AgentDSM-Eval: Developing a Framework on Evaluating Domain-specific Modeling Languages for Multi-agent Systems

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Abstract

Software agents and multi-agent systems (MASs) are recognized as both useful abstractions and effective technologies for modeling and building of autonomous composite systems. However, autonomous, responsive and proactive nature of agents makes development of agent-based software systems more complex than many other systems. Furthermore, both internal agent behavior model and interactions within the agent organizations become even more complex and hard to implement when taking into account the varying requirements of different agent environments. It is obvious that working in a higher abstraction level is of critical importance for the development of MASs since it is almost impossible to observe code level details of MASs due to their internal complexity, distributedness and openness.

In order to master the abovementioned problems of developing MASs, agent-oriented software engineering (AOSE) researchers define various agent metamodels which include fundamental entities and relations of agent models. By enriching those metamodels with some defined syntax and semantics, researchers also propose domain-specific modeling languages (DSML) for facilitating the development of MAS. Domain-specific languages (DSLs) have notations and constructs tailored toward a particular application domain (e.g. MAS). The end-users of these languages have knowledge of the problem domain, but usually they have little programming experience. DSMLs further raise the abstraction level, expressiveness and ease of use, since models are specified in a visual manner and they represent the main artifacts instead of software codes. Apparently, the use of a DSML helps to the model-driven development (MDD) of MASs. MDD aims to change the focus of software development from code to models, and hence many AOSE researchers believe that this paradigm shift introduced by MDD may also provide the desired abstraction level and simplify the development of complex MAS software.

Originating mainly from pre-defined abstract syntaxes, various DSLs / DSMLs (DS(M)Ls) for agent systems have been developed recently. Many of these languages support modelling both static and dynamic aspects of agent software from different MAS viewpoints including agent internal behaviour model, interaction with
other agents, use of other environment entities, etc. In addition, some of those languages were also enriched with appropriate integrated development environments (IDEs) in which both modelling and code generation for system-to-be–developed can be performed properly.

To be effective, the proposed agent DSMLs need to meet the various stakeholder concerns and the related quality criteria for the corresponding MASs. Unfortunately, very often the evaluation of the DSML, especially covering the language components, generated artifacts, and the use of the DSML during design and implementation of agent-based systems, is completely missing or has been carried out with an idiosyncratic approach. If the DSMLs are not well-defined then implicitly this will have an impact on the quality of the MASs. Hence, in this bilateral project, our aim is to develop an evaluation framework which provides the systematic assessment of existing or newly defined DSMLs for MASs. This approach will also pave the way for making the systematic comparison and selection of MAS DSMLs possible.

The bilateral project includes a collaborative work between Turkish and Portuguese research groups from Ege University and Universidade Nova de Lisboa respectively. Co-directors of the project are Assoc. Prof. Dr. Geylani Kardas from Ege University and Asst. Prof. Dr. Vasco Amaral from Universidade Nova de Lisboa. Following the investigation of in-use DSML evaluation approaches, metrics related to both qualitative and quantitative assessment of agent DSMLs will be produced. Formalization of these metrics will be based on the adaptation of the currently available evaluation criteria and then generation of the new criteria which enables to the fair assessment of the MAS DSMLs by taking into consideration of various viewpoints of agent systems, e.g. agent internal architecture, MAS organization and interaction between agents. Derivation of both the evaluation approach and metrics in question will be originated from the broad investigation of the features presented by the various MAS DSMLs. Available IDEs for MAS DSMLs will also be experienced and evaluated in order to construct an extensive framework which is powerful enough to support the evaluation of agent DSMLs from different aspects. Evaluation of those DSMLs will be conducted via a multi case study research approach in which the generation of agent-based software systems for different domains is considered. It also covers the assessment of the tool artifacts, generation performance and user’s evaluation. In the process of the evaluation, all phases of MAS development are elaborated. In addition, the evaluators’ feedback is gained both by developing case studies and by working on questionnaires.

The main outcome of the project will be a complete evaluation framework, called AgentDSM-Eval shortly, which provides the systematic assessment of MAS DSMLs via a multi case study protocol. Well-defined qualitative and quantitative MAS DSML assessment metrics will be developed. Besides, a structural guideline, which may support MAS developers while comparing and/or choosing the most appropriate DSML for the design and implementation of the intended agent system, will be produced at the end of the bilateral project.

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