NIDUS IDEARUM. Scilogs, IV: vinculum vinculorum

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scilogs, IV

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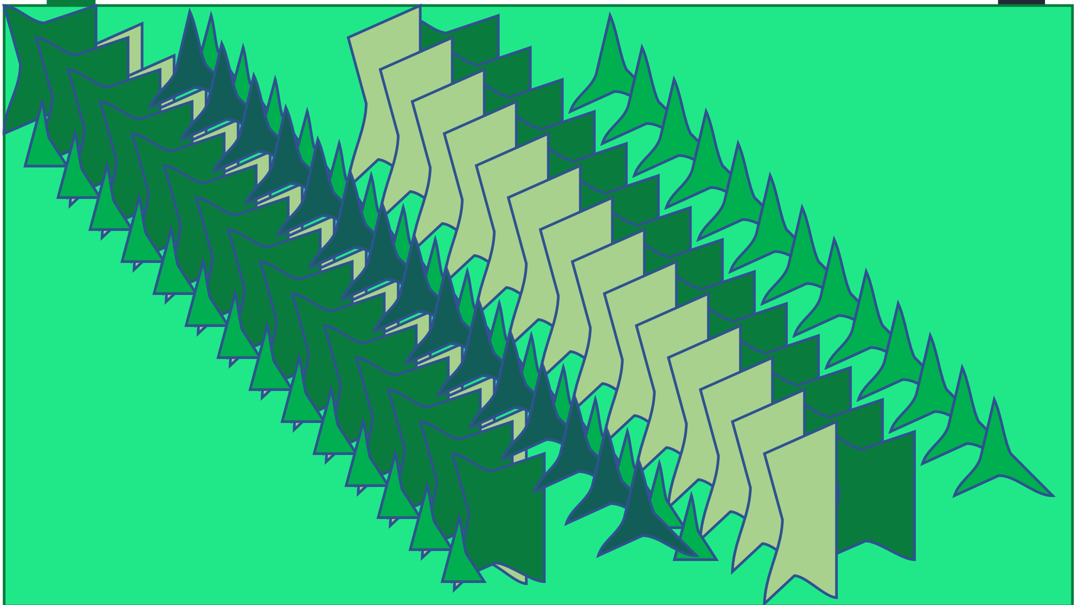
Nidus idearum

vinculum vinculorum



Neutrosophic World

Bipolar Neutrosophic OffSet
Refined Neutrosophic Hypergraph
Neutrosophic Triplet Structures
Hyperspherical Neutrosophic Numbers
Neutrosophic Probability Distributions
Refined Neutrosophic Sentiment
Classes of Neutrosophic Operators

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Subindeterminacies
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Hybrid Numbers

n-Valued Refined Neutrosophic Notions
Theory of Possibility, Indeterminacy, and Impossibility
Theory of Neutrosophic Evolution

pons

Florentin Smarandache

NIDUS IDEARUM.

Scilogs, IV: *vinculum vinculorum*

Brussels, 2019

Exchanging ideas with Mohamed Abdel-Basset,
Akeem Adesina A. Agboola, Mumtaz Ali, Saima Anis,
Octavian Blaga, Arsham Borumand Saeid,
Said Broumi, Stephen Buggie, Victor Chang,
Vic Christianto, Mihaela Colhon, Cuờng Bùi Công,
Aurel Conțu, S. Crothers, Otene Echewofun, Hoda
Esmail, Hojjat Farahani, Erick Gonzalez, Muhammad
Gulistan, Yanhui Guo,
Mohammad Hamidi, Kul Hur,
Tèmítópé Gbóláhàn Jaíyéolá, Young Bae Jun,
Mustapha Kachchouh, W. B. Vasantha Kandasamy,
Madad Khan, Erich Peter Klement,
Maikel Leyva-Vázquez, Dat Luu,
Radko Mesiar, Fatimah M. Mohammed,
John Mordeson, Xindong Peng,
Surapati Pramanik, Dmitri Rabounski,
Adriana Răducan, Gheorghe Săvoiu,
Ajay Sharma, Le Hoang Son,
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FOREWORD

Welcome into my scientific lab!

My **lab**[oratory] is a virtual facility with non-controlled conditions in which I mostly perform scientific meditation and chats: *a nest of ideas* (**nidus idearum**, in Latin). I called the jottings herein *scilogs* (truncations of the words *scientific*, and gr. Λόγος – appealing rather to its original meanings "ground", "opinion", "expectation"), combining the welly of both science and informal (via internet) talks (in English, French, and Romanian).

*

In this *fourth book of scilogs* collected from my nest of ideas, one may find new and old questions and solutions, referring mostly to topics on NEUTROSOPHY – email messages to research colleagues, or replies, notes about authors, articles, or books, so on. Feel free to budge in or just use the *scilogs* as open source for your own ideas!

Special thanks to all my peer colleagues for exciting and pertinent instances of discussing.

CONTENTS

TOPICS

The Dynamics of Opposites and Their Neutrals

Question from Vic Christianto

Hegelian dialectic is false, or is it sometimes true in restricted case?

Florentin Smarandache's answer

It is true in restricted case, i.e. the Hegelian dialectics considers only the dynamics of opposites (<A> and <antiA>), however in our everyday life, not only the opposites interact, but the neutrals <neutA> between them too.

For example: you fight with a man (so you both are the opposites).

But neutral people around both of you (especially the police) may interfere to reconcile you.

Neutrosophy considers the dynamics of opposites and their neutrals.

Neutrosofia, o generalizare a dialecticii

To Adriana Răducan

Neutrosofia este o generalizare a dialecticii (adică dinamica contrariilor, dar și a neutralului dintre ele: <A>, <antiA>, și <neutA>, unde <A> = idee, teorie, noțiune etc., iar <antiA> este opusul lui <A>, și <neutA> este neutralul dintre <A> și <antiA>).

Un exemplu simplu: când două țări <A> și <antiA> se războiesc, unele țări neutre <neutA> intervin de o parte sau de alta.

Vezi saitul meu de la UNM: *http://fs.unm.edu/neutrosophy.htm* .

Datorită neutrosofiei, am dezvoltat logica neutrosofică, mulțimea neutrosofică, probabilitatea neutrosofică etc. (toate bazate pe triade: <A>, <antiA> și <neutA>), care au multe aplicații, sunt teze de doctorat despre ele prin diverse țări...

În neutrosofie, arăți că pot exista părți comune la lucruri necomune (chiar opuse), cu alte cuvinte contrariile se intersectează (deci partea dintre DA și NU este nevidă).

Neutrosofia, o generalizare a paradoxismului

To Octavian Blaga

Neutrosofia (care-i la baza logicii/mulțimii/probabilității neutrosofice) a rezultat tot din paradoxism: nu doar combinarea contrariilor (ca în Yin și Yang, ori în dialectica lui Marx și Hegel, și ca în paradoxism), dar și a neutralelor dintre ele - pentru că așa este în viață: dacă doi se confruntă (opoziții), alții (neutrii) intervin de o parte sau de alta.

Neutrosofia este de asemenea recunoscută internațional - unii mă consideră și... filozof...

Prima jumătate a primei mele cărți despre logica neutrosofică este, într-adevăr, de filozofie.

Applications of Neutrosophy

Question from Mustapha Kachchouh

I am a PhD student, under the supervision of Dr. A. L. Benani and control of Dr. Youssef Tebesse, Department of Philosophy, Faculty of Human Sciences, Dhar Mehraz, Fes, Morocco. I am in the final stages of the thesis; I am currently working on the applications of neutrosophy in science and in philosophy; I search for a link between the philosophy of complexity (Edgar Morin) and the neutrosophy.

Florentin Smarandache's answer

I attach for you some papers on neutrosophy. You will find short applications of neutrosophy in various philosophical schools or philosophical ideas.

Edgar Morin and his philosophy of complexity are not yet investigated in connection with neutrosophy. But neutrosophy is also complex by its nature. As you know, neutrosophy is based on dynamics of <A>, <neuA>, and <antiA>, i.e. dynamics of opposites (<A> and <antiA>) as well as the neutralities (>neutA>) between them. Neutrosophy is more complex than dialectics, since neutrosophy is a generalization of dialectics, since dialectics is based on dynamics of opposites only (<A>, and <antiA>). In neutrosophy, opposite ideas can be put together and we may get common parts of opposites.

Neutrosophic Application in Biology

To Mohamed Abdel-Basset

Charles Darwin talked about the degree Evolution of Species.

But I extended it to:

- *degree of evolution* (some organism parts evolve - since their new functionality is needed in the new environment);
- *degree of involution* (other organism parts involve - since their old functionality is not needed or it is needed less in the new environment),
- and *degree of neutrality or indeterminacy* (other organism parts remain the same - since in the new environment they need the same functionality as in the old environment [neutrality], or their change in the new environment is unclear [indeterminacy]).

All these make: the *Neutrosophic Theory of Evolution*.

Evoluție neutrosofică

To Aurel Conțu

Adaptarea înseamnă evoluția unor părți (necesare supraviețuirii în noul loc), dar și involuția altor părți (care nu mai sunt necesare - și am dat exemple destule), precum și menținerea altor părți cu aceeași funcționalitate deoarece se potrivesc noului loc (neutralitatea). Este vorba de schimbări foarte mici pe perioade de timp foarte mari; așadar, exemplul dvs. cu *homo errectus* transformat în cimpanzeu (schimbare mare, abruptă) nu își are rostul!

Dacă citiți teoriile privind evoluția, ale altor oameni de știință, veți observa că: nimeni n-a făcut o astfel de afirmație aberantă că, de exemplu, o pasăre s-a transformat în mamifer, sau în... reptilă! Transformările sunt graduale, cu pași foarte mici. Mai există și mutațiile, dar acestea sunt tot cu pași mici.

Mușchii cosmonauților, trăind în spațiu un timp îndelungat, s-au atrofiat (lucru dovedit de știința contemporană) - deci este o involuție clară în privința mușchilor, deoarece nu mai sunt necesari din cauza gravitației nule sau reduse. Deci putem vorbi de involuție.

Vedeți și versiunea englezească a articolului publicat:
http://fs.unm.edu/neutrosophic-evolution-PP-49-13.pdf

Theory of Neutrosophic Evolution

A commentary of Dmitri Rabounski

It looks very believable that the combination of evolution and involution takes place in the real world. Remember, before Charles Lyell, the geologists and biologists, took catastrophic theories into account. Otherwise, they were unable to explain the combination of the geological layers and the combination of the biological species that they observed in the nature. But, once Charles Lyell poisoned brains by his idea of monotone evolution, million-by-million years, and the views changed. Instead of the healthy thinking based on direct observations, the geologists and biologists became to follow just the idea of monotone evolution (which is under strong doubt, especially in the nowadays). So, I consider the "neutrosophic evolution" as a real step to return to the real scientific thread based on direct observation, but after two centuries of the non-scientific ideology washing our brains commencing in the time of Lyell and Darwin, by their power.

Evolution: Chernobyl Case

Florentin Smarandache to Dmitri Rabounski

By the way, because you're in the ex-soviet space: I received some messages that at Chernobyl, where no human being lives now, the vegetation became abundant, and rare species of animals have suddenly appeared and populated this highly irradiated area in large number.

What is the explanation? The high radiations do not affect the animals? And even worth, the high radiations positively affect the plants? Some people say that this is because non-human in(ter)ference in this area…

Dmitri Rabounski's answer

There are many tales about the Chernobyl zone, the 30 km circle around the reactor site where three of four reactors are still working properly (they were never stopped because they feed Kiev by electricity).

I watched a detailed movie made within the zone. There was nothing found of the visually different from usual plants. And also no "two-head mooses" or hogs. But so many fish in the rivers (the rivers look like canned cans, especially when the movie makers fed them by bread) and almost no birds. I now explain why. Nuclear radiation is not so dangerous (if non-deadly dosage) as nuclear poisoning. The radiation like many smallest bullets: a person can survive being "wounded" even if very much wounded by the bullets. Just because these are mechanical wounds like those made by led bullets but almost invisible and many thousands. Another case is the radiation poisoning: once radioactive particles arrive within the body, they cause not only short-time "mechanical wounds" (as the previous) but permanent radiation from within the organism. As a result, even if the radioactive particles are not many in the body they produce permanent irremovable radioactive background in the body. This causes several chemical reactions which can be stopped only if removing the radioactive particles from the organism (but in most cases it is impossible). Most deadly is the chemical reaction producing paraphine in the shells of biological cells. The permanently creating paraphione makes mummification of the individual cells and the entire organism. So, a biological entity becomes mummified alive. Many people prefer a bullet to head in such a case, rather than to be mummified alive. But this chemical reaction starts at temperatures higher 30C (maybe +32, I forgot in exact). Therefore, birds die first in the Chernobyl zone: they have temperature +38 and higher. Remember a chicken: how she is warm when taking her under the wings. So... the second who die are mammals: gods, pigs, cows, humans, if they took radioactive particles into lungs (with dust) and into stomach (with food). Therefore, when seeing a nuclear explosion far from you, cover your head by anything like mask, wet mask if possible, and do not breath during all the seconds while the air shock wave reaches you (it carries radioactive dust from the epicenter). Returning to the Chernobyl zone, there is no birds and mammals therefore. Some wild animals appear there on occasion (hogs and mooses). But once they eat grass and drink water there they live no long time after that. While fish is cold-blooded. Its temperature is that of the water. While water is never hotter than +26 at Chernobyl. Therefore, all fish has deadly quantity of radioactive particles in the body, but they live with all these happily just because the mummifying chemical reaction never starts in their bodies. All that has been said is related to the old time, when the radioactive particles were many in the air and dust there. But now all the dust is absorbed by ground and water. You can safely breathe there. The station personnel and guards does not use masks. But they do not drink water from the rivers and do not do fishing there.

There is a sort of extremal tourism to the Chernobyl zone. Thank that the Ukrainian soldiers do not keep the zone surely locked from civilians. I did not hear that someone of the tourists became ill from the visit.

Florentin Smarandache

People expected mutations (two-headed animals, other anomalies etc.), but not (yet?).

How the Darwin's Theory of Evolution will apply in this irradiated environment?

Dmitri Rabounski

Darwinism in particular, and the theory of evolution in general are "local theories" who affect short fragment of time on isolated geographic locations. This is that was observed by Darwin and then erroneously extrapolated on all other. (As usually, when scientists extrapolate local dependencies onto everything without understanding the spectacularity of the world laws.) But the theory of evolution does not work in general. Somewhere evolution gives birth to new species. Somewhere involution leads to decease other species. But, due to the catastrophic breakdowns which are regular in the nature according to the theory of catastrophes coming from the fractal structure of the nature, the developing species have no future: everything becomes re-loaded anew as a matrix, and all the old experience of the biological generations (which should, according to Darwin and the evolutionism in general lead to the monotone development) becomes with nothing due to the catastrophic breakdown leading to absolutely new laws of the nature.

Concerning the radioactive environment, one biological species decease, while other -- survive. This leads only to the selection, not evolution: fish survive while mammals decease. After times, when the radionuclides decay, mammals restore their population. While mutating entities merely die, non-leading to any evolution.

