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Fuzzy Linguistic Cognitive Maps and its applications to Psychological Problems faced by Rural Students studying in Tamil Nadu City Colleges

[1]FR. K. AMAL S.J. and [2]LILLIS THIVAGAR

[1]Loyola College, Nungambakkam, Chennai – 600 034 (INDIA)
Email: kamalsj@gmail.com
[2]Professor, Dept. of Maths Madurai Kamaraj University
Madurai – 625 21 (INDIA)
Email: mlthivagar@yahoo.co.in

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Abstract

In this paper we for the first time introduce a new fuzzy dynamical system, *viz.* Fuzzy Linguistic Cognitive Maps (FLCM) model which works on 'min' and 'max' operations. We apply this new model to the problem of rural students in city colleges, especially taking / studying their psychological problems for it cannot be directly studied using supervised data.

This paper has three sections. Section one introduces this new model. Section two applies this problem to the psychological problems faced by the rural students studying in city colleges. The final section gives the use as well as the advantages of using the model.

Introduction

1. *The New Fuzzy Linguistic Cognitive Maps Model:*

In this section we define and describe the working of the Fuzzy Linguistic Cognitive Maps (FLCM) Model.

For reference about Fuzzy Linguistic Cognitive Maps and its working please refer[1,2].

Let us consider C_1, C_2, …, C_n to be some n attributes / concepts associated with the problem in hand. Now instead of having the 'on' or 'off' state of the concepts C_1, …, C_n as in FCM with for these concepts, we associate linguistic states like; always, never, often, very often, not that often, much, very much, not that much, medium, large etc. So at one time the state C_i may be only one of these states or '0' it is none of these states. Clearly these states are not values between [0, 1] but they are linguistic states and not numbers; that is why

we say the dynamical system which we are defining as the Fuzzy Linguistic Cognitive Maps (FLCM) – model.

Suppose at an instant the attribute / concept C_i is in the state 'often' and its impact on the another attribute C_j ($i \neq j$) increases the effect 'often' in C_j (that is increase in C_i increases C_j) then we map in the linguistic graph with $C_1, \ldots, C_n$ as nodes, the vertex C_i to C_j as '+ often'. If decrease in C_i decrease C_j we mark as '+ often". If increase (decrease) in C_i decrease (increase) C_j we map as '- often'. However C_i cannot have impact on C_i so C_i to C_i is 0. Now our state vectors will be $X = (a_1, a_2, \ldots, a_n)$ where $a_i \in$ {linguistic variables associated with the problem} $\cup$ {0} = L; o (L) $< \infty$, $1 \leq i \leq n$. Now using the linguistic graph we get the linguistic matrix.

If G be some fuzzy linguistic graph and M the corresponding fuzzy linguistic $n \times n$ matrix and if $x = (a_1, \ldots, a_n)$ be the state vector then we define M to be the fuzzy linguistic dynamical system now if $M = (m_{ij})$; $m_{ij} \in L$, $1 \leq i, j \leq n$ then $xM = (b_1, \ldots, b_n)$ where $b_i \in L$; $1 \leq i \leq n$.

Let $xM = x_1$ after updating[1,2]; now we find $x_1M = x_2$ (say) we find x_2M we go on finding such vectors and finally we arrive at a fixed point or a limit cycle since L is a finite set.

This fixed point or the limit cycle is defined as the fuzzy linguistic hidden pattern. If $x_t = (t_1, \ldots, t_n)$ is the fixed point (or limit cycle) we see the direct impact of $x = (a_1, \ldots, a_n)$ on the problem and we can intrepet it.

We will illustrate this first by an example.

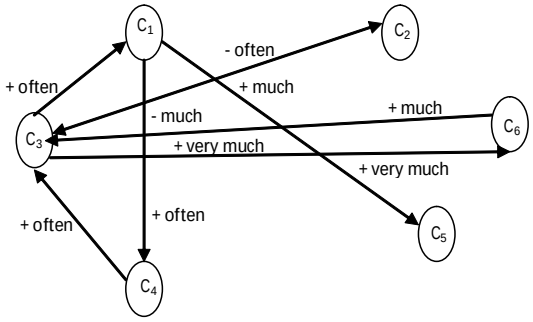
Example 1.1: Suppose we are interested in studying the child labour problem. Let (C_1, C_2, …, C_6) be six attributes/concepts associated with it.

