iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XII **Month of publication:** December 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 5 Issue XII December 2017- Available at www.ijraset.com

Study on Fuzzy Cognitive Map Structures through Category Theory

G.Jenitha[1], Dr. Shenbaga Ezhil[2], Dr. A. Kumaravel[3]
[1] *Department of Mathematics, AMET University, Kanathur, Chennai.*
[2] *Department of Mathematics, Jeppiaar Institute of Technology, Chennai.*
[3]*Dean, School of computing, Bharath University, Chennai.*

Abstract: In this article we have introduced Fuzzy Cognitive Map (FCM) as a Category model also we have introduced category concepts in Fuzzy Cognitive Mapping .Coined a new Formulation in FCM Category Advantages and limitations are discussed.

I. INTRODUCTION

A. Fuzzy Cognitive Map (FCM)

In 1965, L.A. Zadeh has introduced a mathematical model called Fuzzy Cognitive Maps. After a decade in the year 1976, Political scientist R. Axelord used this fuzzy model to study decision making in social and political systems .Then B. Kosko 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, introduced concepts to represent the essential elements and the cause and 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, economical and medical etc. illustrated by W.B. Vasantha Kandasamy in her book, "Application of Fuzzy Models in Social Sciences". In this paper we recall the notion of Fuzzy Cognitive Maps (FCMs), which was introduced by Bart Kosko in the year 1986.

A fuzzy cognitive map (FCM) can be understood as a graphical representation of the knowledge about or the perception of a given system. Fuzzy cognitive mapping 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. A FCM consists of factors (concepts / nodes) which represent the important elements of the mapped system. The directed lines labeled with fuzzy values show the strength of the causal conditions between the factors. A fuzzy cognitive map is a model of system structure.

B. Category Theory

Samuel Eilenberg and Saunders Mac Lane introduced the concepts of categories, functors, and natural transformations in 1942–45 in their study of algebraic topology, with the goal of understanding the processes that preserve mathematical structure. Category theory formalizes mathematical structure and its concepts in terms of a labeled directed graph called a *category*, whose nodes are called *objects*, and whose labelled directed ges are called *arrows* (or morphisms). A category has two basic properties: the ability to compose the arrows associatively and the existence of an identity arrow for each object. A basic example of a category is the category of sets, where the objects are sets and the arrows are functions from one set to another. However, the objects of a category need not be sets, and the arrows need not be functions. Any way of form aliasing a mathematical concept such that it meets the basic conditions on the behavior of objects and arrows is a valid category and all the results of category theory apply to it.

C. Applications of FCM

Fuzzy Cognitive Maps (FCMs) have been applied in several scientific areas such as:

1) Medicine
2) Engineering
3) Business and Management
4) Production Systems
5) Environment and Agriculture
6) Information Systems and Information Technology
7) Telecommunications
8) Education

D. Applications of Category Theory

The above is nice and all, but it's still just sort of hey-take-my-word-for-it, which is not so satisfying. Here are some actual examples:

1) Category theory has been used to study grammar and human language.
2) In building a spreadsheet application.
3) As a descriptive tool in neuroscience.
4) In the analysis and design of cognitive neural network architectures.
5) Many applications in graduate level mathematics (i.e. stuff I don't understand) and physics.
6) In programming languages, especially Haskell and most famously monads, but also, for instance, a typed assembly language and work on the typed lambda calculus.
7) Generating program optimizations.
8) To model systems of interacting agents.
9) To generalize sorting algorithms.
10) To understand collaborative text editing.
11) To understand optimal play in sequential games like chess.
12) To formalize the notion of algorithm.
13) In the study of analogy.
14) As "a language for experimental design patterns" and "a new vocabulary in which to think and communicate."
15) In definitions of emergence and discussions of biology.
16) Generally speaking, there seems to be a cabal of radical category theorists, led by John Baez, who are reinterpreting anything interesting in category theoretic terms. (The trend reminds me of reinventing the wheel for the nth time in the nth newest programming language.)

