International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-10, August 2020

Normalization of Inconsistent Neutrosophic Data in a Model View of Relational Database

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***Abstract:** Database of neutrosophic relational model simplify the relational classical database model by accepting inaccurate data in the neutrosophic form. Here, authors are focused on extensive view of different normalizing neutrosophic forms of classical relational model using neutrosophic set. Initially, in this work authors have introduced the concept of neutrosophic closure of attribute set and neutrosophic key which are essential to develop the normalization concepts of neutrosophic relational database. An algorithm has been developed by the authors for neutrosophic closure based on attributes .These attributes are used to locate the neutrosophic key easily. Then, we have used the α -nfd, partial α -nfd concepts and neutrosophic key as focused in [1] different forms of normalization for the database of neutrosophic relational. Finally, this neutrosophic normalization technique is demonstrated on some real life neutrosophic relation.*

***Keywords:** Neutrosophic set, similarity measure of neutrosophic data, α -nfd, partial α -nfd, Neutrosophic key, neutrosophic attribute closure, forms of different neutrosophic normalization.*

I. INTRODUCTION

Codd [2] in 1970 was introduced the model of classical data relation which can process only deterministic data. However, in real life applications, data is more often uncertain. Database of fuzzy data is introduced by Zadeh [8] in 1965 have been understood. Gau and Buehrer [9] in 1993 is introduced vague theory and it is efficient tool than previous any tool to deal vague data but it is not applicable in imprecise data. A vague set V [10,11,12,13]which is based on membership of truthness(t_V)and a falseness(f_V) functions where $t_V + f_V \le 1$. Now neutrosophic set has been focused [14] for understanding uncertain data or information in better way than vague set theory , using membership of truthness(t_V) , membership of indeterminacy(t_i) and membership of falseness(t_f). The ability of the set properties of neutrosophic data has huge controlling power than vague sets to process the information of uncertain data. The model of extension database is called a model of relational neutrosophic database. A primary objective is to decrease data redundancy and maintain the data consistent in database. Redundancy of data in the form of insertion, update and deletion. Designing a good relational database integrity constraints and normalization both are essential. Studies related to avoiding anomalies with the process of normalization using the model of fuzzy database is given in ref. [3, 4, 5, 6, 7].

Revised Manuscript Received on August 30, 2020.
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We have been studied the dependencies of neutrosophic data based relation [15, 16] in a model concept. The new definition of neutrosophic functional dependency, called α -nfd, based on tuples of α -equality [1] has been explained the authors. Here , our objective is that to design a model using neutrosophic relation database to minimize data inconsistency . Fulfil this concept , attributes of the neutrosophic closure has been taken for neutrosophic key. Next, different normal forms of neutrosophic database is introduced as first neutrosophic normal form (1NNF),second neutrosophic formal form (2NNF), third neutrosophic normal form (3NNF) and neutrosophic boyce codd normal form (NBCNF) based on α -nfd. At last, with an example all concepts are checked.

We have followed some sections: The review of the theory of neutrosophic data in the section 2.Our proposed algorithm using on attributes for finding the neutrosophic closure is in section 3. Different techniques of neutrosophic normalization such as 1NNF, 2NNF, 3NNF, and NBCNF are in section 4. In section 5 ,we have mentioned our conclusion .

II. NEUTROSOPHIC RELATIONAL DATA MODEL

We have reviewed the concepts of set and model representation of neutrosophic data. Here U_1 is used for the universe of discourse and u is an element of U_1.

Definition 1

X is a neutrosophic set on the universe of discourse U_1 is represented by the membership functions such as:

(a) Membership of truthness function $t_z : U_1 \to [0,1]$,

(b) Membership of falseness function $f_z : U_1 \to [0,1]$ and

(c) Membership of indeterminacy function $i_z : U_1 \to [0,1]$

such that $t_z(p) + f_z(p) \le 1$ and $t_z(p) + f_z(p) + i_z(p) \le 2$, written as $Z_1 = \{\langle z, [t_x(p), i_x(p), f_x(p)] \rangle, p \in U_1\}$.