Theory of Catastrophes vs. Continuous Evolution

Dmitri Rabounski

On my view, there were two destructive poisoning of Mankind during the last centuries after the previous destruction, by the "holy" inquisition. First, it is the physical poisoning by the nuclear technologies which are the truly evil invented by scientists: the nuclear power stations, in the case of destruction in global natural catastrophes which are undoubtedly real in the near future, would cause the poisoning for thousands of years. I do not tell about the nuclear weapon which is even less poisoning because the short-time decay. Second, it is the poisoning of brains by the "block" of theories consisting from the economics by Adam Smith (that led to the fake theory of social classes by Karl Marx, and mass killing and unrest in Europe), and also the fake theories by Lyell and Darwin (the so-called "continuous evolution" that is not observed in live nature because the natural catastrophes re-load the world nature in every time, regularly). Also, the idea about millions and billions years of evolution, by

Lyell, came from his interpolation of continuous evolution; this is not supported by observable facts in geology and biology. In other word, all these persons proceeded from an idea, then created the picture of the world according to it. While the real nature does not allow perpetual continuous change like monotone development. The laws of the theory of catastrophes, coming from mathematics and supported by the world history (conventional before Lyell) tells about only dozens of thousand years of the life of Cosmos, with great changes and re-loads. Even ancient chronicles tell about different color of many stars, but astronomers dislike to hear this because their theory of nuclear power of stellar energy tells about billions of years... There are so many facts that break the modern views on the world down. I would prefer do not touch all these in correspondence; otherwise we would spend all our time on writing during many years instead of all other that we do. I only would like to point to these issues for you. In this concern, your "neutrosophic evolution" could be very useful. But I am aware that biologists will deny it because their minds are fixed on Darwinism.

Florentin Smarandache

Yes, I am aware that the *neutrosophic evolution* (upward and downward) will be criticized by biologists... But I was sincere to write what I saw and I gave several examples to support the upward and downward happening.

By the way, the theory of catastrophes can be connected with mutations (abrupt changes)?

Dmitri Rabounski

The theory of catastrophes is rather connected with "creationism", the re-loading of the "matrix". Just because a catastrophe changes the world in principle, in instance, while mutations change the biological entities continuously, generation-by-generation.

Florentin Smarandache

Mutation is an abrupt sudden change of the beings.

I do not know how the re-loading of the matrix is, I did not watch the movie.

So, Dmitri, what should we understand, that the beings transform themselves (evolve or involve) due partially to creationism (or catastrophic theory) and partially to their environment?

Dmitri Rabounski

Evolutionary changes really take place within a system such as the inner involution of one species accompanied with evolutions of the others (biological or geological evolution/involution, no matter what). But this occurs during a very short period of time (thousands of years) until a next catastrophe comes, which completely changes everything within the system. A catastrophe (breaking monotone flow of the function) means that there is no continuous sequence from "before" to "after" within the system. Creationism is only a native view on this process. But, in view of the breaking, we cannot say what occurs between these two monotone states of evolution "before" and "after". You can say that God changed the world. Science remains mute on this subject because no information can be obtained from the breaking duration.

Florentin Smarandache

By the way, the catastrophe is provoked by some forces? Why does it occur?

Dmitri Rabounski

Catastrophe -- the breaking of a function -- occurs not due to internal reasons (as Hegel, then Marx and Engels erroneously believed) but due to the nature of the function itself.

Think: there is a function having breakings at π, 2π, 3π and so on, and we follow along the function. We, watching this situation from "within" the function do not see its shape. So, we can believe that there are internal reasons like transferring quantity into quality for the observed "catastrophe".

While the breaking of this function, observed from "within" as a catastrophe, is only a result of the function shape.

Finally, there is neither external nor internal forces provoking catastrophes. The "global jumps" are resulting from the general scenario of the "global function" of the world, according to the "global scenario" which was "written" by the world creator (who determined this function in the form as it is).

Florentin Smarandache

The nature of the function itself doesn't it mean internal force?

Or it might be frontier force (i.e. neither internal, nor external)?

Dmitri Rabounski

It is such a function having breakings.

I do not know the reason why this function was created to be such one... The question about the "forces" causing catastrophes comes from this field. You may know the answer to the question "why". While I only answer the question "how".

Florentin Smarandache

It may have something with the periodicity of a function(?).

So: internal forces, external forces, and indeterminate (tangent ?) forces --- as in neutrosophy: in, out, and on the edge (or singularity)?

Did I interpret correctly?

Dmitri Rabounski

Functions containing breaking may be periodic, but most of them are non-periodic. Periodicity is unnecessary (and most periodic functions have no breaking: remember sinusoid, cosinusoid and so forth).

A function containing breaking (or many breakings) is determined before the breaking, is indetermined within the breaking, and it determined again after the breaking. It is unnecessary that the breaking is a point (when the function asymptotically comes to the breaking coordinate (singularity) never achieving it, and then asymptotically comes from the breaking point after).

There are many breaking functions which have breaking strips or something like this: in this case the "singularity" occupies the strip or volume (depending on the function).

Thus, concerning neutrosophic views, functions having breaking are definitely indetermined within the breaking strip.

This is not a neutrosophic case. But they are both determined and indetermined (that is the neutrosophic case) in the case of asymptotic breaking in a point: because this point is reached by this function at only infinity, we can mean that this function is determined before and after this point but is both determined and indetermined at the breaking point where this function approaches at infinity.

Neutrosophic Macroeconomics Variable

To Vic Christianto

We may combine the previous macroeconomics theories: Efficient Market Hypothesis and Near to Equilibrium and Financial Instability Hypothesis (Keynes & Minsky) by considering the economy as a *neutrosophic macroeconomics variable* that has:

- a degree of stability/equilibrium (*s*);
- a degree of un-stability/dis-equilibrium (u);
- and a degree of indeterminacy (not clear if it is equilibrium or disequilibrium) (*i*);

where *s*, *u*, *i* are subsets of [0, 1];

because the macroeconomic is not only stable, or only unstable, but moving from a status to another status, and sometimes it is in between them.

Since *s* is a subset (not a crisp number), for example *s* = [0.8, 1], this also includes the Near to Equilibrium status for *s* in [0.8, 1). Similarly for Near to Disequilibrium status, for example if *u* = [0.7, 1).

In each economy we have a degree of efficiency, a degree of inefficiency, and a degree of indeterminacy - as in neutrosophic logic.

I mean, both Steve Keen and Benoit Mandelbrot, are right (in some degree each of them), and wrong (in some degree each of them).

By the way, what *efficient market hypothesis* means? Does it mean stability/equilibrium?

I try to extend the research using a model employing neutrosophic differential equations.

Reference:

Steve Keen, *Debunking Economics / The Naked Emperor of the Social Sciences*, Pluto Press Australia Limited, 2001.

Vic Christianto's answers

1. Concerning *efficient market hypothesis* (EMH), this is market theory developed in dissertation of Eugene Fama (1960). It asserts that the stock market reflects all information by market players, hence market is always efficient. So the basic tenet is that none can beat the stock market, down jones etc.

But many mathematicians have argued that EMH is only myth, the truth is market is inefficient, it is more like playing bridge or poker when no one knows what cards that the other side holds. No market player holds full information regarding the stock prices, hence it is always possible to beat the market.

There are three ways you can beat the market:

a. Technical prediction: many people use microtrading using computerized neural network software, or we can try to use Mandelbrot's fractal theory. See his book, the failure of efficient market hypothesis.
b. Fundamental prediction: people like Warren Buffett play by carefully analyze fundamentals of stocks.
c. Speculative manipulation: people like George Soros play like this. They carefully put positions against weak countries, then take advantage after its economy crash.

2. First of all, do you care what is the distinction between *efficient market hypothesis* and *financial instability hypothesis*? Are they reconcilable or not? And if you improve, will your improved theory be used by working economists or not?
3. Improvement of economics theories are beyond my reach, because I am not economist and were not taught like them. I only try to bring nonlinear dynamics to macroeconomics, and this is first step for common-sense economics modelling based on physical theories.
4. If I become such a talented mathematician like you, I would try to read some papers on Post-Keynesian theories, and then focus on what are weaknesses of

Hyman Minsky and Steve Keen's models? For example, some parameters in econometric are crisp and uncertain numbers, and you can start to extend the existing equations with fuzzy differential equations. Then extend the equations from fuzzy ODE to become Neutrosophic ODE version. That is more making sense...

See for instance: *https://www.ijser.org/researchpaper/A-fourth-order-Runge-Kutta-Method-for-the-Numerical-Solution-of-first-order-Fuzzy-Differential-Equations.pdf*

5. If you wish, I can send to you a review paper on Goodwin and Keen's models, then we can work out an extension to neutrosophic ODE version. Goodwin model can be reduced to become a coupled ODE so they are solvable.
6. Or maybe you can introduce uncertainties in the parameters used for modelling, for instance:

x becomes $x' = x$_average + $k.s$,

where k is coefficient and s is standard deviation.

That is how uncertainty in the models become apparent. So the outcome of prediction always give a range of numbers. For instance, the real GDP growth will be within range 1.0% to 1.5%... or something like that.

7. If you really want to take a deep look at Steve Keen, I can send his PhD dissertation, and you can work starting from that, or at least download and try to use

MINSKY software (gnu license). This is a software for robust macroeconomic modelling based on Keen model.

So, many things to do, but we should choose which path is likely to be useful.

A Real World Application of Neutrosophic Refinement

To Arsham Borumand Saeid

People from USA vote for the President of the United States.

T = percentage of people who vote for the candidate;

I = percentage of people who do not vote;

F = percentage of people that vote against the candidate.

Yet, the political analysts are interested in a detailed report, so they study the voting per each American state (therefore they do a neutrosophic refinement):

T_1, I_1, F_1 = percentage of people from the state of Arizona who voted for, not voted, or against the candidate respectively;

T_2, I_2, F_2 = percentage of people from the state of Arkansas who voted for, not voted, or against the candidate respectively; and similarly for all American states.

Extensions of Neutrosophy

To Hoda Esmail and Surapati Pramanik

We need to extend the neutrosophy in various fields - if possible, like for example in biology: I introduced in 2017 (after visiting Galapagos Archipelago in Pacific) the *Theory of Neutrosophic Evolution*: *Degrees of Evolution, Indeterminacy, and Involution* [*http://fs.unm.edu/neutrosophic-evolution-PP-49-13.pdf*].

I observed that Darwin's Theory of Evolution was incomplete, i.e. he did not say anything about the organism's parts that involve when moving from a location to another, he studied only the parts that evolve.

For example, for an astronaut, after long time in space in little or no gravity, not using his muscles, when returning to Earth his muscles are weakened... This is involution with respect to the muscular activity.

By cooperating with other departments, like chemistry, social sciences (here there are some neutrosophic applications done using Neutrosophic Cognitive Maps, *http://fs.unm.edu/NCMs.pdf*), geography, physics - I did a little herein by defining matter-unmatter-antimatter history, geology etc.

Just simply ask, if in their fields there are triads of the form:

<A>, <neutA>, and <antiA>

{as in neutrosophy, or as in neutrosophic set and logic T, I, F, which are degrees of membership / truth, indeterminacy / neutrality, and nonmembership / falsehood respectively - and so on}, where <A> can be a notion in their field, or a theory, or an idea.

Prof. Dr. Salah Osman, from Egypt, did together with me neutrosophic applications in Arabic philosophy:

http://fs.unm.edu/Arabicneutrosophy-en.pdf {English},

http://fs.unm.edu/Arabicneutrosophy-ar.pdf {Arabic}.

We can do that at least in some part of the very rich Hindu philosophy, i.e. looking for contradictory theories / ideas / concepts in Hindu philosophy and then trying to get their reconciliation (i.e. the middle part in between the opposites that may touch/intersect these opposites).

Surapati Pramanik

At first we would like to write a book on neutrosophy in Bengali (Bangla) language.

Also in education and Indian philosophy I have interest.

We have presented a paper on a character of *Mahabharata*, the great epic, based on neutrosophic logic in December 2018 neutrosophic seminar. I am trying to form a large neutrosophic group for studying neutrosophy in different fields.

Neutrosophy in Social Science

To Muhammad Gulistan

Neutrosophic Cognitive Maps and Neutrosophic Relational Maps have applications in social science.

Neutrosophic Graphs and Neutrosophic Cognitive Maps in Social Sciences

To Hojjat Farahani

There are some books by Vasantha and me on neutrosophics applied in social science.

Search for "social" in my UNM neutrosophic website: *http://fs.unm.edu/neutrosophy.htm*, and let me know.

It is possible, for example, to use NCM (Neutrosophic Cognitive Maps: *http://fs.unm.edu/NCMs.pdf*) in studying social phenomena such as: migration, family, employment etc.

Also, the neutrosophic graphs (in the first above website) that can be employed in social sciences.

Neutrosophic Sports

To Tèmítópé Gbóláhàn Jaíyéolá

The first sport team is <A>, the opposite sport team is <antiA>, and the referees are <neutA>.

A neutrosophic crisp set is defined as <A, B, C>, where A, B, C are sets (not elements).

Neutrosophic Memory

In psychology there are: *conscious* (<A>), what we are aware of; and *unconscious* (<antiA>), what we are not aware of.

But I observed that there are things/memories that we are only partially aware and partially unaware, this is true because there are things that we remember only partially. So I introduced the concept *aconscious* (<neutA> or indeterminacy).

Therefore, a perfect *neutrosophic psychological triad* was formed.

Aconscious

To Stephen Buggie

I partially accepted Freud's ideas, but other ideas of him I didn't.

I tried to go on degrees of psychological terms, as in fuzzy logic and neutrosophic logic, meaning not "white" or "black" but in between, the "grey" area.

For example, about psychological personality, every person has: a degree of "sanguine" personality, a degree of "choleric" personality, a degree of "melancholic" personality, and a degree of "phlegmatic" personality [as in *refined neutrosophy*].

I made some colored designs at the end of the booklet about these degrees (*Neutropsychic Personality. A mathematical approach to psychology*, 2018).

Of course, some degree is bigger than others, meaning that the person is more inclined towards that personality type.

In my University of Craiova study in Romania, in order to become a teacher, it was mandatory to study the child psychology and the general psychology.

I tried to do research on psychological terms that connect in triads, i.e. a term <A>, its opposite term <antiA>, and the neutral between them <neutA).

Thus, I came up with the classification of the memory (different from Freud's) as:

Conscious (denoted mathematically by <A>),

Unconscious (<antiA>, the opposite of Conscious), and then I invented the psychological concept "*Aconscious*" (<neutA>).

Acounscious means partially conscious and partially unconscious, and this occurs in our everyday life, since there are events / objects / ideas that we partially remember, and partially we do not remember. Such events cannot be included completely into Conscious nor into Unconscious. Such events should be into a new category (Aconscious).

The Unconscious Boycotts Us…

Each person is actually two individuals: one conscious, and another unconscious.

They are unfortunately contradictory: because we do sometimes things that we know we shouldn't supposed to do.

Whichever is stronger between conscious and unconscious moves as to a direction or to its opposite.

Where Does Intuition Come From?

To Vic Christianto

Tell me where does intuition come from? Is it divine? Or extraterrestrial? Or just from our subconsciousness?

If from our subconsciousness, how did it get there?

Cum se coc ideile

Lui Andrușa Vătuiu

Da, sunt de acord cu faptul că trebuie să lași să se "coacă" o idee... și apoi îți apare ca și cum ți-ar fi dictat-o cineva...

Așa mi s-a întâmplat și mie cu logica neutrosofică...

Axa Contradicției

Lui Andrușa Vătuiu

Am ales Axa Contradicției [A, antiA] cu valoare [0, 1] pentru a putea face melanjul de A și antiA.

De pildă, 0.2 este considerat ca 80%(A) și 20%(antiA).

