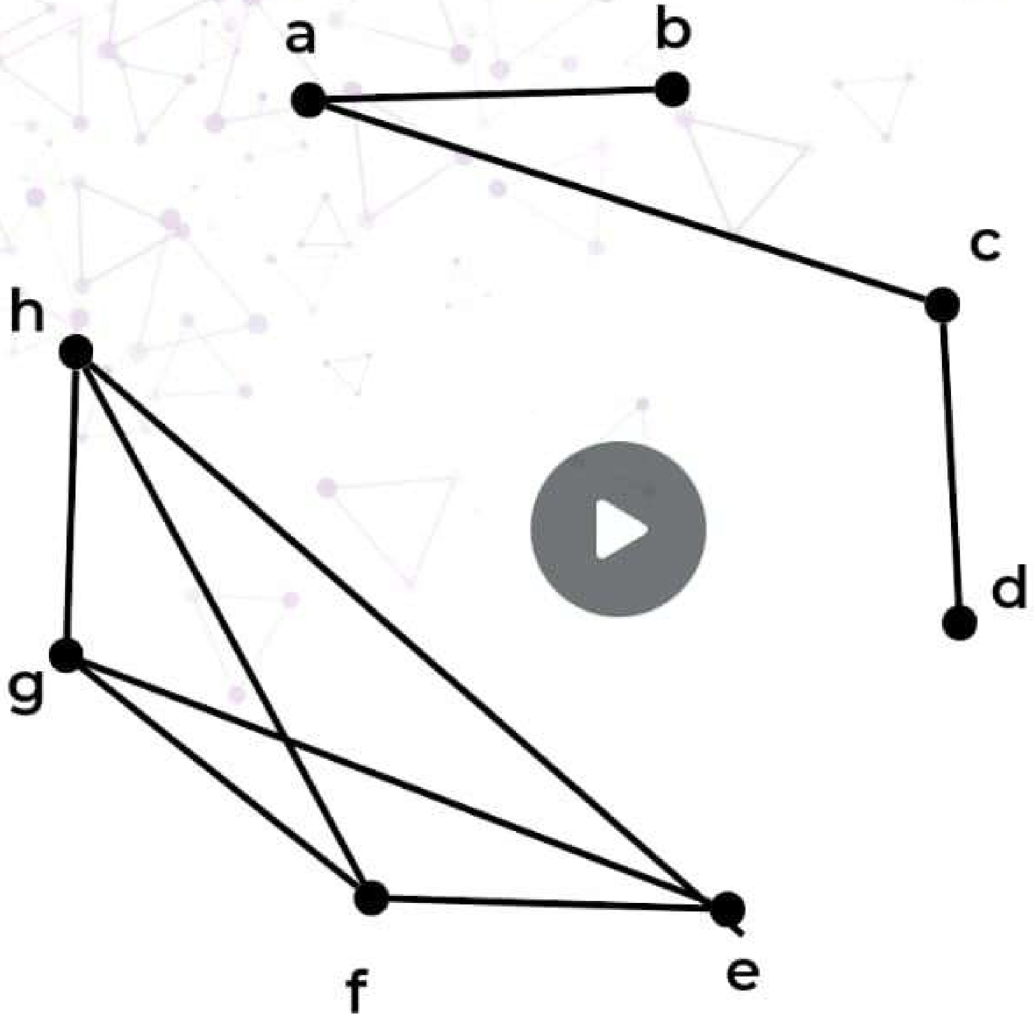
The compatible graph of traffic flows are defined as the traffic flow which is expressed by an edge, two edges of the traffic flow are connected when the traffic flow does not cause a crashes if it flows together.



