A STUDY ON HEALTH PROBLEMS FACED BY RAG PICKERS USING INDUCED FUZZY ASSOCIATIVE MEMORY MODELS

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ABSTRACT

We use fuzzy associative memories (FAM) and induced fuzzy associative memories (IFAM), to analyze the causes for health problems faced by Rag pickers. Based on our study, we made conclusions and suggested some remedial measures.

Keywords : Health hazards, FAM, IFAM, fixed point, limit cycle, hidden pattern.

1. INTRODUCTION :

Fuzzy models are mathematical tools introduced by Zadeh (1965). In 1976, Axelord used the fuzzy tools to study political decisions. Later in 1986, using the concepts of neural networks and fuzzy logic, Bart Kosko proposed many more models (Kosko, 1986). Among the various fuzzy models, b_i directional associative memories (BAM), fuzzy cognitive maps (FCM) and fuzzy relational maps (FRM) are some of the important models which have been used to study these problems. Fuzzy associative memories (FAM) were introduced by Bart Kosko in 1997. FAM yields gradation among the attributes (Kosko, 2001). The research on FAM results many modified models such as adaptive FAM (AFAM), fuzzy hebb FAM, binary input-output FAM (BIOFAM) and adaptive BIOFAM, recurrent fuzzy associative memory (RFAM), fuzzy morphological associative memories (FMAM) and induced FAM (IFAM) (Pathinathan et al., 2005). FAM is much useful if learning algorithms are applied because it allows rules to be updated easily. FAM has been used by many researchers to study evolutionary computation, to predict cement quality, to predict stock price index and to study the application on neural networks and fuzzy systems. In Balasangu et al. (2010) using IFCM model, it is shown that the pollution and the health hazards are mainly due to spray of pesticides and manuring the fields with chemical fertilizers. They have also used IBAM model, IFRM model and neural net work model to analyze this problem (Balasangu et al., 2007; Balasangu et al., 2008; Balasangu et al., 2009 a, b). In this paper, we first use FAM model and then IFAM model to analyze the methods of using health problem faced by Rag Pickers. Thus we have shown that this model is most suitable to find the effective relationship between the causes. We also provide some remedial measures.

2. FUZZY ASSOCIATIVE MEMORIES :

In this section we present the definitions and the basic notions relevant to this paper.

Definition : A fuzzy set is a map $\mu: X\rightarrow [0,1]$, where X is any set called the domain and [0, 1] the range. For every element $x \in X$, μ assigns membership value in the interval [0,1]. the geometry of fuzzy sets aids us to describe fuzziness, to define fuzzy concepts and to prove fuzzy theorems. Visualizing this geometry may by itself provide the most powerful argument for fuzziness.

Definition : The n-dimensional unit hypercube is denoted as $I^n = [0,1]^n = [0,1] \times \ldots \times [0,1]$. A fuzzy set defines a point in the cube I^n. Vertices of the cube I^n are non-fuzzy sets. The n-dimensional unit hyper cube I^n houses all the fuzzy subsets of the form $X = x_1, \ldots, x_n$.

Here we are interested in the distance between points within the unit hypercube $l^n = [0, 1]^n$ which led to measures of size and fuzziness of a fuzzy set and more fundamentally to a measure.

Definition : Fuzzy system defines mappings between cubes. Fuzzy system S maps fuzzy sets to fuzzy sets. That is $S : I^n \rightarrow I^p$, where n and p are finite positive integers. The n-dimensional unit hypercube I^n consists of all the fuzzy subsets of the domain space $X = \{(x_1, \ldots, x_n) \mid x_1 i \in R, i=1, \ldots, n\}$. Similarly I^p consists of all the fuzzy subsets of the range space $Y = \{(y_1, \ldots y_p) \mid y^1 i \in R, i = 1, \ldots p\}$. Hence X denotes a subset of R^n and Y denotes the subset of R^p. The systems behave as an associative memory known as fuzzy associative memory. Thus fuzzy associative memories are transformations. In this paper, the fuzzy sets A and B are points in unit hypercube, which are viewed as natural vectors. These A and B are represented by numerical fit vectors.