[Practic, (p, q) înseamnă q%A și p%(antiA).]

În general, neutA = $(1-\alpha)$(A) + α(antiA), unde $\alpha \in (0, 1)$.

Lingvistica computațională neutrosofică

To Mirela Teodorescu

Neutrosofia merge peste tot unde există nedeterminare (necunoscut, nesiguranță, incompletitudine, vag, aproximație, neutralitate etc.).

De acord pentru *lingvistica computațională neutrosofică*.

Întrebări de gramatică comparată

Vorbind fluent patru limbi (romană, engleză, franceză, spaniolă), și învățând expresii și cuvinte in alte limbi de prin țările (60+) in care am circulat, mi-am pus următoarele întrebări de *gramatică comparată*:

1) De ce în unele limbi substantivele au plural, iar în altele nu?
2) De ce în unele limbi verbele au timpuri trecute și viitoare, iar în altele nu?
3) De ce în unele limbi adjectivele se acordă cu substantivul, iar în altele nu?
4) De ce în unele limbi predicatul se acordă cu subiectul, iar în altele nu?
5) De ce în unele limbi adjectivul se pune înaintea substantivului, în altele după substantiv, iar în a treia categorie de limbi se permit ambele variante?

6) De ce în unele limbi te adresezi diferit unui bărbat față de cum te adresezi unei femei, iar în altele nu?

Neutrosophic Wireless Application

To Said Broumi

For the neutrosophic wireless application, we can define, by adding the indeterminacy:

- path x_i meets the demand of parameter c_j at the level T_{ij};
- path x_i is denied by the demand of parameter c_j at the level F_{ij};
- path x_i neither meets nor is denied the demand of parameter c_j at the level I_{ij}.

Neutrosophic Cloud Computing

To Mohamed Abdel-Basset and Victor Chang

We approach the *neutrosophic clustering* and/or *neutrosophic cloud computing* in operational research.

Neutrosophication

To Vic Christianto

I am interested in applying neutrosophy in other fields, such as: economy, culture, sociology, geography, geology, chemistry, history etc. How can we do that? In each field we are looking for a concept or idea (let's denote it by <A>). Then we check if there exists an opposite of that concept or idea (let's denote it by

<antiA>); if it does not exist, we can define/construct it. Then, we check to reconcile (or blend, or unite <A> and <antiA>, or parts of them - in order to form <neutA>), or we check if it is possible to define / construct / include something in between <A> and <antiA> (that we'll call <neutA>). Sometime it is possible to define/construct more middles (not only one) <neutA>$_1$, <neutA>$_2$ etc. between the opposites <A> and <antiA>.

What field do you propose that we should do a neutrosophication into?

Neutrosophic Statistics for Big Data

To Muhamed Abddel Basset

Bringing the neutrosophic domain into *Big Data* is very appealing.

To Xiaohong Zhang

The study of *Neutrosophic Statistics* may provide new tools for *Big Data mining* / analysis.

Extension of Transdisciplinarity to Plithogeny

To Vic Christianto

From a philosophical point of view, see an extension of *Transdisciplinarity* to *Plithogeny*:

Florentin Smarandache, *Plithogeny, Plithogenic Set, Logic, Probability, and Statistics*, 141 pages, Pons, Brussels, Belgium, 2017; *http://fs.unm.edu/Plithogeny.pdf*.

Plithogeny, an Extension of Neutrosophy

To Selçuk Topal

Plithogeny (= *fusion of many opposite and nonopposite ideas*) is an extension of *neutrosophy* and *dialectics*.

First, *dialectics* = dynamic of opposites (<A> and <antiA>).

Second, *neutrosophy* = dynamic of opposites and their neutrals (<A>, <antiA>, <neutA>).

Third, *plithogeny* = dynamic of opposites, their neutrals, and others not related to them (<A>, <antiA>, <neutA>, <B>, <C>, ...).

Plithogenic Sets

To Xindong Peng

As an extension of *neutrosophic set* to *plithogenic set*, which is a set whose each element is characterized by many attribute values: $x(v_1, v_2, ..., v_n)$, where $v_1, v_2, ..., v_n$ are attribute values.

Then for each attribute value v_i we have a corresponding a neutrosophic degree:

$$x(v_1(t_1, i_1, f_1), v_2(t_2, i_2, f_2), ..., v_n(t_n, i_n, f_n)).$$

For example:

x(white, yellow, red, blue, green), whence:

$$x(\text{ white}(t_1, i_1, f_1), \text{yellow}(t_2, i_2, f_2), \text{red}(t_3, i_3, f_3), \text{blue}(t_4, i_4, f_4), \text{green}(t_5, i_5, f_5)).$$

I think the plithogenic set can easily be used in industry and Multi-Criteria Decision Making, where you are an expert in applications.

Plithogenic BCK/BCI-Algebras

To Young Bae Jun

New food for mind (for *BCK/BCI-algebras*), extending the *neutrosophic set* to *plithogenic set* will be possible to found and study the *Plithogenic BCK/BCI-algebras*.

References:

Florentin Smarandache, *Plithogeny, Plithogenic Set, Logic, Probability, and Statistics*, 141 pages, Pons, Brussels, Belgium, 2017;

arXiv.org (Cornell University):

abstract: *https://arxiv.org/abs/1808.03948*

book: *https://arxiv.org/ftp/arxiv/papers/1808/1808.03948.pdf*

Harvard SAO/NASA ADS:

http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:1808.03948

Florentin Smarandache, *Physical Plithogenic Set*, 71st Annual Gaseous Electronics Conference, November 5–9, 2018; Portland, Oregon, USA,

http://meetings.aps.org/Meeting/GEC18/scheduling?ukey=1348085-GEC18-MBFvZe

Plithogenic Divergence Measures

To Nguyễn Xuân Thảo

In my book [*http://fs.unm.edu/Plithogeny.pdf*] on *Plithogeny*, there are similarity and distance measures between plithogenic sets (see pages 81-82), from which easily we can design *plithogenic divergence measures*.

Mulțimea plithogenică aplicată la cuvintele polisemantice

To Mihaela Colhon

În cartea mea [*http://fs.unm.edu/Plithogeny.pdf*] sunt introduse mulțimi de elemente, și fiecare element este caracterizat de multe valori de atribute.

De exemplu, un cuvânt polisemantic C, sa zicem cu 7 sensuri: s_1, s_2, ..., s_7, poate fi descris astfel: C(d(s_1), d(s_2), ..., d(s_7)), unde d(s_1) este gradul (*degree*) în care cuvântul C are sensul s_1, și la fel pentru celelalte sensuri.

More Accurate Neutrosophic Inequality

To Erich Peter Klement and Radko Mesiar

I know Atanassov is criticized for the "intuitionistic" denomination of his fuzzy set. I have received an email from Didier Dubois and I read Dubois et al.'s paper.

But I am also curious why *picture* fuzzy set? What is the connection with "picture"?

Neutrosophic set is called this way, because of introducing of a neutral (or indeterminate) component: neither true, nor false [in neutrosophic logic]; or neither membership, nor nonmembership [in neutrosophic set]; or neither an event occurring, nor not occurring [in neutrosophic probability] - so it is justified etymologically.

In 2013 I have extended the neutrosophic set to *n*-valued (or refined) neutrosophic set, where $n \geq 4$.

When T is refined/split into T_1, T_2, ...; I is refined/split to I_1, I_2, ...; and F is refined/split into F_1, F_2, ...

This is in our everyday life from many applications.

For example, in voting: T_1 is the percentage of people from region R_1 voting for a candidate, I_1 is the percentage of people from region R_1 not voting or doing black or blank voting, and F_1 the percentage of people from region R_1 voting against the candidate; and so on for T_j, I_j, F_j.

It may be interesting to develop lattices of truth values for the *refined neutrosophic logic*.

And an extension of crisp / fuzzy / intuitionistic fuzzy / neutrosophic set to plithogenic set, where each element of a set is characterized by many attribute values - in arXiv:

https://arxiv.org/ftp/arxiv/papers/1808/1808.03948.pdf

(or second attached file).

In this book the neutrosophic inequality ($\leq_N$) was improved with respect to (13) and (14) in your paper {which actually are used by majority of researchers today}, because it was introduced the degree of contradiction (dissimilarity) between attribute values.

In neutrosophic set we have one attribute (*appurtenance* to the set) which has three values: T (membership), I (indeterminacy), and F (nonmembership).

Then:

$$(x_1, x_2, x_3) \leq_N (y_1, y_2, y_3)$$

if $x_1 \leq y_1$, $x_2 \geq 0.5y_2$, $x_3 \geq y_3$.

This is because the neutrosophic components (T, I, F) are:

F is 100% opposed to T, so if we apply ≤ to T we need to apply the opposite to F i.e. ≥.

But " I " is only half opposed to T, and also half opposed to F.

If the contradiction degree between two attribute values is ≥ 0.5, then using ≤ on T, involves using the opposite ≥ on the other attribute values.

Thus, a more accurate neutrosophic inequality is:

$$(x_1, x_2, x_3) \leq_N (y_1, y_2, y_3)$$

if $x_1 \leq y_1$, $x_2 \geq 0.5y_2$, $x_3 \geq y_3$.

Neutrosophic Set vs. Picture Fuzzy Set

A question from Fatimah M. Mohammed

What's the relation between the *Picture fuzzy sets* and *Neutrosophic sets*?

Florentin Smarandache

Picture fuzzy set (2013) is a particular case of *neutrosophic set* (1998), i.e.

the case when T+I+F ≤ 1 (in picture fuzzy set),

while in neutrosophic set one has T+I+F ≤ 3 (i.e. meaning that the sum T+I+F can be any number between 0 and 3, therefore you may take the sum ≤ 1).

Therefore, "≤ 1" is included in "≤ 3".

See this paper regarding the degree of dependence / independence between the components (sources that provide them) T, I, F in order to understand their sum:

F. Smarandache: *Degree of Dependence and Independence of the (Sub)Components of Fuzzy Set and Neutrosophic Set*, Neutrosophic Sets and Systems, vol. 11, 2016, pp. 95-97. *doi.org/10.5281/zenodo.571359*.

According to the degree of dependence and independence between T, I, F, the sum T+I+F varies in the interval [0, 3].

Picture fuzzy set is a particular case of *refined neutrosophic set* as well, when T, I, F is refined as T, I_1, I_2, F. In a more general refinement, T, I, F are refined as: T_1, T_2, ...; I_1, I_2, ...; and F_1, F_2, ... respectively.

See this paper:

Florentin Smarandache, *n-Valued Refined Neutrosophic Logic and Its Applications in Physics*, Progress in Physics, 143-146, Vol. 4, 2013; *https://arxiv.org/ftp/arxiv/papers/1407/1407.1041.pdf*.

To Said Broumi, Le Hoang Son, Mumtaz Ali, Dat Luu

The dimension of *Neutrosophic Set* is also 3, and the three neutrosophic components are inside of the *Neutrosophic Cube*.

References:

Florentin Smarandache, *Neutrosophic Set, A Generalization of the Intuitionistic Fuzzy Set*, International Journal of Pure and Applied Mathematics, Vol. 24, No. 3, 287-297, 2005;

also in Proceedings of 2006 IEEE International Conference on Granular Computing, edited by Yan-Qing Zhang and Tsau Young Lin, Georgia State University, Atlanta, pp. 38-42, 2006;

second version in Journal of Defense Resources Management, Brasov, No. 1, 107-116, 2010.

Florentin Smarandache, *A Geometric Interpretation of the Neutrosophic Set – A Generalization of the Intuitionistic Fuzzy Set*, 2011 IEEE International Conference on Granular Computing, edited by Tzung-Pei Hong, Yasuo Kudo, Mineichi Kudo, Tsau-Young Lin, Been-Chian Chien, Shyue-Liang Wang, Masahiro Inuiguchi, GuiLong Liu, IEEE Computer Society, National University of Kaohsiung, Taiwan, 602-606, 8-10 November 2011.

While the dimension of *Neutrosophic Set* is 3 (meaning T, I, and F), the dimension of the *Refined Neutrosophic Set* may be any integer n ≥ 4 (because one can refine T, I and F into T_1, T_2, ...; I_1, I_2, ...; F_1, F_2, ... respectively), meaning that we can have any dimension: 3, 4, 5, ..., 100, ..., 1000 etc. depending on the problem we need to solve.

See this paper about refinement of the neutrosophic set (2013) in any number of subcomponents:

Florentin Smarandche, n-Valued Refined Neutrosophic Logic and Its Applications in Physics, Progress in Physics, 143-146, Vol. 4, 2013; *https://arxiv.org/ftp/arxiv/papers/1407/1407.1041.pdf.*

Picture fuzzy set is a particular case of the *Neutrosophic Set*, because: in *Neutrosophic Set*, for single-valued numbers in [0, 1], one has: T+I+F ≤ 3, not T+I+F = 3, which means that the sum T+I+F can be any number between 0 and 3, in particular case one can have T+I+F ≤ 1 (which is the *Picture fuzzy set*), or T+I+F = 1 (which is *Intuitionistic Fuzzy Set*), or one can have T+I+F ≤ 2, or T+I+F = 0.8, or T+I+F ≤ 2.5 etc. (see the paper on the degree of dependence and independence of the neutrosophic components T, I, F).

The neutrosophic components T, I, F can be dependent, or independent, or partially independent and partially dependent.

Therefore: $T+I+F \leq 1$ if all three components are dependent of each other 100%.

But if all of them are independent (for example a source S_1 tells you about T, another source S_2 not connected with S_1, tells you about I, and a source S_3, not connected with the previous two sources tells you about F), then the sum may not be necessarily 1.

A very simple example:

There is a soccer game between Vietnam and Laos;

If I ask you your opinion, you (source 1) will say that Vietnam will win, since you are subjective and patriotic, with 70% chance.

If I ask someone from Laos, he will say that Laos will win, let's say 60%.

But if I ask somebody neutral (assume from Thailand) he may say that it is a high chance 80% that they may have a tie game.

The three sources are independent (do not communicate with each other).

Sum $0.7+0.6+0.8 > 1$.

This is very naturally.

In all previous definitions, *Fuzzy Set*, *Intuitionistic Fuzzy Set*, *Picture Fuzzy Set* the components are assumed all dependent 100%, that's why their sum is up to 1.

Le Hoang Son

If we represent by graphs, then *Neutrosophic Set* consists of 3 separate graphs for the truth, indeterminacy and the falsehood that each is like in the classic fuzzy membership function.

Florentin Smarandache

If T, I, F are independent 100%, then it is right.

But T, I, F are dependent in some degree, this is not right.

If T, I, F are independent 100%, then the sum T+I+F approaches 3.

Let's say that T and I are totally dependent, hence:

$$T+I \leq 1,$$

while F is independent, so F in [0, 1], then:

$$T+I+F \leq 1+1 = 2.$$

None of *Fuzzy Set*, *Intuitionistic Fuzzy Set*, *Picture Fuzzy Set* allow room for partially dependent and partially independent components, nor for completely independent components - they all *Fuzzy Set*, *Intuitionistic Fuzzy Set*, *Picture Fuzzy Set* consider that the components are totally (100%) dependent.

But in our everyday life we have degrees of independence of source (see above) as well.

Reference:

Florentin Smarandache, Degree of Dependence and Independence of the (Sub)Components of Fuzzy Set and Neutrosophic Set, by F. Smarandache, Neutrosophic Sets and Systems, Vol. 11, 95-97, 2016.

