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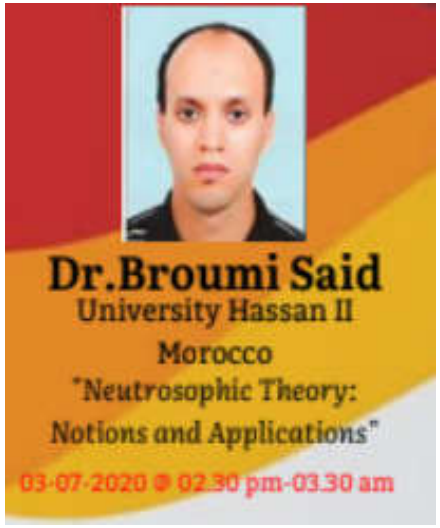
Neutrosophic Theory: Notions and Applications



Objectives of this seminar

Neutrosophic Theory:

- Notions of neutrosophic set, neutrosophic logic with examples.
- Neutrosophic theory indexed in the most known scientific Databases
- Geomertic representation of Neutrosophic Cube
- Extensions of neutrosophic set
- Applications in (medicine, sociology, Wirless networks,….etc)
- Neutrosophic tools
- etc

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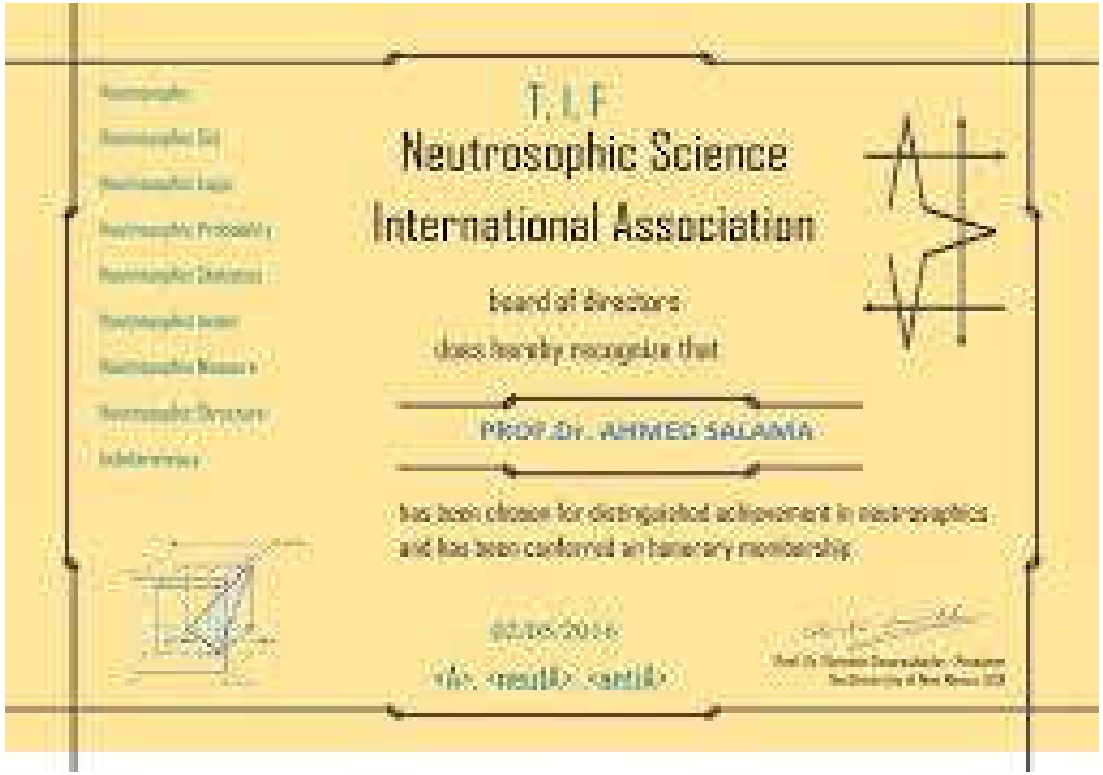
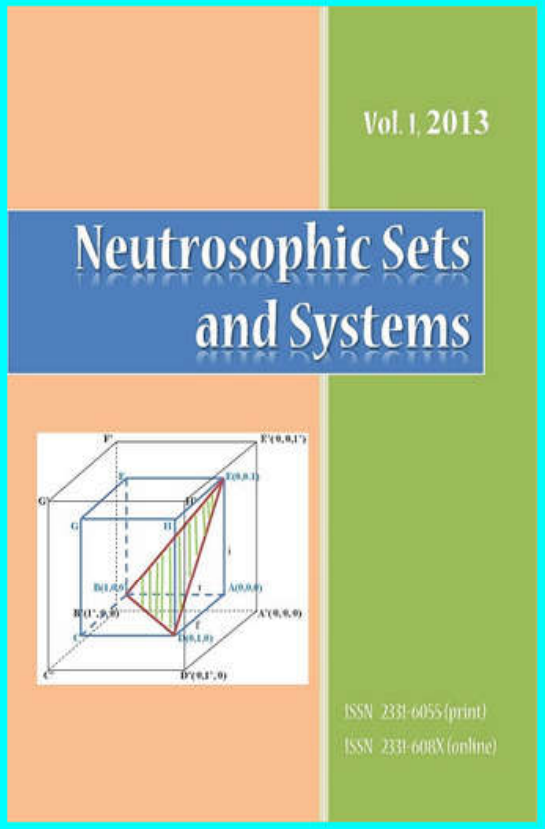
More than 1200 neutroosphic researchers

Neutrosophic Diploma





Neutrosophic Sets and Systems

An International Journal in Information Science and Engineering

Founder: Florentin Smarandache (since 2013)

H-Index: 14 (WOS), SJR 0.236

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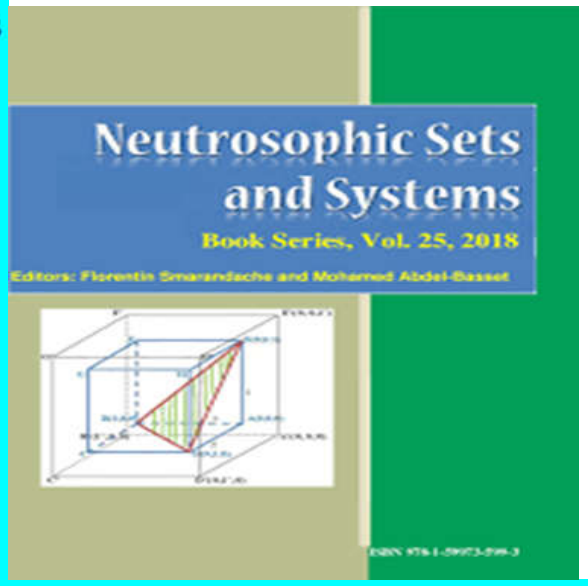

Download Neutrosophic ToolBoxes:

- Said Broumi (2019). Neutrosophic Logic Toolbox Package_Neutrosophic Matrices. MATLAB Central File Exchange.
- Haitham A. El-Ghareeb (2019), Novel Open Source Python Neutrosophic Package.
- Maikel Leyva Vazquez (2018, using Jupyter). Neutrosophic Computation and and Linear Equations & Neutrosofía: Nuevos avances en el tratamiento de la incertidumbre.

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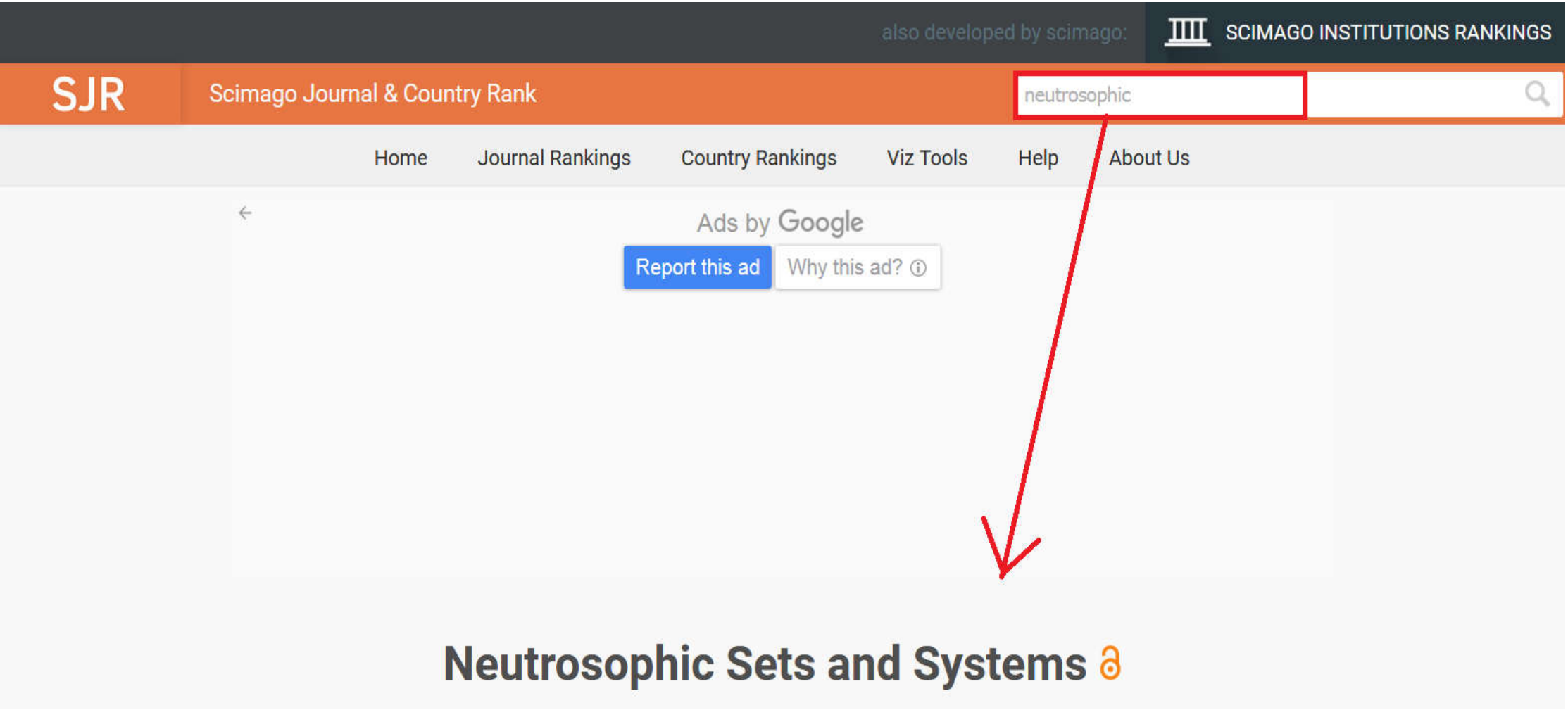
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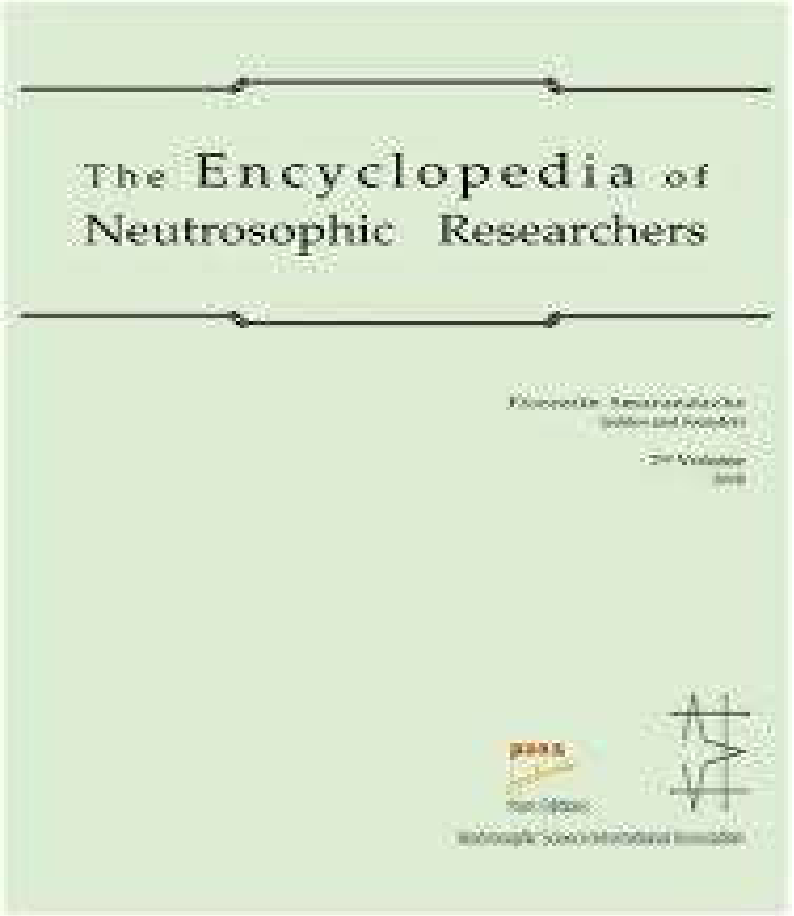

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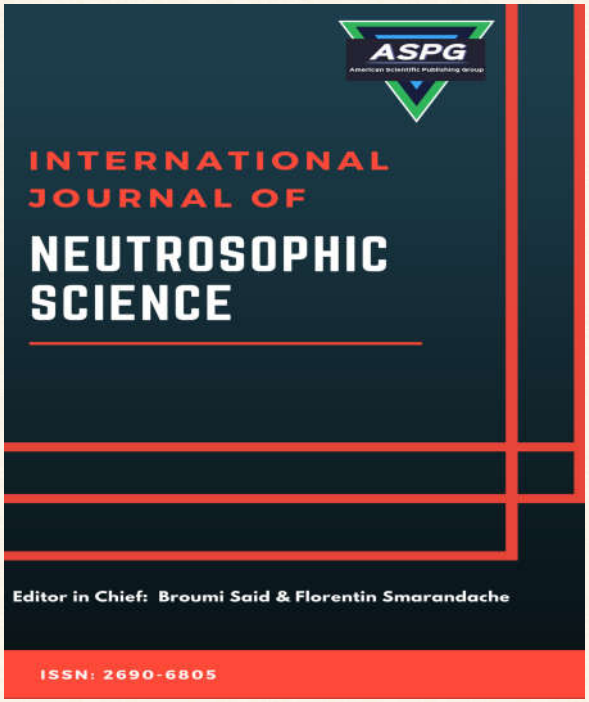

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Editor in Chief

Dr. Broumi Said

Laboratory of Information Processing, Faculty of Science Ben M'Sik, University Hassan II, Casablanca, Morocco

Prof. Dr. Florentin Smarandache

Department of Mathematics, University of New Mexico, United States

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Conferences organized in china on neutrosophic

LIMIT OF THE BOOLEAN LOGIC

to measure the proposition P = "In 2021 there will be a terrorist attack"?
Because in Boolean logic he has to say either P = 0 or P = 1 [only God can say this!].
There are things that are neither black nor white, but also gray...

	Type of Logic	Founder
1	Fuzzy logic (T)	L. Zadeh (1965)
2	Intuitionistic fuzzy logic (T,F)	K.Atanassov (1983)
3	Neutrosophic logic (T,I,F)	F. Smarandache (1995)

L. Zadeh (1965)

Fuzzy logic and fuzzy sets (T)

Zadeh's FS is characterized by one part: Truth
Fuzzy logic handles the concepts of partial truth, that is, the truth with values betwen « completely true or 1 » and « completely false or 0 »

Fuzzy sets: represent the membership without expressing the corresponding degree of non membership so it provides an imperfect expression of uncertain information. The degree of nonmembership in fuzzy sets is the complement of membership for fuzzy sets, Therefore the nonmembership is not independent.

A fuzzy set cannot express the information about **rejection**.

A fuzzy set is defined as $A = \{(x, T(x))\}$, where
$0 \leq T \leq 1$; T is A function in [0, 1].

[4] L. Zadeh, "Fuzzy logic and approximate reasoning," Synthese, vol. 30, no. 3-4, 1975, pp. 407–428

K.Atanassov (1983)

Intuitionistic fuzzy logic and
Intuitionistic fuzzy sets (T,F)

Intuitionstic fuzzy sets is an extension of **fuzzy sets** which describes vaguness and impresion by a range of membership values.
intuitionistic fuzzy set give a degree of membership and a degree of non-membership of an element in a given set
Atanassov introduced the intuitionistic fuzzy set (IFS) to **bring in non-membership.**

Intuitionistic fuzzy sets, as well as vague sets, are suitable in simulating the impreciseness of human understanding in decision making by representing degree of membership and nonmembership, but it also cannot express indeterminacy degree which is the ignorance value between truth and false.

An **Intuitionistic fuzzy sets is defined as** $A = \{(x, T(x), F(x))\}$, **where**

$0 \leq T + F \leq 1$; **T, F are functions in [0, 1].**

[2] K. Atanassov, "Intuitionistic fuzzy sets: theory and applications", Physica, New York, 1999.

F. Smarandache (1995)

Neutrosophic logic and neutrosophic sets(T,I,F)

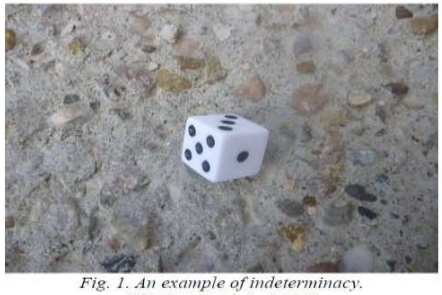


Fig. 1. An example of indeterminacy. What is tossed, 1, 3 or 5?

Smarandache's NS is characterized by three parts: truth, indeterminacy, and falsity. Truth, indeterminacy and falsity membership values behave independently and deal with the problems of having uncertain, indeterminant and imprecise data

[1] F. Smarandache, "Neutrosophy. Neutrosophic Probability, Set, and Logic," ProQuest Information & Learning, Ann Arbor, Michigan, USA, 105 p., 1995

Florentine and Wang et al. [*] gave a new concept of single valued neutrosophic set (SVNS) and defined the set of theoretic operators in an instance of NS called SVNS

A single valued neutrosophic set is defined as $A = \{(x, T(x), I(x), F(x))\}$, where

$$0 \leq T + I + F \leq 3$$; **T, I, F are functions in [0, 1].**

[*] H. Wang, F. Smarandache, Y. Zhang and R.Sunderraman, "Single Valued Neutrosophic Sets," Multispace and Multisrtucture 4, 2010, pp.410-413.

Indeterminacy

- Indeterminacy is present everywhere in real life. If a die is tossed on a irregular surface then there is no clear face to see. Indeterminacy occurs due to defects in creation of physical space or defective making of physical items involved in the events. Indeterminacy occurs when we are not sure of any event. Neutrosophic logic will help us to consider this indeterminacy.

Fig. 1. An example of indeterminacy. What is tossed, 1, 3 or 5?

Indeterminacy

- **Indeterminacy exists almost everywhere in the whole world:**
- **if weather reports say that the probability of rain tomorrow is 70 % then it does not mean that the probability of not raining is 30% because there are some hidden weather factor like jet stream, weather fronts etc that the reporter are not aware of. So there is some ambiguity that leads to indeterminacy.**
- **Different doctors have different views on the same diagnosis of patient's disease so, indeterminacy exists there,**

- **In classical set theory, the membership of elements in a set is assessed in binary terms 0 and 1; according to a bivalent condition-an element either belongs or does not belong to the set.**
- **As an extension, fuzzy set theory permits the gradual assessment of the membership of elements in a set. A fuzzy set A in X is characterised by a membership function which is associated with each element in X, a real number in the interval [0,1].**
- **Lotfi A Zadeh [1] introduced a theory whose objects fuzzy sets-are sets with imprecise boundaries which allow us to represent vague concepts and contexts in natural language.**
- **Fuzzy set theory is limited to modelling a situation involving uncertainty.**
- **As an extension of fuzzy set concept, the theory of intuitionistic fuzzy sets introduced whose elements have degree of membership and non membership.**
- **Intuitionistic fuzzy sets have been introduced by Krassimir Atanassov [2] as an extension of Lotfi Zadeh's notion of fuzzy set.**
- **Let us have a fixed universe X and A is a subset of X .The intuitionistic fuzzy set can be defined as where . for membership μ and ν for non membership, which belongs to the real unit interval [0,1] and sum belongs to the same interval.**

Neutrosophic logic /set

As an alternative to the existing logics, Smarandache proposed the neutrosophic Logic to represent a mathematical model of

- **uncertainty vagueness,**
- **ambiguity, imprecision, undefined,**
- **unknown, incompleteness, inconsistency,**
- **redundancy, Contradiction,**

where the concept of neutrosophy is a new branch of philosophy introduced by Smarandache.

