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A Solution for Effective Teaching using Fuzzy Cognitive Maps (COBFCMS)

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Abstract—The necessity to use various tools – instructional media and technology for effective teaching using combined overlap block fuzzy cognitive maps (COBFCMS) defined by W.B. Vasantha Kandaswamy is analyzed in this paper. The combined overlap block FCM's defined in this method become effective when the number of concepts can be grouped and are large in numbrs. In this paper we have analyzed the various tools needed for effective knowledge transfer. In this paper, we analyzed the effective teaching methods and pedagogical practices and to develop new insights to serve their needs by fuzzy cognitive maps. This paper has five sections: First section gives the information about development of fuzzy cognitive maps, second section gives preliminaries of fuzzy cognitive maps, and combined overlap block fuzzy cognitive maps, in section three we describe the problem, in section four we explain the method of determining their hidden pattern and the final section gives the conclusion based on our studies.

Index Terms— FCMS, CBFCMS, Teaching Methods.

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1 INTRODUCTION

Political scientist R.Axelrod[1] introduced cognitive maps for representing social scientific knowledge and describing the methods that are used for decision making in social and political systems. Then B. Kosko[2,3,4] enhanced the power of cognitive maps considering fuzzy values for the concepts of the cognitive map and fuzzy degrees of interrelationships between concepts. FCMs can successfully represent knowledge and human experience, introduce concept to represent the essential elements and cause the effect relationships among the concepts to model the behavior of any system. It is a very convenient, simple and powerful tool, which is used in numerous fields such as social economic and medical etc. the purpose of study is to identify risk groups, In this case we are discussing about the
teaching methods for the teachers how it is useful for the purpose of teaching.we are identify the best teaching methods and we are conculced the effects of it.

Hence fuzzy tools alone has the capacity to analyze these concepts. Hence it is chosen here.

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2 PRELIMINARIES

Fuzzy cognitive maps (FCMs) are more applicable when the data in the first place is an unsupervised one. The FCMs work on the opinion of experts. FCMs model the worlds as a collection of classes and causal relation between classes.

Definition 2.1: An FCM is a directed graph with concepts like policies, events etc. As nodes and causalities as edges. It represents causal relationship between concepts.

Definition 2.2: When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

Definition 2.3: FCMs with edge weights or causalities from the set {-1,0,1} are simple

Definition 2.4: The edges e_{ij} take values in the fuzzy causal interval [-1,1]. e_{ij} =0 indicates no causality e_{ij} >0 indicates causal increase C_j increases as C_i increases (Or C_j Decreases as C_i Decreases). E <0 indicates causal decrease or negative causality. C Decreases as C increases (And or C_j Increases as C_i Decreases). Simple FCMs have edge values in {-1,0,1}. Then if causality occurs, It occurs to a maximal positive or negative degree. Simple FCMs provide a quick first approximation to an expert stand or printed causal knowledge. If increase (Or decrease) in one concept leads to increase(or decrease) in another, Then we give the value 1.If there exists to relation between the two concepts, The value 0 is given. If increase (or decrease) in one concept decreases(or increases) another, then we give the value -1. Thus FCMs are described in this way. Consider the or concepts $C_1, \ldots, C_n$ Of the FCM. Suppose the directed graph is drawn using edge weight $e_{ij} \varepsilon \{0,1,-1\}$. The matrix E be defined by $E= (e_{ij})$, Where the e_{ij} is the weight

of the directed edge C_i,c_j. E is called the adjacency matrix of the FCM, also known as the connection matrix of the FCM. It is important to note that all matrices associated with an FCM are always square matrices with diagonal entries as zero.

Definiton 2.5: Let C_1 , c_2,…. C_n be the nodes of an FCM. Let $A=(a_1, a_2 ,…., a_n)$. Where $a_i \varepsilon \{0,1\}$. A is called the instantaneous state vector and it denoted the on off position of the node at an instant

$a_i =0$ if a_i is off=1

$a_i =1$ if a_i is on, where i=1,2,….,n.