A Compatible Graph

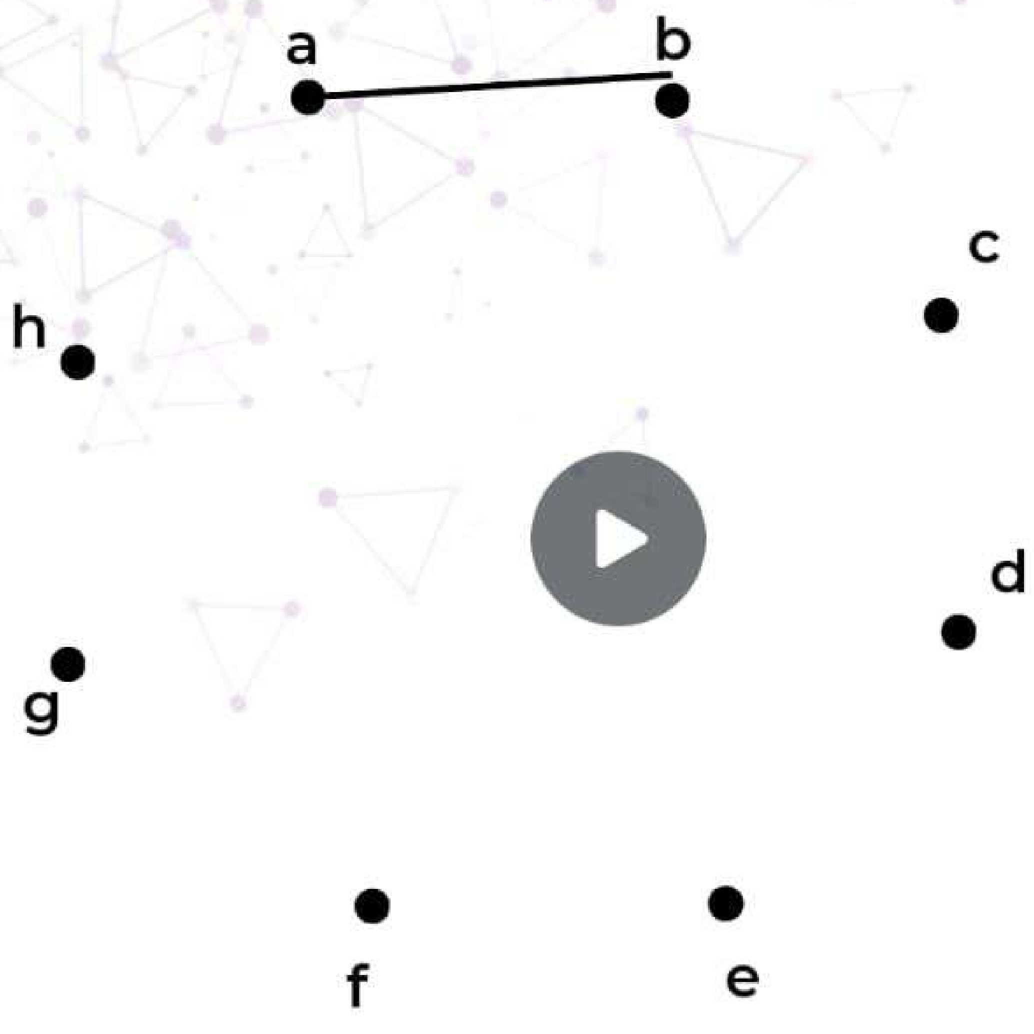
SECTION GRAPH

LetG=(V(G), E(G)) be a graph. Graph H=(V(H), E(H)) is called a section graph G, written as H⊆ G, if V(H) ⊆V(G) and E(H)⊆E(G). If H⊆G and V(H)=V(G), then H is called the graph of the range section G, moreover if H is a complete piece of graph G, then H refers to a clique on G.



