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Verification of a Formal Model for Object-Oriented Methodology

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Recently, many development methodologies are proposed for development of high quality software. Among them, object-oriented development is focused, and applied to many practical system development. OMT is a typical example of Object-oriented methodologies. It proposes an approach for analysing the system from the following three views: (1) Object model for showing the system structure, (2) Dynamic model for specifing behavier of the system and (3) Functional model for describing data and control flows of the system. These are analysis model which is model of target system in system analizing phaze of object-oriented develpoment. But, traditioanl Object-oriented methodologies including OMT are not formal for system modeling. Therefore it makes for development to be difficult for supporting by computer.

As for these requirements, Aoki proposed FO∀M (Formal model for Object-oriented Analysis Model). It provides theoretical basis for object-oriented methodology. FO∀M consists of Basic Models and Unified Model. Basic Models consist of models from three views proposed in OMT, and defined independently each other. And then, Unified Model is defined by Unified Mapping. Unified Mapping is used to define the mapping correspons to elements among each Basic Models. It helps us to support checking consistencies in models, and to support using computer.

In this paper, for the purpose of constructing of Verification Environment for analysing the model is defined by FO∀M . This Verification Environment supports syntax checker and property verification ability for analysis model by FO∀M.

For this reason, we implement Verification Framework which allows us to verify property of analysis model using FO∀M theory, First, we re-struct FO∀M theory implements on Verification Framework and decide its implementation policy. FO∀M theory is defined plural models. Each model consists of data structure (identifiers or expressions etc,) and property defined on it (equality or restriction etc.). According to this implementation policy ,we will define the data structure for FO∀M theory and property. Then We define to classify these definition to each model of FO∀M model for distinction between a definition in one model to in another model.

HOL is used to implement Verification Framework. HOL is a verification system implemented on ML language, which has flexible data structure since it is based on higher-order logic, treat theory modularly and allows external operating written in ML language if necessary. From these abilities, we can define complex data structure of FO∀M theory and FO∀M models independently using modularized theory, and define supporting environment in ML language. For this reason HOL has good property for construction of Verification Framework for analysis model in FO∀M.

We will map data structures of FO∀M to data type in HOL, and its property to axiom or theorem in HOL. For the purpose of modularization of each model of FO∀M, these definition of FO∀M are classified and organized according to category of FO∀M models. As a result of this, each model theory can be used as module. When we verify the model, we can use these theory as module.

Verification Framework has ability as follows: Syntax checking by mapping data sturucture of FO∀M to type in HOL, checking. Consistency checking by mapping model property of it to axiom and theorem in HOL,Property of target system verification. Model information is analysis model for target system written in FO∀M theory in HOL. We can show property verification using model information as assumption and verification property written by logical term and FO∀M theory. We will understand and inspect of target system properties showing from it.

For system analysis using object-oriented development, it is very important to understand target system, and to construct analysis model correctly. Verification Framework proposed in this paper provides model verification by syntax and consistency checking for analysis model and supports us to understand the model property and consistency guarantees by proofs.