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BIPOLAR p- $degree$ PERFECT FUZZY MATCHING FOR BIPOLAR FUZZY GRAPHS BASED ON VERTICES

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ABSTRACT

A Graph is a convenient way of representing information involving relationships between objects. The objects are represented by vertices and edges. When there is vagueness in the description of the objects or in its relationships or in both, it is natural that we need to design a fuzzy graph model. Recently bipolar fuzzy graph is a growing research topic as it is the generalization of fuzzy graph. In this paper, we introduced Bipolar p-$degree$ Perfect Fuzzy Matching for Bipolar Fuzzy Graph based on vertices.

Keywords: Fuzzy Graph, Bipolar p-$degree$ Fuzzy Matching, Bipolar p-$degree$ Perfect Fuzzy Matching, Bipolar p-$degree$ Fuzzy Matching number.

1. INTRODUCTION

In mathematics, graph theory is the study of graphs which are mathematical structures used to model pairwise relations between objects. A graph in this context is made up of vertices which are connected by edges. Fuzzy Graph theory has wider range of applications like research, artificial intelligence, neural networks and other fields. In 1965, Zadeh [8] introduced the notation of fuzzy subset for a set. Then, the theory of fuzzy sets has become a vigorous area of research in different disciplines. In 1975, Rosenfeld [3] discussed the concept of fuzzy graphs. In 1994, Zhang [9] initiated the concept of bipolar fuzzy sets as the generalization of fuzzy sets

2. Preliminaries

Definition 2.1:

A fuzzy graph $G: (\sigma, \mu)$ is a pair of functions (σ, μ) where, $\sigma : V \to [0, 1]$ is a fuzzy subset of a non-empty set V and $\mu : V \times V \to [0,1]$ is a symmetric fuzzy relation on σ such that for all u, v in V, the relation $\mu(u,v) \leq \sigma(u) \wedge \sigma(v)$ is satisfied. A fuzzy graph G is called complete fuzzy graph if the relation $\mu(u,v) = \sigma(u) \wedge \sigma(v)$ is satisfied.

Definition 2.2:

Let $G: (\sigma, \mu)$ be a fuzzy graph. The $d_P - degree$ of a vertex u in G is denoted by $d_P(u)$ means the numberof vertices at a distance p away from u. The $d_P - degree$ of a vertex u in G is $d_P(u) = \sum \mu^p(u,v)$ where

$\mu^p(u,v) = \{\mu(u,v_1) \wedge \mu(v_1,v_2) \wedge \ldots \wedge \mu(v_{n-1},v)\}$. Also $\mu(u,v) = 0$ for $(u,v) \notin E$.The minimum $d_p - degree$ of G is $\delta_p(G) = \wedge\{d_p(u)/ u \in V\}$. The maximum $d_p - degree$ of G is $\triangle_p(G) = \vee\{d_p(u)/ u \in V\}$.

Definition 2.3:

A bipolar fuzzy graph with an underlying set V is defined to be the pair $G : (A,B)$ where $A = (m_1^+, m_1^-)$ is a bipolar fuzzy set on V and $B = (m_2^+, m_2^-)$ is a bipolar fuzzy set on E such that $m_2^+(u,v) \leq \min\{m_1^+(u), m_1^+(v)\}$ and $m_2^-(u,v) \geq \max\{m_1^-(u), m_1^-(v)\}$ for all $(u,v) \in E$. Here A is called a bipolar fuzzy vertex set of V and B is called a bipolar fuzzy edge set of E.

3. Bipolar $p - degree$ Perfect Fuzzy Matching

Definition 3.1:

Let $G : (A,B)$ be a bipolar fuzzy graph where $A = (m_1^+, m_1^-)$ and $B = (m_2^+, m_2^-)$ be two bipolar fuzzy sets on a non-empty finite set V and $E \subset V \times V$ respectively. A subset S of V is called a bipolar $p - degree$ fuzzy matching if for each vertex u, we have $\sum_{\substack{u \neq v \\ u,v \in V}} m_2^{(p,+)}(u,v) \leq m_1^+(u)$ and $\sum_{\substack{u \neq v \\ u,v \in V}} m_2^{(p,-)}(u,v) \geq m_1^-(u)$

Definition 3.2:

A bipolar $p - degree$ fuzzy matching S is called a bipolar second degree perfect fuzzy matching if,$\sum_{\substack{u \neq v \\ u,v \in V}} m_2^{(p,+)}(u,v) = m_1^+(u)$ and $\sum_{\substack{u \neq v \\ u,v \in V}} m_2^{(p,-)}(u,v) = m_1^-(u)$

Definition 3.3:

Let G be a bipolar fuzzy graph on the underlying graph (V,E). Let S be a bipolar $p - degree$ fuzzy matching for G. The bipolar $p - degree$ fuzzy matching number $\Gamma(G)$ is defined as:

$$\Gamma(G) = \left(\sum_{u \in S} m_2^{(p,+)}(u,v), \sum_{u \in S} m_2^{(p,-)}(u,v)\right)$$

Theorem

Let $G : (A,B)$ be a bipolar fuzzy graph on the cycle $G^*: (V,E)$. Then edges of the bipolar fuzzy graph of G is half of their vertices iff all the vertices of G are bipolar $p - degree$ perfect fuzzy matching and is equivalent to $(p,(k_1,k_2))$ is regular bipolar fuzzy graph.

Proof

Suppose that $m_1^+(u)$ and $m_1^-(u)$ are constant functions. Let $m_1^+(u) = k_1$ and $m_1^-(u) = k_2$ for all $u \in V$, $m_2^+(u,v) = {}^{k_1}/_2$ and $m_2^-(u,v) = {}^{k_2}/_2$ for all $(u,v) \in E$. Assume that G is a $(p,(k_1,k_2))$ regular bipolar fuzzy graph on the cycle $G^*:(V,E)$. Then $d_p^+(u) = k_1$ and $d_p^-(u) = k_2$ (i.e.) $d_p(u) = (k_1,k_2)$. By the definition of $d_p - degree$ of vertex in bipolar fuzzy graph $d_p^+(u) = \sum_{\substack{u\neq v\\ u,v\in V}} m_2^{(p,+)}(u,v)$ and $d_p^-(u) = \sum_{\substack{u\neq v\\ u,v\in V}} m_2^{(p,-)}(u,v)$. Since G is $(p,(k_1,k_2))$– regular bipolar fuzzy graph. Each vertex of u satisfies the bipolar $p - degree$ perfect fuzzy matching in G. Now suppose that G is a bipolar $p - degree$ perfect fuzzy matching on G. Since G is a bipolar fuzzy graph on the cycle and only two edges are incident with each vertex for cycles. $d_p^-(u) = \sum_{\substack{u\neq v\\ u,v\in V}} m_2^{(p,-)}(u,v) \Longrightarrow d_p^+(u) = k_1$ and $d_p^-(u) = k_2$. Hence G is a $(p,(k_1,k_2))$ regular bipolar fuzzy graph. The converse of the theorem is trivially true.

III.CONCLUSION

In this paper, we have introduced bipolar $p - degree$ perfect fuzzy matching for bipolar fuzzy graph based on vertices on the cycle. We proved the necessary conditions under which they are equivalent and also proved that, for a particular condition, a bipolar p degree perfect fuzzy matching is not a $(p,(k_1,k_2))$ – regular bipolar fuzzy graph. We also discussed bipolar p degree perfect fuzzy matching and bipolar $p - degree$ perfect fuzzy matching number for cycle graph. In future, we will extend this work for complete graph, regular graph and finally for any connected graph.

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