The constrains for T, I, F to be in [0, 1] are the same as in *Picture Fuzzy Set*, yet in a more general development of the *Neutrosophic Set* to *Neutrosophic Overset / Underset / Offset*, the degrees of membership, indeterminacy, and nonmembership can be outside of the classical unit interval [0, 1], and this resulted from our real life because it is needed into applications, since for example somebody working overtime deserves a degree of membership > 1, compared with someone who works only regular time and has the degree of membership 1 (see the below one book and two papers), while somebody who did not work for a company and in addition produced big damage [for example destroying company machineries] to the company deserves the membership degree < 0 (to be distinguished from somebody who did not work for the company and produced no damage, whose degree of membership = 0).

Surprisingly, this book on *overset/underset/offset*, although very non-orthodox, was accepted by *arXiv.org*.

References:

Florentin Smarandache, Neutrosophic Overset, Neutrosophic Underset, and Neutrosophic Offset. Similarly for Neutrosophic Over-/Under-/Off- Logic, Probability, and Statistics, by Florentin Smarandache, 168 p., Pons Editions, Bruxelles, Belgique, 2016;

https://hal.archives-ouvertes.fr/hal-01340830

https://arxiv.org/ftp/arxiv/papers/1607/1607.00234.pdf

Florentin Smarandache, Degrees of Membership > 1 *and* < 0 *of the Elements With Respect to a Neutrosophic Off-Set*, Neutroosphic Sets and Systems, Vol. 12, 3-8, 2016.

Florentin Smarandache, Operators on Single-Valued Neutrosophic Oversets, Neutrosophic Undersets, and Neutrosophic Offsets, Journal of Mathematics and Informatics, Vol. 5, 63-67, 2016; *https://hal.archives-ouvertes.fr/hal-01340833*

The *Picture Fuzzy Set* has the name "picture" for no reason... Why is it called "picture", I asked them in Hanoi in 2016? No explanation. The *Neutrosophic Set* was proposed first in 1998, while the *Picture Fuzzy Set* much later (2013).

The *Picture Fuzzy Set* is correct mathematically, yet the *Picture Fuzzy Set* is way too narrow and too reduced compared with the *Neutrosophic Set*.

Neutrosophic Set is today the most general form of set.

Le Hoang Son

I know the facts of independent and dependent memberships in *Neutrosophic Set* but is it proper for classical *Fuzzy Set*? In *Fuzzy Set* and *Intuitionistic Fuzzy Set*, the independence is assumption. So its extension should follow that.

Florentin Smarandache

In *Fuzzy Set* it is nothing you can extend, since there is only one component, T = degree of membership, and T as single valued number is already between [0, 1], therefore simply $T \leq 1$.

In *Intuitionistic Fuzzy Set*, you can extend, considering single valued numbers, $T + F \leq 2$, when T and F are totally independent, with of course T, F in [0, 1].

Nobody has done that in *Intuitionistic Fuzzy Set*, although I had proposed it before.

For *Picture Fuzzy Set*, you can extend even further, having three components, T, F, and ε, considering single valued numbers, $T + F + \varepsilon \leq 3$, when T, I, ε are totally independent, but then you get just in *Neutrosophic Set* footstep that I founded much ahead of *Picture Fuzzy Set*.

Le Hoang Son

I feel that the condition within [0, 3] is too broad for an extension. With this you can make all things valid and if anything is missing then you can append easily through the independent/dependent relation.

Florentin Smarandache

Even more, in *Refined Neutrosophic Set*, which is the most extreme case, with *n* neutrosophic subcomponents as single valued numbers in [0, 1], as $T_1, T_2, \ldots, T_p, I_1, I_2, \ldots, I_r, F_1, F_2, \ldots, F_s$, where $p + r + s = n \geq 4$, we may have when all n subcomponents T_j, I_k, F_l for all j, k, l, are totally independent, the sum:

$$T_1 + T_2 + \ldots + T_p + I_1 + I_2 + \ldots + I_r + F_1 + F_2 + \ldots + F_l \leq n,$$

therefore the sum may be between $[0, n]$,

where n can be 3, 4, ..., 1000, etc. Therefore we can go above 3.

We can also go to the sum above 3, for three neutrosophic components only, if we consider the neutrosophic oversets, where the membership may be > 1.

Plithogeny & Image Processing

To Yanhui Guo

I think this book below will be helpful in many-color image processing.

Reference:

Florentin Smarandache, *Plithogeny, Plithogenic Set, Logic, Probability, and Statistics*, 141 pages, Pons, Brussels, Belgium, 2017;

http://fs.unm.edu/Plithogeny.pdf,

http://arxiv.org/abs/1808.03948.

First, I observed the following: let $\wedge_N$ = neutrosophic intersection, $\vee_N$ = neutrosophic union, while $\wedge_F$ = fuzzy intersection (t-norm), $\vee_F$ = fuzzy union (t-conorm).

Then the neutrosophic conjunction (as used today by most researchers) is:

$$(t_1, i_1, f_1) \wedge_N (t_2, i_2, f_2) = (t_1 \wedge_F t_2, i_1 \vee_F i_2, f_1 \vee_F f_2),$$

or if we apply the t-norm on the truth (t_1, t_2), then we need to apply the opposite (t-conorm) on the falsehood, since the truth and falsehood are 100% opposed to each other.

While the indeterminacy is opposed to truth, it is opposed only half (50%), and indeterminacy is opposed to falsehood too but only 50%, therefore on indeterminacy we need to apply neither the t-norm nor the t-conorm, but a linear combination of t-norm and t-conorm, or:

$$(1/2)[\ (i_1 \wedge_F i_2) + (i_1 \vee_F i_2)\ ].$$

Thus, the more accurate neutrosophic intersection should be defined as:

$$(t_1, i_1, f_1) \wedge_N (t_2, i_2, f_2) =$$
$$= (t_1 \wedge_F t_2,\ (1/2)[\ (i_1 \wedge_F i_2) + (i_1 \vee_F i_2)\ ],\ f_1 \vee_F f_2).$$

An example.

Let's take $a \wedge_F b = ab$, and $a \vee_F b = a + b - ab$.

Then:

$$(a, b, c) \wedge_N (d, e, f) = (ad, (1/2)[(be) + (b+e-be)], c+f-cf) =$$
$$= (ad, (b+e)/2, c+f-cf).$$

A Plithogenic Application to Images

To Yanhui Guo

A pixel x may be characterized by colors $c_1, c_2, \ldots, c_n$. We write $x(c_1, c_2, \ldots, c_n)$, where $n \geq 1$.

We may consider the degree of each color either fuzzy, intuitionistic fuzzy, or neutrosophic.

For example.

Fuzzy degree:

$$x(0.4, 0.6, 0.1, \ldots, 0.3).$$

Intuitionistic fuzzy degree:

$$x(\ (0.1, 0.2), (0.3, 0.5), (0.0, 0.6), \ldots, (0.8, 0.9)\ )$$

Neutrosophic degree:

$$x(\ (0.0, 0.3, 0.6), (0.2, 0.8, 0.9), (0.7, 0.4, 0.2), \ldots, (0.1, 0.1, 0.9)\ )$$

Then, we use a plithogenic conjunction operator ($\wedge_P$) to combine them.

For example:

$$x(0.4, 0.6, 0.1, \ldots, 0.3) \wedge_P x(0.1, 0.7, 0.5, \ldots, 0.2) = \ldots$$

We establish first the degrees of contradictions between all colors c_i and the dominant color c_j in order to find the linear combinations of t-norm and t-conorm that one applies to each color (similar to the indeterminacy above) as a linear combination of t-norm and t-conorm.

Dr. Yanhui Guo, let me know if you use pixels with many colors into the image processing?

Why *Neutrosophic* and not *Fuzzy*?

People ask us why using *neutrosophic* and not *fuzzy*.

We explain that neutrosophic logic/set/probability work better on triads (i.e. three parts, as in neutrosophy:

<A>, <neutA>, <antiA>,

for example like winning/tie/losing, positive / neutral / negative etc.)

while fuzzy and intuitionistic fuzzy do not catch well all these 3 (three) components, they do not catch well the indeterminact.

Symmetric Neutrosophic Set

To Mohamed Abdel Baset

The *neutrosophic set* acts as a symmetric tool in the tree-ways method, since the membership is the symmetric of the nonmembership with respect to the indeterminacy.

Complex Neutrosophic Set

To Le Hoang Son

I think that better notations will simply be:

{High, Little}, hence using braces, for single-valued labels,

and [Little, High], using brackets, for interval-valued labels.

"Complex" herein is an ATTRIBUTE that characterizes the real part.

It is very simple. But, for each example / application we need to find the right attribute, otherwise it will look absurd, strange, unrelated.

It depends on us to assign the right attribute.

Le Hoang Son

A.real = {High, Low}

A.complex or imaginary = {"Little", "Very"}

Florentin Smarandache

Again, the sets of labels depend on the EXAMPLE or APPLICATION we do.

If we do not choose the right sets of labels, then their connection will look unmatched, like in that example.

You criticize the term "complex" in general (I mean referring to classical complex set, fuzzy complex set, intuitionistic fuzzy complex set, and neutrosophic complex set), because, frankly speaking this imaginary component does not do much; it is, in my sincere opinion: whim, simple, pretended helping this "complex"; exception might be in physics, where the waves indeed have an amplitude and a phase.

I gave an example where I used "possibility" as the attribute (the complex part) of the real part; but you may get other attributes for the complex parts.

Let's say the first set of labels for the real part is

C = {Green, Yellow, Brown},

meaning color, then the second set of labels for the complex part may be

N = {light, medium, dark},

meaning color nuances.

Suppose the real part of an object is GREEN.

Now the complex part of it, that will be a characteristic of GREEN, may be: nuances of the color green (maybe light green, medium green, dark green etc.).

Pretty obvious example.

Le Hoang Son

So how's about joining these sets of labels? It is intuitively hard to merge them because of different contexts.

Florentin Smarandache

We do nor merge rocks with apples!

The second set of labels has to characterize the first set of labels. First and second sets of labels have to be reliable, connected - it's common sense.

About hedge algebras and neutrosophy: a Vietnamese researcher has proposed to me, after I returned from Vietnam, to work on them... I tried to, but then other things got priority...

This is totally another project - apart from this paper.

Le Hoang Son

Last but not least, where is the "neutrosophic" part there, e,g. (High, "Little")? Since we deal with the linguistic operator, the role of neutrosophic is blurred.

Florentin Smarandache

I feel we do not understand each other.

This {High, Little} has nothing to do against or for the neutrosophic set.

See the distinction below:

Let $U = \{x_1, x_2, ..., x_n\}$ be a universe of discourse. Let A be a neutrosophic set, included in U.

Then $x(t_A, i_A, f_A)$ belongs to A, in the following two ways:

- either *numerically*, meaning that $t_A, i_A, f_A : U \rightarrow [0, 1]$;
- or *linguistically*, meaning that $t_A, i_A, f_A : U \rightarrow S$, where S is a set of linguistic labels, for example {High, Little}.

If we use labels, of course the result will be rough, very approximate, even blurry as you say (but this is in general for all applications where one uses LABELS instead of NUMBERS, not only for the linguistic neutrosophic set as you incriminate it).

To Dat Luu

We can do a hybrid *Complex Neutrosophic Set*, as you say: labels for real parts, and numbers for complex parts.

But it is not difficult using labels for the complex part too, if they are correlated (connected) to the labels of the real parts (as I gave some easy examples above).

To Le Hoang Son

The operations are the same on hybrid *Complex Neutrosophic Set*s!

In the holograph draft I sent you all before, I considered the *Single-Valued Linguistic Complex Neutrosophic Set*, i.e. both the real parts and imaginary parts are single-valued linguistic labels.

For a *Hybrid Single-Valued Linguistic-Numerical Complex Neutrosophic Set*, i.e. the real parts are single-valued linguistic labels, while the complex parts are single-valued numbers in [0, 1], the operations are the same !

The distinction is that: instead of having min / max on labels, we have min / max on numbers!

Pretty easy. And Pretty Nice!

{Similarly, we can straightforwardly extend to *Hesitant-Valued Labels or Numbers*, and *Interval-Valued Labels or Numbers* - if you want.}

The only change, in the paper, is instead of saying that the complex parts of the sets *A* and *B* belong to *S* (set of labels), we replace *S* by the interval [0, 1].

Therefore, one has to adjust as:

$$T_{2A}(x),\ I_{2A}(x),\ F_{2A}(x) \text{ in } [0, 1]$$

and

$$T_{2B}(x),\ I_{2B}(x),\ F_{2B}(x) \text{ in } [0, 1].$$

Neutrosophic Ortogonal Set

To Mumtaz Ali

If one has two neutrosophic sets $A(t_1, i_1, f_1)$ and $B(t_2, i_2, f_2)$, they are orthogonal if $t_1t_2 = i_1i_2 = f_1f_2 = 0$.

But if we have neutrosophic complex numbers:

$$A(\ (t_1, u_1), (i_1, v_1), (f_1, w_1)\ ) \text{ and } B(\ (t_2, u_2), (i_2, v_2), (f_2, w_2)\ )$$

then A and B are orthogonal if

$$t_1t_2\cos(|u_1-u_2|) = i_1i_2\cos(|v_1- v_2|) = f_1f_2\cos(|w_1-w_2|) = 0.$$

Even more, we may extend the definitions to subset (including intervals) of *[0, 1]*, using the same formulas, but having multiplications and subtractions of sets.

We say also that two neutrosophic undersets or offsets (which are sets that have negative neutrosophic components) are orthogonal, if:

$$t_1t_2 + i_1i_2 + f_1f_2 = 0.$$

This general formula actually works for any kind of neutrosophic set, overset, underset, offset, with single-valued, interval-valued, or in general subset-valued from *[0, 1]*.

Similarly we say that two neutrosophic complex undersets or offsets (which are sets that have negative neutrosophic amplitudes and phases)

$A((t_1, u_1), (i_1, v_1), (f_1, w_1))$ and $B((t_2, u_2), (i_2, v_2), (f_2, w_2))$

are orthogonal if

$$t_1t_2cos(|u_1-u_2|) + i_1i_2cos(|v_1- v_2|) + f_1f_2cos(|w_1-w_2|) = 0.$$

This general formula actually works for any kind of neutrosophic complex set, overset, underset, offset, with single-valued, interval-valued, or in general subset-valued from *[0, 1]*.

In the case when t_1, i_1, f_1, t_2, i_2, f_2 are single numbers, intervals, or subsets included in *[0, 1]*, we have that:

$t_1t_2 + i_1i_2 + f_1f_2 = 0$ is equivalent to $t_1t_2 = i_1i_2 = f_1f_2 = 0$;

and similarly:

$$t_1t_2cos(|u_1-u_2|) + i_1i_2cos(|v_1- v_2|) + f_1f_2cos(|w_1-w_2|) = 0$$

is equivalent to

$$t_1t_2cos(|u_1-u_2|) = i_1i_2cos(|v_1- v_2|) = f_1f_2cos(|w_1-w_2|) = 0.$$

The general definition of neutrosophic orthogonal set is:

$$T_1T_2 + I_1I_2 + F_1F_2 = 0,$$

in order to comprise the neutrosophic overset (T, I, F > 1) and neutrosophic underset (T, I, F < 0).

We can take T, I, F as single numbers, intervals, or subsets of [0, 1].