Let $A = \{a_1, \ldots a_n\}$ and $B = \{b_1, \ldots, b_p\}$, where $a_i = \mu_A(x_i)$ and $b_j = \mu_b(y_j)$.

Definition : The fuzzy set association (A_i, B_i) is named as a "rule". The antecedent term A_i and the consequent term B_i in the fuzzy set association (A_i, B_i) are known as input associant and output associant respectively. The FAM system maps points A_j near A_i to points B_j near B_i. If A_j is closer to A_i, then the point (A_j, B_j) is closer to (A_i, B_i) in the product space $I^n \times I^p$. In this sense FAMs map balls in I^n to balls in I^n. Using the rule between the antecedent A_i and consequent B_i, we get the connection matrix M. FAM gives the gradation among the causes as per the attributes chosen by the expert. In this paper we analyze the health problems of rag pickers and suggest some remedial measures.

3. ADAPTATION OF FAM TO THE PROBLEM :

Suppose that there are n attributes, say $X_1, X_2, \ldots X_n$ where n is finite, associated with the rag pickers and let $Y_1, \ldots Y_n$ be the attributes associated with parents and public. The connection matric M of order n x p is obtained through the expert. Let C_1 be the initial input vector 1 x n. A particular component, say C_1 kept on ON state and all other component on OFF state and pass the state vector C_1 through the connection matrix M. We use Min-max principle, to convert the resultant vector into a signal function, choose the first two highest values to ON state and other values OFF state with 1 and 0 respectively. Denote this process by the symbol $\hookrightarrow$. The resulting vector is multiplied with M^T and thresholding yields a new vector C_2. Denote the attribute associated with child and adult become a rag pickers as R_1, R_2, R_3, R_4, R_5, R_6 and R_7 and let denote the attributes associated with the methods of using parents and public as P_1, P_2, P_3, P_4, P_5, P_6, P_7 and P_8 the data collected from child and adult the reasons for the rag pickers are divided as the following attributes.

The attributes related to rag pickers

R_1 - Quarrel at home / ill treatment.

R_2 - Rag picking as an independent profession.

R_3 - School dropout.

R_4 - Take up to all bad habits due to several reasons like bad company, for sleep, etc., so become drug addicts.

R_5 - No hygiene / no knowledge about hygiene / about the hazardous waste they deal with.
R_6 - Poverty and seeks self-respect.
R_7 - Runaway from the family.

The attributes related to parents and public
P_1 - Father a drunkard / no parents / mother dead / Parents in jail
P_2 - No motivation by teacher in school.
P_3 - Enjoy independence / self-support
P_4 - No place to sleep in night.
P_5 - Problem given by police.
P_6 - Malaria / typhoid.
P_7 - Scabies / hepatics / skin aliment due to rag picking.
P_8 - Government and public has taken no steps to manage hazardous waste properly.

The expert's opinion is given in the form a matrix M.

$$M = \begin{array}{c} \\ R_1 \\ R_2 \\ R_3 \\ R_4 \\ R_5 \\ R_6 \\ R_7 \end{array} \begin{array}{c} \begin{array}{cccccccc} P_1 & P_2 & P_3 & P_4 & P_5 & P_6 & P_7 & P_8 \end{array} \\ \left[\begin{array}{cccccccc} 0.8 & 0.7 & 0.6 & 0.0 & 0.5 & 0.4 & 0.3 & 0.4 \\ 0.6 & 0.4 & 0.5 & 0.6 & 0.3 & 0.7 & 0.3 & 0.0 \\ 0.7 & 0.8 & 0.0 & 0.4 & 0.3 & 0.2 & 0.5 & 0.3 \\ 0.6 & 0.0 & 0.5 & 0.3 & 0.2 & 0.4 & 0.6 & 0.7 \\ 0.5 & 0.4 & 0.3 & 0.6 & 0.1 & 0.2 & 0.3 & 0.0 \\ 0.9 & 0.7 & 0.6 & 0.4 & 0.3 & 0.0 & 0.3 & 0.2 \\ 0.4 & 0.0 & 0.4 & 0.3 & 0.4 & 0.5 & 0.3 & 0.2 \end{array}\right] \end{array}$$