II. FORMULATION OF FCM CATEGORY (F_C)

A. Objects

1) A collection of attributes /concepts /notes

(ie) Att (F_C)

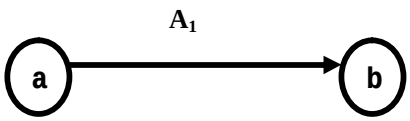
B. Morphism

1) A collection of Arrows /Relations (A)

(ie) Rel (F_C)

2) Each Arrows A has a source 'a' and target 'b' attribute

(ie) A: $a \rightarrow b$

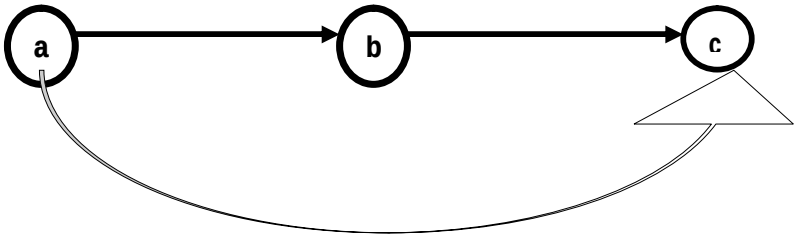


C. Compositions

1) If a, b and c are any three attributes then

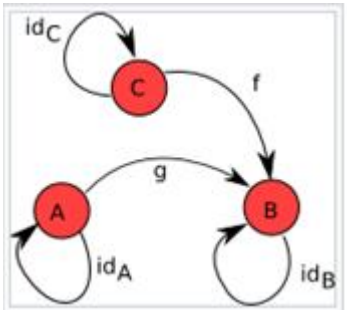
$\text{Rel}\ (a,b) \times \text{Rel}\ (b,c) \rightarrow \text{Rel}\ (a,c)$

this operation is written as composition of Arrows



D. Identity Morphism (ϕ_X)

1) every attributes (relation)X, there exist a morphism $\phi : X \rightarrow X$ is called the identity morphism for X such that for every morphism A : a $\rightarrow$ b, we have $\phi_a * A = A = \phi_b * A$.



III. OVER VIEW FCM CATEGORY (F_C)

A. Definition

A FCM Category (F_C) consist of the following entities /operations ,

1) A collection of attributes /concepts (ie) Att (F_C)
a) A collection of Arrows /Relation
b) (ie) Rel (F_C)
c) Each Arrows A has asource 'a' and target 'b' attribute
d) (ie) A: a $\rightarrow$ b(A is arrow from a to b)
2) If a, b and c are any three attributes then

Rel (a,b) $\times$ Rel (b,c) $\rightarrow$ Rel (a,c)

this operation is written as composition of Arrows

3) *Associatively of (F_C):* A_3 composite to (A_1 composite to A_2) = (A_3 composite to A_1) to composite A_2
4) identity Morphism (ϕ_X):For every attributes (relation)X, there exist a morphism $\phi : X \rightarrow X$ is called the identity morphism for X such that for every morphism A : a $\rightarrow$ b,we have

$$\phi_a * A = A = \phi_b * A$$

IV. FUNCTORS

A functorF_f from a FCM Category X to a FCM Category Y, written $F_f : X \rightarrow Y$ consist of

1) for each attributes /concept a in X, an concept $F(a)$ in Y and\
2) for each morphism A : a $\rightarrow$ b in X, a morphism $F(X) : F(a) \rightarrow F(b)$
3) such that the following two properties hold :
4) identity
5) Morphisms

V. ADVANTAGES AND LIMITATIONS

Specification of FCM Category makes one to implement the mapping function between two different domains.This gives us more insight in the distinct scopesAll FCM data's can not exist with category structure. some of the FCM data'sexist.

