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A study on Domestic Violence against Women Using Induced Fuzzy Associative Memories (IFAM)

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Abstract- Empowerment of women in India is faced with the challenge of 'violence against women'. As violence in perpetrated against women everywhere, domestic violence by the intimate partner or the partner's family assumes more importance in addressing the broader of problem of violence against women. In this paper we analyse the factors which perpetrate domestic violence and how it impinges of women empowerment. The first section of this paper gives an introduction to the problem and the second section gives the basic definitions of the IFAM model. In the third section we adapt IFAM model to the problem of domestic violence and finally the fourth section gives the conclusion and suggestions based on our analysis.

Keywords: Fuzzy, Fuzzy associative memories, Induced FAM, women empowerment, domestic violence.

I. INTRODUCTION

Violence against women is a manifestation of historically unequal power relations between men and women, which have lead to domination and discrimination against women by men and to the prevention of the full advancement of women (Unicef 2000). It is one of the most pervasive of human rights violation, denying women and girls equality and security. Women become more vulnerable and insecure in the society. National Crime Records Bureau data says that Crime against women in India raised up by 7.1 per cent over 2010 and 23.4 per cent over 2007(Rajalakshmi T.K. 2012).Traditional custom that places women in subordinate positions within society or in the family has the potential to turn domestic violent. Women are devalued, subordinated and mistreated in daily life. In this paper we find the factors which create Domestic Violence and how it will affect the women's rights. Efforts towards empowering women are seriously hampered by issues of violence against women. In a patriarchal society like India, a woman's body is objectified and is seen an object on which violence can be inflicted. The root of this problem runs deep in to every institution of society which actively participates in the process of socialisation, starting from family. This being so, violence against women within her own or her intimate partner's family assumes greater importance and it is evident when looks at the number of dowry deaths in India. According to NCRB report while 6,851 dowry deaths were reported in India in 2001, the number increased to 7,618 in 2006 and 8,233 in 2012. This is alarming. Therefore it is our concern to analyse the factors which contribute to domestic violence against women in India.

II. FUZZY ASSOCIATIVE MEMORIES (FAM)

A fuzzy set is a map μ: X → [0, 1] where X is any set called the domain and [0, 1] the range. That is to every element x ∈ X, μ assigns membership value in the interval [0, 1]. Fuzzy theorists often picture membership functions as two-dimensional graphs with the domain X represented as a one-dimensional axis. The geometry of fuzzy sets involves both domain $X = (x_1, x_2, ...x_n)$ and the range [0, 1] of mappings μ: X → [0, 1]. A fuzzy subset equals the unit hyper cube $I^n = [0,1]^n$. The fuzzy set is a point in the cube I^n. Vertices of the cube I^n define a non-fuzzy set. Now within the unit hyper cube $I^n = [0,1]^n$ we are interested in distance between points, which led to measures of size and fuzziness of a fuzzy set and more fundamentally to a measure. Thus within cube theory directly extends to the continuous case when the space X is a subset of R^n. The next step is to consider mappings between fuzzy cubes.

A fuzzy set defines a point in a cube. A fuzzy system defines a mapping between cubes. A fuzzy system S maps fuzzy sets to fuzzy sets. Thus a fuzzy system S is a transformation $S: I^n \to I^p$. The n-dimensional unit hyper cube I^n houses all the fuzzy subsets of the domain space or input universe of discourse $X = (x_1, x_2, ...x_n)$. I^p houses all the fuzzy subsets of the range space or output universe of discourse, $Y = (y_1, y_2, ..., y_p)$. X and Y can also denote subsets of R^n and R^p. Then the fuzzy power sets $F(2^X)$ and $F(2^Y)$ replace I^n and I^p.

