HOCHSCHULE SRH HEIDELBERG

CHINESE POSTMAN PROBLEM

Group II : Team 4

15 OCTOBER 2019

Under the guidance of **Prof Dr. Dejan. E. Lazich**

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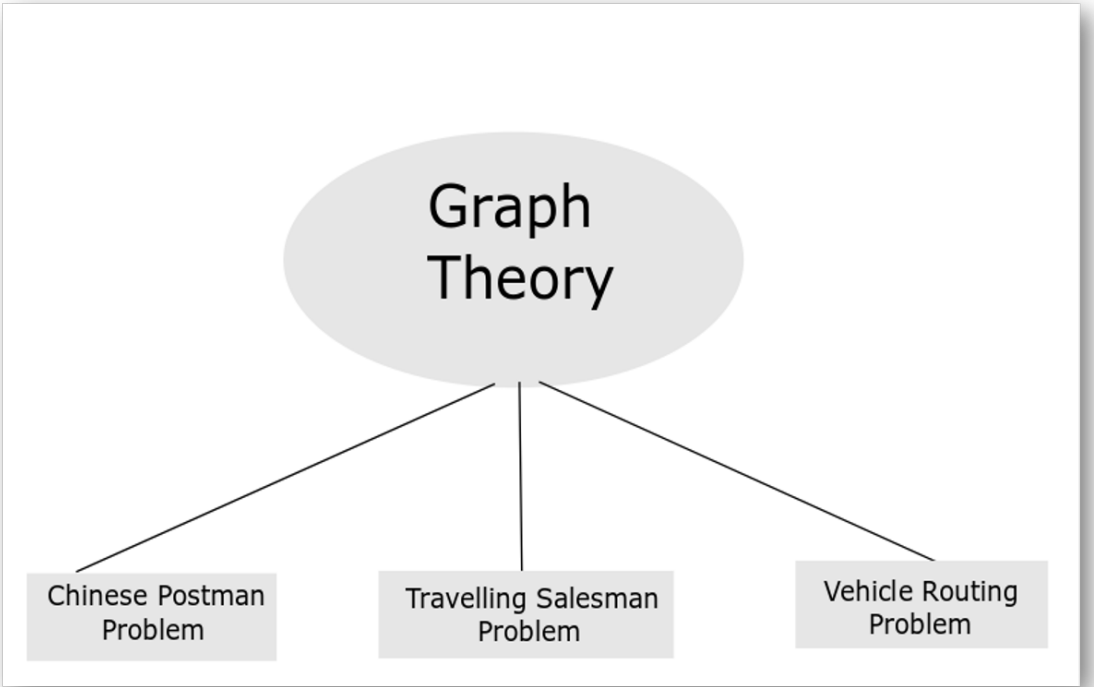
CONTENTS

INTRODUCTION

GRAPH THEORY:

- Graph symbolic representation of a network and connectivity.
- It Includes Edges and Vertices.
- Vertices with the points in a plane is node.
- Line connecting nodes is an edge.
- Order of the graph = number of vertices in it.
- Find the Eulerian trail containing every route.
- **LEONHARD EULAR**- Father of Graph Theory (Konigsberg Bridge Problem).


Graph Theory
Chinese Postman Problem
Travelling Salesman Problem
Vehicle Routing Problem

INTRODUCTION

- Postman Tour or Route Inspection Problem.
- Postman's job to deliver mails with shortest possible path.
- Vertices with the points in a plane is node.
- Mei-Ko Kwan (1962), developed the first algorithm to solve this.
- **Condition:** must pass each street and return to origin.
- Route should be Eulerian Trail.
- Edges and nodes represent streets and intersections.
- A traversable graph is one that can be drawn without taking a pen from the paper and without retracing the same edge. In such a case the graph is said to have a Eulerian trail.

ALGORITHM

- **Step 1:** Find all the nodes of odd order.
- **Step 2:** List possible pairing of odd vertices.
- **Step 3:** For each pairing of odd nodes find the connecting path of minimum weight.
- **Step 4:** Choose the routes with shortest distance.
- **Step 5:** Duplicate this path on the original graph.
- **Step 6:** Find the Eulerian trail containing every route.
- **Step 7:** Find the route with minimum weight.

So let's Understand it with an Example

Campus Rally

Finding the most efficient way to complete the Rally efficiently!!!!

