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Use of fuzzy soft digraphs in a different variety of contexts

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Abstract

In this paper, the idea of soft digraph has been presented. The essential phrasings and tasks of soft digraphs have been characterized. Later network portrayal of a soft digraph has been shown. At last, utilizations of soft digraph in tackling a dynamic issue, entropy estimation, clinical determination issue have likewise been given toward the end.

Keywords: *Fuzzy soft digraphs. Digraphs.*

Introduction

These days, many fields like designing, clinical science, social science, financial aspects and so forth manage the intricacies of displaying with questionable information. Specialists can't necessarily effectively utilize the old-style techniques because of the presence of vulnerabilities in these sorts of issues. A few notable speculations viz. fuzzy set hypothesis, likelihood hypothesis, intuitionistic fuzzy sets hypothesis, obscure sets hypothesis, hypothesis of unpleasant sets can be considered as a numerical device for managing vulnerabilities. Yet these hypotheses have specific constraints. Consequently, research is as yet going for finding better speculations which can display the regular peculiarities all the more everything being equal. Molodtsov started the hypothesis of soft sets as another numerical instrument for managing vulnerabilities which conventional numerical apparatuses can't deal with. He has shown a few utilizations of this hypothesis in tackling numerous functional issues in financial matters, designing, sociology, clinical science, and so forth. Different creators like Maji, Roy and Biswas have additionally concentrated on the hypothesis of soft sets and utilized this hypothesis to tackle some dynamic issues. They have likewise presented the idea of fuzzy soft set and intuitionistic fuzzy soft set, a more summed up idea, which is a mix of fuzzy set and soft set and have concentrated on its properties. In 2009, Ali et al has characterized a few new procedure on soft sets. Research in soft set hypothesis (SST) has been finished in numerous areas like polynomial math, entropy estimation, applications and so on. In 2010, Majumdar and Samanta has presented the thought of summed up fuzzy soft set, where a degree has joined to each fuzzy set that compares a boundary. Then again, the digraph hypothesis assumes a significant part in investigation of arithmetic and different subjects like systems administration, picture handling and so on.

Application of Soft Digraph

1. **Decision Making Problem**

Molodstov showed different utilizations of soft set hypothesis, in actuality, circumstances in his paper. Utilizations of soft digraph in navigation, clinical analysis, soft entropy computation have been shown. In this subsection we will involve soft competition in tackling dynamic issue.

Calculation Now we give a calculation for determination of pads for an imminent purchaser utilizing soft competition. For this, the accompanying advances are to be followed

1. Input the soft set (F,E).
2. Draw the soft digraph T2 relating to the soft set (F,E).
3. Figure out the score arrangement of the soft competition T2.
4. Find out the indegree arrangement of T2 utilizing score succession.
5. Pick k, for which xk = max id(ei),i 6= a

Then xk is the ideal determination. In the event that there exists beyond what one ideal arrangement, any arrangement can be taken.

2. **Traffic Flow Problem**

In this subsection we will consider traffic stream issue for an explorer. In this issue he/she needs to visit every one of the urban communities which are very much associated once.

Calculation Now we give a calculation for traffic stream issue for an explorer utilizing soft digraph. For this, the accompanying advances are to be followed:

(1) Input the soft set (F, E).

(2) Draw the soft digraph D corresponding to the soft set (F,E).

(3) Find out the matrix representation of the soft digraph D.

(4) To visit n cities once at a time, compute Mn.

(5) If the starting and ending point is the city xi, calculate (xi, xi) −th entry of M^n.

(6) If (xi ,xi)-th entry is k, find out the k number of paths from xi to xi in D.

(7) Finally choose desired path in which all cities can be visited once providing the starting and ending point is the city xi.

Soft Set Theory

In this subsection a few definitions, results and models in regards to soft sets are given which will be utilized in the remainder of this paper. The possibility of soft sets was first given by Molodtsov. Later Maji and Roy have characterized procedure on soft set and concentrated on their properties.

