Abstract submitted to 11th International Whitehead Conference
Session: Whitehead, Mathematics and Logic (Vesselin Petrov)

# The Monad in Process-Relational Systems

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Whitehead's Process and Reality introduces many of the concepts of metaphysics. Later workers, including Robert Mesle, Margaret Stout and Mary Follett, have used the ideas of Whitehead to formulate the process-relational philosophy. Such a philosophy has been applied in a social context to handle creativity, Becoming, imagination and experience. In a language context, the same philosophy has been applied to ontology or Being.

The process-relational philosophy considers that the world can be thought of a collection of interrelated processes, rejecting the Cartesian dualism of Descartes and favouring the dynamic process (flux) of Heraclitus. Such a philosophy satisfies current requirements in computer science and information systems but has often been difficult to achieve. This is because the basis of much of computer science is set theory, which provides adequately the static (Being) but is restricted to process as function. Further, handling the logical types across the static and process components in an integrated manner is very difficult in practice, a problem encountered by Russell and Whitehead in their series on set theory, Principia Mathematica. A single-level approach is inadequate for the complexities of information systems.

Much of Whitehead's Process and Reality can be considered as informal category theory, preceding the later developments in pure mathematics, starting in the 1940s by such workers as Mac Lane and Eilenberg. For instance Whitehead's category of prehension, or grasping, corresponds to the categorial adjunction. Other examples are that Whitehead's category of the ultimate corresponds to the topos and his category of existence to the Cartesian-closed category.

In this paper we consider how the process-relational philosophy, naturally arising from Process and Reality, can be considered formally in category theory by the monad, which relates inputs and outputs through adjointness. The monad operates on a category, such as a topos, over three-levels, providing the necessary closure of being defined as unique up to natural isomorphism. The term monad was developed by Leibniz and his use of the term will be compared to its use today in mathematics and computer science.