In the case when T, I, F are included in [0, 1] we have:

$$T_1T_2 + I_1I_2 + F_1F_2 = 0$$

is equivalent to

$$T_1T_2 = I_1I_2 = F_1F_2 = 0.$$

Bipolar Neutrosophic Cube

To Said Broumi

The *Neutrosophic Cube* (of side = 1) can be extended to a *Bipolar Neutrosophic Cube* (of side = 2), simply but extending T, I, F axes from [0, 1] to [-1, 1].

Division of Neutrosophic Complex Numbers

To Saima Anis

There also are neutrosophic complex numbers of the form:

$p+qI$, where p and q are complex (not real) numbers,

for example: $(2-3i) + (-5+9i)I = 2 - 3i - 5I +9iI$ (4-dimensional vector).

Addition, subtraction, multiplication are easy.

For division, we do in a similar way as we did for *Neutrosophic Real Numbers* (when p and q were real numbers):

$(a_1 + a_2i + a_3I + a_4iI)/(b_1 + b_2i + b_3I + b_4iI) = x + yi + zI + wiI,$

then we identify the coefficients and form a system of 4 equations and 4 variables:

$a_1 + a_2i + a_3I + a_4iI \equiv (b_1 + b_2i + b_3I + b_4iI)\cdot(x + yi + zI + wiI),$

we multiply on the right-hand side and combine the like-terms, then we solve for x, y, z, w. There are cases when the division is undefined.

So, you may try the Picard action on them.

Neutrosophic Functions

To Said Broumi

We can in general consider a normal distribution function

$$\mathrm{f}n(x): [a, b] \to [0, 1]:$$

$$\mathrm{t}(x) = \mathrm{f}n(\mathrm{x}),$$

$$\mathrm{f}(x) = 1\text{-}\mathrm{g}n(x),$$

$$\mathrm{i}(x) = 1\text{-}\mathrm{h}n(x),$$

where $\mathrm{g}n(x)$ and $\mathrm{h}n(x)$ are also normal distribution functions, defined as $\mathrm{g}n(x)$, $\mathrm{h}n(x)$: $[a, b] \to [0, 1]$.

This generalizes the *triangular* and *trapezoid neutrosophic functions*.

I think some Chinese researchers published such paper with neutrosophic normal functions.

Neutrosophic trapezoidal functions can be extended to neutrosophic pentagonal (or more general) polygonal functions. Mostly general we can extend even to just any functions:

$$T(x), I(x), F(x): [a, b] \to [0, 1],$$

but we need to get some applications in order to justify this extension.

Neutrosophic Linguistic Labels

To Said Broumi

I have set that the linguistic set has to be organized increasingly, upon the importance (or other attribute) of the labels.

So, {High, Medium, Low} has to be rewritten

{Low, Medium, High},

where one has Low < Medium < High.

Therefore one can compute min/max easily.

One can also compute additions, subtractions, multiplication of labels (I have done within the information fusion), but these are more complex.

Said Broumi

Each linguistic may be a membership value.

Florentin Smarandache

When we go to linguistic, the components T, I, F instead of numbers simply get linguistic labels.

For example,

x(high, low, low)

belongs to the linguistic neutrosophic set A, which means that, with respect to the set A, the membership degree of x is "high", the indeterminate-membership degree of x is "low", and the false-membership degree of x is "low".

For a linguistic complex neutrosophic set B, an element

y((high, low), (low, medium), (medium, low))

belongs to B in the following way:

- ✓ the degree of membership of y is "high" but the quality (phase) of this membership is "low",
- ✓ the degree of indeterminate-membership of y is "low" but the quality of it is "medium",
- ✓ and the degree of false-membership degree of y is "medium" but the quality of it is "low".

The extension is done from 'numbers' to 'labels' - straightforwardly (simply), for single-valued labels {not interval of labels, not subsets of labels}.

For single-values:

- ✓ the *linguistic neutrosophic set* is the same as the *numerical neutrosophic set*, but instead of numbers we put labels. For example, instead of T = 0.8, we put for example T = high; similarly for I and F;

- ✓ the *linguistic complex neutrosophic set* is similar to the *numerical complex neutrosophic set*, again, instead of numbers we put labels.

The extension is trivial, but you all asked for linguistic versions. We have no other way to include labels, unless we say the components having sets of labels, for example T = {medium, high}, instead of T = {high} only.

Neutrosophic Quadruple Loop

To Tèmítópé Gbóláhàn Jaíyéolá

The *Neutrosophic Quadruple Loop* was not studied yet, neither *Neutrosophic Refined Quadruple Loop*.

See the book:

Florentin Smarandache, *Symbolic Neutrosophic Theory*, Europa Nova, Bruxelles, Belgium, 194 p., 2015 (chapter 7, pages 186-193), *http://fs.unm.edu/SymbolicNeutrosophicTheory.pdf.*

Neutrosophic Multiset Loop

To Tèmítópé Gbóláhàn Jaíyéolá

Let's try to develop a *Neutrosophic Multiset Loop* (NML).

Another type of neutrosophic numbers have the form:

$$a+bI,$$

where I = literal indeterminacy, $I^2 = I$, and a, b are real numbers.

a, b can also be in other sets of numbers, for example in C = the complex number set. Etc.

It is much easier to define and develop a *Neutrosophic Multiset Loop* on a neutrosophic set of the form:

$$S = \{a+bI, \text{ where } I^2 = I, \text{ and } a, b \text{ in } \mathbb{R}\}.$$

Neutrosophic Rings

Question from Otene Echewofun

I am student from Federal University of Agriculture, Benue State, Nigeria, West Africa. I am currently reading a book on neutrosophic rings written by you and Vasantha Kandasamy, in 2006. I want to know the real life examples or real life explanation of neutrosophic groups. (…)

Florentin Smarandache

" I " may be some indeterminacy.

For example:

Time: 6 at clock.

If we write 6 + I, " I " may be "a.m. (morning)" or "p.m. (evening)", so it is not known.

Another meaning may be, for example the time duration:

6 h and 20+I min, i.e. the duration is: 6 hours, and 20 and something [indeterminate number of] minutes [could be 21 minutes, or 22 minutes and so on].

Neutrosophic Permittivity

To Tèmítópé Gbóláhàn Jaíyéolá

Neutrosophic Permittivity is the (t_P, i_P, f_P)-neutrosophic degree to which a medium resists an electric charge flow, where:

t_P = degree of permittivity;

i_P = degree of indeterminate-permittivity;

and f_P = degree of un-permittivity.

We prove several theorems related to *Neutrosophic Permittivity*.

Exotic Neutrosophic BCK/BCI-Algebras

To Young Bae Jun

I defined some *Exotic Neutrosophic BCK/BCI-Algebras*:

a. neutrosophic *BCK/BCI-overalgebras* (algebras on neutrosophic overset, when degrees are strictly greater than 1), or *neutrosophic BCK/BCI-underalgebras* (algebras on neutrosophic underset, when degrees are strictly less than 0), or *neutrosophic BCK/BCI-offalgebras* (algebras on neutrosophic offset, when some degrees are strictly greater than 1, and other degrees are strictly less than 0), see this paper on membership degrees > 1 and < 0: *http://fs.unm.edu/NSS/DegreesOf-Over-Under-Off-Membership.pdf* ;

and

b. *intuitionistic BCK/BCI-algebras* (algebras defined on the intuitionistic set - not fuzzy intuitionistic set), *paraconsistent BCK/BCI-algebras* (algebras defined on the paraconsistent set), *faillibilist BCK/BCI-algebras* (algebras defined on the faillibilist set), *paradoxist BCK/BCI-algebras* (algebras defined on the paradoxist set), *pseudo-paradoxist BCK/BCI-algebras* (algebras defined on the pseudo-paradoxist set), *tautological BCK/BCI-algebras* (algebras defined on the tautological set), *nihilist BCK/BCI-algebras* (algebras defined on the nihilist set), *dialetheist BCK/BCI-algebras* (algebras defined on the dialetheist set), and *trivialist BCK/BCI-algebras* (algebras defined on the trivialist set) - see the definitions of intuitionistic set, ..., trivialist set: *http://fs.unm.edu/DefinitionsDerivedFromNeutrosophics.pdf*.

Many Neutrosophic Triplet Neutrals

To W. B. Vasantha Kandasamy

There are two types of *neutrosophic triplet sets*:

1) *Neutrosophic Triplet (Strong) Set* N_1:

If $x \in N_1$, then *neut(x)* and *anti(x)* $\in N_1$ too.

This is the first definition done by Smarandache and Ali.

2) *Neutrosophic Triplet Weak Set* N_2 (second definition by Smarandache):

If $x \in N_2$, then there exists a neutrosophic triplet $<y, neut(y), anti(y)>$ in N_2, such that: $x = y$ or $x = \text{neut}(x)$ or $x = \text{anti}(y)$.

For example:

$Z_3 = \{0, 1, 2\}$, with respect to the classical multiplication modulo 3, is a neutrosophic triplet week set, but it is not a neutrosophic triplet strong set.

Because all neutrosophic triplets are:

$$<0, 0, 0>, <0, 0, 1>, <0, 0, 2>.$$

Z_3 is not a neutrosophic triplet strong set, since for example $2 \in Z_3$, but there is no *neut(2)* nor *anti(2)* in Z_3.

Several Chinese professors told me that there might be no neutrosophic triplet group such that at least one element has two or more neutrals. They believe that in all neutrosophic triplet groups an element has only a neutral (different from the classical unit).

Yet, there are many neutrosophic triplet groups whose elements have many anti's.

Single Valued Neutrosophic Numbers

Question from Amin Vafadarnikjoo

I am a PhD student at the University of East Anglia. (…)

How can I get the inverse of a simplified *Single Valued Neutrosophic Number* (SVNN)?

I mean if $A = <T(x), I(x), F(x)>$ then what is the inverse(A) $= A^{-1}$?

Florentin Smarandache

Please see this paper:

F. Smarandache, *Subtraction and Division of Neutrosophic Numbers*, Critical Review, Volume XIII, 103-110, 2016;

http://fs.unm.edu/CR/SubtractionAndDivision.pdf .

It works for all subtractions and divisions, because of the below remark: for both, subtraction and division, if a component result is < 0, we put 0, and if a component result is > 1, we put 1.

It works even when we have divisions by 0 (since the above remark changes +∞ to 1, and -∞ to 0.

By the way, the general multiplication of SV neutrosophic numbers is defined as follows [see in my previous article]:

$$<t_1, i_1, f_1> \times <t_2, i_2, f_2> = <t_1 \wedge_F t_2, i_1 \wedge_F i_2, f_1 \vee_F f_2>,$$

where $\wedge_F$ can be ANY fuzzy t-norm, and $\vee_F$ can be ANY fuzzy t-conorm.

Therefore, you may get different formulas for addition and multiplication of neutrosophic numbers, and implicitly different formulas for subtraction and division, and implicitly different results for the neutrosophic inverse.

So far, researchers have been used only:

$$x \wedge_F y = xy, \text{ and } x \vee_F y = x+y-xy$$

within the neutrosophic framework.

You might try to check other t-norms / t-conorms (min/max, Lukasiewicz etc.), but I am not confident that the "inverse" would be what you expect.

By the way, you can define yourself the neutrosophic inverse starting with its axioms (or properties) that a neutrosophic inverse should accomplish:

what / how do you expect that A^{-1} should behave in connection with A ?

You said using logic; yes, it is a good idea.

Neutrosophic Triplet Structures

To Kul Hur

You gave examples in Z_n in order to explain some concepts and results.

It was the easiest example to make people understand the concept of "neutrosophic triplet" (NT).

But of course many other examples can be done in broader form, I mean not only in the set of integers modulo n.

Only one single paper was published in NT structures! It is very very new.

Florentin Smarandache

Then by starting a fixed semigroup "S", we want to define "neut(a) and anti(a)" for a member $a \in S$.

It is a good idea.

And in the above sense, we want to use "neutrosophic triplet subgroup" of a semigroup.

Let (S, #) be a semigroup, so the law # is well-defined and associative.

If there exist neutrosophic triplets <*a*, *neut(a)*, *anti(a)*>, for "*a*" in S, indeed their set, let's denote it by R, will form a neutrosophic triplet group, which is actually a neutrosophic triplet subgroup of S, as you said.

Kul Hur

Thus it is not necessary to define "neutrosophic commutative triplet group".

Florentin Smarandache

If the law # is not commutative, then the neutrosophic triplet (sub)group is not commutative either.

If the law # is commutative, then the neutrosophic triplet (sub)group is commutative either.

(R, #) may be a non-commutative neutrosophic triplet group, or a commutative neutrosophic triplet group, depending on # if non-commutative or commutative respectively on R.

Kul Hur

If you want to define "neutrosophic triplet group" and "neutrosophic commutative triplet group", then in order to do examples, it is not necessary to consider Zn.

Florentin Smarandache

Right, we need another type of algebraic structure (different from Z_n), endowed with a law # which is not commutative.

So, please do not identify the neutrosophic triplet set/subgroup/group etc. with Z_n, since in Z_n the multiplication is always commutative.

It will be excellent if you get other examples of NT structure different from Zn (never done before, because we only published just one paper -- after waiting more than one year to some journals since the topic was totally new, so the editors were skeptical!).

Kul Hur

In the future, we try to find some examples of "neut(a) and anti(a)", "neutrosophic triplet subgroup" in a semigroup S.

Florentin Smarandache

Good idea, never done before.

Kul Hur

Also we try to find algebraic structure of the quotient set of a neutrosophic commutative triplet group under an equivalence relation.

Florentin Smarandache

Again, good idea, not done before.

I think you and your team will enrich the NT structures.

Applications of Neutrosophic Triplet Structures

To Selçuk Topal

We can find applications in the fields where there are triads of the form (A, neut(A), anti(A)), where A may be an item (idea, theory, event, object, etc.).

The 'anti' and 'neut' of item A are defined with respect to a given attribute /alpha that characterizes the item A, and they have to make sense in our world.

Let's say a soccer game, where two teams S_1 and S_2 play.

$A = S_1$, $anti(S_1) = S_2$, and $neut(S_1) = R$ (i.e. the referees).

We may have a soccer competition of n teams: $S_1, S_2, \ldots, S_n$, and *k* teams of referees: $R_1, \ldots, R_k$.

We may also consider another game, let's say chess. Each chess game has three possible outputs: win, tie game, or loose.

In physics, there may be: positive particles ($P_1, P_2, \ldots, P_m$), neutral particles ($I_1, I_2, \ldots, I_n$), and negative particles ($N_1, N_2, \ldots, N_r$).

Then we may need to study their interactions.

Or voting: voting pro X, voting contra X, and neutral vote {either not voting, or blank voting (not choosing any candidate from the list), or black voting (cutting all candidates on the list)}.

We have a neutrosophic set of people that may vote, $P_1, P_2, \ldots, P_m$.

By the way, where do we use the classical algebraic structures, such as ring, field etc.?

Although some people say that in physics, it is not much evidence of that, and even so it might be in theoretical (many researchers called them "fantasy, abstract, unrealistic") physics...

Yet, we can use the neutrosophic triplet structures, since they are real, they are based on plenty neutrosophic triads that exist in science and in our everyday life.

We need to dig deeper into these triads for applying them into neutrosophic triplet structures.

Selçuk Topal

It is very appropriate for game theory.

I already started to write something on game theory in neutrosophy space. I can add the triplets to it.

I think neutrosophic triplet group can be used in quantum algebra, what do you think? It is available to be applied by Hilbert space and its applications. Especially in quantum logic. I will try it.

On the other hand in physics, the neutrosophic triplet structure can be used in gravity, mass repulsion, and invariant conditions to apply on objects.