Notations for representation of the college Map

A - Blue tower

B - Tram Station

C – Kurfplaz Café

D – Sports

E – Library

F – BS9

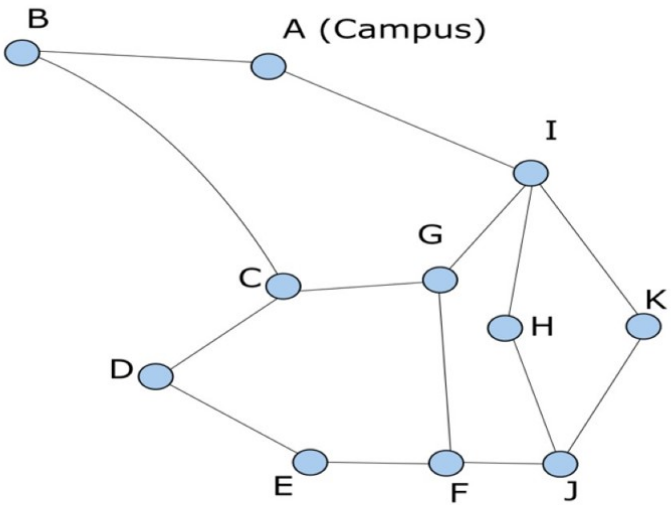
G – Cube

H – BS11

I – MPS3

J – BS13

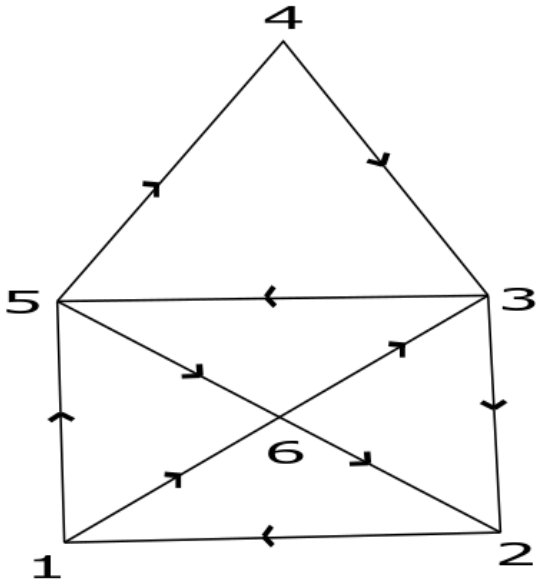
K – Bus stop



- Euler found that the **order of the vertices** determines whether or not a graph is traversable.

- If it is possible to traverse a graph starting and finishing at the same point then the graph has an **Eulerian trail**.

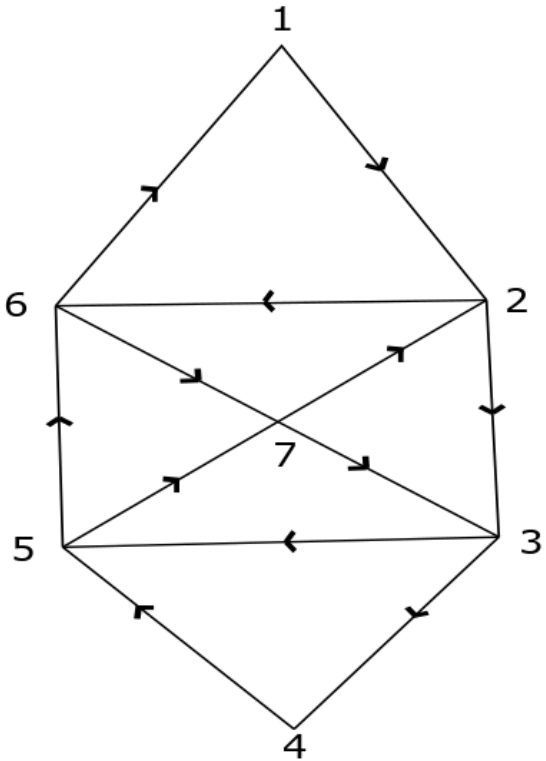
- If it is possible to traverse a graph starting at one point and finishing at a different point then the graph has a **Semi Eulerian trail**.