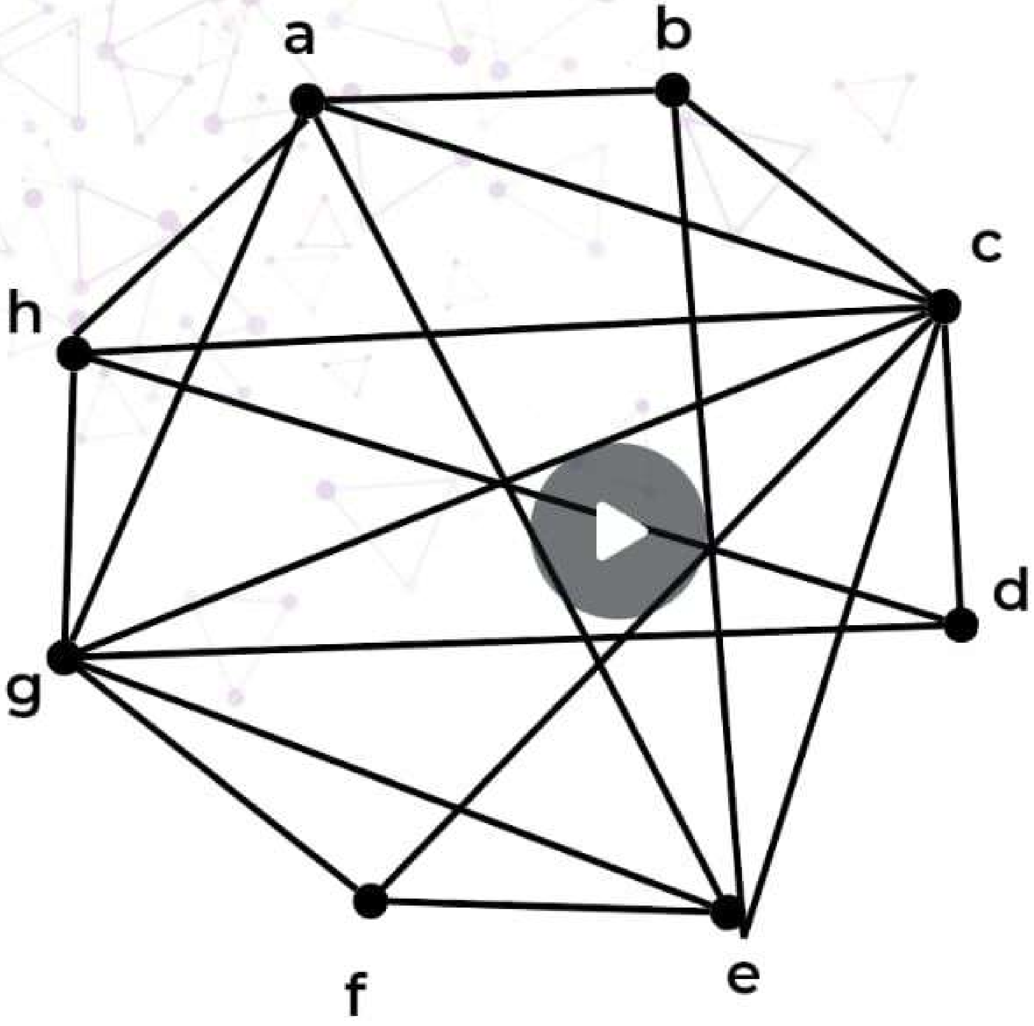
A Graph having 2 sections : {a,b,c,d} and {e,f,g,h}

As we can see in the Flow diagram that the flow a and b can move simultaneously without interacting with each other, let us connect a and b in the graph :-