VI. CONCLUTION

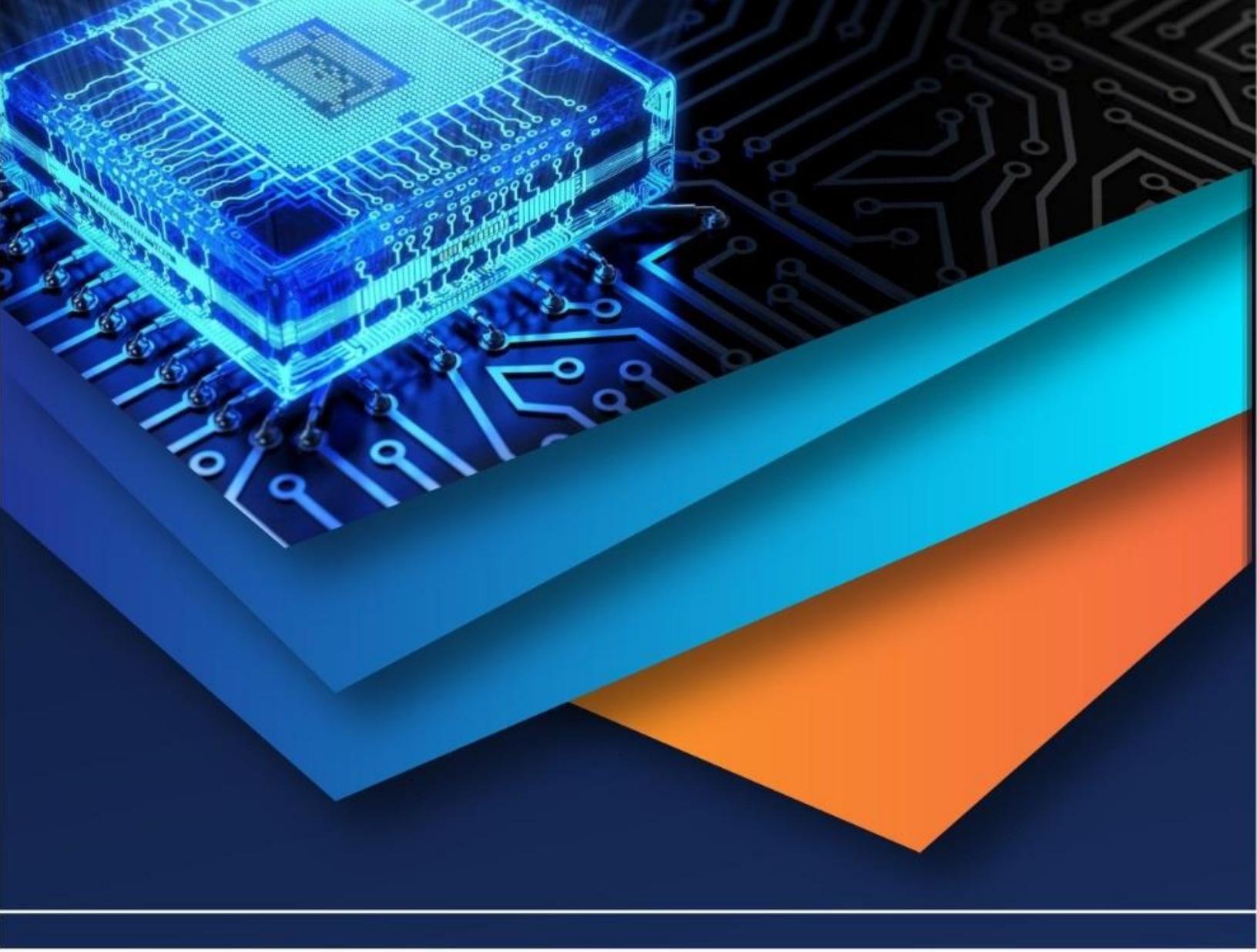
Hence we can map by a function from first category to another category successfully main aim of the functoris connect to these.

