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Intuitionistic Plithogenic graph and it's $\{d_{(\alpha_1,\alpha_2)}, c_\beta\}$ -cut for knowledge processing tasks

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Abstract: Recently, properties of single-valued Plithogenic set is introduced for dealing with several opposite, non-opposite and neutral side of a multi-valued attribute. In this case, a problem arises due to conflict among the experts and their opinions. It is an indeed problem while dealing with single-valued Plithogenic membership. The reason is to deal with conflict or contradictions membership and non-membership values required. To deal with this problem intuitionistic Plithogenic context and its graphical structure visualization is introduced in this paper. In addition, $\{d_{(\alpha_1,\alpha_2)}, c_\beta\}$ -cut is introduced for dealing with intuitionistic degree of appurtenance and contradiction for multi-decision process.

Keywords: Knowledge representation; Neutrosophic set; Plithogenic set; Plithogenic graph; Intuitionistic fuzzy set; Multi-granulation

1. Introduction

Recently, properties of Plithogenic set are introduced for dealing with several opposite and non-opposite or indeterminant conditions [1]. It is considered one of the useful set to deal with dark data like doctor's prescription, sports analytics and other fields [2]. In this process, a problem arises while dealing with vague attributes. One of the suitable examples is a cricket match in which several times people intuition changes towards win, draw or loss of an India-Pakistan match [3]. It used to observe in a democratic country like India where people intuition changes several time towards or

against the given leader [4]. Same time the prescription of one doctor differ from other doctors while disease and symptoms is also same [5]. It creates contradiction in human intuition while preference analysis for multi-decision process in case of bipolarity [6]. In this case, the first problem arises while representing these types of vague attributes as addressed recently [7-8]. Another problem arises while processing the contradiction among human intuition at given multi-granulation to take a conclusive decision [9]. To tackle this problem current paper focused on dealing with intuitionistic Plithogenic set based context and its zoom in and zoom out at user defined granules for the knowledge discovery tasks.

Recently, some of the authors paid attention towards data with intuitionistic Plithogenic attributes [10-11] and its extensive properties [12-13] for multi-decision process at different granulation [15]. The problem arises while visualization of intuitionistic Plithogenic attributes [16-17] as discussed recently [18-19]. Motivated from these studies current paper put forward effort for dealing data with intuitionistic Plithogenic set, its graphical visualization. In addition, another method is proposed to refine the intuitionistic Plithogenic context at defined Plithogenic granules $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$. The goal is to find some hidden pattern in data with intuitionistic Plithogenic set based on its defined degree of appurtenance and contradiction as shown in Figure 1.

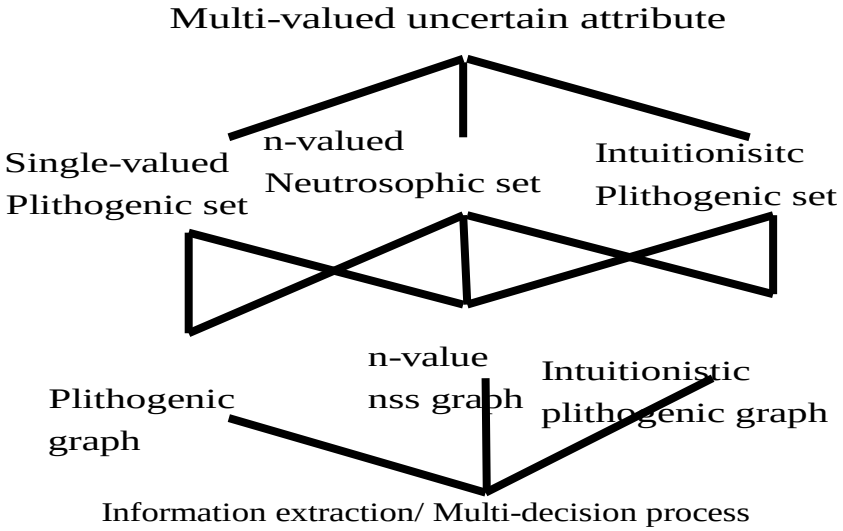

Figure 1: The graphical objective of this paper

The motivation of is to deal with opposite and non-opposite side of intuitionistic attributes for multi-decision process. The objective is to find some useful pattern in intuitionistic Plithogenic context for decision making process. One of the significant outcomes of the proposed method is that it provides a way to deal with contradiction degrees exists in intuitionistic Plithogenic set for conflict analysis.

Rest of the paper is constituted as follows: Section 2 provides basic background about Plithogenic set for data representation. Section 3 provides the proposed method for handling intuitionistic Plithogenic context for knowledge discovery and representation tasks with its illustration in Section 4. Section 5 contains conclusions followed by acknowledgements and references.