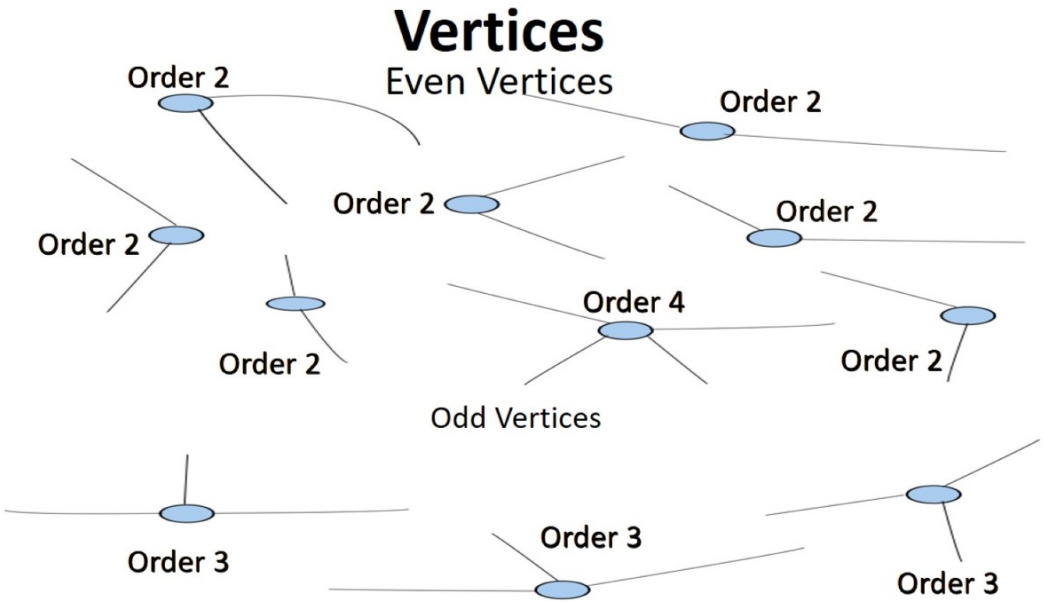
Semi Eulerian Path

Path to be followed:- 1-5-4-3-5-6-2-1-3-2

It is not possible to end the tracing of path at node where it begin



Eulirean Trail


Vertices
Even Vertices
Order 2
Order 2
Order 2
Order 2
Order 2
Order 2
Order 4
Order 2
Odd Vertices
Order 3
Order 3
Order 3

Vertices of the map

A – Order 2

B – Order 2

C – Order 3

D – Order 2

E – Order 2

F – Order 3

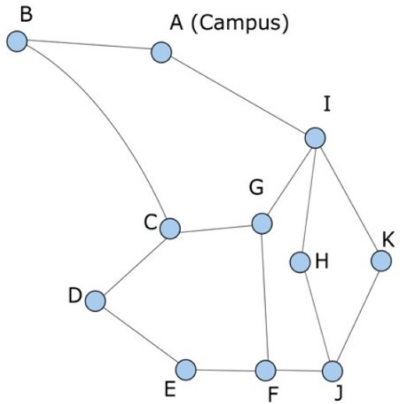
G – Order 3

H – Order 2

I – Order 4

J – Order 3

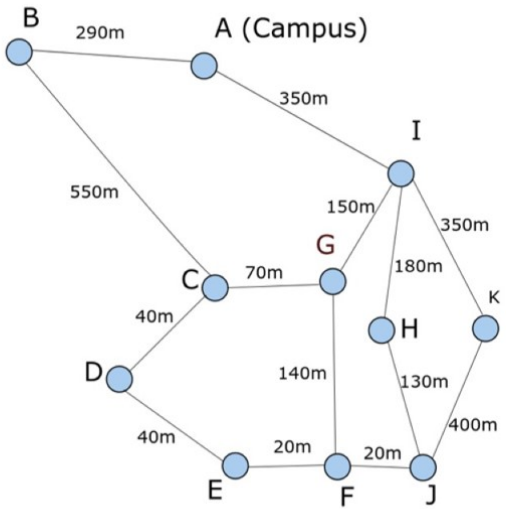
K – Order 2



The odd vertices in the map are C, F, G, J

Possible to solve with odd vertices??

