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Square Perfect Fuzzy Matching

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Abstract. Necessary and Sufficient conditions are given for a fuzzy graph on a cycle or a complete graph to be a square perfect fuzzy matching. As a consequence, it is shown that at a particular condition a square perfect fuzzy matching is not a $(2, k)$ regular fuzzy graph.

Keywords: Fuzzy graph, square fuzzy matching, square perfect fuzzy matching, regular fuzzy graph.

AMS Mathematics Subject Classification (2010): 03E72, 05C72, 05C12

1. Introduction

In 1965, Zadeh introduced the concept of a fuzzy set and fuzzy relation to representing the phenomena of uncertainly in real world problem. In 1975, Rosenfeld [4] introduced the concept of fuzzy graph Nagoor Gani and Radha [3] introduced on Regular fuzzy graph. Alison Northup [1] studied some properties on $(2, k)$ regular graph in her bachelor thesis. In [7], the authors introduced d_2 of a vertex in product graphs and also they discussed on $(2, k)$ regular and totally $(2, k)$ regular fuzzy graphs in [6]. Seethalakshmi and Gnanajothi studied about perfect fuzzy matching [8]. In this paper, we introduce square fuzzy matching and square perfect fuzzy matching. We derive the necessary and sufficient condition for the fuzzy graph on a cycle or a complete graph to be square perfect fuzzy matching. Also, we discuss some properties of square perfect fuzzy matching with examples.

2. Preliminaries

In this section, some basic definitions are given.

Definition 2.1. [4] A fuzzy graph G is a pair of function $G: (\sigma, \mu)$ where σ is a fuzzy subset of a non empty set V and μ is a symmetric fuzzy relation on σ. The underlying crisp graph of $G: (\sigma, \mu)$ denoted by $G^*: (V, E)$ where $E \subseteq V \times V$. A fuzzy graph G is complete if $\mu(u, v) = \mu(uv) = \sigma(u) \wedge \sigma(v)$ for all $u, v \in E$ where uv denotes the edge between u and v.

Definition 2.2. [3] Let $G: (\sigma, \mu)$ be a fuzzy graph. The degree of a vertex u is $d(u) = \sum_{u \neq v} \mu(u, v)$. Since $\mu(uv) > 0$ for $uv \in E$ and $\mu(uv) = 0$ for uv $\notin E$, this is equivalent to $d(u) = \sum_{uv \in E} \mu(u,v)$. The minimum degree of G is $\delta(G) = \wedge\{d(u)/u \in V\}$. The maximum degree of G is $\Delta(G) = \vee\{d(u)/ u \in V\}$.

Definition 2.3. [7] For a given graph G, the d_2 degree of a vertex u in G,denoted by $d_2(u)$ means number of vertices at a distance two away from u.

Definition 2.4. [6] Let $G: (\sigma, \mu)$ be a fuzzy graph. The d_2 degree of a vertex u is $d_2(u) = \sum_{u \neq v} \mu^2(u,v)$, where $\mu^2(u,v) = \{\mu(u,u_1) \wedge \mu(u_1,v)$. Also $\mu(uv) = 0$, for uv $\notin E$. The minimum d_2 degree of G is $\delta(G) = \wedge\{ d_2(u)/ u \in V\}$. The maximum d_2 degree of G is $\Delta(G) = \vee\{ d_2(u)/ u \in V\}$.

Definition 2.5. [7] A graph G is said to be $(2,k)$ regular, (d_2 - regular) if $d_2(u) = k$, for all u in G.

Definition 2.6. [3] Let $G: (\sigma, \mu)$ be a fuzzy graph on $G^*: (V, E)$. If $d_G(u) = k$ for all $u \in V$, (i.e.,) if each vertex has same degree k, then G is said to be a regular fuzzy graph of degree k or a k regular fuzzy graph.

Definition 2.7. [6] Let $G: (\sigma, \mu)$ be a fuzzy graph on $G^*: (V, E)$. If $d_2(u) = k$ for all $u \in V$, then G is said to be $(2, k)$ regular fuzzy graph.

