PREFERRING OLD AGE HOME: A FUZZY APPROACH USING EXTENDED BIDIRECTIONAL ASSOCIATIVE MEMORY

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Abstract: The number of persons above the age of 60 years is fast growing, especially in India. India is the second most populous country in the world. India, like many traditional societies, today faces a unique situation in providing care for its elderly as the existing old-age support structures in the form of family, kith and kin, are fast eroding and the elderly are ill-equipped to cope alone with their lives in the face of infirmity and disability. The onus of caring for the elderly is therefore now much more on the state than the family and will necessitate the creation of adequate institutional support. The BAM modal was introduced by Bart Kosko in 1988 and modified in the year 2001[14]. The extended by directional Associate memories was introduced by S.R.Kannan(2005)[15]. In this paper we find the reason for preferring old age home by the old age people using Extended Bidirectional Associative Memories.

Keywords: Bidirectional Associative Memory, Extended Bidirectional Associative Memory, Old age, Old age Home ,Neural Networks.

Introduction: This paper takes survival data directly from old age people and compares it with different neurons of EBAM, predicting the most influential inputs in each data as to the reasons for preferring old age home. The focus of this research is on real data collected in India. The survival data has been obtained directly from people in the old age home in Chennai, Tamilnadu, India. This paper has determined the feelings of types of reason by the scale from -10 to 10. The feeling has been taken from each old age home about types of reason and it quantized by the scale.

This paper selects the following types of reason for leaving home with the help of experts

A1 – Daughter In Law
A2 – No male child
A3 – Finance Problem
A4 – No Children
A5 – Attitude Problem (ego)
A6 – Health problem

To analyze or get feelings of types of reason from the old people, this paper selects many stages of family

(B1) poor family staging.
(B2) low middle family staging.
(B3) middle family staging.
(B4) high middle family staging.
(B5) rich family staging.

Ebam For Preffering Old Age Home: A discrete two-layers EBAM with threshold signal functions, arbitrary thresholds and inputs, an arbitrary but a constant synaptic connection [4,5] matrix V and discrete time-steps k are defined by the following equations

$$X_i^{k+1} = \sum_{j=1}^{p} S_j(y_j^k)V_{ij} + I_i \qquad (1)$$

$$Y_j^{k+1} = \sum_{i=1}^{n} S_i(x_i^k)V_{ij} + j_j \qquad (2)$$

Where V_{ij} ε V, (S_i and S_j are signal functions). S_i and S_j are representing extended binary or bipolar threshold functions. I_i and J_j represents the directly experienced sensory information or directly applied control information. Here in this two layers BAM, these I_i and J_j are considered as zero. The thresholds for extended binary and bipolar signal functions are defined in the recall process of the EBAM. The extended binary and bipolar single functions are givenin equations (3) , (4).

$$S_i(X_i^k) = \begin{cases} 1, & if\, x_i^k > 0, \\ state\,unchange & if\, x_i^k = 0, \\ -1, & if\, x_i^k < 0. \end{cases} \qquad (3)$$

$$S_j(Y_j^k) = \begin{cases} 1, & if\, y_j^k > 0, \\ state\,unchange & if\, y_j^k = 0, \\ -1, & if\, y_j^k < 0. \end{cases} \qquad (4)$$

At any moment different neurons can "decide" whether to compare their activation to their threshold. At each moment any of the 3^n subsets of F_x neurons, or the 3^p subsets of the F_y neurons, can decide to change state. Each neuron may randomly decide whether to check the threshold conditions in equations (3),(4). At each moment each neuron defines a random variable that can assume the value ON(+1) or state unchanged (0) or ON (-1). The network is often assumed to be deterministic and state changes are synchronous, that is, an entire field of neurons is updated at a time. In case of a simple asynchrony, only one neuron makes a state change decision at a time. When the subsets represent that entire fields Fx and Fy, synchronous state change results. In a real life problem, the entries of the constant synaptic matrix of memory matrix V [6] depends upon the investigators feelings. The memory matrix is given a weight according to their feelings.