Analysing using FAM

Let the initial state vector be C_1 = (1 0 0 0 0 0 0)

The effect of C_1 in dynamical system M is
C_iM = (0.8 0.7 0.6 0.0 0.5 0.4 0.3 0.4) (1 1 0 0 0 0 0 0) = A_1

The result $A_1 \times M^T$ of order 1 x 7 is
(0.8 0.6 0.8 0.6 0.5 0.9 0.4) (1 0 1 0 0 1 0) = C_2

Now $C_1 \neq C_2$. Hence we proceed further to get the limit point as follows.

The effect of C_2 in dynamical system M is
C_2M = (0.9 0.8 0.6 0.4 0.5 0.4 0.5 0.4) (1 1 0 0 0 0 0 0) = A_2

The result $A_2 \times M^T$ of order 1 x 7 is
(0.8 0.6 0.8 0.6 0.5 0.9 0.4) (1 0 1 0 0 1 0) = C_3

Now $C_3 = C_2$

Hence the pair of limit point is ((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0)).

The set of limit points corresponding to different input vectors are given in the following table.

The various limit points for different inputs are given in the following table.

S.No	Input vector	Limit Point
1.	(1 0 0 0 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))
2.	(0 1 0 0 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))
3.	(0 0 1 0 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))
4.	(0 0 0 1 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))
5.	(0 0 0 0 1 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))
6.	(0 0 0 0 0 1 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))
7.	(0 0 0 0 0 0 1)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))

From the above table it is observed that the attributes relative to the causes are highlighted.

Analysis using Induced Fuzzy Associative Memories

Suppose that there are n attributes, say $x_1, x_2, \ldots x_n$ where n is finite, associated with the rag pickers and let $y_1, \ldots y_n$ be the attributes associated with parents and public. The connection matrix M of order n x p is obtained through the expert. Let C_1 be the initial input vector 1 x n. A particular component, say C_1 kept on ON state and all other components on OFF state and pass the state vector C_1 through the connection matrix M. We use Min-max principle, to convert the resultant vector into a signal function, choose the first two highest values to ON state and other values to OFF state with 1 and 0 respectively. Denote this process by the symbol $\hookrightarrow$. The resulting vector is multiplied with M^T and thresholding yields a new vector D1. The vector is related with the connection matrix and that vector which gives the highest number of attributes to ON state is chosen as C_2. That is for each positive entry we get a set of resultant vectors. Among these vectors a vector which contains maximum number of 1's is choses and C_2. If there are two or more vectors with equal number of 1's as ON state. Choose the first occurring one as C_2. Repeat the same procedure till a fixed point or a limit cycle is obtained. This process is done to give due importance to each vector separately as one vector induces another or many more vectors into ON state. Get the hidden pattern by the limit cycle or by getting a fixed point. Next choose the vector with its second component in ON state and repeat the same to get another cycle. This process has been repeated for all the vectors separately. We observe the hidden pattern of some vectors, found in all or many cases. Inference from this hidden pattern highlights the causes.

