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APPLICATION OF CACTUS FUZZY LABELING GRAPH

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Abstract

In this paper, we introduced cactus fuzzy labeling graph. Additionally we utilized average number and cactus fuzzy labeling sub graph. The main work of this paper is we explore the concept of cactus fuzzy labeling graph and we also apply average number of cactus fuzzy labeling graph for three states of Covid-19 data. Finally we gave the outcome which state influenced profoundly in Corona virus.

1. Introduction

Fuzzy graph is a useful tool to analyse the many real world problems. The fuzzy graph is developed to Rosenfield in 1975 [1]. A dynamic survey of graph labeling was told by Gallian [2]. Then several authors towards the field of this

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growing fuzzy graph theory. Fuzzy graph is applied software engineering, tasks research actual sciences, financial matters and furthermore synthetic design of a particle, circulation of an item or administration courses correspondence lines etc, Nagoorgani and Rajalakshmi Contributs a notes on fuzzy labelling graphs and properties of fuzzy labelling graph [3] [4]. J. Sedlacek discuss the theory of graphs and its applications [5]. H. Lu. C. W Stratton and Y. W. Tang are examine an outbreak of Pneumonia of unknown etiology in Wuhan China [6], and A. E. Gorbalenya, S. C. Baker, R. S. Baric, R. J. Groot, and C. Prosten contributes the species severe respiratory syndrome-related Coronavirus [7]. Also K. Kalaiarasi and P. Geethanjali [8] gave some ideas in the basic concepts of fuzzy graphs.

Fuzzy labeling graph is quite possibly the main idea in fuzzy graph theory. Here we introduce the application of cactus fuzzy labelling graphs for covid-19. In the first section contains fundamental definitions and the second area we presented cactus fuzzy labeling graphs and cactus fuzzy labeling star graph. In third segment contains the application of today significant danger of Covid-19 we explore the concept of cactus fuzzy labeling graph and the fourth section is we explain the result of cactus fuzzy labeling star graph. Additionally we contribute, some illustration of genuine report of Covid-19 for certain states. Finally we gave the result which state affected highly in covid-19.

2. Preliminaries

Definition 2.1 [2]. "A fuzzy star graph consists of two vertex sets v and u with $(v) = 1$ and $| u | >|$ such that $\Im(v, u_i) > 0$ and $\Im(u_i, u_{i+1}) = 0$ for $0 \leq i \leq n$"

Definition 2.2 [1]. "Let $G = (\wp, \Im)$ be a fuzzy graph. Then the size of G is defined as

$$S(G) = \sum_{u \neq v} \Im(u, v).\text{"}$$

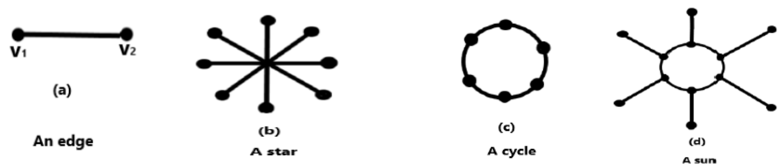
Definition 2.3 [1]. An adjacency fuzzy matrix of the Fuzzy graph is defined as

$$A_{FG} = \begin{cases} \Im(u, v) & \text{if } i, j \text{ in the neighbourhood} \\ 0 & \text{otherwise.} \end{cases}$$

3. Cactus Fuzzy Labeling Graph

Definition 3.1. A fuzzy labeling graph $G = (\wp, \Im)$ is said to be cactus fuzzy labeling graph if every connected fuzzy graph in which any two simple cycles have at most one vertex in common (sometimes called cactus tree). It is signified by $C_{FL}(G)$.

Remark 3.1. A cactus fuzzy labeling graphs have many interesting sub graphs. There are given below.



Definition 3.2. In a fuzzy star graph, if a cactus fuzzy labeling exists then it is called a Cactus fuzzy labeling star graph and it is denoted by $C_{SFL}(G)$.