C_1 - Child Labour
C_2 - Good Teacher
C_3 - School Drop out
C_4 - Poverty
C_5 - Public encouraging child labour
C_6 - Broken Family.

These concepts need not be explained as they are self explanatory we take the following fuzzy linguistic variables as the state vectors. Let L ={0, often, + often, –often, very much, much, not that much, little, very little, more etc}.

So the state vectors as well as the related fuzzy linguistic matrices take their values from the set L. Also the vertices of the fuzzy linguistic graph take their values from L.

Now using the experts opinion we have the following fuzzy linguistic graph.



Now using this linguistic graph we have the following fuzzy linguistic matrix M; where M is the dynamical system associated with the problem of child labour.

$$M = \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \end{array} \begin{array}{c} \begin{array}{cccccc} C_1 & C_2 & C_3 & C_4 & C_5 & C_6 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & +\text{ often} & +\text{ very much} & 0 \\ 0 & 0 & -\text{ often} & 0 & 0 & 0 \\ +\text{ often} & -\text{ much} & 0 & 0 & 0 & +\text{ much} \\ 0 & 0 & +\text{ often} & 0 & 0 & 0 \\ +\text{ very much} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & +\text{ much} & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Now our state vector takes values from L. The min and max operations on L are defined as follows.

Let min $\{0, a_i\} = 0$ and max $\{0, a_i = a_i$ for all $a_i \in L$.

$a_i \in L$ min $\{a_i, a_i\} = a_i$ and max $\{a_i, a_i\} = a_i$.

min $\{a_i - a_i\} = -a_i$ and max $\{a_i, -a_i\} \in a_i$ for all $a_i \in L$.

For instance min {often, very often} = often
max {often, very often} = very often
min {much, often} = often,
max {much, often} = much
min {-much, often} = - much
and max {-much, often} = often.
Like this operations on L are performed.

Now suppose we want to study the effect of state vector "Child labour often occurs" under the condition 'often' $\in$ L and all other states are in the off state or zero state. To find the effect of x = (+ often, 0, 0, 0, 0, 0) on the dynamical system M. xM = (0, 0, 0, + often, + often, 0) after updating the state vector as the first concept was in the on state with '+ often' in the final results as well as in every step it should continue to remain in the '+ often' state. So let x_1 = (+, often, 0, + often, often, 0).

Now we find x_1 M using as before min $\{\min(a_i, m_{ij})\}$ where $x_1 = (a_1, a_2, \ldots, a_6)$ and $M = (m_{ij})$; $m_{ij}, a_i \in L$, $1 \le i, j \le 6$.

Thus x_1M = (+ often, 0, 0, + often, + often, 0) $\times$

$$\begin{bmatrix} 0 & 0 & 0 & +\text{ often} & +\text{ very much} & 0 \\ 0 & 0 & -\text{ often} & 0 & 0 & 0 \\ +\text{ often} & -\text{ much} & 0 & 0 & 0 & +\text{ much} \\ 0 & 0 & +\text{ often} & 0 & 0 & 0 \\ +\text{ very much} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & +\text{ much} & 0 & 0 & 0 \end{bmatrix}$$

we get (+ often, 0, + often, + often, + often, 0) leading to a fixed point.

Thus the hidden pattern clearly presents if 'often' child labour is in vogue it is 'often' poverty. C_4 and C_5, public encouraging child labour.

Likewise we can work with any other attribute in the on state and get the hidden pattern.

2. *Analysis of psychological problems faced by rural students using the new FLCM model :*

Now in the following section we proceed onto show how this new model is used to study the psychological problems of the rural students in city colleges.

The expert in this case has selected the following attributes as the psychological problems faced by the rural students in city colleges.

S_1 - Rural students suffer inferiority complex
S_2 - Lack of communication
S_3 - Lack of understanding the teaching, due to language problems.
S_4 - Personality – dress etc.
S_5 - Poverty – Economic background
S_6 - Social problems
S_7 - Teachers attitude

We will describe each of these attributes in a line or two.