In general a fuzzy system S maps families of fuzzy sets to families of fuzzy sets thus $S: I^{n_1} \times ... \times I^{n_r} \to I^{p_1} \times ... \times I^{p_s}$. Here too we can extend the definition of a fuzzy system to allow arbitrary products or arbitrary mathematical spaces to serve as the domain or range spaces of the fuzzy sets. We shall focus on fuzzy systems $S: I^n \to I^p$ that map balls of fuzzy sets in I^n to balls of fuzzy set in I^p. These continuous fuzzy systems behave as associative memories. The map close inputs to close outputs. Weshall refer to them as Fuzzy Associative Maps or FAMs.The simplest FAM encodes the FAM rule or

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association (A_i, B_i), which associates the p-dimensional fuzzy set B_i with the n-dimensional fuzzy set A_i. These minimal FAMs essentially map one ball in I^n to one ball in I^p. They are comparable to simple neural networks. But we need not adaptively train the minimal FAMs. In general a FAM system $F: I^n \to I^b$ encodes the processes in parallel a FAM bank of m FAM rules $(A_1, B_1)...(A_m, B_m)$. Each input A to the FAM system activates each stored FAM rule to different degree.The minimal FAM that stores (A_i, B_i) maps input A to $B_i^{'}$ a partly activated version of B_i. The more A resembles A_i, the more $B_i^{'}$ resembles B_i. The corresponding output fuzzy set B combines these partially activated fuzzy sets $B_1^1, B_2^1, ..., B_m^1$. B equals a weighted average of the partially activated sets $B = w_1 B_1^1 + ... + w_n B_m^1$ where w_i reflects the credibility frequency or strength of fuzzy association (A_i, B_i). In practice we usually defuzzify the output waveform B to a single numerical value y_j in Y by computing the fuzzy centroid of B with respect to the output universe of discourse Y.

More generally a FAM system encodes a bank of compound FAM rules that associate multiple output or consequent fuzzy sets $B_i^1, ..., B_i^s$ with multiple input or antecedent fuzzy sets $A_i^1, ..., A_i^r$. We can treat compound FAM rules as compound linguistic conditionals. This allows us to naturally and in many cases easily to obtain structural knowledge. We combine antecedent and consequent sets with logical conjunction, disjunction or negation. For instance, we could interpret the compound association (A^1, A^2, B); linguistically as the compound conditional "IF X^1 is A^1 AND X^2 is A^2, THEN Y is B" if the comma is the fuzzy association (A^1, A^2, B) denotes conjunction instead of say disjunction. We specify in advance the numerical universe of discourse for fuzzy variables X^1, X^2 and Y. For each universe of discourse or fuzzy variable X, we specify an appropriate library of fuzzy set values $A_1^r, ...A_k^2$ Contiguous fuzzy sets in a library overlap. In principle a neural network can estimate these libraries of fuzzy sets. In practice this is usually unnecessary. The library sets represent a weighted though overlapping quantization of the input space X. They represent the fuzzy set values assumed by a fuzzy variable. A different library of fuzzy sets similarly quantizes the output space Y. Once we define the library of fuzzy sets we construct the FAM by choosing appropriate combinations of input and output fuzzy sets Adaptive techniques can make, assist or modify these choices.

Induced Fuzzy Associative Memories

Suppose that there are n attributes, say $x_1, x_2, …, x_n$, where n is finite, associated with the effects of climate change and let $y_1, y_2, …, y_p$ be the attributes associated with the health system. The connection matrix M of order n X p is obtained through the expert. Let C_1 be the initial input vector. A particular component, say c_1, is kept in ON state and all other components in OFF state and we pass the state vector C_1 through the connection matrix M. To convert the resultant vector as 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. The resulting vector is multiplied with M^T and thresholding yields a new vector D_1. This 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 the one which contains maximum number of 1s is chosen as C_2. If there are two or more vectors with equal number of 1s in 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 we choose the vector with its second component in ON state and repeat the same to get another cycle. This process is 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.

III. ADAPTATION OF IFAM TO THE PROBLEM

We select the following attributes factors that perpetuate the Domestic Violence as nodes of the domain space from the opinion of the experts:

C_1 – Alcholism
C_2 – Dowry practice
C_3 – Femicide
C_4 – Honour killing
C_5 – Discrimination in food
C_6 – Lack of legal protection
C_7 – Trafficking
C_8 – Lack of information about legal rights
C_9 – Legal cost involved make women reluctant to report incidents of violence

The following attributes related with loss of women's rights are taken as nodes of the range space:
P_1 – Decision making
P_2 – Health
P_3 – Education
P_4 – Freedom of choice of profession
P_5 – Professional promotion
P_6 – Socio-economic status
P_7 – Economic Independence
P_8 – Help seeking behavior
P_9 – Social support