F. Smarandache. A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability", American Research Press, Rehoboth, NM, 1999.

Uncertainties types	Meaning	Example
Vagueness	When avalible information is normally having a degrees of attribute	This man is nearly Tall
Imprecision	When information is not a definite value	The student performance for task is between 80-85%
Ambiguity	When avaliable information has more than one meaning or refer to more than one subject	The flower color may be yellow or red
Inconsistency	When obtainable information is conflicted or contradicted	The chance of raining tomorow is 80%, it does not mean that the chance of not raining is 20%, since there might be hidden weather factors that is not aware of

Neutrosophy

- Neutrosophy is a new branch of philosophy introduced by Florentin Smarandache, which is studying the origin, nature and scope of neutralities as well as their interactions with different additional spectral (i.e. notions or ideas located between the two extremes, supporting neither nor).
- Etymologically, neutro-sophy [French neuter < Latin neuter, neutral and Greek sophia, skill/wisdom] means knowledge of neutral thought and started in 1995.

• The fundamental theory of neutrosophy is:

Every idea <A> tends to be neutralized, diminished, balanced by <nonA> ideas (not only <antiA> as Hegel asserted) -as a state of equilibrium: <nonA> = what is not <A>,

<antiA> = the opposite of <A>,

and <neutA> = what is neither <A> nor <antiA>.

Neutrosophy consider a proposition, theory, event, concept, or entity, "A" in relation to its opposite, "AntiA" and which is not "A", "Non –A", and that which is neither "A" nor "Anti-A", denoted by "Neut-A".

Neutrosophy is the basis of, neutrosophic set, neutrosophic logic, neutrosophic probability and neutrosophic statistic.

- the neutrosophic triplet (<A>, <neutA>, <antiA>) works when it makes sense in our real world, when it does exist in our everyday life -- not always.
- For example, if <A> = small, then <antiA> = big, and <neutA> = medium; it works.
- But if <A> = table, then it is not possible to say "anti-table" or "neut-table"!

- In a classical way ”A”,”neutA”, and”antiA” are disjoint two by two. Nevertheless, since in many cases the borders between notions are vague and imprecise, it is possible that ”A”, ”neutA”, and ”antiA” have common parts two by two, or even all three of them as well.
- A neutrosophic set is defined as A = {(x, T(x), I(x), F(x))},

Where $0 \leq T + I + F \leq 3$; T, I, F are functions in [0, 1].

Example : In a soccer game there are three chances: to win (<A>), to have a tie game (<neutA>), or to loose (<antiA>).

The Neutrosophy's Triplet is (<A>, <neutroA>, <antiA>),

where <A> may be an item (concept, idea, proposition, theory, structure, algebra, etc.),

<antiA> the opposite of <A>,

while <neutroA> {also the notation <neutA> was employed before} the neutral between these opposites.

Based on the above triplet the following Neutrosophic Principle one has: a law of composition defined on a given set may be true (T) for some set elements, indeterminate (I) for other set's elements, and false (F) for the remainder of the set's elements.

- Neutrosophy is a new branch of philosophy and logic introduced by Florentin Smarandache in 1995 which studies the origin and features of neutralities in nature.
- Each proposition in Neutrosophic logic is approximated to have the percentage of truth (T), the percentage of indeterminacy (I) and the percentage of falsity (F).
- So this Neutorsophic logic is called generalization of classical logic, conventional fuzzy logic, intuitionistic fuzzy logic and interval valued fuzzy logic.
- This mathematical tool is used to handle problems like imprecise, indeterminate and inconsistent data.
- The use of neutrosophic theory becomes inevitable when a situation involving indeterminacy is to be modelled

NEUTROSOPHIC SET

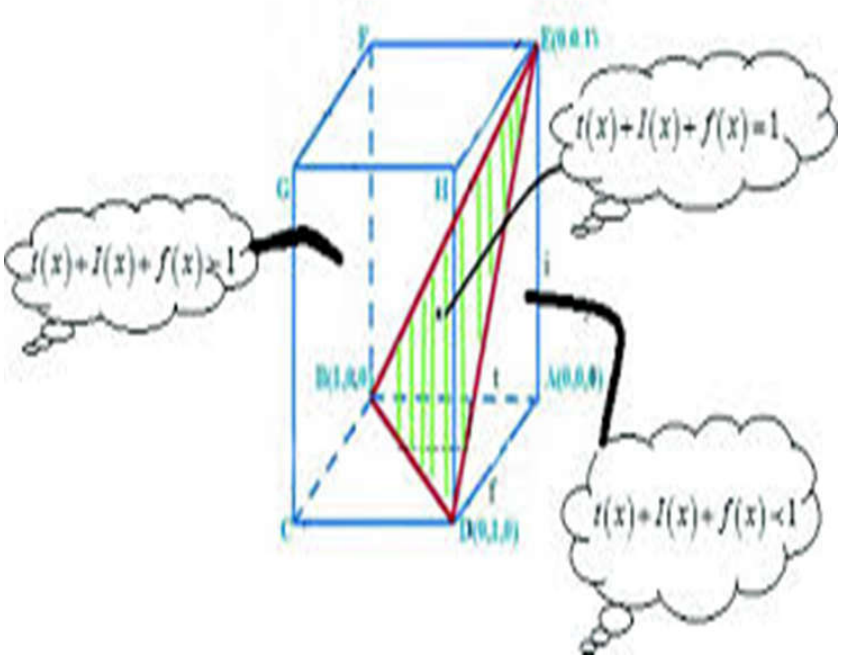
- **Let *X be a space of points (objects), with a generic element in X denoted by x. A neutrosophic set A in X is* characterized by a truth membership function *TA, an indeterminacy-membership function IA and a falsity membership* function *FA. TA(x), IA(x) and FA(x) are real standard or non-standard subsets.***
- **To maintain consistency with the classical and fuzzy logics and with probability, there is the special case where $t + i + f = 1$.**
- **But to refer to intuitionistic logic, which means incomplete information on a variable, proposition or event one has $t + i + f < 1$.**
- **Analogically, referring to paraconsistent logic, which means contradictory sources of information about a same logical variable, proposition, or event one has $t + i + f > 1$.**

NEUTROSOPHIC LOGIC

- It was created by Florentin Smarandache (1999) and is an extension/combination of the fuzzy logic, intuitionistic logic, paraconsistent logic. In neutrosophic logic, in an easy way, every logical variable x is described by an ordered triple.x= (t, i, f)

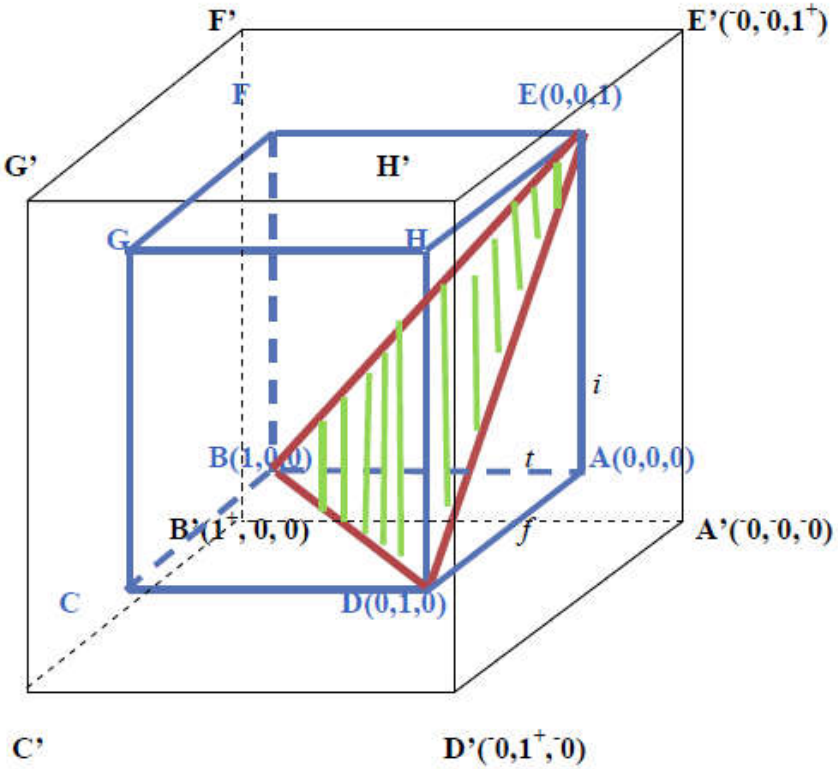
where t is the degree of truth, f is the degree of false and i is the level of indeterminacy. T, I, and F are called *neutrosophic components, representing the truth, indeterminacy, and falsehood values* respectively referring to neutrosophy, neutrosophic logic, neutrosophic components, neutrosophic set.

Every element of the NS's features has not only a certain degree of truth(T), but also a falsity degree (F) and indeterminacy degree(I). This concept is generated from many others such as crisp set, intuitionistic fuzzy set, fuzzy set, interval-valued fuzzy set, interval-valued intuitionistic fuzzy set, etc.

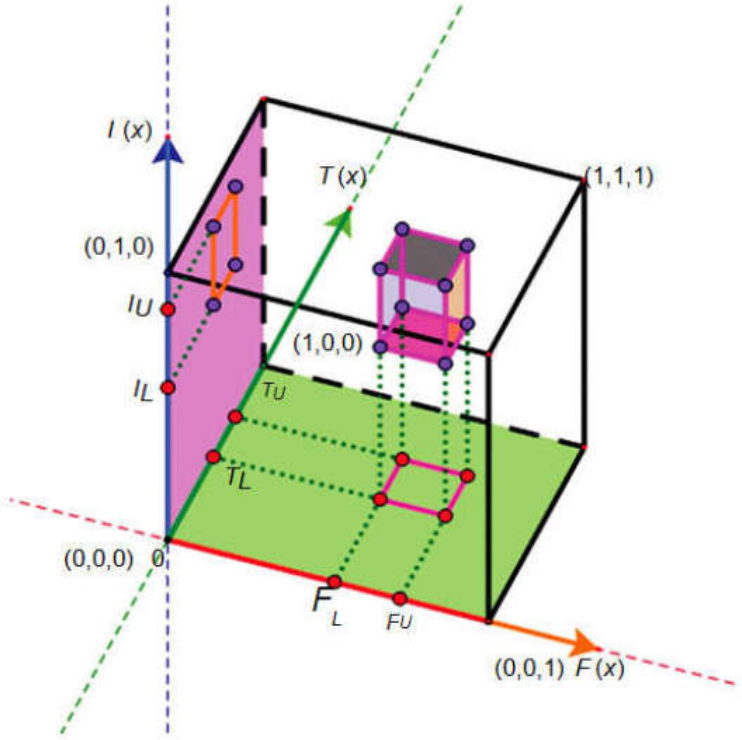


GEOMERTIC REPRESENTATION OF NEUTROSOPHIC CUBE

-The focal objective of neutrosophic logic is to characterize each logical statements in a 3D-neutrosophic space, where each dimension of space represents respectively the
truth(T) , falsehood(F) and indeterminacies (I) of the statements under consideration
-in an easy way, every logical variable x is described by an ordered triple. x= (t, i, f)



GEOMERTIC REPRESENTATION OF INTERVAL VALUED NEUTROSOPHIC NUMBERS



$[T_L, T_U]x[I_L, I_U]x[F_L, F_U]$

Difference between Neutrosophic Set and Intuitionistic Fuzzy Set

Neutrosophic set (NS) is a generalization of Fuzzy set, especially intuitionistic fuzzy set (IFS). Hence, the differences between NS and IFS was studied deeply because one's has known ᵗheir relation and differences in the first explanation. The difference between NS and IFS summarized in Table 1

TABLE 1. The difference between Neutrosophic Set and Intuitionistic Fuzzy Set.

Neutrosophic Set	Intuitionistic Fuzzy Set
1. In NS there is no restriction on T, I, F: thus NL can characterize the incomplete information (sum < 1), paraconsistent information (sum > 1).	IFS the sum of components (or their superior limits) = 1
2. NS can distinguish, between absolute membership [NS(absolute membership)=1^+] and relative membership[NS(relative membership)=1]	IFS cannot; absolute membership is membership in all possible worlds, relative membership is membership in at least one world.
3. In NS components can be nonstandard	IFS, they don't
4. NS operators can be defined with respect to T,I,F.	IFS operators are defined with respect to T and F only.
5. I can split in NS in more subcomponents (examples in Belnap's four-valued logic (1977) indeterminacy is split into uncertainty and contradiction.)	IFS cannot
6. NS, like dialetheism (some contradiction are true), can deal with paradoxes, NS (paradox element) = (1,I,1)	IFS cannot

Generalization and comment

Because the neutrosophic set is related to intuitionistic fuzzy set, paraconsistent set and fuzzy set, the generalization will focus on these type of sets. Hence, NS generalizes:

1. the *intuitionistic set*, which supports incomplete set theories (for $0 < n < 1$, $0 =< t, i, f <= 1$) and incomplete known elements belonging to a set;
2. the *fuzzy set* (for $n = 1$ and $i = 0$, and $0 =< t, i, f <= 1$);
3. the *classical set* (for $n = 1$ and $i = 0$, with t, f either 0 or 1);
4. the *paraconsistent set* (for $n > 1$, with all $t,i,f < 1^+$);
5. the *faillibilist set* ($i > 0$);
6. the *dialetheist set*, a set M has at least one of its elements also belongs to its complement C(M); thus, the intersection of some disjoint sets is not empty;
7. the *paradoxist set* ($t=f=1$);
8. the *pseudoparadoxist set* ($0 < i < 1$, $t=1$ and $f > 0$ or $t > 0$ and $f = 1$);
9. the *tautological set* ($i,f < 0$).

Smarandache comment's that; compared to other types of sets, in the neutrosophic set each element has three components which are subsets (not numbers as in fuzzy set) and considers a subset, similarly to intuitionistic fuzzy set, of "indeterminacy" - due to unexpected parameters hidden in some sets, and let the superior limits of the components to even boil over 1 (overloaded) and the inferior limits of the components to even freeze under 0 (underdried).

Difference between Neutrosophic Logic and Intuitionistic Fuzzy Logic

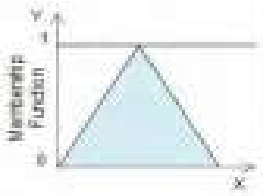
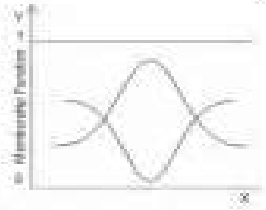
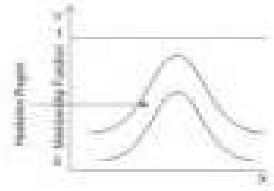
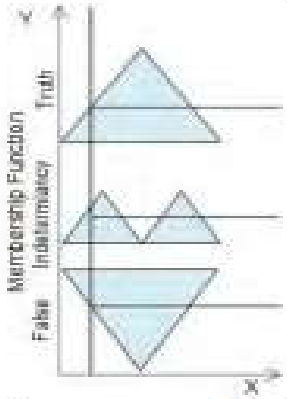
The differences between neutrosophic logic (NL) and intuitionistic fuzzy set (IFS) was summarized in Table 2 NL is attempting to unify many logics in a single field. NL is a generalization of fuzzy logic, especially IFL. Therefore, the difference between them was the importance part in studying NL.

TABLE 2. The difference between Neutrosophic Logic and Intuitionistic Fuzzy Logic.

Neutrosophic Logic	Intuitionistic Fuzzy Logic
1. In NL there is no restriction on T, I, F: thus NL can characterize the incomplete information (sum < 1), paraconsistent information (sum > 1).	IFL the sum of components (or their superior limits) = 1
2. NL can distinguish, in philosophy, between absolute truth [NL(absolute truth)=1^+] and relative truth[NL(relative truth)=1]; absolute truth is truth in all possible worlds (Leibniz), relative truth is truth in at least one world	IFL cannot
3. In NL components can be nonstandard.	IFL they don't
4. NL, like dialetheism [some contradictions are true], can deal with paradoxes, NL (paradox) = (1, I, 1).	IFL cannot

MULTIVALUED LOGIC

Table 1. *Multivalued Logic Membership Function*

	Fuzzy set	Intuitionistic Fuzzy	Vague	Neutrosophic
Membership Function	Degree of belonging	Degree of membership function and non-membership function	Degree of membership function and non-membership function	Degree of membership function, indeterminacy and non-membership function
	 Fig 1. Type1 fuzzy membership function [1]	 Figure 2. Intuitionistic Fuzzy Set [24]	 Figure 3. Vague Set [24]	 Figure 4. Neutrosophic Set [11]

The Neutrosophic Logic: Indetermiancy?

- It is known, The neutrosophic Logic is the only logic that can deal with the paradoxes, since a paradox P is a proposition that is true (its truth degree T = 1) and false (its false degree F = 1) in the same time, and as a consequence the paradox is also completely indeterminate (its indeterminate degree I = 1). Therefore, the neutrosophic truth-values of the paradox is P(1, 1, 1), where 1+1+1 = 3 > 1. No other logics allow the sum of its components to go over 1. *Self-Referential Paradoxes* have the same neutrosophic representation: T =1, F = 1, and I = 1.

Advantages of Neutrosophic Logic

- The advantage of using neutrosophic logic is that this logic distinguishes between relative truth, that is a truth in one or a few worlds only, noted by 1, and absolute truth, that is a truth in all possible worlds, noted by 1+. And similarly, neutrosophic logic distinguishes between relative falsehood, noted by 0, and absolute falsehood, noted by –0.
- In neutrosophic logic the sum of components is not necessarily 1 as in classical and fuzzy logic, but any number between –0 and 3+, and this allows the neutrosophic logic to be able to deal with paradoxes, propositions which are true and false in the same time: thus NL(paradox)=(1, I, 1); fuzzy logic cannot do this because in fuzzy logic the sum of components should be 1.
- When the sum of components $t + i + f = 1$ (classical and fuzzy logic);
- When the sum of components is $t + i + f < 1$ (intuitionistic logic);
- When the sum of components is $t + i + f >= 1$ (paraconsistent logic).

Situations characterized by 3 states

- Now we can give some examples of situations intrinsically characterized by 3 states, some of which stem from, or are similar to, this elementary statistical vision.

- **Chemistry: acidity**

- Also related to life and the conditions it imposes, in organic chemistry we have the measurement of the pH (hydrogen potential, hydrogen ion concentration) of a solution and its representation in 3 classes, neutral, acidic and basic. Here this is due to the primordial role of water in life, and pH 0, therefore neutral, is defined as that of water.

•Chemistry: phase change

In each discipline many examples can be found, here is another in chemistry. During the phenomenon of phase change, as between solid and liquid, matter does not only have two states, the original and the final one, but also a transition state (viscous matter in fusion).

•Physics: electrical charges

Any particle in quantum physics has an electric charge or not, and this charge can be positive or negative. This produces 3 states for the electric charge characteristic of particles: positive, neutral, negative.

Similarly molecules also have a charge that is likewise either positive, neutral or negative. If they are charged then they are called ions, subdivided into positively charged cations and negatively charged anions.

Neutrosophic examples

- We may say for example (0.9, 0.05, 0.05) meaning that 90% of 5 km we are sure about, while 5% of 5 km it is indeterminate, and 5% of 5 km unsure,
- in neutrosophic triplet: proved, unprovable (indeterminate), disproved,
- **in an application Form there are three option : Yes- No/ N.A For gendre M/F/other**
- , ***Neutrosophic logic has its chance to simulate human thinking and to be utilized for real environment executions***

- Let's say there is a soccer game between India and Pakistan. If I ask you who will win, you may say, since you're subjective and patriot, that India will win, let's say with a chance of 70%; but if I ask somebody from Pakistan, he would say that Pakistan will win, let's say with 60% chance. But asking a neutral expert, he may say that there is 40% chance of tie game.
- All sources are independent, meaning they do not communicate with each other and they do not know the response of each other.
- Summing we get $0.7 + 0.6 + 0.4 > 1$.