S_1 – Rural students suffer inferiority complex: Rural students as soon as they enter city and the city colleges they suffer inferiority complex due to several reasons main among them is due to the way city students and city based people behave be it, a city autodriver or a city bus driver or even a tea shop owner in the city. This makes them suffer for, they openly comment, he is from a village in a colloquial Tamil.

S_2 – Lack of communication: The rural students cannot in general communicate as city students. Further we see their rural language be it Tamil or English is not as eloquent as the city students language. This also leads to some psychological problems for them.

S_3 – Lack of understanding the teaching, due to language problems. Due to language problems the rural students are not in a position to understand or follow the lessons taken in the class. This also adds to the psychological problems in the rural students.

S_4 – Personality. The very dress, hair style the way they hold themselves proves them to be a rural students hence wherever they go the city students in general laugh at them or at times ill-treat them.

S_5–Poverty or Economic Background. Most of the rural students who come to city for their college education belong to a poor or middle class economic background, so they are in despair and suffer silently. For their very dress the bag they carry, devoid of cellphone, laptops, wrist watches *etc*. make them feel small or inferior before the city students.

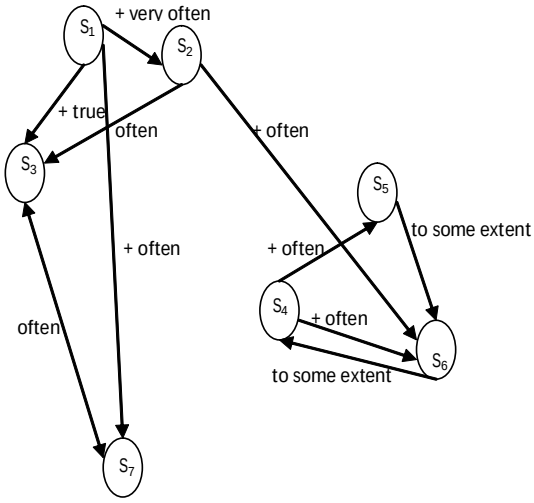
S_6 – Social problems; Social problem is that they cannot immediately mingle with

the city students and their appearance show them to be less in every thing including in city set up due to dress, caste, behaviour or economy.

S_7 – Teachers Attitude: City teachers do not understand the state of mind of the rural students, on the other hand they may asks questions which will make the student loose even the little hopes which they have. Further the rural students may not follow the accent or the language in which the lessons are taught, so a teacher may never understand their problems. Unless the teacher are kind and approachable to the rural students, to understand the students problem.

The fuzzy linguistic attributes associated with these seven concepts in this problem are; L={0, ± very true, ± mostly true, ± true, ± true to some extent, ± partially false, ± false, never, ± often, ± very often, ± little, ± very little, ± more, ± not that much and so on}.

The fuzzy linguistic graph given by the expert is as follows.



The associated fuzzy linguistic matrix M associated with the fuzzy linguistic graph;

$$M = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \\ S_6 \\ S_7 \end{array} \begin{array}{c} \begin{array}{ccccccc} S_1 & S_2 & S_3 & S_4 & S_5 & S_6 & S_7 \end{array} \\ \begin{bmatrix} 0 & +\text{veryoften} & +\text{true} & 0 & 0 & 0 & +\text{ often} \\ 0 & 0 & +\text{ often} & 0 & 0 & +\text{ often} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & +\text{ often} \\ 0 & 0 & 0 & 0 & +\text{ often} & +\text{ often} & 0 \\ 0 & 0 & 0 & 0 & 0 & \text{to some exten} & 0 \\ 0 & 0 & 0 & \text{to some exten} & 0 & 0 & 0 \\ 0 & 0 & +\text{ often} & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Suppose we are given the state vector x = (+ often, 0, 0, 0, 0, 0, 0) to be in the on state. To find the effect of x on the dynamical system M.