Let the input vector be C_1 = (1 0 0 0 0 0 0)

Now (1 0 0 0 0 0 0) M = (0.8 0.7 0.6 0.0 0.5 0.4 0.3 0.4) (1 1 0 0 0 0 0 0)

(1 1 0 0 0 0 0 0) M^T = (0.8 0.6 0.8 0.6 0.5 0.9 0.4)

$\hookrightarrow$ (1 0 1 0 0 1 0) = C_1

The new vectors are

$C_1^{(1)}$ = (1 0 0 0 0 0 0)

$C_1^{(2)}$ = (0 0 1 0 0 0 0)

$C_1^{(3)}$ = (0 0 0 0 0 1 0)

Case – (i) :

$C_1^{(1)}$ M = (1 0 0 0 0 0 0)M = (0.8 0.7 0.6 0.0 0.5 0.4 0.3 04.)

(1 1 0 0 0 0 0 0)

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)M^T = (0.8\ 0.6\ 0.8\ 0.6\ 0.5\ 0.9\ 0.4)$

$(1\ 0\ 1\ 0\ 0\ 1\ 0)$ ROW SUM is 3

Case – (ii) :

$C_1^{(2)}\ M = (0\ 0\ 1\ 0\ 0\ 0\ 0)M = (0.7\ 0.8\ 0.0\ 0.4\ 0.3\ 0.2\ 0.5\ 0.3)$

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)$

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)M^T = (0.8\ 0.6\ 0.8\ 0.6\ 0.5\ 0.9\ 0.4)$

$(1\ 0\ 1\ 0\ 0\ 1\ 0)$ ROW SUM is 3

Case – (iii)

$C_1^{(3)}\ M = (0\ 0\ 0\ 0\ 0\ 1\ 0)M = (0.9\ 0.7\ 0.6\ 0.4\ 0.3\ 0.0\ 0.3\ 0.2)$

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)$

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)M^T = (0.8\ 0.6\ 0.8\ 0.6\ 0.5\ 0.9\ 0.4)$

$(1\ 0\ 1\ 0\ 0\ 1\ 0)$ ROW SUM is 3

Therefore the new input vector C_2 to be multiplied with M is :

$(1\ 0\ 1\ 0\ 0\ 1\ 0)$.

Now $C_2M = (1\ 0\ 1\ 0\ 0\ 1\ 0)M – (0.9\ 0.8\ 0.6\ 0.4\ 0.5\ 0.4\ 0.5\ 0.4) \hookrightarrow$

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)$

$(1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)M^T = (0.8\ 0.6\ 0.8\ 0.6\ 0.5\ 0.9\ 0.4)$

$\hookrightarrow\ (1\ 0\ 1\ 0\ 0\ 1\ 0) – C_2^1 = C_1^1$

Now $C_2 = C_1$. Hence the pair of limit point is

$((1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)\ (1\ 0\ 1\ 0\ 0\ 1\ 0))$.

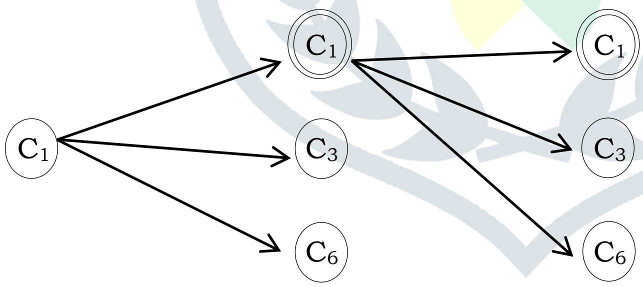

Figure 1 : The graph for triggering patterns of IFAM

For various input vectors, we get different triggering patterns and all these triggering patterns are given in the following table.

S.No	Input vector	Limit Point	Triggering pattern
1.	(1 0 0 0 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_1 \Rightarrow C_1 \Rightarrow C_1$
2.	(0 1 0 0 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_2 \Rightarrow C_1 \Rightarrow C_1$
3.	(0 0 1 0 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_3 \Rightarrow C_1 \Rightarrow C_1$
4.	(0 0 0 1 0 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_4 \Rightarrow C_1 \Rightarrow C_1$
5.	(0 0 0 0 1 0 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_5 \Rightarrow C_1 \Rightarrow C_1$

6.	(0 0 0 0 0 1 0)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_6 \Rightarrow C_1 \Rightarrow C_1$
7.	(0 0 0 0 0 0 1)	((1 1 0 0 0 0 0 0) (1 0 1 0 0 1 0))	$C_7 \Rightarrow C_1 \Rightarrow C_1$

The triggering patterns for these limit points are shown in figure (1). The merged graph is shown in Figure 2.

