Chapter III

The World Code:
Mathematical Ontology as the Real Road to Reality

Introduction

Formalizing the world in rigorous mathematical terms is no less significant than its fundamental understanding and modeling in terms of ontological constructs. Like black and white, opposite sexes or polarity signs, ontology and mathematics stand complementary to each other, making up the unique and unequaled knowledge domain or knowledge base, which involves two parts:

- **Ontological (real) mathematics**, which defines the real significance for the mathematical entities, so studying the real status of mathematical objects, functions, and relationships in terms of ontological categories and rules.
- **Mathematical (formal) ontology**, which defines the mathematical structures of the real world features, so concerned with a meaningful representation of the universe in terms of mathematical language.

The combination of ontology and mathematics and substantial knowledge of sciences is likely the only one true road to reality understanding, modeling and representation. Ontology on its own can't specify the fabric, design, architecture, and the laws of the universe. Nor theoretical physics with its conceptual tools and models: general relativity, quantum physics, Lagrangians, Hamiltonians, conservation laws, symmetry groups, quantum field theory, string and M theory, twistor theory, loop quantum gravity, the big bang, the standard model, or theory of everything material. Nor mathematics alone with its abstract tools, complex

number calculus, differential calculus, differential geometry, analytical continuation, higher algebras, Fourier series and hyperfunctions is the real path to reality (Penrose, 2005).

The richest conceptual representations of the world structures and changes come from the intimate unification of fundamental ontology and mathematics.

For, providing the realistic foundations for mathematical quantities and relationships, ontology is concerned with an abstract modeling of the real world and its basic features. Mathematics in turn is ultimately concerned with the quantitative models of reality, so furnishing the quantitative forms for the real world content, designing the pattern of a full-dress conceptual uniform tailored to fit the world body.

It is rather symptomatic that computing ontology, as formal specification for AI systems, agent communication and knowledge reuse started as a sort of mathematical ontology, built on abstract algebra and measurement theory (Gruber & Olsen, 1994). But such a reciprocal connection opens up much broader avenues to human and machine understanding of things, rather than just formalizing mathematical modeling in engineering and establishing the conceptual grounding for some variable quantities, physical dimensions, or metrics.

Complete with their interrelations, the totality of ontological classes constitutes the world general framework as an all-defining system of things. What is mostly remarkable about the general framework is that its highest universal class and the base kinds are susceptible of symbolism and computation. Or, the ontological entities are subject to quantity and accurate representations in terms of their subordinate abstract structures: sets, classes, functions, categories, relations, numbers, and other magnitudes.

As it happens in all contemporary science, the possibility to be quantified and formulated may sharply reduce the ambiguity of the propositions and speculative reasoning upon reality, revealing its true constitution, structure, composition, and order. However, in order to correctly apply mathematical formulations and models, several considerations are necessary to bear in our minds, so that to avoid the congenital defects of set-theoretical and logical constructions of the world structure.

And the issue of issues is: what kind of reality makes the subject matter of **real mathematics** and **mathematical ontology**, assuming that there are several types of existence or being or reality:

- Ontological existence as entity kinds, rules, and patterns of relationships at the axiomatic, absolute, ultimate, and truthful level of reality
- Physical existence, as concrete things and processes at the factual, natural, scientific, experimental, commonsense, or objective level of reality
- Mental existence, as abstract constructs and images at the phenomenological, perceptual,cognitive, subjective, or experiential level of reality
- Cultural or social existence, as the artificially created level of hyperreality
- Virtual existence, at the simulated level of reality.

Crucially, there is the underlying world per se, the inherent reality, the implicit universe, the fundamental existence, independent of any conceptions, worldviews, or mathematical formulations on it. And there are then the modeled worlds, constructed existence, or represented

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