We find xM using the min of min operation; and

Let xM = (0, + often, + often, 0, 0, 0, + often);
we after updating the resultant vector xM we get x_1;
x_1 = (+ often, + often, + often, 0, 0, 0, + often);

we find now the effect of x_1 on the dynamical system M; x_1M = (0, + often, +

often, 0, 0,+ often, + often,) after updating x_1M we get x_2=(+ often, + often, + often, 0, 0, + often, + often); we find now the effect of x_2 on M, x_2M = (0, + often,+often, to some extent, 0, + often, + often) after updating x_2M we get x_3 = (+ often, + often, + often, to some extent, 0, + often, + often). Now we find effect of M on x_3, this is given by x_3M = (0, + often, + often, to some extent, to some extent, + often, + often).

Now we update x_3M and get x_4 = (+ often, + often, + often, to some extent, to some extent, + often, + often).

We find the effect of x_4 on M;

x_4M = (0, + often, + often, to some extent, to some extent, often, + often); after updating we get

x_5 = (+ often, + often, + often, to some extent, to some extent, + often, + often) to be the hidden pattern.

Thus the '+ often' state of the concept C_1 results in a fixed point which is such that 'often' the rural students who suffer inferiority complex lack communication, and 'often' they do not follow the teachers teaching in the day and to some extent the inferiority complex of the rural students is due to their personality ie., hair style dress etc; "to some extent", these rural people who suffer with complex are poor and often they find it difficult to mingle with the other students and also often it is the teachers attribute to question them in the class etc.

We study with one more state vector namely the attribute, lack of understand in the class (S_3) is + true state to be on and all other concepts are in the off state. To find the effect of y = (0, 0, + true, 0, 0, 0, 0) on the dynamical system M

yM = (0, 0, + true, 0, 0, 0, + often); y_1 after updating to find the effect of y_1 on M; y_1M = (0, 0, true, 0, 0, 0, often) is the fixed point.

Thus we see the hidden pattern is a fixed point and only the concept S_7 is in the + often state, that is lack is understanding in the class is due to the teachers attribute and all other concepts remain in the off state.

Suppose we consider the state vector M = (0, 0, 0, 0, true, 0, 0), to find the effect of M on the dynamical system M.

We see mM = (0, 0, 0, 0, 0, to some extent, 0) after updating we get m_1 = (0, 0, 0, 0, true, to some extent, 0).

Now the effect of m_1 on the dynamical system gives m_1M =(0, 0, 0, to some extent, 0, to some extent, 0) after updating we get m_2 = (0, 0, 0, to some extent, true, to some extent, 0). The effect of m_2 on M gives after updating.

m_3=(0, 0, 0, to some extent, true, to some extent, 0)

Thus we see if Poverty is in 'true' state and all other attributes are in the off state then we see this directly affects personality to 'some extent' also they face 'social problems'

'to some extent'.

One can work with any other state. We give the conclusions and suggestions based on our study in the following section.

3. Conclusions and suggestions :

At the outset we would like to say that in most of the study of social issues / problems it is better to use fuzzy linguistic cognitive maps model instead of Fuzzy Cognitive Maps. These FLCM models are built to be used in studying or analyzing the social issues.

It is useful for even if an expert is a non mathematician he can easily serve as an expert for any other expert can always give fuzzy linguistic values from L. Further in this problem of rural students the following are the conclusions.

1. Poverty affects the students personality and to some extent involves only the social problems.

2. When the node lack of understanding is in the class is 'true'; state we see no node becomes on only the node / concept teacher attitude comes to 'often' state.

3. If the 'often' is the state of "Rural students suffer from the inferiority complex" then we see the hidden pattern says the students suffer from lack of communication often results in lack of understanding, the teaching in class, they suffer 'to some extent' personality problems also 'to some extent' they suffer from poverty, 'often' they suffer social problems and 'often' teachers attitude also affects the students suffering from inferiority complex.
   If the students are willing to take up parttime job, either in the campus or in the close by places they should be encouraged which would help them to feel better with some earning.

Thus we see the 'often' state of 'students suffering from inferiority complex' leads to the on state of all the other attributes. So we suggest if Rural students are given proper counciling and short term training before joining colleges certainly it will help them to over come all problems.

Secondly teachers should be trained to handle rural students with care and concern. When these two are achieved all other psychological problems can be set right.

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