Definition 3.3. An average number of cactus fuzzy labeling graphs $C_{FL}(G)$ is the sum of the membership values of the edges incident to a vertex.

$$\wp(u) = \sum \frac{1}{n} \Im[E(e)]$$

Where n-number of incident vertex

$\wp(u)$-average membership value of a vertex u and $\Im(E(e))$-membership value of an edge incident to u.

4. Application of Cactus Fuzzy Labeling Graph

Fuzzy labeling graphs have many real-life applications. We are applying the concept of fuzzy labeling graphs in Covid-19 data. Today Covid-19 is the major threat to human lives. Here we take Covid-19 survey in state wise affected patients. We have collected the daily basis data from many websites, for six days. These websites are used for all of our research. In this section to capture affected, discharge and death of Covid-19. In this cactus fuzzy labeling graph is used to represent the Covid-19 affected region in India.

This Coronavirus was first detected in Wuhan, China in December 2019. Then it has been speeding globally. In April 2020 at most all countries were affected by this virus. In India, the first case of Covid-19 infection was reported in Kerala. Here we considered three states survey for Covid-19 affected in India. (link) dated 7th May 2021.

The States and Reports of Covid-19 are assumed as vertices and the edge is connection of two states and connection of one states to report of Covid-19.In table 1-6, figure 1-4 are shows the six days survey of three states and the report of Covid-19 (In daily basis data we collected from website https://bit.ly/3fcg5Am). Here the vertices are denoted by $s_1, s_2, s_3, r_1, r_2, r_3, r_4, r_5, r_6, r_7, r_8, r_9$. Let us assume $\wp(s_1) = 0.0908$, $\wp(r_1) = 0.0501$, $\wp(r_2) = 0.0486$, $\wp(r_3) = 0.0006$, $\wp(s_2) = 0.0563$, $\wp(r_4) = 0.0249$, $\wp(r_5) = 0.0247$, $\wp(r_6) = 0.0002$, $\wp(s_3) = 0.0224$, $\wp(r_7) = 0.0809$, $\wp(r_8) = 0.0645$, $\wp(r_9) = 0.0013$.

$\Im(s_1r_1) = 0.0500$ $\Im(s_1r_2) = 0.0485$ $\Im(s_1r_3) = 0.0005$ $\Im(s_1s_2) = 0.0564$ $\Im(s_1s_3) = 0.0223$ $\Im(s_1r_4) = 0.0248$ $\Im(s_2r_5) = 0.0246$ $\Im(s_2r_6) = 0.0563$ $\Im(s_2s_3) = 0.0222$ $\Im(s_3r_7) = 0.0808$ $\Im(s_3r_8) = 0.0644$ $\Im(s_3r_9) = 0.0012$.

May 1

Table 1.

States\Reports	Affected	Discharge	Death
Maharashtra	0.0501	0.0486	0.0006
Tamil Nadu	0.0249	0.0247	0.0002
Delhi	0.0809	0.0645	0.0013

May 2

Table 2.

States\Reports	Affected	Discharge	Death
Maharashtra	0.0449	0.0407	0.0005
Tamil Nadu	0.0264	0.0224	0.0002

Delhi	0.0654	0.0805	0.0013

May 3

Table 3.

States\Reports	Affected	Discharge	Death
Maharashtra	0.0385	0.0472	0.0004
Tamil Nadu	0.0267	0.0229	0.0002
Delhi	0.0579	0.0742	0.0014

May 4

Table 4.

States\Reports	Affected	Discharge	Death
Maharashtra	0.0411	0.0522	0.0007
Tamil Nadu	0.0270	0.0229	0.0001
Delhi	0.0640	0.0689	0.0011

May 5

Table 5.

States\Reports	Affected	Discharge	Death
Maharashtra	0.0457	0.0452	0.0007
Tamil Nadu	0.0297	0.0255	0.0002
Delhi	0.0672	0.0808	0.0010

May 6

Table 6.

