



A Study on Plithogenic Fuzzy Relational Mapping and Its Application in Python Program

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Abstract

In this research paper, we explore the notion of Plithogenic Fuzzy Relational Mapping (PFRM) and its applications. Plithogenic Fuzzy Relational Mapping concept is utilized as a logical procedure with a defined contradiction degree to evaluate multiple attributes. A Plithogenic fuzzy relational matrix is used as the adjacency matrix. Using Plithogenic fuzzy union and intersection operators, the resultant vector is calculated. The degree of contradiction for each attribute value with the dominating attribute gives a way to better accurate results. A case study has been taken and we have implemented the newly proposed idea. Python Program has been written using the algorithm proposed and we have obtained the result as well.

Keywords: PFRM, Fuzzy Relational Mapping; Plithogenic Cognitive Map; Plithogenic Fuzzy t – norm (union) and t – conorm (intersection) operators.

1. Introduction

R. Axelrod [1] in his book outlines a brand-new approach to the analysis of higher {cognitive process} supported "cognitive maps." A cognitive map may be a graphic illustration meant to capture the structure of a call maker's expressed beliefs a couple of explicit problem. Following introductory chapters that develop the idea and techniques of cognitive mapping, a group of 5 empirical studies applies these new techniques to 5 policy areas. In this study [2], they used the Induced Fuzzy Associative Memory (IFAM) model and the Fuzzy Associative Memory (FAM) model to investigate the effects of pollution in Sipcot Cuddalore. There are numerous similar clusters of polluting industries in India, one of which is the Sipcot Chemical Industrial Estate near Cuddalore. Chemical contamination posed a health risk to those who lived in and around the Sipcot Chemical Industrial Estate. We came to our conclusions and advised some corrective actions based on our analysis. In this work [3], neural networks and fuzzy systems are combined. Neural networks are presented as trainable dynamical systems, and techniques and principles of adaptation, self-organization, convergence, and global stability are developed. It demonstrates how to use fuzzy set theory for adaptive control and how to create structured fuzzy systems using unsupervised neural approaches. It also includes the new geometric theory of fuzzy sets, systems, and related memories. In paper [4], dropouts are young children who enrol in school however leave before graduating the grade without transferring to another school for a reason other than death. It could be referred to as "dropouts." The dropout rate is the proportion of students who leave a programme during a given year out of all those who are enrolled in

that programme during that same year. There are many reasons why students leave school and claims of an increase in dropouts have come from many different places. Therefore, STRFCM&CETDM can be used to investigate the reasons why students drop out of school. The Pearson correlation coefficient between the ranking variable and Charles Spearman's coefficients, which are suitable for ordinal and continuous variables alike. With examples from the Holy Bible in [5], this research tries to thoroughly examine the many explanations for miracles using Modified Induced Fuzzy Relational Maps, a generalisation of Fuzzy Relational Maps. The text provides an overview of FRM and MIFRM along with a description of the issue and examples of MIFRM's use in numerous Bible miracles. The collected data is analysed to draw conclusions about the most crucial factor that, in various circumstances, triggers the release of miracles. In [6] & [7] pesticides and fertilisers are sprayed on farming areas and fields using agricultural aeroplanes. Across the world, agricultural aeroplanes are utilised for farming. By considering several criteria based on linguistic principles of their attributes, we are doing research on the rating of the finest agricultural aircraft performance. The linguistic parameterization is done with the aid of fuzzy relational mapping and dodecagonal fuzzy numbers. Analyzing the outcome can help you get the agricultural aircraft to work at its finest. In this work [8] membership functions, which have been categorised into triangular and trapezoidal shapes at various places in real numbers, are the foundation of fuzzy numbers. The decision data of human judgement with preference are frequently ambiguous in many real-life situations. Therefore, the conventional methods of using crisp values are insufficient. Fuzzy numbers, such as triangular and trapezoidal shapes, are inappropriate situations when doubts develop at various points. The ordering of fuzzy numbers is used in this study to provide a parametric technique, with the parameters being dodecagonal and octagonal normal uncertain numbers with a trapezoidal form. In [10], the concepts of Fuzzy Cognitive Maps (FCMs) and its Neutrosophic analogue, the Neutrosophic Cognitive Maps, are examined in this work (NCMs). Fuzzy Cognitive Maps are fuzzy structures that closely mimic neural networks, and as a mathematical tool for modelling complex systems, they have significant and far-reaching implications. Neutrosophic Cognitive Maps are generalisations of FCMs, and they distinguish themselves by being able to handle ambiguity in the relationships between concepts, increasing the sensitivity of the results. In this book, we've explained a variety of FCM and NCM applications, including modelling supervisory systems, creating hybrid models for complex systems, using mobile robots and in-office plants as intimate technology, analysing business performance assessment, the formalism debate, and legal regulations. In this paper [11] numerous mathematical instruments, including Crisp, Fuzzy, Intuitionistic Fuzzy Sets, and Neutrosophic Sets, are available to gauge the degree of precision. A generalisation of these four sets is the Plithogenic set. The purpose of this study is to determine whether Plithogenic aggregation procedure is superior to other sets in terms of accuracy and decision-making. The Plithogenic aggregation process, such as Fuzzy set [FS], Intuitionistic fuzzy set [IFS], and Neutrosophic set [NS], uses t_{norm} and t_{conorm} to achieve greater precision. This study examines an example to demonstrate the benefit of utilising plithogenic aggregation operators in decision making.