IDETERMINACY(I)

(T, I,F)=(0,1,0)

LET'S FLIP THE COIN ON THE SURFACE OF A SEA, THEN THE COIN FALLS INTO THE SEA AND WE DO NOT KNOWN ANYTHINGS ABOUT IT, THUS INDTERMINACY =1

Other example

- An example of neutrosophic logic is as following; the argument "Tomorrow it will be sunny" does not mean a constant-valued components structure; this argument may be 60% true, 40% indeterminate and 35% false at a time, neutrosophicaly represented by (0,6, 0,4, 0,35) ; but at in a second time may change at 55% true, 40% indeterminate, and 45 % false according to new indications, provenances,neutrosophicaly represented by (0,55,0,40,0,45) , etc.

Neutrosophic example: voting process

For another example, suppose there are 10 voters during a voting process. Five vote “aye”, two vote “blackball” and three are undecided. For neutrosophic notation, it can be expressed as $x(0.5,0.3,0.2)$.

Using fuzzy it is not possible to separate the voting process in favour or against. Using Vague notation we can separate the votes in favour or votes in against but with constraint tv + fv≤1. Neutrosophic Notation has no restrictions on the boundary. In Neutrosophic Set, indeterminacy is quantified explicitly and true-membership, indeterminacy-membership and false-membership are independent. This assumption is very important in many applications

EXAMPLE OF NS

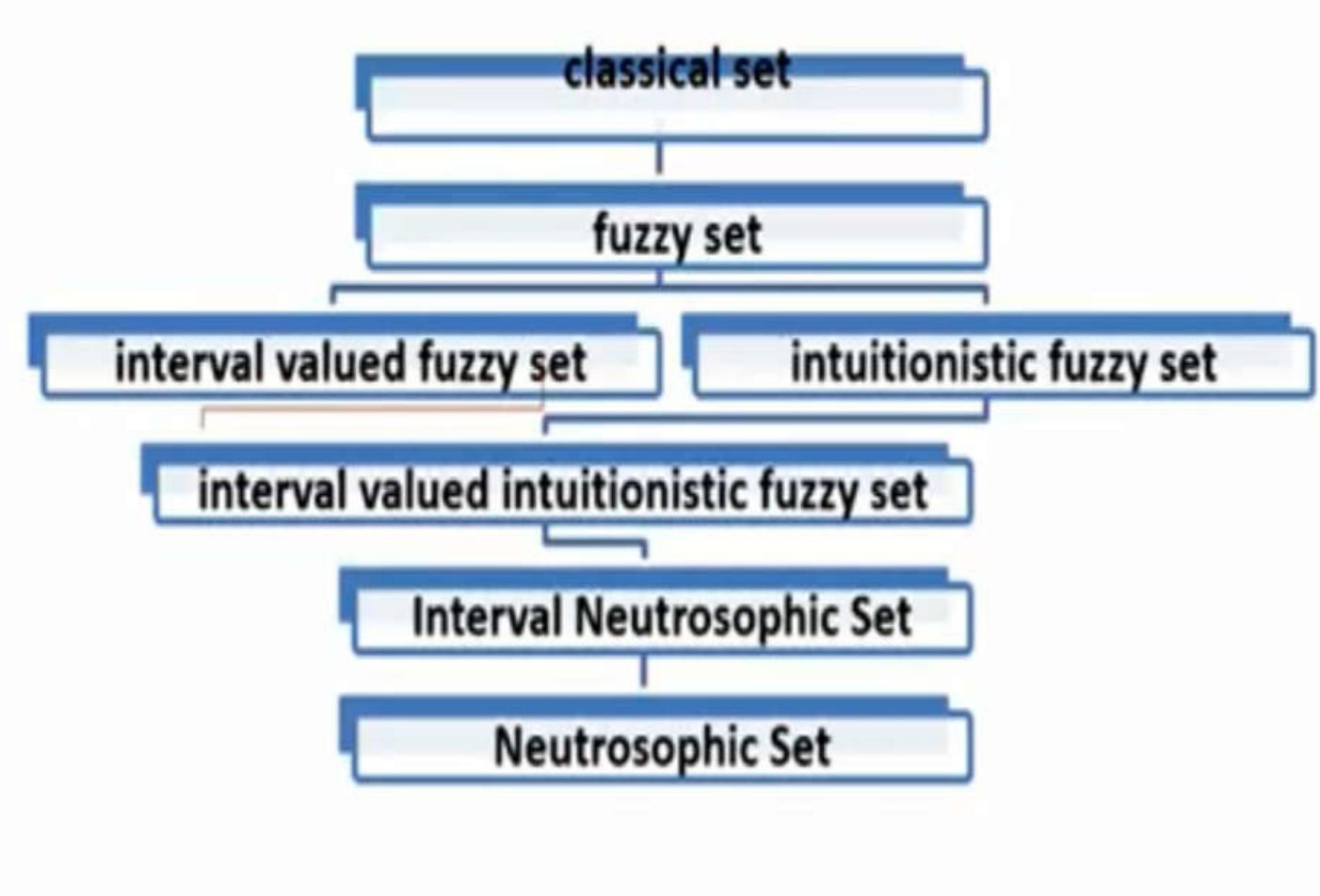
- For (0,1,0), which means totally indeterminate: Two points, diametrically opposed, on the margins of a marsh have to be connected by a route; it may be a total indeterminacy not knowing in what way to build the route.

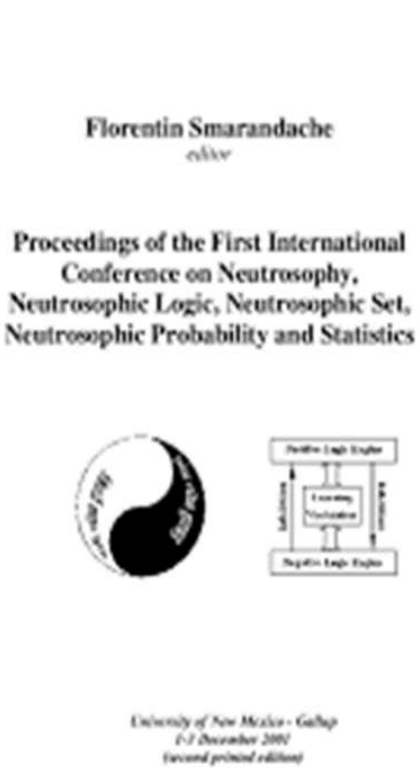
- For (0,1,1), with total indeterminacy and total falsehood. The two points, diametrically opposed, on the margins of a marsh having to be connected by a route; the route construction company starts the project and builds the route on the wrong trajectory that the route sinks into the marsh.
- two nodes as the two marsh, and the line as the route.

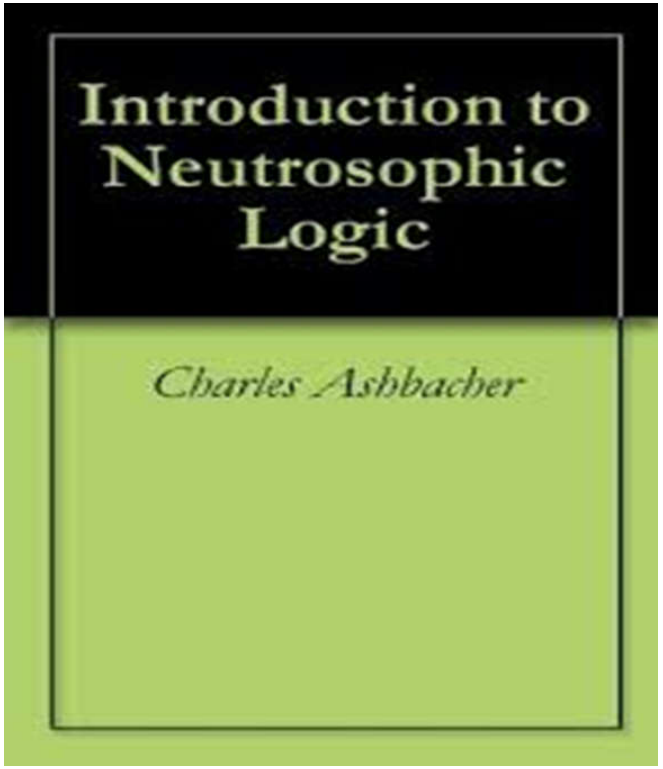
NEUTROSOPHIC EXAMPLES……

- Suppose there are few places in a city and roads connect the places. Hence the places and roads together form a network. But the problem is to find a way that a salesman can visit all the planes once with the lowest travelling cost. Now the travelling cost is directly proportional to the road distance travel by salesman. But all the roads are not in the same smooth conditions in practical. So the real travelling distance with cost may be effected the bad weather, road jam and non-pucca roads. Hence the travelling distance between the places should be taken as neutrosophic. If (T , I, F) be membership value of the road distance between two places, then T indicates distance on good, well-constructed road; I indicates distance on bad (marsh, muddied) road and F indicates distance above the water, where the bridge is not built yet...(i.e. the distance where the road does not exist yet, but it may be build under the form of a bridge to be constructed).

The relationship among neutrosophic sets and other sets







Book on neutrosphic logic with JAVA application

ACADEMIC PRESS

Neutrosophic Set in Medical Image Analysis

2019, Pages 3-29

1 - Introduction to neutrosophy and neutrosophic environment

Florentin Smarandache *, Said Broumi †, Prem Kumar Singh ‡, Chun-fang Liu §, V. Venkateswara Rao ¶, Hai-Long Yang ‖, Ion Patrascu #, Azeddine Elhassouny **

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https://doi.org/10.1016/B978-0-12-818148-5.00001-1

Abstract

Neutrosophic connectives

- Like other non-classical logic, several definitions for the logical connectives are used
- we will concentrate on the simplest case, where the neutrosophic components are real values instead of intervals or subsets of the unit interval.

Neutrosophic basic connectives: Negation

$$(\mathrm{N1}) \quad v(\neg p) = (1 - t, 1 - i, 1 - f)$$

$$(\mathrm{N2}) \quad v(\neg p) = (f, i, t)$$

$$(\mathrm{N3}) \quad v(\neg p) = (f, 1 - i, t)$$

Conjunction-disjunction-implication

- Conjunction

(C1) $v(p_1 \wedge p_2) = (t_1 \cdot t_2, i_1 \cdot i_2, f_1 \cdot f_2)$

(C2) $v(p_1 \wedge p_2) = (min(t_1, t_2), min(i_1, i_2), max(f_1, f_2))$

(C3) $v(p_1 \wedge p_2) = (min(t_1, t_2), max(i_1, i_2), max(f_1, f_2))$

- Disjunction

(D1) $v(p_1 \vee p_2) = (max(t_1, t_2), max(i_1, i_2), min(f_1, f_2))$

(D2) $v(p_1 \vee p_2) = (max(t_1, t_2), min(i_1, i_2), min(f_1, f_2))$

- Implication

(I1) $v(p_1 \rightarrow p_2) = v(\neg p_1 \vee p_2)$

(I2) $v(p_1 \rightarrow p_2) = (min(1, 1 - t_1 + t_2), max(0, i_2 - i_1), max(0, f_2 - f_1))$

Diffrent types of neutrosophic Sets

- Single valued neutrosophic numbers
- Interval valued neutrosophic numbers
- Bipolar neutrosophic numbers
- Trapezoidal fuzzy neutrosophic numbers
- Triangular fuzzy neutrosophic numbers
- Single valued triangular fuzzy numbers
- Single valued trapezoidal fuzzy numbers
- Hesitant Single valued neutrosophic numbers
- Refinned neutrosophic numbers. etc

Neutrosophic numbers

- Numerical neutrosophic components: (T, I, F)
- Literal neutroosphic componets : x=a+Ib

The formula neutrosophically works in the following way:

- x = a+bI is a neutrosophic number whose determinate part is "a" and indeterminate part is "bI", where I = indeterminacy;

NNs can effectively describe incomplete or indeterminate information because they consist of a determinate part and indeterminate part.

Neutrosophic Complex Numbers based on literal component (I)

- Neutrosophic Real Number
- Neutrosophic Complex Number

F.Smarandache, "Introduction to Neutrosophic statistics", Sitech-Education Publisher, PP:34-44, 2014

Neutrosophic Real Number

Suppose that w is a neutrosophic number, then it takes the following standard form: $w = a + bI$ where a , b are real coefficients, and I represent indeterminacy, such $0.I = 0$ and $I^n = I$, for all positive integers n.

Neutrosophic Complex Number

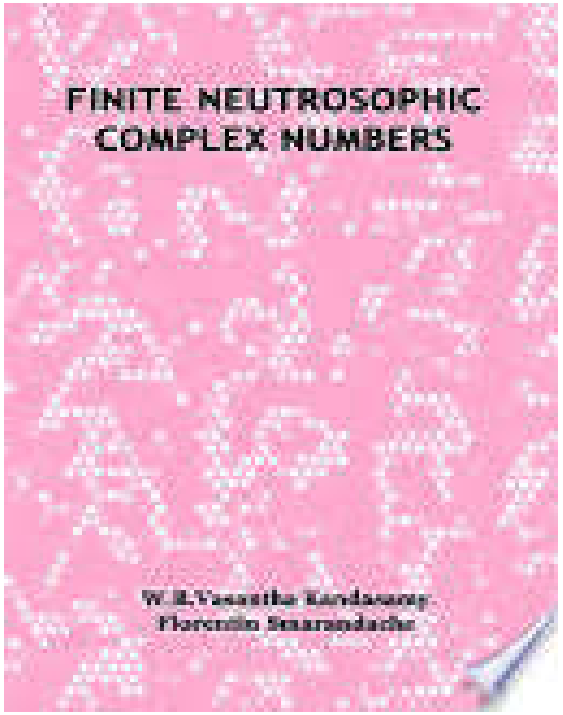
Suppose that z is a neutrosophic complex number, then it takes the following standard form: $z = a + cI + bi + diI$

where a , b, c, d are real coefficients, and I indeterminacy, such that $i^2 = -1 \Rightarrow i = \sqrt{-1}$.

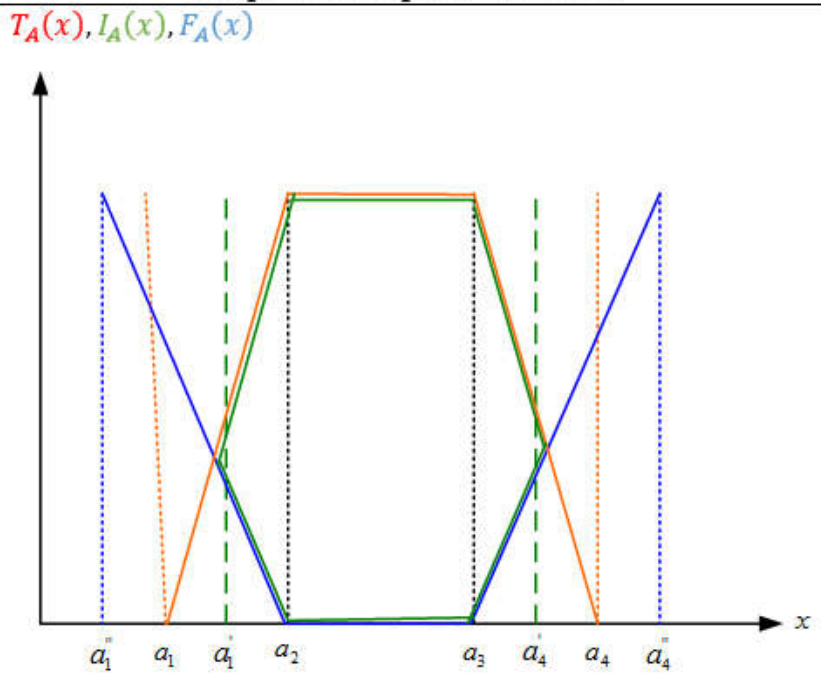
Note: we can say that any real number can be considered a neutrosophic number.

For example: $2 = 2 + 0.I$, *or*: $2 = 2 + 0.I + 0.i + 0.i.I$

F.Smarandache, "Introduction to Neutrosophic statistics", Sitech-Education Publisher, PP:34-44, 2014


FINITE NEUTROSOPHIC
COMPLEX NUMBERS
W.B.Vasantha Kandasamy
Florentin Smarandache

- The following tables represents the various forms of trapezoidal fuzzy neutrosophic numbers (TrFNN) have been listed out and it shows the uniqueness of the proposed graphical representation among the existing graphical representations.

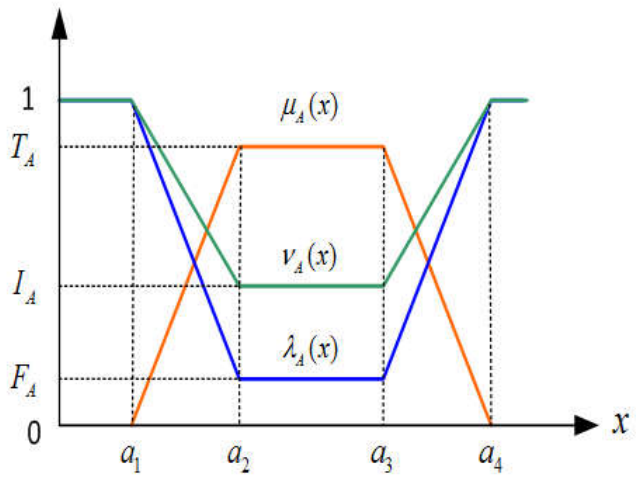
Trapezoidal fuzzy neutrosophic forms	Graphical representation
Darehmiraki [11]; A is a TrFNN, $a_1^{''}, a_1, a_1^{'}, a_2, a_3, a_4^{'}, a_4, a_4^{''} \in R$ such that $a_1^{''} \le a_1 \le a_1^{'} \le a_2 \le a_3 \le a_4^{'} \le a_4 \le a_4^{''}$ $A = \langle (a_1^{''}, a_1, a_1^{'}, a_2, a_3, a_4^{'}, a_4, a_4^{'}), T_A, I_A, F_A \rangle$	

Liang [21]; A is a TrFNN,

$a_1, a_2, a_3, a_4 \in [0,1]$ such that

$0 \le a_1 \le a_2 \le a_3 \le a_4 \le 1$

$A = \langle [a_1, a_2, a_3, a_4], (T_A, I_A, F_A) \rangle$



Biswas [5]; A is a TpFNN,

$(a_{41}, a_{21}, a_{31}, a_{41}), (b_{41}, b_{21}, b_{31}, b_{41}),$

$(c_{41}, c_{21}, c_{31}, c_{41}) \in R$

such that

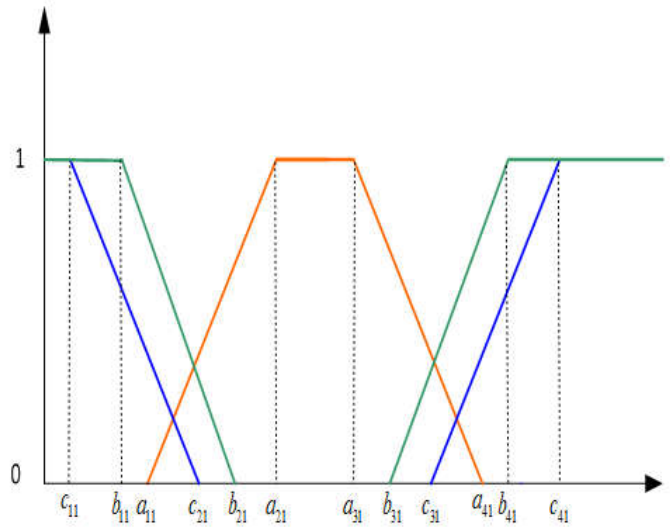
$c_{11} \le b_{11} \le a_{11} \le c_{21} \le b_{21} \le a_{21}$

