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Applications of Graph Theory in Science and Computer Science

Dr. Gurusharan Kaur[1] Dr. Namrata Tripathi[2] Dr. Mona Verma[3]
Asst. Prof.(Dept. of Computer Science/ Mathematics) Career College, Bhopal (M.P)
Asst. Prof.(Department of Mathematics) Govt. PG. College,Rajgarh (M.P)
Asst. Prof.(Department of Mathematics) Govt. PG. College, Narsinghgarh (M.P)

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ABSTRACT: Graph Theory is one of the significant and important area in Mathematics , which is used in Network Security. Cryptography is art of science to achieving security by encoding message to make it non-readable (secretive) to unintended users. Many techniques are presents to encrypt plain text and convert it to the cipher text[2]. Any cryptographic scheme is secure if and only if it is unbreakable in reasonable time, using feasible resources in spite of the intruder's being aware of the encryption and decryption algorithm and size of the key. In the proposed algorithm, adjacent matrix of graph can be used to obtain key for encryption and decryption which is safer compared to other keys.

Keywords: adjacent matrix, sparse, symmetric, asymmetric,trading graph.

I. INTRODUCTION:

Graph theory is rapidly moving into the mainstream of mathematics mainly because of its applications in diverse fields which include Biology,Electronic engineering , Communication Networks and Mathematics. The wide scope of these and other applications has been well-documented cf. **[1][6]**. The powerful combinatorial methods found in graph theory have also been used to prove significant and well-known results in a variety of areas in mathematics itself.. There are many examples of applications of graph theory to other parts of mathematics**[7]**. Graph theoretical ideas are highly utilized in Technology. Especially, in research areas ofcomputer science such data mining, image segmentation, clustering, image capturing, networking etc., For examplea data structure can be designed in the form of tree which in turn utilized vertices and edges. Similarly, modeling ofnetwork topologies can be done using graph concepts. In the same way the most important concept of graph coloringis utilized in resource allocation, scheduling. Also, paths, walks and circuits in graph theory are used in tremendousapplications say traveling salesman problem, database design concepts, resource networking. This leads to thedevelopment of new algorithms and new theorems that can be used in tremendous applications.

This paper has beendivided into two sections. First section gives the application of graph theory in Sciences. Second section emphasizes how graph theory is utilized in various technical (Computer Science)fields.

Section – I

History of Graph theory:

The origin of graph theory started with the problem of Koinsbergbridge, in 1735. This problem lead to the concept of Eulerian Graph. Euler studied the problem of Koinsberg bridge and constructed a structure to solve the problem called Eulerian graph. In 1840, A.F Mobius gave the idea of complete graph and bipartite graph andKuratowski proved that they are planar by means of recreational problems. The concept of tree, (a connected graph without cycles[10]) was implemented by Gustav Kirchhoff in 1845, and he employed graph theoretical ideas in the calculation of currents in electrical networks or circuits. In 1852, Thomas Gutherie found the famous four color problem. Then in 1856, Thomas. P. Kirkman and William R.Hamilton studied cycles on polyhydra and invented the concept called Hamiltonian graph by studying trips that visited certain sites exactly once. In 1913, H.Dudeneymentioned a puzzle problem. Eventhough the four color problem was invented it was solved only after a century by Kenneth Appel and Wolfgang Haken. This time is considered as the birth of Graph Theory.

Applications of Graph theory in Sciences :

Graph theoretical concepts are widely used in different areas.They include study of molecules, construction of bonds in chemistry and

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the study of atoms. Similarly, Graph theory is used in biology and conservation efforts where a vertex represents regions where certain species exist and the edges represent migration path or movement between the regions. This information is important when looking at breeding patterns or tracking the spread of disease, parasites and to study the impact of migration that affect other species.Graph theoretical concepts are widely used in Operations Research. For example, the traveling salesman problem,the shortest spanning tree in a weighted graph, obtaining an optimal match of jobs and men and locating the shortest path between two vertices in a graph. It is also used in modeling transport networks, activity networks and theory of games. The network activity is used to solve large number of combinatorial problems. The most popular and successful applications of networks in OR is the planning and scheduling of large complicated projects. The best well known problems are PERT(Project Evaluation Review Technique) and CPM (Critical Path Method).

Graph Theory in Chemistry:

Graph Theory is used to study molecules in chemistry, graph makes a natural model for a molecules,where vertices represent atom and edges bonds.The importance of graph theory for chemistry stemsmainly from the existence of the phenomenon of isomerism,which is rationalized by chemical structure theory. This theory accounts for all constitutional isomers by using purely graph-theoretical methods, which earlier chemists viewed as 'tricks with points and lines (valencies)".Graphs are used in the field of chemistry to model chemical compounds. In computational biochemistry some sequences of cell samples have to be excluded to resolve the conflicts between two sequences. This is modeledin the form of graph where the vertices represent the sequences in the sample. An edge will be drawn between two vertices if and only if there is a conflict between the corresponding sequences.

Graph Theory in Physics:

In Physics, the three dimensional structure of complicated simulated atomic structures can be studied quantitatively by gathering statistics on graph-theoretic properties related to the topology of the atoms.Forexample,Franzblau's shortest-path(SP) rings.

