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APPLICATION OF FUZZY NETWORK GRAPH IN HOSPITAL

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Abstract

In this paper symptoms and diseases of diabetic patient are explained and represented as a fuzzy network graph. If the relationship among them measured as strong or weak based on the strong symptoms, fuzziness should be added to representation.

I. Introduction

1.1. Network

Network analysis has originated as a branch of sociology and mathematics which provides formal models and methods for the systematic study of social structures and it has an especially long tradition in sociology, social psychology and anthropology. But concepts of network analysis capture the common properties of all networks and its methods are applicable to the analysis of networks in general. Network analysis is carried out in area such as project planning, complex systems, electrical circuits, social networks, transportation systems, communication networks, epidemiology,

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bioinformatics, hypertext systems, text analysis, organization theory, event analysis, bibliometrics, genealogical research, and others [1].

1.2. Graph theory

Graph theory is a very important tool to represent many real world problems. Nowadays graphs do not represent all the systems properly due to the uncertainty or haziness of the parameters of systems. Crisp graph and fuzzy graph both are structurally similar. But when there is an uncertainty on vertices and /or edges the fuzzy graph has a separate importance. Applications of fuzzy graph include data mining, image segmentation, clustering, image capturing, networking, communication, planning, scheduling, etc [2].

1.3. Fractals

The word Fractal was coined by Mandelbrot in his fundamental essay from the Latin fractus meaning broken, to describe the objects that were too irregular to fit into a traditional geometrical setting [7, 8]. Many fractals have some degree of self-similarity - they are made up parts that resemble the whole in some way. Sometimes, the resemblance may be weaker than strict geometrical similarity for example the similarity may be approximate or statistical. Sierpinski Triangle, Cantor Set and Von Koch Curve are the examples of fractals. He defined a fractal to be a set with Hausdorff dimension strictly greater than its topological dimensions.

Fractal has some form of self-similarity, perhaps approximate or statistical. The main tool of fractal geometry is dimension in its many forms. Fractals are used to describe the roughness of surfaces. A rough surface is characterized by a combination of two different fractals [6, 8].

1.4. Diabetes

Diabetes care is complex [9, 8]. The side effects of Diabetes, medications and the uncertainties of adherence to treatment, decision-making becomes more difficult. By adding hypertension, dyslipidemia and obesity, many or all of which are found in most people with Diabetes, and the treatment options become even more complex [8].

R. Radha [10] explained fuzzy relations between symptoms and diseases of Diabetic patients. In section 2 some basic definitions are discussed and in section 3 methods of fuzzy network graph between diabetic patients, symptoms and related diseases are discussed.

II. Prelimininaries

2.1. Fuzzy set [2]**.** A fuzzy set A on a set X is characterized by a mapping $m : X \to [0, 1]$, which is called the membership function. A fuzzy set is denoted by $A = (X, m)$.

2.2. Fuzzy Graph [3]**.** A fuzzy graph $\xi = (V, \sigma, \mu)$ is an algebraic structure of non-empty set V together with a pair of functions $\sigma : V \to [0, 1]$ and $\mu : V \times V \to [0, 1]$ such that for all $x, y \in V$, $\mu(x, y) \leq \sigma(x) \wedge \sigma(y)$ and μ is a symmetric fuzzy relation on σ.

Here $\sigma(x)$ and $\mu(x, y)$ represent the membership values of the vertex x and of the edge (x, y) in ξ respectively. The fuzzy graph $\xi_1 = (V\sigma_1, \mu_1)$ is called a fuzzy subgraph of $\xi = (V, \sigma, \mu)$ if $\sigma_1(x) \leq \sigma(x)$ for all x and $\mu_1(x, y) \leq \mu(x, y)$ for all edges (x, y), $x, y \in V$.

2.3. Strong Fuzzy graph [4]**.** For the fuzzy graph $\xi = (V, \sigma, \mu)$ an edge (x, y), $x, y \in V$ is called strong if $1/2\{\sigma(x) \wedge \sigma(y)\} \leq \mu(x, y)$ and it is called weak otherwise.

The strength of an edge (u, v) is denoted by $I(u, v) = \mu(u, v)/\sigma(u) \wedge \sigma(v)$.

2.4. Connected Graph [5]**.** A path in ξ is a sequence of vertices $x_0, x_1, \ldots, x_n$, such that $\mu(x_{i-1}, x_1) > 0$ and $i = 1, 2, \ldots, n$. The path is said to have length n.

