FUZZY RELATION BASED MINIMAL COVER APPROACH FOR AVOIDING REDUNDANT OR DUPLICATE FUZZY FUNCTIONAL DEPENDENCY

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ABSTRACT

Fuzzy data model based on the mathematical framework of fuzzy set theory to process imprecise or uncertain information. While designing such a fuzzy relational database model that does not suffer from data redundancy and anomalies, the current author have introduced dependency based on minimal cover algorithm to ignore the redundant fuzzy dependency and get back minimum numbers of fuzzy functional dependency from the large number of fuzzy functional dependency. This fuzzy functional dependency based on minimal cover algorithm, will help to normalizing the fuzzy unnormalized relation which will try to focus on next paper.

Keywords: FS, FFD, FCAS, DBMC

I. INTRODUCTION

One of the main objectives of any good database design is to decrease data redundancy and provide data consistency. 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 incomplete or imprecise relation should need some extra tool for avoiding redundant functional dependency and minimize the functional set for healthy maintaining the non discrete relational based data for its consistency. The concept of fuzzy functional dependency based on the idea of α -equality of tuples [1, 2]. The present paper is devoted to minimal cover algorithm based on dependency so that fuzzy relation should free from data redundancies and different kinds of anomalies. Incomplete fuzzy relation concept came from precise relational database with shared data introduced by Codd [3] in 1970.

II. BASIC DEFINITIONS

In this section, we first review the basic definitions of fuzzy set, fuzzy functional dependency and the basic propositions related to α value of fuzzy relation [1, 2]**,** fuzzy closure of an attribute set that will be useful throughout the paper.

2.1 Fuzzy Set (FS)

Fuzzy set theory, introduced by Zadeh [4] in 1965 has been widely used in the areas where we have to deal with imprecise or ambiguous data. A fuzzy 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 1

A fuzzy set F in a universe of discourse U is characterized by a membership function $\mu_F : U \rightarrow [0,1]$ and F is defined as the set of ordered pairs $F = \{(u, \mu_F(u)) : u \in U\}$, where $\mu_F(u)$ for each $u \in U$ denotes the grade of membership of u in the fuzzy set F.

Note that a classical subset A of U can be viewed as a fuzzy subset with membership function μ_A that takes binary values, i.e.,

μ_A =1 if $u \in A$

=0 if $u \notin A$

2.2 Fuzzy Functional Dependency (FFD)

Next, to introduce the new notion of FFD as defined in [2], we give the following definitions and terminologies. Let X be a universal set and $\Re$ be a fuzzy tolerance relation on X. Consider a choice parameter $\alpha \in [0,1]$ to be predefined by the database designer.

Definition 2

$(\alpha)_\Re$ *-nearer elements.*

Two elements $x_1, x_2 \in X$ are said to be $(\alpha)_\Re$ -nearer or α -nearer if $\mu_\Re(x_1, x_2) \geq \alpha$. We denote this by the notation $x_1 N_{(\alpha)_\Re} x_2$.

$(\alpha)_\Re$ *-equality elements.*

$x_1, x_2 \in X$ are said to be $(\alpha)_\Re$ -equal or α -equal if

$x_1 N_{(\alpha)_\Re} x_2$

Definition 3

$(\alpha)_\Re$ *-equality of* $t_1[X]$ *and* $t_2[X]$.

The equality notation is denoted as $t_1[X]\varepsilon_{(\alpha)_\Re} t_2[X]$ or simply by $t_1[X]\varepsilon_\alpha t_2[X]$.

Definition 4

Let $X, Y \subset R = \{A_1, A_2, \ldots\ldots, A_n\}$. Choose a parameter $\alpha \in [0,1]$ and propose a fuzzy tolerance relation $\Re$. A fuzzy functional dependency (FFD) is to be denoted by $t_1[X]\varepsilon_\alpha t_2[X]$, it is also the case that $t_1[Y]\varepsilon_\alpha t_2[Y]$.

2.3 Propositions

2.3.1 Proposition

$t_1[X]\varepsilon_\alpha t_2[X] \Rightarrow t_2[X]\varepsilon_\alpha t_1[X]$.

2.3.2 Proposition

If $0 \leq \alpha_2 \leq \alpha_1 \leq 1$, then X→Y for α_1 and it implies to X→Y for α_2

2.4 Fuzzy Closure of Attribute Set (FCAS)

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

Fuzzy closure of an attribute set X denoted by X^+ is the set of attributes which are fuzzy 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, then the attribute set X is called the fuzzy key of the relation R. The fuzzy closure of an attribute or a set of attributes concepts are really helpful to minimizing the attribute set of a relation from large set by reducing redundant attributes[5,6].

