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PRIORITIZING THE PERSPECTIVES OF INDIAN GURUKULA EDUCATION SYSTEM AND NEED IN THE PRESENT EDUCATION SCENARIO USING AUGMENTED FUZZY COGNITIVE MAP

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Abstract:

Recently, Education has become a commercial commodity rather than acquiring excellence in knowledge. Students affected directly or indirectly by the social evils such as idleness, egotism, materialistic appeal, corruption, decline in moral values, lack of human relationship. In Gurukula Education System, mental and emotional health of the students can be trained through meditation and practice of ethical purity. Modern Education System is totally different from the Gurukula Education System. The aim of this paper is to analyze perspectives of Gurukula Education System, need of Indian Gurukula Education System in Present Education Scenario.For this analysis, an efficient tool which has the capability of solving an unsupervised data namely augmented fuzzy cognitive map has been used.

Key Words: Fuzzy Cognitive Map, Augmented Fuzzy Cognitive Map, Gurukula Education System, Current Education System.

1. Fuzzy Cognitive Map:

An FCM is a signed directed graph with concepts like events, policies etc. as nodes and causalities as edges. It represents causal relationship between concepts.

Between nodes, there are three possible types of causal relationships, which express the type of influence of one nodes to the others.

- The weight, represent by v_{ij}, of the causality between concept c_i and concept c_j could be positive ($v_{ij} > 0$) which means that an increase in the value of node c_i leads to the increase of the value of node c_j and a decrease in the value of node c_i leads to the decrease of the value of nodec_j
- There is negative arc ($v_{ij} < 0$) which means that an increase in the value of node leads to the decrease of the value of node and decrease in the value of node c_i leads to the increase of the value of nodec_j.
- There is no relationship between node c_i, and node c_j, then v_{ij} =0 [4].

2. Basic Concepts:

Definition: An FCM is a signed directed graph with concepts like policies, events etc. as nodes and causalities as edges. It represents causal relationship between concepts.

Definition: When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

Definition: FCMs with edge weights or causalities from the set {-1, 0, 1} are called simple FCMs.

Definition: Consider the nodes / concepts $c_1, \ldots, c_n$ of the FCM. Suppose the directed graph is drawn using edge weight $w_{ij} \in \{0, 1, -1\}$. The matrix E be defined by E = (w_{ij}) where w_{ij} is the weight of the directed edge $c_i c_j$. E is called the connection matrix of the FCM.

Note: All matrices associated with an FCM are always square matrices with diagonal entries as zero.

Definition: Let $c_1, \ldots, c_n$ be the nodes of an FCM. B = $b_1, \ldots, b_n$where $b_i \epsilon \{0,1\}$. B is called the instantaneous state vector and it denotes the ON - OFF position of the node at an instant.

$b_i = 0$ifb_i is OFF and
$b_i = 1$ifb_i is ON

Definition: Let $c_1, \ldots, c_n$ be the nodes of an FCM. Let$\overrightarrow{c_1c_2}$, $\overrightarrow{c_2c_3}$, , …$\overrightarrow{c_ic_j}$, be the edges of the FCM ($i = j$). Then the edges form a directed cycle. An FCM is said to be cyclic if it possesses a directed cycle. An FCM is said to be acyclic if it does not possess any directed cycle.

Definition: An FCM with cycles is said to have a feedback.

Definition: When there is a feedback in an FCM, i.e., when the causal relations flow through a cycle in a revolutionary way, the FCM is called a dynamical system.

Definition: Let $\overrightarrow{c_1c_2}$, $\overrightarrow{c_2c_3}$, , …$\overrightarrow{c_ic_j}$, When c_i is switched on and if the causality flows through the edges of a cycle and if it again causes c_i , we say that the dynamical system goes round and round. This is true for any node c_i, for i = 1, 2,…, n. The equilibrium state for this dynamical system is called the hidden pattern.

Definition: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point.

Example: Consider a FCM with $c_1, \dots, c_n$ as nodes. For example let us start the dynamical system by switching on c_1. Let us assume that the FCM settles down with c_1 and c_n on. That is, the state vector remains as (1, 0, 0, … , 0, 1) this state vector (1, 0, 0, … , 0, 1) is called the fixed point.