Graph representing the traffic flow system

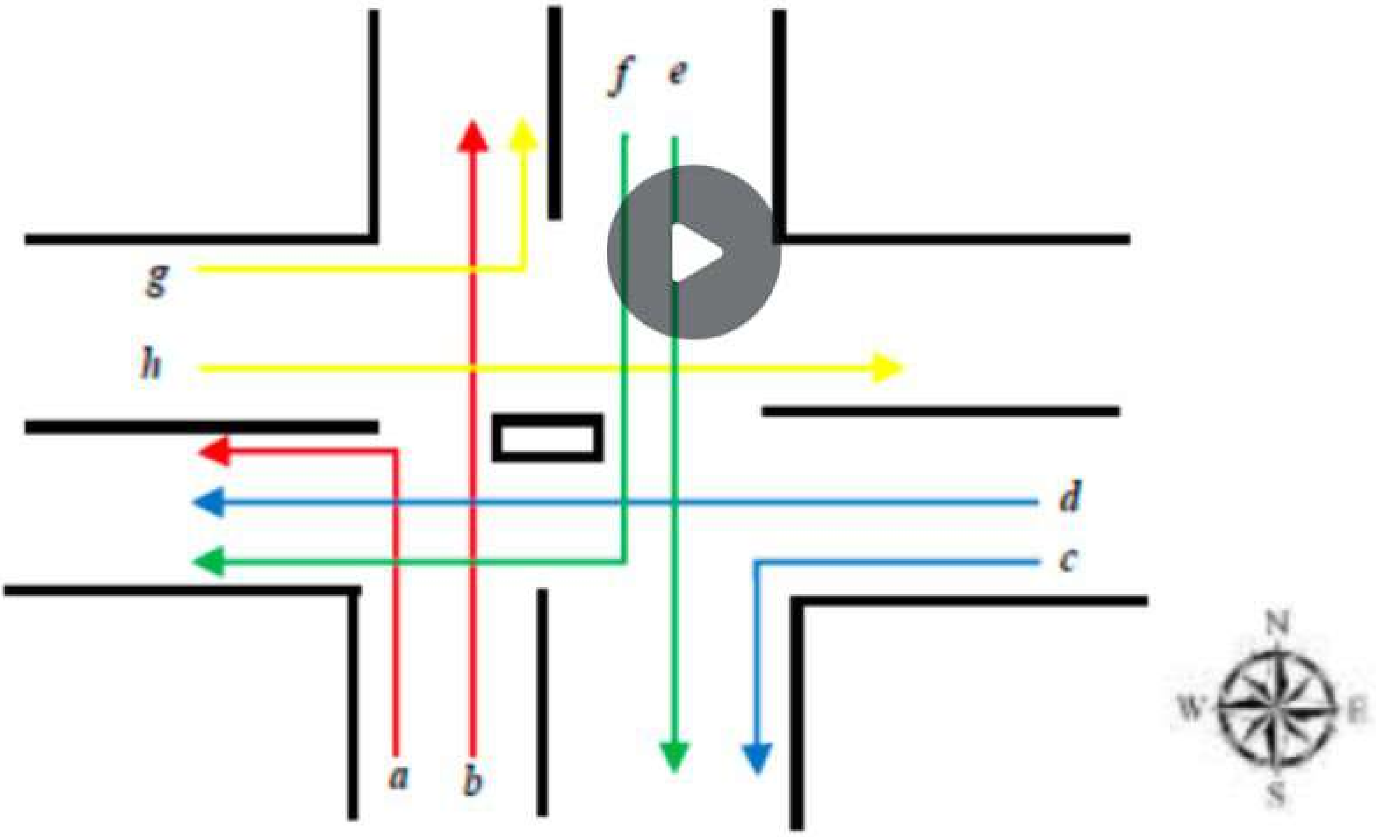
Similarly Connecting the nodes which can flow simultaneously, we get the following Graph :-



