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Applications of Graph Theory in Real Life Problems –A Review

Shakera Tanveer

Department of Mathematics, Government First Grade College, Sedam-585222 Dist. Kalaburagi, Karnataka

ABSTRACT

This paper presents the graph theory applications in real life problems.The conceptslike coloringof Graphs, Eulerian graph, Hamiltonian path etc. are used in modelling for awide variety of scheduling and assignment problems. Graph coloring and chromatic number has several applications in scheduling, timetabling andscheduling of final examinations of universities and colleges. This article providesa review with few examples of real life situations in terms of graphs, finallyit is concluded that graph theory can be applied for solving and finding the solutions too many real life problems in an effective way.

Key Words: Graph theory, Graph Coloring, Chromatic Number, Eulerian Graph, Hamiltonian path.

INTRODUCTION

In the year 1736, when considering the Konigsberg Bridge problem, is there a walk which crosses all seven Konigsberg's bridges exactly once?Euler demonstrated that it is impossible to walk through all of the Kongsberg bridges exactly once and then return to the starting point.From that point forward, the concept of the Eulerian cycle was introduced.In 1857, Hamilton invented a game based on the dodecahedron graph.This game introduces the concept of Hamiltonian graphs, which has many applications for finding the shortest paths between cities, i.e. the travelling salesman problem.Given that the four-color problem was invented, it took a century and finally the two American mathematicians, Kenneth Appel and Wolfgang Haken have solved it. In 1913, H. Dudeney mentioned a puzzle problem.Caley studied particular analytical forms from differential calculus to study the trees. This had many implications in theoretical chemistry. This lead to the invention of enumerative graph theory [12].Many researchers in computer science and engineering have investigated the applications of graph theory [2, 3, 4 & 9].Graph Theory has numerous applications in real-world problems [1, 5& 12].This paper presents a few real-life problems, which are listed below:

APPLICATIONS OF GRAPH THEORY IN REAL LIFE PROBEMS

1. The Internet:
The internet itself is the biggest graph in day today life. There are different web search engines available like Google, Yahoo, and Bing etc. Since these pages and websites are linked by a graph which may help to rank these search engines to bring out the best results for the user.

2. Social Networks:
Through social media, we can connect with our friends. In a friendship graph, a user is a vertex, while other users who are connected to them create edges.It is typical to want to study a society by looking at the structure of its connections in sociology, economics, political science, medicine, social biology, psychology, anthropology, history, and other related fields.This could be a network of Facebook or college friends, community support networks, or political/business connections.

The relationship between factors like information flow, wealth flow, or shared opinions and the network structure, as well as who has the most influence, are some fundamental questions for these kinds of networks.In medicine, physical examination is a common practice. In medicine, modelling and prevention of disease and physical contact networks are frequently of interest.

How we gather the data to identify these networks, or, if that is not possible, how we model these networks, are in some ways even more fundamental questions.Facebook unveiled Facebook Graph Search in March 2013, a cutting-edge semantic search engine.All search engines typically return results in the form of a list of links, but Facebook Graph Search instead provides natural language results.Users can access both specific search results and big data compiled from its more than two billion users thanks to the graph search feature in the Facebook Graph Search engine.

3. Graph Theory in Pandemic situations like Covid-19:
It is very interesting to apply graph theory in fighting corona virus by tracking the spread of the virus by modelling the available data into a directed graph by considering the infected person as a node and the directed edge helps us to identify from whom the person has contracted the disease. Millions of lives can be saved by breaking the chain of the graph (i.e disconnecting the graph) by avoiding the further contracts and quarantine the infected persons.

4. GPS Navigation or Google Maps:
The purpose of GPS or Google Maps is used to find the shortest path from one location to another. Vertices represent the goals, and Edges represent the distance between them. The software limits the best routes possible. Schools and colleges are also utilizing this proficiency to transport students from one location to another in a short duration and the same is used by many individuals in a new city for finding the routes in a limited time. Each stop is a vertex, and the path is an edge. The efficiency of including every vertex in the route is demonstrated by a Hamiltonian path.

5. Traffic Control Signals:
The traffic control problem can be studied at any given intersection, it must be mathematically modelled using a simple graph for the traffic accumulation data problem [10, 11]. The rudimentary graph's set of edges will represent the communication link between the set of nodes at an intersection. The graph signifies the traffic control problem; the traffic streams that moves at the same time at an intersection with no difference are joined by an edge, while the streams that cannot move together are not connected by an edge.The operation of traffic lights, such as the turning of Green/Red/Yellow lights and the timing between them.The vertex coloring technique is used here to solve time and space paradoxes by determining the chromatic number for the number of cycles required.

6. Road blockageclear:
When the roads in a city are closed due to ice. Road salting necessitates forethought. The streets are then traversed in the most efficient way possible using Euler paths or circuits[1].

7. Traveling Salesman Problem (TSP):-
TSP is a very familiar problem based on the Hamilton cycle.The problem statement is as follows: Considering the set of cities and the cost of travelling from one city to another, find the cheapest round-trip route that visits each city exactly once and come back to the starting point[1].In graph terminology, the travelling salesman problem is almost trying to find the Hamilton cycle with the least weight, where the vertices of the graph represent cities and the edges represent the cost of travelling between the connected cities (adjacent vertices).

8. The matching problem:
The concept of bipartite graph can be applied for assignment problems like assigning n jobs to memployees (servers), chairs to desks and also to assign n subjects to m teachers etc.

9. Timetable scheduling:
Every university or college faces problems while preparing the timetable for exams or for conducting classes in every semester that is one of the major issues is allocating classes and subjects to teachers due the large number of students and the large number of courses offered to the students.Graph theory is very important for solving this problem.The concept of graph coloring approach can be applied to solve such problems. For solving this problem we assign total subjects as vertices and connect each subject to every semester depending upon the subjects that appear in that particular semester and construct a graph and then construct the adjacency matrix of that graph. If two subjects are adjacent then that row should be assigned one color and if they are not adjacent then same color can be assigned to it. By finding the chromatic number the minimum slots can be assigned.

10. Solving Sudoku Puzzle:
A classic game of numbers to train the brain of the students and increase their logical ability, the concept of coloring of a graph can be used to solve the Sudoku puzzle of 9×9 grid puzzle by dividing them into 3×3 grids within a short span of time.

CONCLUSION

The objective of this paper is to present the significance of graph theoretic concepts in everyday problems and a review is articulated to highlight the graph theory notions and also it is beneficial for researchers gain an understanding of graph theory and its practical applications in different day today life and areas such as Network Theory, Computer Science, Operation Research etc. to have a connection with their area of research [6, 7, 8& 9]. There are many problems in modern life that are unresolved and need to be studied in order to find optimised solutions in a very short amount of time with the help of fundamental ideas in graph theory for the specific circumstances and the proper application of the right algorithm as needed.

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