Definition: If the FCM settles down with a state vector repeating in the form $A_1 \to A_2 \to \cdots \to A_i \to A_1$ then this equilibrium is called a limit cycle.

Definition: Finite number of FCMs can be combined together to produce the joint effect of all the FCMs. Let $E_1, \dots, E_p$ be the adjacency matrices of the FCMs with nodes $c_1, \dots, c_n$ then the combined FCM is got by adding all the adjacency matrices $E_1, \dots, E_p$. Denote the Combined FCM adjacency matrix by $E = E_1 + E_1 \dots, E_P$.

Notation: Suppose $A = (a_1, \dots, a_n)$ is a vector which is passed into a dynamical system E. Then $AE = (a_1', \dots, a_n')$ after thresholding and updating the vector suppose we get $(b_1, \dots, b_n)$ we denote that by $(a_1', \dots, a_n') \to (b_1, \dots, b_n)$. Thus the symbol '→' means the resultant vector has been thresholded and updated [1].

3. Algorithmic Approach of FCM:

To derive an optimistic solution to the problem with an unsupervised data, the following steps to be followed:

Step 1: For the given model (problem), collect the unsupervised data that is indeterminant factors called nodes.

Step 2: According to the expert opinion, draw the directed graph.

Step 3: Obtain the connection matrix M_1, from the directed graph (FCM). Here the number of rows in the given matrix = number of steps to be performed.

Step 4: Consider the state vector C_1 which is in ON position. Find $C_1 \times M_1$. The state vector is updated and threshold at each stage.

Step 5: Threshold value is calculated by assigning 1 for the values > 1 and 0 for the values < 0. The symbol '!' represents the threshold value for the product of the result.

Step 6: Now each component in the C_1 vector is taken separately and product of the given matrix is calculated. The vector which has maximum number of one's is found. The vector with maximum number of one's which occurs first is considered as C_1.

Step 7: When the same threshold value occurs twice, the value is considered as the fixed point. The iteration gets terminated.

Step 8: Consider the state vector C_2 by setting C_2 in ON state that is assigning the second component of the vector to be 1 and the rest of the components as 0. Proceed the calculations discussed in Steps 4 to 6 [8].

4. Augmented FCM:

The Augmented FCM approach different from the Delphi method, does not need experts to change their former opinions slightly for reaching a consensual result. This is possible because the Augmented FCM approach is an additive method. This approach consists in adding the FCM generated by each expert. Combining the FCMs together, contrasting relationship is canceled out, whereas agreement strengthen causal connections. The resulting augmented matrix is computed as follows:

$$A^{aug} = \sum_{i=1}^{n} A_i$$

where n is the number of experts A_i and is the adjacency FCM matrix for expert i. Define two FCMs with no common concepts:

$$FCM_a \text{ with } C_i \text{ as nodes } FCM_a = \{C_i\}$$
$$FCM_b \text{ with } C_j \text{ as nodes } FCM_b = \{C_j\}$$

The adjacency matrix of FCM_b is $A_b = ({v_{ij}}^b)$

The augmented connection matrix is $A^{aug} = \begin{pmatrix} {v_{ij}}^a & 0 \\ 0 & {v_{ij}}^b \end{pmatrix}$

If there are common concepts, then the element ${v_{ij}}^{aug}$ in the augmented matrix is ${v_{ij}}^{aug} = \frac{\sum {v_{ij}}^k}{n}$

where n is the number of FCMs added, one from each expert, k is the identifier for each FCM, and i and j are identifiers of the relationships.

Example:

Consider two FCMs with some common concepts. Starting from each connection matrix:

$$A^{FCM\ I} = \begin{matrix} \\ A \\ B \\ C \end{matrix} \begin{matrix} \begin{matrix} A & B & C \end{matrix} \\ \begin{pmatrix} 0 & 0.6 & -0.1 \\ 0 & 0 & 0.2 \\ 0 & 0 & 0 \end{pmatrix} \end{matrix}$$

$$A^{FCM\ 2} = \begin{matrix} \\ A \\ B \\ C \end{matrix} \begin{matrix} \begin{matrix} A & B & D \end{matrix} \\ \begin{pmatrix} 0 & 0.6 & -0.1 \\ 0 & 0 & 0.2 \\ 0 & 0 & 0 \end{pmatrix} \end{matrix}$$

The augmented connection matrix would be construct as follows.

$$A^{Aug} = \begin{matrix} \\ A \\ B \\ C \\ D \end{matrix} \begin{matrix} \begin{matrix} A & B & C & D \end{matrix} \\ \begin{pmatrix} 0 & 0.45 & -0.05 & 0 \\ 0 & 0 & 0.1 & 0 \\ 0 & 0 & 0 & 0 \\ 0.3 & 0.05 & 0 & 0 \end{pmatrix} \end{matrix}$$ [5][6].