2. Data with Plithogenic Set

This section provides preliminaries about Plithogenic set and its examples for understanding of intuitionistic Plithogenic set:

Definition 1. Plithogenic Set [1-2]: This set contains five parts to represents the multi-valued attributes of the given data sets. Let us suppose,ξbe a universe of discourse, P be a subset of this universe of discourse, "a" a multi-valued attribute, V is the range of the multi-valued attribute, "d" be the known (fuzzy, intuitionistic fuzzy, or neutrosophic) degree of appurtenance with regard to some generic of element x's attribute value to the set P, and c is the (fuzzy, intuitionistic fuzzy, neutrosophic) degree of contradiction (dissimilarity) among the attribute values as (<A, Neutral A, Anti A>; <B, Neutral B, Anti B>; <C, Neutral C, Anti C>). It can be represented as a set (P, a, V, d, c)which named as a Plithogenic Set (**P**). The Plithogenic set is a set **P**(P, a, V, d, c) in which each element $x \in P$ is characterized by all attribute's (a) values in $V = \{v_1, v_2, \ldots, v_n\}$, for $n \geq 1$ for the degree of appurtenance (d). The contradiction degree function (c) distinct the Plithogenic set from all of the above set. It represents the between the attribute values in form of fuzzy t-norm and fuzzy t-conorm as:

(i)c: $V \times V \rightarrow [0, 1]$represents the contradiction degree function among $v_1$and v_2.

It used be noted as $c(v_1, v_2)$, and satisfies the following axioms:

(ii) $c(v_1, v_1) = 0$ *i.e.* the contradiction among v_1 and $v_2$is zero.

(iii) $c(v_1, v_2) = c(v_2, v_1)$,the contradiction among v_1 and v_2 or v_2 and v_1 used to be considered as per the commutative properties. In this paper author focuses on single-valued fuzzy membership to handle the Plithogenic set.

Example 1: Let us suppose, two experts or commentator (y_1) and (y_2) given an opinion towards the player (x_1). The expert (y_1)agreed that player (x_1) is 60 percent suitable TEST match whereas expert (y_2) agreed on 70 percent with zero contradiction. The expert (y_1)agreed that player (x_1) is 20 percent suitable for one day match whereas the expert (y_2) agreed on 40 percent which created $\frac{1}{3}$ contradiction. The expert (y_1) agreed that player (x_1) is 70 percent suitable for T20 match whereas the expert (y_2) agreed 60 percent which created $\frac{2}{3}$ contraction on this attribute. The reason given by expert (y_1) that player (x_1) is consistent at 80 percent matches whereas the expert (y_2) agreed on it 60 percent without any contradiction. Another reason given by expert (y_1) that player (x_1) is consistent due to 50 percent suitable health conditions whereas expert (y_2) agreed 40 percent on this attribute with $\frac{1}{2}$ contradiction. This type of complex or large information can be written using the properties of Plithogenic set as shown in Table 1 and Table 2 The Table 1represents the opinion of expert 1 towards the player (x_1) whereas Table 2 represents opinion of expert 2 towards player (x_1). The union and intersection among expert opinion can be computed as given below.

Table 1: The expert (y_1) opinion towards a player (x_1)

Contradiction degree	0	$\frac{1}{3}$	$\frac{2}{3}$	0	$\frac{1}{2}$
Multi-attributes	TEST Player	ODI Player	T20 Player	*Consistent*	*Health*
Fuzzy degree	0.6	0.2	0.7	0.8	0.5

Table 2: The expert (y_2) opinion towards a player (x_1)

Contradiction degree	0	$\frac{1}{3}$	$\frac{2}{3}$	0	$\frac{1}{2}$
Multi-attributes	TEST Player	ODI Player	T20 Player	*Consistent*	*Health*
Fuzzy degree	0.7	0.4	0.6	0.6	0.4

Definition 2. Intersection of PlithogenicSet [1]: Let us suppose two Plithogenic set (P_1, P_2) then the intersection can be computed as follows:

$$d_{p_1}(a_p, v_p) \wedge d_{p_2}(a_p, v_p) = (1 - c_p) \times (d_{p_1}(a_p, v_p) \wedge_f d_{p_2}(a_p, v_p)) + c_p (d_{p_1}(a_p, v_p) \vee_f d_{p_2}(a_p, v_p))$$

where *dp* represents degree of appurtenance, $c_p$represents contradiction degrees for the multi-valued attributes a_p. Others are fuzzy t-norms to define the intersection.

Example 2: Let us suppose, the example shown in Table 1 and 2 to find the intersection using above defined Plithogenic operator. Table 3 represents the intersection of expert opinion shown in Table 1 and 2 using the above operations. It shows the Plithogenic degree that on what level both the expert are maximal common point convinced each other on the given contraction.