3. Square perfect fuzzy matching

Definition 3.1. Let $G: (\sigma, \mu)$ be a fuzzy graph on $G: (V, E)$. A subset M of E is called a square fuzzy matching if for each vertex u, we have $\sum_{v \in V} \mu^2(u,v) \leq \sigma(u)$.

Example 3.2. Let $G : (\sigma, \mu)$ be a fuzzy graph on the cycle $G^*: (V, E)$ where $V = \{ v_1, v_2, v_3, v_4 \}$ and $E = \{ e_1, e_2, e_3, e_4 \}$ with $e_1 = v_1v_2$, $e_2 = v_2v_3, e_3 = v_3v_4, e_4 = v_4v_1$. $\sigma(v_1) = 0.7$, $\sigma(v_2) = 0.5$, $\sigma(v_3) = 0.4, \sigma(v_4) = 0.7$.
$\mu(e_1) = 0.3$, $\mu(e_2) = 0.4$, $\mu(e_3) = 0.2, \mu(e_4) = 0.5$

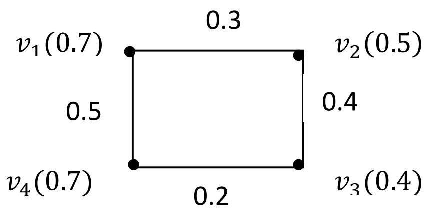

Figure 1:

$$\sum_{\substack{v_2 \in V \\ (v_1,v_2) \in M}} \mu^2(v_1,v_2) = \sum_{v_2 \in V} \left(\mu(v_1,u) \wedge \mu(u,v_2)\right) = 0.3 \wedge 0.4 + 0.2 \wedge 0.5$$

$$= 0.3 + 0.2 = 0.5 \leq \sigma(v_1)$$

$$\sum_{\substack{v_3 \in V \\ (v_2,v_3) \in M}} \mu^2(v_2,v_3) = 0.4 \wedge 0.2 + 0.3 \wedge 0.5 = 0.2 + 0.3 = 0.5 = \sigma(v_2)$$

$$\sum_{\substack{v_4 \in V \\ (v_3,v_4) \in M}} \mu^2(v_3, v_4) = 0.2 \wedge 0.5 + 0.3 \wedge 0.4 = 0.2 + 0.3 = 0.5 \nleq \sigma(v_3)$$

$$\sum_{\substack{v_1 \in V \\ (v_4,v_1) \in M}} \mu^2(v_4, v_1) = 0.5 \wedge 0.3 + 0.2 \wedge 0.4 = 0.3 + 0.2 = 0.5 \leq \sigma(v_4)$$

Thus $M = \{ e_1, e_2, e_4 \}$ is a square fuzzy matching in G.

Definition 3.3. A square fuzzy matching M is called a square perfect fuzzy matching if $\sum_{v \in V} \mu^2(u, v) = \sigma(u)$.

Definition 3.4. Let $G: (\sigma, \mu)$ be a fuzzy graph and M be a square fuzzy matching. Then square fuzzy matching number $\Gamma(G)$ is defined to be $\Gamma(G) = \sum_{\substack{v \in M \\ (u,v) \in M}} \mu^2(u, v)$.

Example 3.5. In example 3.2, $\Gamma(G) = 1.5$.

Theorem 3.6. Let $G: (\sigma, \mu)$ be a fuzzy graph on the cycle $G^*: (V, E)$. Then $\sigma(u) = k$ is a constant function for all $u \in V$ and $\mu(u, v) = \frac{k}{2}$ for all $(u, v) \in E$ if and only if the following statement are equivalent

(i) E is a square perfect fuzzy matching

(ii) $(2, k)$ regular fuzzy graph.

