

Paper Type: Original Article

Neutrosophics of Precise Imprecision

Florentin Smarandache ^{1,*} 

¹ University of New Mexico, Mathematics, Physics and Natural Sciences Division 705 Gurley Ave., Gallup, NM 87301, USA; smarand@unm.edu.

Received: 04 Oct 2024

Revised: 13 Jan 2025

Accepted: 17 Apr 2025

Published: 18 Apr 2025

Abstract

The world, as we experience it, is suffused with indeterminacy. From the behavior of subatomic particles to the complexities of human thought and social systems, ambiguity and uncertainty are not exceptions but intrinsic properties of reality. Classical frameworks—whether grounded in strict probabilities, binary logic, or clear set membership—often falter in their ability to grapple with this pervasive indeterminacy. That is why Neutrosophy seeks to lay the groundwork for a paradigm shift across disciplines.

Keywords: Neutrosophy; Indeterminacy; Precise Imprecision; Interdisciplinary Philosophy; Complex Systems Modeling; Neutrosophic Logic; Neutrosophic Set; Neutrosophic Probability; Dialectical Thinking; Triadic Reasoning; Quantum Mechanics; Heisenberg Uncertainty Principle; Superposition; Quantum Entanglement; Probabilistic Systems; Artificial Intelligence; Machine Learning.

1 | Introduction

Classical probability, set theory, and logic operate under assumptions of *definiteness*. For example, in probability theory, an event either occurs or it does not, with a single probability value assigned. In classical logic, a proposition is *true* or *false*. While these frameworks have provided robust tools for centuries, they stumble in contexts where uncertainty, paradox, or ambiguity dominate.

Quantum mechanics is a poignant example. The Heisenberg Uncertainty Principle highlights the inherent limitations in measuring a particle's position and momentum simultaneously. Similarly, in human cognition and social dynamics, ambiguity often arises not as a failure of understanding but as a natural state.

Traditional frameworks reduce this complexity to oversimplified binaries, losing essential nuances. Capra's 'Web of Life,' [2] with its synthesis of complexity, Gaia, and chaos theories, presents a systemic framework that resonates strongly with the core principles of neutrosophy. Both philosophies advocate for a move away from reductionism towards a holistic, ecological perspective that acknowledges the inherent interconnectedness and complexity of systems.

2 | The Need for Neutrosophic Extensions

To address these limitations, we require what might be termed a precise imprecision. Neutrosophy offers a foundational perspective for such precision [6]. At its core, Neutrosophy generalizes classical notions by introducing the concept of truth, falsity, and indeterminacy as coexisting components. Unlike fuzzy logic [4],



Corresponding Author: smarand@unm.edu



<https://doi.org/10.61356/j.hsse.2025.3539>



Licensee **HyperSoft Set Methods in Engineering**. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0>).

which focuses on degrees of truth, neutrosophic logic explicitly incorporates doubt and indeterminacy as intrinsic elements of reasoning. In this framework:

- Neutrosophic probability extends classical probability by accounting for the degree of indeterminacy in an event's occurrence.
- Neutrosophic sets allow elements to have varying degrees of membership, non-membership, and neutral membership, acknowledging partial and ambiguous associations.
- Neutrosophic logic integrates truth, falsity, and indeterminacy, making it possible to model complex, uncertain systems more faithfully. [5]

3 | Applications in Science and Beyond

Classical probability, set theory, and logic operate under assumptions of *definiteness*.

3.1 | Quantum Mechanics

The probabilistic nature of quantum mechanics aligns naturally with neutrosophic ideas. In the subatomic realm, particles often defy classical concepts of exact location and momentum. Instead of seeking definitive probabilities, we calculate *neutrosophic probabilities*, which incorporate percentages of indeterminacy [7]. This approach not only reflects the intrinsic uncertainties of quantum systems but also opens new pathways for understanding phenomena like superposition and entanglement.

