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A view point on Applications of Graph Labeling in Communication Networks

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Abstract:

In this paper, the research has been focus on application of graph theory in various field of Science & Engineering like Chemistry in Caterpillar Trees, Time Table Scheduling in Academics, Communication Network and Computer Science.

Key words: Bipartite graph, Caterpillar graph, Graph labeling, Complete graph, Semi graceful labeling, Golomb Ruler.

1. Introduction

Due to its wide variety of applications, graph labelling is becoming a more attractive field. A vital role has played by labeled graphs in various fields of graph theory. Coding theory, missile guidance codes, design of good Radar type codes, astronomy, circuit design, X-ray

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crystallography, data base management are few names of such important fields. This chapter gives an overview of graph labeling as well as some information of important applications.

In this paper, I'd want to improve graph labelling applications in computer science. Graph labeling applications have been studied and here I explore the usage of this field in several areas like communication networks, image processing, data mining, crypto systems and bird view has been proposed. Graph theory has been applied in investigation of electrical network is a collection of components and device interconnected electrical gazettes. The network components are idealized physical devices and system, in order to represent several properties. Also they must obey the Kirchhoff's law of currents and voltage.

2. Bipartite Graph and Time Table Scheduling

When there are constraints and complexity, one of the key difficulties is allocating classes and subjects to all of the professors at an institute. A bipartite graph can aid in the solution of such a problem. It also plays a vital part in these types of issues. The timetable for m instructors and n subjects available periods p must be constructed as follows.

A bipartite graph G, I mean a set of teachers $v1, v2, v3, \ldots, vm$ and another set of subjects $u1, u2, u3, \ldots, un$. The periods of these vertices are pi. It is assumed that each instructor will work on nearly one subject at a time. In addition, each topic can only be taught by one instructor at a time. The time table for the first period corresponds to a matching in the bipartite graph G, and each matching, in turn, corresponds to a probable assignment of certain instructors to subjects taught during that period. As a result, the solution will be found by dividing the edges of the provided graph into the fewest possible matching pairs. The edge must also be coloured with the fewest possible colours, which is a challenge that the vertex colouring method can address. The provided graph's line graph contains an equal number of vertices and edges. In the provided graph, the vertices of the line graph are also nearby if they

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are incident. The line graph is a simple graph, and its correct colouring provides the supplied graph suitable edges colouring.

3. Application in Communication

Network A type of graph is used to describe the problem in any sort of application, depending on the problem scenario. In order to address the challenge, an appropriate labelling is applied to that graph. Each station is given a channel number (a positive integer) to avoid interference when a group of transmitters is used. Interference is stronger when the distance between two stations is less. As a result, the channel assignment difference must be larger. Each vertex represents a transmitter and any of its pairs of transmitters that are linked to nearby transmitters. To obtain an effective network, radio labelling is employed. For this, I define some terminology as take $G = (V(G), E(G))$ a connected graph and $d(u,v)$ = distance between any two vertices of G. The Maximum distance between any pair of vertices is the diameter of G and denote it by diam(G). A radio labeling on G, I mean an injective function $f: V(G) \rightarrow N \cup \{0\}$ and define it such a way so that for any $u, v \in V(G), |f(u) - f(v)| \geq diam(G) - d(u,v) + 1$. The span of f is the difference of the largest and the smallest channel used, that is max $\{ f(u)\, f(v)\}, for\ every\ u, v \in V(G)$.. The radio number of the given graph G is the maximum span of radio labeling of G and denote it by $\gamma n(G)$. Each station is specified as a channel for a collection of transmitters so that interference can be minimized or avoided. The radio labelling method proven to be an effective method of calculating the communication time for sensor networks. The network is modelled as a chain graph, with each sensor connected to the others in the network. It's also a communication at time t, where t is the assigned radio channel. The time at which the sensor communicates may be determined via channel labelling. Radio labeling on different kind of graphs are shown in Figure 1.1.