Table 3: Intersection of Table 1 and 2 using Plithogenic operator

Contradiction degree	0	$\frac{1}{3}$	$\frac{2}{3}$	0	$\frac{1}{2}$
Multi-attributes	TEST Player	ODI Player	T20 Player	*Consistent*	*Health*
$y_1 \wedge_x y_1$	0.42	0.23	0.73	0.48	0.45

Definition 3. Union of Plithogenic Set [1]: Let us suppose two Plithogenic set (P_1, P_2) then the union can be computed as follows:

$$d_{p_1}(a_p, v_p) \vee d_{p_2}(a_p, v_p) = (1 - c_p) \times (d_{p_1}(a_p, v_p) \vee_f d_{p_2}(a_p, v_p)) + c_p (d_{p_1}(a_p, v_p) \wedge_f d_{p_2}(a_p, v_p))$$

where *dp* represents degree of appurtenance, $c_p$represents contradiction degrees for the multi-valued attributes a_p. Others are fuzzy t-conorms to define the intersection.

Example 3: Let us suppose, the example shown in Table 1 and 2 to find the union using above defined Plithogenic operator. Table 4 represents the union of expert opinion shown in Table 1 and 2 using the above operations. It shows the Plithogenic degree that on what level both the expert convinced each other in the infimum way on the given contraction.

Table 4: Union of Table 1 and 2 using Plithogenic operator

Contradiction degree	0	$\frac{1}{3}$	$\frac{2}{3}$	0	$\frac{1}{2}$
Multi-attributes	TEST Player	ODI Player	T20 Player	*Consistent*	*Health*
$y_1 \vee_x y_1$	0.88	0.37	0.57	0.92	0.45

Definition 4. Complement of Plithogenic Set [1]: The complement can be computed as follows: $(d_p(a_p, v_p))' = (1 - c_p) \times d_p(a_p, v_p)$ where *dp* represents degree of appurtenance, c_p represents contradiction degrees for the multi-valued attributes a_p.In case of conflict or quanta information of human cognition can be represented using intuitionistic fuzzy set.

Definition 5: Intuitionistic Fuzzy Set [13-14]: The intuitionistic fuzzy set is a generalization of fuzzy set. It represents the acceptation, rejection part of any attributes simultaneously. The intuitionistic fuzzy set *A* can be defined by $A = \{x, \mu_X(x), \nu_X(x) / x \in X\}$ where

$\mu_A(x): E \to [0,1], \nu_A(x): E \to [0,1]$ for each $x \in E$ such that $0 \le \mu_A(x) + \nu_A(x) \le 1$. Here $\mu_A(x): E \to [0,1]$ denote degrees of membership and $\nu_A(x): E \to [0,1]$ denotes non-membership of x ∈ A, respectively.

Example 5: Let us suppose the above examples that an expert *(y_1)* gives opinion about a player *(x_1)* that the given player is 60 percent suitable for ODI whereas 30 percent not suitable based on his/her performance towards the given team. This type of data can be written using the Intuitionistic Plithogenic set as shown in Table 5.

Table 5: The expert (y_1) opinion towards a player (x_1) based on Intuitionistic set

Contradiction degree	0	$\frac{1}{3}$	$\frac{2}{3}$	0	$\frac{1}{2}$
Multi-attributes	ODI Player	TEST Player	T20 Player	*Consistent*	*Health*
Fuzzy degree	(0.6, 0.3)	(0.2, 0.6)	(0.7, 0.1)	(0.8, 0.1)	(0.5, 0.3)

It can be observed that, the Plithogenic set provides a chance to deal with multi-valued attributes and contradiction among expert opinion [15]. The problem arises when the expert agree or disagree for the same Plithogenic attribute in case of multi-decision process. It creates conflict among them. To deal with it based on membership and non-membership values the mathematics of intuitionistic fuzzy set is connected with Plithogenic set in this paper. Same time a new graph to visualize the data with intuitionistic Plithogenic context is introduced motivated from [4, 16]. Same

time another method is introduced to zoom in and zoom out the intuitionistic Plithogenic context based on defined neutrosophic multi-granulation motivated from [9, 15-18]. In the next section one of the methods is proposed for intuitionistic Plithogenic graph and its processing to deal with conflict analysis arises due to contradiction.

3. Proposed method:

In this section, two methods are proposed the first one focused on graphical structure visualization of intuitionistic Plithogenic attributes and another one focused on decomposition of intuitionistic Plithogenic context. The computation time for the proposed method is also discussed.

3.1 A method for processing data with Intuitionistic Plithogenic Attribute

Let us suppose any data set having Intuitionistic Plithogenic attribute and need to process for multi-decision tasks. It can be done as follows:

Step 1. Let us consider, data with Intuitionistic Plithogenic attributes. Try to represent them in contextual format as shown in Table 6.

