Some Simple Advantages Of Reasoning In Intuitionistic Neutrosophic Logic

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Abstract: The traditional form of reasoning in logic and automated reasoning is severely limited in that it cannot be used to represent many circumstances. In this paper, we demonstrate two simple examples of the superiority of intuitionistic neutrosophic logic in representing the data of the real world.

The Definition of Intuitionistic Neutrosophic Logic

Intuitionistic neutrosophic logic is an extension of fuzzy logic, where the elements are assigned a four-tuple (t, i, f, u) representation of their truth value. t is the value of truth, i the value of indeterminacy, f the value of false and u is the degree to which the circumstances are unknown. The sum of the four terms is 1.0 and all are greater than or equal to zero, which maintains consistency with the classical and fuzzy logics. The logical connectives of and ($\wedge$), or ($\vee$) and not ($\neg$) can be defined in several ways, but here we will use the definitions used by Ashbacher to define INL2[1].

Definition 1:

$\neg(t_1, i_1, f_1, u_1) = (f_1, i_1, t_1, u_1)$

$(t_1, i_1, f_1, u_1) \wedge (t_2, i_2, f_2, u_2) = (t = \min\{t_1, t_2\},\ i = 1 - t - f - u,\ f = \max\{f_1, f_2\},\ u = \min\{u_1, u_2\})$

$(t_1, i_1, f_1, u_1) \vee (t_2, i_2, f_2, u_2) = (t = \max\{t_1, t_2\},\ i = 1 - t - f - u,\ f = \min\{f_1, f_2\},\ u = \min\{u_1, u_2\})$

It is easy to verify that the elements of INL2 are closed with respect to these definitions of the basic logical connectives. Furthermore, many of the algebraic properties such as the associative and commutative laws also hold for these definitions.

An Example of Clauses In Automated Reasoning

In automated reasoning, facts are defined by stating instances of a predicate. For example, in Wos[2], the clause

FEMALE(Kim)

is used to represent that Kim is a female. A set of clauses is then developed which stores the knowledge of all persons who are female. Clauses such as

MALE(John)

are used to represent that John is a male. A query to the database of facts will have a form similar to

FEMALE(Kim)?

which is asking the question, "Is Kim female?" In standard reasoning, the response would be a yes or a true if the database of facts contains a clause of the form

FEMALE(Kim)

or there is a line of reasoning that leads to the conclusion that Kim is female.

In the case where there is no such fact or line of reasoning, the response would be no or false. Therefore, a negative response could be a no that was inferred from the data or a case where Kim does not appear in the database of females. The difference between these two conditions is substantial and the INL2 allows for them to be distinguished. If any form of knowledge can be inferred about the query, the value returned would be computed from the values. In the case where there is no information about the clause, the value returned by the query would be (0,0,0,1), which could be interpreted as unknown or unsupported by the facts. This value can then be considered the default for all items not in the database.

Using Intuitionistic Neutrosophic Logic In The Representation of Gender

In his book, Wos[2] uses the fact

$\neg$MALE(Kim)

to infer that Kim is female. Such rigid, two gender representations are in fact inaccurate. According to the Intersex Society of North America (http://www.isna.org) approximately 1 in 2000 children are born with a condition of "ambiguous" external genitalia. The condition ranges in a continuous manner from slight differences from the standard structure to a complete, functioning set of male and female reproductive systems.

Intersex conditions cannot be represented by the classical reasoning, for example if a person has the functioning sex organs of both gender, then to say either FEMALE(x) or MALE(x) is true is to arbitrarily assign a gender. Fuzzy systems are also of little value, for if MALE(x) and FEMALE(x) are both assigned values of 0.50, then the data supports the notion that the person is half male and half female. This is just as inaccurate, as the person is simultaneously of both sexes rather than made up of parts of both.

These ambiguities are easy to describe using intuitionistic neutrosophic logic. By assigning a nonzero value to the indeterminate value, it is then possible to represent the full spectrum of possible genders. For example, a value of (0, 1, 0, 0) assigned to FEMALE(Jane) could mean that Jane has complete sets of both sex organs.

References

1. C. Ashbacher, **Introduction to Neutrosophic Logic**, American Research Press, 2002. http://www.gallup.unm.edu/~smarandache/IntrodNeutLogic.pdf .
2. L. Wos, **Auomated Reasoning: 33 Basic Research Problems**, Prentice-Hall, 1988.