Since the IFAM gives a gradation, we are able to get the triggering pattern between the attributes which causes the problems.

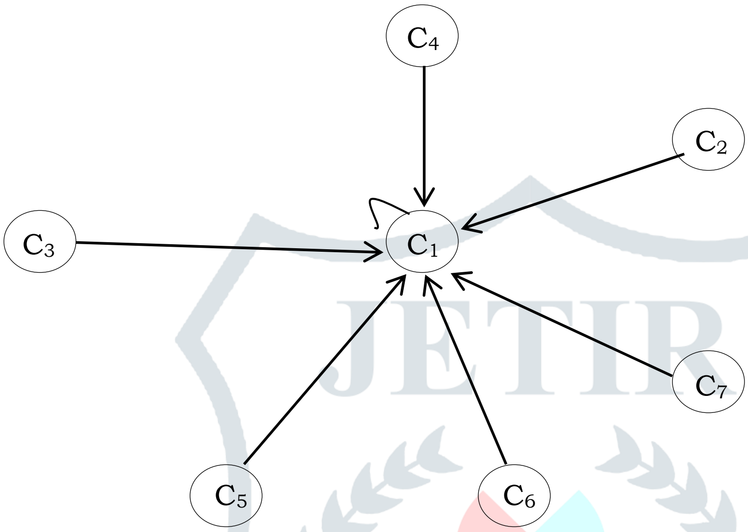

Figure 2 : The merged graph of triggering pattern

CONCLUSION

We analyzed the problems of rag pickers using IFAM model and we identified the following attributes R_1, R_3 and R_6 are the cause for them to become a rag pickers. That is, the reasons quarrel at home / ill treatment, school dropout and poverty and seeks self-respect. The attributes P_1 and P_2 are highlighted and which related to father a drunkard / no parents / mother dead / parent in jail and malaria / typhoid.

REFERENCES :

1. Axelrod, R., Structure of Decision; The Cognitive Maps of Political Elites, Princeton University Press, New Jersey, (1976).
2. Balasangu, K., Thirusangu, K. and Rajkumar Dare, V., IFAM Model approach on the Impact of pesticides on Agricultural Labourers, Indian Journal of Science Technology, 4, No.2, 151-154 (2011).
3. Cornelius, T.L., Fuzzy Theory and Systems; Techniques and Applications, I-IV, Academic Press Inc., New York, (1999).
4. Kosko, B., Fuzzy Cognitive Maps, Int. Journal of Man-Machine Studies, 24, 65-75 (1986).
5. Kosko, B., Bi-directional Associative Memories, IEEE Transaction on Systems, Man and Cybernetics, SMC-18, 49-60 (1988)
6. Kosko, B., Neural Networks and Fuzzy Systems; A Dynamical Systems Approach to Machine Intelligence, Prentice Hall of India (1997).
7. S. Narayanamoorthy, S., Kalaiselvam, "Adaptation of Induced Fuzzy Cognitive Maps to the Problems Faced by the Power Loom Workers:, IJISA, Vol.4, No.9, PP.75-80 (2012).

8. S. Narayanamoorthy, Application of fuzzy cetd matrix technique toestimate the maximum age group of silk weavers as bonded laborers:. Int.j.of. Appl. Math and Mech.8(2) : 89-98(2012).
9. Zedeh. L.A., Fuzzy Sets. Inf. Control.8, 338-353 (1965).
10. Zurada, J.M. Introduction to Artificial Neural Systems, St., Paul, MN; West (1992).