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Review paper on a Semigraph

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Abstract: Semigraph was defined by Sampathkumar as a generalization of graph. Incidence matrix and adjacency matrix of a semigraph was studied by Deshpande C M ,Gaidhani Y S , B P Athavale.In this paper Laplacian matrix of a semigraph is obtained.
Keywords: incidence matrix, adjacency matrix, Laplacian matrix, semigraph.

I. INTRODUCTION

The concept of semigraph was first introduced by E Sampathkumar(1)as as generalization of graphs in which an edge may contain more than two vertices.Semigraph and their applications was studied by E Sampathkumar in 2001 since then the study of semigraph has become an important field in graph theory. Semigraph has different types of edge like subedge and partial edges these types of edges play an important role in modelling road networks and also useful in resolvind traffic problems . The concept of semigraph has a wide application in molecular biology and its application in DNA splicing has been studied by K Thiagarajan, J Padmashree & S Jeyabharathi.(2).The concept of domination in bipartite semigraphs is introduced by Venkatakrishnan YB, Swaminathan V[3]. Domination in semigraph can be used to study the traffic routing and traffic density at junctions of road networks. Also the concept of dominating set of semigraph is used for clustering in wireless networks like adjacent dominating set is used in algorithm for cluster head selection in wireless network .

Definition : A semigraph S is a pair (V , X) where V is a nonempty set whose elements are called vertices of S and X is a set of ordered n-tuples called edges of S of distinct vertices $n \geq 2$ satisfying the following conditions:

i. any two edges have at most one vertex in common.

ii. two edges $(u_1,u_2 ,.....u_n)$ and $(v_1,v_2,....v_m)$ are said to be equal iff

a. m =n and

b. either $u_i = v_i$ for $1 \leq i \leq n$ or $u_i = v_{n-i+1}$ for $1 \leq i \leq n$.

Thus, the edge $E = (u_1,u_2 ,.....u_n)$ is same as the edge$(u_n,u_{n-1} ,.....u_1)$. u_1 and u_n are called the end vertices of , while $u_2 u_3$ ...., u_{n-1} called the middle vertices of edge E

A semigraph S may be drawn as a set of points representing the vertices. An edge $E = (v_1,v_2,\ldots,v_n)$ is represented by a curve joining the points corresponding to the vertices $(v_1,v_2,\ldots,v_n)$ in the same order as they appear in E. The end points of the curve (i.e. the end vertices of E) are denoted by thick dots. The points lying in between the end points (i.e. middle vertices of E) are denoted by small circles. If an end vertex v of an edge E is a middle vertex of some edge E1 , a small tangent is drawn to the circle (representing v on E1) at the end of E

Adjacency of two vertices in a semigraph: There are different types of adjacency of two vertices in a semigraph.

1. Two vertices u and v in a semigraph are said to be adjacent if they belong to the same edge.
2. Two vertices u and v are said to be consecutively adjacent if in addition they are consecutive in order as well.
3. Two vertices u and v are said to be e-adjacent if they are the end vertices of edge in the semigraph.
4. Two vertices u and v are said to be 1e-adjacent if both the vertices u and v belong to the same edge and at least one of them is an end vertex of that edge.

Cardinality of an edge is the no of vertices lying on the edge.

II. DEGREE OF VERTEX IN SEMIGRAPH:

In semigraph there are various types of degreesi) $d_e(i)$ = number of edges containing i as an end vertex. ii) $d_m(i)$ = number of edges containg i as a middle vertexiii) $d_{ca}(i)$= number of vertices consecutively adjacent to i

III. ADJACENCY MATRIX OF A SEMIGRAPH

Let S(V,X) be a semigraph with vertex set V{1,2,3,4,.....,m} and edge set $X=\{e_1,e_2,e_3,e_4,.........e_n\}$. Adjacency matrix of S(V,X) is a square matrix of order mxm $A(S)=[a_{ij}]$ is defined as

i)for edge e in X of cardinality k, $e_i=\{i_1,i_2,i_3,i_4, ...i_k\}$a) $a_{i1,ir}=r-1$

b)$a_{ik,ir}=k-r$

ii) All remaining entries of A(S) are zero.

To construct a Laplacian matrix of a semigraph definition of Laplacian matrix of a graph is used. If S(V,X) is a semigraph with n vertices then Laplacian matrix is defined as nxn matrix L=D-A where A is adjacency matrix of a semigraph which is discussed in detail above

D: is diagonal matrix whose diagonal entries are degrees of corresponding vertices.Since in semigraph there are various types of degrees of a vertex here we will be using $d_e(v)$= number of edges whose v is end vertex.

Example 1:
Let S = (V,X) be a semigraph where V ={1,2,3,4,5,6} and X={(1,2,3),(1,4,6),(2,4,5),(5,6)}.
In S, 1,3,5,6 are end vertices, 4 is middle vertex and 2is middle-end vertex Laplacian matrix of Semigraph S,

$$L = D - A = \begin{matrix} 2 & -1 & -2 & -1 & 0 & -2 \\ 0 & 1 & 0 & -1 & -2 & 0 \\ -2 & -1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -2 & 0 & -1 & 2 & -1 \\ -2 & 0 & 0 & -1 & -1 & 2 \end{matrix}$$

$$\text{Where } D = \begin{matrix} 2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2 \end{matrix}, \quad A = \begin{matrix} 0 & 1 & 2 & 1 & 0 & 2 \\ 0 & 0 & 0 & 1 & 2 & 0 \\ 2 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 1 & 0 & 1 \\ 2 & 0 & 0 & 1 & 1 & 0 \end{matrix}$$

IV. CONCLUSION AND SCOPE

Laplacian matrix can be used to find many usefull properties of semigraph. It can be used for variety of Machine Learning applications. The eigen values of the matrix can be used to find good clusters in data mining ,can be used to decide the quality of cluster and they can be used in dimensionality reduction in data representation

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