Definition 2.6: Let C_1 ,C_2 , ……, C_n be the nodes of an FCM. LetC_1 C_2,C_2 C_3,…, C_iC_j, be the edges of the FCM ($i \neq j$). Then, the edges form a directed cyclic. An FCMs said to be cyclic if it possesses a directed cyclic. An FCM is said to be a cyclic if it does not possess any directed cyclic.

Definition 2.7: An FCM with cycles is said to have a feedback.

Definition 2.8: Where 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 2.9: Let C_1C_2, C_2 C_3,…, C_i C_j, be a cycle 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 2.10: If the equilibrium state of a dynamical system is a unique state vector, Then it is called a fixed point. Consider a FCM with C_1, C_2,…, C_N as nodes. For example let us start the dynamical system by switching on C. Let us assume that the FCM settles down with C_1 and C_n on, i.e. the state vector remains as (1, 0, 0,…, 0, 1). This state vector (1, 0, 0, …, 0, 1) is called the fixed point.

Definition 2.11: If the FCM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow \ldots A_1 \rightarrow A_1$. Then this equilibrium is called limit cycle.

Definition 2.12: Finite number of FCMs can be combined together to produce the joint effect of all the FCMs. Let E_1,E_2 ,…, E_p be adjacency matrices of the FCMs with nodes C_1,C_2 ,…, C_n. Then the combined FCM[5,6,7] is got by adding all the adjacency matrices E_1 ,…, E_p . We denote the combined FCM adjacency matrix by $E= E_1 +E_2 +\ldots+E_p$

Definition: 2.13: Let P be the problem under investigation. Let $\{C_1,C_2,\ldots, C_n\}$ be n concepts associated with p(n very large). Now divide the number of concepts $\{C_1,C_2,\ldots,C_n\}$ into classes S_1 ,…, S_t where classes are such that

(1) $S_i \bigcap S_{i+1} \neq \Phi$ where (i=1,2,…, t-1)

(2) $\cup s_i=(c_1,\ldots\ldots\ldots c_n)$

(3) $(s_i) \neq s_j$ if $i \neq j$ in general

Now we obtain the FCM associated with each of the classes S_1 ,…, S_t . We determine the relational matrix associated with each S . Using theses matrices we obtain a nxn matrix. This n x n matrix is the matrix associated with the combined overlap block FCM(COBFCM) of blacks of same sizes.

Definition 2.14: Suppose $A= (a_1 ,\ldots, a_n)$ is a vector which is passed into a dynamical system E. Then $AE=)a'_1,\ldots,a'_n)$. After thresholding and updating the vectors suppose we get $(b_1 ,\ldots, b_n)$. We denote that by $(a'_1 ,a'_2 ,\ldots, a'_n) \rightarrow (b_1,b_2 ,\ldots,b_n)$. Thus the symbol $\rightarrow$ means that the resultant vector has been thresholded and updated. FCMs have several advantages as well as some disadvantages. The main advantage of this method it is simple. It functions on experts opinion's. when the data happens to be an unsupervised one the FCM comes handy. This is the only known fuzzy technique that gives the hidden pattern of the situation. As we have a very well known theory, which states that the strength of the data depends on the number of experts opinions we can use combined FCMs with several experts opinions. At the same time the disadvantage of the combined FCM is when the weightages are 1 and -1 for the same C_i C_j. We have the sum adding to zero thus at all times the connection matrices $E_1 ,\ldots, E_k$ may not be comfortable for addition. This problem will be easily overcome if the FCM entries are only 0 and 1.

3 TEACHING METHODS

1. Effective delivery of conceptual knowledge: Conceptual knowledge refers to a person's representation of the major concepts in a system. This would enable a person to tackle technical questions with relative ease. **Conceptual Knowledge includes** Knowledge rich in relationships and understanding and must be learnt through thoughtful reflective learning.

