International Journal of
Fuzzy Mathematical
Archive

A Report on Studies in Private Engineering Colleges Using Fuzzy Cognitive Map (FCM)

M. Mohamed Salih Mukthar

C. Abdul Hakeem College (Autonomous)

Abstract. In this paper, we are discussed about the fuzzy cognitive map and the method of finding the hidden pattern. Importantly in this paper, we are taken a report on studies in private engineering colleges. Then, we are analyzed the causes and also the corrective actions for the improvement of studies in private engineering colleges using fuzzy cognitive map.

1. Introduction

In the year 1976, Axelrod introduced cognitive maps for representing social scientific knowledge and describing the methods that are used for decision making in social and political systems. While in the period of 1986 to 1992, Kosko enhanced the power of cognitive maps considering fuzzy values for the concepts of the cognitive map and fuzzy degrees of interrelationships between concepts. After this pioneering work, Fuzzy Cognitive Maps attracted the attention of scientists from many fields and have been used in a variety of different scientific problems.

Fuzzy Cognitive Maps are inference networks, using cyclic digraphs, for knowledge representation and reasoning. Over the past decade, FCMs have gained considerable research interest and are widely used to analyze causal complex systems, which have originated from the combination of fuzzy logic and neural networks. FCMs have been applied in diverse application domains, such as computer science, engineering, environmental sciences, behavioral sciences, medicine, business, information systems, and information technology. Their dynamic characteristics and learning capabilities make them essential for a number of tasks such as modeling, analysis, decision making, forecast, etc. FCM is one analysis tools that it uses graphic network to show the causal relationships of influenced factors in a dynamic system.

There are two mainstreams of techniques for creation of FCM models. The first group covers techniques that exploit only human (expert) knowledge. We refer to them later as manual methods. For a long time this was practically the only way for establishing FCM models, mainly because of lack of automated or semi-automated approaches that would support this process. Recently several attempts were made to develop computational methods. They aim to substitute the expert and learn the model's

structure from historical data. Using this FCM technique, we are going to analyze the studies in private engineering colleges.

Nowadays, there are many numbers of private engineering colleges in TamilNadu. Of course, the students are not getting adequate knowledge in their studies. So, let us find out the causes and how to rectify them.

2.1. Preliminaries

First we discuss about some preliminary concepts of Fuzzy cognitive map and hidden pattern from [2,3,5, 7].

Definition 2.1.1. A fuzzy cognitive map is a combination of fuzzy logic and cognitive mapping. Cognitive mapping is based on graph theory, which is also the basis of most calculations and indices. 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 2.1.2. Let $C_1, C_2,\ldots,C_n$ be the nodes(vertices) of an FCM. Let $A=(a_1, a_2,\ldots,a_n)$, where $a_i \in \{0,1\}$. 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, where i = 1,2,…,n and $a_i = 1$ if a_i is on, where i = 1,2,…,n

Definition 2.1.3. Let $C_1, C_2,\ldots,C_n$ be the nodes of an FCM. Let $C_1C_2, C_2C_3, \ldots,C_iC_j$ 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 2.1.4. An FCM with cycles is said to have a feedback. When there is a feedback in an FCM, the FCM is called a dynamical system. The equilibrium state for this dynamical system is called the hidden pattern.

2.2. Method of finding the hidden pattern

Let $C_1, C_2,\ldots,C_n$ be the nodes of an FCM, with feedback. Let E be the 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 $A_1E = (a_1, a_2,\ldots,a_n)$ 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 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 $A_1E \rightarrow A_2$, then consider A_2E and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.

3. Analyzing studies in private engineering colleges using fuzzy cognitive map
3.1. Concept of the problem

Using linguistic questionnaire and the experts' (teachers) opinion, we have taken the following eight concepts $\{C_1, C_2,\ldots, C_8\}$:

A Report on Studies in Private Engineering Colleges Using Fuzzy Cognitive Map

C_1- Inefficient teachers, C_2- Instability of teachers, C_3- Students (Poor) standard, C_4- Mentality of Management, C_5- Focusing on Result, C_6- Insufficient Infrastructure, C_7- No quality of Education, C_8- Less Job opportunities

3.1.1. Inefficient teachers (C_1)

They refer the teachers who are not having sufficient knowledge to deliver thesubject in the classroom. This situation is happening in private engineering colleges since the management committee recruits the teachers based on salary but not on knowledge.

3.1.2. Instability of teachers (C_2)

They refer that the teachers are not working for long years in any institution. It is happening because of that the management is not giving proper salary orthey get work pressure or other reasons.

3.1.3. Students (Poor) standard (C_3)

There is no specific ways (like entrance exam) for identifying students' standard and their knowledge apart from plus two marks. Also, Management admits the students directly to join B.E without identifying their interest and capability.

3.1.4. Mentality of Management (C_4)

Generally, Management thinks that the college is one of the businesses. So, they are running the engineering colleges to develop their earnings. They don't bother about the development of the academic.

3.1.5. Focusing on Result (C_5)

If the result of the students is higher, the college will get good rank and consequently, get good admission. So, the college focuses on results.

3.1.6. Insufficient Infrastructure (C_6)

In many of theprivate engineering colleges, there are no sufficient lab facilities and other kind of infrastructure.