Two nodes that are joined by a path are said to be connected. A component of a fuzzy graph is the fuzzy sub graph such that any two vertices are connected by path. So, a fuzzy graph is said to be connected fuzzy graph if it has one component and disconnected otherwise.

2.5. Strength of the path [2]**.** The strength of a path is defined as $\min\{\mu(x_{i1}, x_i) : i = 1, 2, 3, \ldots, n\}$. In other words, strength of a path is the weight (membership value) of the weakest arc of the path. The strength of connectness between two nodes x and y is defined as the maximum of the strengths of all paths between x and y and it is denoted by $CONN_G(x, y)$.

III. Methods

Symptoms for diabetic general (initial stage) [10]**.** Fatigue, weight loss, polydipsia, polyuria, altered mental status, polyphagia.

Symptoms of diabetic ketoacidosis [10]**.** Nausea and vomiting, dehydration, abdominal pain, low blood pressure, polyuria, thirsty, loss of appetite, dry skin, dry mouth.

Symptoms of diabetic nephropathy [10]**.** Loss of appetite, nausea and vomiting, polyuria, swelling of legs and puffiness around the eyes, itching, easy bruising, pale skin, headaches, numbness in the feet or hands, disturbed sleep, bleeding, high blood pressure, bone pain, decreased sexual interest and erectile dysfunction.

Symptoms of diabetic retinopathy [10]**.** All the symptoms similar to staring stage of diabetic, mild to severe blurring or vision loss, cataract, glaucoma.

Let S denote the crisp universal set of all symptoms $S = \{s_1, s_2, s_3, s_4,\}$

Let D be the crisp universal set of all diseases $D = (d_1, d_2, d_3, d_4)$.

Let P be the crisp of universal set of all patients. $P = \{p_1, p_2, p_3, p_4\}$.

- $D_1 = DIABETIC\ GENERAL$
- $D_2 = DIABETIC\ NEPHROPATHY$
- $D_3 = DIABETIC\ KETOACDOSIS$
- $D_4 = DIABETIC\ RETINOPATHY$

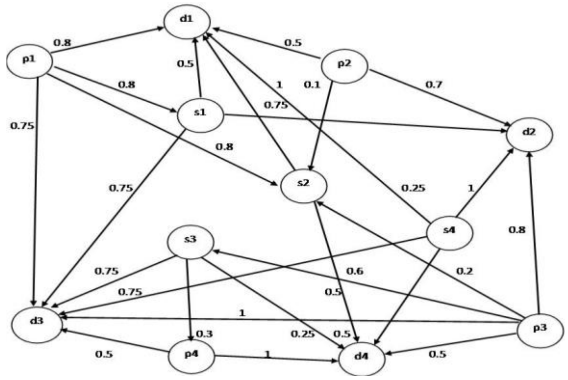

Figure 1. Fuzzy Network graph between patients, symptoms and diseases.

Based on 2.5 and from the Figure 1 the strength of path is given below

Path	Strength
$S_1 - \to D_1 - \to P_1$	0.75
$S_2 - \to D_2 - \to P_1$	0.10
$S_3 - \to D_3 - \to P_1$	0.75
$S_4 - \to D_4 - \to P_1$	0.25
$S_1 - \to D_1 - \to P_2$	0.50
$S_2 - \to D_2 - \to P_2$	0.25
$S_3 - \to D_3 - \to P_2$	0.75
$S_4 - \to D_4 - \to P_2$	0.50
$S_1 - \to D_1 - \to P_3$	0.50
$S_2 - \to D_2 - \to P_3$	0.75
$S_3 - \to D_3 - \to P_3$	0.75
$S_4 - \to D_4 - \to P_3$	0.50
$S_1 - \to D_1 - \to P_4$	0.50

$S_2 - \to D_2 - \to P_4$ 0.25

$S_3 - \to D_3 - \to P_4$ 0.50

$S_4 - \to D_4 - \to P_4$ 0.50.

From the definition 2.5, The maximum strength of all paths $\max\{0.1, 0.25, 0.5, 0.75\} = 0.75 = CONN_G$. Thus, the strongest path is $S_1 - \to D_1 - \to P_1$, $S_3 - \to D_3 - \to P_1$, $S_3 - \to D_3 - \to P_2$, $S_2 - \to D_2 - \to P_3$, $S_3 \to D_3 \to P_3$.

IV. Conclusion

From the Figure 1 it clearly shows that symptoms 3 for patient 3 confirmed diseases D3 and symptoms 4 and diseases 4 is confirmed for patient 4. Each network is different and has irregularity between them, it shows that it has fractal.

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