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Neutrosophic Based Minimal Cover Approach to Avoid Redundant or Duplicate Neutrosophic Functional Dependency

Soumitra De[1], Jaydev Mishra[2]

[1]Assistant Professor, Dept of CSE, College of Engineering & Management, Kolaghat, West Bengal, (India)

[2] Assistant Professor, Dept of CSE, College of Engineering & Management, Kolaghat, West Bengal, (India)

ABSTRACT

Neutrosophic data model is used to process imprecise or uncertain information. Neutrosophic relational database model that does not suffer from data redundancy and anomalies during designing of it, we have introduced dependency based on minimal cover algorithm to ignore the redundant neutrosophic dependency and get back minimum numbers of neutrosophic functional dependency from the large number of neutrosophic functional dependency. This neutrosophic functional dependency based on minimal cover algorithm will help to normalizing the neutrosophic unnormalized relation.

Keywords: neutrosophic set, neutrosophic functional dependency, neutrosophic closure of attribute set, dependency based on minimal cover.

1. INTRODUCTION

The main objective of any good database design is to provide data consistency and decrease the data redundancy. Data redundancies as well as insertion, deletion and updation of anomalies have been of great concern in the design theory of a relational database. But in imprecise relation should need some extra tool for avoiding redundant functional dependency and minimize the functional dependency for healthy maintaining the non discrete relational data for its consistency. The concept of neutrosophic functional dependency based on the α -equality of tuples [3,4,5]. This paper is devoted to minimal cover algorithm based on dependency so that neutrosophic relation should free from data redundancies and different kinds of anomalies.

2. BASIC DEFINITIONS

In this section, we have reviewed the basic definitions of neutrosophic set, neutrosophic functional dependency and the basic propositions related to α value of neutrosophic relation [2,6,7,8] neutrosophic closure of an attribute set.

2.1 Neutrosophic Set

Neutrosophic set theory, introduced by Smarandache in 2001 [1] has been widely used in the areas where we have to deal with imprecise or ambiguous data. A neutrosophic set is a generalization of a crisp set which is defined as follows: Let U be a classical set of elements, called the universe of discourse. An element of U is denoted by u .

Definition 2.1

A neutrosophic set X on the universe of discourse U is characterized by three membership functions given by:

(i) a truth membership function $t_x : U \to [0,1]$,

(ii) a false membership function $f_x : U \to [0,1]$ and

(iii) a indeterminacy membership function $i_x : U \to [0,1]$ such that $t_x(a) + f_x(a) \le 1$ and

$t_x(a) + f_x(a) + i_x(a) \le 2$ and is written as $X = \left\{ \left\langle x, \left[t_x(a), i_x(a), f_x(a) \right] \right\rangle, a \in U \right\}$.

2.2 Neutrosophic Functional Dependency

In this paper, we have discussed a new notion of neutrosophic functional dependency (called α -nfd) based on the concept of α -equality of neutrosophic tuples.

Definition 2.2

Let *r*(*R*) be a neutrosophic relation on the relational schema *R*(A_1, A_2 ,…… , A_n). Let t_1 and t_2 be any two neutrosophic tuples in *r*. Let $\alpha \in [0,1]$ be a threshold or choice parameter, predefined by the database designer, and $X = \{ A_1, A_2 ,\ldots\ldots , A_k \} \subseteq R$. Then the neutrosophic tuples t_1 and t_2 are said to be α -equal on X if $SE(t_1[A_i], t_2[A_i]) \geq \alpha$ $\forall i$ =1,2,3…..*k*. We denote this equality by the notation $t_1[X](NE)_\alpha t_2[X]$.

The following proposition is straightforward from the above definition.

Proposition 2.1

If $0 \le \alpha_2 \le \alpha_1 \le 1$, then $t_1[X](NE)_{\alpha_1} t_2[X] \Rightarrow t_1[X](NE)_{\alpha_2} t_2[X]$

Definition 2.3

Let $X, Y \subset R = \{A_1, A_2 \ldots A_n\}$. Choose a threshold value $\alpha \in [0,1]$. Then a neutrosophic functional dependency (α -nfd), denoted by $X \xrightarrow[\alpha]{nfd} Y$ is said to exist if, whenever $t_1[X](NE)_\alpha t_2[X]$, it is also the case that $t_1[Y](NE)_\alpha t_2[Y]$.

Proposition 2.2

If $0 \le \alpha_2 \le \alpha_1 \le 1$, then $X \xrightarrow[\alpha_1]{nfd} Y \Rightarrow X \xrightarrow[\alpha_2]{nfd} Y$

2.3 Neutrosophic Closure of Attribute Set

Neutrosophic key can be actually computed using the concept of neutrosophic closure of an attribute or set of attributes.

closure of an attribute set X denoted by X^+ is the set of attributes which are functionally determined by the attributes X .

If the closure set X^+ is the minimal set which contains all the attributes of the relation scheme R_1, then the attribute set X is called the neutrosophic key of the relation R_1. The neutrosophic closure of an attribute or a set of attributes, are really helpful to minimizing the attribute set from large set of a relation by reducing redundant attributes .