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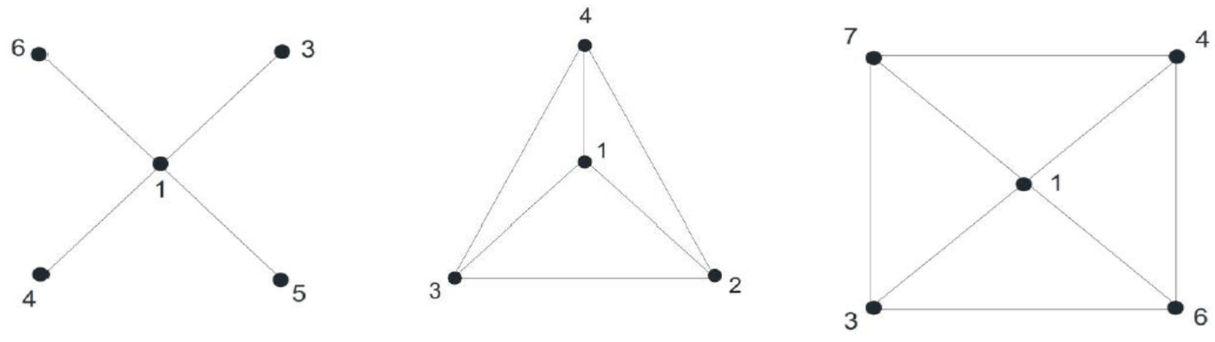

Figure 1.1

4. Caterpillar Trees in Chemistry

Combinatorial as well as physical properties of benzenoid hydrocarbons can be studied by study of related caterpillars. The simple way of defining a caterpillar by $S(x1, x2, .., xn)$. When all the pendent vertices of $S(x1, x2, ..., xn)$ are deleted, it leaves a path Pn. Here xi denotes number of pendant vertices, which are adjacent to i th vertex of the path Pn obtained from $S(x1, x2, ..., xn)$ by removing all the pendent vertices. In chemistry, such trees are used to explore the topological characteristics of benzenoid hydrocarbons. They are said to be resonant if a set of three circularly conjugated double bonds can be drawn in both of them, with the remainder of the carbon atoms covered either by a double bond or a sextet of electrons. If the matching hexagons in the zenoid system are non resonant, two edges in a caterpillar are incident. The labelling of the edges of a caterpillar and the hexagons of a benzenoid system have a one-to-one relationship. Explicitly, these concepts are referred to as Gutman Trees in chemistry. All graphs played an essential role in chemical graph theory, which is connected to caterpillars, which is remarkable. As a result, such objects play a critical role in comprehending and reducing the combinatorial characteristics of considerably more complex graphs. The potential of such trees in data reduction, computational graph theory, and graph ordering are all taken into account. As a result, characteristics of huge graphs like bezenoid graphs may be studied in terms of much smaller trees.

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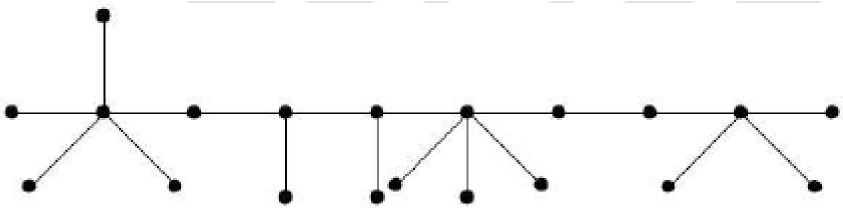

Figure 1.2

5. Application of Graph Labeling in Electrical Networks

Kirchhoff's circuit laws are two equalities, which deal with potential and current. They states the sum of all voltages around a loop is zero and the total resistance of n resistors in series is $RT = R1 + R2 + \ldots + Rn$.

An electric circuit is complete when current flows from the power source's negative terminals. There are three types of electrical circuits: series, parallel, and both. The graph representation in circuit network is one of the types of graph representation, and in the graph, the current flows in the circuit and the current connecting of resistors series and parallel connections are determined in the circuit.