States\Reports	Affected	Discharge	Death
Maharashtra	0.0493	0.0506	0.0007
Tamil Nadu	0.0317	0.0274	0.0002

Delhi	0.0614	0.0754	0.0011

Figure 1-3. x-axis represents the days and y-axis represents the reports.

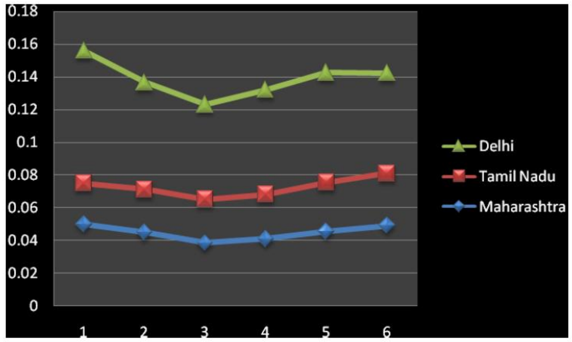


Figure 1. Coronavirus Affected Cases.

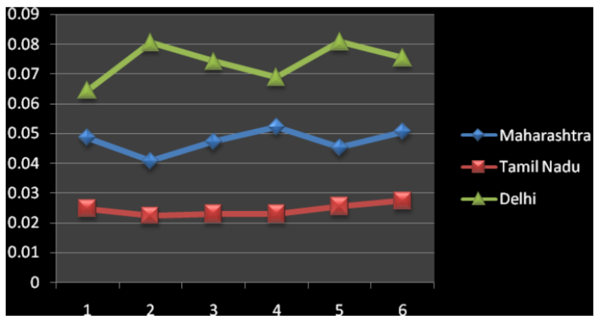


Figure 2. Coronavirus Discharge Cases.

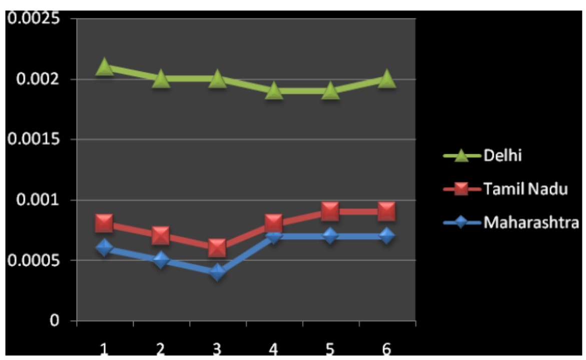


Figure 3. Coronavirus Death Cases.

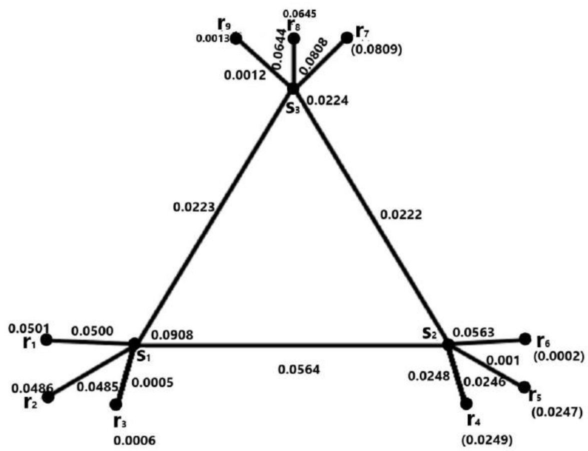


Figure 4. Day wise (In May 1) Report of Cactus Fuzzy Labeling Graph.

Here, s_1, s_2, s_3 represents States and s_1-Maharashtra, s_2-Tamilnadu, s_3- Delhi r_1, r_4, r_7 represents Affected people, r_2, r_5, r_8 represents Discharge people, r_3, r_6, r_9 represents Death people.

Size of cactus fuzzy labeling graph $= 0.3958$.