Definition 2.1 ([11]). Suppose U be an initial universal set and let E be a set of parameters. Let $P(U)$ denote the power set of U and $A \subseteq E$. A pair (F, A) is called a *soft set* over U if and only if F is a mapping given by $F : A \to P(U)$.

Throughout this paper, we consider U and E to be a finite set.

Example 2.2. As an illustration, consider the following example. Suppose a soft set (F, E) describes choice of places which the authors are going to visit with his family.

U = the set of places under consideration $= \{x_1, x_2, x_3, x_4, x_5\}$. E = {desert, forest, mountain, sea beach} $= \{e_1, e_2, e_3, e_4\}$. Let $F(e_1) = \{x_1, x_2\}$, $F(e_2) = \{x_1, x_2, x_3\}$, $F(e_3) = \{x_4\}$, $F(e_4) = \{x_2, x_5\}$.

So, the soft set (F, E) is a family $\{F(e_i); i = 1, \ldots, 4\}$ of U.

Definition 2.3 ([15]). For two soft sets (F, A) and (G, B) over a common universe U, we say that (F, A) is a soft subset of (G, B) if

(i) $A \subseteq B$,

(ii) $\forall e \in A$, $F(e) \subseteq G(e)$.

Definition 2.4 ([15]). Two soft sets (F, A) and (G, B) over a common universe U are said to be soft equal if (F, A) is a soft subset of (G, B) and (G, B) is a soft subset of (F, A).

Definition 2.5 ([16]). The complement of a soft set (F, A) is denoted by $(F, A)^c$ and is defined by $(F, A)^c = (F^c, A)$, where $F^c : A \to P(U)$ is a mapping given by

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$$F^c(\alpha) = U - F(\alpha), \forall \alpha \in A.$$

Definition 2.6 ([15]). A soft set (F, A) over U is said to be null soft set denoted by $\widetilde{\Phi}$, if $\forall e \in A, F(e) = \phi$.

Definition 2.7 ([15]). A soft set (F, A) over U is said to be absolute soft set denoted by $\widetilde{A}$, if $\forall e \in A, F(e) = U$.

Definition 2.8 ([15]). Union of two soft sets (F, A) and (G, B) over a common universe U is the soft set (H, C) , where $C = A \cup B$, and $\forall e \in C$,

$$H(e) = \begin{cases} F(e), & \text{if } e \in A - B \\ G(e), & \text{if } e \in B - A \\ F(e) \cup G(e), & \text{if } e \in A \cap B. \end{cases}$$

We write, $(H, C) = (F, A)\widetilde{\bigcup}(G, B)$.

Definition 2.9 ([15]). Intersection of two soft sets (F, A) and (G, B) over a common universe U is the soft set (H, C), where $C = A \cap B$, and $e \in C$, $H(e) = F(e) \cap G(e)$. We write $(H, C) = (F, A)\widetilde{\bigcap}(G, B)$.

Definition 2.10 ([15]). If (F, A) and (G, B) are two soft sets, then *(F,A) AND (G,B)* denoted by $(F, A) \wedge (G, B)$ is defined by

$$(F, A) \wedge (G, B) = (H, A \times B),$$

where $H(\alpha, \beta) = F(\alpha) \cap G(\beta)$, $\forall$ $(\alpha, \beta) \in A \times B$.

Definition 2.11 ([15]). If (F, A) and (G, B) are two soft sets, then *(F,A) OR (G,B)* denoted by $(F, A) \vee (G, B)$ is defined by

$$(F, A) \vee (G, B) = (O, A \times B),$$

where $O(\alpha, \beta) = F(\alpha) \cup G(\beta)$, $\forall$ $(\alpha, \beta) \in A \times B$.

