ORIGINAL RESEARCH PAPER
VOLUME-6 | ISSUE-5 | MAY - 2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

CERTAIN INVESTIGATION ON GRAPH COLORING AND ITS APPLICATIONS

Computer Science

R. Aishwarya Student, Department of CSE, Karpagam College of Engineering, Coimbatore, Tamilnadu

A. Gokulapriya Student, Department of CSE, Karpagam College of Engineering, Coimbatore, Tamilnadu

Dr. S. Kannimuthu B.Tech.,ME., PhD Associate Professor, Department of CSE, Karpagam College of Engineering, Coimbatore-641 032.

ABSTRACT

Graphs in Computer Science are used to represent networks of communication, data organization, computational devices, the flow of computation, etc. The development of algorithms to handle graphs related problems are therefore of major interest in computer science. Graph theory is also used to study molecules in chemistry and physics. In condensed matter 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. A graph structure can be extended by assigning a weight to each edge of the graph. Graphs with weights, or weighted graphs, are used to represent structures in which pairwise connections have some numerical values. For example, if a graph represents a road network, the weights could represent the length of each road. In this paper, a comprehensive study on graph coloring and its application in diversified areas are done.

KEYWORDS:

Graph, Graph Theory, Graph Coloring.

1. INTRODUCTION

A Graph is formed by vertices and edges connecting the vertices. Graph theory was first started in Euler, Sir William Rowan Hamilton (1805-1865) in 1859. The Graph called from different conceptions of the edge set V is a set of together with a relation of incidence that associates with each edge two vertices. In another generalized notion, E is a multi-set of unordered pairs of (not necessarily distinct) vertices. Many authors call this type of object a multi-graph or pseudo graph. V and E are usually taken to be finite, and many of the well-known results are not true (or are rather different) for infinite graphs because many of the arguments fail in the infinite case. The order of a graph is |V|, its number of vertices. The size of a graph is |E|, its number of edges. The degree of a vertex is the number of edges that connect to it, where an edge that connects a vertex to itself (a loop) is counted twice.

The remainder section of this paper is structured as follows. Section two discusses about graph coloring concepts. In section three, application of graph theory in various areas are discussed. Section four presents the conclusion and possible trends for future research directions.

2. GRAPH COLORING

In graph theory, graph coloring is a special case of graph labeling. The Iterated Greedy (IG) graph coloring algorithm uses the greedy, or simple sequential, graph coloring algorithm repeatedly to obtain ever better colorings. On each iteration, the permutation presented to the greedy algorithm is generated so that the vertices of the independent sets identified in the previous coloring are adjacent in the permutation. It is trivial to prove that this ensures that the new coloring will use no more colors than the previous coloring. It is a way of coloring the vertices of a graph such that no two adjacent vertices share the same color; this is called a vertex coloring. Similarly, an edge coloring assigns a color to each edge so that no two adjacent edges share the same color. Total coloring is a type of coloring on the vertices and edges of a graph. When used without any qualification, a total coloring is always assumed to be proper in the sense that no adjacent vertices, no adjacent edges, and no edge and its end-vertices are assigned the same color. An unlabeled coloring of a graph is an orbit of a coloring under the action of the automorphism group of the graph. If we interpret a coloring of a graph on vertices as a vector in, the action of an automorphism is a permutation of the coefficients of the coloring.

3. APPLICATIONS OF GRAPH COLORING

3.1 APPLICATION IN SCHEDULING:

The Graph coloring problems and their applications in scheduling are devised by Daniel MaarX. Among several interesting practical problems two jobs cannot be executed at the same time and here coloring of graphs occurs. The chromatic numbers of graph is determined with an N-P hard problem. The Aircraft scheduling for both flights we cannot assign; the same aircraft. In Biproccesor, processor cannot work on two jobs at a time. In frequency assignment due to interference stations close each other receives the different frequencies. There are two types of multicoloring the non-primitive multicoloring assigned to web text with continuous interval of colors where has the premitive multicoloring with non continuous. In the pre-coloring extension with already decided for we cannot control or modify it. This problem is solved with conflict graph, List coloring is processed only by certain machines and by using the standard dynamic programming technique. In the minimum sum coloring the scope is to minimize the sum of completion of jobs with the average completion time and is used to model arbitrary length jobs by the finish time of vertex.[1]

3.2 ELLIPSOID METHOD:

The Graph coloring application of the ellipsoid method in combinational optimization is delivered by Robert Nikel. By applying ellipsoid method, one can polynomically solve a minimum graph coloring of subclasses. Here no two vertices have same label such that a minimum number of label is used and through edges are also we connect the graph. In real world applications such as time-tabling scheduling, Frequency assignment (radio) register allocation hardware are used. To solve separation of problem in polynomial algorithm to optimize linear functional over a bounded convex set is used in ellipsoid method. The semi define programming requires some background information that seemed usual here. Optimization and separation are two symbol problems of ellipsoid method. In the graph theory for lower bound chromatic number X(G) is cardinality of maximum clique. The perfect graph definition is given by BERGE and proved by M.CHODNOVSKY & P.SEYMOUR. The semi definite optimization lead to an algorithm for chromatic number of perfect graphs. The ellipsoid method is applicable to class of feasible sets included by arbitrary and directory graphs. Without evaluating a maximum clique in polynomial time for the perfect graph. We can construct a coloring. Finally clique of G by linear programming duality we can get maximum clique. Thus, the perfect graph sorting

can be computed in the time polynomially bounded [2]