5. Gurukula Education System Vs Current Education System in India:

Gurukula was established in the Vedic age. Their main motto is transmitting higher knowledge and enlightenment to the students by yogic powers by the Guru and to develop their personality physically, mentally, spiritually and morally through exercises and meditation. Gurukula taught 64 skills to their students and also taught how to improve theirself esteem, self confidence through Vedas. Vedic literature used to be common in Ancient Gurukula System which helps students learn values & ethics [10], [11].

The Modern Education System brought to India in the year 1835 by Lord Macauley. In this System, students have to read and mug up full text book without any understanding of it and have no freedom to think creatively and to raise the question about content in the text books. Now a days, Children are not able to do critical analysis and alsounable to face any problem [9].

6. Implementation of the Problem:

The Current Education System focuses on grades more than the students themselves. The schools have no interest in the character development of the students. They are only concentrate on marks of the students. The biggest defect about this education is that it is more commercial in nature rather than an institutional concept that should impart holistic learning to the students [9]. In Gurukula education, Guru will teach how to makeup defects, analyse mistakes, develops the right use of the sex, senses by training and practice. This paper discusses the needs of Gurukula Education System in the Present Education System. There are some features of Gurukula Education System which are known as nodes. The nodes are

C_1:The attitude of the people towards life was intellectual and spiritual, rather than materialistic.

C_2: Much emphasis was put on the formation of character through 'plain living and high thinking'.

C_3: Gurukula education concentrate all round development of the child's Personality. So teaching method was psychological in nature.

C_4: The discipline of Celibacy was mandatory for all. Education helped in the observance of celibacy, control over senses and purity of life.

C_5: Students who skip their duties towards the preceptor were ban from education and were debarred from the institution.

C_6: Students were obtained working knowledge in agriculture and other vocation oflife.

C_7: The basis of admission was moral fitness and pure conduct. The Students belonging to a lower order of moral conduct was forbidden to live in the house of the Guru.

C_8: A man can be free from the cycle of births & deaths under the guidence of guru.

C_9: This world according to almighty, was unreal & full of fetters. The highest wisdom was a release from these betters.

C_{10}: Education was regarded as a means of inculcating values such as strict Obedience to elders, temperance, honesty, and truthfulness.

C_{11}: Personality was developed through (a) Self-respect (b) Self-confidence (c) Self-restraint (d) judgement and Discrimination

C_{12}: The promotion of national culture, preservation and heritage was also stressed

C_{13}: This system of education stressed needs of the Physical, Mental, Emotional and Spiritual.

Using these 13 nodes, we obtain two experts opinion. First expert's opinion in the form of connection matrix E_1 is

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	0	0.9	0	0.2	0	0.8	0.8	0.4	0.2	0.9	0.5	0.2	0.8
C_2	0.8	0	0.3	0.4	0.9	0.9	0.8	0.1	0.7	0.8	0.7	0.5	0.7
C_3	0.9	0.8	0	0.6	0.8	0.7	0.5	0	0.2	0.8	0.8	0	0.5
C_4	0.8	0.7	0.2	0	0.6	0.8	0.3	0.7	0.8	0.6	0.4	0	0.8
C_5	0.4	0.2	0.9	0	0	0.1	0.6	0	0.4	0.6	0.7	0.2	0.5
C_6	0.9	0.8	0.2	0.7	0	0	0.9	0.1	0.4	0.8	0.9	0.5	0.8
C_7	0	0.7	0.3	0.8	0.9	0.8	0	0	0.2	0.5	0.6	0.4	0.6
C_8	0.8	0.6	0	0.8	0	0.5	0.6	0	0.7	0.2	0.7	0.6	0.3
C_9	0.8	0.7	0	0.5	0.1	0,6	0.8	0	0	0.4	0.8	0.5	0.8
C_{10}	0.9	0.8	0.2	0.5	0.7	0.6	0.8	0	0.2	0	0.7	0.4	0.7
C_{11}	0.8	0.7	0.4	0.8	0.6	0.7	0.8	0	0.4	0.8	0	0.2	0.5
C_{12}	0.6	0.5	0	0.8	0.2	0.5	0.7	0.8	0.6	0.4	0.3	0	0.2
C_{13}	0.7	0.4	0.2	0.7	0.6	0.8	0.9	0.6	0.5	0.2	0.1	0.5	0