The classical algebraic structures are very manageable and useful in computer science applications. Especially Symbolic Computation. They are also used in graph theory (chromatic numbers etc.), in chemical graph theory etc.

Functional programming is evaluated and used mostly as algebraic structure.

Lattice defined on Neutrosophic Triplets

To Nguyễn Xuân Thảo and Cường Bùi Công

It is possible to extend the lattice defined on neutrosophic triplets $<x_1, x_2, x_3>$, with $x_1+x_2+x_3 < 1$, for the case when the sum $x_1+x_2+x_3$ is any number less than or equal to 3.

For example, if x_1 and x_2 are totally dependent, then $x_1+x_2 \leq 1$ (as in intuitionistic fuzzy logic), and if x_3 is independent with respect to x_1 and x_2, then $x_3 \leq 1$, so $x_1+x_2+x_3 \leq 2$.

And so on, depending on the degree of dependence / independence between the components taken two by two.

We may also refine the neutrosophic components T, I, F (denoted as x_1, x_2, and x_3 respectively into the lattice) and get more neutrosophic sub-components: T_1, T_2, ...; I_1, I_2, ...; F_1, F_2, … .

Therefore, we construct a refined lattice on more than three components: x_1, x_2, x_3, x_4, etc.

Neutrosophic Extended Triplet Loop

To Tèmítópé Gbóláhàn Jaíyéolá

In order to enrich the neutrosophic triplet structures, I considered that the neut(x) can be allowed to be equal to the unitary element of a law *. I noted the enlarged neutral elements of x by neut'(x) or ${}_e$neut(x).

Therefore, let E be a set, and x in E. Then neut'(x) should be in E such that:

$$x\text{*neut'}(x) = \text{neut'}(x)\text{*}x = x,$$

where neut'(x) can be the unitary element of law * on E.

Therefore, the axioms of the *Neutrosophic Extended Triplet Loop* on (E,*) are:

1) (E,*) is an *Neutrosophic Extended Triplet Set*,

i.e. for any x in E, one has neut'(x) (which can be the unitary element too) in E, such that x*neut'(x) = neut'(x)*x = x, and anti'(x) in E such that: x*anti'(x) = anti'(x)*x = neut'(x). I used the notation anti'(x) to distinguish it from the previous papers' anti(x).

2) The law * is well-defined and non-associative.

It will be interesting to compare the *Neutrosophic Extended Triplet Group* with the General Group, and the *Neutrosophic Extended Triplet Loop* with the Neutrosophic Triplet Loop.

Neutrosophic Extended Triplet Set upgraded

To Tèmítópé Gbóláhàn Jaíyéolá

I agree with your observation that any group becomes automatically a *Neutrosophic Extended Triplet Group* if we consider that the classical neutral element should be allowed into the set of neutral of x, denoted as {*neut*(x)}.

But let's upgrade the definition of *Neutrosophic Extended Triplet Set* as follow:

1) A set (E, *), with a well-defined law, such that there exist at least an element x in E that has 2 or more distinct *neut(x)'s* - where the classical neutral element with respect to the law * is allowed to belong to the set of neutrals {*neut(y)*}, for any *y* in E. We used { } to denote a set.

In this case, not all classical groups are *Neutrosophic Extended Triplet Group*s.

2) A set (E, *), with a well-defined law, such that there exist at least an element *x* in E that has 2 or more distinct *anti(x)'s* - where the classical neutral element with respect to the law * is allowed to belong to the set of neutrals {neut(*y*)}, for any *y* in E, and the classical symmetric element x^{-1} with respect to the law * is allowed to belong to the set of opposites {*anti(y)*}, for any *y* in E.

In this case, similarly, not all classical groups are *Neutrosophic Extended Triplet Groups*.

Tèmítópé Gbóláhàn Jaíyéolá

The opposite is dependent on neutrality, but neutrality is not necessarily dependent on opposite (generally speaking).

Florentin Smarandache

Since there are more neutrals in *Neutrosophic Triplet* structures, we write {neut(x)}, meaning the set of all neutrals of x. We can redefine the axiom as follows: x*anti(x) = anti(x)*x belongs to the set of x's neutrals {*neut(x)*}, which means that x*anti(x) is equal to one neutral into the set of its neutrals.

That's why we use { } for *neut(x),* meaning more neutrals (i.e. a set of neutrals).

Neutrosophic Quadruple Number

To Tèmítópé Gbóláhàn Jaíyéolá

A *Neutrosophic Quadruple Number* is a number of the form:

$$NQ = a + bT + cI + dF,$$

where a, b, c, d are real or complex numbers, while T = truth, I = indeterminacy, and F = falsehood. For each NQ, a is called the determinate part of NQ, while bT + cI + dE the indeterminate part of NQ.

A Preference Law, with respect to T, I, F, we may define on the set of neutrosophic quadruple numbers. For example, let’s say T < I < F (in a pessimistic way).

With respect to this preference law, we define the Absorbance Law for the multiplications

of T, I, and F, in the sense that the bigger one absorbs the smaller one (or the big fish eats the small fish); for example: TT = T (T absorbs itself), TI = I (because I is bigger), FT = F (because F is bigger), and so on.

The addition and subtraction of neutrosophic quadruple numbers are defined as:

$$(a_1+b_1T+c_1I+d_1F) + (a_2+b_2T+c_2I+d_2F) =$$

$$= (a_1+a_2) + (b_1+b_2)T+(c_1+c_2)I+(d_1+d_2)F;$$

$$(a_1+b_1T+c_1I+d_1F) - (a_2+b_2T+c_2I+d_2F) =$$

$$= (a_1-a_2) + (b_1-b_2)T+(c_1-c_2)I+(d_1-d_2)F.$$

While multiplication

$$(a_1+b_1T+c_1I+d_1F)(a_2+b_2T+c_2I+d_2F)$$

is defined as in classical multiplication of polynomials, but taking into consideration the above absorbance law when multiplying the T, I, F among themselves.

Various neutrosophic quadruple algebraic structures are studied on the set of NQs.

Neutrosophic Quadruple Structures

To Tèmítópé Gbóláhàn Jaíyéolá

Let Q = {a + bT + cI + dF, where a, b, c, d are real numbers, and T = truth, I = indeterminacy, F = falsehood}.

Another preference law among T, I, F may be defined as T > I > F (in an optimistic way), which means that when one multiplies two of them the result is equal to the greater one similarly that absorbs the smaller one, i.e. TT = T (T absorbs itself), TI = T, IF = I, etc.

Hyperspherical Neutrosophic Numbers

The *q-Rung Orthopair Fuzzy Numbers* [R. R. Yager, *Generalized orthopair fuzzy sets*, IEEE Trans. Fuzzy Syst., vol. 25, no. 5, pp. 1222-1230, Oct. 2017] are particular cases of Hyperspherical Neutrosophic Numbers defined as (T, I, F), where

$$0 \leq T^m + I^m + F^m \leq 3, \text{ for } m \geq 1,$$

and $T, I, F \in [0, \sqrt[m]{3}\,]$.

If we take a number less than 3, let's say 1 (when the neutrosophic components are dependent all together), and $I = 0$, then:

$$0 \leq T^m + F^m \leq 1, \text{ for } m \geq 1,$$

where $T, F \in [0, \sqrt[m]{1}\,] = [0, 1]$,

so we get the *q-Rung Orthopair Fuzzy Numbers*.

Hyperpsherical Refined Neutrosophic Numbers

Even more general are the *Hyperpsherical Refined Neutrosophic Numbers*,

$$(T_1, T_2, \ldots, T_p; I_1, I_2, \ldots, I_r; F_1, F_2, \ldots, F_s),$$

with integers $p, r, s \geq 1$, and $p + r + s = n \geq 4$,

where

$$0 \leq \sum_{j=1}^{p} T_j^{\,m} + \sum_{k=1}^{r} I_k^{\,m} + \sum_{l=1}^{s} F_l^{\,m} \leq n,$$

for $m \geq 1$,

and $T_1, T_2, \ldots, T_p, I_1, I_2, \ldots, I_r, F_1, F_2, \ldots, F_s \in [0, \sqrt[m]{n}\,]$.

Refined Neutrosophic Hypergraph

To Mohammad Hamidi

It will be possible to extend the *neutrosophic hypergraph* to *refined neutrosophic hypergraph* (where T is refined/split into T_1, T_2, ...; I is split into I_1, I_2, ...; and F is split into F_1, F_2, ...).

Bipolar Neutrosophic OffSet

To Erick Gonzalez, Maikel Leyva-Vázquez

In the Bipolar Neutrosophic Set M we have a generic element $x(T^+, T^-, I^+, I^-, F^+, F^-)$, where $T^+, I^+, F^+ : M \to [0, 1]$ and $T^-, I^-, F^- : M \to [-1, 0]$.

Yet, a *Bipolar Neutrosophic OffSet* was defined:

$$x(T^+, T^-, I^+, I^-, F^+, F^-),$$

where $T^+, I^+, F^+: M \to [0, \Omega]$, where $\Omega > 1$ and

$T^-, I^-, F^- : M \to [\Psi, 0]$, where $\Psi < -1$.

Neutrosophic Logic

As in fuzzy logic/set, in the neutrosophic logic/set the inference operators are approximations. They work differently for an application than for another application. Actually, as Angelo de Oliveira pointed out, there are classes of neutrosophic operators, not unique operators, similarly to the fuzzy logic/set).

For the neutrosophic negation operator, there is a class too of such operators.

Some of them you already mentioned into the paper.

For several of these negation operators, the double negation holds as in classical logic {i.e. non(nonA) = A}.

But there are others that do not respect this classical logical law [double negation].

For example:

$$non(t, i, f) = (1\text{-}t, 1\text{-}i, f)$$

as used by some authors considering that T and I are more important than F. {It is possible to give weights to T, I, F, depending on the application to solve.}

Then non(non(t, i, f)) = (t, i, 1-f) which is different from (t, i, f).

Another thing that occurs in neutrosophic logic and it is different from other logics. It is the *normalization*. This is the fact that in NL one can normalize if needed.

Let's have an example: (0.4, 0.5, 0.3) and use non(t,i,f) = (1-t, i, 1-f), then non(0.4, 0.5, 0.3) = (1-0.4, 0.5, 1-0.3) = (0.6, 0.5, 0.7). Let's normalize and divide each component by their sum (1.8). We get (0.33, 0.28, 0.0.39). Then non(0.33, 0.28, 0.39) = (1-0.33, 0.28, 1-0.39) = (0.67, 0.28, 0.61) which is different from (0.4, 0.5, 0.3).

Indeed, the *neutrosophic modal logic* was not explored (only very little in my 1998 book on neutrosophic, first edition).

Example where Neutrosophic Logic works, but Fuzzy Logic does not work

Neutrosophic logic is an extension of fuzzy logic. In fuzzy logic a proposition is t% true and f% false, t + f = 1.

In neutrosophic logic a proposition is t% true, i% indeterminacy (neutral, i.e. neither true nor false), and f% false.

For example, in games based on 3 possibilities (win, tie, loose) you can use the neutrosophic logic better than the fuzzy logic.

Let's consider the proposition P about a future scheduled soccer game between USA and Argentina: "USA will win against Argentina". The experts can predict that P has the following truth-values: (0.5, 0.1, 0.4) meaning that the chance that USA wins is 50%, the chance the USA has tie game with Argentina is 10%, while the chance that USA loses against Argentina is 40%.

We cannot characterize this game better in fuzzy logic, since in fuzzy logic you do not have Indeterminacy (= Neutrality, i.e. tie game).

The word "neutrosophic" comes from this middle component Indeterminacy (or Neutrality), meaning neither true/winning nor false/loosing, which is not used in fuzzy logic (not even in intuitionistic fuzzy logic it is defined, only what remains may be…).

Soft *n*-Valued Neutrosophic Algebraic Structures

We can generalize the *soft neutrosophic algebraic structures* to *soft n-valued neutrosophic algebraic structures*.

Let's consider a universe of discourse U and let $\mathscr{P}$(U) be the set of all *n*-valued neutrosophic sets included in U.

Let's A be a set of attributes. The collection (f, A), where f: A→ $\mathscr{P}$ (U) is a soft *n*-valued neutrosophic set. For example, let U = {x, y, z, w} a set of houses, and A = {quality, price} a set of attributes. One has:

$$f(\text{quality}) = <x; (T_1, T_2, T_3; I_1; F_1, F_2)>,$$

where T_1 = very high quality, T_2 = high quality, T_3 = medium quality; I_1 = indeterminate quality; and F_1 = low quality, F_2 = very low quality.

With $T_1 + T_2 + T_3 + I_1 + F_1 + F_2 \in [0, 6]$, since 3 + 1 + 2 = 6.

Similarly for price:

$$f(\text{price}) = <x; (T_1, T_2, T_3; I_1; F_1, F_2)>,$$

where T_1 = very high price, T_2 = high price, T_3 = medium price; I_1 = indeterminate price; and F_1 = low price, F_2 = very low price.

As numerical example, we may consider:

f(quality) = {$<x; (0.4, 0.5, 0.6; 0.1; 0.9, 0.3)>$, $<y; (0.0, 0.1, 0.9; 0.5; 0.8, 0.2)>$, $<z; (0.6, 0.0, 0.9; 0.7; 0.5, 0.5)>$, $<w; (0.1, 0.3, 0.6; 0.8; 0.3, 0.1)>$} and f(price) = {$<x; (0.3, 0.1, 0.5; 0.4; 0.2, 0.5)>$, $<y; (0.6, 0.6, 0.1; 0.5; 0.1, 0.9)>$, $<z; (0.3, 0.8, 0.2; 0.2; 0.5, 0.4)>$, $<w; (0.7, 0.2, 0.1; 0.2; 0.5, 0.9)>$}.

Extending the Neutrosophic Notions to *n*-Valued Refined Neutrosophic Notions

To W. B. Vasantha Kandasamy

We can extend all previous papers (neutrosophic notions) such as: *Similarity Measure, Distance between Neutrosophic Sets, Correlation Coefficient of Interval Neutrosophic Set, Neutrosophic Fuzzy Matrice, Rough Neutrosophic Set, Neutrosophic Implication, soft neutrosophic algebraic structures*, etc. to their corresponding n-valued refined neutrosophic notions i.e.: *Similarity Measure between n-valued neutrosophic sets, Distance between n-valued Neutrosophic Sets, Correlation Coefficient of n-valued Interval Neutrosophic Set, n-valued Neutrosophic Fuzzy Matrice, Rough n-valued Neutrosophic Set, n-valued Neutrosophic Implication, n-valued soft neutrosophic algebraic structures*, etc.

When we refine T, I, F to T_1, T_2, ...; I_1, I_2, ...; F_1, F_2, ... all T_j, I_k, and F_l can be subsets of [0, 1] (in a particular case they are just single numbers in [0, 1]).

n-Valued Neutrosophic Decision Making

I thought that it is possible to extend the score, accuracy, and score-accuracy functions, used by Prof. Jun Ye, from single-value and interval-value neutrosophic set of the form T, I, F to n-valued refined neutrosophic set of the form: T_1, T_2, ...; I_1, I_2, ...; F_1, F_2, ... and then use them into a *n*-valued neutrosophic decision making.