$\le a_{31} \le b_{31} \le c_{31} \le a_{41} \le b_{41} \le c_{41}$

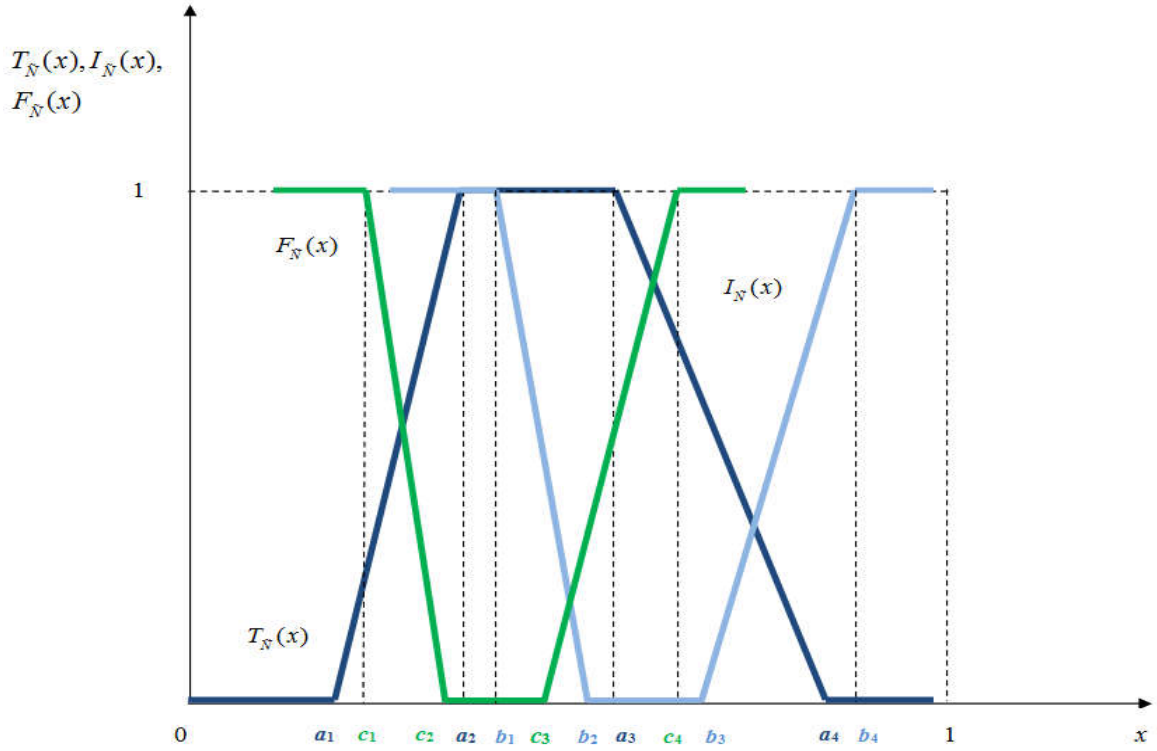
and

$A = \langle (a_{11}, a_{21}, a_{31}, a_{41}), (b_{11}, b_{21}, b_{31}, b_{41}),$

$(c_{11}, c_{21}, c_{31}, c_{41}) \rangle$



Trapezoidal fuzzy neutrosophic numbers



(a) Graphical representation of TrNFN

Diffrence between TFN and NN

- About neutrosophic number(T,I,F) and triangular fuzzy number (a,b,c) although have three parametres;however;the three parametres in triangular fuzzy numbers can only express the membership, and those in neutrosophic number can express the membership function,indterminacy-membership function and non-membership function,So they are completley diffrent

The score function of neutrosophic numbers

- The score function is an important index for evaluating neutrosophic numbers. For a neutrosophic R =<T, I, F > , the truth-membership T is positively correlated with the score function, and the indeterminacy-membership I and false-membership F are negatively correlated with the score function. In terms of the accuracy function, the greater the difference between the truth-membership T and false-membership F is, the more affirmative the statement is. Additionally, in regard to the certainty function, it positively depends on the truth-membership T.

RANKING OF NEUTROSOPHIC NUMBERS

$$S_{1,1}(x) = \frac{2}{3} + \frac{T_x}{3} - \frac{I_x}{3} - \frac{F_x}{3}.$$

$$sc(x) = T_1 + 1 - I_1 + 1 - F_1;$$

$$S_{\alpha,\beta}(x) = \frac{2}{3} + \frac{T_x}{3} - \alpha\frac{I_x}{3} - \beta\frac{F_x}{3},$$

$$K(A) = \frac{1 + a - 2b - c}{2}$$

where $K(A) \in [-1,1]$.

Extensions of neutrosophic sets

The core idea of modeling such a neutrosophic situation has been expanded together with the previous methods and tools to the following new cases:

- to handle the neutrosophic in qualitative environments in which information is linguistic form
- to manage the truth-membership, indeterminacy-membership and falsity-membership

that are not exactly defined but expressed by interval-values, intuitionistic fuzzy sets,

triangular fuzzy sets, cubic sets, bipolar fuzzy set, trapezoidal fuzzy sets, or hesitant

fuzzy set

- to deal with the inadequacy of the parameterized by combining soft set
- to cope with the lower and upper approximations by fusing with rough set
- These extensions are further detailed in the following table ,

Table 1 The extensions of neutrosophic set

Sets	Abbreviation	Proposed
Single valued neutrosophic set	**SVNS**	Wang et al. (2010)
Interval neutrosophic set	**INS**	Wang et al. (2005a)
Simplified neutrosophic set	**SNS**	Ye (2014h)
Neutrosophic soft set	**NSS**	Maji (2013)
Single valued neutrosophic linguistic set	**SVNLS**	Ye (2015a)
Multi-valued neutrosophic set	**MVNS**	Wang and Li (2015)
Rough neutrosophic set	**RNS**	Broumi et al. (2014a)
Simplified neutrosophic linguistic set	**SNLS**	Tian et al. (2016b)
Bipolar neutrosophic set	BNS	Deli et al. (2015)
Trapezoidal neutrosophic set	TNS	Biswas et al. (2014b)
Neutrosophic hesitant fuzzy set	NHFS	Ye (2015d)
Neutrosophic cubic set	NCS	Ali and Deli (2016) and Jun et al. (2017)
Possibility neutrosophic soft set	PNSS	Karaaslan (2017b)
Neutrosophic vague soft expert set	NVSES	Al-Quran and Hassan (2016)
Time neutrosophic soft set	TNSS	Alkhazaleh (2016)
Triangular neutrosophic set	TrNS	Deli and Şubaş (2017b)
Interval-valued neutrosophic soft set	IVNSS	Deli (2017)
Complex neutrosophic set	CNS	Ali and Smarandache (2017)
Normal neutrosophic set	NNS	Liu and Teng (2017a)
Simplified neutrosophic uncertain linguistic set	SNULS	Tian et al. (2018)

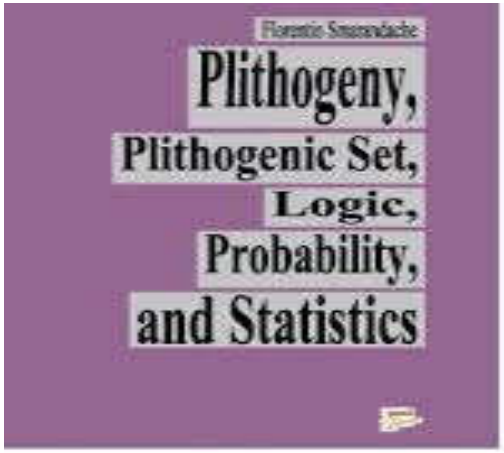
Interval neutrosophic linguistic set	INLS	Ye (2014f)
Single-valued neutrosophic refined soft set	SVNRSS	Karaaslan (2017a)
ivnpiv-Neutrosophic soft set	ivnpiv-NSS	Deli et al. (2018)
Probability multi-valued neutrosophic set	PMVNS	Peng et al. (2016b)
Probability multi-valued linguistic neutrosophic set	PMVLNS	Wang and Zhang (2017)
Interval neutrosophic hesitant fuzzy set	INHFS	Ye (2016a)
Intuitionistic neutrosophic set	InNS	Bhowmik and Pal (2009)
Generalized neutrosophic soft set	GNSS	Broumi (2013)
Intuitionistic neutrosophic soft set	INSS	Broumi and Smarandache (2013b)
Neutrosophic refined set	NRS	Smarandache (2013)
Possibility simplified neutrosophic set	PSNS	Şahin and Liu (2017c)
Linguistic neutrosophic set	LNS	Li et al. (2017)
Single valued neutrosophic trapezoid linguistic set	SVNTLS	Broumi and Smarandache (2014c)
Single-valued neutrosophic uncertain linguistic set	SVNULS	Liu and Shi (2017)
Multi-valued interval neutrosophic set	MVINS	Wang et al. (2005b)

Sets	Abbreviation	Proposed
Single valued neutrosophic rough set	SVNRS	Yang et al. (2017a)
Neutrosophic valued linguistic soft set	NVLSS	Zhao and Guan (2015)
Single valued neutrosophic multiset	SVNM	Ye and Ye (2014)
Single valued multigranulation neutrosophic rough set	SVMNRS	Zhang et al. (2016b)
n-Valued refined neutrosophic soft set	n-VRNSS	Alkhazaleh (2017)
Double-valued neutrosophic set	DVNS	Kandasamy (2018)

The bold eight NS extensions are widely used in real life

Plithogenic sets and plithogenic logic

- plithogenic sets and plithogenic logic which is the generalisation of neutrosophic sets and logic.
- Plithogenic sets can model real-life applications in a better way as they are characterised by one or more attributes which can accommodate many values.

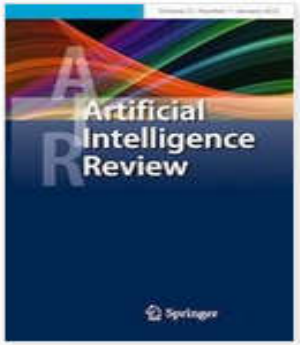


A bibliometric analysis of neutrosophic set: two decades review from 1998 to 2017

-A total of 137 neutrosophic set publication records from Web of Science are analyzed.
-57 pages
-VOSviewer software

18-08-2018 | Issue 1/2020

A bibliometric analysis of neutrosophic set: two decades review from 1998 to 2017



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Authors: Xindong Peng, Jingguo Dai

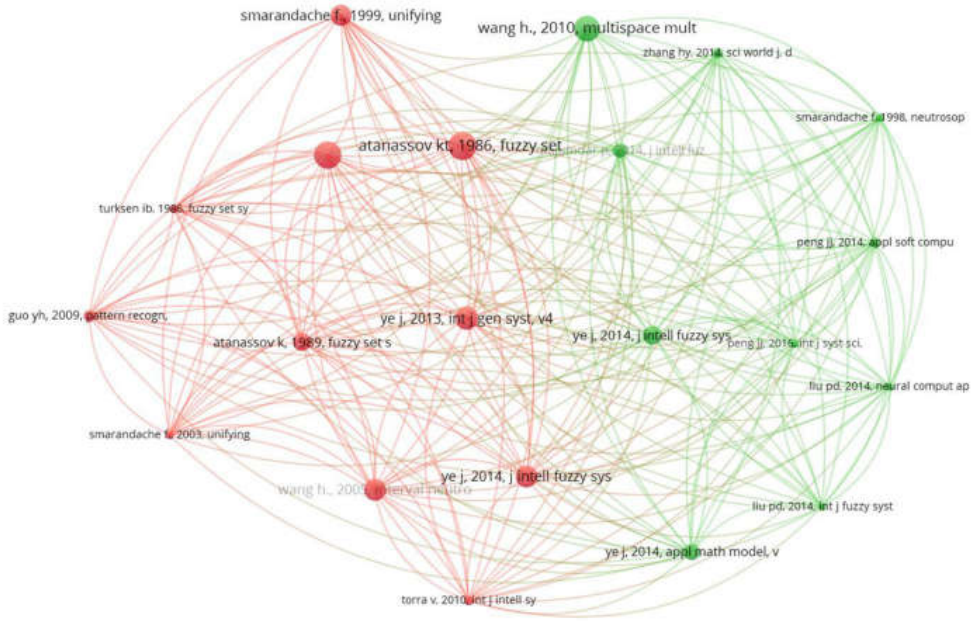


Fig. 7 The reference co-authorship network of NS-related publications

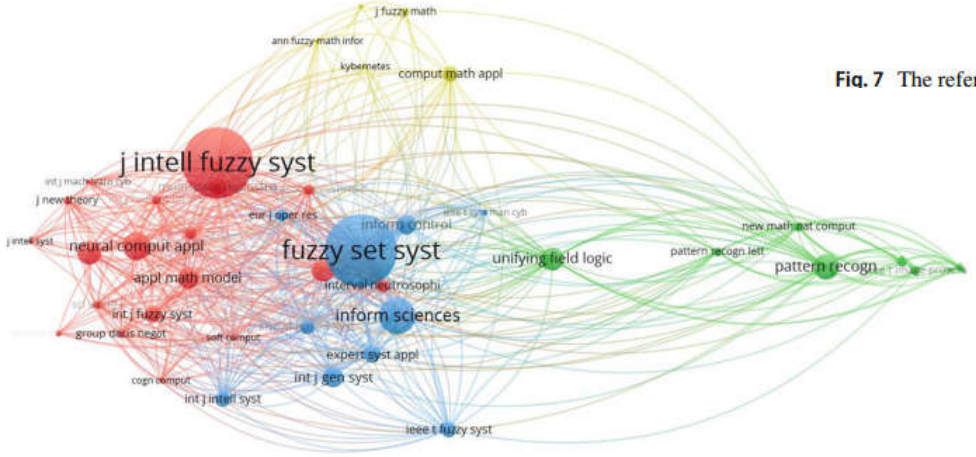


Fig. 8 The journal co-authorship network of NS-related publications

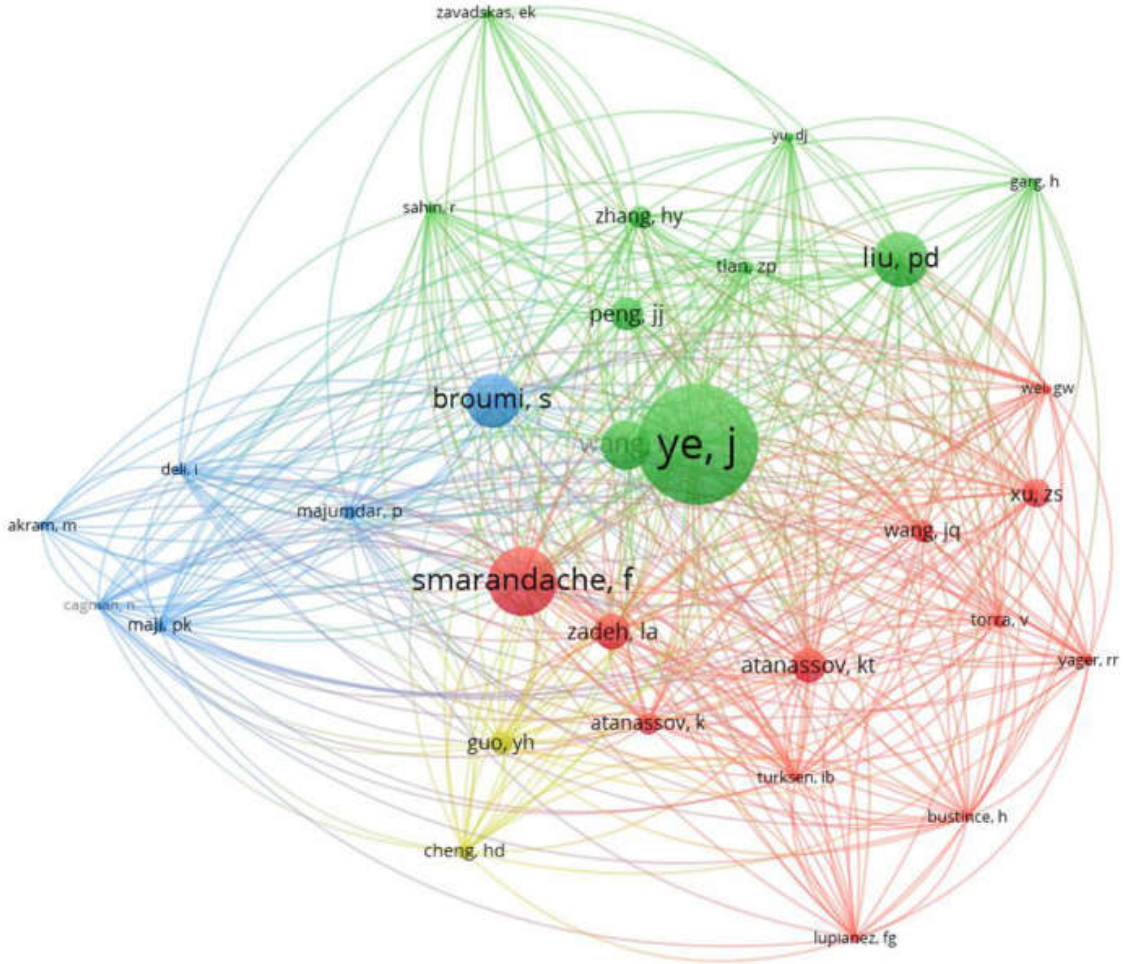
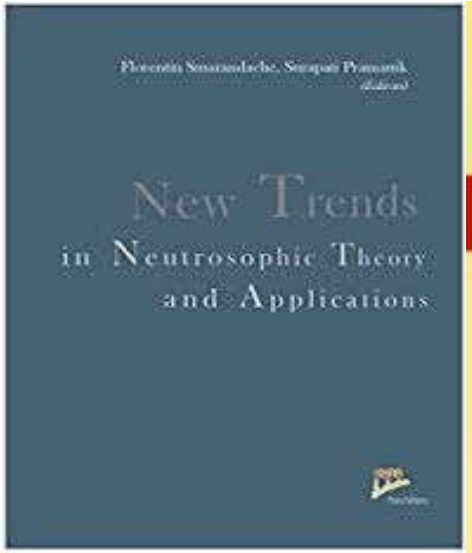


Fig. The author co-authorship network of NS-related publications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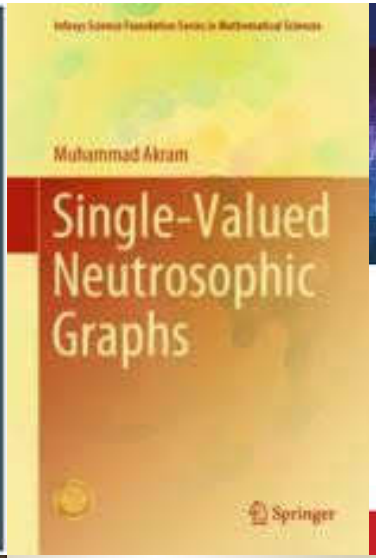
in Neutrosophic Theory
and Applications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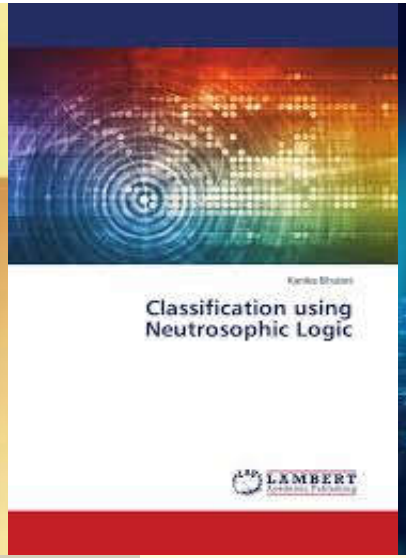
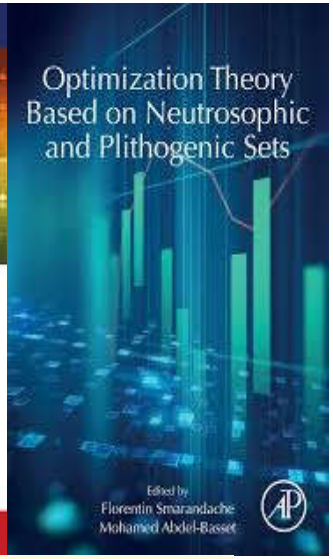