Table 6: Data with Intuitionistic Plithogenic attributes and its context representation

Contradiction degree	c_1	c_2	…	c_k	c_{k+1}	…	c_m
Attribute values	a_1	a_2	…	a_k	a_{k+1}	…	a_m
a_1	$d_{1,1}(\mu,\nu)$	$d_{1,2}(\mu,\nu)$	…	$d_{1,k}(\mu,\nu)$	$d_{1,k+1}(\mu,\nu)$	…	$d_{1,m}(\mu,\nu)$
a_2	$d_{2,1}(\mu,\nu)$	$d_{2,2}(\mu,\nu)$	…	$d_{2,k}(\mu,\nu)$	$d_{2,k+1}(\mu,\nu)$	…	$d_{2,m}(\mu,\nu)$
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
a_n	$d_{n,1}(\mu,\nu)$	$d_{n,2}(\mu,\nu)$	…	$d_{n,k}(\mu,\nu)$	$d_{n,k+1}(\mu,\nu)$	…	$d_{n,m}(\mu,\nu)$

Step 2. Write all the Plithogenic attributesas(*P*,*a*,*V*,*d*,*c*), where *P* is a set, *a*is the set of multi-valued attributes, *V is* the defined range of the attributes, *d* is the intuitionistic set based degree of appurtenance and *c* is the single-valued degree of contradiction. It means the intuitionistic degree of appurtenance and its contradiction value for the given attribute can be determined with respect to the dominant value of the attribute.

Step 3. Let us consider the,Plithogenic graph G=$\left\{V_p, E_p, a_p, (\mu_{d_p}, \nu_{d_p}), c_p\right\}$ can be called as intuitionistic Plithogenic graph where(*Vp*)represents Intuitionistic Plithogenic attributes as vertex, (*Ep*) represents the intuitionistic Plithogenic set based edges, (a_p)represents the multi-valued i.e. one or more attributes of distinct values. The intuitionistic degree of appurtenance (*dp*) says that at what level the given multi-valued attributes belongs to the set or does not belongs to the set. The (c_p) represents the contradiction degrees as single-valued fuzzy membership.

Step 4. Write each of the vertexes using the Intuitionistic Plithogenic set as: $\frac{\left\{a_p,(\mu_{d_p},\nu_{d_p}),c_p\right\}}{V_p}$

where (a_p)represents multi-valued attributes defines theIntuitionistic Plithogenic vertex(Vp). The degree of appurtenance (dp) represents the belongingness and non-belongingness of multi-valued attributes via intuitionistic Plithogenic set. The contradiction degree is represented using single-valued fuzzy membership as (c_p).

Step 5. Write edges for each of the Plithogenic vertexes as: $\frac{\left\{a_{pq},(\mu_{d_{pq}},\nu_{d_{pq}}),c_{pq}\right\}}{E_{pq}(V_pV_q)}$ where (a_{pq}) represents one or more attributes which defines the Intuitionistic Plithogenic edges (E_{pq}). The degree of appurtenance (d_{pq}) represents the belongingness and non-belongingness of multi-valued edges with its single-valued contradiction degrees (c_{pq}) for the given edge.

Step 6. The contradiction among v_1 and v_2 (or v_2 and v_1) satisfies commutative property as follows: $c(v_1, v_2) = c(v_2, v_1)$. It means the Intuitionistic Plithogenic set based edges (E_{pq}) and (E_{qp}) represents same edge.

Step 7. The contradiction degrees $c(v_1, v_1) = 0$ due to which the edges can be edges can be represented as $(E_{pq} \subseteq V_p \times V_q - V_p \times V_p - V_q \times V_q)$.

Step 8. The computation of relations for the Intuitionistic Plithogenic graph and its edges can be computed using extensive properties of union and intersection of single-valued Plithogenic set as follows:

(a) Intersection of single-valued Plithogenic set as

$$d_{p_1}(a_p,v_p)\wedge d_{p_2}(a_p,v_p)=(1-c_p)\times(d_{p_1}(a_p,v_p)\wedge_f d_{p_2}(a_p,v_p))+c_p(d_{p_1}(a_p,v_p)\vee_f d_{p_2}(a_p,v_p))$$

(*b*) Union of single-valued Plithogenic set as

$$d_{p_1}(a_p,v_p)\vee d_{p_2}(a_p,v_p)=(1-c_p)\times(d_{p_1}(a_p,v_p)\vee_f d_{p_2}(a_p,v_p))+c_p(d_{p_1}(a_p,v_p)\wedge_f d_{p_2}(a_p,v_p))$$

In case of Intuitionistic Plithogenic sets degree of appurtenance can be represented as:

$V_1 = \left\{ v_1, \mu_{v_1}(x), \nu_{v_1}(x) / x \in X \right\}$ and $V_2 = \left\{ v_2, \mu_{v_2}(x), \nu_{v_2}(x) / x \in X \right\}$ he union and intersection can be computed as follows:

$(A).\ V_1 \vee_p V_2 = \left(\mu_{v_1} \vee_p \mu_{v_2}, \nu_{v_1} \wedge_p \nu_{v2} \right)$

$(B).\ V_1 \wedge_p V_2 = \left(\mu_{v_1} \wedge_p \mu_{v_2}, \nu_{v_1} \vee_p \nu_{v2} \right)$

Otherwise the relation can be as follows:

$$d_{p_1}(a_p, v_p) \wedge d_{p_2}(a_p, v_p) \geq (1 - c_p) \times (d_{p_1}(a_p, v_p) \wedge_f d_{p_2}(a_p, v_p)) + c_p (d_{p_1}(a_p, v_p) \vee_f d_{p_2}(a_p, v_p))$$

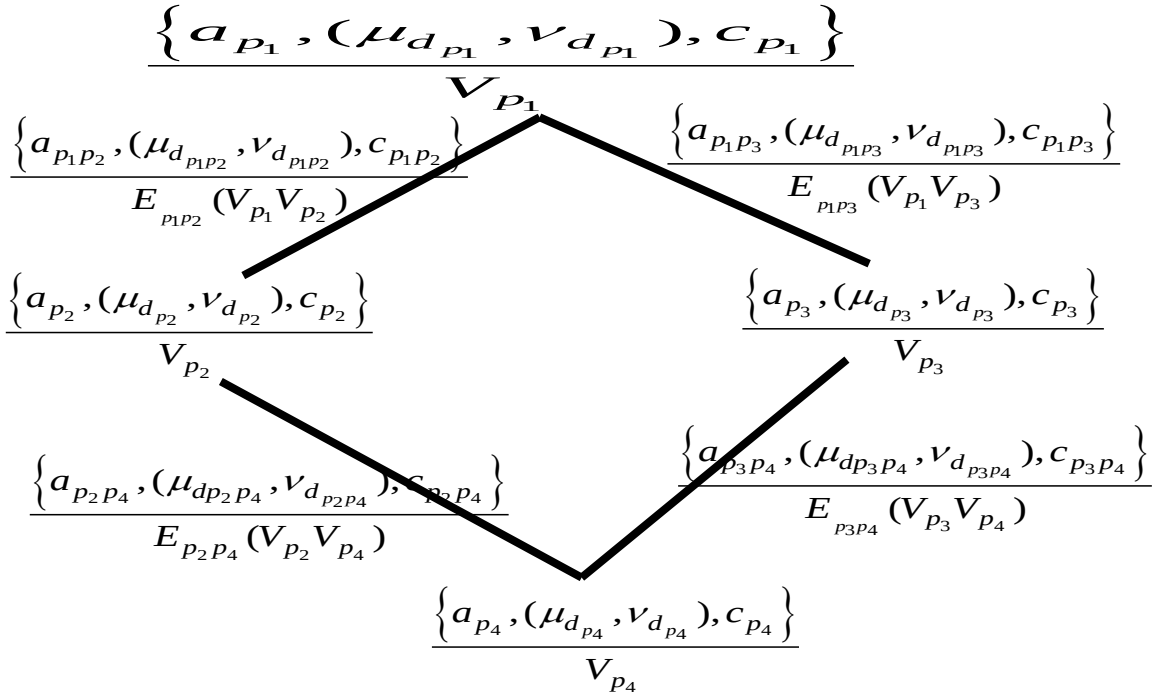

Figure 2. The graphical structure visualization of Plithogenic graph

Step 9. In this way, the data with Intuitionistic Plithogenic set can be analyzed. It can be visualized as Intuitionistic Plithogenic set of vertex and its edges as computed above.

Step 10. The Intuitionistic Plithogenic graph and its visualization is shown in Figure 2.

Step 11. In this way, the proposed method provides a visualization of data with Intuitionistic Plithogenic set which will help in adequate decision making process.

Time complexity: Let us suppose, there are *n*-number of Intuitionistic Plithogenic attribute in the given data set with *m*-number of multi-valued appurtenance degree of attributes. In this case, the

time complexity taken in drawing the Intuitionistic Plithogenic graph can be takeO(nm). The intuitionistic degree of appurtenance can take maximum O($n.m^3$).

3.2 A method for $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$ -cut for Intuitionistic Plithogenic context:

In this section, a method is proposed to decompose the Plithogenic context for precise analysis of pattern based on user or expert requirements as shown in Table 6.

Step 1. Let us consider the Intuitionistic Plithogenic graph G=$\left\{V_p, E_p, a_p, (\mu_{d_p}, \nu_{d_p}), c_p\right\}$.

