

Some Useful Application of Graph Theory in Science and Our Daily Life

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Abstract: - Mathematics have many important branches, Graph theory is one of them whose application's are useful in mathematics as well as in other branches of Science. It plays an important role in our daily life. In this chapter we have discussed some important application of Graph Theory in our daily life and in many other branches of Science such as Chemistry, Physics, Computer Science, Operational research, Engineering, Internet etc.

Keywords: - Network, Path, Graph, Eulerian graph.

1. Introduction

In the first part of this article, we discuss the some important definitions of Graph theory which are helpful to studying this part of mathematics. Also studying the history and origin of Graph theory. Graph theory is a branch of discrete mathematics. Graph theory is the study of graphs which are mathematical structures used to find the relation between objects. A graph is made up of vertices V (nodes) and edges E (lines) that connect them. A graph is an ordered pair $G=(V,E)$ containing a set of vertices V with a set of edges E . Graph theory is oriented on the main problem of Konigsbergbridge in 1735. This problem escort to the concept of Eulerian Graph. Euler studied the problem of Konigsbergbridge and established a structure to solve the problem which is called Eulerian graph. Euler introduced a new branch of mathematics namely Graph Theory. In 1840, A.F. Mobius gives an idea of complete graph and bipartite graph. In 1845 Gustav Kirchhoff introduced the concept of tree and he applied the concept of tree in calculation of currents in electric circuits. In 1852, Thomas Guthrie found the famous four color problem. Then in 1856, P. Kirk man and William R Hamilton studied the cycles of polyhydric and established the concept of Hamiltonian graph. After this the four color problem was invented and was solved after a century by Kenneth Apple and Wolfgang Haken in 1976. This was the first major problem to be solved by using computer. The word Graph was used by Sylvester in 1878. In this way the Graph theory was developed.

2. Preliminaries

In this part we gives some important definition's which are used in Graph theory:-

- 2.1- A graph G is defined by the set of V and E as (V,E) Where the elements of the set V are called Vertices of graph G and the elements of the set E are called edges of Graph G .
- 2.2- A Walk on a Graph is a finite alternating sequence of vertices and edges, beginning and ending with vertices such that each edge is incident to its preceding and following vertices. Length of a walk is given by the number of edges in the walk.
- 2.3- A trail is a walk in which all edges are different.
- 2.4- A path is an open walk in which no vertex appears twice or more
- 2.5- A Simple path in a graph G is called Euler Path if it visits every edge of graph exactly once.
- 2.6- A circuit is a path which ends at the same vertex where it begins.
- 2.7- A Graph which contains either Euler path or Euler circuit is called Eulerian Graph.
- 2.8- A path which contains each vertex of graph exactly once is called Hamiltonian path.
- 2.9- A circuit that contains each vertex of graph exactly once except for the first and the last vertex is called Hamiltonian circuit.
- 2.10- A graph which contains either Hamiltonian circuit or Hamiltonian path is called Hamiltonian graph.

3. Some Important applications of Graph theory

Some ideas and concepts of Graph theory are very useful in many branches of science some applications of Graph theory are very useful in our daily life. Here we are going to discuss some applications of graph theory in different branches of science and our daily life.

3.1- Applications in GPS or Google maps

Now a day Google map is a very useful tool for travelling anywhere in the world. With the help of Google map we can find the shortest route from one place to another place. In this we can consider the places as vertices of graph and the routes are the edges.

3.2- Applications in Physics

Graph theory is also used in the field of physics; Generally, Graph theory concepts are very helpful in making different electric circuits. The current voltage and resistance on a circuit is drawn by using Graph theory concept.

3.3- Application in Biology

Graph theory is very useful in many areas of Biology. Graph theory can be used in drug target identification, determining a protein's. The concepts of Graph theory can be used in studying the structures of D.N.A and R.N.A.

3.4- Application in Chemistry

Graph Theory is used for mathematical modeling of chemical phenomena in chemistry. We can make natural model of a molecule where vertices represent atoms and edges represent bond. The chemical information is associated with structural formulae and that structural formulae may be systematically and uniquely indexed and redeemed. One does translate chemical structures into words by nomenclature rules. Graph theory is also used in computational biochemistry.

3.5- Application in Computer Science and Data Mining

Graph theory plays an important role in Computer science to develop the algorithm of different programs, and using these, we can solve different theoretical problems. Some algorithms and computer languages are given below-

- a) Shortest path algorithm in a network.
- b) Finding minimum spanning tree.
- c) Finding graph planarity.
- d) Algorithms to find the connectedness.
- e) Algorithms to find the cycles in a graph.
- f) GIRL- Graph Information Retrieval Language.
- g) GTPL- Graph Theoretic Language.
- h) GASP- Graph Algorithm software Package.
- i) HINT- Extension of LISP.
- j) GRASPE- Another extension of LISP.

3.6- Application in Operation Research

Graph theory is a very useful tool in operation research. In OR some problems can be solved using graphs. In Transportation problem, when we need to minimize the transportation cost or maximizes the profit then we use the graph theory. Graph theory is also used in different assignment problems such as assigning different peoples to different jobs, manager of time table for school, college and assigning office staffs.

3.7- Application in Internet

Internet is very useful invention of modern science. The concept of graph theory is used in the working technique of internet. In case of connectivity of internet, all the users are considered as vertices and the connection between them are edges. Then all internet users form every complicated graph and data and information from one user to another user are shared through the shortest route in between them. Similarly, in case of social networking sites one friend is connected to his entire friend and his friends are also connected to others. If we consider the friends as vertices of graph and define an-edge in between them if they are friends then it will be a graph.

4- Application of Graph theory in Daily life

4.1- Traffic Lights

The functioning of traffic lights i.e. turning Green/Red and timing between them. Here vertex coloring technique is utilized to solve conflicts of time and space by identifying the chromatic number for the number of cycles needed.

4.2- To clear road blockage

When roads of a city are blocked due to ice. Planning is needed to put salt on the roads. Then Eulex paths or circuits are used to traverse the streets in the most efficient way.

4.3- The Matching Problem

In order to assign jobs to employees is an analogue in software to maximize the efficiency.

4.4- Social Network

We connected with friends via social media or a video gets viral, here user is a vertex and other connected users create an edge therefore videos get viral when reached to certain connections.

5. Conclusion

The main objective of this paper is to investigate the applications of Graph theory in different branches of science and our daily life. Here we discussed only a few application of Graph theory. There are many applications of Graph theory in different branches like economics, logistics and others. Therefore Graph theory has developed into a subject itself with variety of applications.

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