3.2 | Artificial Intelligence and Neural Networks

In AI, uncertainty and ambiguity are prevalent, [8] whether in natural language processing, image recognition, or decision-making systems [1]. Neutrosophic logic provides a richer framework for designing algorithms capable of handling contradictory or incomplete information, enabling more adaptive and human-like reasoning.

3.3 | Psychology, Sociology, and Economics

Human behavior and societal dynamics are often characterized by conflicting motivations and ambiguous outcomes [3]. Neutrosophic philosophy provides tools to model these complexities, bridging quantitative and qualitative analyses. For instance, in economics, decisions are rarely based purely on rational probabilities; incorporating neutrosophic principles could refine models of market behavior.

3.4 | Literature and the Arts

Ambiguity and paradox are central to artistic and literary expression. Neutrosophic ideas can deepen our understanding of texts and artworks by providing a framework for interpreting the interplay of truth, falsity, and indeterminacy in creative works.

4 | The Interdisciplinary Nature of Neutrosophic Philosophy

The significance of Neutrosophy lies not only in its technical applications but also in its philosophical implications. By emphasizing the interplay of positive, negative, and neutral elements, Neutrosophy resonates with dialectical traditions in philosophy. It invites a reevaluation of historical schools of thought, encouraging researchers to extract their positive, negative, and neutral contributions.

Moreover, the interrelationship between mathematics and the humanities underscores the unifying potential of neutrosophic philosophy. Mathematics, often seen as a domain of rigid precision, becomes a language for exploring psychological, sociological, and literary complexities. Neutrosophy thus serves as a bridge between seemingly disparate disciplines, fostering a holistic understanding of reality.

5 | Conclusion: A Paradigm of Indeterminacy

The foundation of neutrosophic philosophy is an invitation to collective inquiry. By embracing indeterminacy and striving for a precise imprecision, neutrosophic philosophy offers a transformative lens through which to view the complexities of the world. It is a philosophy not of closure but of openness, a framework not of final answers but of endless exploration.

Acknowledgments

The author is grateful to the editorial and reviewers, as well as the correspondent author, who offered assistance in the form of advice, assessment, and checking during the study period.

Funding

This research has no funding source.

Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

References

- [1] Bishop, Christopher M. (2006). Pattern Recognition and Machine Learning. New York: Springer, Series: Information Science and Statistics.
- [2] Capra, Fritjof (1996). The Web of Life: A New Scientific Understanding of Living Systems. Anchor Books Doubleday.
- [3] Kahneman, Daniel (2011). Thinking, Fast and Slow. Farrar, Straus, and Giroux.
- [4] Kosko, Bart (1993). Fuzzy Thinking: The New Science of Fuzzy Logic. New York: Hyperion.
- [5] Smarandache, Florentin (2002). "Neutrosophy, A New Branch of Philosophy." Multiple Valued Logic, 3: 297-384. Retrieved from the The University of New Mexico Digital Repository, https://digitalrepository.unm.edu/math_fsp/24
- [6] Smarandache, F. (2007). A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability and Statistics, 6th edition. Ann Arbor: InfoLearnQuest. Retrieved from the The University of New Mexico Digital Repository, https://digitalrepository.unm.edu/math_fsp/163/
- [7] Smarandache, Florentin (2005). Introduction to Neutrosophic Measure, Neutrosophic Integral, and Neutrosophic Probability. Craiova, Romania: Sitech. https://digitalrepository.unm.edu/math_fsp/34
- [8] Tegmark, Max (2018). Life 3.0: Being Human in the Age of Artificial Intelligence. New York: Vintage Books.

Disclaimer/Publisher's Note: The perspectives, opinions, and data shared in all publications are the sole responsibility of the individual authors and contributors, and do not necessarily reflect the views of Sciences Force or the editorial team. Sciences Force and the editorial team disclaim any liability for potential harm to individuals or property resulting from the ideas, methods, instructions, or products referenced in the content.