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AVOID INCONSISTENCY IN FUZZY RELATIONAL DATABASE FOR SECURE OPERATION

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ABSTRACT

Fuzzy relational database handle uncertain and imprecise information for consistent operation on database and manipulate information. In this paper, I introduced fuzzy normal forms for similarity based fuzzy relational database model. First of all I have focused on fuzzy closure of attribute set which can be utilized to find fuzzy key. Next, with the concepts of α -ffd [1], I have defined fuzzy normal forms in fuzzy relational database. I also show some real life application to handle normalization based on α -ffds.

Keywords: α: ffd , fuzzy key, fuzzy relation, attribute set, fuzzy normal forms.

I. INTRODUCTION

It is well known that the classical relational data model introduced by Codd [2] in 1970 can handle only precise and exact data in an information source.. Fuzzy database models [3-12] based on the fuzzy set theory proposed by Zadeh [13] in 1965 have been extensively studied and cultivated in literature to deal with such uncertain and fuzzy information in relational databases.

One of the primary purposes of any databases is to decrease data redundancy and to provide data consistency. Data redundancies and insertion, deletion and update anomalies have also been of great concern in relational database. In this paper, my objective is to handle fuzzy relational database model by minimizing redundancies and also minimizing the insertion, deletion and update anomalies. For this first of all fuzzy closure of attribute set is presented which is require to find fuzzy key. Finally, all these concepts are verified with an example. In this paper to find fuzzy closure of attribute set to discusses different fuzzy normalization techniques of a fuzzy relational database model by giving a real-life application.

II. BASIC DEFINITIONS

In this section, I first define fuzzy functional dependency as introduced (α-ffd) in [14] and revisit the basic propositions related to α -ffd.

2.1 Definition

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 $\{(u, \mu_F (u)): u \in U\}$, 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_F taken binary values, i.e.,

$\mu_A = 1$ if $u \epsilon A$

$= 0$ otherwise

The usual set theory operations such as union, intersection and complementation etc., have been extended to deal with fuzzy sets.

2.2 Definition

Let $U = U_1 \times U_2 \times \cdots \times U_n$ be the Cartesian product of n universes, and F_i , $i = 1$ to n be fuzzy sets in their corresponding universe of discourses U_i , $i = 1,2,\cdots,n$ respectively.

Also, let $u_i \epsilon U_i$, $i = 1,2,\cdots,n$. Then the Cartesian product $F = F_1 \times F_2 \times \cdots \times F_n$ *is* defined to be a fuzzy set of $U = U_1 \times U_2 \times \cdots \times U_n$ with the membership function defined as follows:

$\mu_F(u_1, u_2, \cdots, u_n) = \min(\mu_{F1}(u_1), \mu_{F2}(u_2), \cdots, \mu_{Fn}(u_n))$.

2.3 Definition

Mathematically an n -ary fuzzy relation r is a fuzzy subset of the Cartesian product of n universes. Thus for given n universes $U_1, U_2, \cdots U_n$, a fuzzy relation R is a fuzzy subset of $U_1, U_2, \cdots U_n$ and is characterized by the n -variate membership function $\mu_R : U_1 \times U_2 \times \cdots \times U_n \rightarrow [0,1]$.

2.4 Fuzzy Functional Dependency (Ffd)

Let X, Y ϵ R= {A_1, A2 ,.....,A_n } . Choose a parameter $\alpha \epsilon [0,1]$ and propose a fuzzy tolerance relation R^1 . A fuzzy functional dependency (**ffd**), denoted by X→Y based *on α values of* R^1, is said to exist, if whenever $t_1[X] \epsilon_\alpha t_2[X]$, it is also the case that $t_1[Y] \epsilon_\alpha t_2[Y]$.

This **ffd** can be read as " *X* fuzzy functionally determines *Y* at α -level of choice" or "*Y* fuzzy functionally depends on *X* at α -level of choice" and is called an α **-ffd.** Clearly, by definition of α **-ffd**, it follows that for any subset *X* of *R* and for any $\alpha \epsilon [0,1]$, $X \rightarrow Y$ *with α value.*

2.5 Fuzzy Key

Extending the idea of classical key in the fuzzy environment we have defined fuzzy key as follows:

2.5.1 Definition

Let K_1 is subset of R_1 and *F* be a set of **ffd**s for R_1 . Then, K_1 is called a **fuzzy key** of R_1 at α -level of choice where $\alpha \epsilon [0,1]$ iff $K_1 \rightarrow R_1$ *with α value,* ϵF and $K_1 \rightarrow R_1$ *with α value* is not a partial **ffd**.

III. FUZZY NORMALIZATION

An important problem of the relational database design is how to obtain relation schemes in which the storage anomalies are avoided . Storage anomalies occur during updating operations and cause the inconsistency of data. In order to avoid anomalies, Codd [15] introduced a series of normal forms, such as first (**1NF**), second (**2NF**), third (**3NF**) **normal** forms.