3.2 APPLICATIONS OF VERTEX COLORING IN A PARTICULAR TRIANGULAR CLOSED PATH STRUCTURE AND IN KRAFT'S INEQUALITY:

Ghosh devised an application of vertex coloring in a particular triangular closed path structure and in kraft's inequality. This vertex coloring needs more than four colors to color the map in order to avoid confusion. The front view of pyramidal structure in the triangle and 91 points are placed there with horizontal and 10 inclined lines. After inclining coloring property is applied here with two adjacent vertices have a same color. The vertex color combinations are successful in case of triangular closed path. By applying the property of coloring repetition to explain kraft inequlity. In case of binary tree we use red and blue respectively. The upper branch and lower branch are two branches in binary tree, Coloring from mother node to the terminal node with the repetition of coloring successfully placed. Here prefix coding is successful and has a great scope in the field of image processing and digital signal processing [3]

4. APPLICATION IN GENERATING UNIVERSITY TIME TABLE

The graph coloring algorithm to create university timetable devised by timothy A. Redl. This model involves creating a conflict graph with essential and preferential conditionals. By allocating one or more process at same time. The problem occurs the minimum coloring problem is called as NP hard problem is solved by giving optimal solution. Most based on essential conditions we choose the best one. By using the optimal data fields like number of days, time of days, room type, room, class max_size in graph coloring. Here clique concept is used to overcome such problems SSG, LFSG, SFSG, RSG. Four greedy graph coloring algorithms are involved Coloring vertices by sort posed by couse_Id, instructor and class max_size with decreasing degree procedure balanced and evenly distributed colors [4]

3.5 COMMUNICATION NETWORKS

The concept of applications of graph labeling in communication network was devised by Prasanna et al. The graph labeling comes under the category graph theory which have X-Ray crystallography, Coding theory, Communication network addressing and circuit design applications. This paper greatly deals about graph labeling applied on network addressing, channel assignment, network security and social network. Global data structure use under old graceful labeling, one of the most used graph labeling. Radio labeling having fast communication in sensor network can be applied hardware and software facility graphs are designed using graph labeling. DSATUR (degree of saturation)is the labeling algorithm for heuristic search. The vertex covering algorithm for avoiding stealth worms to protect against network virus and minimum vertex cover .The graph in the sensor network for analyzing the efficiency of communication. MANETS (Mobile Ad hoc Networks) issued in scalability and modeling and connectivity. Social networks plays also important role in effective communication. Using certificates and tree graphs, short labeling are given using identification of routing algorithm. Thus, Graph labeling a powerful tool in various fields of network [5].

3.6 GRAPH THEORY IN COMPUTER SCIENCE

Shrinivas et al. told about their point of view on application of graph theory in computer science. The discussed the application of graph theory in the research areas of computer science such as data mining, image segmentation, clustering, image capturing, network etc. The best well known problem in operations research is Project Evaluation Review Technique (PERT) and Critical Path Method (CPM) and game theory. In the computational biochemistry sequences of cell samples are excluded to resolve conflicts between two sequences. There are many algorithms and graph theoretic languages are used to solve the problem.

DENDRAL has been developed to identify the chemical compounds, Pre-coloring, List coloring, Multi-coloring, Minimum sub coloring are the some scheduling problems in graph coloring methodologies. It constraints are complex allocating of classes and subjects are took risk in the time table scheduling. College course time tabling problem (CCTP) is one more time tabling problem solved by graph coloring algorithms through modules and constraints. Graph construction algorithm, job shop scheduling problem (JSS), Standard model, Map coloring and GSM mobile phone network (Group Special Mobile). Graph algorithm in computer network security & to ad-hoc network are used to solve the problem. Moreover a graph model for fault tolerant computing system with optimal K-FT single loop system in symbol recognition with clustering of web documents in modeling sensor network and through graph based on structural methods for finger print classification to solve a problem faced in computer science and an overview [6]

3.7 STUDY OF VERTEX-EDGE COLORING TECHNIQUE WITH APPLICATIONS:

Preeti discussed about her point of view on a study of vertex –edge coloring techniques with application. In graph theory, graph coloring is most important in real time application of engineering science. This problem was originated in 1735 by Koinsber bridge and solved using computer by Heinrich in 1969. The minimum number of color is called chromatic number and graph called properly colored graph. The vertex coloring types are k-vertex coloring, k-vertex colorable, uniquely k-colorable, chromatic number x(G), k-chromatic, k-critical, chromatic polynomial f(G,t). The applications of vertex coloring is storage problem, store incompatible chemicals in different compartments. The Types of k-edge coloring, k-edge colorable, k-edge chromatic, optimal k-edge coloring and uniquely k-edge colorable. The application of edge coloring are the Time tabling with a complete timetable in minimum possible number of periods, graph coloring techniques in scheduling-graph coloring methodologies, job scheduling-two jobs cannot be executed simultaneously, Aircraft scheduling-Flight overlapping takes place, Bi-processor tasks, each task has to be executed on two processors simultaneously, pre-coloring extension –assignments of jobs of already decided. List coloring used in model situations ,Minimum sum coloring applied in scheduling theory, Time tabling and Map coloring and Groups Special Mobile (GSM) [7]