2. Effective knowledge transfer (EKT): EKT ia a set of activities and approaches that are undertaken to move knowledge among those who have interests or needs in it.

3. Innovative Pedagogical Practices: Pedagogy is the act of teaching together with its attendant discourse. It is what one needs to know, and the skills one needs to command in order to make and justify the many different kinds of decisions of which teaching is constituted. As Leach and Moon (1999) expanded further on what may define pedagogy by describing a *Pedagogical Setting* as 'the practice that a teacher, together with a particular group of learners creates, enacts and experiences'.

4. Knowledge base: A **knowledge base** is a special kind of

database for knowledge management. A knowledge base provides a means for information to be collected, organised, shared, searched and utilised.

5. Instructional media and technology(ohp/lcd/video clips/e-learning): Use of tools related to Information and Communication Technology (ICT) such as computer hardware/software, networking and other technologies such as audio, video, and other multimedia tools for effective dissemination of knowledge

6. Brain storming: Brainstorming is an informal way of generating topics to write about, or points to jot down on a particular topic which can be done at any time during the writing process. The key to effective brainstorming is that there should be no pressure to be Brilliant. Part of brainstorming will involve a selection process.

7. Mind mapping: This is a powerful graphic technique which provides a universal key to unlocking the potential of the brain. The Mind Map can be applied to every aspect of life where improved learning and clearer thinking will enhance human performance.

8. Case study for illustration of concept: Documented study of a specific real-life situation or imagined scenario, used as a training tool in business schools and firms. Students or trainees are required to analyze the prescribed cases and present their interpretations or solutions, supported by the line of reasoning employed and assumptions made.

9. Modelling for practical application of concept : A representation of a system that allows for investigation of the properties of the system and, in some cases, prediction of future outcomes. Models are often used in quantitative analysis and technical analysis, and sometimes also used in fundamental analysis.

10. Student knowledge testing methods-(GD/QA/MCQ's): Group discussions, multiple choice questions, reasoning questions, questionnaires are various ways in which the extent of knowledge reception can be gauged. This would help segregate the student community of a class into sections. Further , the section that would require a different approach of teaching and tutoring

4 METHOD OF DETERMINING HIDDEN PATTERN

Let $C_1, C_2, \ldots, C_n$ be the nodes of an FCM, With feedback. Let E be the associated adjacency matrix. Let us find the hidden pattern when C_1 is switched on. When an input is given as the vector $A_1 = (1, 0, 0, \ldots, 0)$, the data should pass through the relation matrix E. this is done by multiplying A_1 by the matrix E. Let $A_1 E = (a_1, \ldots, a_n)$ with the threshold operation that is by replacing a_i by 1 if $a_i > k$ and a_i by 0 if $a_i < k$ (k is a suitable positive integer). We update the resulting concept, The concept C_1 is included in the updated vector by making the first coordinate as 1 in the resulting vector. Suppose $A_1 E \rightarrow A_2$ then consider A_2 E and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.

5 CONCEPT OF THE PROBLEM

Using the linguistic questionnaire and the expert's opinion we have taken the following eleven concepts $\{C_1, C_2, \ldots, C_{10}\}$

C_1 = Effective delivery of conceptual knowledge

C_2 = Effective knowledge transfer (EKT)

C_3 = Innovative Pedagogical Practices

C_4 = Knowledge base

C_5 = Instructional media and technology (ohp/lcd/videolips /e-learning)

C_6 = Brain storming

C_7 = Mind mapping

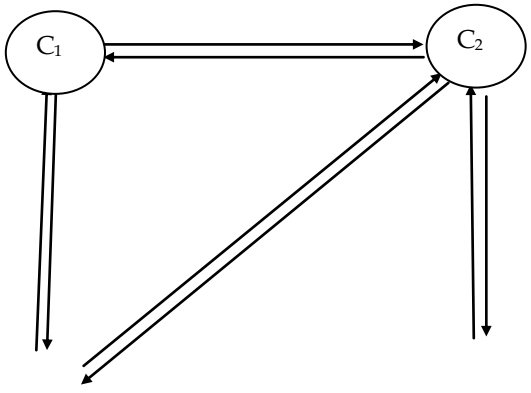
C_8 = Case study for illustration of concept