3. **Working Procedure**: The basic structure of the EBAM with two layers is explained. EBAM will be used in finding the reason for preferring old age homes . Consider, the n neurons in layer one correspond to vector F_x and p neurons in layer two correspond to vector F_y . The two layers are bidirectional related. The vector F_y is recalled from activation F_x by the memory matrix (or weight matrix) V [7]. The memory matrix (weight matrix) transpose V^T allows activation F_y to recall Fx, [8,9]. When an arbitrary vector is an input into a network, the network activates to a stable state via an interactive process. In the EBAM, if an arbitrary input is presented, the activation process is explained as following. Consider two layers EBAM with n neurons in F_x and p neurons in F_y. An n by p, matrix V represents the forward synaptic projections from F_x to F_y [10,11]. The p by n matrix transpose V^T , represents the backward projection F_y to F_x. Let the matrix V and V^T corresponds to

$$V = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \cdots & \vdots \\ a_{p1} & \cdots & a_{pn} \end{pmatrix} \quad V^T = \begin{pmatrix} a_{11} & \cdots & a_{pn} \\ \vdots & \cdots & \vdots \\ a_{1n} & \cdots & a_{pn} \end{pmatrix}$$

Suppose at initial time k, all the neurons in Fy are ON. So, the signal state vector S (Y_K) at time k corresponds to S (Y_K) = (n signal vectors). Suppose also, that the joint effects of feedback from F_x and prior initial input produce the activation-state vector X_K at F_X,

Where $X_k = (x_1^2 + x_2^2 + ... + x_n^2)$

Now, consider how the EBAM network behaves if all neuronal state-change decisions are synchronous. First, at time $k + 1$ the F_x neurons transduce their real valued activations into a binary signal state vector S $(X_K,)$. Synchronous operation means that each Fx neuron thresholds its activation in parallel, according to equations (3),(4) and with zero thresholds. The result gives the binary signal vector S = (X_k) = [1, 1 ..... -1, 0, 1] (Since 'zero' neuron is considered as zero and all other neurons are in the ON (+ or - direction) state). The index notation in $S(X_k)$ implicitly assumes that neurons instantaneously transduce activations to signals. If this is unrealistic, we can introduce an extra time-step to model the time lag. For simplicity, we shall assume instantaneous activation transduction.

Next, at time k + 1, these Fx signals pass forward through the filter V to affect the activations of the Fv neurons. The p of Fy neurons computes p dot products or correlations. The signal state vector S = (X_k) multiplies each of the p columns of V. Since $S(X_k)$ denotes a row vector, we can write this parallel dot product computation as the vector matrix multiplication,

$$S(X_k)V = \left(\sum_{i=1}^{n} S_i(x_i^k)V_{i1}, \sum_{i=1}^{n} S_i(x_i^k)V_{i2}, \dots, \sum_{i=1}^{n} S_i(x_i^k)V_{in} \right) = y_1^{k+1}, y_2^{k+1}, \dots, y_p^{k+1} \quad (5)$$

We synchronously compute the new signal state vector $S(Y_{k+l})$ by applying in parallel the threshold law (3),(4) with zero threshold to each F_y neuron. The result gives the new F_y signal state vector. S = (Y_{k+l}) = [0, *l*,... -*l*, 0, 1], where *l* ε [-1,0, 1]. The first neuron of Y_{k+l} is negative, all other neurons are in the ON (+ and - direction) state. The signal vector $S(Y_{k+l})$ then passes backward through the synaptic filter V^T at time k + 2. $S(Y_k)$ $V^T = x_1^{k+2}, x_2^{k+2}, \dots, x_n^{k+2} = x_{k+2}$.

Synchronous thresholding at F_x at time k + 2, now reveals a EBAM fixed-point equilibrium.

$S(X_{k+1}) = [\, l_1 , l_2, \dots , l_{n-2}, 0, l_n \,] = S(X_k)$. Since $S(X_{k+2}) = S(X_k)$ passing $S(X_{k+2})$ forward through V will produce $S(Y_{k+1})$ at Fy at time k + 3. Passing $S(Y_{k+3}) = S(Y_{k+1})$ backward through V^T will produce $S(X_{k+2})$ again at Fx. These three signal-state vectors will pass back and forth in extended bidirectional equilibrium forever or until new inputs perturb the system out of equilibrium. Suppose we keep the first Fy neuron ON, this may be called asynchronous state-change policy. At time k, all the F_Y neurons are ON. The k + 1 vectors of Fx signals $S(X_k)$ is the same as before, and so leads to the same Fy activation vector F_{y+1}. $S(Y_{k+1}) = S(X_k)V$.