2. Discussion

The concept of Plithogeny has awakened the minds of the researchers and academicians in a wide way. It has made them to extend their ideologies and concepts to reach the next level in terms of diminishing vagueness and ambiguity. Also, there are many research studies going on to prove that Plithogenic concept gives better results with fuzzy, intuitionistic fuzzy and neutrosophic numbers. So, to achieve better results, we have explored the concept of Plithogenic Fuzzy Relational Mapping to rank the cricket players.

Plithogenic Fuzzy Relational Map Methodology for the MCDM problem and the following steps need to be followed to find the hidden chain by using PFRM

Step 1: $P_1, P_2, P_3, \dots, P_{11}$ are the attributes of the given players which is taken as the decision matrix.

Step 2: From the cricinfo website, the value of the attributes is taken. Linguistic scale is set up for the attribute values and the connection matrix is obtained using dodecagonal fuzzy number.

Step 3: The dodecagonal fuzzy number is defuzzified using score function to convert it into a crisp value. The linguistic values are entered in the connection matrix table with the defuzzified value obtained.

Step 4: The connection matrix is represented using dodecagonal fuzzy number matrix and the process of finding the resultant vector is done using plithogenic fuzzy operators. We take each attribute to be in ON state and the remaining attributes to be in OFF state for each calculation.

Step 5: The instantaneous state vector $P = (1\ 0\ 0\ 0\ 0\ \dots\ 0)$ is arrived at the connection matrix followed by the operations of plithogenic fuzzy operators. In this suggested research work, the value 0 is assigned to all values lesser than 0.5 and 1 is assigned to all values greater than 0.5.

Following are the plithogenic fuzzy operators,

$a \wedge_p b = (1 - c) \cdot \langle a \wedge_f b \rangle + c \cdot \langle a \vee_f b \rangle$, where c is the contradiction degree, $\langle a \wedge_f b \rangle$ is the tnorm operator given by ab and $\langle a \vee_f b \rangle$ is the t-conorm operator given by $a + b - ab$.

Step 6: The plithogenic threshold represents a modified resultant vector. This method is repeated until a fixed point is attained.

3. Definitions:

1. Plithogenic Fuzzy Relational Mapping

PFRM is a digraph integrating notion such as guidelines, occurrences etc. as vertex and causations as lines (boundaries). It indicates a causal happening between the notions.

2. Plithogenic Fuzzy Vertex

If the vertex of the FRM with contradiction degree be Plithogenic fuzzy sets, then they are called as Plithogenic fuzzy vertex.

