Neutrosophic Logic as a Theory of Everything in Logics

Prof. Florentin Smarandache
Dept. of Mathematics and Science
University of New Mexico, USA

Abstract.
Neutrosophic Logic (*NL*) is a Theory of Everything in logics, since it is the most general so far. In the Neutrosophic Propositional Calculus a neutrosophic proposition has the truth value (T, I, F), where T is the degree of truth, I is the degree of indeterminacy (or neutral, i.e. neither truth nor falsehood), and F is the degree of falsehood, where T, I, F standard or non-standard subsets of the non-standard unit interval $]^-0, 1^+[$. In addition, these values may vary over time, space, hidden parameters, etc.
Therefore, *NL* is a triple-infinite logic but, by splitting the Indeterminacy, we prove in this article that *NL* is a *n-infinite logic*, with $n = 1, 2, 3, 4, 5, 6, \ldots$.
Also, we present a total order on Neutrosophic Logic.

1. Introduction.

The neutrosophic component of Indeterminacy can be split into more subcategories, for example Belnap split Indeterminacy into: the paradox (<*A*> *and* <*antiA*>) and uncertainty (<*A*> *or* <*antiA*>), while truth would be <*A*>, and falsehood <*antiA*>. This way Belnap got his four-valued logic.

In neutrosophy we can combine <*A*> and <*nonA*>, getting a degree of <*A*> a degree of <*neutA*> and a degree of <*antiA*>.
<*A*> actually gives birth to <*antiA*> and <*neutA*> (not only to <*antiA*> as in dialectics).

But Indeterminacy can be split, depending on each application, in let's say: vagueness, ambiguity, unknown, unpredicted, error, etc. given rise to n-infinite logic, for $n \geq 1$.

2. History of Infinite Logics.

A *1-infinite logic* is the **fuzzy logic**, since in fuzzy logic $t + f = 1$, where t = truth value and f = false value.
Intuitionistic fuzzy logic is a *2-infinite logic*, since t and f vary in the interval $[0, 1]$, while $i = 1 - t - f$, where i = indeterminacy.
Neutrosophic logic is a *3-infinite logic*, since t, i, f are independent, and their sum is not necessarily equal to 1, but with 3, since *NL* also generalizes the intuitionistic logic which supports incomplete theories (the sum of the components is less than 1), and paraconsistent logic (when the sum of components is greater than 1). In *NL* all three components t, i, f vary in the non-standards interval $]^-0, 1^+[$.
Belnap Logic can be consider as a *3-infinite logic,* by taking (t, p, u, f) truth value of a proposition, where $t + p + u + f = 1$.
It can be generalized to a **Neutrosophic Belnap Logic**, which will be a *4-infinite logic*, by letting $t + p + u + f \leq 4$ in order to include the Paraconsistent Neutrosophic Belnap

Logic (sum of all four components is greater than *1,* but less than or equal to *4*) and the Intuitionistic Neutrosophic Belnap Logic (sum of components is less than *1*).
(2+*k*)-infinite neutrosophic logic. In we split the Indeterminacy in *k*-parts {like paradox (true and false simultaneously), ignorance (true or false), unknown, vagueness, error, etc.} then we get a *(2+k)-infinite logic*, for $k \geq 1$.

NL is, so far, the most general logic, that's why we can call it a Theory of Everything in Logics.

Etymologically, *neutro-sophic* means a logic based on a 'neutral' component (indeterminacy, unknown, i.e. neither true nor false, hidden parameters, and tight result).

3. **A Total Order in Crisp Neutrosophic Logic**.

Umberto Rivieccio recommended in his article [13] that "it would be very useful to define suitable order relations on the set of neutrosophic truth values".
Yes, but I think for each application we might have a different order relation;
I am not sure if one can get one such order relation workable for all problems;

About the total order on *NL* with crisp components, here it is a small extension of Charles Ashbacher's order defined in the book:
http://www.gallup.unm.edu/~smarandache/IntrodNeutLogic.pdf, page 119, i. e.
for crisp values t, i, f we can define a total order:
$(t_1, f_1, i_1) < (t_2, f_2, i_2)$ if:
a) either $t_1 < t_2$;
b) or $t_1 = t_2$ but $f_1 > f_2$;
c) or $t_1 = t_2, f_1 = f_2,$ but $i_1 > i_2$.
Ashbacher has only the first two conditions: a) and b).
Condition c) is needed in the case when the sum of components is not *1* {I mean when $t+f+i < 1$ for intuitionistic (incomplete) logic; or $t+f+i > 1$ for paraconsistent logic; if $t+f+i = 1$ the third condition is not needed - it is implicit}.
We can re-write the components as:
(t, f, i) since f is more important than i.

Ashbacher also does a splitting of Indeterminacy into more components, as I wrote to Umberto Rivieccio in some e-mails, giving rise to different neutrosophic logics.

References

1. C. Ashbacher, *Introduction to Neutrosophic Logic*, Am. Res. Press, Rehoboth, USA, 2002.

2. Anne-Laure Jousselme, Patrick Maupin, *Neutrosophy in Situation Analysis*, Fusion 2004 International Conference, Stockholm, Sweden, June 28 – July 1, 2004;
http://www.fusion2004.foi.se/papers/IF04-0400.pdf.

3. PlanetMath, *Neutrosophic Logic*
http://planetmath.org/encyclopedia/NeutrosophicLogic.html
and *Neutrosophic Set*
http://planetmath.org/encyclopedia/NeutrosophicSet.html.

4. Umberto Rivieccio, *Neutrosophic logics: Prospects and problems*, in Fuzzy Sets and Systems, Vol. 159, Issue 14, pp. 1860 – 1868, 2008.

5. Florentin Smarandache, *An Introduction to the Neutrosophic Probability Applied in Quantum Statistics*, in <Bulletin of Pure and Applied Sciences>, Physics, 13-25, Vol. 22D, No. 1, 2003.

6. Florentin Smarandache, *Neutrosophy. / Neutrosophic Probability, Set, and Logic*, American Research Press, Rehoboth, USA, 1998, 105 p.;
republished in 2003, *A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability (fourth edition)*, American Research Press, 143 p.;
Chinese translation by Feng Liu, *A Unifying Field in Logics: Neutrosophic Logic. / Neutrosophy, Neutrosophic Set, Neutrosophic Probability and Statistics*, Xiquan Chinese Branch, 2003, 121 p.

7. Haibin Wang, Praveen Madiraju, Yanqing Zhang, Rajshekhar Sunderraman, *Interval Neutrosophic Sets*, International Journal of Applied Mathematics & Statistics, Vol. 3, No. M05, pp. 1-18, March 2005.