Proof: Suppose that σ is a constant function. Let $\sigma(u) = k$ is a constant, for all $u \in V$ and $\mu(u, v) = \frac{k}{2}$ for all $(u, v) \in E$. Assume that G is a $(2, k)$ regular fuzzy graph on the cycle $G^*: (V, E)$. Then $d_2(u) = k$. By definition of d_2- degree of a vertex in fuzzy graph ie., $\sum \mu^2(u, v) = d_2(u)$

$\Rightarrow \sum \mu^2(u, v) = k$ for all $u \in V$. Since G is a $(2, k)$ regular fuzzy graph.

$\Rightarrow \sum \mu^2(u, v) = \sigma(u)$ for all $u \in V$.

Each vertex of u is satisfies the square perfect fuzzy matching in G.

Thus (ii) $\Rightarrow$(i)

Now, suppose that E is a square perfect fuzzy matching on G.Since G is a fuzzy graph on the cycle and only two edges are incident with each vertex for cycles, for any vertex $u \in V$.

$\Rightarrow \sum_{\substack{v \in V \\ (u,v) \in M}} \mu^2(u, v)$ where $v, w \in V = \sigma(u)$.

$\Rightarrow \sum_{\substack{v \in V \\ (u,v) \in M}} \mu^2(u, v) = k$ for all $u \in V$.

$\Rightarrow d_2(u) = \sum_{\substack{v \in V \\ (u,v) \in M}} \mu^2(u, v) = k$ for all $u \in V$.

Hence G is a $(2, k)$ regular fuzzy graph on cycle. Thus (i)$\Rightarrow$ (ii). Therefore, (i) $\Leftrightarrow$ (ii)

The converse parts holds trivially.

Example 3.7. Let $G: (\sigma, \mu)$ be a fuzzy graph on the cycle $G^*: (V, E)$ where V = $\{ v_1, v_2, v_3, v_4 \}$ and E = $\{ e_1, e_2, e_3, e_4 \}$ with $e_1 = v_1 v_2$, $e_2 = v_2 v_3, e_3 = v_3 v_4, e_4 = v_4 v_1$.

$\sigma(v_1) = 0.8$, $\sigma(v_2) = 0.8$,$\sigma(v_3) = 0.8$,$\sigma(v_4) = 0.8$

$\mu(e_1) = 0.4$, $\mu(e_2) = 0.4$,$\mu(e_3) = 0.4$,$\mu(e_4) = 0.4$.

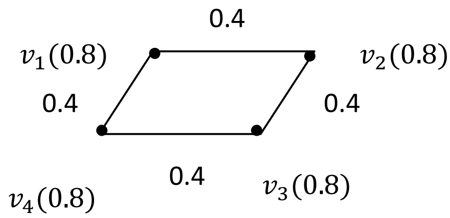

Figure 2:

$$\sum_{\substack{v_2\in V\\(v_1,v_2)\in M}} \mu^2(v_1,v_2) = \sum_{v_2\in V} (\mu\,(v_1,u)\wedge\mu\,(u,v_2))$$

$$= 0.4\wedge 0.4 + 0.4\wedge 0.4 = 0.4 + 0.4 = 0.8 = \sigma(v_1)$$

$$\sum_{\substack{v_3\in V\\(v_2,v_3)\in M}} \mu^2(v_2,v_3) = 0.4\wedge 0.4 + 0.4\wedge 0.4 = 0.4 + 0.4 = 0.8 = \sigma(v_2)$$

$$\sum_{\substack{v_4\in V\\(v_3,v_4)\in M}} \mu^2(v_3,v_4) = 0.4\wedge 0.4 + 0.4\wedge 0.4 = 0.4 + 0.4 = 0.8 = \sigma(v_3)$$

$$\sum_{\substack{v_1\in V\\(v_4,v_1)\in M}} \mu^2(v_4,v_1) = 0.4\wedge 0.4 + 0.4\wedge 0.4 = 0.4 + 0.4 = 0.8 = \sigma(v_4)$$

Hence G is a square perfect fuzzy matching and also $(2,k)$ regular fuzzy graph.