Classification using
Neutrosophic Logic
LAMBERT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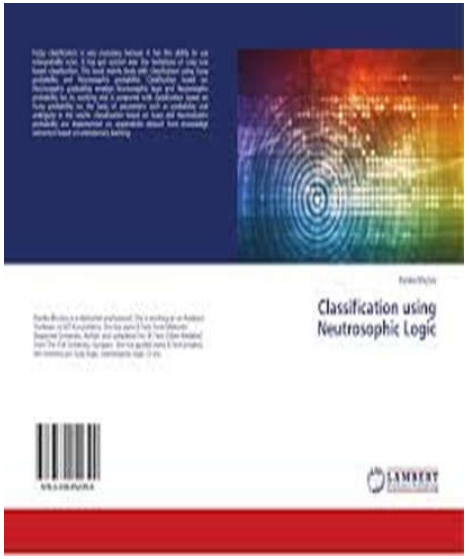
Classification using
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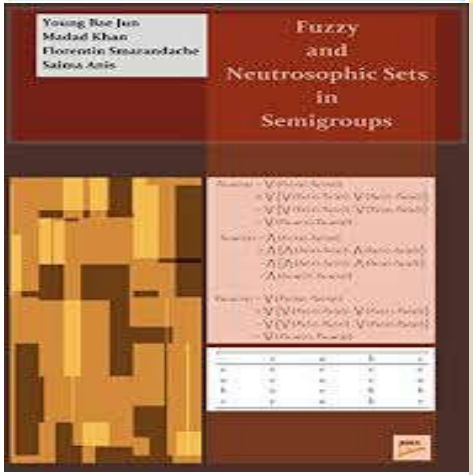
LAMBERT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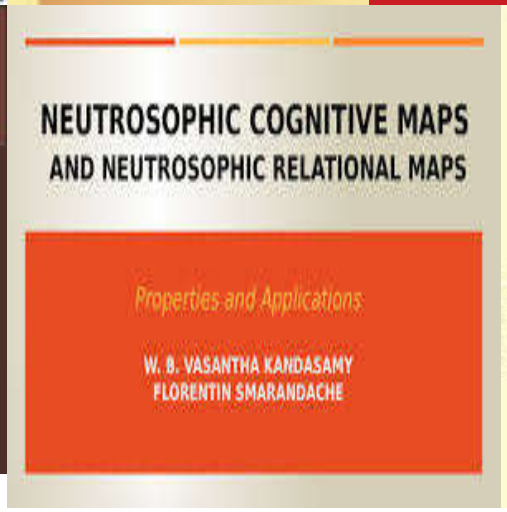
Fuzzy
and
Neutrosophic Sets
in
Semigroups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AND NEUTROSOPHIC RELATIONAL MAPS
Properties and Applications
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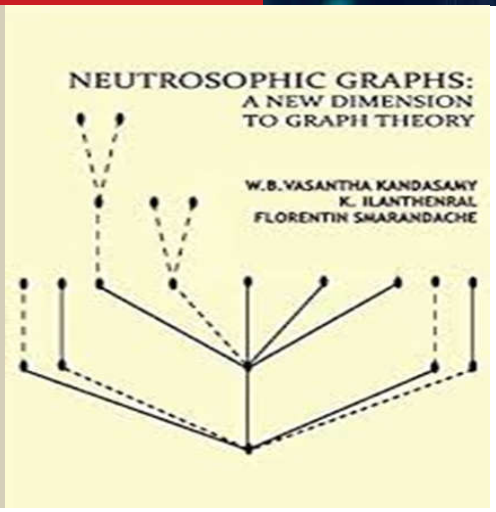
FLORENTIN SMARANDACHE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TO GRAPH THEORY
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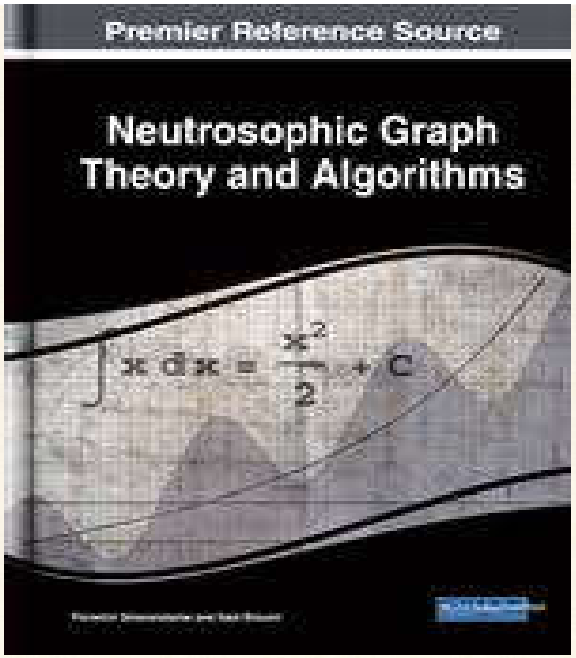
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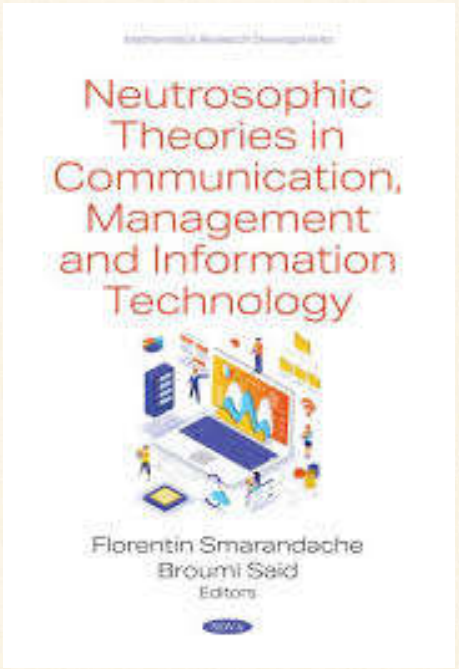
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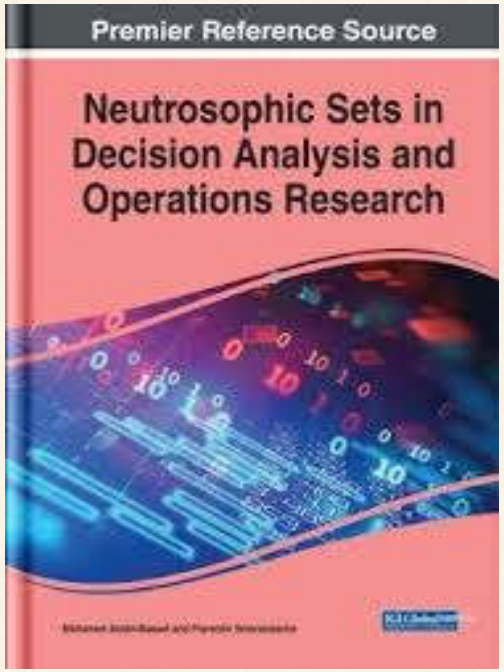
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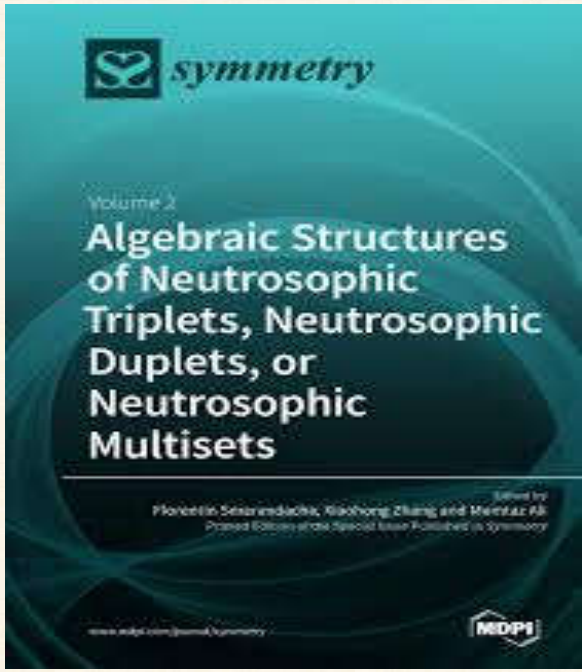
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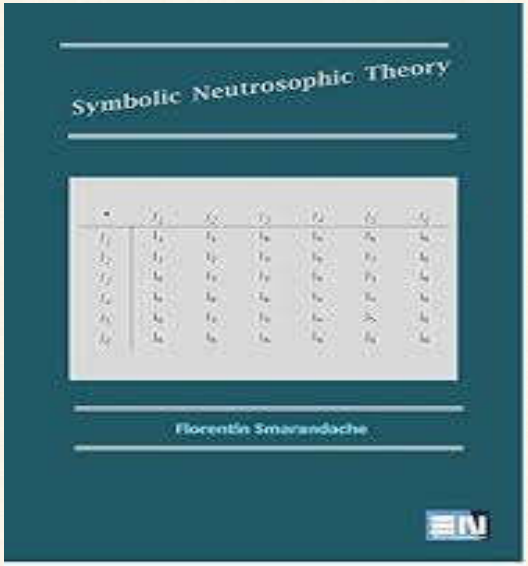
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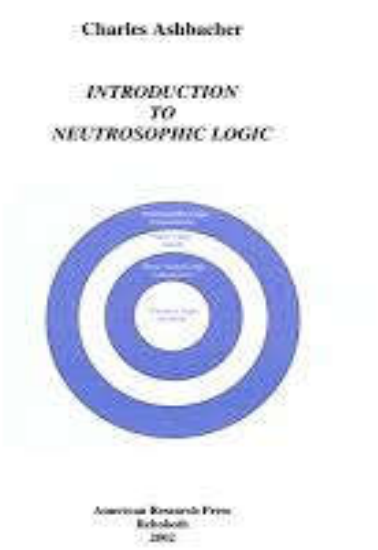
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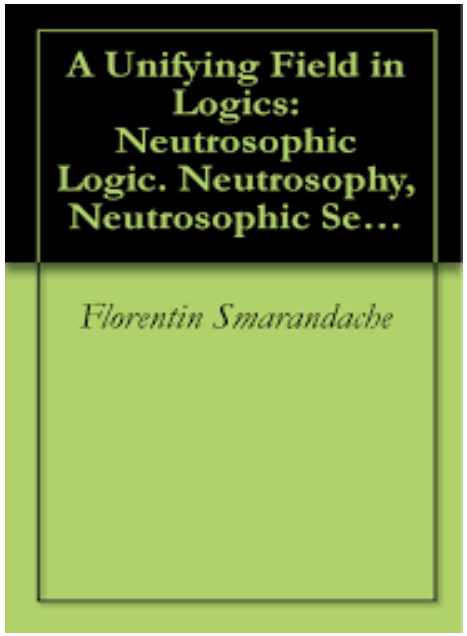
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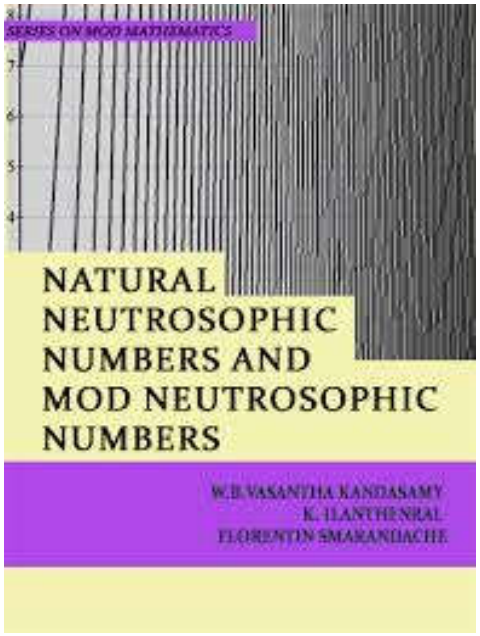
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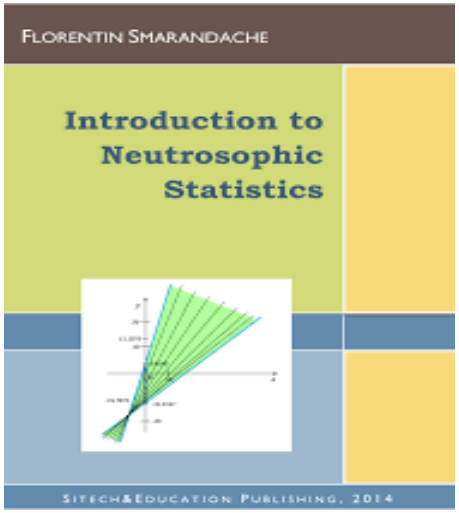
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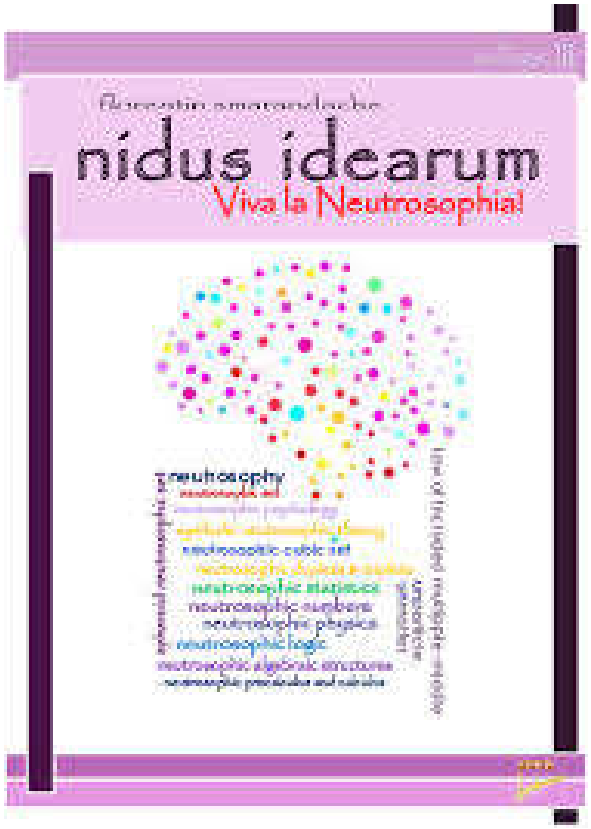

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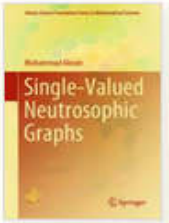

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Book • 2020

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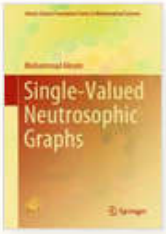

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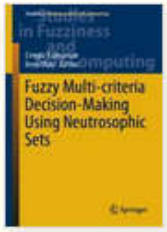

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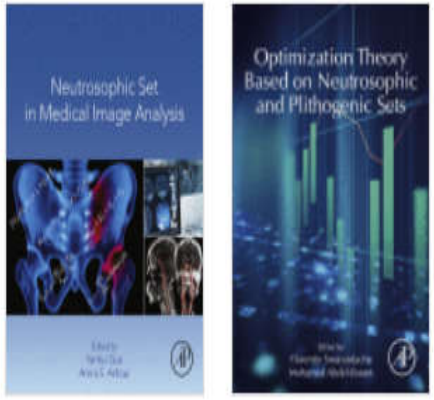

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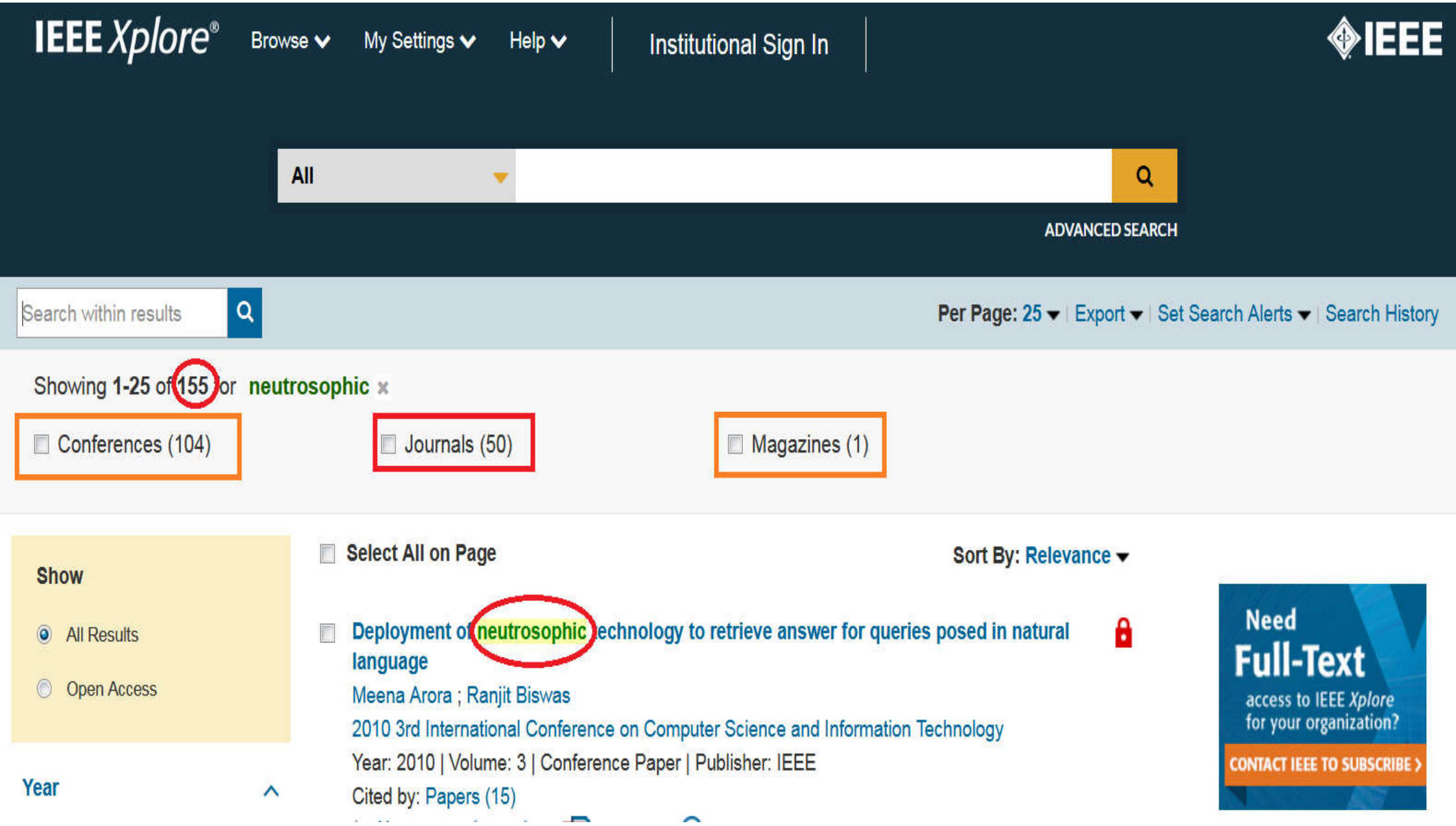
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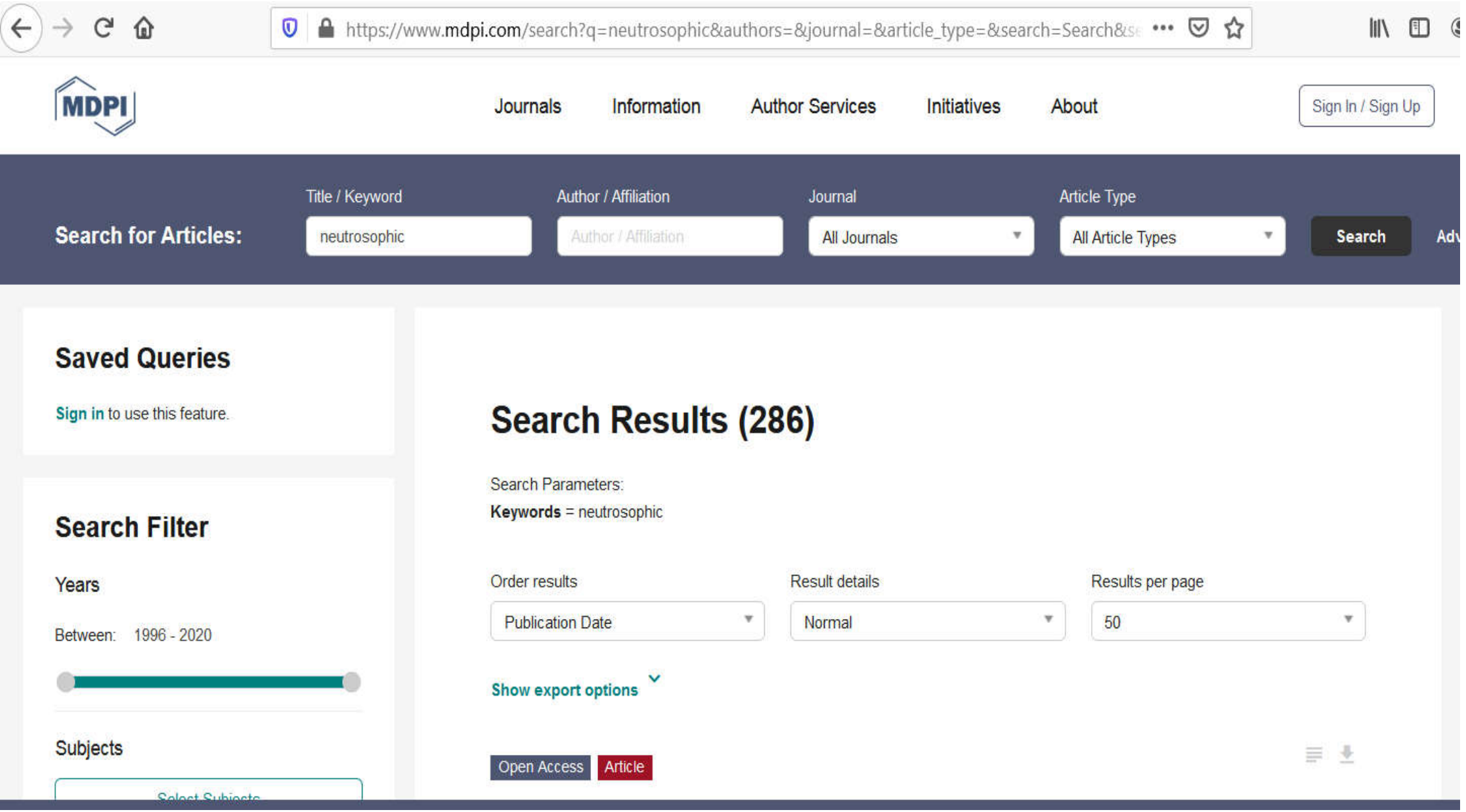
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by Subhadip Roy, Jeong-Gon Lee, Anita Pal and Syamal Kumar Samanta