The equilibrium state may set at $S(Y_{k+3}) = S(Y_{k+1})$. Similarly, the equilibrium state for S = (X_{k+4}) = S =

(X_{k+2})S. The binary pair ($[l_1, l_2, \dots, l_n]$,$[l_1, l_2, \dots, l_p]$) represents a fixed point of the EBAM dynamical system. The following three-quantization levels are taken for signal vectors. They are [-1, 0, 1] extended binary and bipolar codings.

3.1. EBAM with Survival Data: In this section, this paper proposes EBAM with several neurons, to do most influential input selection for survival data(s). As described in the previous section, EBAM with neurons that capture the semantic flexibility inherent in the survival data.

Now, consider the EBAM with six neurons in the first layer Fy and five neurons in the second layer Fx. The six neurons of the first layer are representing the types of reason, the five neurons of the second layer are representing the family stagings. The Table 1, lists the types of reason from family stagings.

Table 1.Survival data

	B_1	B_2	B_3	B_4	B_5
A_1	5	6	0	6	2
A_2	8	8	6	-5	4
A_3	6	9	10	9	5
A_4	10	6	8	5	-4
A_5	-5	-4	6	7	8
A_6	-3	0	5	8	9

$$V = \begin{pmatrix} 5 & 6 & 0 & 6 & 2 \\ 8 & 8 & 6 & -5 & 4 \\ 6 & 9 & 10 & 9 & 5 \\ 10 & 6 & 8 & 5 & -4 \\ -5 & -4 & 6 & 7 & 8 \\ -3 & 0 & 5 & 8 & 9 \end{pmatrix}$$

$$V^T = \begin{pmatrix} 5 & 8 & 6 & 10 & -5 & 3 \\ 6 & 8 & 9 & 6 & -4 & 0 \\ 0 & 6 & 10 & 8 & 6 & 5 \\ 6 & -5 & 9 & 5 & 7 & 8 \\ 2 & 4 & 5 & -4 & 8 & 9 \end{pmatrix}$$

$S(X_k)$ = [1 -1 0 1 1 1] V = [-1 0 1 1 1] = Y_{k+1},
$S(Y_{k+1})$ = [-1 0 1 1 1] V^T = [1 -1 1 -1 1 1] = X_{k+2},
$S(X_{k+2})$ = [1 -1 1 -1 1 1] V = [-1 -1 1 1 1] = Y_{k+3},
$S(Y_{k+3})$ = [-1 -1 1 1 1] V^T = [-1 -1 1 -1 1 1] = X_{k+4},
$S(X_{k+4})$ = [-1 -1 1 -1 1 1] V = [-1 -1 1 1 1] = Y_{k+5},
$S(Y_{k+5})$ = [-1 -1 1 1 1] V^T = [-1 -1 1 -1 1 1] = X_{k+6},
$S(X_{k+6})$ = [-1 -1 1 -1 1 1] V = [-1 -1 1 1 1] = Y_{k+7},
$S(Y_{k+5}) = S(Y_{k+7})$

The pair [-1 -1 1 -1 1 1] , [-1 -1 1 1 1] represents a fixed point of the EBAM dynamical system. Equilibrium for the system occurs at the time *k+6,* when the starting time was *k*. The fixed point suggest that Daughter In Law is the major cause for preferring old age home by the old age people. Attitude Problem (ego), Health problem are not a reasons for preferring old age home. It also shows that No Children is also a major cause for preferring old age home.

Conclusion: The EBAM introduced 60 training set of neurons for survival data , and the survival data analyzed with neurons. The fixed point of the EBAM dynamical system is obtained for each training set of neurons, this way, the neurons capture the semantic flexibility inherent in complex feelings or opinion from survival data. This paper has only given the result from the analysis. Result for survival data from neurons of EBAM. Regarding EBAM for survival data , Daughter In Law plays an important role . The other factors also contribute to preferring old age home. The fixed point for the input vectors are reached at different times (that is at k + 6 or at k + 7).

Suggetions: The Daughter-in-Law are suggested to treat their parent-in-laws and their parent equally. Some more suggestion to daughter-in-laws: Treat your parent-in-law with respect. Consider their older and wiser. They may have been through a lot of hardships in their life. In fact, talk to your paerent-in-law and ask them about their childhood, growing up, raising kids, and life experiences. When they shares their life with you they will develop a liking for you and that can lead to a strong bond between the two of you.

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