Definition 2

An empty Neutrosophic set 'N' means its membership of truthness function $t_n(m) = 0$, membership of indeterminacy function $i_n(m) = 0$ and membership of falseness function $f_n(m) = 1$ for all m on U_1. A Neutrosophic set 'Z' is within other neutrosophic set 'X', written as $X \subseteq Z$, if and only if, $t_X \le t_Z$, $i_X \le i_Z$ and $f_X \ge f_Z$.

A. Database Model of Neutrosophic Relation

Here, we focused on classical database model with its extension part of neutrosophic data and is called a database model of neutrosophic relation. Now we have mentioned a Neutrosophic relational schema. Let AT_i, i = 1 to n, be n attributes are defined in the universe with set U_1. A relation ***r*** of neutrosophic relation schema R_1 (AT_1, AT_2, … , AT_n) is defined with neutrosophic subsets: nr $\subseteq$ N (AT_1) ×N (AT_2) ×….. ×N (AT_n) where N(AT_i) denotes the neutrosophic domain set of AT_i on universal set U_1 . Neutrosophic domain set N(AT_i) contains neutrosophic as well as crisp data.

Here, we extend the relation of classical database model to include neutrosophic data with the theory of neutrosophic set, which means the Database model Neutrosophic Relation.

Table I. Neutrosophic relational instance of Immunity System relation

PName	Age	Hemoglobin (Hb)	Fasting Sugar(FS)
Bimal	31	{8.5 <.91,.01,.03> }	{100 <.97.02,.02> }
Jack	23	{10.5 <.98,.015,.01> }	{95 <.92,.03,.04> }
Kallis	46	{7.8 <.94,.02,.03> }	{88 <.85,.01,.1> }
Bikas	30	{6.2 <.71,.026,.12> }	{92 <.80,.015,.14> }
Rintu	42	{11.5 <.99,.001,.01> }	{105.5 <.99,.12,.01> }
Pratap	56	{6.8 <.86,.012,.05> }	{97 <.96,.02,.03> }
Amal	66	{9.2 <.97,.01,.02> }	{84 <.80,.15,.04> }
Niloy	50	{7.4 <.90,.02,.03> }	{101 <.97,.01,.02> }
Mita	32	{8.7 <.92,.01,.07> }	{104 <.98,.15,.02> }
Nitu	44	{11.1 <.99,.01,.01> }	{110 <.98,.001,.02> }

Example 1

The relational of neutrosophic instance (nr) to a Immunity System relation (PName, Age, Hemoglobin, Fasting Sugar) given above in Table I. In nr , Hemoglobin and Fasting Sugar are neutrosophic attributes. The first nr based tuples indicates Immunity System relation with Name = "Nitu" has Hemoglobin of {11.1, <.99,.01,.01>} and Fasting Sugar of {110, <.98,.001,.02>}, both are neutrosophic sets. Neutrosophic data {11.1, <.99,.01,.01>} indicates favour of "Hemoglobin is 11.1" is .99, indeterminacy part .01 and against truthness is .01 and so on.

B. Measure of Neutrosophic Data Similarity

We introduced the measure of neutrosophic sets based similarity [17, 18, 19] which is more effective and we have used it in our present work which is defined as follows:

Definition 3

Let two neutrosophic values of a and b represented as $a=[t_a, i_a, f_a]$ and $b=[t_b, i_b, f_b]$ where $0 \le t_a \le 1, 0 \le i_a \le 1, 0 \le f_a \le 1$ and $0 \le t_b \le 1, 0 \le i_b \le 1, 0 \le f_b \le 1$ with $0 \le t_a + f_a \le 1$, $0 \le t_b + f_b \le 1$,

$0 \le t_a + i_a + f_a \le 2,\ 0 \le t_b + i_b + f_b \le 2$.