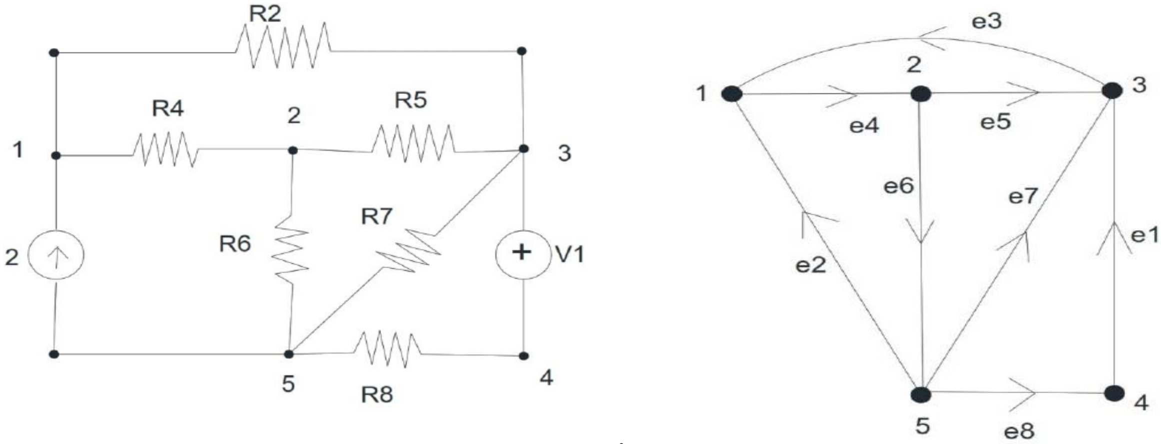

Figure 1.3

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6. Application Computer Science

6.6.1: Communication Network

Conventional network represent global nature. Gigantic graphs are everywhere from communication network. Arithmetical representation of the graph structure inflict on these data sets. It provide to visualizing and understanding of study of the data. As I discussed in 1.1 that the radio labeling provides communication effectively. Graph labeling plays role in sensor network, adhoc network etc.

6.6.2: Data Mining

Graph mining represents the relational attribute of the data. There are five hypothetical based approaches in data mining. Subgraph categories, isomorphism, graph invariants, mining measures, and many more mining measures that are widely used in the machine learning field are names of graph based data mining methodologies, particularly information entropy and information gain, as well as solution methods..

6.6.3: Web Designing

In a web graph, web pages are represented by vertices, the hyper links by edges and using it find one of the attractive information. Another application of graphs are website community, in which vertices are classes of the object and each vertex are adjacent each other. In graph theory, such graph is called Complete graph on n −vertices of Kn.

7. Golomb Rulers

It is obvious that Kn is graceful $iff\ n \leq 4$. By this fact Golomb motivated to define a new classes namely semi graceful labeling. According to him if the constraint edge labels to be consecutive integers is relaxed them such labeling is called semi graceful labeling. Semi graceful labeling is optional if it minimizes the largest edge label of Kn, which denoted by G (Kn). Using it, Golomb got semi graceful labeling for $K5$, which consist $\{1,2,3,4,5,6,7,8,9,10,11\}$ edge labels And $\{0, 1, 4, 9, 11\}$ vertex labels. Golomb has observed equivalence for the coding theory context between a semi graceful labeling, it helps to minimize $G(Kn)$. Using this observation he developed a special ruler on which n division marks are placed and it highlighted by Golomb Ruler. He produced vertices sets $\{0, 1, 4, 10, 12, 17\}$ and $\{0, 1, 4, 10, 18, 23, 25\}$ for $K6$ and $K7$ respectively to Minimize G (Kn), where $n = 6, 7$ respectively.

Following Table summarized the particular regarding possible semi graceful labeling for Kn $(n = 10)$.

$\|V(K_n)\|$	$\|E(K_n)\|$	**Division**	**Label of Vertices**
2	1	1	0,1
3	3	1,2	0,1,3
4	6	1,3,2	0,1,4,6
5	11	1,3,5,2	0,1,4,9,11
		2,5,1,3	0,2,7,8,11
		1,3,6,2,5	0,1,4,10,12,17
6	17	1,3,6,5,2	0,1,4,10,15,17
		1,7,3,2,4	0,1,8,11,13,17
		1,7,4,2,3	0,1,8,12,14,17
7	25	1,3,6,8,5,2	0,1,4,10,18,23,25
		1,6,4,9,3,2	0,1,7,11,20,23,25
		1,10,5,3,4,2	1,1,11,16,29,23,25
		2,1,7,6,5,4	0,2,3,10,16,21,25
		2,5,6,8,1,3	0,2,7,13,21,22,25
8	34	1,3,5,6,7,10,2	0,1,4,9,15,22,32,34
9	44	1,4,7,13,2,8,6,3	0,1,5,12,25,27,35,41,44
10	55	1,5,4,13,3,8,7,12,2	0,1,6,10,23,26,34,41,53,55

Semi graceful labeling and Golomb ruler are shown in Figure 1.4.