Example 3.8. In example 3.7, $\Gamma(G) = 3.2$.

Theorem 3.9. Let G : (σ,μ) be a $(2,k)$ regular fuzzy graph on the cycle $G^*: (V, E)$. If $\sigma(u) = k$ which is a constant function for all $u\in V$ and $\mu(u,v) = c$ where $c\le k$ and $c\neq \frac{k}{2}$ for all $(u,v)\in E$. Then E is not a square perfect fuzzy matching on G.

Proof: Suppose that G is a fuzzy graph on the cycle and only two edges are incident with each vertex for cycles, for any vertex $u\in V$.

$$\Rightarrow \sum_{\substack{v\in V\\(u,v)\in M}} \mu^2(u,v) \text{ where } v,w\in V = \mu^2(u,v)+\mu^2(v,w)$$

$$= \mu\,(u,u_1)\wedge\mu\,(u_1,v) + \mu\,(v,u_n)\wedge\mu\,(u_n,w)$$

$$= c\wedge c + c\wedge c = c+c = 2c \le k$$

$$= c \le \frac{k}{2}, \text{ but } c\neq\frac{k}{2}$$

$$= c < k/2 .$$

Similarly $c > k/2$

$$\Rightarrow \sum_{\substack{v\in V\\(u,v)\in M}} \mu^2(u,v) \neq k \text{ for all } u\in V$$

$$\Rightarrow \sum_{\substack{v\in V\\(u,v)\in M}} \mu^2(u,v) \neq \sigma(u) \text{ for all } u\in V .$$

Hence, E is not a square perfect fuzzy matching on G.

Remark 3.10. The condition $\mu\,(u,v) = k/2$ is essential in theorem 3.6.This is illustrate with the following example.

Example 3.11. Let $G:(\sigma,\mu)$ be a fuzzy graph on the cycle $G^*:(V,E)$ where $V = \{v_1, v_2, v_3, v_4\}$ and $E = \{e_1, e_2, e_3, e_4\}$ with $e_1 = v_1v_2$, $e_2 = v_2v_3, e_3 = v_3v_4, e_4 = v_4v_1$.
$\sigma(v_1) = 0.8$, $\sigma(v_2) = 0.8$, $\sigma(v_3) = 0.8$, $\sigma(v_4) = 0.8$; $\mu(e_1) = 0.5$, $\mu(e_2) = 0.5$,$\mu(e_3) = 0.5$, $\mu(e_4) = 0.5$

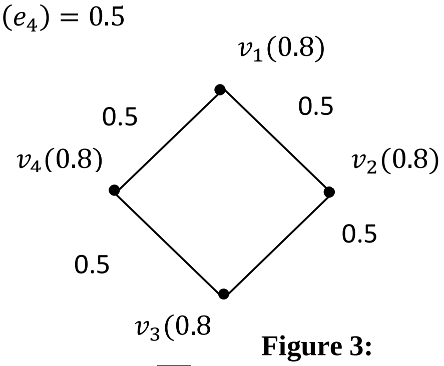

Figure 3:

$$\sum_{\substack{v_2\in V\\(v_1,v_2)\in M}} \mu^2(v_1,v_2) = \sum_{v_2\in V} (\mu(v_1,u) \wedge \mu(u,v_2)) = 0.5\wedge 0.5 + 0.5\wedge 0.5$$

$$= 0.5 + 0.5 = 1 \neq \sigma(v_1)$$

$$\sum_{\substack{v_3\in V\\(v_2,v_3)\in M}} \mu^2(v_2,v_3) = 0.5\wedge 0.5 + 0.5\wedge 0.5 = 0.5 + 0.5 = 1 \neq \sigma(v_2)$$

$$\sum_{\substack{v_4\in V\\(v_3,v_4)\in M}} \mu^2(v_3,v_4) = 0.5\wedge 0.5 + 0.5\wedge 0.5 = 0.5 + 0.5 = 1 \neq \sigma(v_3)$$

$$\sum_{\substack{v_1\in V\\(v_4,v_1)\in M}} \mu^2(v_4,v_1) = 0.5\wedge 0.5 + 0.5\wedge 0.5 = 0.5 + 0.5 = 1 \neq \sigma(v_4)$$

Hence G is not a square perfect fuzzy matching.