Now the measure of two neutrosophic data based similarity is denoted by $SM_N = (a,b)$ is defined as follows

$$SM_N(a,b) = \sqrt{1 - \frac{\left|(t_a - t_b) - (i_a - i_b) - (f_a - f_b)\right|}{3}\left(1 - \left|(t_a - t_b) + (i_a - i_b) + (f_a - f_b)\right|\right)}$$

C. Neutrosophic Functional Dependency

In this paper, similar to classical functional dependency, we define the dependency notion of neutrosophic function (α -nfd) based on the α -equality of neutrosophic tuples which plays important role in designing neutrosophic database.

Definition 4

Let nr(R_1) be a neutrosophic relation on the relational schema R_1 (AT_1, AT_2 , …… , AT_n). Let t_1 and t_2 be any two neutrosophic tuples in nr and the threshold value is $\alpha \in [0,1]$ is given by the database designer, and X_1 = { AT_1, AT_2 , …… , AT_k } $\subseteq$ R_1. Then the α -equal of t_1 and t_2 tuples of neutrosophic data on X_1 means if SM_N(t_1[AT_i], t_2[AT_i]) $\ge$ α $\forall$ i =1 to k. This equality is denoted by the notation $t_1[X_1](NE)_\alpha t_2[X_1]$.

Definition 5

Let X_1, Y_1 $\subset$ R_1 = {AT_1, AT_2... AT_n } and $\alpha \in [0,1]$. Then a neutrosophic functional dependency (α -nfd), given by $X_1 \xrightarrow[\alpha]{nfd} Y_1$ is exist if, whenever $t_1[X_1](NE)_\alpha t_2[X_1]$, also we can write $t_1[Y_1](NE)_\alpha t_2[Y_1]$.

It means "*X* neutrosophic functionally determines *Y* at α -level". In another way, "*Y is* neutrosophic functionally determined by X at α –level". The following proposition for α -nfd is straightforward.

Definition 6

Partial dependency of neutrosophic function (partial α -nfd) for neutrosophic database relation is given:

Partial dependent of neutrosophic function of Y_1 on X_1 at α -level means $X_1 \xrightarrow[\alpha]{nfd} Y_1$ partially dependent, if $X_1 \xrightarrow[\alpha]{nfd} Y_1$ hold with the existence of a non-empty set $X_1' \subset X_1$, such that, $X_1' \xrightarrow[\alpha]{nfd} Y_1$. After removal of an attribute X_j from X_1 , still dependency holds means , for an attribute $X_j \in X_1, X_1 - \{X_j\}$, still determines the neutrosophic function of Y_1 at α -level of choice. The partial α -nfd is also needed for neutrosophic key definition .

D. Neutrosophic Key

We have defined neutrosophic key[1] in neutrosophic environment as follows:

Let $K_1 \subseteq R_1$, N be a set of nfds for R_1 . Here neutrosophic key is K_1 of R_1 at α -level of choice with $\alpha \in [0,1]$, iff $K_1 \xrightarrow[\alpha]{nfd} R_1 \in N$ and $K_1 \xrightarrow[\alpha]{nfd} R_1$ is not a partial $\alpha -$ nfd.

III. NEUTROSOPHIC CLOSURE

X_1 is a attribute set of neutrosophic closure which is noted by X_1^+ is the attributes set and these attributes are determined the neutrosophic function by the X_1 attributes. If X_1^+ is the minimal attribute set of the schema of R_1 relation then X_1 is a neutrosophic key of R_1 relation . We find the neutrosophic closure from an algorithm which is given below.