Semi-Eulerian



In B-A-I-G-C-B (CLOSED PATH)

red line- shortest to reach 'C'

In D-C-G-F-E-D PATH

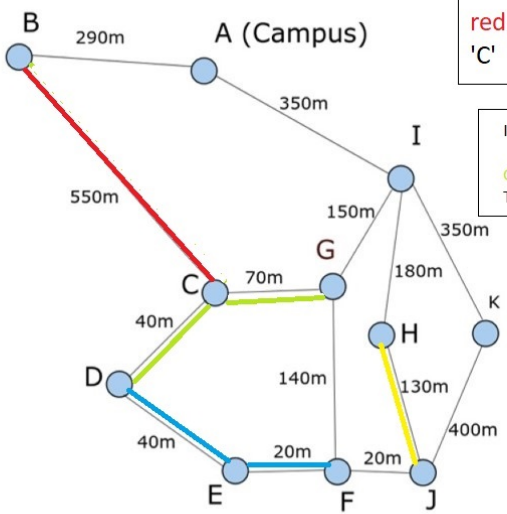
BLUE LINE- SHORTEST TO REACH'F'

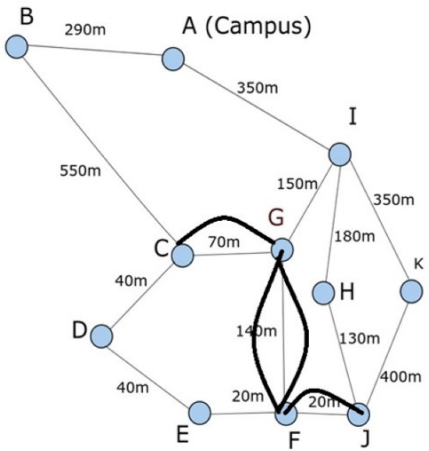
In D-C-G-F-E-D PATH

GREEN LINE- SHORTEST TO REACH 'G'

IN H-J-F-G-I-H PATH

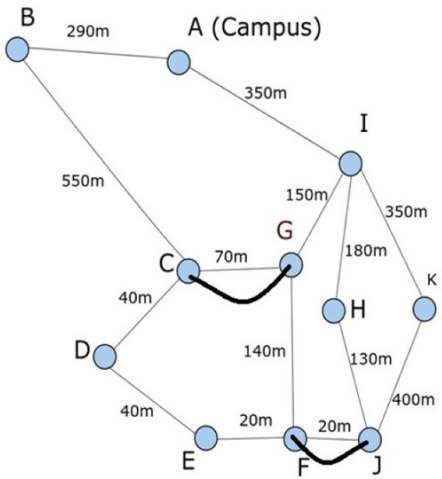
YELLOW LINE - SHORTEST TO REACH 'J'





Possible path:

B-A-I-K-J-H-I-G-C-G-F-G-F-J-F-E-D-C-B



Possible path:

B-A-I-K-J-H-I-G-C-G-F-J-F-E-D-C-B

REAL TIME APPLICATIONS

- Chinese Postman Problem (CPP) are concerned with routing in a more general way, as in planing snow ploughs or street maintenance
- More widely used in network algorithm checking.
- mobile robot exploration problem, where a robot has to explore a network by exploring every edge and vertex of the network before it knows the entire map.
- Easier method to check the functionality.
- Finding a maximum cut in a planar graph and a minimum-mean length circuit in an undirected graph.
- A route around a website (or other multimedia resource) that exercises. every link, with minimal effort. Benjamin Franklin's House website has 1121 links.(2248 steps to 250 steps).

KEY POINT SUMMARY

- **A traversable** graph is one that can be drawn without taking a pen from the paper and without retracing the same edge. In such a case the graph is said to have an **Eulerian trail**.
- An **Eulerian trail** uses all the edges of a graph. For a graph to be Eulerian all the vertices must be of even order.
- If a graph has two odd vertices then the graph is said to be **semi-Eulerian**. A trail can be drawn starting at one of the odd vertices and finishing at the other odd vertex.
- A minimum Chinese postman route requires each edge to be walked along at least once and in addition the least pairings of odd vertices must be walked along on one extra occasion.

CONCLUSION

- As illustrated by the example, The algorithm provides an optimal solution.
- The proof is straight forward. However, it is perhaps more realistic, not to insist on traversing the minimal length.
- For various ratios between the costs assigned, we would in general get different optimal solutions to the optimization problem.
- For example, the solutions found here are valid for the case, where the cost of additional edges traversed is much bigger that the cost of delays
- More detailed study of various cost functions may be an interesting topic for future research.

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Any Questions?

Thank You