3. Simple PFRM

Simple PFRMs are PFRMs with line weights from the set $(0, 1)$.

4. Connection Matrix

An PFRM, $R_1, R_2, R_3, \dots, R_n$ are the vertex and the connection matrix A is defined by Plithogenic weights of the vertex. A connection matrix is always a square matrix with a zerodiagonal entry.

5. ON & OFF position of an PFRM

Let $R_1, R_2, R_3, \dots, R_n$ be PFRM vertex. The instant position vector denotes $I = (i_1, i_2, i_3, \dots, i_n)$, such that $i_i \in \{0, 1\}$ and it describes the position of the vertex at an instant and if $i_i = 1$ represents on-position and $i_i = 0$ off-position respectively. The important vertex in the instant position vector is the on-position vertex, and the others are off-position vertex.

6. Simple Directed Cycle of an PFRM

Let $R_1, R_2, R_3, \dots, R_n$ be the vertex of PFRM. Let the length of vertex be the branch of PFRM ($i \neq j$). Then the branch constructs a simple directed cycle.

7. Feedback of an PFRM

PFRM obtained cycle is said to be feedback of a PFRM.

8. Dynamical System of an PFRM

The PFRM is called a dynamical system when it has feedback in a unique manner.

9. Hidden Pattern

This dynamical system obtains equilibrium state vector called as hidden pattern and the hidden pattern is also known as the fixed point if it is a unique position vector.

10. Limit Cycle

The equilibrium $I_1 \rightarrow I_2 \rightarrow I_3 \rightarrow I_4 \dots \dots \rightarrow I_i \rightarrow I_1$ called a limit cycle if the PFRM resolves down with a state vector replicating in the form.

11. PFRM (Plithogenic Fuzzy Relational Mapping)

Let $R_1, R_2, R_3, \dots, R_n$ be various characteristics of the related problem. The number of characteristics is very large and should be non-prime. These n characteristics are divided into groups by the expert's opinion in the directed graph. The divided groups should be a square matrix, with distinct

attributes for each group. In the plithogenic fuzzy relational map, the connection matrix of groups in a directed cycle is assigned by a linguistic variable. Then all the disjoint blocks are combined into a single plithogenic connection matrix, which is called a plithogenic fuzzy relational map.

Plithogenic aggregation operators

Let P be a plithogenic fuzzy set and its elements characterized by attributes of value. Let A be an attribute value, then $a \in A$. The most important attribute value is called the dominant attribute, which is identified by experts.

The linear combination of the fuzzy $t_{norm} (\wedge_F)$ and $t_{conorm} (\vee_F)$ aggregation operators generate plithogenic aggregation operators.

$$u \wedge_F v = (1 - c_0)[u \wedge v] + c_0 [u \vee_F v]$$

Where the fuzzy t-norm - $u \wedge v = u \cdot v$ Fuzzy t-conorm - $u \vee_F v = u + v - uv$

Definition

Let $R_1, R_2, R_3, \dots, R_n$ be the vertex of PFRM and B be the connection matrix of the vertex and the respective instant vector is $I = (i_1, i_2, i_3, \dots, i_n)$, Let the expert ascertain a dominant attribute which is on-position, and the other attribute is off-position. The R_1 be on vector then the instant vector $I = (1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)$. The plithogenic aggregation operators are used to multiply the instant vector into connection matrix B, then the new instant vector is IB, and modified by the plithogenic threshold operations. In this threshold operation, assign the value 1 if the value is larger than 0.5. and assign value 0, if it is less than 1 in the instant vector IB.

4. Practical Example

A. The Neutrosophic Context of the Problem

Now, we analyse the problems factors of ranking of IPL batsmen using PFRM. By using the linguistic scale and the expert’s opinion, we have taken the following 11 attributes as a problem that impact the performance of the players.

