Applications of Graph Theory

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Abstract- Numerous fields rely heavily on the field of mathematics. Graph theory is a significant topic of mathematics that is utilized in model structures. The structural adjustments made to various things or technologies lead to new discoveries and changes made to the environment to promote advancement in such sectors. The Konigsberg Bridge Problem in 1735 served as the impetus for the development of the area of graph theory. This paper provides a general introduction of graph theory's applicability in a variety of domains, but it primarily concentrates on computer science applications that make use of these notions. An overview has been provided here of a number of publications on graph theory that have looked at scheduling ideas and computer science applications.

Keywords- Geometric spanner, Median graph, Bipartite graph.

Introduction- Applications in the computer sciences make extensive use of graph theoretical concepts. Especially in computer science study fields including data mining, picture segmentation, clustering, image capture, networking, etc. For instance, a tree-like data structure that made use of vertices and edges could be created. Similar to this, graph ideas can be used to model network topologies. The most crucial aspect of graph colouring is also used in setting up resource allocation. In addition, the graph theory's pathways, walks, and circuits have many wonderful applications, such as the travelling salesman issue, ideas for designing databases, and resource networking. This results in the creation of novel theorems and algorithms that have a wide range of useful applications.

There are two sections in this article. The historical context of graph theory and various setup-related applications are provided in the first section I. The second section focuses on the use of

History- In 1735, the Koinsber Bridge problem marked the beginning of graph theory. In order to solve the Koinsberg bridge puzzle, Euler researched the issue and created what is now known as an Eulerian graph. In 1840, A.F. Mobius introduced the concepts of the complete graph and bipartite graph, and Kuratowski demonstrated their planarity using amusing puzzles. Gustav Kirchhoff introduced the idea of a "tree," which is a linked graph devoid of cycles, in 1845. He used graph theoretical concepts to compute the currents in electrical networks or circuits. Thomas Gutherie discovered the renowned four-color issue in 1852. Thomas P. Kirkman and William R. Hamilton developed the idea of the Hamiltonian graph in 1856 while researching cycles on polyhydra and journeys that visited specific locations exactly once. H.Dudeney mentioned a puzzling issue in 1913. The four colour dilemma was created, but it took Kenneth Appel and Wolfgang Haken a century to solve it. Caley used specific differential

calculus analytical forms to investigate the trees. This had a lot of theoretical chemistry implications. As a result, enumerative graph theory was developed. Sylvester first used the term "Graph" in 1878, when he compared "Quantic invariants" to the covariant of algebra and molecular diagrams. In 1941, Ramsey's work on colorations helped to identify the extremely graph theory subfield of graph theory. Heinrich used computers to solve the four-color conundrum in 1969. Random graph theory was developed through the investigation of asymptotic graph connectedness.

Applications:

Concepts from graph theory are frequently utilized to investigate and model a wide range of applications in numerous fields.

1. Molecular science study.
2. Creating bonds in chemistry and learning about atoms
3. Sociology makes use of graph theory
4. Biology makes advantage of it
5. Operations Research frequently makes use of principles from graph theory.
6. It is also utilised in the simulation of games, activity networks, and transit networks.
7. Computational biochemistry makes advantage of it.

Briefly stated, graph theory is a burgeoning field that has a distinctive influence in many different areas. The applications of graph theory, particularly in computer science, are examined in the next section.

Algorithms and graph theory:

The development of graph algorithms is the most significant function of graph theory in computer applications. Graph-based models of problems are solved using a variety of algorithms. These algorithms are used to address the theoretical issues with graphs that the intern utilised to address the relevant computer science application issues.

Some algorithms are as follows:

1. Shortest path algorithm in a network
2. Finding graph planarity
3. Finding a minimum spanning tree
4. Algorithms to find adjacency matrices.
5. Algorithms to find the cycles in a graph
6. Algorithms to find the connectedness
7. Algorithms for searching an element in a data structure (DFS, BFS) and so on.

Use of graph enumeration techniques- The computerised chemical identification is identified using a process called graph enumeration. Based on the provided chemical formula and the valence criteria for every new substance, a list of all distinct chemical structures will be produced. DENDRAL is a computer language that has been created to automatically identify chemical compounds.

Graph Theory in OR- A very useful and natural tool in combinatorial operations research is graph theory. Here are a few significant OR issues that can be resolved with graphs. A network called the transport network uses a graph to simulate the movement of goods from one location to another. The goal is to increase flow or reduce cost while maintaining the required flow. Despite the fact that these problems have additional restrictions, the graph theoretic method is proven to be more effective.

Graph Coloring- One of the most important ideas in graph theory is graph colouring, which has numerous practical uses in computer science. There are numerous colouring techniques that can be employed as needed. The vertices and edges of a graph should be coloured with the fewest possible colours so that no two vertices have the same colour. The term "correctly coloured graph" refers to a graph that has the proper number of colours, which is known as the chromatic number.

List coloring- In the list colouring problem, each vertex (V) has a list of colours that are currently available, and we must find a colouring where each vertex's colour is selected from the list of colours. This list colouring can be used to simulate scenarios where a work can only be executed during specific times or by specific computers.

This section examines graph applications, particularly those related to computer science. Graph theory concepts are used in many computer-related applications.

Application examples:

1. GSM mobile phone networks and map colour.

2. The graph algorithm for secure computer networks.

3. Ad-hoc network-related graph theory

4. A fault-tolerant computing system graph model

5. The ideal single loop k-FT system.

6. Automatic channel allocation for small wireless local area networks using graph coloring algorithm approach

7. Clustering of web documents using graph model

8. Modeling sensor networks as graph.

Conclusion:

This paper's primary goal is to highlight the value of graph theoretical notions in diverse computing applications so that researchers might use these ideas in their own work. The idea of graph theory is projected specifically through the presentation of an overview. In each publication, the graph theory component is therefore given more weight than the other sections. Researchers may learn more about graph theory and its uses in the computer industry, as well as gain insight into potential directions for their own study.

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