Second expert's opinion in the form of connection matrix E_2 is

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	0	0.9	0	0.7	0.1	0.9	0.8	0.6	0.1	0.7	0.8	0.2	0.7
C_2	0.9	0	0.5	0.9	0.8	0.8	0.2	0.9	0.9	0.8	0.9	0.4	0.6
C_3	0.9	0.1	0	0.5	0.7	0.2	0.1	0.8	0	0.5	0.4	0	0.3
C_4	0.8	0.9	0.9	0	0	0.1	0.3	0.1	0.9	0.9	0.8	0.7	0.9
C_5	0.1	0	0.2	0	0	0.2	0	0	0	0.5	0.6	0.1	0.2
C_6	0.9	0.8	0	0	0.2	0	0.9	0	0.6	0.7	0.9	0.8	0.5
C_7	0.2	0.8	0	0.8	0	0.9	0	0.9	0.7	0.7	0.8	0.6	0.8
C_8	0.8	0.7	0.1	1	1	0.8	0	0	0.9	0.8	0.9	0.9	0.9
C_9	0.7	0.9	0.2	0.7	0	0.4	0.1	0.8	0	0.6	0.7	0.2	0.5
C_{10}	0.9	0.8	0	0.4	0	0.5	0.6	0.1	0.2	0	0.6	0	0.1
C_{11}	0.8	0.9	0.1	0.7	0	0.6	0.3	0.8	0.3	0.2	0	0.2	0.3
C_{12}	0.5	0.6	0	0	0	0.7	0.1	0	0.2	0.8	0.2	0	0.4
C_{13}	0.8	0.7	0	0.4	0.1	0.8	0.2	0.7	0.6	0.5	0	0.4	0

The Augmented matrix E is

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	0	0.9	0	0.45	0.05	0.85	0.8	0.5	0.15	0.8	0.65	0.2	0.75
C_2	0.85	0	0.4	0.65	0.85	0.85	0.5	0.5	0.8	0.8	0.8	0.45	0.65
C_3	0.9	0.45	0	0.55	0.75	0.45	0.55	0.4	0.1	0.65	0.6	0	0.4
C_4	0.8	0.8	0.5	0	0.3	0.85	0.45	0.85	0.85	0.75	0.6	0.35	0.85
C_5	0.25	0.1	0.55	0	0	0.15	0.3	0	0.2	0.55	0.65	0.15	0.35
C_6	0.9	0.8	0.1	0.35	0.1	0	0.9	0.05	0.5	0.75	0.9	0.65	0.65
C_7	0.1	0.75	0.15	0.8	0.45	0.85	0	0.45	0.45	0.6	0.7	0.5	0.7
C_8	0.8	0.65	0.05	0.9	0.5	0.65	0.3	0	0.8	0.5	0.8	0.75	0.6
C_9	0.75	0.8	0.1	0.6	0.05	0,5	0.45	0.4	0	0.5	0.75	0.35	0.65
C_{10}	0.9	0.8	0.1	0.45	0.35	0.55	0.7	0.05	0.2	0	0.65	0.25	0.4
C_{11}	0.8	0.8	0.25	0.75	0.3	0.65	0.55	0.4	0.35	0.5	0	0.2	0.4
C_{12}	0.55	0.55	0	0.4	0.1	0.6	0.4	0.4	0.4	0.6	0.25	0	0.3
C_{13}	0.75	0.55	0.1	0.55	0.35	0.8	0.55	0.65	0.55	0.35	0.05	0.45	0