The expert's opinion is given in the form of the relational matrix M

$$M = \begin{array}{c|ccccccccc} & P_1 & P_2 & P_3 & P_4 & P_5 & P_6 & P_7 & P_8 & P_9 \\ \hline C_1 & 0.3 & 1 & 1 & 0.6 & 0.7 & 0.8 & 0.6 & 0.5 & 0.9 \\ C_2 & 0.5 & 0.4 & 0.9 & 0.5 & 0.6 & 0.5 & 0.4 & 0.6 & 0.8 \\ C_3 & 0 & 0 & 0 & 0 & 0 & 0.6 & 0 & 0.1 & 0.4 \\ C_4 & 0.5 & 0.6 & 0.9 & 0.6 & 0.2 & 0.5 & 0.9 & 0.1 & 0.6 \\ C_5 & 0.7 & 0.3 & 0.7 & 0 & 0 & 0.7 & 0.5 & 0.8 & 0.7 \\ C_6 & 0.9 & 1 & 0.6 & 0.5 & 0.9 & 0.8 & 0.7 & 0.4 & 0.8 \\ C_7 & 0.1 & 0.6 & 0.5 & 0.2 & 0.4 & 0.5 & 0.5 & 0.5 & 0.1 \\ C_8 & 0.5 & 0.7 & 0.5 & 0.5 & 0.3 & 0.4 & 0.5 & 0.9 & 1 \\ C_9 & 0.6 & 0.9 & 0.4 & 0.1 & 0.2 & 0.8 & 0.9 & 0.5 & 0.5 \end{array}$$

Let us choose the input vector C_1 = (1 0 0 0 0 0 0 0 0). That is the attribute alcoholism is kept in ON and the rest of the nodes in OFF state.

$$C_1 = (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$
$$C_1M = (.3\ 1\ 1\ .6\ .7\ .8\ .6\ .5\ .9)$$
$$\rightarrow (0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 1) = C_1^{'}$$
$$C_1^{'}M^T = (1\ .9\ .4\ .9\ .7\ 1\ .6\ 1\ .9)$$
$$\rightarrow (1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1) = C_1$$
$$C_1^{(1)} = (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$
$$C_1^{(1)}M = (.3\ 1\ 1\ .6\ .7\ .8\ .6\ .5\ .9)$$
$$\rightarrow (0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 1) = C_1^{'(1)}$$
$$C_1^{'(1)}M^T = (1\ .9\ .4\ .9\ .7\ 1\ .6\ .1\ .9)$$
$$\rightarrow (1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1)$$

The Sum is 6.

$$C_1^{(2)} = (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$
$$C_1^{(1)}M = (.5\ .4\ .9\ .5\ .6\ .5\ .4\ .6\ .8)$$
$$\rightarrow (0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 1) = C_1^{'(2)}$$
$$C_1^{'(2)}M^T = (1\ .9\ .4\ .9\ .7\ 1\ .6\ .1\ .9)$$
$$\rightarrow (1\ 1\ 0\ 1\ 0\ 0\ 0\ 1\ 0)$$

The sum is 4.

$$C_1^{(3)} = (0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0)$$
$$C_1^{(3)}M = (.5\ .6\ .9\ .6\ .2\ .5\ .9\ .1\ .6)$$
$$\rightarrow (0\ 1\ 1\ 1\ 0\ 0\ 1\ 0\ 1) = C_1^{'(3)}$$
$$C_1^{'(3)}M^T = (1\ .9\ .4\ .9\ .7\ 1\ .6\ 1\ .9)$$
$$\rightarrow (1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1)$$

The sum is 6.

$$C_1^{(4)} = (0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0)$$
$$C_1^{(4)}M = (.9\ 1\ .6\ .5\ .9\ .8\ .7\ .4\ .8)$$
$$\rightarrow (1\ 1\ 0\ 0\ 1\ 0\ 0\ 0\ 0) = C_1^{'(4)}$$
$$C_1^{'(4)}M^T = (1\ .6\ 0\ .6\ .7\ 1\ .6\ .7\ .9)$$
$$\rightarrow (1\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 1)$$