Symmetry **2020**, *12*(6), 1012; **https://doi.org/10.3390/sym12061012** - 16 Jun 2020

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Abstract In this paper, a definition of quadripartitioned single valued bipolar neutrosophic set (QSVBNS) is introduced as a generalization of both quadripartitioned single valued neutrosophic sets (QSVNS) and bipolar neutrosophic sets (BNS). There is an inherent symmetry in the definition of QSVBNS. Some operations **[...] Read more.**

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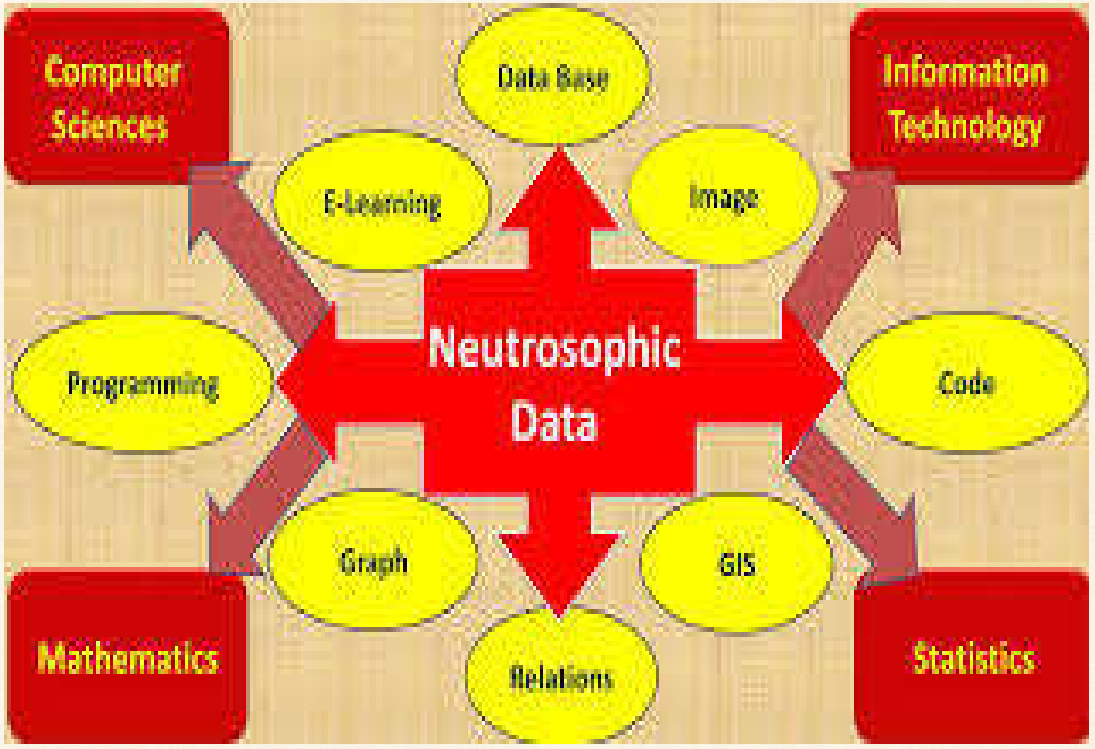

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Neutrosophic set in medical imaging

- Generally, the neutrosophic set (NS) approaches were applied successfully into image processing including image de-noising based on neutrosophic median filtering

Neutrosophic set for medical image de-noising

- Noise is one kind of indeterminant information on images. de-noising research domain Hence, NS can be successfully applied into image.
- The neutrosophic image properties allow the NS to achieve superior performance in several image de-noising applications in computer vision and image processing

Neutrosophic Set in Medical Image Analysis

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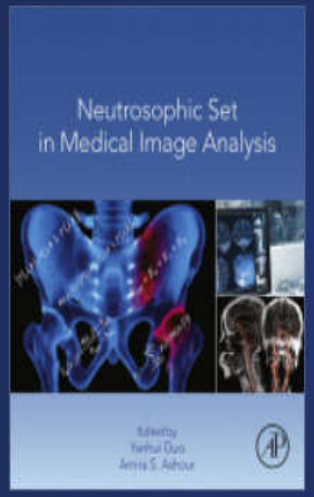

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Doi : 10.1016/j.irbm.2017.11.003

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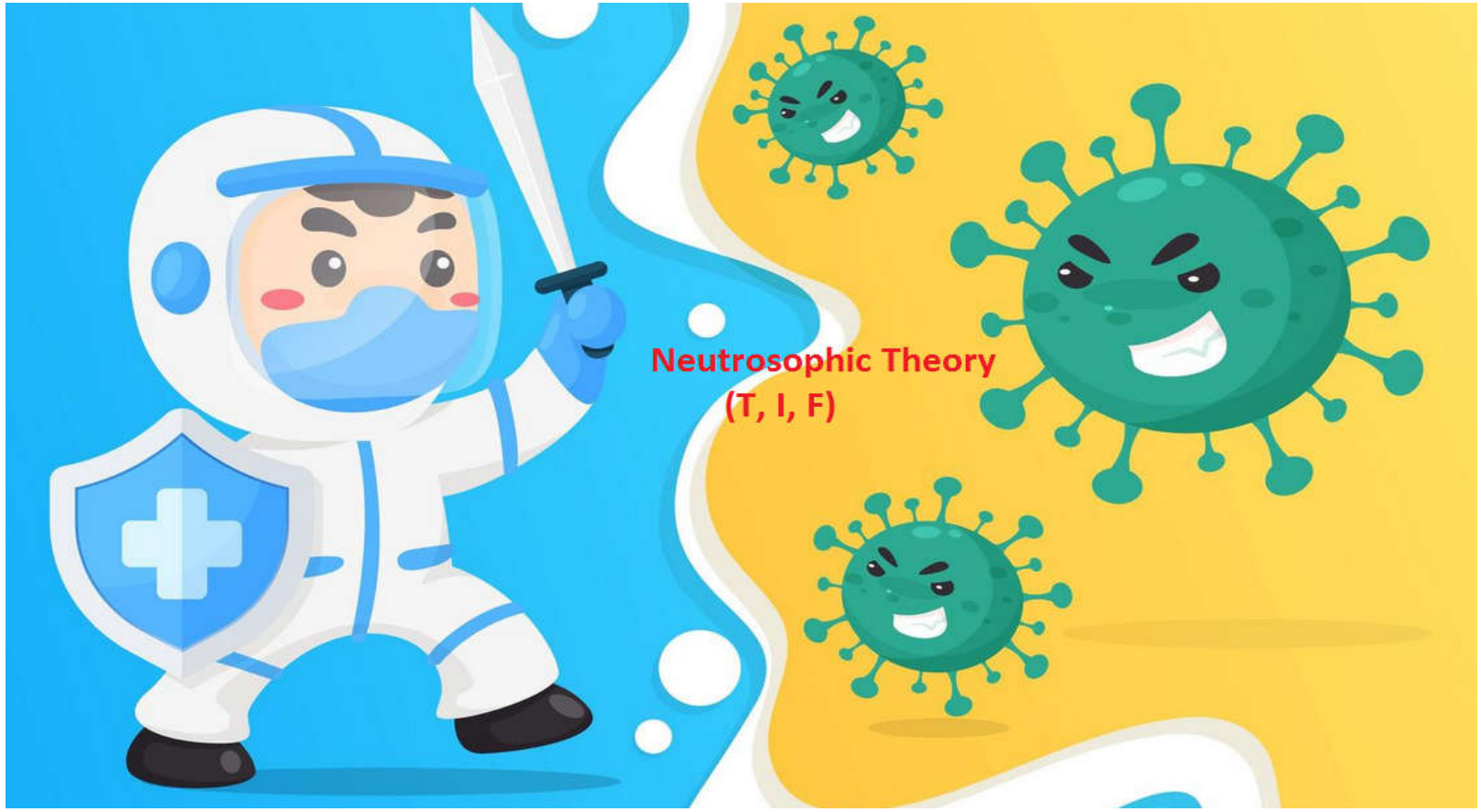

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A Study of the Neutrosophic Set Significance on Deep Transfer Learning Models: An Experimental Case on a Limited COVID-19 Chest X-Ray Dataset

Nour Eldeen M. Khalifa *, Florentin Smarandache, Mohamed Loey

Version 1 : Received: 27 April 2020 / Approved: 28 April 2020 / Online: 28 April 2020 (09:57:20 CEST)

Machine Learning in Neutrosophic environment

List of major contributions on machine learning algorithms in Neutrosophic environment.

Authors	Title	Publisher
Salama, A. A., Eisa, M., ELhafeez, S. A., Lotfy, M. M. (2015)	Review of recommender systems algorithms utilized in social networks based e-Learning systems neutrosophic system	Neutrosophic Sets and Systems 8 : 32-40
Ansari, A. Q., Biswas, R., Aggarwal, S. (2013)	Neutrosophic classifier: An extension of fuzzy classifer	Applied Soft Computing, 13(1), 563-573
Zhang, M., Zhang, L., Cheng, H. D. (2010)	A neutrosophic approach to image segmentation based on watershed method	Signal Processing, 90(5), 1510-1517
Zhang, X., Bo, C., Smarandache, F., Dai, J. (2018)	New inclusion relation of neutrosophic sets with applications and related lattice structure	International Journal of Machine Learning and Cybernetics, 9, 1753-1763
Mondal, K. A. L. Y. A. N., Pramanik, S. U. R. A. P. A. T. I., Giri, B. C. (2016)	Role of neutrosophic logic in data mining. New Trends in Neutrosophic Theory and Application	Pons Editions, Brussels, 15-23.
Sengur, A., Guo, Y. (2011)	Color texture image segmentation based on neutrosophic set and wavelet transformation	Computer Vision and Image Understanding,115(8), 1134-1144
Akbulut, Y., engr, A., Guo, Y., Smarandache, F. (2017)	A novel neutrosophic weighted extreme learning machine for imbalanced data set	Symmetry, 9(8), 142
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Kavitha, B., Karthikeyan, S., Maybell, P. S(2012)	An ensemble design of intrusion detection system for handling uncertainty using Neutrosophic Logic Classifier	Knowledge-Based Systems, 28, 88-96

Ye, J. (2014).	Single-valued neutrosophic minimum spanning tree and its clustering method	Journal of intelligent Systems, 23(3), 311-324
Thanh, N. D., Ali, M. (2017, July)	Neutrosophic recommender system for medical diagnosis based on algebraic similarity measure and clustering	In 2017 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE) (pp. 1-6). IEEE
Akbulut, Y., engr, A., Guo, Y., Polat, K. (2017)	KNCM: Kernel neutrosophic c-means clustering	Applied Soft Computing, 52, 714-724
Kraipeerapun, P., Fung, C. C., Wong, K. W. (2006)	Multiclass classification using neural networks and interval neutrosophic sets	World Scientific and Engineering Academy and Society (WSEAS)
Ali, M., Khan, M., Tung, N. T. (2018)	Segmentation of dental X-ray images in medical imaging using neutrosophic orthogonal matrices	Expert Systems with Applications, 91, 434-441
Long, H. V., Ali, M., Khan, M., Tu, D. N. (2019)	A novel approach for fuzzy clustering based on neutrosophic association matrix	Computers and Industrial Engineering, 127, 687-697
Kraipeerapun, P., Fung, C. C. (2008, February)	Comparing performance of interval neutrosophic sets and neural networks with support vector machines for binary classification problems	In 2008 2nd IEEE International Conference on Digital Ecosystems and Technologies (pp. 34-37). IEEE
Thanh, N. D., Ali, M. (2017)	A novel clustering algorithm in a neutrosophic recommender system for medical diagnosis	Cognitive Computation, 9(4), 526-544

Safety analysis of marine system

Safety modelling of marine systems using neutrosophic logic

- Neutrosophic sets and logic using IF-THEN rules has been proposed to capture uncertainty and make less risky decisions in risk/safety assessment
- The model is proposed to explore the concept of neutrosophic logic further in risk / safety analysis with complex engineering systems
- Linear tr**apezoidal neutrosophic number** is used to collect the subjective data from experts
- Quantification and deneutrosophication of collected data are done to help use the neutrosophic logic IFTHEN rules
- The proposed Model was compared and validated with an example of risk and safety analysis of critical system with high degree of uncertainty on board ship
- The proposed Model can be effectively used in qualitative modelling of the systems for decision-making

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Sunay P Pai, Rajesh S Prabhu Gaonkar

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A. Olaru, S. Olaru, N. Mihai, and N. Smidova

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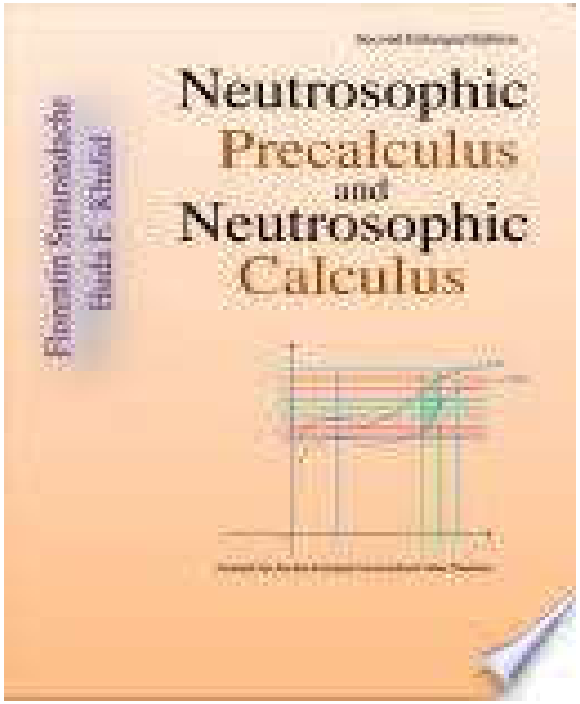

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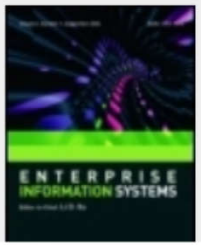

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Received 04 Jan 2019, Accepted 16 Jun 2019, Published online: 27 Jun 2019

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Neutrosophic approach in data warehouse concepts

International Journal of Neutrosophic Science (IJNS) *Vol. 8, No. 2, PP. 87-109, 2020*

Online Analytical Processing Operations via Neutrosophic Systems

A. A. Salama[1], M.S.Bondok Henawy[2], Rafif Alhabib[3]

[1,2]Department of Mathematics and Computer Science, Faculty of Sciences, Port Said University Egypt.
drsalama44@gmail.com
[3]Department of Mathematical Statistics, Faculty of Science, Albaath University, Homs, Syria;
rafif.alhabib85@gmail.com

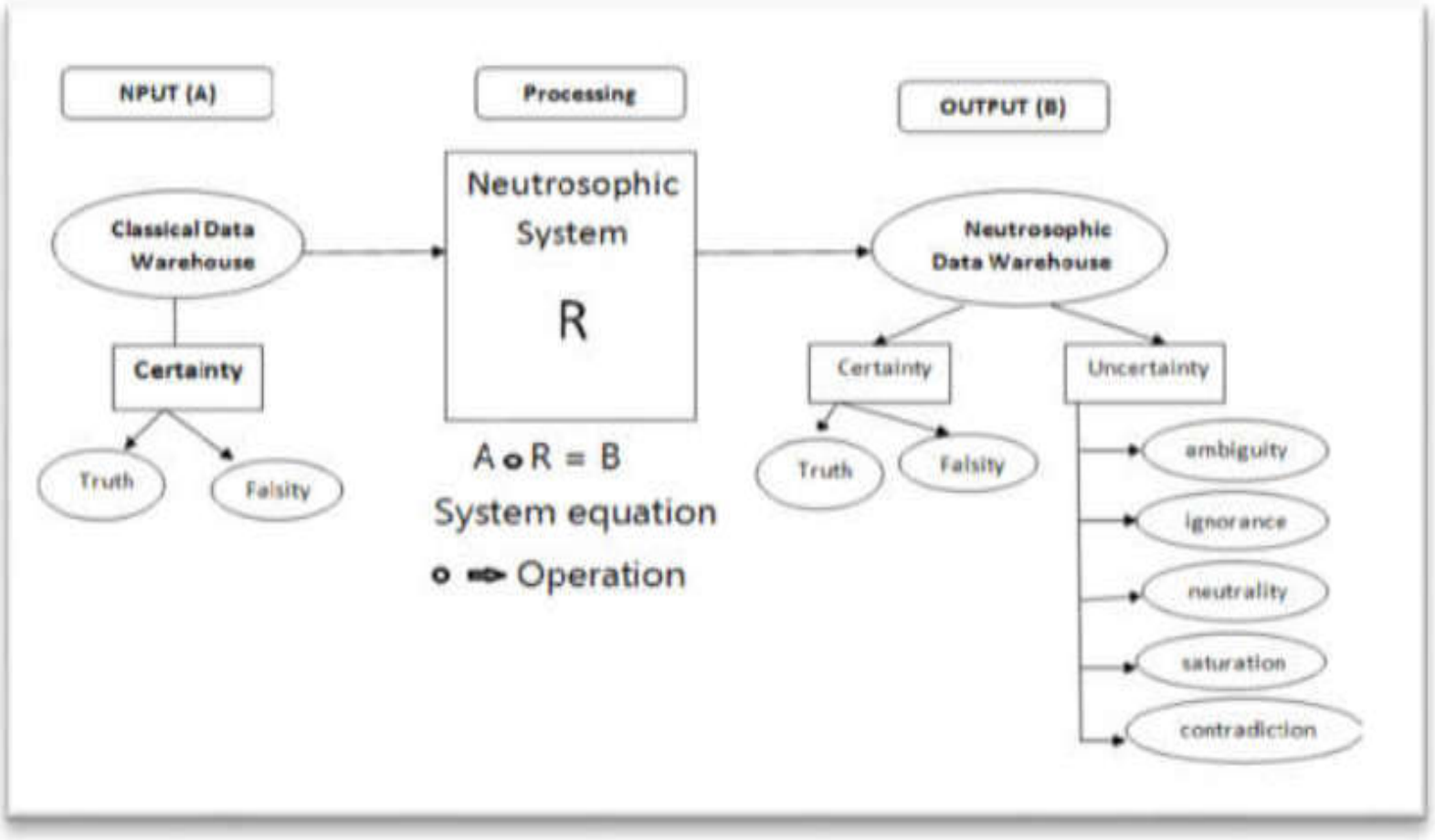

Figure 1: convert classical data warehouse into Neutrosophic Fuzzy Data warehouse