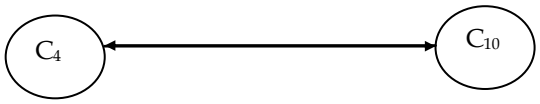
C_9 = Modelling for practical application of concept

C_{10} = Student knowledge testing methods-(GD/QA/MCQ's)

Now we proceed on to apply the effect of combined overlap block. FCM of equal length. Let us consider the eleven concepts $\{C_1, C_2, \ldots, C_{10}\}$. We divide these concepts into cyclic way of classes, each having just four concepts in the following way.

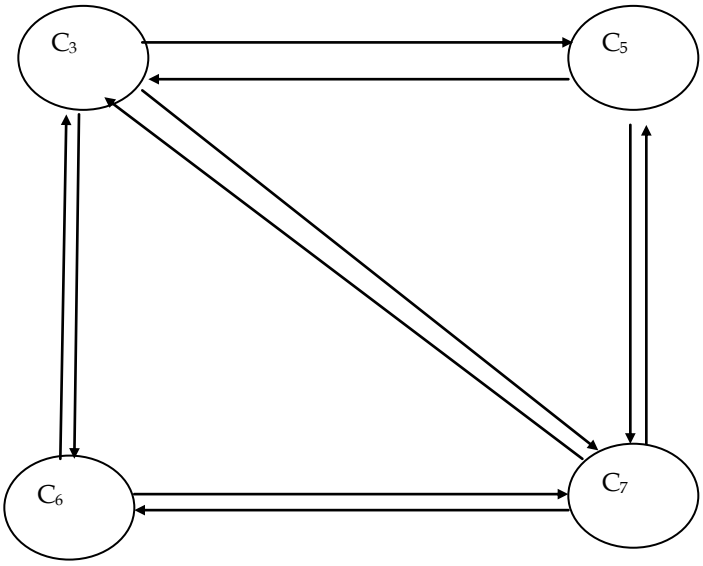
The directed graph and the relation matrix for the class C = {C_1, C_2, C_4, C_{10}}. Given by the expert is as follows:





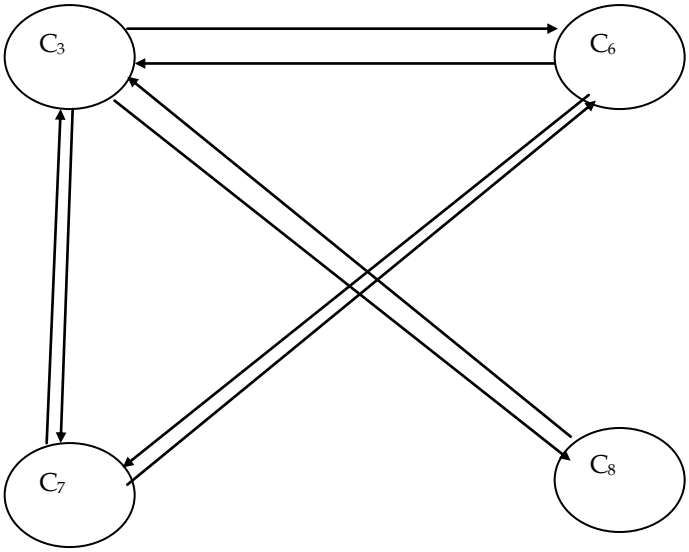
	C_1	C_2	C_4	C_{10}
C_1	0	1	1	0
C_2	1	0	1	1
C_4	1	1	0	1
C_{10}	0	1	1	0

The directed graph and the relational matrix for the class C = { C_3 , C_5 , C_6 , C_7}. Given by the expert is as follows:



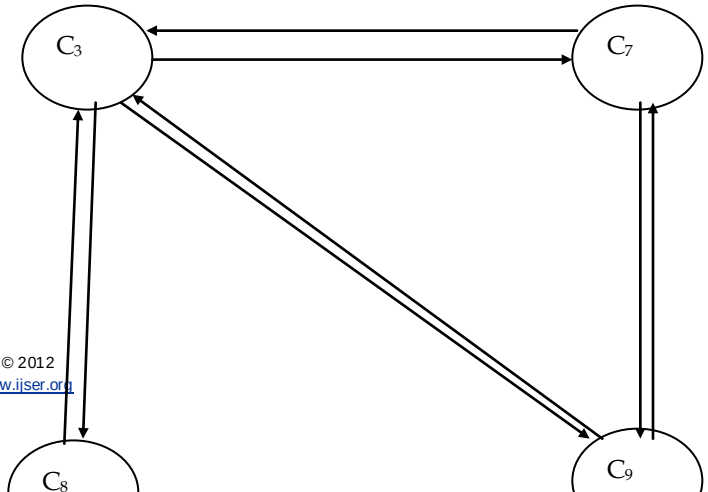
	C_3	C_5	C_6	C_7
C_3	0	1	1	1
C_5	1	0	0	1
C_6	1	0	0	1
C_7	1	1	1	0

The directed graph and the relational matrix for the class C = {C_3 , C_6 , C_7, C_8}. Given by the expert is as follows:



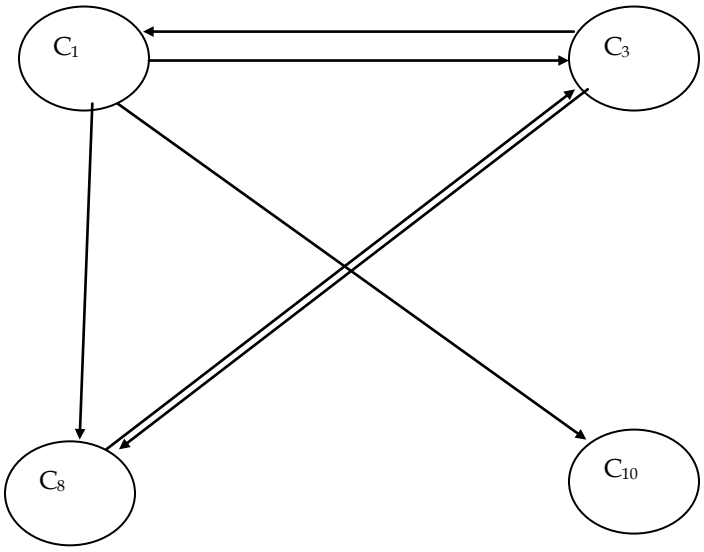
	C_3	C_6	C_7	C_8
C_3	0	1	1	1
C_6	1	0	1	0
C_7	1	1	0	0
C_8	1	0	0	0

The directed graph and the relation matrix for the class C ={C_3, C_7, C_8, C_9} Given by the expert is as follows:



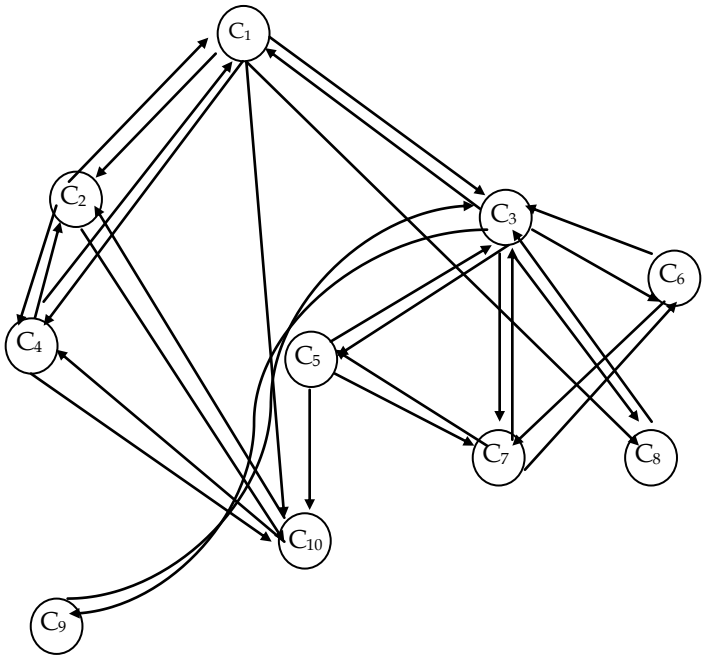
	C_3	C_7	C_8	C_9
C_3	0	1	1	1
C_7	1	0	0	1
C_8	1	0	0	0
C_9	1	0	0	0