Algorithm 1

Input :
Schema of neutrosophic relation i.e. R_1 , a set of nfds N on R_1 and attributes set X_1 .
Output :
Attributes set X_1^+ , the closure neutrosophic set of X_1 .
Method :

Let $X_1^+ = X_1$.

i.e., $X_1^+ = (X_1, \alpha_1)$ where $\alpha_1 = 1$ [$\because X_1 \xrightarrow[1]{nfd} X_1$]

repeat $X_1^* = X_1^+$.

for each nfd $Y_1 \xrightarrow[\alpha_2]{nfd} Z_1$ in N

do

if $Y_1 \subseteq X_1^+$ then $X_1^+ = (X_1^+ \cup Z_1, \alpha_3)$ where α_3 = min(α_1 , α_2) .

end for until ($X_1^* = X_1^+$) .

Example 2

Let relational scheme $R_1(A_1, B_1, C_1, D_1)$ and nfds N on R_1 is given as

$N = \{A_1 \xrightarrow[.8]{nfd} C_1, B_1 \xrightarrow[.8]{nfd} D_1, C_1 \xrightarrow[.9]{nfd} B_1\}$.

Find closure of A_1 .

Explaination :

Now, $X_1^+ = A_1$ i.e., $X_1^+ = (A_1, 1)$

Repeat Case -1:

$X_1^* = (A_1, 1)$

for $A_1 \xrightarrow[.8]{nfd} C_1, X_1^+ = (A_1C_1, .8)[\because A_1 \subseteq X_1^+]$

for $B_1 \xrightarrow[.8]{nfd} D_1, X_1^+ = (A_1C_1, .8)[\because B_1 \not\subset X_1^+]$

for $C_1 \xrightarrow[.9]{nfd} B_1, X_1^+ = (A_1B_1C_1, .8)[\because C_1 \subseteq X_1^+]$

Since $X_1^* \neq X_1^+$ do the following repeat case

Repeat Case -2 :

$X_1^* = (A_1 B_1 C_1, .8)$

for $A_1 \xrightarrow[.8]{nfd} C_1, X_1^+ = (A_1B_1C_1, .8)[\because A_1 \subseteq X_1^+]$

for $B_1 \xrightarrow[.8]{nfd} D_1, X_1^+ = (A_1B_1C_1D_1, .8)[\because B_1 \subseteq X_1^+]$

for $C_1 \xrightarrow[.9]{nfd} B_1, X_1^+ = (A_1B_1C_1D_1, .8)[\because C_1 \subseteq X_1^+]$

Since $X_1^* \neq X_1^+$ do the following repeat case

Repeat Case -3:

$X_1^* = (A_1 B_1 C_1 D_1, .8)$

for $A_1 \xrightarrow[.8]{nfd} C_1, X_1^+ = (A_1B_1C_1D_1, .8)[\because A_1 \subseteq X_1^+]$

for $B_1 \xrightarrow[.8]{nfd} D_1, X_1^+ = (A_1B_1C_1D_1, .8)[\because B_1 \subseteq X_1^+]$

for $C_1 \xrightarrow[.9]{nfd} B_1, X_1^+ = (A_1B_1C_1D_1, .8)[\because C_1 \subseteq X_1^+]$

These repeating case will stop since $X_1^* = X_1^+$.

A_1 *is* the closure of neutrosophic set i.e., $X_1^+ = (A_1 B_1 C_1 D_1, 0.8)$ which means $A_1 \xrightarrow[.8]{nfd} A_1B_1C_1D_1$.

IV. NEUTROSOPHIC NORMALIZATION

Main problem is to design the database in relational approach, to avoid the anomalies [20] . Inconsistent data may lead to different database anomalies during database operation. Codd was introduced different normal forms such as first, second, third and boyce codd normal forms to minimise anomalies. To design any relational database, must follow at least third normal form from the redundancy point of view. We have introduced the techniques of normalization for neutrosophic relation is called neutrosophic normalization which is up to the neutrosophic boyce codd normal forms. Here we have discussed different normalization forms of relational neutrosophic database such as, neutrosophic first (1NNF), neutrosophic second (2NNF), neutrosophic third (3NNF) and neutrosophic BCNF (NBCNF) normal forms. We considered the neutrosophic relation scheme ARMY (A*Name*, A*City*, AOperation*Status*, A*Exp*, A*Sal*) to explain these forms in Table II.