Open Access Feature Paper Article

Neutrosophic Association Rule Mining Algorithm for Big Data Analysis

by Mohamed Abdel-Basset [1,*], Mai Mohamed [1], Florentin Smarandache [2,*] and Victor Chang [3]

MANET, WIRLESS Network and telephony

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Volume 2018 | Article ID 5828517 | 10 pages | https://doi.org/10.1155/2018/5828517

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Haitham Elwahsh,[1] Mona Gamal,[2] A. A. Salama,[3] and I. M. El-Henawy[4]

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Author

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  (Department of Mathematics, Faculty of Mathematics, Payame Noor University, Tehran, Iran)
- Arsham Borumand Saeid
  (arsham@uk.ac.ir) (Department of Pure Mathematics, Faculty of Mathematics and Computer, Shahid Bahonar University of Kerman, Kerman, Iran)

Global Journal of Computer Science and Technology: E
Network, Web & Security
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Novel System and Method for Telephone Network Planing based on Neutrosophic Graph

By Said Broumi, Kifayat Ullah, Assia Bakali, Mohamed Talea, Prem Kumar Singh, Tahir Mahmood, Florentin Smarandache, Ayoub Bahnasse, Santanu Kumar Patro & Angelo de Oliveira

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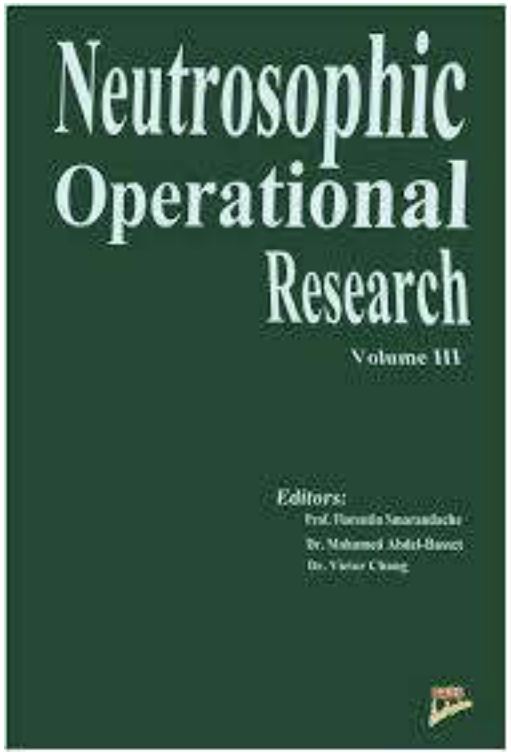
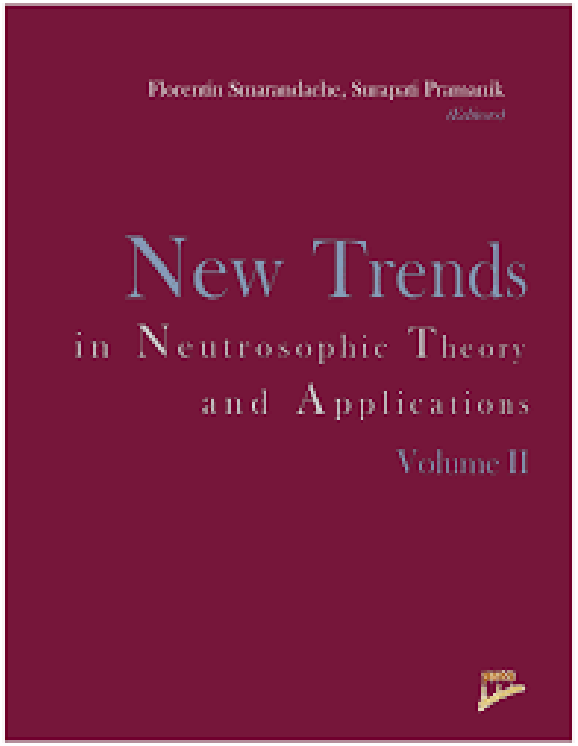
Neutrosophic operational Research





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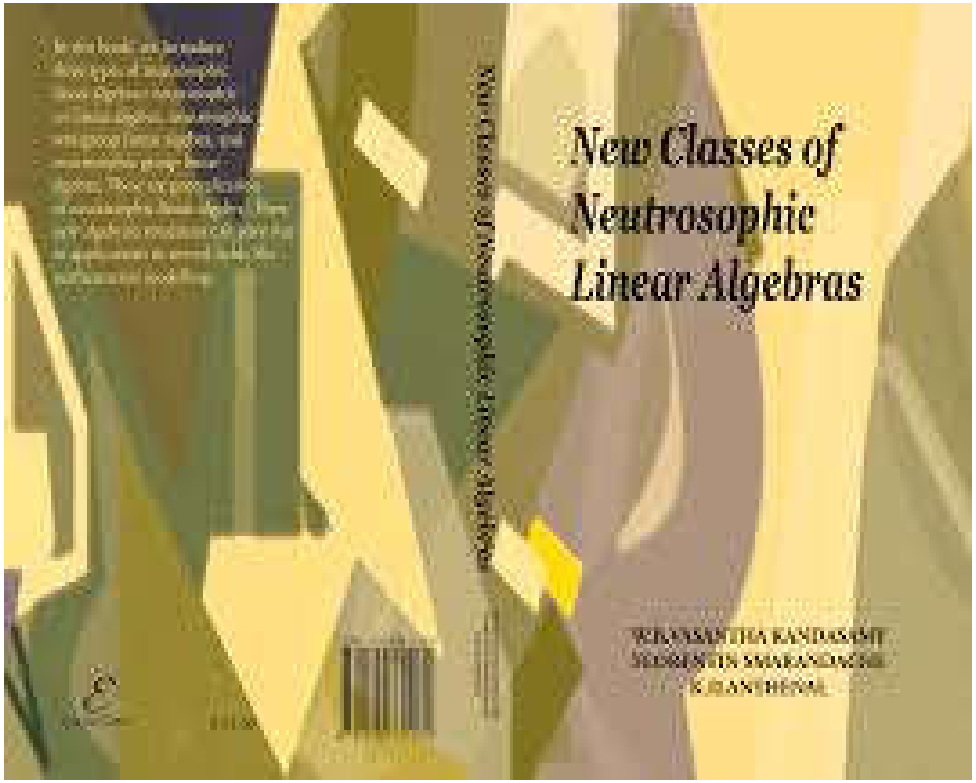

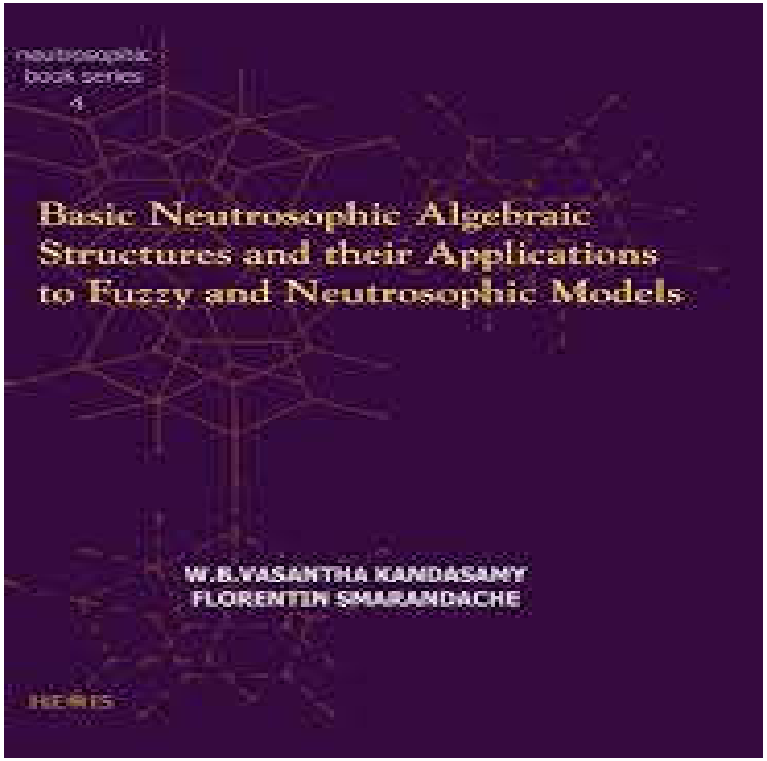

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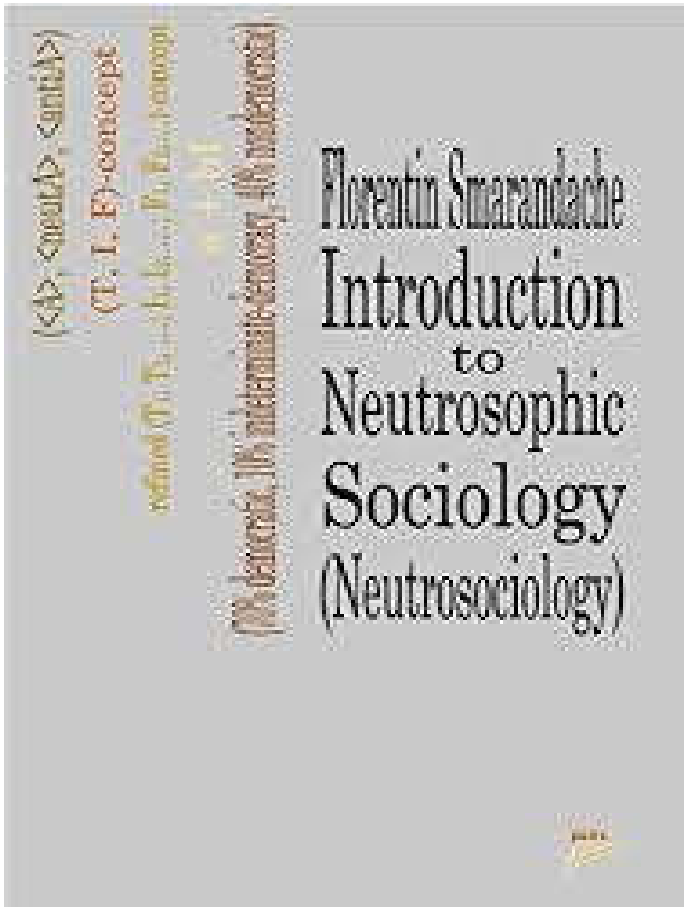

The physical world as seen through human eyes at the most immediate level is organized into three categories: average, above average, and below average. This basic perception can be applied to any observation. Typically in sociology, one of the basic criteria of (socio-professional) classification is to consider 3 levels of wealth: the middle, upper and lower classes.

Neutrosophic Quantum Computer

Intern. J. Fuzzy Mathematical Archive
Vol. 10, No. 2, 2016, 139-145
ISSN: 2320 –3242 (P), 2320 –3250 (online)
Published on 12 May 2016
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Neutrosophic Quantum Computer

Florentin Smarandache
University of New Mexico
Mathematics & Science Department
705 Gurley Ave., Gallup, NM 87301, USA
Email: smarand@unm.edu

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Article

Neutrosophic Logic Based Quantum Computing

Ahmet Çevik [1], Selçuk Topal [2,*] and Florentin Smarandache [3]

1 Gendarmerie and Coast Guard Academy, Department of Science, Ankara 06805, Turkey, a.cevik@hotmail.com
2 Department of Mathematics, Faculty of Science and Arts, Bitlis Eren University, Bitlis 13000, Turkey
3 Department of Mathematics, University of New Mexico, Gallup, NM 87301, USA; smarand@unm.edu
* Correspondence: s.topal@beu.edu.tr; Tel.: +90-532-709-0239

Received: 18 October 2018; Accepted: 16 November 2018; Published: 20 November 2018

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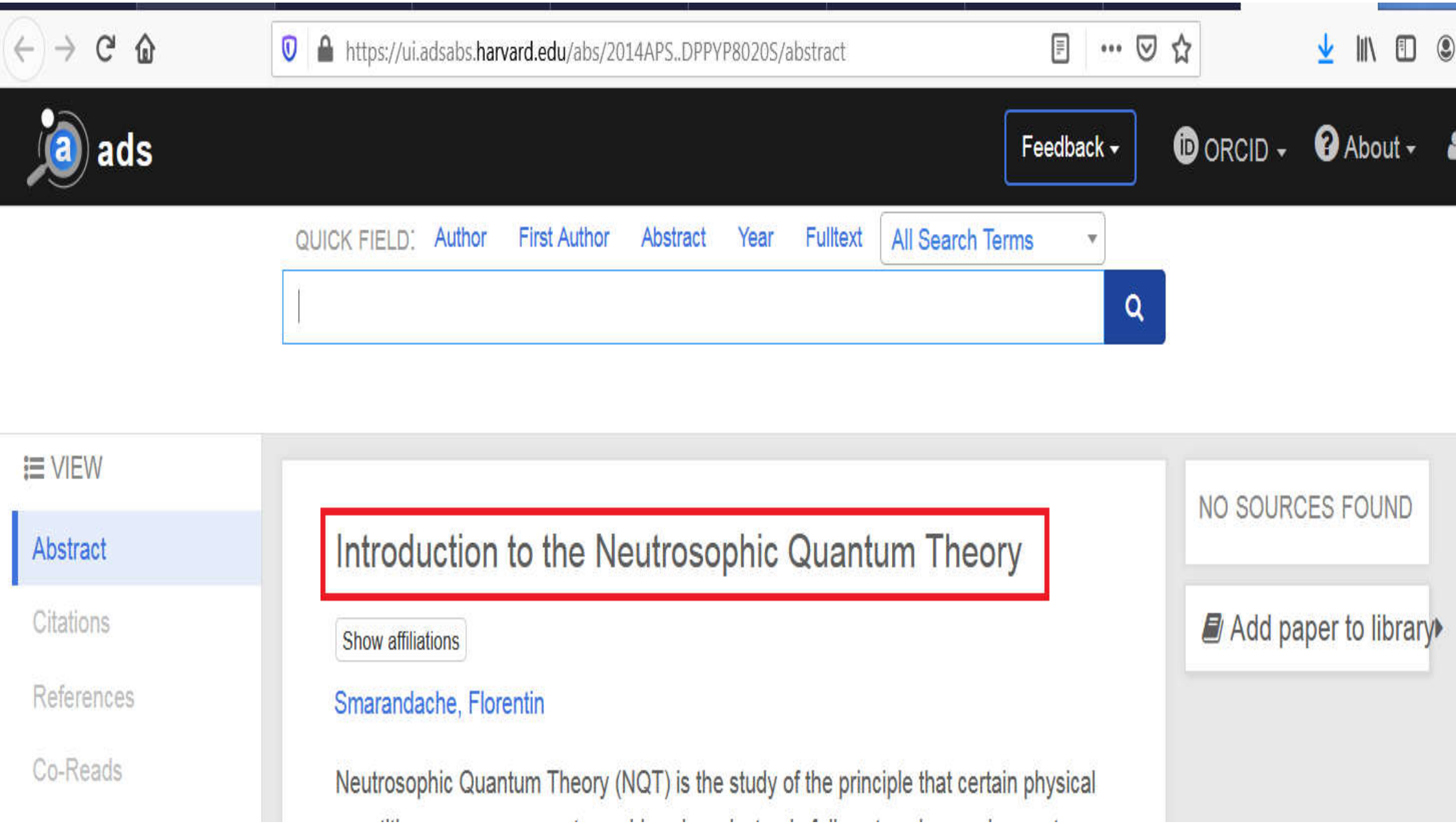
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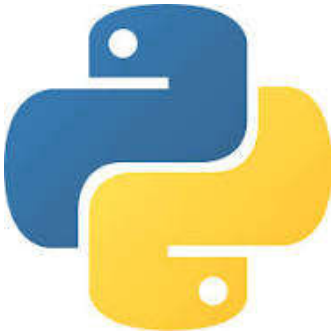


- A lot of researches has been proposed neutrosophic to solve problems but proposed algorithms and solutions misses of basic operations calculations tool to build on it .**SVNS and IVNS** are sharing a good percentage of those proposals and preferred in many situations.
- The Neutrosophic python tool allow researchers to perform operations on:

Interval-valued neutrosophic sets (IVNS. Operations can be done over matrices of IVNS.

Single-valued neutrosophic sets (SVNS. Operations can be done over matrices of SVNS).

- The neutrosophic Python tool can be embedded in other software or tool or it can be used via its web application.

Neutrosophic python
online running web application

Neutrosophic Sets and Systems Projects

Projects Implemented by Python.

IVNS Operations Neoutrosophic Matrix Normalization

Interval valued neutrosophic sets

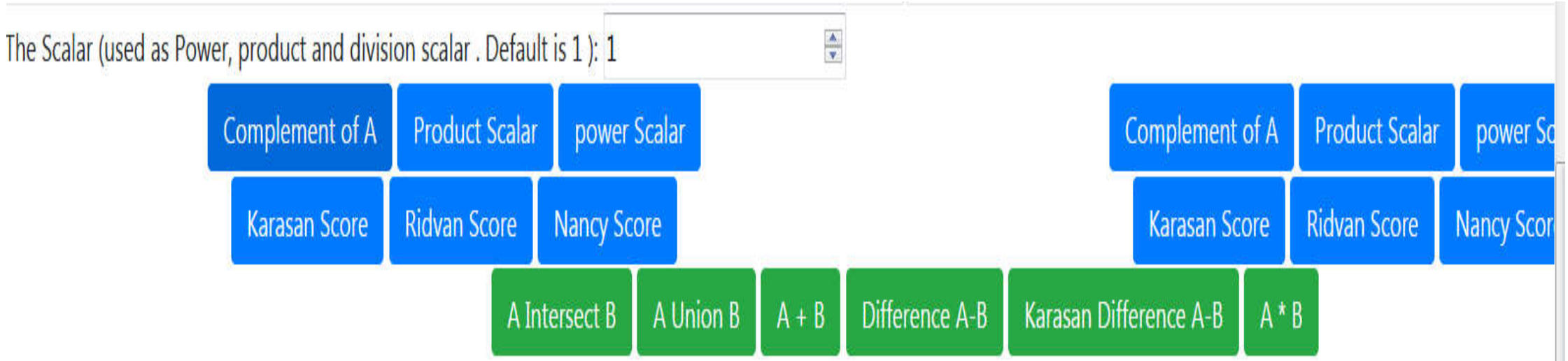
You can copy and paste your neutrosophic matrix here.
each elment in form of <[TL,TU],[IL,IU],[FL,FU]>
use **double** space between elements and use **new line** for new row.
Matrix A and B must have the same size for operations implemnted on both of them like intersection.

