Assigning altitude levels to flyovers

- Tejaswani Narla

Plan for the talk

- Real World Problem Description
- Constructing a graph from the problem
- Graph Problem Description
- Introduction to Permutation Graphs
- Special Properties of the Graph
- Solution to resolve the problem

Real World Problem Description

There are junctions or intersections where many routes intersect having high traffic and lot of time delay due to long wait at the signals.

To avoid these signals, flyovers are chosen as the best path moving forward with minimum stops.

There are cases where there is a need of complex flyovers having many intersections to traverse to the destinations.

Real World Problem Description

- Here we are discussing about a junction where many routes intersect and we need to suggest a better approach for construction of complex flyover.
- Routes are connecting various X areas with various Y areas, all routes being utilized by the vehicles and these intersections represent those traffic signals where there is always a long wait to cross them.
- Our mission here is to assign levels to complex flyovers to create non-stop routes, minimizing traffic signals and avoid time delays.
- We have two collections of areas on two parallel lines and considering only few routes where there is high traffic and are intersecting

Constructing a Graph

- The collection of areas are given below

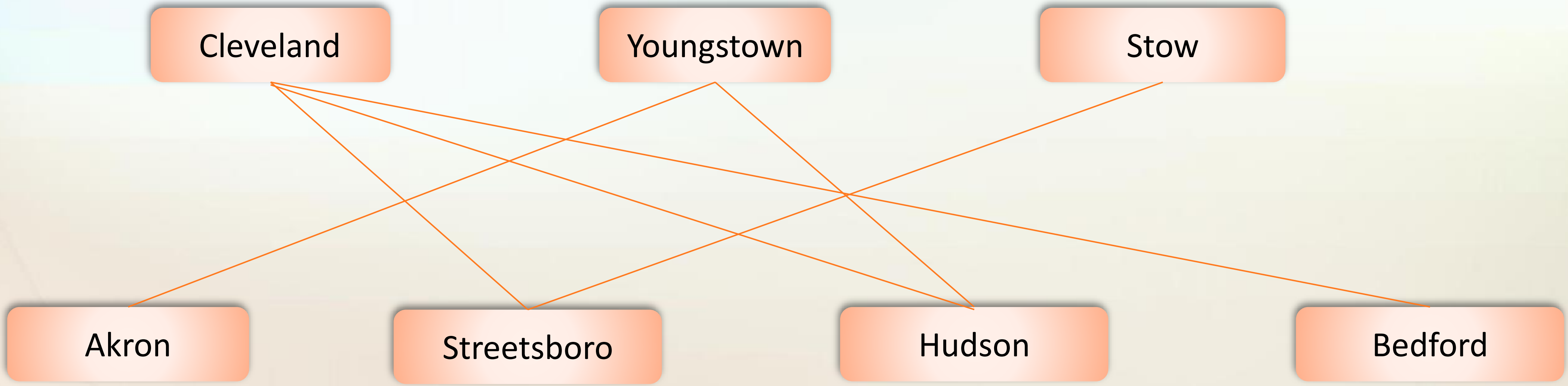
X - areas	Y – areas
Cleveland	Akron
Youngstown	Streetsboro
Stow	Hudson
	Bedford

Constructing a Graph

- By the above data, we can provide a bipartite graph.
- We number the route paths by traversing the areas.
- From this we can extract a matching diagram or draw a corresponding permutation graph.
- While depicting the problem, areas are taken as vertices and routes are taken as edges.

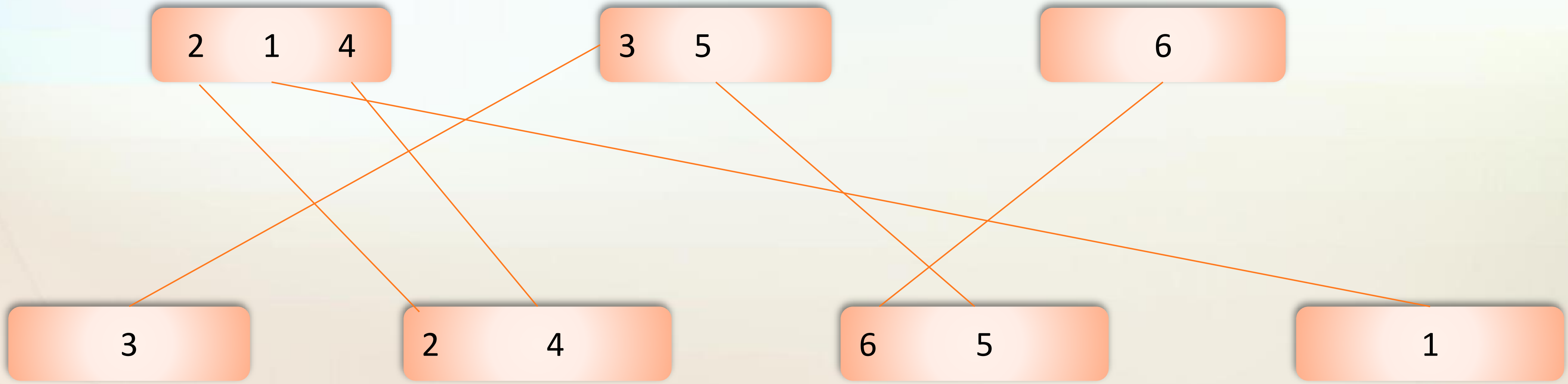
Depicting the Graph Problem

- The matching diagram for the data is given below:



Depicting the Graph Problem

- The matching diagram for the data is given below:
- Here, each route is assigned with a number.