- P_1 – Matches
- P_2 – Innings
- P_3 – Not Out (NO)
- P_4 – Runs Scored
- P_5 – Highest Score (HS)
- P_6 – Balls Faced (BF)
- P_7 – Strike Rat (SR)
- P_8 – No. of 100s
- P_9 – No. of 50s
- P_{10} – No. of 4s
- P_{11} – No. of 6s

Linguistic Values of the Dodecagonal Fuzzy Number:

The linguistic values of the dodecagonal fuzzy number are taken as follows:

Linguistic Variable	Dodecagonal fuzzy number
Very Low	(0.02,0.04,0.06,0.08,0.10,0.12,0.14,0.16,0.18,0.20,0.22,0.24)
Low	(0.22,0.24,0.26,0.28,0.30,0.32,0.34,0.36,0.38,0.40,0.42,0.44)
Medium	(0.42,0.44,0.46,0.48,0.50,0.52,0.54,0.56,0.58,0.60,0.62,0.64)
High	(0.62,0.64,0.66,0.68,0.70,0.72,0.74,0.76,0.78,0.80,0.82,0.84)
Very High	(0.78,0.80,0.82,0.84,0.86,0.88,0.90,0.92,0.94,0.96,0.98,1)

Step 1: Attributes of the cricket players from the espn cric info website

S.No	Names	Mat	Inns	NO	Runs	HS	Ave	BF	SR	100s	50s	4s	6s
1	Sanju Samson	181	175	16	4343	119	27.31	3338	130.1	3	25	338	187
2	KS Williamson	206	197	31	5291	101	31.87	4214	125.55	1	38	491	134
3	Quinton de Kock	219	213	16	6598	126	33.49	4755	138.75	4	39	682	263
4	Manish Pandey	262	239	55	5944	129	32.3	4764	124.76	3	32	494	183
5	Jos Butler	292	270	47	7066	124	31.68	4915	143.76	1	49	617	296
6	Shikar Dhawan	295	292	30	8568	106	32.7	6844	125.18	2	63	967	192
7	DA Warner	304	303	38	10017	135	37.79	7114	140.8	8	82	973	379
8	Virat Kohli	311	296	58	9929	113	41.71	7412	133.95	5	72	879	315
9	SK Raina	331	314	49	8617	126	32.51	6265	137.54	4	53	775	324
10	AB de Villers	332	312	65	9318	133	37.72	6192	150.48	4	69	746	430
11	MS Dhoni	338	299	122	6858	84	38.74	5084	134.89	0	27	471	303
12	Rohit Sharma	350	337	47	9315	118	32.12	6981	133.43	6	65	815	397
13	AD Russell	368	313	80	6225	121	26.71	3669	169.66	2	24	424	493
14	Chris Gayle	436	428	51	14084	175	37.35	9642	146.06	22	87	1085	1032
15	KA Pollard	549	487	143	10898	104	31.68	7130	152.84	1	54	689	734

Step 2: Converted defuzzified crisp value table

Linguistic Variable	Dodecagonal fuzzy number	Crisp value
Very Low	(0.02,0.04,0.06,0.08,0.10,0.12,0.14,0.16,0.18,0.20,0.22,0.24)	0.13
Low	(0.22,0.24,0.26,0.28,0.30,0.32,0.34,0.36,0.38,0.40,0.42,0.44)	0.33
Medium	(0.42,0.44,0.46,0.48,0.50,0.52,0.54,0.56,0.58,0.60,0.62,0.64)	0.53
High	(0.62,0.64,0.66,0.68,0.70,0.72,0.74,0.76,0.78,0.80,0.82,0.84)	0.73
Very High	(0.78,0.80,0.82,0.84,0.86,0.88,0.90,0.92,0.94,0.96,0.98,1)	0.89

Linguistic Values of the Dodecagonal Fuzzy Nodes:

Names	Mat	Inns	NO	Runs	HS	BF	SR	100s	50s	4s	6s
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Sanju Samson	VL	VL	VL	VL	M	VL	L	M	VL	VL	VL
KS Williamson	VL	VL	L	VL	VL	VL	VL	VL	L	L	VL
Quinton de Kock	VL	VL	VL	L	H	L	M	H	L	M	L
Manish Pandey	L	L	H	VL	H	L	VL	M	L	L	VL
Jos Butler	L	L	L	M	M	L	H	VL	M	L	L
Shikar Dhawan	L	L	VL	M	L	H	VL	L	H	VH	L
DA Warner	M	M	L	VH	VH	H	H	VH	VH	VH	H
Virat Kohli	M	M	H	H	L	VH	L	H	VH	H	M
SK Raina	M	M	M	M	H	M	M	M	M	H	M
AB de Villers	H	H	H	H	VH	M	VH	H	H	M	H
MS Dhoni	H	H	VH	L	VL	M	M	VL	VL	VL	M
Rohit Sharma	H	H	M	H	L	H	L	VH	H	H	H
AD Russell	VH	VH	VH	L	M	VL	VH	L	VL	VL	VH
Chris Gayle	VH	VH	M	VH	VH	VH	H	VH	VH	VH	VH
KA Pollard	VH	VH	VH	VH	VL	VH	VH	L	M	M	VH

Step 4:

Names	Mat	Inns	NO	Runs	HS	BF	SR	100s	50s	4s	6s
Sanju Samson	0.1 3	0.13	0.13	0.13	0.53	0.13	0.33	0.5 3	0.13	0.13	0.13
KS Williamson	0.1 3	0.13	0.33	0.13	0.13	0.13	0.13	0.1 3	0.33	0.33	0.13
Quinton de Kock	0.1 3	0.13	0.13	0.33	0.73	0.33	0.53	0.7 3	0.33	0.53	0.33
Manish Pandey	0.3 3	0.33	0.73	0.13	0.73	0.33	0.13	0.5 3	0.33	0.33	0.13
Jos Butler	0.3 3	0.33	0.33	0.53	0.53	0.33	0.73	0.1 3	0.53	0.33	0.33
Shikar Dhawan	0.3 3	0.33	0.13	0.53	0.33	0.73	0.13	0.3 3	0.73	0.89	0.33
DA Warner	0.5 3	0.53	0.33	0.89	0.89	0.73	0.73	0.8 9	0.89	0.89	0.73
Virat Kohli	0.5 3	0.53	0.73	0.73	0.33	0.89	0.33	0.7 3	0.89	0.73	0.53
SK Raina	0.5 3	0.53	0.53	0.53	0.73	0.53	0.53	0.5 3	0.53	0.73	0.53
AB de Villers	0.7 3	0.73	0.73	0.73	0.89	0.53	0.89	0.7 3	0.73	0.53	0.73
MS Dhoni	0.7 3	0.73	0.89	0.33	0.13	0.53	0.53	0.1 3	0.13	0.13	0.53

Rohit Sharma	0.73	0.73	0.53	0.73	0.33	0.73	0.33	0.89	0.73	0.73	0.73
AD Russell	0.89	0.89	0.89	0.33	0.53	0.13	0.89	0.33	0.13	0.13	0.89
Chris Gayle	0.89	0.89	0.53	0.89	0.89	0.89	0.73	0.89	0.89	0.89	0.89
KA Pollard	0.89	0.89	0.89	0.89	0.13	0.89	0.89	0.33	0.53	0.53	0.89

Step 5:

(1000000000000000)

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
1	0.13	1.000	0.13	0.000	1	0.130
0	0.13	0.933	0	0.067	0.13	0.009
0	0.13	0.867	0	0.133	0.13	0.017
0	0.33	0.800	0	0.200	0.33	0.066
0	0.33	0.733	0	0.267	0.33	0.088
0	0.33	0.667	0	0.333	0.33	0.110
0	0.53	0.600	0	0.400	0.53	0.212
0	0.53	0.533	0	0.467	0.53	0.247
0	0.53	0.467	0	0.533	0.53	0.283
0	0.73	0.400	0	0.600	0.73	0.438
0	0.73	0.333	0	0.667	0.73	0.487
0	0.73	0.267	0	0.733	0.73	0.535
0	0.89	0.200	0	0.800	0.89	0.712
0	0.89	0.133	0	0.867	0.89	0.771
0	0.89	0.067	0	0.933	0.89	0.831
						0.831