Table II: A neutrosophic relational instance *r* of ARMY *relation*

AName	ACity	AOperationStatus	AExp	ASal
Kant	Kol	{ 10 <.89,.01,	{11.5 <.92,.01,.03>	{43000 <.94,.01,.02>
Jack	Haldia	{7 <.95,	{15 <.99,.0015,.01	{50000 <.99,.012,.01>
Jassi	Malda	{12 <.94,.01,.02>}	{11 <.9,.02,.04> }	{40000 <.98,.01,.01>
Amit	Kgp	{ 8 <.78,.04,	{5 <.71,.026,.12>	{20000 <.80,.015,.14>
Rupam	Kol	{ 10 <.91,.01,	{15 <.98,.01,.01>	{50000 <.74,.125,.22>
Pritam	Malda	{ 12 <.90,.01,	{11.5 <.913,.012,.03	{43000 <.96,.02,.01>
Akhile	Kol	{10.5 <.95,.015,.02>	{12 <.97,.01,.02>	{45000 <.85,.015,.04>
Niloy	Kgp	{ 8 <.90,.001,	{11 <.90,.02,.03>	{40000 <.91,.01,.06>
Mita	Haldia	{ 7 <.91,.01,	{7 <.76,.01,.22>	{25000 <.95,.001,.02>
Jatin	Haldia	{ 6.5 <.75,.02,	{7 <.70,.02,.23>	{25000 <.72,.04,.17>

The attributes AOperationStatus, AExp and ASal are neutrosophic attributes as the domain of these attributes contain neutrosophic data.

Now using the domain of AOperationStatus, AExp and ASal in Table II with the apply of Definition 3 to find similarity measure. The resultant AOperationStatus, AExp and A*Sal* matrices are in Table III, Table IV and Table V respectively.

Table III: Similarity Measures of AOperationStatus

	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
t_1	1	.93	.95	.94	.94	.96	.95	.98	.96	.91
t_2	.93	1	.95	.91	.97	.95	.94	.78	.98	.81
t_3	.95	.95	1	.84	.98	.95	.99	.96	.986	.78
t_4	.93	.91	.84	1	.78	.85	.8	.82	.84	.95
t_5	.94	.97	.98	.78	1	.93	.98	.94	.92	.76
t_6	.96	.95	.95	.85	.93	1	.94	.99	.97	.81
t_7	.95	.94	.99	.8	.98	.94	1	.95	.94	.80
t_8	.98	.78	.96	.82	.94	.99	.95	1	.97	.79
t_9	.96	.98	.96	.84	.92	.97	.79	.97	1	.82
t_{10}	.91	.81	.78	.95	.76	.81	.80	.79	.82	1

Table IV: Similarity Measures of AExp

	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
t_1	1	.94	.97	.78	.94	.98	.96	.87	.92	.91
t_2	.94	1	.94	.82	.98	.96	.93	.86	.91	.87
t_3	.97	.94	1	.73	.95	.97	.96	.98	.88	.89
t_4	.78	.82	.73	1	.82	.76	.81	.74	.92	.98
t_5	.94	.978	.95	.82	1	.94	.97	.91	.89	.86
t_6	.98	.96	.97	.76	.94	1	.96	.89	.77	.73
t_7	.96	.93	.96	.81	.97	.96	1	.84	.91	.86
t_8	.87	.86	.98	.74	.91	.89	.84	1	.92	.84
t_9	.94	.91	.88	.92	.89	.77	.91	.92	1	.96
t_{10}	.91	.87	.89	.98	.86	.73	.86	.84	.96	1