Definition 2.12 ([16]). If (F, E) and (G, E) are two soft sets over an universal set U, the similarity measure between (F, E) and (G, E) is defined by,

$$S(F, G) = \frac{\sum_i F(e_i).G(e_i)}{\sum_i [F(e_i)^2 \vee G(e_i)^2]}.$$

Two soft sets (F, E) and (G, E) are called significantly similar if $S(F, G) > \frac{1}{2}$.

Digraphs

A large portion of the hypothesis in regards to diagrams and digraphs can be tracked down in any standard reference, for instance. A coordinated chart or digraph D is a couple (V, A) where V is a limited nonempty set of items, called vertices, and a (conceivably unfilled) set of requested sets of vertices, called circular segments or coordinated edges. We signify the vertex set and the bend set of D by VD and Promotion, individually. In some cases, we just compose v ∈ D (resp. (u, v) ∈ D) to mean v ∈ VD (resp. (u, v) ∈ Promotion). The request for D, meant by |D|, is the quantity of vertices of D.

A bend x = (u, u) in D is known as a circle in D. The outdegree (resp. indegree) of a vertex v in D is the quantity of vertices of D neighboring from (resp. to) v. It is standard to address a digraph by an outline with hubs addressing the vertices and coordinated line portions (circular segments) addressing the bends of the digraph. In the event that two bends of D have similar end vertices, the circular segments are called equal curves. A digraph with no equal bends is known as a basic digraph, generally that digraph is known as a multi digraph.

A digraph D1 is a sub digraph of the digraph D if VD1 ⊆ VD, AD1 ⊆ Promotion. The supplement of a straightforward digraph D is the basic digraph D, where VD = VD and (v, w) ∈ Promotion if and provided that (v, w) ∈/Promotion.

Given two sub digraphs D1 and D2 of D, the association of D1 ∪ D2 is the sub digraph of D with vertex set containing of every one of these vertices which are in either D1 or D2 (or both) and with curve set containing of that large number of circular segments which are in either D1 and D2 (or both), i.e.,

$$V_{D_1 \cup D_2} = V_{D_1} \cup V_{D_2},$$
$$A_{D_1 \cup D_2} = A_{D_1} \cup A_{D_2}.$$

If D1 and D2 are two sub digraphs of D with at least one vertex in common than the intersection D1 ∩ D2 is given by

$$V_{D_1 \cap D_2} = V_{D_1} \cap V_{D_2},$$
$$A_{D_1 \cap D_2} = A_{D_1} \cap A_{D_2}.$$

Let D = (VD, AD) and E = (VE, AE) be digraphs such that |VD| = n, |VE| = m. The cartesian product D × E = (V, A) of D and E is defined as V = VD × VE and A = {((u1, v1),(u2, v2))|((u1, u2) ∈ AD and v1 = v2) or (u1 = u2 and (v1, v2) ∈ AE)}.

Soft Digraph

Review that, U = {hi; I ∈ ∆} be an underlying widespread set and let E = {ei; I = 1, . . ., n} be a bunch of boundaries. Let P(U) mean the power set of U. Then, at that point, a couple (F, E) is known as a soft set over U if and provided that F is a planning given by F: E → P(U). Presently we partner a digraph relating to each soft set, called a soft digraph, as follows:

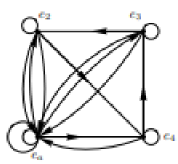
Definition 3.5. Suppose $H = (V_H, A_H)$ and $D = (V_D, A_D)$ be two soft digraphs corresponding to two equal soft sets (G, B) and (F, E) respectively. Then H and D are said to be the equal soft digraph if $V_H = V_D$ and $A_H = A_D$ respectively.

In this case also, we see that $B = E$, and $G(e) = F(e)\ \forall e \in B = E$

Definition 3.6. Suppose (F, E) be a soft set over a universal set U and $D = (A_D, V_D)$ be a soft digraph corresponding to it. Consider a digraph $\overline{D}$ such that $V_D = V_{\overline{D}}, A_{\overline{D}} = \{(e_i, e_j) : h_j \notin F(e_i) \text{ and } j \leq |E|\} \cup \{(e_i, e_a) : h_j \notin F(e_i) \text{ and } j > |E|\}$. Then the soft digraph $\overline{D}$ is called a complement of the soft digraph D. It can be easily seen that the soft set corresponding to $\overline{D}$ is the complement soft set (F^c, E) of (F, E), where $F^c : E \to P(U)$ is a mapping given by $F^c(\alpha) = U - F(\alpha), \forall \alpha \in E$.