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
1	0.13	1.000	0.13	0.000	1	0.130
1	0.13	0.933	0.13	0.067	1	0.188
1	0.13	0.867	0.13	0.133	1	0.246
1	0.33	0.800	0.33	0.200	1	0.464
1	0.33	0.733	0.33	0.267	1	0.509
1	0.33	0.667	0.33	0.333	1	0.553
1	0.53	0.600	0.53	0.400	1	0.718
1	0.53	0.533	0.53	0.467	1	0.749
1	0.53	0.467	0.53	0.533	1	0.781

1	0.73	0.400	0.73	0.600	1	0.892
1	0.73	0.333	0.73	0.667	1	0.910
1	0.73	0.267	0.73	0.733	1	0.928
1	0.89	0.200	0.89	0.800	1	0.978
1	0.89	0.133	0.89	0.867	1	0.985
1	0.89	0.067	0.89	0.933	1	0.993
						0.993

(010000000000000)

A	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
0	0.13	0.933	0	0.067	0.13	0.009
1	0.13	1.000	0.13	0.000	1	0.130
0	0.13	0.867	0	0.133	0.13	0.017
0	0.33	0.800	0	0.200	0.33	0.066
0	0.33	0.733	0	0.267	0.33	0.088
0	0.33	0.667	0	0.333	0.33	0.110
0	0.53	0.600	0	0.400	0.53	0.212
0	0.53	0.533	0	0.467	0.53	0.247
0	0.53	0.467	0	0.533	0.53	0.283
0	0.73	0.400	0	0.600	0.73	0.438
0	0.73	0.333	0	0.667	0.73	0.487
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0	0.89	0.200	0	0.800	0.89	0.712
0	0.89	0.133	0	0.867	0.89	0.771
0	0.89	0.067	0	0.933	0.89	0.831
						0.831

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
1	0.13	0.933	0.13	0.067	1	0.188
1	0.13	1.000	0.13	0.000	1	0.130
1	0.13	0.867	0.13	0.133	1	0.246
1	0.33	0.800	0.33	0.200	1	0.464
1	0.33	0.733	0.33	0.267	1	0.509
1	0.33	0.667	0.33	0.333	1	0.553
1	0.53	0.600	0.53	0.400	1	0.718

1	0.53	0.533	0.53	0.467	1	0.749
1	0.53	0.467	0.53	0.533	1	0.781
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1	0.89	0.200	0.89	0.800	1	0.978
1	0.89	0.133	0.89	0.867	1	0.985
1	0.89	0.067	0.89	0.933	1	0.993
						0.993

(0010000000000000)

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
0	0.13	1.000	0	0.067	0.13	0.009
0	0.13	0.933	0	0.133	0.13	0.017
1	0.13	0.867	0.13	0.000	1	0.113
0	0.33	0.800	0	0.200	0.33	0.066
0	0.33	0.733	0	0.267	0.33	0.088
0	0.33	0.667	0	0.333	0.33	0.110
0	0.53	0.600	0	0.400	0.53	0.212
0	0.53	0.533	0	0.467	0.53	0.247
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0	0.73	0.333	0	0.667	0.73	0.487
0	0.73	0.267	0	0.733	0.73	0.535
0	0.89	0.200	0	0.800	0.89	0.712
0	0.89	0.133	0	0.867	0.89	0.771
0	0.89	0.067	0	0.933	0.89	0.831
						0.831

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
1	0.13	1.000	0.13	0.067	1	0.197
1	0.13	0.933	0.13	0.133	1	0.255
1	0.13	0.867	0.13	0.000	1	0.113
1	0.33	0.800	0.33	0.200	1	0.464
1	0.33	0.733	0.33	0.267	1	0.509