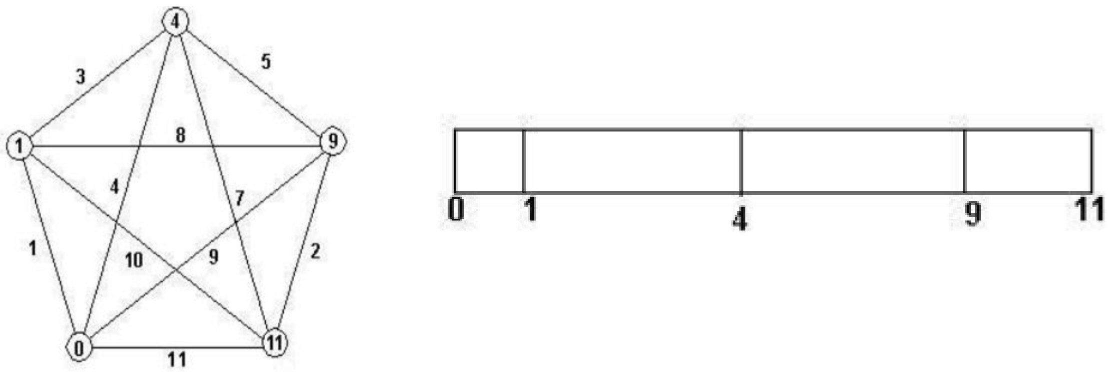

Figure 1.4

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Research Paper
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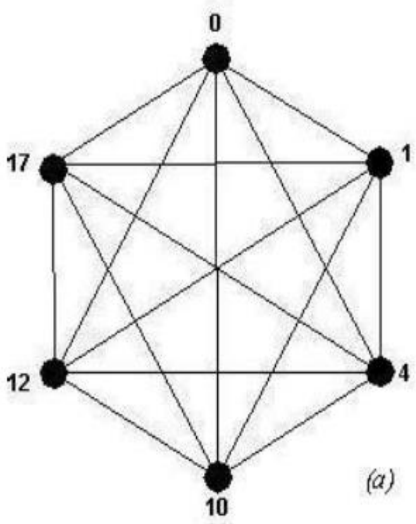
Similarly if I take the ruler R with 6 marks placed at 0,1, 4,10,12 and 17 semigraceful labeling Golomb ruler is shown in Figure 1.5.



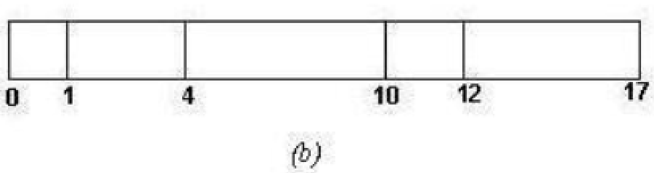


Figure 1.5

8. Conclusive Remarks

For future study, comparable ruler issues with similar applications in communication networks might be investigated. The issue of finding the shortest ruler with k markings that measures all integer lengths from 1 to n falls under this category. The ruler model may also be used to investigate the structure of various crystals. This method might be beneficial in multidisciplinary study. Graph labelling is a typical occurrence across a wide range of theoretical and practical issues.

In this paper i have tried to explore some graph labeling applications and bird view of some graph theoretical applications which does not includes graph labeling techniques. Researchers may get some information related to graph labeling and its applications in the field of computer science. I also focused on the application of graphs to electrical network. These topics create an impression of graph labeling as a unifying model. It has vital potential to provide partial or complete solution for practical problems. This techniques may work as a powerful unifying model with some filed like bio-technology, information technology and new generation communication network

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