Table V: Similarity Measures of ASal

	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
t_1	1	.96	.97	.81	.64	.97	.94	.96	.99	.90
t_2	.96	1	.98	.91	.77	.95	.82	.89	.93	.87
t_3	.97	.98	1	.85	.81	.98	.95	.96	.95	.89
t_4	.81	.91	.86	1	.95	.94	.97	.91	.95	.96
t_5	.64	.77	.81	.95	1	.83	.94	.83	.84	.97
t_6	.97	.95	.98	.94	.83	1	.92	.95	.98	.89
t_7	.94	.82	.95	.97	.94	.92	1	.89	.94	.93
t_8	.96	.89	.96	.91	.84	.95	.89	1	.96	.87
t_9	.99	.93	.95	.95	.84	.98	.94	.96	1	.89
t_{10}	.90	.87	.89	.96	.97	.89	.91	.87	.89	1

Now from the above Table II, III, IV and V nfds and fds for the relation scheme

ARMY (AName, ACity, AOperationStatus, AExp, ASal) is defined as follows:

N= { $ACity \xrightarrow[.81]{nfd} AOperationStatus$,

$AExp \xrightarrow[.89]{nfd} ASal$, $ANameACity \rightarrow AExp$ }

The fd $ANameACity \rightarrow AExp$ is expressed in nfd i.e. $ANameACity \xrightarrow[1]{nfd} AExp$.

So the new N set as follows:

$N = ACity \xrightarrow[.81]{nfd} AOperationStatus$,

$AExp \xrightarrow[.89]{nfd} ASal$, $ANameACity \xrightarrow[1]{nfd} AExp$ }

Next we expressed the neutrosophic key with the relation ARMY. Now we obtained the neutrosophic closure of ANameACity, using Algorithm 1 is given below:

$(ANameACity)^+$ =

(A*Name ACity A Operation Status AExp ASal*, 0.81)

which means

$ANameACity \xrightarrow[.81]{nfd} ANaneACityAOperationStatusAExpAsal$.

Therefore, from ARMY -relation , we got the neutrosophic key ANameACity with 0.81 –level.

A. Neutrosophic Prime and Non-prime Attributes

Let $B_1 \in R_1$ and the neutrosophic key set is S for R_1 . B_1 is the neutrosophic prime attributes if only $B_1 \in S$. Neutrosophic nonprime attributes are not neutrosophic prime. Neutrosophic prime attribute is at least one of the neutrosophic candidate keys of the relation. Neutrosophic nonprime attribute is not the neutrosophic candidate keys in any relation.

Example 3

We considered the ARMY (AName, ACity, AOperationStatus, AExp, ASal*)* relation with nfd set

N= { $ACity \xrightarrow[.81]{nfd} AOperationStatus$,

$AExp \xrightarrow[.89]{nfd} ASal$, $ANameACity \rightarrow AExp$ } of Table II.

Here neutrosophic key is AName and ACity *at* 0.81 –level. Therefore, both attributes A*Name* and A*City* are neutrosophic prime attributes at 0.81-level and AOperationStatus, AExp and ASal attributes are non-prime neutrosophic attributes.

Retrieval Number: J73120891020/2020©BEIESP
DOI: 10.35940/ijitee.J7312.0891020
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication

B. First Neutrosophic Normal Form

Let D_i has the attributes domain A_i, R_1 is the schema of a relation which is called the first neutrosophic normal form (1NNF) for any relation r_1 in R_1, no one attribute is multi-valued. 1NNF is given in Table 2. α -cut similarity based relation is in 1NNF

C. Second Neutrosophic Normal Form

Let N is the nfds set for the schema of R_1 relation and S is a neutrosophic key at α –level. R_1 is called the second neutrosophic normal form(2NNF), for no one of the nonprime attribute is partially neutrosophic functionally dependent on the neutrosophic key.