Theorem 3.12. Let $G:(\sigma,\mu)$ be a square perfect fuzzy matching on the cycle $G^*:(V,E)$ of length ≥ 5. If $\sigma(u_i) = \begin{cases} \frac{3k}{4} & ,i = 1,2,n-1,n \\ k & ,i = 3,4,\dots,n-2 \end{cases}$ for all $u \in V$ and $\mu(e_i) = \begin{cases} \frac{k}{2} & ,i = 1,2,\dots,n-1 \\ \frac{k}{4} & ,\quad i = n \end{cases}$
for all $(u,v) \in E$. Then G is not a $(2,k)$ regular fuzzy graph.

Proof: Let G : (σ,μ) be a square perfect fuzzy matching on the cycle on $G^*:(V,E)$ is any cycle of length ≥ 5. Let $e_1, e_2, \dots, e_n$ be edges of a cycle of G^*in that order.

$$d_2(u) = \sum_{\substack{v\in V\\(u,v)\in M}} \mu^2(u,v)$$

$$d_2(u_1) = \mu(e_1) \wedge \mu(e_2) + \mu(e_n) \wedge \mu(e_{n-1}) = \frac{k}{2}\wedge\frac{k}{2} + \frac{k}{4}\wedge\frac{k}{2} = \frac{3k}{4} = \sigma(u_1)$$

$$d_2(u_2) = \mu(e_1) \wedge \mu(e_n) + \mu(e_2) \wedge \mu(e_3) = \frac{k}{2}\wedge\frac{k}{4} + \frac{k}{2}\wedge\frac{k}{2} = \frac{k}{4} + \frac{k}{2} = \frac{3k}{4} = \sigma(u_2).$$

For $i = 3,4,\dots,n-2$

$d_2(u_i) = \mu(e_{i-1}) \wedge \mu(e_{i-2}) + \mu(e_i) \wedge \mu(e_{i+1}) = \frac{k}{2} \wedge \frac{k}{2} + \frac{k}{2} \wedge \frac{k}{2} = k = \sigma(u_i)$

$d_2(u_{n-1}) = \mu(e_{n-2}) \wedge \mu(e_{n-3}) + \mu(e_{n-1}) \wedge \mu(e_n) = \frac{k}{2} \wedge \frac{k}{2} + \frac{k}{2} \wedge \frac{k}{4} = \frac{3k}{4} = \sigma(u_{n-1})$

$d_2(u_n) = \mu(e_1) \wedge \mu(e_n) + \mu(e_{n-1}) \wedge \mu(e_{n-2}) = \frac{k}{2} \wedge \frac{k}{4} + \frac{k}{2} \wedge \frac{k}{2} = \frac{3k}{4} = \sigma(u_n)$.

Hence G is not a $(2,k)$ regular fuzzy graph.

Example 3.13. Let $G : (\sigma,\mu)$ be a fuzzy graph on the cycle $G^* : (V, E)$ where $V = \{v_1, v_2, v_3, v_4, v_5\}$ and $E = \{e_1, e_2, e_3, e_4, e_5\}$ with $e_1 = v_1v_2$, $e_2 = v_2v_3, e_3 = v_3v_4, e_4 = v_4v_5, e_5 = v_5v_1$.

$\sigma(v_1) = 0.6$, $\sigma(v_2) = 0.6$, $\sigma(v_3) = 0.8$, $\sigma(v_4) = 0.6$, $\sigma(v_5) = 0.6$.