2.4 Neutrosophic Prime and Nonprime Attributes

We will also need the concepts of neutrosophic prime and nonprime attributes for a relation. These are defined as follows:

Definition 2.4

Let $A \in R_1$ and K be a neutrosophic key for R_1. A is called neutrosophic prime attribute if and only if $A \in K$. Those attributes which are not neutrosophic prime are called neutrosophic nonprime attributes.

3. DEPENDENCY BASED ON MINIMAL COVER

The normalization process should also confirm the existence of desirable properties; dependency based minimal cover and lossless join property. We have designed algorithm that ensure the dependency based on minimal cover which is achieved by the minimal cover algorithm.

3.1 Minimal Cover

As we proceed the algorithms for the dependency preservation and lossless join properties, it is essential to introduce the concept of minimal cover.

Definition 3.1

A minimal cover of a set of dependencies F , is a set of dependencies that is equivalent to F with no redundancies. A set of NFDs F is minimal if the following conditions hold:

i) Every dependency in F has a single attribute for its right hand side.
ii) We cannot replace any NFD $X \xrightarrow[\alpha_1]{} A$ with $Y \xrightarrow[\alpha_2]{} A$ where $Y \subset X$ and $\alpha_2 > \alpha_1$.

We cannot remove any dependency from F and still have a set of NFDs equivalent to F. The algorithm finds the minimal cover of a given NFD set and prepares the set without any partial NFD.

3.2 Minimal Cover Algorithm

Let A be the set of NFDs, and assign M to U, i.e. U:=M.
Step1: Atomicity in right side
Replace each NFD X→{M_1, M_2, …….., M_n) in U by n NFDs with α_1.

.**Step2:** Delete redundancy from the left side attribute
For each NFD X→M_k in U with the dependant of α_1 and for each attribute $A \in X$ if ((U- {X→M_k; depends on α_1}) union ((X- {A}) → M_k; depends on α_2)) where $\alpha_2 > \alpha_1$ is equivalent to U, then replace X →M_k depends on α_1, with (X-{A})→ M_k depends on α_2 in U.

Step3: Delete any redundant NFD
For each remaining NFD X → M_k , depends on α_1 in U
If (U- {X→M_k; depends on α_1}) is equivalent to U , then remove X→M_k; depends on α_1 from U.

Example 3.2.1

Let R_1= (A, B, X, Y, Z) and a set of NFDs
F_1=AB→PQZ, PB→Z, P→Q, Q→Z for α_1 is 0.7, 0.7, 0.8 and 0.9 respectively. Find minimal cover of F_1.

Solution

We have applied the minimal cover algorithm to get the minimal cover of F_1. U is initialized to the set of NFDs F_1 i.e.,
U_1= AB→PQZ, PB→Z, P→Q, Q→Z for α_1 is 0.7, 0.7, 0.8 and 0.9 respectively.
Step1: Prepare to atomicity at right side
U_1=AB→P, AB→Q, AB→Z PB→Z, P→Q, Q→Z for α_1 0.7, 0.7, 0.7, 0.7, 0.8 and 0.9 respectively.
Step2: Delete redundant left side attribute
From P→Q with α_1=0.8 and Q→Z with α_1=0.9, using NFD-transitive rule based on α**,** we get P→Z with α_2=0.8 which implies P→Z with α_1=0.7 using Proposition. Hence in PB→Z with α_1=0.7, B is a redundant attribute.
So PB→Z with α_1=0.7 is replaced by P→Z with α_1=0.7 in U_1.
Therefore U= AB→P, AB→Q, AB→Z PB→Z, P→Q, Q→Z for α_1 0.7, 0.7, 0.7, 0.7, 0.8 and 0.9 respectively.
Step3: Delete redundant NFD
The NFD P→Z with α_1=0.7 is now redundant in U_1, since P→Z with α_1=0.7 is obtained from P→Q, Q→Z for NFD is 0.8 and 0.9 of U by using NFD-transitive rule based on α **.** So P→Z with α_1=0.7 is removed from U_1.
Therefore U_1=XY→A, XY→B, XY→Z , A→B, B→Z for α_1 0.7, 0.7,0.7, 0.8 and 0.9 , is the minimal cover.

4. CONCLUSION

Neutrosophic relational database may have data redundancy and anomalies if it's schema is not defined properly. Neutrosophic functional dependency plays an important role in designing a good neutrosophic relational database. Neutrosophic functional dependency with the minimal cover algorithm help to identify and judgment the neutrosophic database for its different form of neutrosophic normalization. Neutrosophic normalization which will be based on minimal cover dependency of neutrosophic relation. Here we have focused on minimal cover algorithm based on dependency to ensure the duplicate or redundant dependency for the betterment of neutrosophic relation which will be used for neutrosophic normalization.

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AUTHOR

Soumitra De received the B.TECH. and M.TECH. degrees in Information Technology and Computer Science & Engineering from Kalyani University in West Bengal and West Bengal University of Technology in 2004 and 2007, respectively. Since 2007 to till day, I am working as an Assistant Professor in College of Engineering and Management Kolaghat, West Bengal.