Step 2. The Intuitionistic Plithogenic context can be processed based on (α_1, α_2) -cut defined for the appurtenance degree (dp) as $d_{(\alpha_1,\alpha_2)}$ where $0 \le \alpha_1 + \alpha_2 \le 1$.

Step 3. The β -cut can be defined on contradiction degree (c_p) for measuring the conflict and its liabilities as c_β where $0 \le \beta \le 1$.

Step 4. Let us suppose, expert wants to analyze the Intuitionistic Plithogenic context based on defined $d_{(\alpha_1,\alpha_2)}$-cut for degree of appurtenance and c_β for contradiction as $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$.

Step 5. In this case the expert wants that the given Intuitionistic Plithogenic context contain more degree of appurtenance from chosen $d_{(\alpha_1,\alpha_2)}$-cut with less contradiction for the chosen c_β-cut.

$$P_{\{(\alpha_1,\alpha_2),\beta\}} = \left\{\left\{V_p, E_p, a_p, (\mu_{d_p}, \nu_{d_p}), c_p\right\} \mid (\mu_{d_p} \ge \alpha_1), (\nu_{d_p} \le \alpha_2), c_p \le \beta, \forall a_p \in P\right\}$$

where $0 \le \alpha_1 + \alpha_2 \le 1$ and $0 \le \beta \le 1$.

Step 6. In case the given Intuitionistic Plithogenic relation satisfies the –cut defined at step 5 then represent as 1 at particular entry of the attributes otherwise write as 0.

Step 7. In this way all the entries of given Intuitionistic context can be decomposed into 1 and 0 based on defined $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$-cut.

Step 8. The $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$-cut can be changed based on user or expert requirement to zoom in and zoom out the given Intuitionistic context for adequate information extraction.

Step 9. In this way, the proposed method provides intuitionistic level of granulation to deal with Intuitionistic Plithogenic context for knowledge processing tasks. In case the expert unable to draw its graph.

Time complexity: Let us suppose, the given Intuitionistic Plithogenic context contains n-number of attributes having m-number of multi-attributes. In this case, the $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$-cut may takeO($nm$) time for the membership and non-membership value traversal, independently. In this case it may cost maximum O(n^2m) and vice versa for decomposition of intuitionistic degree of appurtenance. The consideration of contradiction degree for decomposing m-number of multi-valued attributes brings the complexity as O($n^2.m^2$).

In the next section both of the method is illustrated for handling Intuitionistic Plithogenic context for multi-decision process. Same time the obtained results are compared for validation.

4. Illustration

The uncertainty and vagueness in Plithogenic attributes creates major issues with its representation and analysis [10-11]. The reason is Plithogenic set represents each multi-valued attributes as a generic element x characterized by one attribute only (appurtenance) [1-2]. In this case, intuitionistic fuzzy set can be helpful to represent the degree of appurtenance based on membership and non-membership. Recently, intuitionistic Plithogenic set is received attention of some of the researchers [10-12]. This paper focused on precise representation of data with intuitionistic Plithogenic attributes. In addition, zoom in and zoom out of Intuitionistic Plithogenic attributes for knowledge processing tasks. Same time the knowledge discovered from them is compared for validation of result. To achieve this goal, two methods are proposed in Section 3.1 and 3.2.

Section 4.1: The illustration of Intuitionistic Plithogenic context and its visualization

In this section, the proposed method shown in Section 3.1 using the cricket data set motivated from [3].

Example6: Let us consider the cricket data set[1]. An expert wants to give opinion on performance of Cheteshwar Pujara that he is good batsman for Test, ODI or T20 or selection in the team. The expert can give opinion based on his performance available on time as shown in Table 7. The expert (y_1) wants to give opinion that Pujara is 40 percent good player for test due to his 80 percent ball faced and 40 percent strike rate. Same time the expert wants to express that Pujara is 30 percent not good for some Test due to his 20 percent wrong played ball and 50 percent non-strike or slow rate with 50 percent contradiction. In similar way the expert (y_1) can give opinion about the Pujara based on his performance shown in Table 7 for ODI or T20. This type of data can be written precisely using the Intuitionistic Plithogenic set as shown in Table 8. In case, the selection committee unable to take decision based on expert (y_1) opinion. Then the committee can ask other experts having contradictory with expert (y_1) as shown in Table 9. The problem is to discover comprehensive decision for selecting the Pujara for Test, ODI or T20. This type of data can be solved using the proposed method shown in Section 3.1. The Table 10 represents intersection and union among the expert opinions about performance of Pujara.