3.8 INTERFERNCE REDUCTION IN WIRELESS NETWORKS USING GRAPH COLORING METHODS

Chickadel mentioned about her point of view in interference reduction in wireless networks using graph coloring methods. The drawback of wireless network is signal interference and we can prevent it by reducing interference in adjacent or connected nodes that conflict together from receiving and transmitting signals and we can minimize the number of channel which is allocated to a specific network. For efficient channel selection, the efficient coloring algorithm required for browsing wireless interference. The greedy weighted algorithm assigns the access point to broadcast for imposing the minimum distance between two nodes we can use the channel reuse. Radio Frequency spectrum is used for investigating strict upper and lower bounds of number of channels. For knowing its relative geometric position the location oblivious network do not relay where the topology changes often and dramatically. We can reduce the interference using the dynamic channel assignment. In Unit Disk Graph (UDG), we can analyze the BFS-CA(Breadth first channel assignment) in both empirically and analytically. For more realistic UDG we can study the same algorithm on Quasi unit disk graph. The best algorithm in today's use is BFS-CA [8].

3.9 AN APPLICATION OF INTERATED LOCAL SEARCH TO GRAPH COLORING PROBLEM

An application of iterated local search to graph coloring problem is devised by Chiarandini and stutzle. For giving colors k feasible coloring is found, so number of colors is decreased and local search starts that is simple, meta heuristic shows good result on optimization problems. The solution obtained from perturbation. The approximate algorithm for graph coloring problem (GCP) classified into two classes, construction heuristics and local search

algorithm. The algorithm for these classes is initialization phase, color number decreasing phase, local search phase. The bench mark problems are divided into three groups and we use five graphs for this, there are random graphs, height on graph, Queen Graph, Full insertion graph, Latent square graph. The iterated local search (ILS) is simpler and produce good results. Diversification is achieved in extreme case by accepting every new solution and applying large perturbations for searching 1-opt neighborhood two local search architectures are used 1-min conflicts heuristic,2-it examines all possible combinations of vertices and color. In addition we use Tabeu search meheuristic to avoid stuck in local optimum. The three possibilities of perturbations is directed diversification, random recoloring, dsat recoloring [9].

4. CONCLUSION

Graph coloring is the one of the major problem in the research literature. It is widely used in many areas like register allocation and time table management. In this paper, graph coloring and its application in variety of application are discussed. In future, graph coloring concept can be applied in many areas like resource management in agriculture field and medicine.

REFERENCES

[1]. Dániel Marx,"Graph colouring problems and their applications in scheduling", PERIODICA POLYTECHNICA SER. EL. ENG, Vol. 48, No. 1 pp.11-16 , 2004.
[2]. M. Grötschel, L. Lovász & A. Schrijver, , "The ellipsoid method and its consequences in combinatorial optimization", Combinatorica, Vol. 1, No. 2, pp. 169-197, 1981.
[3]. Sabyasachi Mukhopadhyay, Paritosh Bhattacharya & B.B.Ghosh "Application of Vertex coloring in a particular triangular closed path structure and in Kraft's inequality", arXiv preprint arXiv:1309.3513, 2013.
[4]. Timothy A.Redl, "On Using Graph Coloring to Create University Timetables with Essential and Preferential Conditions", ADVANCES IN MARKETING, MANAGEMENT AND FINANCES, pp. 162-167, 2016.
[5]. K.Sravanthi, "Applications of Graph Labeling in Communication Networks", Oriental Journal of Computer Science and Technology, Vol. 7, No. 1, pp. 139-145, 2014.
[6]. S.G.Shirinivas, "Applications of graph theory in computer science an overview", International Journal of Engineering Science and Technology Vol. 2, No. 9, pp. 4610-4621, 2010
[7]. Preeti Gupta, "A study of Vertex - Edge Coloring Techniques with Application", International Journal Of Core Engineering & Management , Vol.1, No. 2, pp. 27-32, 2014.
[8]. Andrew Chickadel,"Interference Reduction in Wireless Networks Using Graph Coloring Methods", International Journal of Computing Algorithm, Vol. 3, pp. 845-848, 2014.
[9]. Marco Chiarandini &Thomas St¨utzle, "An application of Iterated Local Search to the Graph Coloring Problem", PROCEEDINGS OF THE COMPUTATIONAL SYMPOSIUM ON GRAPH COLORING AND ITS GENERALIZATIONS, 2002.