For example: a 6-valued neutrosophic element <x; (T_1, T_2, T_3; I_1; F_1, F_2)> referring to quality, where T_1 = very high quality, T_2 = high quality, T_3 = medium quality; I1 = indeterminate quality; and F1 = low quality, F2 = very low quality. With $T_1 + T_2 + T_3 + I_1 + F_1 + F_2$ in [0, 6], since 3 + 1 + 2 = 6. In this way we can define neutrosophic elements of any *n*-valued length.

Neutrosophic Calculus

An approach to the *Neutrosophic Calculus* will be to consider functions with neutrosophic coefficients. For example, $f(x) = (2 - I) + (1 + 3I)x^2$, where I = indeterminacy is considered a constant.

Another approach to Neutrosophic Calculus would be to use indeterminacy related to the values of the function.

We consider that in practice somebody wants to design a function that describes a certain process. But for some values he is not able to determine exactly if, for example, f(3) = 5 or 6...

So, we should be able to work with such non-well known functions...

For example, f(1) = [0, 2], f(2) = 5 or 6, f(3) = (4, 5) $\cup$ (7, 8), ... i.e. we do not know exactly the value of function f.

In general, we mean

$$f: A \to \mathscr{P}(A),$$

where $\mathscr{P}(A)$ is the power set of A.

Possibility Neutrosophic Soft Set

Possibility Theory + Neutrosophic Soft Set = Possibility Neutrosophic Soft Set.

I think we can further extend this to: possibility theory + refined soft set.

Neutrosophic Codeword

To Mumtaz Ali

We can compare as well the "neutrosophic soft code" with the "neutrosophic refined soft code".

We can go even further and refine the neutrosophic set, remember my paper on having $x(T_1, T_2, ...; I_1, I_2, ...; F_1, F_2, ...)$? So, we can generalize to: "refined neutrosophic refined soft code" (refined twice, once we refine the soft set, and second we refine the neutrosophic set).

While 11 means true and 00 means false in the neutrosophic code, it is a good idea that 01 and 10 may mean indeterminacy. Is it any meaning of the codewords 1I (I = indeterminacy), 1I' (where I' = 1 + I), 0I, and 0I' ?

Mumtaz Ali

Neutrosophic code is needed for indeterminacies such as: when a system is unable to recognize the information, when someone receives corrupt messages on cell phone (some text missing), or when sometime your call to a person gets someone else’s number.

The corrupted file is just an example of neutrosophic code. I send it to you for the confirmation of neutrosophic code that the file is corrupted but the data is still present and we are unable to recognize it. The system is not recognizing it.

All 0I, 1I, 0I', and 1I' are indeterminacies of different types.

I (Indeterminacy) is a multibit or dual bit, which can be 0 or 1 at the same time. So 0I can become 00 or 01 at the same time - which is unrecognizable for us. That's why we can call it *neutrosophic codeword*.

Neutrosophic Intersection

Neutrosophic intersection (similarly to the fuzzy intersection) can actually be defined in other ways too, since neutrosophic intersection (like fuzzy intersection) is an approximation of the classical intersection.

In neutrosophic and fuzzy theories we work with approximations.

Actually each neutrosophic operator (intersection, strong union, weak union, negation, implication, equivalence) is a class of rules defined in slightly different ways. So, yes, lot of structures for each of them.

Similarly for fuzzy operators, for intuitionistic fuzzy, and picture fuzzy operators.

Neutrosophic Graphs

To Mumtaz Ali

A *neutrosophic graph* is a (direct or not direct) graph that has some indeterminacy with respect to its edges, or with respect to its vertexes, or with respect to both (edges and vertexes simultaneously).

1) The *(t,i,f)-Edge Neutrosophic Graph*.

In such a graph, the connection between two vertexes A and B, represented by edge AB:

A------------------------------B

has the neutroosphic value of (t,i,f).

2) *I-Edge Neutrosophic Graph*.

In the book (2003) *Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps*, Dr. Vasantha Kandasamy and F. Smarandache used a different edge:

A------------------------------B

which can be just I = literal indeterminacy of the edge, with $I^2 = I$ (as in I-Neutrosophic algebraic structures).

Therefore, simply we say that the connection between vertex A and vertex B is indeterminate.

3) *I-Vertex Neutrosophic Graph*.

Or a literal indeterminate vertex, meaning we do not know what this vertex represents.

4) *(t,i,f)-Vertex Neutrosophic Graph*.

We can also have neutrosophic vertex, for example vertex A only partially belongs to the graph (t), indeterminate appurtenance to the graph (i), does not partially belong to the graph (f), we can say A(t,i,f).

And combinations of any two, three, or four of the above four possibilities of neutrosophic graphs.

If (t,i,f) or the literal I are refined, we get corresponding refined neurosophic graphs.

To Said Broumi

You might consider for your PhD thesis the following type of neutrosophic graphs, called "(t,i,f)-edge and vertex neutrosophic graphs" since the neutrosophic values are referred to both the edges and the vertexes [they are also generalizations of the intuitionistic fuzzy graphs from the paper you e-mailed me]:

$$A_1(t_1,i_1,f_1)\xrightarrow[]{\quad(t_3,i_3,f_3)\quad}A_2(t_2,i_2,f_2)$$

where the vertexes A_1 and A_2 have a neutrosophic appurtenance to the graph, and the edge A_1A_2 connects the vertexes in a neutrosophic way too (t_3,i_3,f_3), meaning that t_3% connection, i_3% indeterminate connection, and f_3% non-connection, where all t_j, i_j, f_j are single-valued numbers in [0, 1].

You'll consider these for all graph edges and vertexes.

But you can also consider, as a second chapter, the case when all t_j, i_j, f_j are interval-values included into [0, 1].

Four Types of Neutrosophic Graphs

To Mumtaz Ali

1) In *Neutrosophic Cognitive Maps* we used the following. The edge values' meaning:
   0 = no connection between vertices,
   1 = connection between vertices,
   I = indeterminate connection (not known if it is or if it is not).

2) *(T,I,F)-neutrosophic edge graph*.

But we extended the neutrosophic graph in a different way: an edge between two vertices A and B can be T% relationship, I% indeterminate relationship, and F% not in relationship.

And how should we name this new type of graph?

3) *(T,I,F)-neutrosophic vertex graph*.

Also, again a different type of graph: we can consider a vertex A as: T% belonging/membership to the graph, I% indeterminate membership to the graph, and F% nonmembership to the graph.

4) Types 1, 2, or 3 together.

Neutrosophic AG-Groupoid

To Madad Khan

We extend now for the first time the *AG-Groupoid* to the *Neutrosophic AG-Groupoid*.

A *Neutrosophic AG-groupoid* is a neutrosophic algebraic structure that lies between a neutrosophic groupoid and a neutrosophic commutative semigroup.

Let *M* be an *AG-groupoid* under the law "." One has:

$$(ab)c = (cb)a$$

for all *a*, *b*, *c* in *M*.

Then

$$MUI = \{a+bI,$$

where *a*, *b* are in *M*, and *I* = literal indeterminacy such that $I^2 = I\}$ is called a *neutrosophic AG-groupoid*.

A neutrosophic AG-groupoid in general is not an *AG-groupoid*.

If on *MUI* one defines the law "*" as:

$$(a+bI)*(c+dI) = ac+bdI,$$

then the neutrosophic AG-groupoid (*MUI*, *) is also an AG-groupoid since:

$$[(a_1+b_1I)*(a_2+b_2I)]*(a_3+b_3I) = [a_1a_2+b_1b_2I]*(a_3+b_3I) =$$
$$(a_1a_2)a_3+(b_1b_2)b_3I = (a_3a_2)a1+(b_3b_2)b_1I$$

and also

$$[(a_3+b_3I)*(a_2+b_2I)]*(a_1+b_1I) = [a_3a_2+b_3b_2I]*(a_1+b_1I) =$$
$$(a_3a_2)a_1+(b_3b_2)b_1I.$$

(T,I,F)-neutrosophic groupoid or (T,I,F)-groupoid

To Madad Khan

Should we say *(T,I,F)-neutrosophic groupoid* or *(T,I,F)-groupoid*?

We have done so far two types of neutrosophic structures:

1) those based on elements of the form $a + bI$ (where I = literal indeterminacy),

and

2) those based on T,I,F components of truth, indeterminacy and falsehood.

But we can also combine these two types of neutrosophic structures together and get a third type:

3) both $a + bI$ and T,I,F together in the same structure.

Fuzzy Tendential Neutrosophic

To Gheorghe Săvoiu

Atanassov a introdus în 1986 și gradul (procentul) de neapartenență a unui element la o mulțime, și a introdus mulțimea intuiționistică fuzzy.

Smarandache a introdus în 1995 și gradul (procentul de nedeterminare a apartenenței, adică nu știm nici dacă aparține, nici daca nu aparține un element la o mulțime), definind mulțimea neutrosofică.

Neutrosofia se bazează pe partea neutră, nici de apartenență, nici de neapartenență. Iar în logică, la fel pe partea neutră: nici adevărat, nici fals, ci între ele. In probabilitate: nici șansa ca un eveniment să se întâmple, nici șansa ca evenimentul să nu se întâmple.

Așadar, un element x(t,i,f) aparține la o mulțime neutrosofică M în felul următor: x este t% în M, i% apartenență nedeterminată, și f% nu aparține; t = adevăr, i = nedeterminare, f = fals.

Alții însă folosesc litere grecești, ca dvs. Notația nu contează prea mult aici.

Sau putem privi din punct de vedere probabilistic astfel: șansa ca elementul x să aparțină la mulțimea M este t%, șansa nedeterminată de apartenență este i%, iar șansa de neapartenență este f%.

În cazuri normalizate, t + i + f = 1 (100%), dar în general, daca informațiile despre posibilitatea de apartenență a elementului x la multimea M provin din surse independente (care nu comunică una cu alta, deci nu se influențează reciproc), sau provin de la aceeași sursă dar care consideră parametri / standarde diferiți / diferite de evaluare a fiecărei componente neutrosofice t, i, f, atunci se poate ca $0 \leq t + i + f \leq 3$.

În cazuri mai generale și mai aproximative, t,i,f pot fi intervale incluse in [0, 1], sau chiar submulțimi oarecare incluse în [0, 1], adică atunci când lucrăm cu date imprecise rău, contradictorii, vagi...

Întelegeți logica neutrosofică de la fotbal:

Să presupunem că FC Arges joacă împotriva lui Dinamo București la Pitești. Șansa de a câștiga (t) să zicem că este 60%, șansa de meci egal (i) de 30%, și șansa de a pierde (f) de 10%.

Revenind la economie și prețuri, ar mai trebui adăugate și gradele (procentele) de nedeterminare (i) și de neapartenență (f) ale prețurilor.

Numărul prezentat în articol este număr fuzzy triunghiular, dar putem să-l extindem la număr neutrosofic triunghiular dacă adăugăm același lucru pentru funcția de nedeterminare (i) și pentru cea de neapartenență (f).

Cum să interpretăm deci conceptul "fuzzy tendential neutrosophic"? Cred că prin faptul că avem un grad de apartenență (deci fuzzy), dar mai există șansa unui grad de nedeterminare (deci neutrosofic) datorită impreciziei și neprevăzutului care există în fluctuațiile de market.

Neutrosophic Complement

To John Mordeson

Now, if the complement *c(.)* is involutive in fuzzy set and intuitionistic fuzzy set, i.e. $c(c(a)) = a$ for all a in [0, 1], the complement in general is not involutive in neutrosophic set.

In neutrosophic set there are several classes of definitions (designs) of neutrosophic complement, such as:

$$c(T,I,F) = (F, I, T),$$

which is involutive;

$$c(T,I,F) = (1-T, I, 1-F),$$

which is also involutive; but

$$c(T,I,F) = (F, (T + I + F)/3, T)$$

is not involutive since c(c(T,I,F)) is different from (T,I,F) due to the indeterminacy which is not the same [although T and F are complementary];

similarly

$$c(T,I,F) = (1 - T, (T + I + F)/3, 1 - F)$$

is not involutive since c(c(T,I,F)) is different from (T,I,F) due again to the indeterminacy which is not the same [although T and F are complementary];

also, the optimistic complement defined as:

$$c(T,I,F) = (1 - T, (T + I + F)/3, |1 – F – I|)$$

is not involutive, nor T and F are complementary;

similarly the pessimist complement defined as:

$$c(T,I,F) = (|1 – T – I|, (T + I + F)/2, 1 - F)$$

is not involutive, nor T and F are complementary.

T,I,F are more flexible in neutrosophic set, that they are in intuitionistic fuzzy set.

The case T+I+F = 1 does not coincide with the intuitionistic fuzzy set (IFS), since when applying the IFS operators these operators are **not** applied to the indeterminacy I, while in neutrosophic set (NS) the neutrosophic operators are also applied to the indeterminacy I.

For example:

In IFS one has the intersection ($\wedge_{IF}$):

$$(0.1, 0.2, 0.7) \wedge_{IF} (0.4, 0.5, 0.1) = (0.1,0.7) \wedge_{IF} (0.4,0.1) =$$
$$(\min\{0.1,0.4\}, \max\{0.7,0.1\}) = (0.1,0.7) = (0.1,0.2,0.7)$$

since it is understood that the difference to 1 is hesitancy (indeterminacy).

In NS one has the intersection:

$$(0.1, 0.2, 0.7) \wedge_{N} (0.4, 0.5, 0.1) =$$
$$(\min\{0.1, 0.4\}, \max\{0.2, 0.5\}, \max\{0.7, 0.1\}) = (0.1,0.5,0.7)$$

whose sum of components is not 1 any longer, so the neutrosophic operators take in general the case T+I+T=1 outside of the intuitionistic fuzzy set limits, i.e. the result in general is

$$T+I+F < 1 \text{ or } T+I+F > 1.$$

Hence we obtained two different results even in the case T+I+F=1 with respect to IFS and NS.

In fuzzy theory and intuitionistic fuzzy theory, if T is big, then F has to be small in order to counterbalance the sum of them to be 1.

For example, if T = 0.90, then F ≤ 0.10.

So, T and F are complementary in fuzzy theories.

But in neutrosophic theory, if T is big, then F can be anything (i.e. small, medium, or big), because their sum does not have to be 1.

For example, if T = 0.90, then F can be even bigger, let's say F = 0.95.

So, T and F are not complementary in neutrosophic theory.

I recall that $T+I+F \leq 3$.

Now, going to neutrosophic algebraic research,

if

$$T(xy) \geq \min\{T(x), T(y)\}$$

it does not mean that

$$F(xy) \leq \max\{F(x), F(y)\}.$$

See this counter-example:

Let $A = \{2(0.1, 0.4, 0.3), 3(0.2, 0.5, 0.4), 6(0.3, 0.6, 0.5)\}$.

$T(2 \times 3) = T(6) = 0.3 \geq \min\{T(2), T(3)\} = \min\{0.1, 0.2\} = 0.2$.

But

$$F(2 \times 3) = F(6) = 0.5$$

is not smaller than

$$\max\{F(2), F(3)\} = \max\{0.3, 0.4\} = 0.4.$$

Similarly

$$I(2 \times 3) = I(6) = 0.6$$

is not smaller than

$$\max\{I(2), I(3)\} = \max\{0.4, 0.5\} = 0.5.$$

Justification of $I^2 = I$

In the previous neutrosophic algebraic structures (started by W. B. Vasantha Kandasamy & F. Smarandache in 2003) we have neutrosophic numbers of the form:

$$a + bI,$$

where I = indeterminacy, and $I^2 = I$.

In many examples we can consider I = contradiction = T∧F (i.e. true and false simultaneously).

