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An Ontological View on Types

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Types are fundamental for modeling, being an essential construct in all major modeling languages. These include traditional conceptual modeling languages - such as Entity-Relationship models, UML class diagrams, or Object-Role-Modeling (ORM) specifications, and knowledge representation languages alike (e.g., the Web Ontology Language - OWL).

In the past decades, there has been a growing interest in providing support for representing not only first-order types (i.e., types whose instances are individuals), but also higher-order types (i.e., types whose instances are other types) [1]–[8]. Domains such as software development [2], product types [3] and biological taxonomies [7], [8] are filled with rich multi-level classification schemes in which first-order and higher-order types as well as their ties have to be properly represented.

Despite the fundamental role played by types of all levels in modeling practices, from an ontological point of view, there has been a lack of theoretical support for precisely defining a consensual view on types [9]. From an ontological perspective, fundamental questions include: are types just equivalent to (unary) logical predicates? are types abstract or concrete entities? can types change and, if so, in which ways? are there multiple types of types? how different identity and individuation criteria relate to different types of types? In this talk, I defend that properly answering these questions is fundamental for the theory and practice of (multi-level) conceptual modeling. To do that, I discuss the theory of types behind the Unified Foundational Ontology (UFO).

UFO is an axiomatic ontological theory combining results from formal ontology, cognitive sciences, logics and linguistics to provide foundations for modeling constructs and tools [13]. Thus, the theory of types in UFO is ontologically well-founded, psychologically informed, and formally characterized [10]. Moreover, it has been systematically employed to generate several methodological and computational tools centred around the OntoUML modelling language [8], [11], [12], but also including instruments for pattern-based model construction, formal verification and validation, anti-pattern detection and rectification, constraint learning and model repair, automated reasoning, complexity management and code generation.

As I shall demonstrate, these results offer a sophisticated theory, as well as concrete engineering support for creating and reasoning with ontologically sound taxonomic structures, type-characterizing properties, as well as multi-level schemes.

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