1	0.33	0.667	0.33	0.333	1	0.553
1	0.53	0.600	0.53	0.400	1	0.718
1	0.53	0.533	0.53	0.467	1	0.749
1	0.53	0.467	0.53	0.533	1	0.781
1	0.73	0.400	0.73	0.600	1	0.892
1	0.73	0.333	0.73	0.667	1	0.910
1	0.73	0.267	0.73	0.733	1	0.928
1	0.89	0.200	0.89	0.800	1	0.978
1	0.89	0.133	0.89	0.867	1	0.985
1	0.89	0.067	0.89	0.933	1	0.993
						0.993

(00010000000000)

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
0	0.13	0.933	0	0.067	0.13	0.009
0	0.13	0.867	0	0.133	0.13	0.017
0	0.13	0.800	0	0.200	0.13	0.026
1	0.33	1.000	0.33	0.000	1	0.330
0	0.33	0.733	0	0.267	0.33	0.088
0	0.33	0.667	0	0.333	0.33	0.110
0	0.53	0.600	0	0.400	0.53	0.212
0	0.53	0.533	0	0.467	0.53	0.247
0	0.53	0.467	0	0.533	0.53	0.283
0	0.73	0.400	0	0.600	0.73	0.438
0	0.73	0.333	0	0.667	0.73	0.487
0	0.73	0.267	0	0.733	0.73	0.535
0	0.89	0.200	0	0.800	0.89	0.712
0	0.89	0.133	0	0.867	0.89	0.771
0	0.89	0.067	0	0.933	0.89	0.831
						0.831

a	b	1-c	ab	c	a+b-ab	(1-c).(a^b)+c.(avb)
1	0.13	0.933	0.13	0.067	1	0.188
1	0.13	0.867	0.13	0.133	1	0.246
1	0.13	0.800	0.13	0.200	1	0.304

1	0.33	1.000	0.33	0.000	1	0.330
1	0.33	0.733	0.33	0.267	1	0.509
1	0.33	0.667	0.33	0.333	1	0.553
1	0.53	0.600	0.53	0.400	1	0.718
1	0.53	0.533	0.53	0.467	1	0.749
1	0.53	0.467	0.53	0.533	1	0.781
1	0.73	0.400	0.73	0.600	1	0.892
1	0.73	0.333	0.73	0.667	1	0.910
1	0.73	0.267	0.73	0.733	1	0.928
1	0.89	0.200	0.89	0.800	1	0.978
1	0.89	0.133	0.89	0.867	1	0.985
1	0.89	0.067	0.89	0.933	1	0.993
						0.993

Similarly, the values for the remaining instantaneous state vectors can be calculated using the proposed procedure.

Step 6:

Values	Names	Average	Ranking
(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	Chris Gayle	16.0156	1
(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	KA Pollard	15.87166667	2
(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)	Rohit Sharma	14.7728	3
(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)	AD Russell	14.67766667	4
(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)	AB de Villers	14.58866667	5
(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)	DA Warner	13.8666	6
(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)	Virat Kohli	13.26	7
(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)	MS Dhoni	13.1466	8
(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)	SK Raina	13.0974	9
(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)	Shikar Dhawan	10.4556	10
(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)	Jos Butler	9.5358	11
(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)	Manish Pandey	8.507733333	12
(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)	Quinton de Kock	8.150333333	13
(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)	KS Williamson	4.6596	14
(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	Sanju Samson	4.444866667	15

5. Conclusion

The paper has been dealt with the information taken in the database given in the ESPN CRIC info website. The concentration is focused only on the batsmen who are involved in IPL. The performance values of the batsmen are taken and have found the ranking of the players using Plithogenic fuzzy union

and fuzzy intersection operators which helps us to consider the all the values which gives an overall performance analysis.

In future, academicians and mathematicians can apply the concept of Plithogenic Fuzzy Relational Mapping in various fields like image processing, fuzzy clustering, data analytics, data recognition, pattern recognition, prediction using different mathematical models and so on. Also, the same concept can be applied to various other sports to find the best players. The same operations can be applied to the bowlers as well and will be able to find the best bowler for an IPL team. The concept can be applied to do a detailed analysis on any sports players which thereby helps them to identify the best player for the team. It will be having a major role in the sports arena.

