Modelling Uncertainty in Architectures of Parametric Component-Based Systems

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Abstract

One of the main issues in component-based design is the efficient modelling of the underlying software architecture that determines the topology and the interaction principles among the components of a system. On the other hand, at the early stages of the systems' development and hence of the modelling at the architectural level, there is the challenge of the proper representation of uncertainty in the components' connections. In this paper we propose a logic-based characterization of uncertainty in architectures of a wide class of component-based systems, and specifically of parametric systems where the number of instances of each component type is a parameter. For this, we introduce an extended propositional interaction logic over a De Morgan algebra and investigate its first-order level for modelling uncertainty in parametric interactions. We prove that the equivalence problem for a large class of the formulas of that logic is decidable in doubly exponential time by providing an effective translation to fuzzy recognizable series. Moreover, we present several examples of formulas encoding uncertainty in well-known parametric architectures with ordered and recursive interactions.

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