

**APPLICATION OF SUPER FUZZY COGNITIVE MAPS
IN THE ANALYSIS OF OPINION ABOUT THE
EMPLOYMENTS IN 'INFORMATION TECHNOLOGY SECTOR'**

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Abstract

In this article, the authors attempted to analyse the opinion about employments in IT sector using Super Fuzzy Cognitive Maps based on the data collected from five groups of people whose role influence the choice of career either directly or indirectly.

Introduction

At present, IT sector provides ample employment opportunities to the educated youth in India and plays a significant role in the socio-economic development of our country. It has become the aspiration of most of the educated youth in India to become a software engineer. The new education policy in India facilitated enormous growth in the number of institutions, offering higher education in the fields of medicine, engineering, arts and science. The lucrative jobs in IT sector and the existence of more number of educational institutions motivated Indian youths to prefer IT profession. Such human resource elevated the status of our country to new heights in the global arena.

Opinion about the Employments in IT Sector in the Present Scenario

Indian IT sector has vast employment potential, consequently contributes much for economic development. Majority of the educated youth are much fascinated by the jobs in IT sector due to various reasons like attractive salary, foreign assignment, career advancement, easy mobility, recognition of talents and skills, status in the society and so on.

However, the other side of the coin has certain negative features like work stress, harassment by team leaders, night shifts, health hazards, lack of time to fulfill family and social obligations and so on. If one gives weightage to the advantages of jobs in IT sector he joins in such jobs. Otherwise he prefers the jobs in other sector.

The authors attempted to analyse the opinion about employments in IT sector using super fuzzy cognitive maps and collected data from five groups of people whose role influence the choice of career either directly or indirectly.

Basic Definitions [2,4]

Super Fuzzy Cognitive Maps

A Fuzzy Cognitive Map (FCM) is a directed graph with concepts like policies, events etc., as nodes and causalities as edges or arcs. It represents causal relationship between concepts. Each arc is accompanied by a weight that defines the type of causal relation between the two nodes.

The matrix E defined by $E = (e_{ij})$ where e_{ij} is the weight of the directed edge $C_i \rightarrow C_j$ is called the **adjacency matrix** of the FCM, also known as the **connection matrix** of the FCM.

Suppose n experts want to work with a problem P using a FCM model, then how to form an integrated dynamical system which can function simultaneously using the n experts opinion. Suppose the first expert spells out the attributes of a problem as $x_1^1, x_2^1, \dots, x_{t_1}^1$, the second expert gives the attributes as $x_1^2, x_2^2, \dots, x_{t_2}^2$ and so on. Thus the i^{th} expert gives the attributes with which he wishes to work as $x_1^i, x_2^i, \dots, x_{t_i}^i$; $i = 1, 2, 3, \dots, n$. The problem is modeled using super fuzzy cognitive maps and the special diagonal super fuzzy matrix; this super matrix will be called as the super connection matrix of the **Super Fuzzy Cognitive Map**. The special feature of this special super diagonal fuzzy matrix would be all the diagonal matrices are square matrices and the main diagonal of each of these sub matrices of the special fuzzy super diagonal matrix is zero. The special diagonal super fuzzy matrix for the problem takes the following form and is denoted by M_D .

$$M_D = \begin{array}{c} \begin{array}{c} x_1^1 \quad x_2^1 \quad \dots \quad x_{t_1}^1 \\ x_1^2 \quad x_2^2 \quad \dots \quad x_{t_2}^2 \\ \vdots \\ x_1^n \quad x_2^n \quad \dots \quad x_{t_n}^n \end{array} \\ \left(\begin{array}{c|c|c|c} & & & \\ \hline & M_1^1 & (0) & \dots & (0) \\ \hline & (0) & M_2^2 & & (0) \\ \hline & & & & \\ \hline & (0) & (0) & & M_n^n \end{array} \right) \end{array}$$

M_i^1 is a fuzzy matrix with main diagonal elements to be zero i.e.,

$$M_i^i = \begin{bmatrix} 0 & m_{12}^i & \dots & m_{1t_i}^i \\ m_{21}^i & 0 & \dots & m_{2t_i}^i \\ \vdots & \vdots & & \vdots \\ m_{t_i 1}^i & m_{t_i 2}^i & \dots & 0 \end{bmatrix}$$

$i = 1, 2, \dots, n.$

Let C_1, C_2, \dots, C_n be the nodes of an FCM. $A = (a_1, a_2, \dots, a_n)$ where $a_i \in \{0, 1\}$ is called the **instantaneous state vector** and it denotes the on-off position of the node at an instant.

$$a_i = 0 \text{ if } a_i \text{ is off and } a_i = 1 \text{ if } a_i \text{ is on}$$

for $i = 1, 2, \dots, n.$

Let C_1, C_2, \dots, C_n be the nodes of an FCM. Let $\overline{C_1 C_2}, \overline{C_2 C_3}, \overline{C_3 C_4}, \dots, \overline{C_1 C_j}$ be the edges of the FCM ($i \neq j$). 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.