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Appendix:

Python program:

```
import math
import numpy as np
```

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```

import csv
import collections
#IMPORTED REQUIRED LIBRARY

def calculate(array):
    array_len = int(len(array))
    temp = np.zeros((15,11)) #Temporary array for current result
    result = np.zeros((15,11)) #Final Array for aggregated result
    exp=len(array) - 1 #exponent for 2
    col = int((array.size)/(array_len)) #Total number of column

    #Exponent Traverse for 2
    for pointer in range(array_len-1,-1,-1):
        #Traversing Column one by one
        for column in range(0,col) :
            binRep = pow(2,pointer) #Binary Representation
            iter1 = array_len-1
            numerator = 1 #Numerator for C
            max = 0
            #Traversing Rows
            for row in range(0,array_len):
                if max > 0.5:
                    break
                a=0.0
                c = numerator/array_len
                if ((binRep & (1<<iter1))!=0 ):
                    a=1.0
                    c=0
                else :
                    numerator+=1
                b = array[row,column]
                ab = a*b
                step1 = 1 - c
                step2 = a+b
                avg = step2 - ab
                ans = (step1 * (ab)) + (c * (avg))
                #print(a,b,c,ab,step1,avg,ans)
                #value = result[row,column] + ans
                if ans > max :
                    max = ans
                temp[row,column] = ans
                iter1-=1
            if max > 0.5:
                iter1 = array_len-1
                numerator = 1
                a=1.0
                for row in range(0,array_len):
                    c = numerator/array_len
                    if ((binRep & (1<<iter1))!=0 ):
                        c=0
                    else :
                        numerator+=1
                    b = array[row,column]
                    ab = a*b
                    step1 = 1 - c
                    step2 = a+b
                    avg = step2 - ab
                    ans = (step1 * (ab)) + (c * (avg))
                    temp[row,column] = ans
                    iter1-=1

```

```
#MAKE NEW INDIVIUAL FILE FOR EACH BINARY
```

```
    # name = array_len-pointer
    # f = open(str(name)+''.csv','w')
    # writer = csv.writer(f)
    # writer.writerows(temp)
    # f.close
    #MAKE in copy to another array
    for row in range(0,array_len):
        for column in range(0,col):
            result[row,column] += temp[row,column]
    return result
```

```
def aggregateSorting(array):
```

```
    #SORTING THE ARRAY
    nameList = open('namemap.csv','r')
    readedNames = nameList.read()
    names_value = readedNames.split('\n')
    nameList.close
    points_key = list()
    column = int(array.size/len(array))
    for row in range(0,len(array)):
        total = 0
        for col in range(0,column):
            total += array[row,col]
        avg = total/col
        #print(total)
        points_key.append(avg)
    result = dict(zip(points_key,names_value))
```

```
rankList = sorted(result)
```

```
outputFile = open('output.csv','w',newline='')
writer = csv.writer(outputFile)
#MAKING A NEW OUTPUT FILE
for key in range(len(rankList)-1,-1,-1):
    temp = [result[rankList[key]],rankList[key]]
    print(temp)
    writer.writerow(temp)
outputFile.close
#END OF FUNCTION
```

```
def createFile_makeArray():
```

```
    sruc = np.zeros((15,11))
    fs1 = open('src.csv','r')
    var1 = fs1.read()
    temp = var1.split('\n')
    for row,rcontent in enumerate(temp) :
        temp2 = rcontent.split(',')
        for col,ccontent in enumerate(temp2):
            sruc[row,col] = float(ccontent)
    #calculate(sruc)
    fs1.close
```

```
    return sruc
```

```
if __name__ == '__main__':
    array = createFile_makeArray()
    calculated = calculate(array)
```

```
#print(calculated)
print('Displaying Players Rank')
aggregateSorting(calculated)
```