$\mu(e_1) = 0.4$, $\mu(e_2) = 0.4$, $\mu(e_3) = 0.4$, $\mu(e_4) = 0.4$, $\mu(e_5) = 0.2$.

$$\sum_{\substack{v_2 \in V \\ (v_1,v_2)\in M}} \mu^2(v_1,v_2) = \sum_{v_2 \in V} (\mu(v_1,u) \wedge \mu(u,v_2)) = 0.4 \wedge 0.4 + 0.2 \wedge 0.40.6 = \sigma(v_1)$$

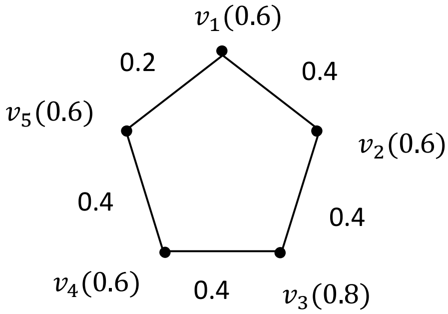

Figure 4:

$$\sum_{\substack{v_3 \in V \\ (v_2,v_3)\in M}} \mu^2(v_2,v_3) = 0.4 \wedge 0.4 + 0.4 \wedge 0.2 = 0.4 + 0.2 = 0.6 = \sigma(v_2)$$

$$\sum_{\substack{v_4 \in V \\ (v_3,v_4)\in M}} \mu^2(v_3,v_4) = 0.4 \wedge 0.4 + 0.4 \wedge 0.4 = 0.4 + 0.4 = 0.8 = \sigma(v_3)$$

$$\sum_{\substack{v_5 \in V \\ (v_4,v_5)\in M}} \mu^2(v_4,v_5) = 0.4 \wedge 0.2 + 0.4 \wedge 0.4 = 0.2 + 0.4 = 0.6 = \sigma(v_4)$$

$$\sum_{\substack{v_1 \in V \\ (v_5,v_1)\in M}} \mu^2(v_5,v_1) = 0.2 \wedge 0.4 + 0.4 \wedge 0.4 = 0.2 + 0.4 = 0.6 = \sigma(v_5)$$

Hence G is not a $(2,k)$ regular fuzzy graph.

Theorem 3.14. Let G : (σ,μ) be a fuzzy graph on complete graph K_n on $G: (V, E)$.If $\sigma(u) = k$ which is a constant function for all $u \in V$ and $\mu(u,v) = \left[\frac{k}{n}\right] = k_1$ for all $(u,v) \in E$ on the cycle C_n and $\mu(u,v) = \frac{k-2k_1}{n(n-3)}$ for all interior edges $(u,v) \in E$. Then E is a square perfect fuzzy matching on G.

Proof: Let G : (σ, μ) be any fuzzy graph on complete graph K_n, two edges are incident with each vertex of the cycle and remaining (n-3) edges are incident with interior vertices. The two distance of n(n-3) edges are some edge one is interior and another one is cycle (or) some two edges are interior.

Hence $\sum_{\substack{v \in V \\ (u,v) \in M}} \mu^2(u,v) = \sum_{\substack{v \in V \\ (u,v) \in M}} (\mu(u,w) \wedge \mu(w,v))$

$$= 2[\mu(u,w) \wedge \mu(w,v)] + (n-3)n[\mu(u,w) \wedge \mu(w,v)]$$

$$= 2(k_1 \wedge k_1) + n(n-3)\left(\frac{k-2k_1}{n(n-3)} \wedge k_1\right)$$

$$= 2k_1 + n(n-3)\left(\frac{k-2k_1}{n(n-3)}\right) = 2k_1 + k - 2k_1 = k = \sigma(u).$$

Hence E is a square perfect fuzzy matching on G.

Remark 3.15. The condition $\mu(u,v) = \frac{k-2k_1}{n(n-3)}$ is essential in theorem 3.14. This is illustrate with the following example.

