International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 02 | Feb-2016 www.irjet.net p-ISSN: 2395-0072

ANALYSIS OF IMPACT OF GRAPH THEORY IN COMPUTER APPLICATION

Ajit Singh, Rakhi Singh

Assistant Professor, Jagran Lakecity University,Bhopal

Abstract - *The background of mathematics and its significance play very important role in a range of fields. One of the significant domains in mathematics is graph theory which is used in structural models. This structural planning of various objects or technologies lead to new inventions and modifications in the existing environment for enrichment in those fields. The field of graph theory started its journey from the problem of Koinsberg bridge in 1735. This paper gives an impression of the applications of graph theory in various fields to some extent but primarily focused on the computer science applications that already adopt graph theory in significant domain of networking, computations and design of Algorithms for particular problems. Different papers based on graph theory have been studied related to scheduling concepts, computer science applications and an overview has been presented here.*

***Key Words*: Bipartite graph, Ad-hoc networks, Geometric spanner, Median graph, Voronoi graph.**

1. INTRODUCTION

Graph theoretical concepts and methodologies are tremendously utilized by computer science applications. Particularly in research areas of computer science and electronic data transfer with help of digital network with advance computing concept such as data mining, image segmentation, clustering, image capturing, calculation of shortest path in networking etc., For example a data structure can be considered as in the form of hierarchical structure called tree which in turn utilized vertices and edges. Similarly simulation and modeling of electronic network topologies can be done by using graph concepts. In similar manner the most significant concept of graph coloring is utilized in resource scheduling and allocation. Also, circuits, paths, and walks in graph theory are used in remarkable applications like resource networking, traveling salesman problem, and database design concepts. This leads to the expansion of innovative algorithms with optimistic time and space complexity and new theorems that can be applicable in tremendous applications. This research paper demonstrates how graph theory is utilized in different computer applications.

1.1 Application In Map Coloring And Gsm Mobile Phone Networks

Groups Special Mobile (GSM) is a mobile phone network in which the physical or geographical region of this network is separated into hexagonal regions or cells. Each and every cell has its own communication tower which connects with mobile phones within the cell. Every mobile phone connects to the GSM network by searching for cells in its neighbours. Since GSM works only in four different frequency ranges, and it is clear by the concept of graph theory that only four colors are capable to color the cellular regions. These four identical colors are used for proper coloring of the cellular regions. Therefore, the vertex coloring algorithm of graph theory may be used to assign at most four different frequencies for any GSM mobile phone network.

Authors demonstrate the concept as follows: Given map can be drawn on the plane or on the surface of a sphere, the four coloring theorem state that it is always promising to color the regions of a map properly by using at most four distinct colors such that no two adjacent regions are assigned the same color. Now, a dual graph is constructed by putting a vertex surrounded by each region of the map and connects two distinct vertices by an edge if their respective regions share a whole segment of their boundaries in common. Then proper coloring of the dual graph gives proper coloring of the original map. Since, coloring the regions of a planar graph G is alike to coloring the vertices of its dual graph and vice versa.[7] By coloring the map regions using four color theorem, the four frequencies can be assigned to the regions accordingly.[9]

1.2 APPLICATION OF GRAPH ALGORITHM IN COMPUTER NETWORK SECURITY

The vertex cover algorithm (Given as input a simple graph G with n vertices labeled 1, 2, …, n,

search for a vertex cover of size at most k. At each stage, if the vertex cover obtained has size at most k, then stop.[7]) is used to simulate the propagation of stealth worms on huge computer networks and drawing best strategies to protect the network in opposition to virus attacks in real time. Simulation was approved out in large internet like virtual network and showed that the topology routing has large impact on worm propagation. The significance of finding the worm propagation is to hinder them in real time. The main thought here is to find a least vertex cover in the graph whose vertices are the routing servers and the edges are the connections between the routing servers. Then an most favorable solution is found for worm propagation and a network protection strategy is defined. [9] In a graph G, a set of edges g is said to cover G if every vertex in G is occurrence on at least one edge in g. The set of edges that covers a graph G is said to be an edge covering or a covering sub graph or simply a covering of G. Eg. A spanning tree of a connected graph is a covering. A Hamiltonian circuit is also a covering. [7] The sample computer network with corresponding minimum vertex cover is shown below.