Matrix A

<[.2,.5],[.2,.4],[.1,.5]> <[.1,.4],[.3,.6],[.1,.4]>
<[.1,.3],[.2,.3],[.3,.7]> <[.2,.7],[.1,.4],[.4,.6]>
<[.3,.5],[.1,.3],[.2,.3]> <[.3,.8],[.2,.2],[.3,.7]>
<[.4,.6],[.2,.4],[.1,.5]> <[.1,.5],[.3,.6],[.2,.8]>

Matrix B

<[.3,.4],[.2,.6],[.1,.3]> <[.1,.6],[.2,.4],[.1,.5]>
<[.3,.7],[.1,.6],[.2,.5]> <[.1,.3],[.1,.4],[.2,.7]>
<[.2,.3],[.1,.4],[.1,.3]> <[.3,.6],[.1,.5],[.2,.6]>
<[.2,.4],[.1,.3],[.4,.5]> <[.2,.2],[.2,.4],[.2,.6]>



Result - Complement of Matrix A - :

<[0.1,0.5],[0.6,0.8],[0.2,0.5]> <[0.1,0.4],[0.4,0.7],[0.1,0.4]>
<[0.3,0.7],[0.7,0.8],[0.1,0.3]> <[0.4,0.6],[0.6,0.9],[0.2,0.7]>
<[0.2,0.3],[0.7,0.9],[0.3,0.5]> <[0.3,0.7],[0.8,0.8],[0.3,0.8]>
<[0.1,0.5],[0.6,0.8],[0.4,0.6]> <[0.2,0.8],[0.4,0.7],[0.1,0.5]>

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fx plos

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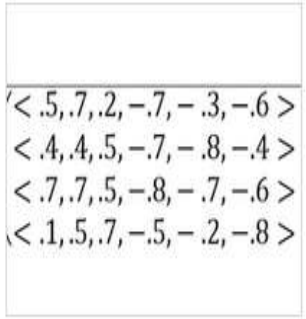

A Matlab Toolbox for Bipolar Neutrosophic Matrices version 1.0.1 by said broumi

★★★★★

2 Downloads

Updated 2 Jun 2019

Software package for computing bipolar neutrosophic operational matrices

This toolbox is built in order to compute the operations of union, intersection, complement, transpose and other operations of bipolar neutrosophic matrices. Bipolar neutrosophic matrices are

fx transpose - bipolar neutrosophic matrix A

fx power - of bipolar neutrosophic matrix A

fx complement - of bipolar valued neutrosophic matrix A

fx display - s bipolar neutrosophic matrix A formated on the screen

fx intersect

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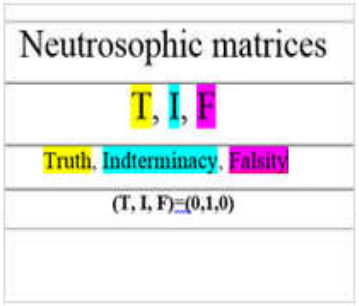
Toolbox



toolbox for the interval valued bipolar neutrosophic matrice version 1.0.0 by said broumi

software package for computing operations on interval valued bipolar neutrosophic matrices

This package is used to calculate the operations on interval valued bipolar neutrosophic matrices This package is descriped with examples in a submited articlethis pakage is under construction and

- *fx* transpose - interval valued bipolar neutrosophic matrix A
- *fx* minmaxmax - of two interval valued bipolar neutrosophic matrix A and B
- *fx* ivbnm
- *fx* isempty
- *fx* complement

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Toolbox

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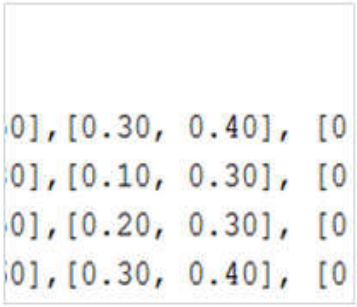

A Matlab Toolbox for Interval Valued Neutrosophic Matrices version 1.0.0 by said broumi

Software package for computing a variety of operations on interval valued neutrosophic matrices

A Matlab Toolbox for Interval Valued Neutrosophic Matrices for Computer ApplicationsThis pakage aims to provide an new tools to be utilized in Neutrosophic community. This pakages was developped in

- *fx* transpose - interval valued neutrosophic matrix A
- *fx* power - of interval valued neutrosophic matrix A
- *fx* complement - of an interval valued neutrosophic matrix A
- *fx* scalar - of interval valued neutrosophic matrix A
- *fx* Spec - trum of an interval valued neutrosophic matrix A

★★★★★
5 Downloads
Updated 27 May 2019

Implementation of Neutrosophic Function Memberships Using MATLAB Program

Definition:A trapezoidal neutrosophic number $a=\langle (a,b,c,d);w_a,u_a,y_a\rangle$ is a special neutrosophic set on the real number set R, whose truth-membership, indeterminacy– membership and falsity-membership functions are defined as follows:

$$\mu_a(x)=\begin{cases}\dfrac{(x-a)}{(b-a)}w_a & , \quad a\le x\le b\\ w_a & , \quad b\le x\le c\\ \dfrac{(d-x)}{(d-c)}w_a & , \quad c\le x\le d\\ 0 & , \quad otherwise\end{cases}$$

$$v_a(x)=\begin{cases}\dfrac{(b-x)+u_a(x-a)}{(b-a)} & , \quad a\le x\le b\\ u_a & , \quad b\le x\le c\\ \dfrac{(x-c)+u_a(d-x)}{(d-c)} & , \quad c\le x\le d\\ 1 & , \quad otherwise\end{cases}$$

$$\lambda_a(x)=\begin{cases}\dfrac{(b-x)+y_a(x-a)}{(b-a)} & , \quad a\le x\le b\\ y_a & , \quad b\le x\le c\\ \dfrac{(x-c)+y_a(d-x)}{(d-c)} & , \quad c\le x\le d\\ 1 & , \quad otherwise\end{cases}$$

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fx Spec - trum of an interval valued neutrosophic matrix A

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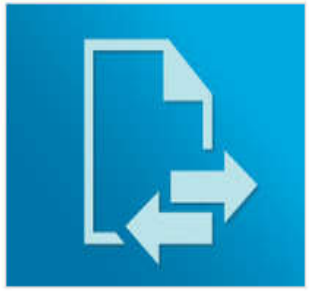

Matlab code to find Trapezoidal Neutrosophic Function version 1.0.1 by said broumi

A novel Matlab code for trapezoidal neutrosophic function

the matlab code of trapezoidal neutrosophic function is generalisation of trapezoidal fuzzy function and trapezoidal intuitionistic fuzzy function.

Function

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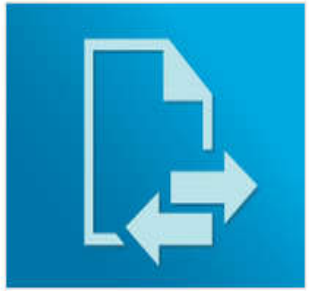

A Neutrosophic Recommender System for Medical Diagnosis Based on Algebraic Neutrosophic Measures version 1.0 by pham viet

Implementation of Neutrosophic Recommender System

Implementation of Neutrosophic Recommender System

Toolbox

1 Download

Updated 4 Feb 2016

Trapezoidal neutrosophic Function (trin)

```
%x=45:70;
%[y,z]=trin(x,50,55,60,65, 0.6, 0.4,0.6)%

U truth membership
V indterminacy membership
W :falsemembership

function [y,z,t]=trin(x,a,b,c,d,u,v,w)
y=zeros(1,length(x));
z=zeros(1,length(x));
t=zeros(1,length(x));
for j=1:length(x)
if(x(j)<=a)
    y(j)=0;
    z(j)=1;
    t(j)=1;
elseif(x(j)>=a)&&(x(j)<=b)
y(j)=u*(((x(j)-a)/(b-a)));
z(j)=(((b-x(j))+v*(x(j)-a))/(b-a));
t(j)=(((b-x(j))+w*(x(j)-a))/(b-a));
elseif(x(j)>=b)&&(x(j)<=c)
y(j)=u;
    z(j)=v;
    t(j)=w;
```

4.1 Example

The figure 1 portrayed the pictorical representation of the trapezoidal neutrosophic function $a=\langle(0.3,0.5,0.6,0.7);0.4,0.2,0.3\rangle$

The line command to show this function in Matlab is written below:

```
x=0:0.01:1;
[y,z,t]=trin(x,0.3,0.5,0.6,0.7, 0.4, 0.2,0.3)
```

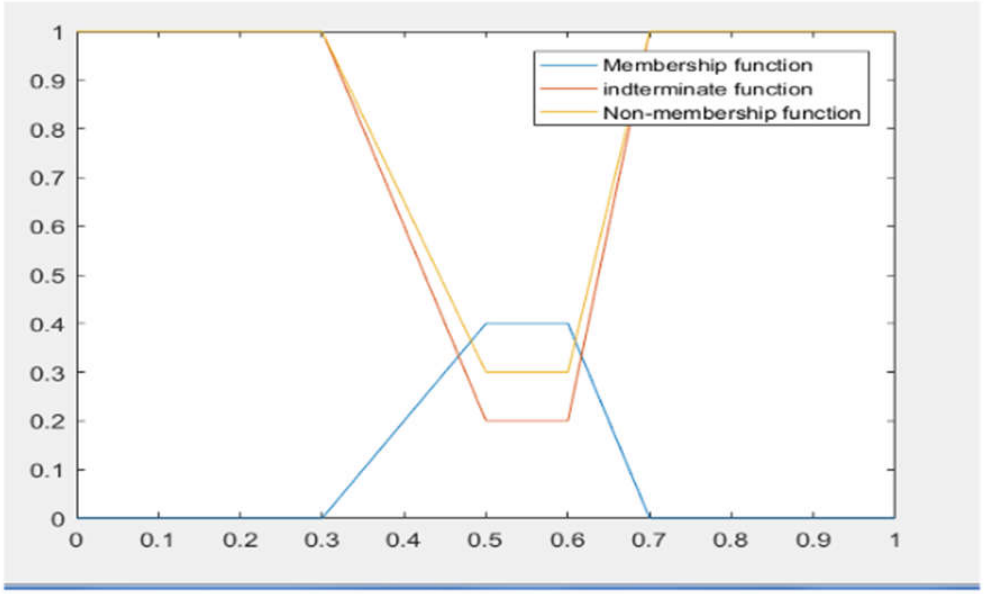

Figure 1: Trapezoidal neutrosophic function for example 4.1

neutrosophic 0.0.5

```
pip install neutrosophic
```

Latest version

Released: Oct 30, 2019

Novel Open Source Python based Neutrosophic Package

Navigation

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- Download files

Statistics

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Project description

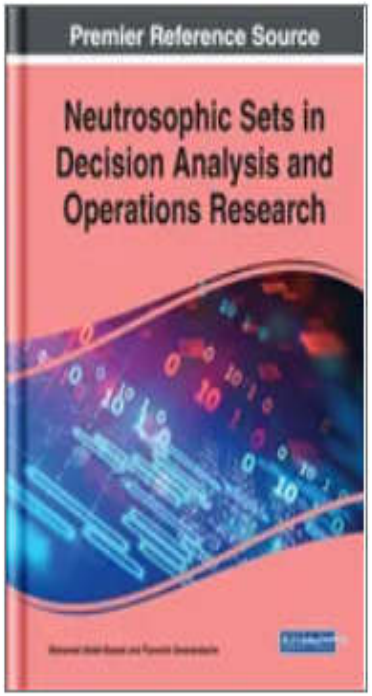
بسم الله الرحمن الرحيم

Open Source Neutrosophic Package

This project aims to provide an open-source Python package to be utilized in Neutrosophic research, academia, and insdustry. This project was initialized in 6th of January 2019.

Publications

Publications of the Projet



A Novel Python Toolbox for Single and Interval-Valued Neutrosophic Matrices

Said Broumi (Laboratory of Information Processing, Faculty of Science Ben M'Sik, University Hassan II, Morocco), Selçuk Topal (Faculty of Science and Arts, Bitlis Eren University, Turkey), Assia Bakali (Ecole Royale Navale, Casablanca, Morocco), Mohamed Talea (Laboratory of Information Processing, Faculty of Science Ben M'Sik, University Hassan II, Morocco) and Florentin Smarandache (Department of Mathematics, University of New Mexico, USA)

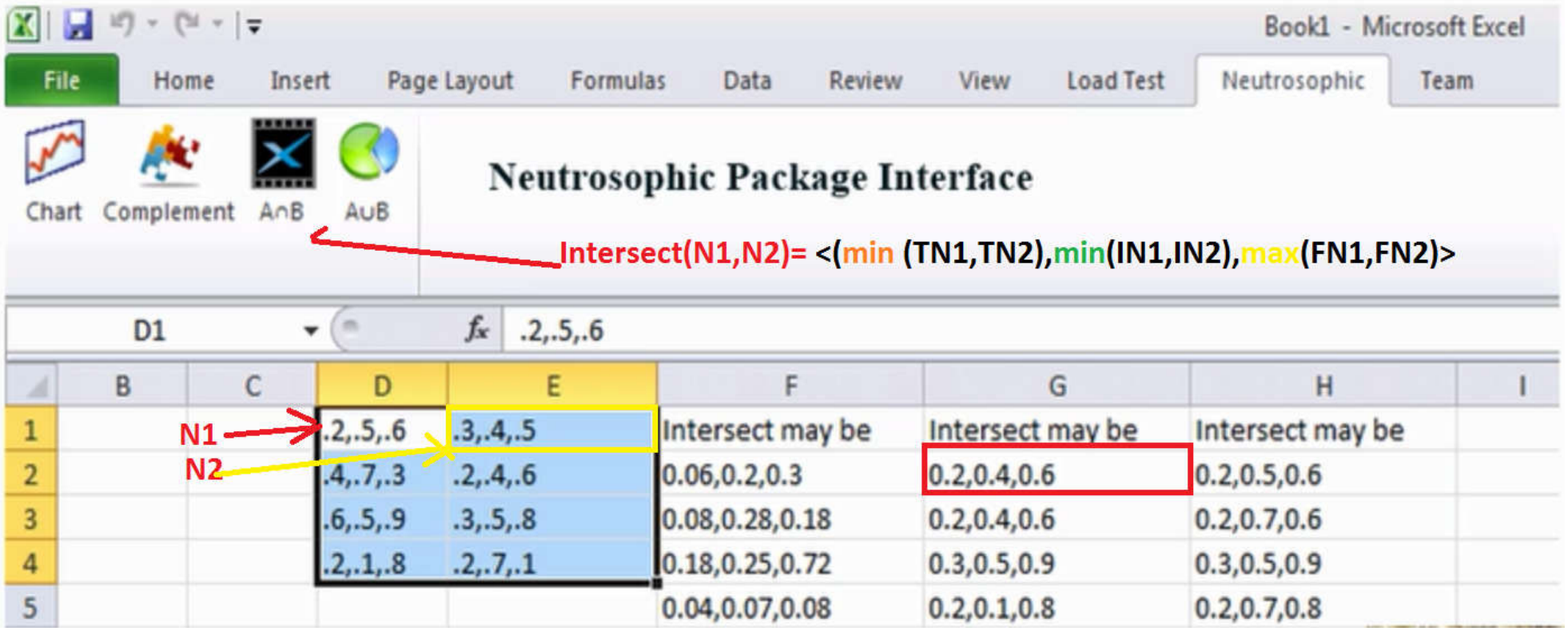
Source Title: Neutrosophic Sets in Decision Analysis and Operations Research

 | Pages: 50

DOI: 10.4018/978-1-7998-2555-5.ch013

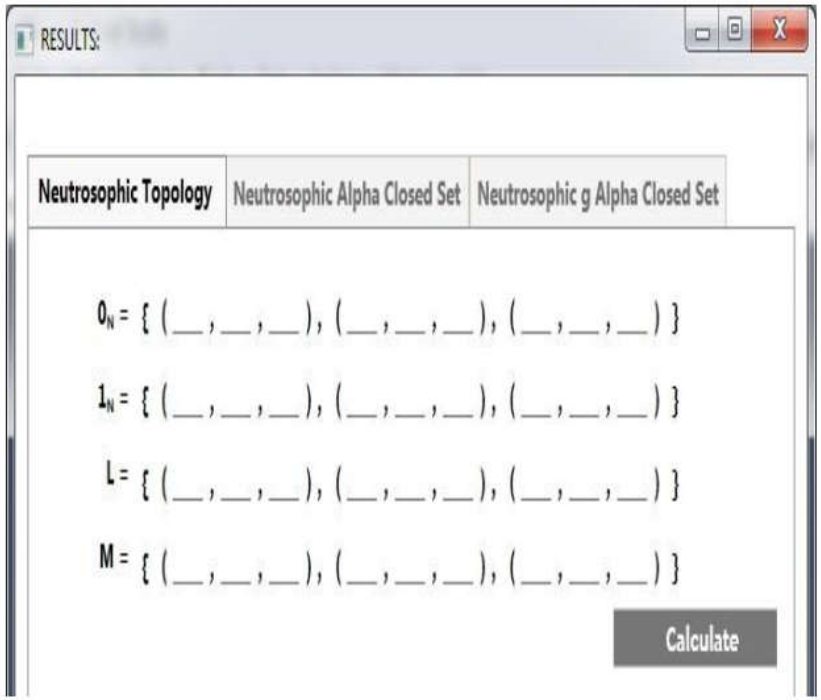
Neutrosophic Excel package

- utilized for calculating neutrosophic data and analyze them.

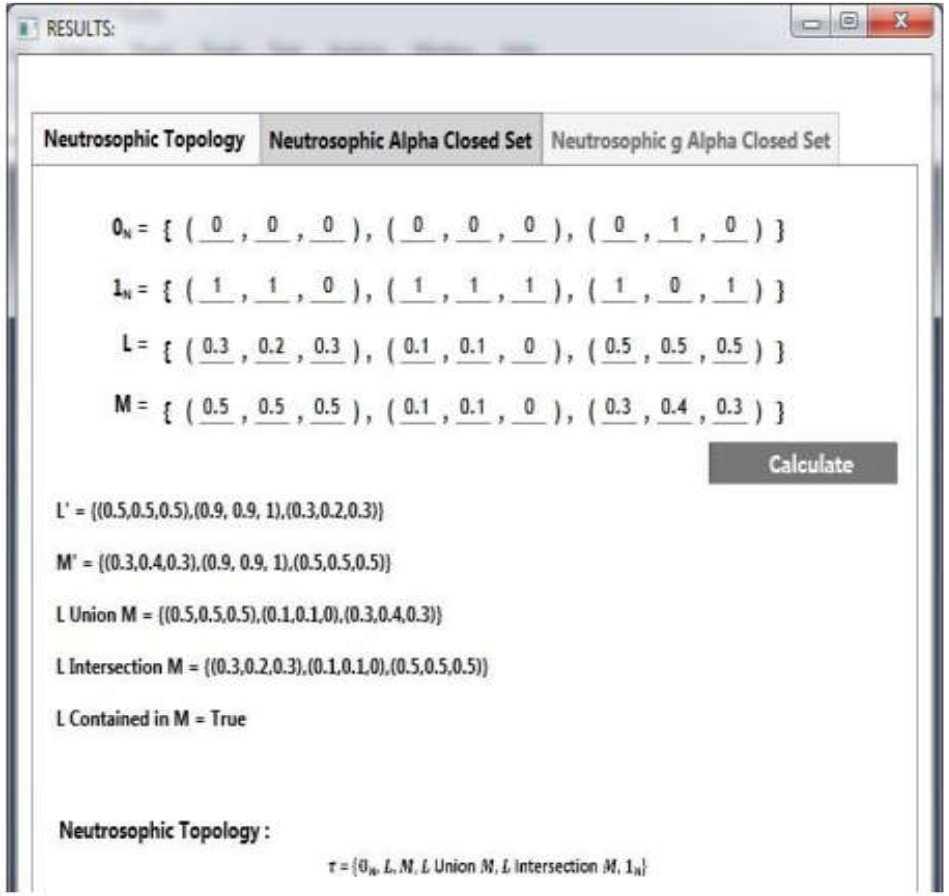


C# Application to Deal with Neutrosophic - Closed Sets in Neutrosophic Topology

- **In this work the authors developed a C# application for finding the values of the complement, union, intersection and the inclusion of any two neutrosophic sets in the neutrosophic field by using .NET Framework, Microsoft Visual Studio and C# Programming Language.**
- **The system can find neutrosophic topology (τ), neutrosophic α-closed sets and neutrosophic g α-closed sets in each resultant screens.**
- **This computer based application produces the complement values of each neutrosophic closed sets,**



"**Figure 2**: Initial Resultant Screen / User Screen"



"**Figure 7**: Existance of Neutrosophic Topology via C# Application"

Finally.

- Neutrosophic theory studies objects whose values vary in the sets of elements and are not true or false, but in between, that can be called by neutral, indeterminate, unclear, vague, ambiguous, incomplete or contradictory quantities,
- Neutrosophy is a modeling based on three states and not just two as in classical logic

Thank you