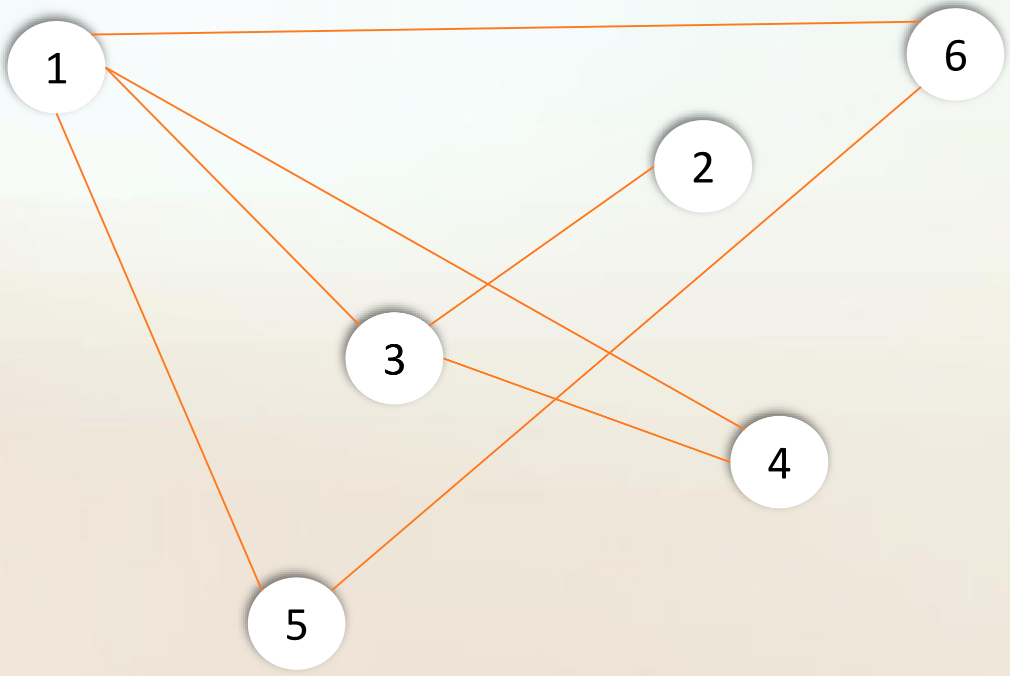


Introduction to Permutation Graphs

- A graph is a permutation graph if and only if it has an intersection model consisting of straight lines (one per vertex) between two parallels.
- Permutation graphs can also be defined as the intersection graphs of line segments whose end points lie on two parallel lines.

Graphical Representation

- The permutation graph for the matching diagram can be shown below:
- Routes are taken as vertices and if there are any intersections among the routes they are taken as edges.



Special Properties

- If a given graph G is a permutation graph and reversing the order of graph G gives us it’s complement. The complement is also a permutation graph.
- Permutation graphs are transitively orientable.
- Permutation graphs are perfect.
- A graph G is a permutation graph if and only if both G and it’s complement G’ are comparability graphs.

Special Properties

- A given graph G is a permutation graph if and only if it is a comparability graph of a partially ordered set that has order dimension at most two.
- A graph G is a bipartite permutation graph if it is both bipartite and permutation graph

Solution to the Graph

- We provide the coloring concept to solve the permutations graph by giving proper coloring to the vertices of the graph.

- This application can be viewed as coloring problem where we can set distinct colors to set distinct altitudes or levels.

- Assigning levels to flyovers so that intersecting paths receive different levels that is equivalent to coloring the vertices of the graph so that adjacent vertices receive different colors.