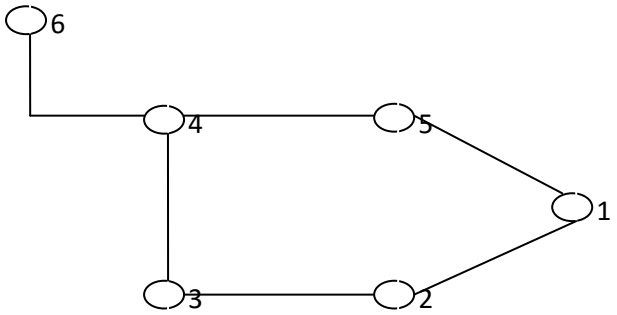

Fig- 1: The vertex Set g={2,4,5} covers all vertices in G.

1.3 APPLICATION OF GRAPH THEORY RELEVANT TO AD-HOC NETWORKS

Here, the authors have discussed the function of graph theory associated to the issues in Mobile Adhoc Networks (MANETS). In Adhoc networks, challenges such as modeling, scalability connectivity, routing the network and simulation are to be considered. Since a network can be modeled as a graph, the model can be used to analyze these challenges. Graphs can be algebraically represented as matrices. Also, networks can be computerized by means of algorithms. The issues such as node density, mobility among the nodes, link formation between the nodes and packet routing have to be simulated. To simulate these concepts arbitrary graph theories are sued. The connectivity issues are analyzed by means of graph spanners, (A geometric spanner or a k-spanner graph or a k-spanner was primarily introduced as a weighted graph above a set of points as its vertices and every pair of vertices has a path between them of weight at most k times the spatial distance between these points, for a fixed k.) proximity graphs, (A proximity graph is basically a graph in which two vertices are connected by an edge if and only if the vertices satisfy particular geometric necessities), sparsification and spectral graph theory. A range of algorithms are also presented to analyze the congestion in MANET's where these networks are modeled based on graph theoretical ideas.[13]

1.4 A GRAPH MODEL FOR FAULT TOLERANT COMPUTING SYSTEMS

This domain is based on graph theory where it is applied to model the fault tolerant system. Here, the computer is represented as S and the algorithm to be executed by S is known as A. Both S and A are represented by way of graphs whose nodes represent computing amenities. It is shown that the algorithm A is executable by S if A is isomorphic to a sub graph of S. The authors have presented a graph model and algorithms for computing systems for fault tolerant systems. These graphs show the computing facility of a particular computation and the interconnection among them. This model is applied directly to the lowest configuration or structure essential to achieve fault tolerance to a particular extent. The model is represented in the form of a facility graph. A facility graph is a graph G whose nodes stand for system facilities and whose edges represent access links between facilities.[6] A facility here is said to be a hardware or software components of several system that can fail independently. Hardware facilities consist of control units, arithmetic processors, storage units and input/output equipments. A software facility incorporates compilers, application programs, library routines, operating systems etc. Since every

facility can access some other facilities, the real time systems are represented as a facility graph. The subsequent is a labeled directed facility graph. Facility types are indicated by numbers in parentheses. The graph indicates the types of facilities accessed by other facilities. The node x1 access the nodes x2 and x4. Likewise, the node x5 with facility type t1 access the facility types t3, t1 and t2 of nodes x6, x2 and x4 correspondingly.

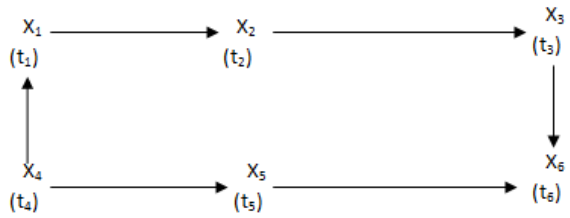

Fig-2: The Facility Graph

1.5 GRAPHICAL REPRESENTATION OF ALGORITHM

Algorithm would be defined as facility graph in which nodes of graph represent the facilities necessary to execute the algorithm and whose edges signify the links required among these facilities. This can be demonstrate as A is a algorithm which is executable with computing environment S if A algorithm is isomorphic to a sub graph of computing system S. This indicates that there is a one to one mapping from the nodes of A into the nodes of S that conserve node labels and adjacencies between nodes. This shows that S contains every facilities and connections among facilities required by A. As a result A can be rooted in S. If G1 and G2 represent a system and an algorithm in that order, then G2 is executable by G1. The demonstration of G2 is as follows.

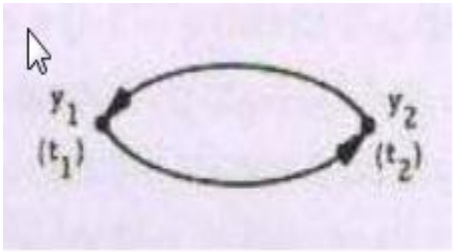

Fig-3: Graph G2

The isomorphism Representation is as follows:

(y_1,Y_2)----------->(X_1,X_2)
(y_1,Y_2)----------->(X_1,X_2)

1.6 Clustering of web documents using graph model

In this we discussed here the improved demonstration of web documents by means of clustering them. At this point professionals have used the classical k-means clustering algorithm which uses the highest common sub graph distance quantify instead of usual distance measure and the concept of median graphs in its place of centroid calculations.