So, in fuzzy relational database, I have focusing the normalization techniques for fuzzy relation schemes called fuzzy normalization. The different normalization forms of fuzzy relational database say, fuzzy first (**F1NF**), fuzzy second (**F2NF**), fuzzy third (**F3NF**) normal forms. To fulfil the above concepts I have considered the fuzzy relation scheme EMPLOYEE(EName, ECityname, ECstatus, EExp, ESal) given below in Table-I with a set **fd**s and **ffd**s F as follows:

F = {ECityname→ECstatus, with α value 0.97

EExp→ESal,with α value 0.89

ENameECityname→EExp}

Table-I EMPLOYEE Relation Based on Fuzzy Data

E Name	E City Name	EC status	E Exp.	E Sal
Ratan	Pune	25	10	More or less 30000
Bikram	Kolkata	22	10.7	30000
Asim	Mumbai	20	13	60000
Tapan	Delhi	Around 30	13	75000

The functional dependency ENameECityname→EExp, it can be express in fuzzy functional dependency ENameECityname→EExp, with α= 1. So the above F_1 set can be rewritten as follows:

F = {ECityname→ECstatus, with α= 0.97

EExp→ESal, with α= 0.89

ENameECityname→EExp, with α= 1}.

Next finding the fuzzy key of the relation EMPLOYEE. Using the concept of fuzzy closure ENameECityname is obtained as

$(\text{ENameECityname})^+$ = (EName ECityname ECstatus EExp ESal ,.89) which means

ENameECityname → EName ECityname ECstatus EExp ESal, with α= 0.89.

So, I can mentioned that, ENameECityname is the fuzzy key of EMPLOYEE relation at 0.89-level of choice.

IV. FUZZY PRIME AND NON PRIME ATTRIBUTES

Let $A_1 \in R_1$ *and* K_1 be a fuzzy key set for R_1 . A_1 is called fuzzy prime attributes if and only if $A_1 \in K_1$. Those attributes which are not fuzzy prime are called fuzzy non-prime.

For an attribute to be fuzzy prime attribute, it should be a part of at least one of the fuzzy candidate keys of the relation. Similarly, for an attribute to be a fuzzy non-prime attribute, it should not appear in any of the fuzzy candidate keys of the relations.

4.1 Fuzzy First Normal Form

Let D_i be the domain of attributes A_i , a relation schema R_i is called to be in first fuzzy normal form i.e., F1NF if and only if for any relation *r* in R_i , none of the attributes contained multi-valued.

So Table-I defined above is in F1NF.

4.2 Fuzzy Second Normal Form

Let F_i be the set of ffds for relation schema R_i and K_i be a fuzzy key of R_i at α -level of choice. R_i is called to be in fuzzy second normal form i.e., F2NF, if and only if for none of the nonprime attributes is partially fuzzy functionally dependent on the fuzzy key.

As per Table-I ENameECityname at 0.89-level of choice.Here nonprime attributes ECstatus which is fuzzy partially dependent on fuzzy key ENameECityname at 0.9-level of choice. So, Table-I is not in F2NF.
To satisfy F2NF, need to decomposed the above Table-I into $EMPLOYEE_1$ and $EMPLOYEE_2$.
$EMPLOYEE_1$ (ECityname, ECstatus) with ffds
F^1 = {ECityname→ECstatus,with α=0.97}
Fuzzy Key: ECityname at 0.97-level of choice.
and
$EMPLOYEE_2$ (EName, ECityname, EExp, ESal) with ffds
F^2 ={EExp→ESal(with α=0.89), ENameECityname→ EExp}
Fuzzy Key: ENameECityname at 0.89-level of choice.

4.3 Fuzzy Third Normal Form

Let F_1 be the set of ffds for relation schema R_1 and K_1 be a fuzzy key of R_1 at α -level of choice. R_1 is called to be in fuzzy third normal form i.e., F3NF, if and only if R_1 is in F2NF and R_1 should not contain any ffd among fuzzy nonprime attributes i.e., for any non-trivial ffd $X_1 \rightarrow A_1$ in F_1 either X_1 contains the fuzzy key or A_1 is fuzzy-prime.
From this definition of F3NF, I can say that the above relation $EMPLOYEE_1$ is in F3NF, but relation $EMPLOYEE_2$ is not in F3NF. So, decompose the relation $EMPLOYEE_2$ as follows:
$EMPLOYEE_3$(E*Exp*, E*Sal*) with ffds
F^3 = {E*Exp→ESal,with α=0.89*}
Fuzzy Key: E*Exp* at 0.89-level of choice.
$EMPLOYEE_4$(E*Name*,E*Cityname*, E*Exp*) with ffds
F^4 = {E*NameECityname→EExp*}
Fuzzy Key: E*NameECityname* at 1-level of choice. Here fuzzy key is also the classical key.

V. CONCLUSION

Fuzzy relational database is being suffered from redundancy and different anomalies of data if it is not designed properly. Fuzzy normalization based on α -ffd to design a good fuzzy relational database. In this paper, firstly applying fuzzy closure of attribute set which helps in determining fuzzy key and then normalization process of fuzzy relation has been discussed by defining different fuzzy normal forms.
I have also introduced the definition of fuzzy prime and fuzzy nonprime attributes in order to state the condition for fuzzy normal forms. Fuzzy normal forms can be used to decompose an un-normalized fuzzy relation into a set of normalized relations. I have plan to study and applying some concepts of fuzzy relation for better utilizing of dependency reservation and lossless join of fuzzy relational database and fuzzy join dependency.

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