3.1.7. No quality of Education (C_7)

Because of the inefficient teachers and insufficient lab facilities, the students are unable to get the quality of education.

3.1.8. Less Job opportunities (C_8)

Since the students are not having sufficient knowledge in academic and less communication, they are unable to get the jobs in right time.

Based on the experts' (teachers) opinion, we get the following directed graph as follows:
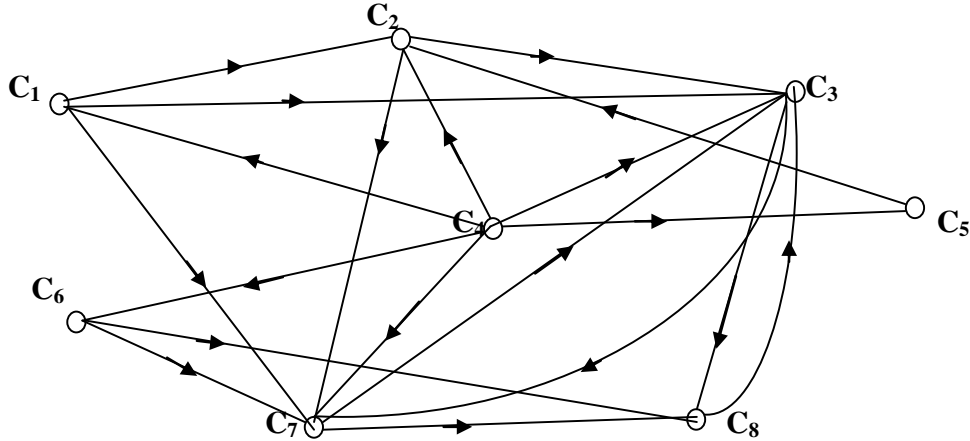
3.2. Calculation

Now, we find the adjacency matrix of order 8x8 (since there are 8 concepts) for the above digraph.

Adjacency matrix A =

$$
\begin{array}{cccccccc}
 & C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 \\
\end{array}
$$

$$
\begin{pmatrix}
0 & 1 & 1 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\
1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
\end{pmatrix}
$$

Using this adjacency matrix of the FCM, we determine the hidden pattern in the following manner:

First let us assume that C_4 is on state.

i.e., assume $X_1 = (0\ \ 0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 0)$

Then $\quad X_1 A = (1\ \ 1\ \ 1\ \ 0\ \ 1\ \ 1\ \ 1\ \ 0) = X_2$

$\quad\quad X_2 A = (0\ \ 2\ \ 3\ \ 0\ \ 0\ \ 0\ \ 4\ \ 3)$

$\quad\quad\quad\quad \rightarrow (0\ \ 1\ \ 1\ \ 0\ \ 0\ \ 0\ \ 1\ \ 1) = X_3$

$\quad\quad X_3 A = (0\ \ 0\ \ 3\ \ 0\ \ 0\ \ 0\ \ 2\ \ 2)$

$\quad\quad\quad\quad \rightarrow (0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 1\ \ 1) = X_4$

$\quad\quad X_4 A = (0\ \ 0\ \ 2\ \ 0\ \ 0\ \ 0\ \ 1\ \ 2)$

$\quad\quad\quad\quad \rightarrow (0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 1\ \ 1) = X_4$

Here $\rightarrow$ denotes the resultant vector after thresholding and updating

Finally, we get X_4 is the hidden pattern, which is the fixed point.

4. Conclusion

In analyzing the studies in private engineering colleges using FCM, when the concept C_4 (Mentality of Management) is on state, C_3(Students Poor standard), C_7(No quality of

A Report on Studies in Private Engineering Colleges Using Fuzzy Cognitive Map

Education) and C_8 (Less Job opportunities)are all on state but C_1 (Inefficient teachers), C_2 (Instability of teachers), C_5 (Focusing on Result) and C_6 (Insufficient Infrastructure) are all off state. If the management thinks the college as business, the students' standard will be poor in academic, the students won't get quality in education and they will lose job opportunities. So, we conclude that the management mentality should be changed for the betterment of studies in the private engineering colleges.

REFERENCES

1. Elpiniki I. Papageorgiou, Jose L. Salmeron, A review of fuzzy cognitive maps research during the last decade, *IEEE Transactions on Fuzzy Systems*, 21(1) (2013) 66-79.
2. J.A.Dickerson and B.Kosko, Virtual worlds as fuzzy cognitive maps, *Presence,* 3(2) (1994) 173-189.
3. Vasantha Kandaswamy, Anthony Raj and Victor Devadoss, Some new fuzzy techniques, *Journal of Math & Comp.Sci.*, 17(2) (2004) 157-160.
4. M.Khan and M.Quaddus, Group Decision Support using Fuzzy cognitive maps for Causal reasoning, *Group Decision and Negotiation Journal,* 13(5) (2004) 463-480.
5. D.Chrysostomos,   E.Stylios and P.Peter, Mathematical formulation of fuzzy cognitive maps, *Proceedings of the 7th Mediterranean Conference on Control and Automation* (MED99) Haifa, Israel - June 28-30, 1999.
6. B.Kosko, Hidden patterns in combined and adaptive knowledge networks, *International Conference of Neural Networks*, (1988) 377-393.
7. L.A.Zadeh, Fuzzy sets, *Information and Control*, 8 (1965) 338-353.