VII. ACKNOWLEDGEMENT

The authors would like to thank the arrangement of AMET University for its support and encouragement

REFERENCES

[1] Axelrod,R, Structure of decision. "The cognitive maps of political elites". Princeton University (1976).
[2] A.W. Roscoe. Understanding concurrent systems. Springer, London, United Kingdom, 2010.
[3] A.T. Sampson. Process-oriented patterns for concurrent software engineering. PhD thesis, University of Kent, Kent, United Kingdom, 2008.
[4] C.A.R. Hoare. Communicating sequential processes. Prentice-Hall, Englewood Cliffs, United States, 1985.
[5] Gonzalez, J., Castillo, O., Aguilar, L., Performance Analysis ofCognitive Map-Fuzzy Logic Controller Model for Adaptive Control Application, Proceedings of the 2008 IEEE World Congress oncomputational Intelligence, WCCI2008, Hong Kong, 2008, pp. 23752381.
[6] George J. klir/Bo Yuan, "Fuzzy Sets and Fuzzy logic(Theory and application)",PHI Learning Private limited 2010
[7] J.R. Kiniry and F. Fairmichael. Ensuring consistency between designs, documentation,formal specifications, and implementations. In Proceedings of 12th International Symposium on Component-Based Software Engineering, pages 242–261, 2009.
[8] Kosko,B."Fuzzy Cognitive Maps", International Journal of man-machine studies, Jan (1986).
[9] Kosko B, "Neural Networks and Fuzzy System", Prentice Hall of India (1997).
[10] Kosko,B. "Hidden patterns in Combined and adaptive Knowledge Networks" , International Conference of Neural Networks(ICNN-86) 377- 393,(1988).
[11] Kaufman. A; " Theory of Fuzzy Subsets",volume -1,1973.
[12] M. Zhu, P. Grogono, and O. Ormandjieva. Using category theory to verify implementation against design in concurrent systems. In The 6th International Conference on Ambient Systems, Networks and Technologies, pages 530–537, 2015.
[13] M. Zhu, P. Grogono, O. Ormandjieva, and P. Kamthan. Using category theory and data flow analysis for modeling and verifying properties ofcommunications in the process-oriented language erasmus. In Proceedings of the Seventh C* Conference on Computer Science and SoftwareEngineering, pages 24:1–24:4, 2014.
[14] P. Welch. Life of occam-pi. In Communicating Process Architectures 2013. Open Channel Publishing Ltd., 2013.
[15] P. Godefroid. Partial-order methods for the verification of concurrent systems: an approach to the state-explosion problem. Springer,Secaucus, United States, 1996.
[16] P. Grogono and B. Shearing. Concurrent software engineering: Preparing for paradigm shift. In Proceedings of the First C* Conference onComputer Science and Software Engineering, pages 99–108, 2008.
[17] Praveen Prakash.A,EstherJerlin J, BenniloFernande , "A Study on the causes for aversion to mathematics by engineering students using Fuzzy Cognitive Maps (FCMs)", International Journal of Innovative Research in Science, Engineering and Technology,ISSN: 2319-8753, Vol. 3, Issue 3, March 2014
[18] P. Grogono and N. Jafroodi. A fair protocol for non-deterministic message passing. In Proceedings of the Third C* Conference on Computer Science and Software Engineering, C3S2E '10, pages 53–58, 2010.
[19] SagayaBavia.M, J. Maria Roy Felix, K. Ponnivalavan, "Study on Disappearance of House Sparrow Using Induced Fuzzy Cognitive Maps (IFCMs)", International Journal of Computing Algorithm,Volume: 03, May 2014, Pages: 871-875
[20] VasanthaKandasamy .W.B and SmarandacheFlorentin, "Analysis of social aspects of migrant laborers living with HIV/AIDs using FuzzyTheory and Neutrosophic Cognitive Maps",Xiquan Phoenix.(2004).



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY