Chapter IX

The Role-Based Metamodelling Language for Specifying Design Patterns

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Abstract

This chapter describes a UML-based pattern specification language called the role-based metamodelling language (RBML), which defines the solution domain of a Design pattern in terms of roles at the metamodel level. The goal of the RBML is to support the development of precise pattern specifications that can be used for the development of pattern tools. The author describes the approach and benefits of the RBML, and demonstrates the notation for capturing various perspectives of pattern properties using the Observer, Interpreter, and Iterator patterns. The author also discusses tool support for the RBML and the future trends in pattern specification.
Introduction

A major goal of software development is to develop high quality software in less time. Systematic reuse of software artifacts that encapsulate high quality development experience can help developers reduce the development time (Mili, Mili, Yacoub, & Addy, 2002; Pressman, 2005). A common form of such reusable software artifacts is Design patterns. A Design pattern describes a family of solutions for a class of recurring design problems. Prevalent descriptions of Design pattern (e.g., Buschmann, Meunier, Rohnert, Sommerlad, & Stal, 1996; Gamma, Helm, Johnson, & Vlissides, 1995; Grand, 1999; Pree, 1995; Schmidt, Stal, Ronhert, & Buschmann, 2000) describe the pattern solution domain using a combination of diagrams and text. Such informal descriptions are useful for communicating Design patterns. However, the nature of informal descriptions inhibits their use as a base for systematic use of patterns (e.g., tool development) in software development.

There have been many efforts to address this problem. These efforts can be categorized into two formal methods-based approaches and UML-based approaches. Formal methods-based approaches (e.g., Eden, 1999; Lano, Bicarregui, & Goldsack, 1996; Mikkonen, 1998; Taibi & Ngo, 2003) make use of formal specification techniques to specify Design patterns. While these techniques have, by virtue of formalism, strong support for reasoning and verifying pattern properties, it is difficult for users who are not familiar with the formal techniques to use them. This contributes to the absence of widely accepted formal techniques. There have been recent efforts (e.g., Guennec, Sunye, & Jezqueul, 2000; Lauder & Kent, 1998, Maplesden, Hosking, & Grundy, 2002) to specify Design patterns using the unified modeling language (UML) (OMG, 2005), a widely accepted modeling language. A major benefit of these approaches is that because of the wide acceptance of the UML, these approaches can be easily adopted. However, these approaches exhibit several limitations, such as high complexity in representation.

In this chapter, we present a UML-based pattern specification notation called role-based metamodeling language (RBML) (France, Kim, Ghosh, & Song, 2004; France, Kim, Song, & Ghosh, 2003; Kim, 2004) that specifies a Design pattern in a precise and concise manner. The RBML describes a Design pattern in terms of roles that define a specialization of the UML metamodel. The benefits of the RBML include:

- The support for the model-level use of Design patterns,
- The capability to capture various perspectives of a Design pattern,
- The adoptability supported by the UML,
- The precise and concise representation of pattern properties,
- The rigorous notion of pattern conformance for UML models, and
- Its tool support that facilitates the systematic use of patterns in the development of UML models.

The rest of the chapter is organized as follows. Section 2 describes the role-based metamodeling approach and the notion of pattern roles. Section 3 describes the metamodel of the
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