Graph Theory in Mathematics:

In mathematics, graphs are useful in geometry and certain parts of topology,e.g. Knot Theory . Algebraic graph theory has close links with group theory. Graph theory is a very natural and powerful tool in combinatorial operations research. Some important OR problems that can be solved using graphs are given here. A network called transport network where a graph is used to model the transportation of commodity from one place to another. The objective is to maximize the flow or minimize the cost within the prescribed flow. The graph theoretic approach is found more efficient for these types ofproblems though they have more constraints [9].

Section – II:

Graph Theory inComputer Science:

Mathematically speaking trees are a special class of a graph. The relationship of trees to a graph is very important in solving many problems in Math's and Computer Science. Trees and many other definition of graph theory are having its application in various field of computer science.

Applications of Graph Theory in Artificial Intelligence:

Various AI troubles may be direct as the trouble of discovering a trail in a graph. A graph is fabricated of arcs and nodes. Arcs are planned pairs of nodes which may contain connected expenditure. Many sort of trouble is frequently resolved through a graph search technique. We symbolize the trouble as an array of states that are snapshots of the world and operators that alter one state into a further States may be mapped to nodes of a graph and operators are the edges of the graph. Game tree used in artificial intelligence also uses concept of graph theory.

Applications of Graph Theory in communication network:

Graph theory may be utilized to symbolize communication systems. A communications system is a compilation of links, nodes and terminals that join to facilitate telecommunication amid the terminals users. Every terminal in the system should encompass a inimitable address as a result connections or messages may be routed to the accurate receivers. The compilation of addresses in the system is known as the address space. Each communications system has three fundamental constituents: terminals (the starting and stopping points of system), processors (that offer data transmission control functions), transmission channels (that assist in transmission of data).

The communication system intends to convey data packets amid telephones, computers, processors or other appliances.

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Applications of Graph Theory in Social Networking sites Analysis:

Rightnow, online social networking sites is just like a trend and so it in popularity for sharing and accessing various information among friends, society etc. Various sites are dedicated to sustaining the contacts and perform a good role as a mediator to share and keep relation between the users. Online social networks are a type of web, so there is need to analyze for arranging, customizing and navigate information among users.The properties of the Web graph have been studied extensively for analysis of social networking sites.

Applications of Graph Theory in Cloud Computing:

Today, Cloud computer plays an very important role in graph theory.Application of graph is in cloud computing technology is unique. This technology is an open standard, service-based, Internet-centric, safe, convenient data storage and network computing services. Cloud provides us three service models IaaS, PaaS and SaaS. Cloud computing is actually an internet based model for assist convenient, on demand network access to a shared pool of configurable computing resources. The software,application, data all are save on server instead of a personal data. These types of services are provided by Cloud Computing.

A graphical authentication password is a verification program that works when the customer uses proposed table on the basis of which data is substituted. Proposed table is original and can be used by both sender and receiver to protect data. The algorithm is not easy to crack and it also enhanced security of the cloud from malicious users.

Cloud computing is a term used to describe both a platform and type of application. A cloud computing platform dynamically provisions, configures, reconfigures, and de-provisions servers as needed. Servers used in the cloud can be physical machines or virtual machines. Advanced clouds typically include other computing resources such as storage area networks (SANs), network equipment, firewall and other security devices .

Key Cloud Computing providers: IBM, HP, Google, Microsoft, Amazon Web Services, Salesforce.com, NetSuite, VMware, EMC etc.

Examples of Cloud Computing services includes Google Docs, Office 365, Drop Box, SkyDrive, facebook etc.

Applications of Graph Theory in Network Security:

Until recently computer and network security has been formulate as a technical problem. However, it is now widely recognized that most security mechanisms cannot succeed without taking into account the user (Patrick, Long, &Flinn, 2003). A key area in security research is authentication, the determination of whether a user should be allowed access to a given system or resource. Traditionally, alphanumeric passwords have been used for authentication, but they are known to have security and usability problems.

Applications of Graph Theory in many other fields in Computer science:

- Graph theory is having its application in modeling
- Networking security to keep data safe.
- Used for representing and analysis of Social networking sites
- Application in data and Communications networks
- Used in Information network
- Developers used Software design to represent different modules
- In Transportation networks
- In the field of Artificial Intelligence
- In solving problem of neural network

The major role of graph theory in computer applications is the development of graph algorithms. Numerous algorithms are used to solve problems that are modeled in the form of graphs. These algorithms are used to solve the graph theoretical concepts which intern used to solve the corresponding computer science application problems.

Various computer languages are used to support the graph theory concepts. The main goal of such languages is to enable the user to formulate operations on graphs in a compact and natural manner

II. CONCLUSION:

The main aim of this paper is to present the importance of graph theoretical ideas in various areas ofcomputer applications for researches that they can use graph theoretical concepts for the new research. An overview ispresented especially to project the idea of graph theory. So, the graph theory section of each paper is givenimportance than to the other sections. Researches may get some information related to graph theory and itsapplications in computer field and can get some ideas related to their field of research.

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