The directed graph and the relation matrix for the class C ={C_1, C_3, C_8, C_{10}} Given by the expert is as follows:



	C_1	C_3	C_8	C_{10}
C_1	0	1	1	1
C_3	1	0	1	0
C_8	1	1	0	0
C_{10}	0	0	0	0

The combined direct graph and combined overlap block FCM of equal sizes as follows:



C(m)	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
C_1	0	1	1	1	0	0	0	2	0	2
C_2	1	0	0	1	0	0	0	0	0	1
C_3	1	0	0	0	1	2	3	0	0	1
C_4	1	1	0	0	0	0	0	0	0	1
C_5	0	0	1	0	0	0	1	0	0	0
C_6	0	0	2	0	0	0	2	0	0	0
C_7	0	0	3	0	1	2	0	0	1	0
C_8	2	0	3	0	0	0	0	0	0	0
C_9	0	0	1	0	0	0	0	0	0	0
C_{10}	0	1	0	1	0	0	0	0	0	0

Now using the matrix A of the combined overlap block FCM,

We determine the hidden pattern. Suppose the concept S_1 is in the on state and another nodes are in the off sate. Let the initial input vector be X={ 0 0 0 0 1 0 0 0 0 0 }

X C(m) = {0 0 1 0 0 0 1 0 0 0} =X1
X1 C(m) = {1 0 3 0 2 4 3 2 2 0} → (1 0 1 0 1 1 1 1 1 0) = X2
X2 C(m) = {3 1 1 1 2 4 6 4 2 2} → (1 1 1 1 1 1 1 1 1 1) = X3
X3 C(m) = {5 3 1 3 2 4 6 4 2 2} → (1 1 1 1 1 1 1 1 1 1) = X3
Where → Denotes the resultant vector after thresholding and updating.
X3 is the hidden pattern which is the fixed point.

CONCLUSION

While analyzing FCM, when the concept C5, "Instructional media and technology (ohp/lcd/videolips/e-learning) is in the on state, the other concepts C_2, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9, C_{10} are in the on state. The educational process needs to focus on the equipping and satisfying the needs of the students for ongoing learning, for social and personal competence to meet complex, real-life challenges. For this the Teaching learning Process has t impact the young mind sufficiently to leave a lasting impression with foundations rooted strongly in the individual's knowledge base. This would involve enriching the classroom experience which can only be done with the effective implementation of the available instructional media(teaching tools) and technology.

The teaching process equipped with the tools mentioned in this paper would rejuvenate not only the teacher but would be successful in instigating the young mind to think beyond – as commonly put " thinking out of the box". As is well known, visual perception often leaves a lasting impression while practical implementation of concepts would forever forge the concepts in the thinking faction of the mind. Such lectures would invite participation from the students clarifying doubts and causing them to venture in to new dimensions. There will be an immense satisfaction for the teacher in terms of effective delivery of knowledge using all the available resources besides the ultimate satisfaction that the student has learnt a new concept.

As technology gives us the tools to dispense information in the best possible way, teachers can continue on with their efforts to make information available interestingly and in relation to the current scenario.

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