

Ontology of Functions:

A Domain-independent Framework for Modeling Functions

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Abstract

In many domains entities are considered in terms of their functions, starting with the design of artifacts, through natural and social sciences and ending with folk theories and common sense knowledge. However, there is a lack of a domain-independent ontological framework for representing and modeling functions. Such a framework could be given by top-level ontologies, providing the specification of the most general, domain-independent concepts, in contrast to domain ontologies which describe conceptualizations of particular domains. However, current top-level ontologies such as DOLCE, SUMO or GFO either do not include the notion of function or handle it scantily.

The objective of this work is to develop a formal top-level ontology of functions (OF), applicable across various domains, and to incorporate it into a broader ontological framework. OF is concerned with five main issues, namely the representation of the structure of functions and their interrelations, the realization of functions, function ascription, and the incorporation of OF into the top-level ontology GFO. The first two issues are of relevance in functional modeling, where it is required to represent functions independently of the particular ways of their realization. Secondly, we find it important to provide the ontological foundations for the evaluation of entities against their capabilities of realizing functions. Thirdly, since the functional description is often a part of the knowledge about entities, it is important to provide conditions for assigning functions to entities. Finally, OF is incorporated into the wider framework of GFO which provides the means for a cohesive representation of both functional and non-functional knowledge.

The developed solution is intended to be applied in domain ontologies and conceptual models. For example, OF has been recognized to be beneficial for the Open Biomedical Ontologies (OBO) as a general framework for representing biological functions and together with GFO it is used as the foundation for a Biological Core Ontology. In addition, OF provides the basis on which an extension to the Unified Modeling Language (UML) has been proposed, the current de facto standard in object-oriented conceptual modeling, that is recently also proposed for ontological engineering. The extension is introduced to UML in the form of a profile, enabling the construction of functional models. The profile, among others, introduces graphical notations which allow for the visualization of functional models.