LOSSLESS JOIN DECOMPOSITION AVOID INCONSISTENCY IN FUZZY RELATIONAL DATABASE FOR PERFECT OPERATION

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ABSTRACT

Fuzzy relational database handle imprecise information on database to maintain integrity of operation. Already I handled different normal form to reduce redundancy of data in a database. Decomposition of a relation should not be arbitrary either by tuples or attributes of a relation. In this paper, I have focused on lossless decomposition of third or Boyce Codd normal form based relation so that I can get back original relation after joining all sub relations. Original relation can not retrieve from decomposed relation if the decomposition is not lossless. So any decomposed relation should follow lossless and dependency preservation for it’s accurate normalized operation.

Keywords: A -Ffd, Fuzzy Key, Fuzzy Relation, Dependency Preservation, Lossless Join.

I. INTRODUCTION

I know that the classical relational data model introduced by Codd [1] in 1970 can use only precise and exact data. Database models using Fuzzy logic [2-11] is based on the fuzzy set theory proposed by Zadeh [12] in 1965 have been extensively studied to deal with such uncertain information in relational database. One of the main moto of any databases is to minimise data redundancy which may lead to data consistency. In this paper, my objective is to handle fuzzy relational database to keep the data in consistent form. Here I basically try to focus on lossless join operation on fuzzy data to make perfect operation for keeping consistent data into database.

II. BASIC DEFINITIONS

2.1 Definition

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

Note that a classical subset $B$ of $U$ can be viewed as a fuzzy subset with membership function $\mu_{BS}$ taken binary values, i.e.,

$\mu_{BS} = 1$ if $u \in B$
2.2. FUZZY FUNCTIONAL DEPENDENCY (ffd)

Let X, Y ∈ R = {A1, A2, ..., An} . Choose a parameter α[0,1] and propose a fuzzy tolerance relation R1. A fuzzy functional dependency (ffd), denoted by X → Y based on values of R1, is said to exist, if whenever t1 [X ] ̵ α t2 [X] , it is also the case that t1 [Y ] ̵ α t2 [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 α∈[0,1] , X → Y with α value.

2.3 Fuzzy Key

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

2.3.1 Definition

Let K1 is subset of R1 and FS be a set of ffd's for R1 . Then, K1 is called a fuzzy key of R1 at α-level of choice where α∈[0,1] iff K1 → R1 with α value, ∈ FS and K1 → R1 with α value is not a partial ffd.

III. LOSSLESS JOIN DECOMPOSITION

Lossless join property guarantees that the problem of spurious tuple generation does not occur with respect to the relation schemas created after decomposition.

Method:

Step1: Set ρ := {R}

Step2: While there is a relational schema S in ρ that is not in FBCNF do

{ Find a fuzzy functional dependency X → Y in S that violates FBCNF, i.e., X → Y violates FBCNF if X is not a fuzzy key of R .

Replace S in ρ by S1 and S2 , where S1 contains the attributes in X ∪ Y and S2 will contain the attributes in S except those in Y . i.e., S1 = {X ∪ Y} and S2 = {S − Y} .

} Output: A set of decomposed relation schemas R1, R2, ..., Rk with ffd sets F1, F2, ..., Fk respectively, satisfying the desired Fuzzy Boyce Codd Normal form (FBCNF) and lossless join property i.e., R = R1 ⊔ R2 ⊔ ..., ⊔ Rk .

Example 4.1

Let us consider the EMPDetail(Name, City, City Status, Experience, Salary) relation and ffd set

F = {City → City Status, Experience → Salary, Name City → Experience} 

Find a lossless join decomposition of the relational schema EMPDetail into FBCNF.
**Solution:** Fuzzy key of EMPDetail is \((\text{Name City})\) at 0.9-level of choice.

**Step 1:** Set \(\rho := \{\text{EMPDetail}(\text{Name, City, CityStatus, Experience, Salary})\}\)

**Step 2:** Here EMPDetail is not in FBCNF, since in the ffd \(\text{City} \rightarrow 0.99 \text{CityStatus}\), \(\text{City}\) is not a fuzzy key. Therefore, EMPDetail is decomposed into the following two relations:

- \(E_1(\text{City, CityStatus})\) : \(F_1 = \{\text{City} \rightarrow 0.99 \text{CityStatus}\}\); fuzzy key: \(\text{City}\) at 0.99-level of choice and
- \(E_2(\text{Name, City, Experience, Salary})\) :
  \[F_2 = \{\text{Experience} \rightarrow 0.9 \text{Salary}, \text{Name City} \rightarrow \text{Experience}\}\];
  fuzzy key: \((\text{Name City})\) at 0.9-level of choice.

Here \(E_1\) is in FBCNF, but \(E_2\) is not in FBCNF since \(\text{Experience} \rightarrow 0.9 \text{Salary}\) violates the rule. So, we again decompose \(E_2\) into the following two relations:

- \(E_{21}(\text{Experience, Salary})\) : \(F_{21} = \{\text{Experience} \rightarrow 0.9 \text{Salary}\}\);
  fuzzy key: \(\text{Experience}\) at 0.9-level of choice and
- \(E_{22}(\text{Name, City, Experience})\) : \(F_{22} = \{\text{Name City} \rightarrow 1 \text{Experience}\}\);
  fuzzy key: \((\text{Name City})\) at 1-level of choice.

Here both \(E_{21}\) and \(E_{22}\) are in FBCNF.

Therefore, finally EMPDetail is decomposed into following three relation schemas \(E_1(\text{City, CityStatus})\), \(E_{21}(\text{Experience, Salary})\) and \(E_{22}(\text{Name, City, Experience})\) with the ffd set

- \(F_1 = \{\text{City} \rightarrow 0.99 \text{CityStatus}\}\),
- \(F_{21} = \{\text{Experience} \rightarrow 0.9 \text{Salary}\}\)
- \(F_{22} = \{\text{Name City} \rightarrow 1 \text{Experience}\}\)

Also we get \(\text{EMPDetail} = (E_1 \bowtie E_{21} \bowtie E_{22})\). Hence the lossless join property has been achieved in the above decomposed relations that satisfy the fuzzy Boyce Codd normal form. It may be noted that the above decomposition also satisfies the dependency preservation property since \(F = \{F_1 \cup F_{21} \cup F_{22}\}\).

**IV. CONCLUSION**

Fuzzy relational database is being suffered from redundancy and different anomalies of data if it is not designed properly. Fuzzy normalization based on \(\alpha\)-ffd to design a good fuzzy relational database. Fuzzy normal forms can be used to decompose an un-normalized fuzzy relation into a set of normalized relations. I have plan to applying some concepts of fuzzy relation for better utilizing of lossless join of fuzzy relational database and fuzzy join dependency. Finally, it has been illustrated with examples how these fuzzy normal forms can be used
to decompose an unnormalized fuzzy relation into a set of normalized relations that satisfy the lossless join properties.

REFERENCES