Chapter VI

User Requirements Validation and Architecture Discovery through Use Case Invariants and Model Animation

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Abstract

This work proposes a technique for requirements validation and logical structure discovery, compatible with evolutionary process models. The technique is based on a conservation law, called business value invariant, which quantifies the exchange of business objects between a system and its environment. With the invariant, the logical class structure of the designed system is algorithmically derived from its use case model. To
validate that the modeled requirements and derived structure faithfully reflect the user requirements, the behavior of the constructed prototype is projected on the business objects exchanged on the system’s boundary, and the projected behavior is animated with a labeled transition system analyzer. The model animation approach explicitly describes the interface between the system and its environment, and through OCL pre- and post-conditions, it distinguishes between system and environment responsibilities. The animated prototype links the outwardly visible “interobject” behavior to the information structures and the behaviors of the comprising parts, or “intraobject” behavior. Unlike formal notations based on logic, the proposed approach does not preclude the owners of the problem from taking part in the problem-solving process, that is, the knowledge locked in the prototype can be validated. The proposed prototyping technique acts as a discursive communication instrument, bringing the worlds of clients and developers a step closer.

Introduction

Software development is a problem-solving activity where a problem has been identified and a software system is commissioned to address this problem. Brooks (1995) points out that “the hardest single part of building a software system is deciding precisely what to build”; in other words, the principal challenge faced by a development team is the elicitation of precise user requirements.

Requirements engineering (RE) is a branch of systems engineering concerned with the elicitation, modeling, validation, and management of evolving user requirements. The activities in requirements engineering both situate and orient the software development effort to a real-world problem and give it a narrow compass toward satisfying the goals of the various system stakeholders.

The results from a recent, and so far the only, significant field survey (Neill & Laplante, 2003) on RE practices indicate that 33% of companies do not employ any methodology for requirements modeling and analysis. Out of the remaining 67%, only 7% use formal techniques, compared to 51% using informal natural language representations. In an earlier study, Nikula, Sajaniemi, and Kälviäinen (2000) report that none of the 15 participants they surveyed had a requirements management tool in use. Against this backdrop, the