The sum is 3.

$$C_1^{(5)} = (0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0)$$
$$C_1^{(5)}M = (.5\ .7\ .5\ .5\ .3\ .4\ .5\ .9\ 1)$$
$$\rightarrow (0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 1) = C_1^{'(5)}$$
$$C_1^{'(5)}M^T = (.9\ .8\ .4\ .6\ .8\ .8\ .5\ 1\ .5)$$
$$\rightarrow (1\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0)$$

The sum is 2.

$$C_1^{(6)} = (0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1)$$
$$C_1^{(6)}M = (.6\ .9\ .4\ .1\ .2\ .8\ .9\ .5\ .5)$$
$$\rightarrow (0\ 1\ 0\ 0\ 0\ 1\ 1\ 0\ 0) = C_1^{'(6)}$$
$$C_1^{'(6)}M^T = (1\ .5\ .6\ .9\ .7\ 1\ .6\ .7\ .9)$$
$$\rightarrow (1\ 0\ 0\ 1\ 0\ 1\ 0\ 0\ 1)$$

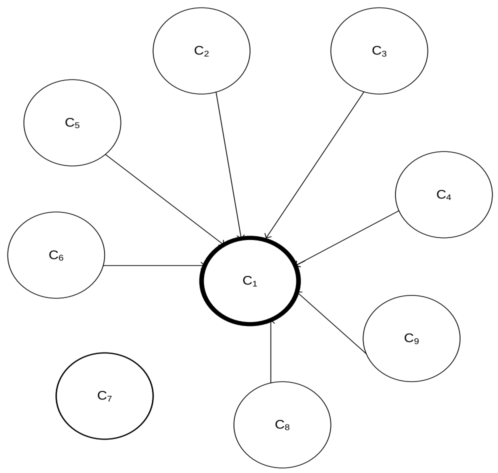
The sum is 4

Therefore $C_2 = (1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1)$

$$C_2 = (1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1)$$
$$C_1M = (.9\ 1\ 1\ .6\ .7\ .8\ .9\ .9\ 1)$$
$$\rightarrow (1\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ 1) = C_2^{'}$$
$$C_2^{'}M^T = (1\ .9\ .4\ .9\ .8\ .9\ .6\ 1\ .9)$$
$$\rightarrow (1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1) = C_2$$

The following table gives different limit points and triggering patternwe get for various input vectors.

Input vector	Limit point	Triggering pattern
(100000000)	(111000111), (110101011)	$C_1 \Rightarrow C_1$
(010000000)	(111000111), (110101011)	$C_2 \Rightarrow C_1$
(001000000)	(111000111), (110101011)	$C_3 \Rightarrow C_1$
(000100000)	(111000111), (110101011)	$C_4 \Rightarrow C_1$
(000010000)	(111000111), (110101011)	$C_5 \Rightarrow C_1$
(000001000)	(111000111), (110101011)	$C_6 \Rightarrow C_1$
(000000100)	(011001110), (110101111)	$C_7 \Rightarrow C_7$
(000000010)	(111000111), (110101011)	$C_8 \Rightarrow C_1$
(000000001)	(111000111), (110101011)	$C_9 \Rightarrow C_1$



It can be seen that the node C_1 (Alcoholism) becomes the converging point. Triggering pattern also suggests that C_7 (Trafficking) remains disconnected from other factors and does not influence any other. It can also be observed that C_4 and C_6 have their sum maximum. This implies that Honour killing and Lack of legal protection play crucial role in domestic violence against women.

IV. CONCLUSION

According to the expert's opinion alcoholism plays a crucial role in perpetrating violence against women as it has an influence on almost all other attributes. Therefore efforts must be taken to address alcoholism. In many cases those who involve in violence against women are under the influence of alcohol, sale of liquor should be banned within or around the residential areas. From determining the hidden pattern it can also be observed that Honour killing and Lack of legal protection have greater role in domestic violence against women. Therefore those reasons which lead to honour killing should beaddressed immediately. As the root cause of honour killing in India is due to caste system, efforts must be made to abolish caste system and those who go for intercaste marriage should be protected by law. Laws pertaining to protection of women rights and prevention of domestic violence should be made more strict and enforced without any loopholes.

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