But I^2 = (T∧F)∧(T∧F) = T∧F = I,

where we associated to the ∧ in between the parentheses the multiplication [as in fuzzy and neutrosophic logic/set t-norm, where $t_1 \wedge t_2 = t_1t_2$ (multiplication)].

Similarly, in other examples we may consider I = uncertainty = T∨F (i.e. true or false).

But I^2 = (T∨F)∧(T∨F) = T∨F = I,

where we associated in the same way to the ∧ in between the parentheses the multiplication [as in fuzzy and neutrosophic logic/set, where $t_1 \wedge t_2 = t_1t_2$ (multiplication)].

Of course, there may be cases (applications) where I^2 is not equal to I.

This will be a new class of neutrosophic algebraic structures.

You might think to such examples. I'd be eager to see them.

Splitting Indeterminacy

To Akeem Adesina A. Agboola

For example, you might think about such example.

In the case of split indeterminacy I to sub-indeterminacies I_1 and I_2, Dr. Agboola has a paper for *Neutrosophic Sets and Systems* no. 10 where $I_1I_2 = I_2I_1$,

where I_1 = contradiction, and I_2 = uncertainty (I_1 and I_2 were defined as above),

because $I_1I_2 = (T \wedge F) \wedge (T \vee F) = T \wedge F = I_1$, and

also $I_2I_1 = (T \vee F) \wedge (T \wedge F) = T \wedge F = I_1$.

But is it possible to get other example (I mean to redefine I_1 and I_2 in different ways from above) such that I_1I_2 is different from I_2I_1?

All cases ($I^2 = I$, or I^2 different from I) will be good if we get justifications, examples, or applications.

Neutrosophic Automata Theory

The *fuzzy automata theory* can be extended to *neutrosophic automata theory*.

Neutrosophic Derivation and Integration

To W. B. Vasantha Kandasamy

We can define polynomials whose coefficients are (real or complex) sets (not necessarily intervals). It is also interesting to study polynomials whose coefficients are *neutrosophic numbers* or even *neutrosophic intervals*.

Similarly to the definition of the interval polynomial transformed into polynomial interval, we can extend the *neutrosophic interval matrix* to a *matrix neutrosophic interval*.

Also, *neutrosophic interval vector* transformed into *vector neutrosophic interval*.

I think neutrosophic derivation and integration would be very innovatory in science.

The problem would be how to differentiate and integrate *I* (*indeterminate*)? What justification to give to the result?

Neutrosophic Ideals

To W. B. Vasantha Kandasamy

In algebraic structures an IDEAL is a subring of a ring such that it is closed under difference and under multiplication for any two elements from the ring.

Therefore the ideal is in the first hand a SET.

Therefore a *neutrosophic ideal* in our books is a set of the form $a+bI$, where I=*indeterminacy*.

While professor Ahmed Salama from Egypt presents the neutrosophic ideal as a FAMILY of neutrosophic sets (not as a single set), family closed under union of its elements, and hereditary (if the family contains A that contains B, then the family also contains B). We can say the family is closed under containment.

Salama uses more topology in my opinion.

He is right in his work, but I hope there would be no confusion between the two different notions, named the same: *neutrosophic ideal*.

Maybe I should tell him to change his denomination to *neutrosophic ideal family* or something else?

Neutrosophic Intervals

To W. B. Vasantha Kandasamy

We can extend the interval polynomial and polynomial interval to interval function and function interval in the same way.

Even more general: to set function and function set.

I think we can also include the natural class of *neutrosophic intervals*, like:

$$[4+5I, -3+2I]$$

as a decreasing one, and

$$[-3+2I, 4+5I]$$

as an increasing one.

An interval $[a+bI, c+dI]$ is increasing iff $a \leq c$ and $b \leq d$.

Multi-Polynomials

To W. B. Vasantha Kandasamy

We may use polynomials with coefficients and variables as matrices, but actually we get a multi-polynomial. Actually, even with coefficients as matrices and variables as letters we also get multi-polynomials, i.e. like solving at once more polynomials equations for example.

Now, what about, as a similar product to the natural product of matrices, to consider a *natural product of complex numbers*:

$$(a+bi)(c+di) = ac+bdi$$

(but we need some applications or connections with other theories).

We can define too a *natural product of neutrosophic numbers*:

$$(a+bI)(c+dI) = ac + bdI$$

but again we need some justification: where is it useful?

Neutrosophic Linguistic Topological Space

To W. B. Vasantha Kandasamy

We may extend the *Fuzzy Linguistic Topological Space* to a *Neutrosophic Linguistic Topological Space*. A simple way would be to just include the work "indeterminate" in the fuzzy linguistic space: {0, *bad*, *good*, *very good*, etc., *indeterminate*}. Herein *indeterminate* = *unknown*.

Neutrosophic Quaternion

To W. B. Vasantha Kandasamy

It would interesting in extending the neutrosophic numbers to quaternions - at least some chapters in the next books.

The *Neutrosophic Quaternion* is:

$$a+b_i+c_j+d_k,$$

where the constants *a*, *b*, *c*, *d* (or at least one) are neutrosophic real numbers, i.e.:

$$a = a_1+a_2I,$$
$$b = b_1+b_2I,$$
$$c = c_1+c_2I,$$
$$d = d_1+d_2I,$$

with all a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2 real numbers, and I = indeterminate.

We can keep the same properties:

$$i^2 = j^2 = k^2 = ijk = -1,$$
$$ij = k,\ jk = i,\ ki = j, \text{ etc.}$$

Neutrosophic Biquaternion

To W. B. Vasantha Kandasamy

Similarly, the *Neutrosophic Biquaternion* is:

$$a+b_i+c_j+d_k,$$

where the constants a, b, c, d (or at least one) are neutrosophic complex numbers, i.e.

$$a = a_1+a_2I,$$
$$b = b_1+b_2I,$$
$$c = c_1+c_2I,$$
$$d = d_1+d_2I,$$

with at least one of the constants a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2 being complex number, and I = indeterminate.

We can keep the same properties:

$$i^2 = j^2 = k^2 = ijk = -1,$$
$$ij = k,\ jk = i,\ ki = j, \text{ etc.}$$

Applications to practice and/or other theories would be welcome.

Neutrosophic Dual Number

To W. B. Vasantha Kandasamy

A *Dual Number* has the form:

$$a+b\varepsilon,$$

where *a, b* are real numbers and ε has the nilpotent property: $\varepsilon^2 = 0$. Used in physics.

A *Neutrosophic Dual Number* will be:

$$a+b\varepsilon,$$

where at least one of *a* or *b* is a neutrosophic real or complex number, and $\varepsilon^2 = 0$.

Neutrosophic Hyperbolic Number

To W. B. Vasantha Kandasamy

A *Split-Complex Number* (or *Hyperbolic Number*) has the form:

$$a+bj,$$

where *a, b* are real and $j^2 = 1$.

We can define a *Neutrosophic Split-Complex Number* (or *Neutrosophic Hyperbolic Number*) as:

$$a+bj,$$

where at least one of *a* or *b* is a neutrosophic real or complex number and $j^2 = 1$.

Literal Indeterminacy vs. Numerical Indeterminacy

To Jun Ye

We have two types of indeterminacies:

1) *Literal Indeterminacy*, when we deal with numbers of the form $a + bI$, where a, b are real or complex numbers, while I = literal indeterminacy, with $I^2 = I$.

"*I*" is a letter only, does not represent a number, nor a numerical interval, neither a numerical subset.

These numbers are used in neutrosophic algebraic structures, such as *Neutrosophic Groups*, *Neutrosophic Rings, Neutrosophic Vector Spaces* etc. on sets of the form:

S_1 = {$a + bI$, where I is the literal intederminacy, with $I^2 = I$, and $a, b \in R$, with R the set of real numbers} and

S_2 = {$a + bI$, where I is the literal intederminacy, with $I^2 = I$, and $a, b \in C$, with C the set of complex numbers}.

2) *Numerical Indeterminacy* (that you used in many papers), of the form $a + bI$, where "*I*" is a numerical subset (" I " may represent an interval, let's say $I = [0.2, 0.4]$, or a hesitant set let's say I = {0.9, 1.1, 3, 5}, or any real (or complex) subset, for example $I = [3, 4] \cup (5, 6)$.

On this case $I^2 \neq I$ in general.

For example $I^2 = [0.20, 0.40]^2 = [0.20^2, 0.40^2] = [0.04, 0.16]$.

With or Without Indeterminacy

When one has indeterminacy (I) in a problem, one uses neutrosophy. But even without indeterminacy, the neutrosophic theories can work, since we assign I = 0 { or I = ϕ (empty set), if we work on intervals, on hesitant sets, or in general on any subset of [0, 1] }.

Subindeterminacies

To W. B. Vasantha Kandasamy

Please see: *http://fs.unm.edu/SymbolicNeutrosophicTheory.pdf.*

I refined the neutrosophic number $a + bI$ as:

$$a + b_1I_1 + b_2I_2 + \ldots + b_nI_n,$$

where $a, b_1, b_2, \ldots, b_n$ are real (or complex) numbers,

while indeterminacy "I" was refined into sub-indeterminacies $I_1, I_2, \ldots, I_n$, for $n \geq 1$.

For example, I_1 = ignorance, I_2 = contradiction, I_3 = vagueness, etc.

Then we can defined refined neutrosophic algebraic structures on refined indeterminacy of neutrosophic numbers, i.e. semigroup, group, ring etc.

Then we need to define the multiplication $I_p \times I_r$ using the absorption principle: the bigger fish eats/absorbs the small fish, i.e. if $I_1 \leq I_2$, then $I_1 \times I_2 = I_2$.

We may first establish the indeterminacy order:

$I_1 \leq I_2 \leq \ldots$.

So we construct $R \cup \{I_1, I_2, \ldots, I_n\}$ algebraic structures, where R is the set of real numbers.

Blending Big Science & Deep Science

To Vic Christianto

I think as in neutrosophy, there is a blending of Big Science [theory] & Deep Science [reality], what I mean, much of today's science is partially Big and partially Deep.

Since, in order to arrive from Big Science to Deep Science we need to have some intuition, some empiricism that may result from our mathematical equations as laws.

Going backwards, from Deep Science we look back and improve our previous practical intuition and empiricism modelling them with abstract mathematical equations.

Big Bang?

To Vic Christianto

On the American TV (Science channel) it was a documentary that "another universe existed before the Big Bang"!

What does it mean? Were there many Big Bangs?

God vs. Evil

To Victor Christianto

Why doesn't God fix our economy since He is so powerful? Since God is very powerful, why does He kill all Evil?

If He cannot do that, then He is not powerful enough...

Questions around Big Bang Theory

To S. Crothers

I read your paper called "Correspondence". Thank you for sending it to me. So Big Bang is related to Black Holes.

The point that the Big Bang Theory sustains that exploded and created the universe had infinite density (therefore infinite mass)?

1) My question is: what was before that infinite-density point?

2) What is the density of a black hole (as the mainstream says)?

3) I thought the Event Horizon is a spherical (or almost spherical) surface around the black hole (as said by the mainstream) where its gravitational field is very high.

4) Does it exist infinite gravitational fields?

Open question: What is the Maximum Chain Length of Orbiting Bodies?

In the macrocosmos, let's consider an astronomical body (A_1),

around which orbits another astronomical body (A_2),

and around (A2) orbits another astronomical body (A_3),

and again around (A_3) orbits another astronomical body (A_4),

and so one.

Let's call such astronomical bodies A_1, A_2, A_3, A_4, … as a chain of orbiting bodies.

At level three (A_1, A_2, A_3) we know: Sun, Earth, and Moon.

What is the maximum chain length of such astronomical bodies that has been discovered in the universe A_1, A_2, A_3, ..., A_n (n = ?), and what might be the hypothetical largest chain length of orbiting bodies in the macrocosmos ?

Similar questions in the microcosmos.

Then the questions extended to the macrocosmos-microcosmos put together.

Each Research Field

To Surapati Pramanik

Each research field in any discipline is liked by some people (T), disliked by other people (F), and ignored by those who are not interested in (I)... as in neutrosophic set are (T, I, F).

If a theory (i.e. its space of work, or its axioms, or its theorems, or its concepts) has some indeterminacy, then one can apply the neutrosophic theory.

It would be interesting if one can prove that each theory has its own indeterminacy.

Then we'd have a neutrosophic part of it.

Our Neutrosophic World

To Selçuk Topal

We live in a neutrosophic world (not because I, as founder of the neutrosophic sciences, want this, but because it is the truth).

I mean, a person John is not only friend, or only enemy, but it may be partially friend and partially enemy (it depends on the attribute a_1 or attribute a_2 we talk about).

Therefore, things are not only white (A) or black (antiA), but also gray - in between the opposites, or combinations of white and black (neutA), as in neutrosophy.

Let's forgive and work all together with our positive (connective) sides!

Societățile converg și diverg una către alta

După cât am umblat prin această lume tumultoasă, am constatat că societățile converg una către alta (influențându-se reciproc)... până la un punct culminant ca nivel de omogenitate colectivă. Iar de la acest punct culminant, ele diverg înapoi spre eterogenitate. Și acest proces oscilatoriu continuă, continuă...

All The Things in The Nature Are Not Perfect

An important idea that the physical laws are not perfect, therefore they have indeterminacy, therefore we can use the neutrosophic theory to represent all (or most) of them.

We might have the same idea in other fields: biology, chemistry, etc. Meaning that the theoretical laws are not perfect, so they are not true in totality but in a smaller than 100%.

Therefore the neutrosophic theory could be applied for these laws.

My **lab**[oratory] is a virtual facility with non-controlled conditions in which I mostly perform scientific meditation and chats: *a nest of ideas* (**nidus idearum**, in Latin). I called the jottings herein *scilogs* (truncations of the words *scientific*, and gr. Λόγος (*lógos*) – appealing rather to its original meanings "ground", "opinion", "expectation"), combining the welly of both science and informal (via internet) talks (in English, French, Spanish, and Romanian).

In this *fourth book of scilogs* collected from my nest of ideas, one may find new and old questions and solutions, referring mostly to topics on NEUTROSOPHY – email messages to research colleagues, or replies, notes about authors, articles, or books, future projects, and so on.

Special thanks to all my peer colleagues comprised in this booklet for exciting and pertinent instances of discussing (alphabetically ordered): Mohamed Abdel-Basset, Akeem Adesina A. Agboola, Mumtaz Ali, Saima Anis, Octavian Blaga, Arsham Borumand Saeid, Said Broumi, Stephen Buggie, Victor Chang, Vic Christianto, Mihaela Colhon, Cuờng Bùi Công, Aurel Conțu, S. Crothers, Otene Echewofun, Hoda Esmail, Hojjat Farahani, Erick Gonzalez, Muhammad Gulistan, Yanhui Guo, Mohammad Hamidi, Kul Hur, Tèmítópé Gbóláhàn Jaíyéolá, Young Bae Jun, Mustapha Kachchouh, W. B. Vasantha Kandasamy, Madad Khan, Erich Peter Klement, Maikel Leyva-Vázquez, Dat Luu, Radko Mesiar, Fatimah M. Mohammed, John Mordeson, Xindong Peng, Surapati Pramanik, Dmitri Rabounski, Adriana Răducan, Gheorghe Săvoiu, Ajay Sharma, Le Hoang Son, Mirela Teodorescu, Nguyễn Xuân Thảo, Selçuk Topal, Amin Vafadarnikjoo, Andrușa Vătuiu, Jun Ye, Xiaohong Zhang.

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