An FCM with cycles is said to have a **feedback**.

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**.

Let $\overline{C_1C_2}$, $\overline{C_2C_3}$, $\overline{C_3C_4}$, ..., $\overline{C_{n-1}C_n}$ 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 $i = 1, 2, \dots, n$. The equilibrium state for this dynamical system is called **hidden pattern**.

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

If the FCM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow \dots \rightarrow A_i \rightarrow A_1$ then this equilibrium is called a **limit cycle**.

Methods of Finding the Hidden Pattern

We pass state vector C repeatedly through the FCM connection matrix E , thresholding or non-linearly transforming the result after each pass. Independent of FCMs size, it quickly settles down to a temporal associative memory limit cycle or fixed-point which is the hidden pattern of the system for that state vector C . The limit cycle or fixed-point inference summarizes the joint effects of all the interacting fuzzy knowledge.

Application of Super Fuzzy Cognitive Maps

An interview schedule was administered to 30 respondents of each of the following five groups to express their opinion about employments in IT sector :

1. College / University students preferring employments in IT sector.
2. College / University students not preferring employments in IT sector.
3. Staff working in IT sector.
4. Public having knowledge about employments in IT sector.

5. College / University teachers.

Based on the opinion of the majority of respondents in each group, a list of both favourable and adverse features were listed and further analysis was made using super FCM as detailed below :

1. College / University students preferring employments in IT sector

- F₁¹ - High salary
- F₂¹ - High status
- F₃¹ - More opportunities for jobs in abroad
- F₄¹ - Development of skills
- F₅¹ - Healthy social movement
- F₆¹ - Talent based work
- F₇¹ - Talent based reward

2. College / University students not preferring employments in IT sector

- F₁² - High salary
- F₂² - Work pressure
- F₃² - Prolonged work hours
- F₄² - Health problems
- F₅² - Lack of time to care family affairs
- F₆² - Lack of time to fulfil social obligation
- F₇² - Healthy social movement.

3. Staff working in IT sector

- F₁³ - High salary
- F₂³ - High status

F_3^3 - More opportunities for jobs in abroad

F_4^3 - Healthy social movement

F_5^3 - Health problems

F_6^3 - Lack of time to fulfil social obligations

F_7^3 - Lack of time to care family affairs

F_8^3 - Talent based reward

4. Public having knowledge about employments in IT sector

F_1^4 - High salary

F_2^4 - High status

F_3^4 - Work pressure

F_4^4 - Lack of time to care family affairs

F_5^4 - More opportunities for jobs in abroad

5. College / University Teachers

F_1^5 - High salary

F_2^5 - Development of skills

F_3^5 - Healthy social movement

F_4^5 - More opportunities for jobs in abroad

F_5^5 - Talent based work

F_6^5 - Talent based reward.

Based on the opinion given by the respondents on the causal relation between the features (nodes), a Super FCM was framed. Here the FCM is a weighted directed graph. The weightage for each edge is the ratio between the number of respondents who opined the existence of causal relation between two features (nodes) and the total number of respondents.

Results

The effect of the variable “High Salary” on the other variables for each of the five groups is found as follows:

Group I

The effect of “High Salary” is
0.9 degree on “High status”,
0.6 degree on “More opportunities for jobs in abroad”,
0.6 degree on “Development of skills”,
0.7 degree on “Healthy social movement”,
0.3 degree on “Talent based work” and
0.5 degree on “Talent based reward”.

Group II

The effect of “High Salary” is
0.1 degree on “Healthy social movement” and it has no effect on other features”.

Group III

The effect of “High Salary” is
0.9 degree on “High status”,
0.6 degree on “More opportunities for jobs in abroad”,
0.8 degree on “Healthy social movement”,
0.2 degree on “Lack of time to fulfil social obligations”,
0.3 degree on “Lack of time to care family affairs” and
0.6 degree on “Talent based reward and no effect on health problems”.

Group IV

The effect of “High Salary” is
0.9 degree on “High status and it has no effect on other features”.

Group V

The effect of “High Salary” is
0.4 degree on “Development of skills”,
0.7 degree on “Healthy social movement”,
0.4 degree on “More opportunities for jobs” and
0.4 degree on “Talent based reward”.

Conclusion

In the present competitive world, ample job opportunities are available to the educated youth. It is a great challenge to them to choose the job that best fit their aspirations. The above scientific and logical analysis helps them to take right decision in the selection of career.

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