Step 1

Consider the first node c_1 is an on state,

$$A_1 = (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$
$$A_1E = (0\ 0.9\ 0\ 0.45\ 0.05\ 0.85\ 0.8\ 0.5\ 0.15\ 0.8\ 0.65\ 0.2\ 0.75)$$
$$\rightarrow (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0) = A_2$$
$$A_2E = (7.45\ 6.6\ 2.3\ 5.45\ 3.35\ 6.4\ 5\ 3.75\ 5.1\ 5.85\ 6.15\ 4.1\ 5.55)$$
$$\rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = A_3$$
$$A_3E = (8.35\ 7.95\ 2.3\ 6.45\ 4.15\ 7.7\ 6.35\ 4.65\ 5.35\ 7.3\ 7.4\ 4.3\ 6.55)$$
$$\rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = A_4 = A_3$$

Step 2

Consider c_2 is an on state,

$$B_1 = (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$
$$B_1E = (0.85\ 0\ 0.4\ 0.65\ 0.85\ 0.85\ 0.5\ 0.5\ 0.8\ 0.8\ 0.8\ 0.45\ 1)$$
$$\rightarrow (1\ 0\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = B_2$$
$$B_2E = (7.5\ 7.95\ 1.9\ 5.8\ 3.3\ 6.85\ 5.85\ 4.15\ 4.55\ 6.5\ 6.6\ 3.85\ 6.05)$$
$$\rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = B_3$$
$$B_3E = (8.35\ 7.95\ 2.3\ 6.45\ 4.15\ 7.7\ 6.35\ 4.65\ 5.35\ 7.3\ 7.4\ 4.3\ 6.55)$$
$$\rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = B_4 = B_3$$

Step 3

Consider c_3 is an on state,

$$C_1 = (0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$
$$C_1E = (0.9\ 0.45\ 0\ 0.55\ 0.75\ 0.45\ 0.55\ 0.4\ 0.1\ 0.65\ 0.6\ 0\ 0.4)$$
$$\rightarrow (1\ 1\ 0\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 1) = C_2$$
$$C_2E = (7.25\ 7.05\ 2.3\ 6.25\ 3.25\ 6.6\ 5.3\ 3.5\ 4.9\ 6.4\ 6.6\ 4.3\ 5.85)$$
$$\rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = C_3$$
$$B_2E = (8.35\ 7.95\ 2.3\ 6.45\ 4.15\ 7.7\ 6.35\ 4.65\ 5.35\ 7.3\ 7.4\ 4.3\ 6.55)$$
$$\rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = C_4 = C_3$$

Step 4

Consider c_8 is an on state,

$$D_1 = (0 \quad 0 \quad 1 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0)$$
$$D_1E = (0.8 \quad 0.65 \quad 0.05 \quad 0.9 \quad 0.5 \quad 0.65 \quad 0.3 \quad 0 \quad 0.8 \quad 0.5 \quad 0.8 \quad 0.75 \quad 0.6)$$
$$\rightarrow (1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 0 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1) = D_2$$
$$D_2E = (7.55 \quad 7.5 \quad 2.25 \quad 5.55 \quad 3.65 \quad 7.05 \quad 6.05 \quad 4.65 \quad 4.85 \quad 6.8 \quad 6.6 \quad 3.55 \quad 6.1)$$
$$\rightarrow (1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1) = D_3$$
$$D_2E = (8.35 \quad 7.95 \quad 2.3 \quad 6.45 \quad 4.15 \quad 7.7 \quad 6.35 \quad 4.65 \quad 5.35 \quad 7.3 \quad 7.4 \quad 4.3 \quad 6.55)$$
$$\rightarrow (1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1) = D_4 = D_3$$

7. Results:

In this problem, the most impactful factor was found out (i.e.), most needed aspect of Gurukula Education System in Present Education System. Here all factors of Gurukula Education System have maximum number of ones after thresholding. So all factors are the most needful factor. In all cases, Augmented FCM gives reliable results comparing to Fuzzy Cognitive Map. So from this work, we conclude that the concepts of Augmented Fuzzy Cognitive Map are a reliable technique for many complex situations.

8. Conclusion:

In this paper, the basic concepts of Fuzzy Cognitive Map and Augmented Fuzzy Cognitive Map were discussed. From solution of this problem, all factors are more impactful factor. Because they influence the remaining factors well. We conclude that all features of Gurukula Education System are more impactful in Present Education Scenario.

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