Table 7. The Batting performance of Cheteshwar Pujara in various format

	Mat	Inns	NO	Runs	HS	Ave	BF	SR	100	50	4s	6s	Ct	St
Test	86	144	8	6267	206*	46.08	14038	44.64	18	29	740	14	57	0
ODI	5	5	0	51	27	10.19	130	39.23	0	0	4	0	0	0
FC	214	351	37	16311	352	51.94			50	65			139	0
List A	103	101	19	4445	158*	54.20			11	29			39	0
T20	64	56	10	1356	100*	29.47	1240	109.35	1	7	158	20	32	0

Table 8.An Expert(y_1) opinion about Pujara on various format

Contradiction degree	0	0.33	0.66	0.0	0.5
Attribute values	Test	One Day	T20	Ball faced	Strike rate
Puajara	(0.4, 0.5)	(0.1, 0.2)	(0.0, 0.3)	(0.8, 0.2)	(0.4, 0.5)

Table 9. An Expert (y_2) opinion about Pujara on various format

Contradiction degree	0	0.33	0.66	0.0	0.5
Attribute values	Test	One Day	T20	Ball faced	Strike rate
Puajara	(0.6, 0.3)	(0.4, 0.3)	(0.2, 0.5)	(0.6, 0.1)	(0.5, 0.3)

Table 10. The Intuitionistic Plithogenic context representation of Table 8 and 9

Contradiction degree	0	0.33	0.66	0.0	0.5
Attribute values	Test	One Day	T20	Ball faced	Strike rate
Expert $y_1$opinion about Pujara	(0.4, 0.5)	(0.1, 0.2)	(0.0, 0.3)	(0.8, 0.2)	(0.4, 0.5)
Expert $y_2$opinion about Pujara	(0.6, 0.3)	(0.4, 0.3)	(0.2, 0.5)	(0.6, 0.1)	(0.5, 0.3)
$y_1 \wedge_p y_2$ as per step 7 of Section 3.1	(0.24, 0.65)	(0.18, 0.31)	(0.13, 0.32)	(0.48, 28)	(0.45, 0.40)
$y_1 \vee_p y_2$ as per step 7 of Section 3.1	(0.76, 0.15)	(0.32, 0.19)	(0.07, 0.48)	(0.92, 0.02)	(0.45, 0.40)

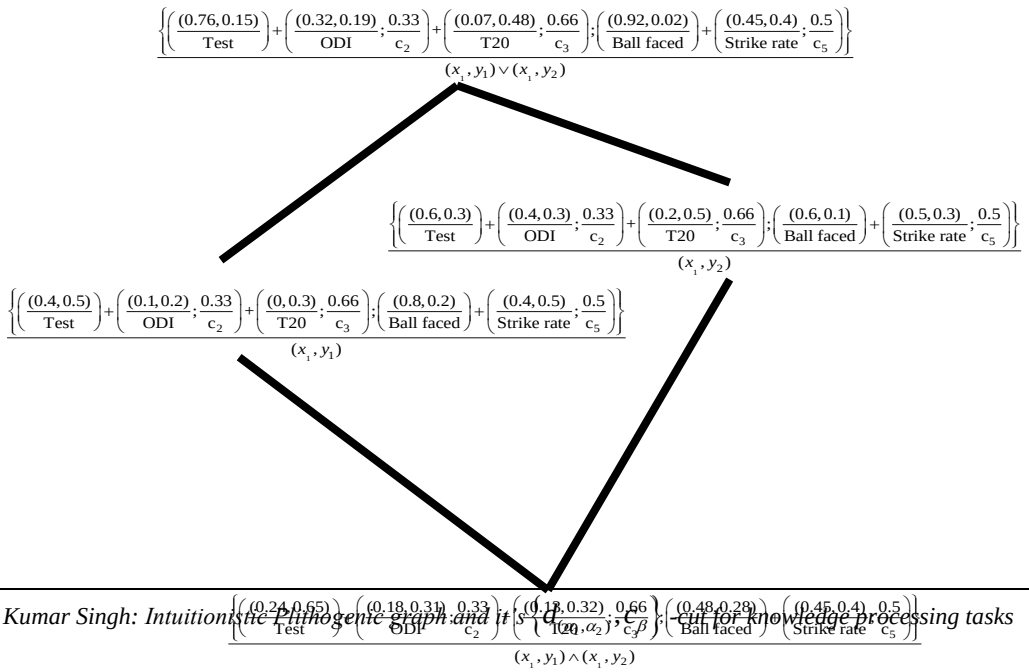

Figure 3. The Intuitionistic Plithogenic graph visualization of Table 10.

Figure 3 represents Intuitionistic Plithogenic graph for the context shown in Table 10 which reflect following information:

(i) The top node represents the infimum among expert's opinion (y_1) and (y_2). It represents that, the player (x_1) is 76 percent suitable for Test without any contradiction, 32 percent suitable for ODI with 30 percent contradiction, 7 percent for T20 with 66 percent contradiction due to his 92 percent ball faced and 45 percent strike rate with contradiction 0.5.