Adjacency Matrix. $A_{CF}(G) =$

$$\begin{bmatrix} 0 & 0.0500 & 0.0485 & 0.0005 & 0.0564 & 0 & 0 & 0 & 0.0223 & 0 & 0 & 0 \\ 0.0500 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.0485 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.0005 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.0564 & 0 & 0 & 0 & 0 & 0.0248 & 0.0246 & 0.0001 & 0.0222 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.0248 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.0246 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.0001 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.0223 & 0 & 0 & 0 & 0.0222 & 0 & 0 & 0 & 0 & 0.0808 & 0.0644 & 0.0012 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0808 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0644 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0012 & 0 & 0 & 0 \end{bmatrix}$$

Sum of all entries in the adjacency matrix $= 0.7916$.

Result 4.1. In column and row wise vertex S_3 value is large. S_3 is affected Covid-19 highly. S_3 is Delhi.

Hence Delhi affected Covid-19 highly (compare to other two states) in the day of may 1.

Also we find Average number of cactus fuzzy labeling graph.

$$A_{CF}(G) = \sum \frac{1}{n} \Im(E(e)),\ A_{CF}(D) = 0.0382,\ A_{CF}(M) = 0.0355,$$

$$A_{CF}(T) = 0.0256.$$

Also we using the average number formula we get the same result.

Delhi affected Covid-19 highly (compare to other two states) in the day of may 1.

Note 4.1. Sum of all entries in the adjacency matrix is twice the size of cactus fuzzy labeling graph. In table 7 and figure 5 shows the survey (upto may 19) of three states and the report of Covid-19.

Here the vertices are denoted by $s_1, s_2, s_3, r_1, r_2, r_3, r_4, r_5, r_6, r_7, r_8, r_9$. Let us assume, $\wp(s_1) = 0.0908$, $\wp(r_1) = 0.035$, $\wp(r_2) = 0.029$, $\wp(r_3) = 0.0003$, $\wp(s_2) = 0.0565$, $\wp(r_4) = 0.014$, $\wp(r_5) = 0.012$, $\wp(r_6) = 0.002$, $\wp(s_3) = 0.0224$, $\wp(r_7) = 0.04$, $\wp(r_8) = 0.03$, $\wp(r_9) = 0.0006$.

$\Im(s_1r_1) = 0.013$ $\Im(s_1r_2) = 0.011$ $\Im(s_1r_3) = 0.001$ $\Im(s_1s_2) = 0.01 \Im(s_1s_3) = 0.05$ $\Im(s_2r_4) = 0.004$ $\Im(s_2r_5) = 0.005$ $\Im(s_2r_6) = 0.0001$ $\Im(s_2s_3) = 0.003$ $\Im(s_3r_7) = 0.034$ $\Im(s_3r_8) = 0.028$ $\Im(s_3r_9) = 0.0003$.

Table 7.

States	State value	Affected	Discharge	Death
Maharashtra	0.0908	0.035	0.029	0.0003
Tamil Nadu	0.0565	0.014	0.012	0.002
Delhi	0.0224	0.04	0.03	0.0006

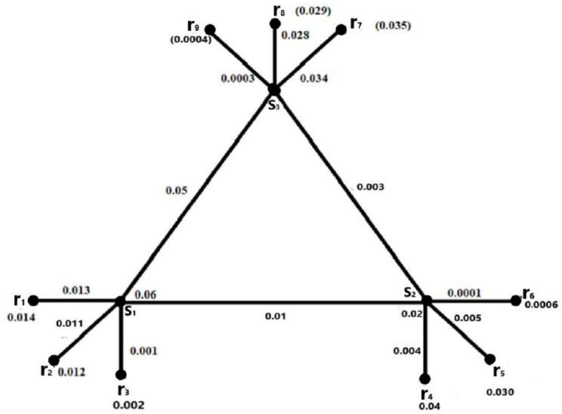


Figure 5. Covid-19 Report of Cactus Fuzzy Labeling Graph.