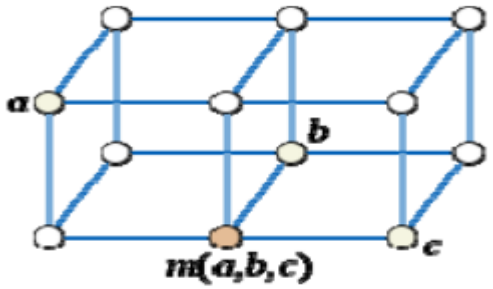

Fig-4: Median of three vertices in a median graph

Since, conventional clustering methods are working simply on numeric characteristic vectors, the actual data requests to be transformed to a vector of numeric values by the removal of possibly useful structural information. Otherwise, latest customized algorithms have to be developed for specific demonstration. Modeling the web documents as graphs has two major benefits.

1. It keeps the actual structure of the original documents, rather to arrive numeric feature vectors that hold term frequencies.

2. There is no requirement to develop new clustering algorithm right from the scratch. But the extension of classical algorithms can be developed to deal with graphs that use numerical vectors.

The graph modeling of the web documents can be implemented by following method.

1. Every word that appears in the web document apart from stop words is represented by the vertex of the graph. This can be executed by a node labeling utility which gives labels to each node. If there is a repeated word in a web document, it is represented by only one vertex. Consequently each vertex in the graph shows a unique word and is labeled with a unique term.

2. If any word say B follows a different word say A then there is a directed edge between these two words A and B. If these two words are in a single section say S, then the edge between A and B will be labeled as S.

3. Several punctuation marks are not taken into account for edge creation.

4. Three sections are defined here. They are sections for title tag, Section link and Section text.

5. A stemming verification is performed for plural forms.

6. The majority of infrequent words are removed from all pages by leaving maximum nodes say M for each and every graph where M is the user declared parameter.

CONCLUSIONS

The important aim of this paper is to present the significance of graph theoretical ideas in a range of areas of compute applications for researches that they can implement theoretical concepts of graph in various research domains. An overview is presented particularly to project the multidisciplinary application of graph theory.

REFERENCES

[1] Adam Schenker, Mark Last, horst Banke,Abraham andel,"Clustering of Web documents using a graph model", Springer werlog, Septermber 2007.

[2] Anindya J.Pal, Samar S.Sarma, Biman Ray, "CCTP, Graph Coloring algorithms – Soft computing Solutions IEEE, 2007.

[3] Bing Hong Liu, Wel Chieh Ke, Chin-Hsien Tsai, Ming-Jer Tsai, "Constructing a message pruning tree with minimum cost for tracking moving objects in wireless sensor networks", IEEE Volume 57, Number 6, July 2008.

[4] Daniel Marx, "Graph Coloring problems and their applications in scheduling".

[5] Gian Luca Marcialis, Fabio Roli, Alessandra Serrau, "Graph Based and Structural Methods for Fingerprint Classification, Springer verlag, Berlin Heidelberg 2007.

[6] John.P.Hayes, "A graph Model for Fault Tolerant Computing Systems", IEEE September 1976.

[7] Narasingh Deo, "Graph theory with applications to engineering and computer science", Prentice Hall of India, 1990.

[8] Perri Mehonen, Janne Riihijarvi, Marina Petrova, "Automatic Channel allocation for small wireless area networks using graph coloring algorithm approach", IEEE 2004.

[9] Shariefuddin Pirzada and Ashay Dharwadker, "Journal of the Korean Society for Industrial and applied Mathematics, Volume 11, No.4, 2007.

[10] Sven Dickinson, Pelillo, Ramin Zabih, "Introduction to the special section on graph algorithms in computer vision", IEEE on pattern analysis, Vol 23 No. 10, September 2001.

[11] V.P.Eswaramoorthy, "New algorithm for analyzing performance of neighbourhood strategies in solving job shop scheduling problems, Journal of Scientific & Industrial Research, August 2008.

[12] Zongheng Zhou,† Samir Das, Himanshu Gupta, "Connected K-Coverage Problem in Sensor Networks".

[13] http://www.britinaca.com/bps/additionalcontent/18/33373769/concepts-of-graph-theory-relevant-to-Adhoc-Networks.

BIOGRAPHIES

Name:- Ajit Singh
Designation: Assistant Professor
Organization: Jagran Lakecity University
Qualification: B.Sc, MCA, M.Tech