(ii) The last node represents supremum among the expert opinion. It represents that, the player (x_1) is 24 percent suitable for Test without any contradiction, 18 percent suitable for ODI with 30 percent contradiction, 13 percent for T20 with 66 percent contradiction due to his 48 percent ball faced and 45 percent strike rate with contradiction 0.5.

It can be observed that, both of the expert agreed about player (x_1) and its suitability maximally for the Test when compared to other parameters based on his performance available at Crickinfo[1]. The conflict among them is about his suitability for the ODI as 33 percent. To deal with it another method is proposed in Section 3.2 which is illustrated in the next section.

Section 4.1: The illustration of $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$ ***-cut for Intuitionistic Plithogenic context***

The precise analysis of Intuitionistic Plithogenic context as per user requirement and its traversal is another concern. One of the reason is dealing the conflict among expert arises by contradiction degrees. To resolve this issue, current paper tries to introduce the properties of multi-granulation in this paper as shown in Section 3.2. The proposed method illustrated using the Intuitionistic

Plithogenic context shown in Table 10. Some potential level of $\left\{d_{(\alpha_1,\alpha_2)}, c_\beta\right\}$ -cut is shown in Table 11 to process the given Intuitionistic Plithogenic context.

Example 7: Let us supposethe Intuitionistic Plithogenic context shown in Table 10 and decomposition using the defined granulation as shown in Table 11. The selection committee required an average player with less than 33 percent contradiction. This is shows as Level 3 in the Table 11. The decomposed context at {(0.4, 0.3), 0.33}-cut is shown in Table 12 for knowledge processing tasks. The value 1 means satisfies the chosen information granules and o means does not satisfy the information granulation. In this way, the expert can select the player for which section his/her performance satisfies maximum rows as 1.

Table 11. Level of Intuitionistic Plithogenic granulation and its interpretation

Level	Degree of appurtenance $d_{(\alpha_1,\alpha_2)}$ where $0<\alpha_1+\alpha_2<1$	Contradiction degree c_β where $0<\beta<1$	Interpretation
1	(0.8, 0.1)	0.1	Top Player
2	(0.6, 0.3)	0.2	Good Player
3	(0.4, 0.3)	0.3	Average Player
4	(0.3, 0.2)	0.4	Player
5	(0.2, 0.1)	0.5	Last player/ Bowler

Table 12. Table 10 at {(0.4, 0.3), 0.33}-cutfor degree of appurtenance and contradiction

Contradiction degree	0	0.33	0.66	0.0	0.5
Attribute values	Test	One Day	T20	Ball faced	Strike rate
Expert $y_1$opinion about Pujara	1	0	0	1	1
Expert $y_2$opinion about Pujara	1	1	0	1	1

It can be observed that both reviewer agreed that Pujara is good player for the Test when compared to ODI and T20 as per given {(0.4, 0.3), 0.33}-cut shown in table 12 due to his ball faced and strike rate. The expert y_2 agreed that due to this reason Pujara can play some of the ODI match also. However, none of the expert agreed that Pujara is good player for T20. In this way, the selection committee can prefer Pujara for the Test as first preference which echo with results obtained from the Intuitionistic Plithogenic context graphshown in Figure 3 as per Section 4.1.

Table 13: The comparison of proposed method with recent approaches

	Plithogenic set [3]	Intuitionistic Plithogenic Set [18]	The proposed method
Plithogenic attributes	Yes	No	Yes
Vagueness measurement	No	Yes	Yes
Intersection and Union	Yes	Yes	Yes
Graph	No	No	Yes
Information granulation	No	No	Yes
Time complexity	Not given	Not given	O($n.m^3$) or O(n^2m^2)

Table 13 represents comparison of the proposed method with recently available methods on Intuitionistic Plithogenic set. It shows that, the proposed method distinct from each approach in various ways and provides an extensive version to deal with intuitionistic Plithogenic context.

In this way, the proposed method is helpful while dealing with data with Plithogenic attribute. The proposed method does not provide any clue about dealing with uncertainty [18] and its changes [19] arises due to conflict among experts. Hence the author will focus on tackling this problem in near future.

4. Conclusions

This paper focused on handling data with Intuitionistic Plithogenic data and its graphical visualization as shown in Figure 3. Same time the decomposition of Intuitionistic Plithogenic context based on user required intuition degree of appurtenance and contradiction as shown in Section 3.2. The knowledge discovered from both of the proposed methods is compared with each other and recently available methods as shown in Table 13. It is shown that, the proposed method is distinct from any of the available approaches in Intuitionistic Plithogenic context. In near future author will focus on dealing with uncertainty in Intuitionistic Plithogenic attributes and its precise measurement for knowledge processing tasks.

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Footnotes:

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