Example 3.16. Let G : (σ, μ) be a fuzzy graph on complete graph K_n where V = $\{v_1, v_2, v_3, v_4, v_5\}$ and E = $\{e_1, e_2, e_3, e_4, e_5, e_6, e_7, e_8, e_9, e_{10}\}$ with $e_1 = v_1v_2$, $e_2 = v_2v_3, e_3 = v_3v_4, e_4 = v_4v_5$, $e_5 = v_5v_1, e_6 = v_1v_3$, $e_7 = v_1v_4, e_8 = v_2v_4, e_9 = v_2v_5$, $e_{10} = v_3v_5$. $\sigma(v_1) = 1$, $\sigma(v_2) = 1$, $\sigma(v_3) = 1$, $\sigma(v_4) = 1$, $\sigma(v_5) = 1$.
$\mu(e_1) = 0.2, \mu(e_2) = 0.2, \mu(e_3) = 0.2, \mu(e_4) = 0.2, \mu(e_5) = 0.2, \mu(e_6) = 0.1,$
$\mu(e_7) = 0.1, \mu(e_8) = 0.1, \mu(e_9) = 0.1, \mu(e_{10}) = 0.1.$

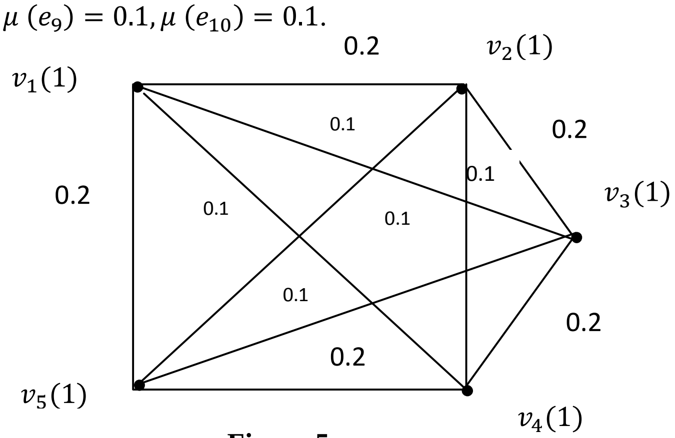

Figure 5:

$$\sum_{\substack{v_2 \in V \\ (v_1,v_2) \in M}} \mu^2(v_1,v_2) = \sum_{v_2 \in V} \left(\mu(v_1,u) \wedge \mu(u,v_2)\right) = 0.4 + 1 = 1.4 \neq \sigma(v_1)$$

$$\sum_{\substack{v_3 \in V \\ (v_1,v_3) \in M}} \mu^2(v_1,v_3) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_1)$$

$$\sum_{\substack{v_4 \in V \\ (v_1,v_4) \in M}} \mu^2(v_1,v_4) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_1)$$

$$\sum_{\substack{v_5 \in V \\ (v_1,v_5) \in M}} \mu^2(v_1,v_5) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_1)$$

$$\sum_{\substack{v_3 \in V \\ (v_2,v_3)\in M}} \mu^2(v_2, v_3) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_2)$$

$$\sum_{\substack{v_4 \in V \\ (v_2,v_4)\in M}} \mu^2(v_2, v_4) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_2)$$

$$\sum_{\substack{v_5 \in V \\ (v_2,v_5)\in M}} \mu^2(v_2, v_5) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_2)$$

$$\sum_{\substack{v_4 \in V \\ (v_3,v_4)\in M}} \mu^2(v_3, v_4) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_3)$$

$$\sum_{\substack{v_5 \in V \\ (v_3,v_5)\in M}} \mu^2(v_1, v_4) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_3)$$

$$\sum_{\substack{v_5 \in V \\ (v_4,v_5)\in M}} \mu^2(v_4, v_5) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_4)$$

$$\sum_{\substack{v_1 \in V \\ (v_5,v_1)\in M}} \mu^2(v_5, v_1) = 2(0.2 \wedge 0.2) + 5(5-3)[0.1] = 0.4 + 1 = 1.4 \neq \sigma(v_5)$$

Hence fuzzy graph on complete graph K_n is not a square perfect fuzzy matching in G.

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