Graph representing the traffic flow system

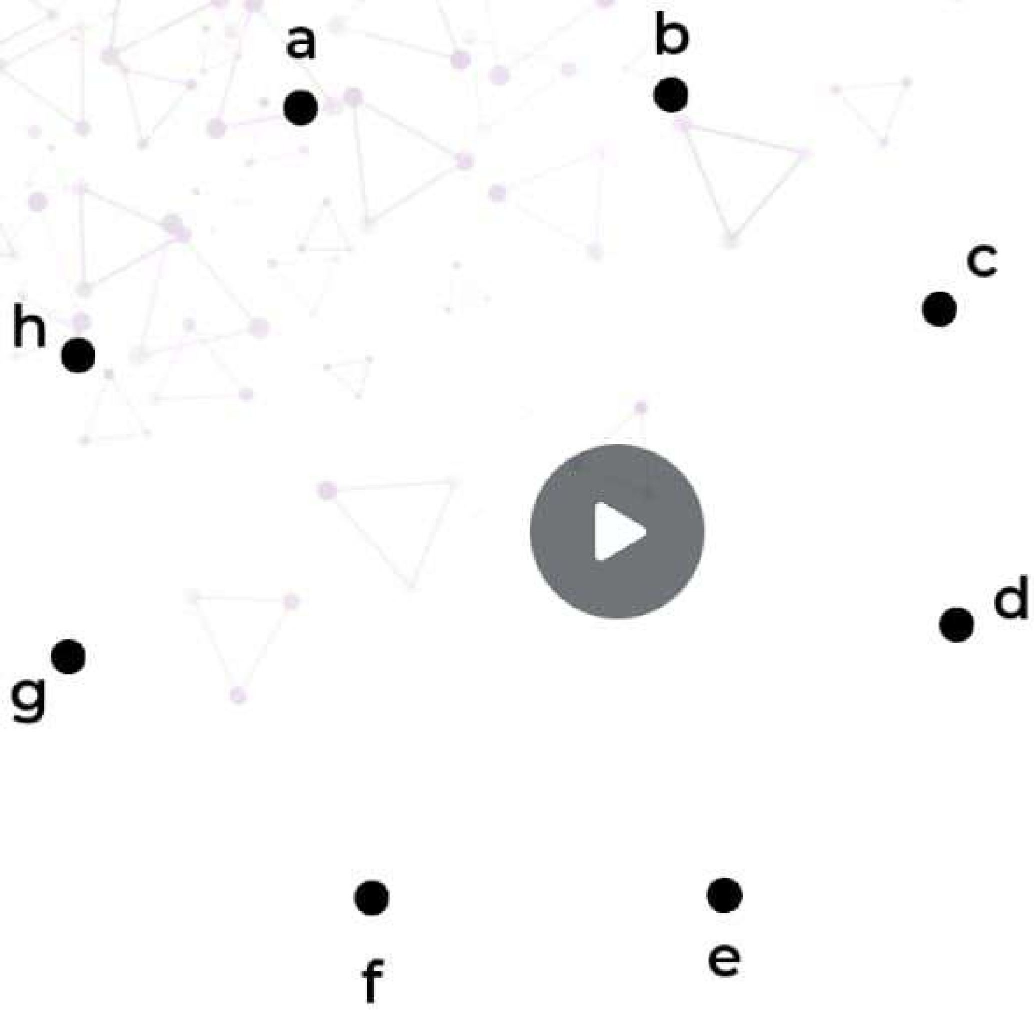
GRAPHICAL REPRESENTATION

Let us have a Crossroad in which the different flows of the traffic are represented by {a,b,c,d,e,f,g,h} :-



Flow Diagram

Now, let us have a Graph in which there are 8 Nodes representing all the 8 traffic flows{a,b,c,d,e,f,g,h} :-



Graph representing the traffic flow system

INTRODUCTION

In any city, traffic management is one of the most important tasks to perform. The management of the traffic ensures the smooth functioning of the city . Traffic signals are one of the equipments that regulate the traffic flow. They play an important role on the impact of traffic. If the traffic light arrangements are not optimal, then not only it will effect traffic order, but can also lead to accident.

These lights instructs the driver that one to stop the car and when to drive, they are designed in such a way that the movement of one group of vehicles will not interfere with the existing group. However, i reality we see that their is more vehicle volume at specific crossroads rather than the congested roads. This is because the traffic light system is less efficient.

The Traffic light system doesn't focus on maximum number of vehicles that can move simultaneously. The answer to this question can be found out using a very important branch of Discrete Mathematics: Graph Theory. We can make a Graph in which the nodes represent the flow of a particular traffic and edge represent the two flows which are compatible with each other. We can call two particular flows compatible on a crossroad if they can move simultaneously without interacting each other.

INDEX :-

GRAPH THEORY

According to the Graph Theory, Graph G = (V(G),E(G)) is a set of ordered pairs V(G) and E(G) where:

1. V(G) = A non empty finite set of points called Nodes.
2. E(G) = A finite (can be empty) set of lines (known as edges) which connects any two Nodes.

Types of Graphs:-

- **Complete Graphs** - A complete graph with n vertices (denoted by Kn), is a simple undirected graph in which every pair of distinct vertices is connected by a unique edge.

- **Null Graphs** - A graph with no edges is called a Null Graph.

- **Section Graphs** - LetG=(V(G), E(G)) be a graph. Graph H=(V(H), E(H)) is called a section graph G, written as $H \subseteq G$, if $V(H) \subseteq V(G)$ and $E(H) \subseteq E(G)$. If $H \subseteq G$ and V(H)=V(G), then H is called the graph of the range section G, moreover if H is a complete piece of graph G, then H refers to a clique on G.

- **Bipartite Graphs** - A graph in which the vertices can be divided into two disjoint sets such that every edge connects a vertex in one set to a vertex in the other set.

PROJECT CS101

COMPATIBLE GRAPH MODEL OF TRAFFIC PROBLEM AT THE CROSSROADS

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Thank you!