Example 4

We considered the relation of ARMY with set of N nfd in Table II.
ARMY (AName, ACity, AOperationStatus, AExp, ASal) and

$N = \{ ACity \xrightarrow[.81]{nfd} AOperationStatus,$

$AExp \xrightarrow[.89]{nfd} ASal, \; ANameACity \rightarrow AExp \}.$

Neutrosophic Key: PNamePCity at the level of 0.81.
Here the attribute AOperationStatus is non prime which is partially neutrosophic dependent on neutrosophic key ANameACity at the level of 0.81. So, Table II is not in 2NNF.
We decompose the Table 2 to satisfy 2NNF. We know only nfd $ACity \xrightarrow[.81]{nfd} AOperationStatus$ is violating the 2NNF condition, so the we got two decomposed relations in 2NNF which are
$ARMY_1$ (ACity, A Operation Status) with nfds
$N_1 = \{ ACity \xrightarrow[.81]{nfd} AOperationStatus \}$
Neutrosophic Key: PCity at the level of 0.81
$ARMY_2$ (AName, ACity, AExp, ASal) with nfds
$N_2 = \{ AExp \xrightarrow[.89]{nfd} ASal, \; ANameACity \rightarrow AExp \}$
Neutrosophic Key: PNamePCity at .89

D. Third Neutrosophic Normal Form

Let consider relation schema R_1 with the nfds set and the neutrosophic key is S at α –level . R_1 is to be in third neutrosophic normal form(3NNF), only if R_1 is in 2NNF and R_1 should not contain any nonprime attribute with nfd , for any non-trivial nfd $X \xrightarrow[\alpha]{nfd} A$ in N either A is neutrosophic –prime or the neutrosophic key is present in X.

Example 5

The concept of 3NNF we say that the relation $ARMY_1$(ACity, ACityStatus) is in 3NNF and the relation $ARMY_2$(AName, ACity, AExp, ASal) is not in 3NNF. In relation $ARMY_2$ $AExp \xrightarrow[.89]{nfd} ASal$ is violating the 3NNF condition. So, we need to decompose the $ARMY_2$ relation into 3NNF relations as
follows:
$ARMY_3$ (AExp, ASal) with nfds
$N_3 = \{ AExp \xrightarrow[.89]{nfd} ASal \}$
Neutrosophic Key: P*Exp* at the level of .89

$ARMY_4$ (AName, ACity, AExp) and the nfds
$N_4 = \{ ANameACity \rightarrow AExp \}$
Neutrosophic Key: The level of ANameACity is 1
Now the neutrosophic key is acts as the classical key.

E. Boyce Codd Neutrosophic Normal Form

In relation R_1 schema consists of neutrosophic key S and the set of nfds noted by N at the level of α . R_1 is BCNF neutrosophic normal form(NBCNF), only if R_1 is in 3NNF and for any nfd which is non-trivial $X \xrightarrow[\alpha]{nfd} A$ in N , X is a neutrosophic key of R_1 means $X \supseteq S$.

Example 6

These decomposed relations satisfy 3NNF are also in NBCNF.
$ARMY_1$ (*ACity, ACityStatus*),
$N_1 = \{ ACity \xrightarrow[.81]{nfd} AOperationStatus \}$
$ARMY_3$ (*AExp, ASal*), $N_3 = \{ AExp \xrightarrow[.89]{nfd} ASal \}$,
$ARMY_4$ (*AName , ACity, AExp*),
$N_4 = \{ ANameACity \rightarrow AExp \}$

V. CONCLUSION

Any relation of neutrosophic database will be affected badly due to different data anomalies and redundancy if the design of the neutrosophic database is improper. Normalization process of neutrosophic database is based on mainly α -nfd, as defined in this work. This α -nfd will act as a good designer role for any relation of neutrosophic database. Here, we have designed an algorithm to find the closure of neutrosophic attributes which is play a role to find the neutrosophic key and then we have proceed using the relation of neutrosophic database to satisfy the normalization process which is explained in this paper by the different neutrosophic normal forms such as 1NNF, 2NNF, 3NNF, and NBCNF. Also we introduced the prime and non-prime attributes using neutrosophic data for neutrosophic normalization. We have shown an example with neutrosophic normal forms which can be decomposed into an unnormalized relation of neutrosophic data into a normalized neutrosophic set of relations.

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