Definition 3.6. Suppose (F, E) be a soft set over a universal set U and $D = (A_D, V_D)$ be a soft digraph corresponding to it. Consider a digraph $\overline{D}$ such that $V_D = V_{\overline{D}}, A_{\overline{D}} = \{(e_i, e_j) : h_j \notin F(e_i) \text{ and } j \leq |E|\} \cup \{(e_i, e_a) : h_j \notin F(e_i) \text{ and } j > |E|\}$. Then the soft digraph $\overline{D}$ is called a complement of the soft digraph D. It can be easily seen that the soft set corresponding to $\overline{D}$ is the complement soft set (F^c, E) of (F, E), where $F^c : E \to P(U)$ is a mapping given by $F^c(\alpha) = U - F(\alpha), \forall \alpha \in E$.

Example 3.7. We take the complement soft set (G^c, B) of the soft set (G, B) defined in the Example 3.4 over the universal set $U = \{x_1, x_2, x_3, x_4, x_5\}$. Then we have $G^c(e_2) = \{x_1, x_2, x_4, x_5\}$, $G^c(e_3) = \{x_1, x_2, x_3, x_5\}$, $G^c(e_4) = \{x_1, x_3, x_4\}$. Also by definition of soft digraph, $G(e_a) = \phi$ for the universal vertex e_a in D_1. Therefore, we have $G^c(e_a) = \{x_1, x_2, x_3, x_4, x_5\}$. Now we draw the complement digraph $\overline{D_1}$ of D_1. Clearly $\overline{D_1}$ is the soft digraph corresponding to the soft set (G^c, B).



$\overline{D_1}$

Definition 3.8. Suppose (F, A) and (G, B) are two soft set over a common universe U. Let H_1 and H_2 are two soft digraphs corresponding to the soft sets (F, A) and (G, B) respectively. Consider a digraph D by taking the union of two soft digraph H_1 and H_2 respectively as follows:

$V_D = V_{H_1} \cup V_{H_2} = A \cup B \cup \{e_a\}$, where e_a is the universal vertex for a soft digraph and $A_D = A_{H_1} \cup A_{H_2} \cup S$ where $S = \big\{\{(e_i, e_j)\} \backslash \{(e_i, e_a)\}$, if $h_j \in F(e_i)$, $e_i \in A \backslash B, e_j \in B \backslash A\big\}$ or $S = \big\{\{(e_i, e_j)\} \backslash \{(e_i, e_a)\}$, if $h_j \in G(e_i), e_i \in B \backslash A, e_j \in A \backslash B\big\}$ or $S = \phi$ in all other cases.

Then the soft digraph D is called the *union of two soft digraphs* H_1 and H_2. One can see that the soft digraph D corresponds the soft set which is the union of two soft sets (F, A) and (G, B) respectively.

Conclusion

Molodtstov presented the soft set hypothesis in his paper to manage the vulnerabilities, in actuality, issues. Presently research in SST is happening at a high stage. Many creators have concentrated on SST in different manner and have applied this hypothesis in tackling numerous commonsense issues. We have presented the soft digraph hypothesis in our past paper. In that paper we have fostered the soft digraph hypothesis in blend of soft set hypothesis and digraph hypothesis. In this paper we have concentrated on the properties of soft digraphs and soft competitions and showed numerous potential utilizations of this hypothesis. The curiosity of soft digraphs is that they can graphically address any issue that is initially addressed by a soft set. One can additionally concentrate on soft competition and utilize the soft competition in numerous other genuine issues.

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