Solution to the Graph

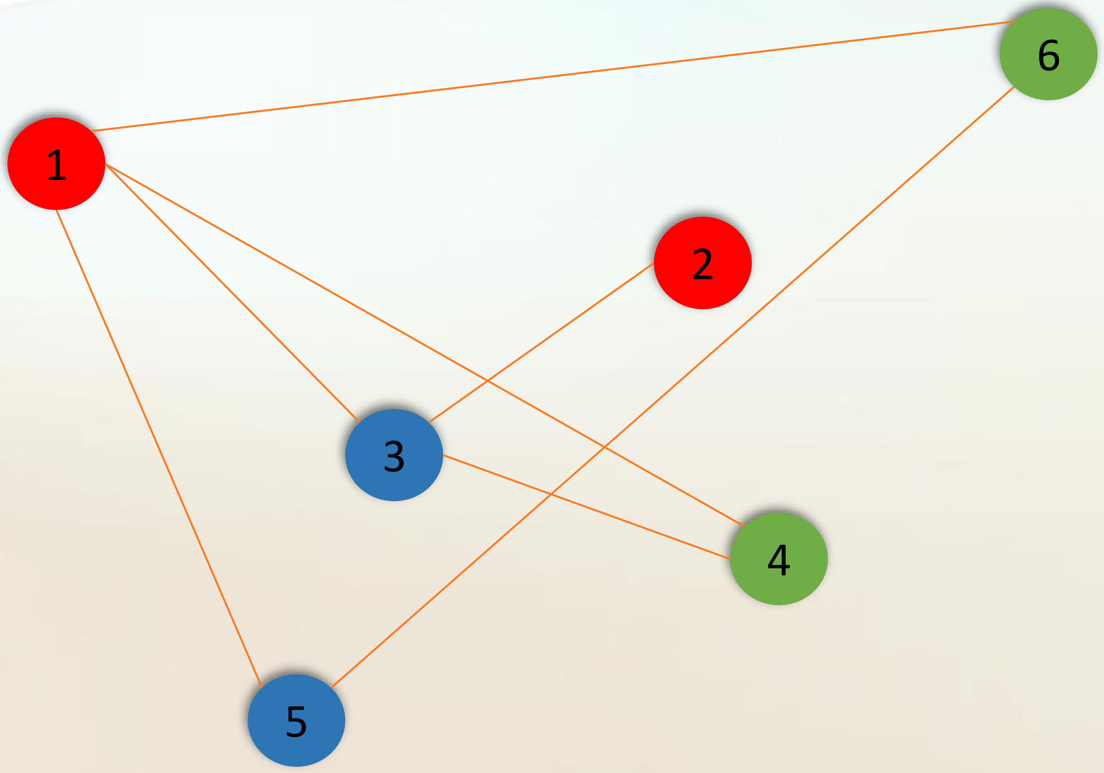
- Coloring of graph G=(V,E) is an assignment of colors to it's vertices so that no two adjacent vertices have the same color
- The coloring problem is to color the graph G with k colors.
- The number k is called the chromatic number of G denoted by $\chi(G)$.

Solution to the Graph

- The coloring of each vertex of the graph is shown which solves the altitude problem for flyovers.
- The coloring is done in such a way that no two adjacent vertices have the same color which implies that no two intersecting flyovers have same altitudes
- We are using minimum number of colors to solve the problem.

Solution to the Graph

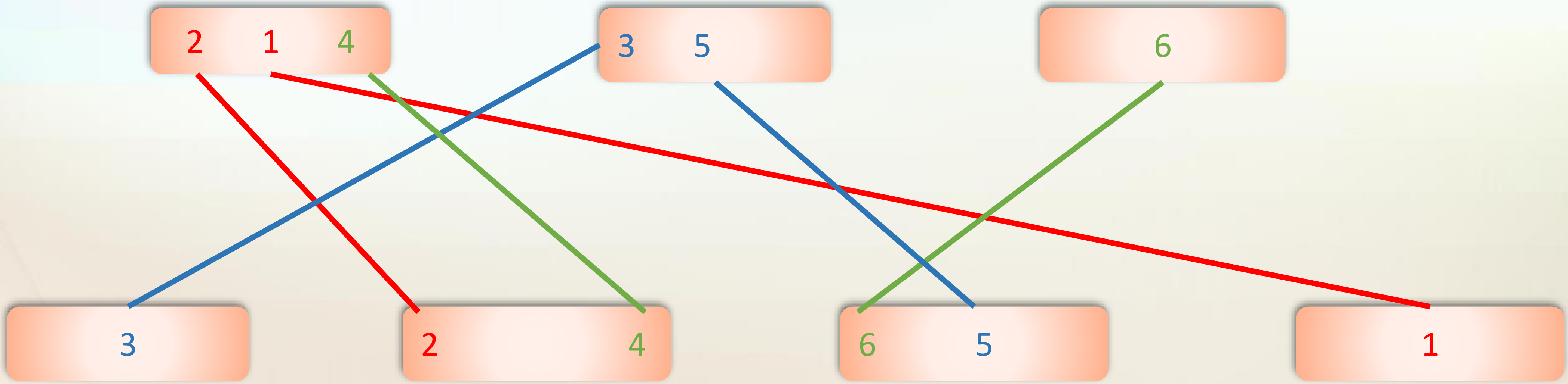
- The coloring solution for the obtained graph can be shown below:



Solution to the Problem

- The final solution to the problem using graph coloring:

Three different colors represent three different levels of the flyover



References

Wikipedia :

https://en.wikipedia.org/wiki/Permutation_graph

Permutation graphs and applications:
http://www.slideshare.net/Tanzalratier/permutation-graphsandapplications

Graph theory:

http://www.cse.iitd.ac.in/~naveen/courses/CSL851/arpit.pdf

THANK YOU!!!