2.5 Fuzzy Prime and Nonprime Attributes

In order to define fuzzy normal forms, we will also need the concepts of fuzzy prime and nonprime attributes for a relation. These are defined as follows:

Definition 5

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

III. DEPENDENCY BASED ON MINIMAL COVER (DBMC)

The normalization process should also confirm the existence of two additional and desirable properties; dependency based minimal cover and lossless join property. Below we have designed algorithms that ensure that the dependency based on minimal cover properties is achieved by handling the minimal cover algorithm.

3.1 Minimal Cover

As I proceed to present the algorithms for the dependency preservation and lossless join properties, it would be essential to introduce the concept of minimal cover.

Definition 6

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 FFDs F is minimal if the following conditions hold:

a) Every dependency in F has a single attribute for its right hand side.

b) I cannot replace any FFD $X \xrightarrow[\alpha_1]{} A$ with $Y \xrightarrow[\alpha_2]{} A$ where $Y \subset X$ and $\alpha_2 > \alpha_1$.

I cannot remove any dependency from F and still have a set of FFDs equivalent to F. The algorithm below finds the minimal cover of a given FFD set and prepares the set without any partial FFD.

3.2 Minimal Cover Algorithm

Let A be the set of FFDs, and assign A to U, i.e. U:=A.

Step1: Prepare right side atomicity

Replace each FFD $X \rightarrow \{A_1, A_2, \ldots\ldots, A_n\}$ in U by n FFDs with α_1.

.**Step2:** Delete redundant left side attribute

For each FFD $X \rightarrow A_k$ in U with the dependant of α1 and for each attribute $B \in X$ if ((U- {$X \rightarrow A_k$; depends on α_1}) union ((X- {B}) $\rightarrow A_k$; depends on α2)) where $\alpha_2 > \alpha_1$ is equivalent to U, then replace $X \rightarrow A_k$ depends on α_1, with (X-{B})$\rightarrow A_k$ depends on α_2 in U.

Step3: Delete any redundant FFD

For each remaining FFD X → A_k , depends on α_1 in U

If (U- {X→A_k; depends on α_1}) is equivalent to U , then remove X→A_k; depends on α_1 from U.

Example

Let R= (A, B, X, Y, Z) and a set of FFDs

F=XY→ABZ, AY→Z, A→B, B→Z for α1 is 0.7, 0.7, 0.8 and 0.9 respectively. Find minimal cover of *F* .

Solution

Minimal cover algorithm is applied to get the minimal cover of *F* . U is initialized to the set of FFDs *F* i.e., U=XY→ABZ, AY→Z, A→B, B→Z for α1 is 0.7, 0.7, 0.8 and 0.9 respectively

Step1: Prepare right side atomicity

U=XY→A, XY→B, XY→Z AY→Z, A→B, B→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 A→B with α_1=0.8 and B→Z with α_1=0.9, using FFD-transitive rule based on α**,** we get A→Z with α_2=0.8 which implies A→Z with α_1=0.7 using Proposition. Hence in AY→Z with α_1=0.7, **Y** is a redundant attribute.

So AY→Z with α_1=0.7 is replaced by A→Z with α_1=0.7 in U.

Therefore U=XY→A, XY→B, XY→Z A→Z, A→B, B→Z for α_1 0.7, 0.7, 0.7, 0.7, 0.8 and 0.9 respectively.

Step3: Delete redundant FFD

The FFD A→Z with α_1=0.7 is now redundant in U, since A→Z with α_1=0.7 is obtained from A→B, B→Z for FFD is 0.8 and 0.9 of U by using FFD-transitive rule based on α **.** So A→Z with α_1=0.7 is removed from U.

Therefore U=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.

IV.CONCLUSION

Fuzzy relational database may data redundancy and anomalies if its schema is not perfect. Fuzzy functional dependency plays an important role in designing a good fuzzy relational database. Fuzzy functional dependency with the minimal cover algorithm help to identify and judgment the fuzzy database for its different form of fuzzy normalization.

Hope the fuzzy normalization which will be started based on minimal cover dependency of fuzzy relation.

Here I have concentrated on minimal cover algorithm based on dependency that ensure that duplicate or redundant dependency should be ignored for betterment of fuzzy relation which will be used for fuzzy normalization in future .

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