Here s_1, s_2, s_3 represents States. s_1-Tamilnadu, s_2-Delhi, s_3-Maharashtra and r_1, r_4, r_7 represents Affected people, r_2, r_5, r_8 represents Discharge people, r_3, r_6, r_9 represents Death people.

Size of cactus fuzzy labeling graph $= 0.1594$.

Adjacency matrix. $A_{CF}(G) =$

$$\begin{bmatrix} 0 & 0.013 & 0.011 & 0.001 & 0.01 & 0 & 0 & 0 & 0.05 & 0 & 0 & 0 \\ 0.013 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.011 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.001 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.01 & 0 & 0 & 0 & 0 & 0.004 & 0.005 & 0.0001 & 0.003 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.004 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.005 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.0001 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.05 & 0 & 0 & 0 & 0.003 & 0 & 0 & 0 & 0 & 0.034 & 0.028 & 0.0003 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.034 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.028 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0003 & 0 & 0 & 0 \end{bmatrix}$$

Sum of all entries in the adjacent matrix $= 0.3188$.

Result 4.2. In column and row wise the vertex S_3 value is high. S_3 is affected covid-19 highly. S_3 is Maharashtra.

Hence Maharashtra affected Covid-19 highly.

Also we find average numbers of cactus fuzzy labeling graph.

$$A_{CF}(G) = \sum \frac{1}{n} \Im(E(e)),$$

$$A_{CF}(T) = 0.017,\ A_{CF}(D) = 0.0044,\ A_{CF}(M) = 0.0231.$$

$\therefore$ Maharashtra affected Covid-19 highly.

Note 4.2. Sum of all entries in the adjacency matrix is twice the size of cactus fuzzy labeling graph.

5. Cactus Subgraph of Fuzzy Labeling Graph

The example of cactus fuzzy labeling graph have many sub graphs. Star graph is one of the sub graph of cactus fuzzy labeling graph. In Figure 6-8 shows the cactus fuzzy labeling star graph.

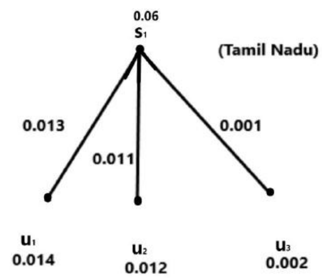


Figure 6.

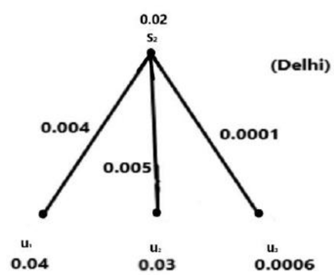


Figure 7.

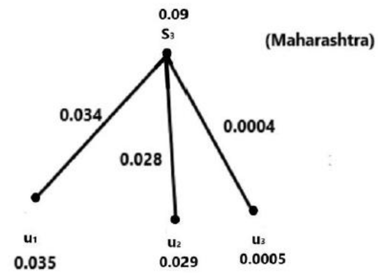


Figure 8.

We find size of cactus fuzzy labeling subgraph in above graphs,

$$S(s_1) = 0.025,\ S(s_2) = 0.0091,\ S(s_3) = 0.0624.$$

Here, s_1, s_2, s_3 represents States and u_1, u_2, u_3 represents Affected, discharge and Death. Size of v_3 value is high.

$\therefore S_3$ is affected covid-19 highly S_3 is Maharashtra.

Hence Maharashtra affected Covid-19 highly.

Conclusion

In this paper, an idea of cactus fuzzy labeling graph has been presented. More over the term Average number is defined. The sub graph of cactus fuzzy labeling graphs that is the star cactus fuzzy labeling graphs are also examined. The principle work of this paper is we investigate the idea of cactus fuzzy labeling graph and we likewise apply average number of cactus fuzzy labeling graph for three states of Covid-19 data. Finally we gave the outcome which state influenced profoundly in Coronavirus.

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