Editors' Introduction to the Special Issue on Autonomic and Self-Adaptive Systems

Traditionally, handling changing requirements, faults, or upgrades on different kinds of software-based systems have been tasks performed as a maintenance activity conducted by human operators at design or development time. However, factors such as uncertainty in the operational environment, resource variability, or the critical nature of some systems which cannot be halted in order to be changed, have lead to the development of systems able to reconfigure their structure and behaviour at run time in order to improve their operation without any human intervention.

This kind of systems, which typically operate using an *explicit representation* of their structure and goals, has been studied within different research areas of software engineering (e.g., component-based development, requirements engineering, software architectures, etc.) and described with different names, which put their emphasis on different aspects. From those different names (self-healing, self-managed systems, etc.) we have selected two which are among the most popular, namely *autonomic* and *self-adaptive* systems, for the title of this special issue.

Though there are many definitions for them - and sometimes they are even considered equivalent - we will provide here a brief distinction between both terms, which still refer to closely related approaches. A system will be considered *autonomic* when it automatically provides a number of essential features and system-wide properties, without the need of explicit human intervention - sometimes, not even from the programmer. On the other hand, a system is *self-adaptive* when it provides the means to adapt to either external or internal changes by using its own resources. Obviously, many of the autonomic functions provide adaptivity, and most of the self-adaptive features must be automatically provided.

Another promising approach to systems able to dynamically adapt themselves is that of *self-organizing* systems. These are typically composed by a large number of constituent components which operate according to a set of local rules, rather than with an explicit representation of its structure and goals – i.e. providing a decentralized setting. In this case, the *emergent* behaviour derived from component interaction stabilizes the system in the event of faults or changes in the environment which need to be handled.

Although most research efforts in both approaches have been isolated and lacked specific forums for discussion until recently, there is a thriving international community currently involved in the study of these, sometimes known as *self-* systems*, laying out the foundations that will enable their systematic development. There are already several workshops, conferences and symposia devoted to the study and discussion of this topic; and this special issue follows also from the efforts of this growing community.

This special issue gathers several selected, extended and enhanced versions for papers from the First and Second editions of the Workshop on Autonomic and Self-Adaptive Systems (WASELF), which were respectively celebrated in 2008 and 2009 in Spain, emphasizing the participation of both authors and reviewers from the international research community. Additionally, several internationally recognized experts in the area have been invited to contribute to this issue, providing a baseline for the high quality of the material included in this issue. Every published article has followed a rigorous reviewing process, and had to be approved by at least three reviewers with a high expertise in the selected topics.

After the selection and approval of the reviewing committee, this special issue gathers five valuable contributions. The first two of them present frameworks to support full-fledged self-adaptation; while the next one discusses reconfiguration for behavioural adaptation. The latter two discuss the topic in the context of services, considering their choreographies and model-driven composition. We will briefly summarize all of them in the following.

The first paper, entitled *"A Framework for Automatic Generation of Processes for Self-Adaptive Software Systems"* has been authored by Carlos Eduardo da Silva and Rogério de Lemos, and presents a framework for run-time generation of self-adaptation processes in software systems, explaining the need for the automatic generation of these processes at run-time, and how to base this approach on AI planning and workflows.

The second paper, entitled *"An Aspect-Oriented Approach for Supporting Autonomic Reconfiguration of Software Architectures"*, and authored by Cristóbal Costa, Jennifer Pérez, and José A. Carsí presents a proposal to support the *autonomic reconfiguration* of hierarchical software architectures, taking a semi-decentralized approach to tackle the problems of maintainability present in *self-organizing* systems and scalability in *self-adaptive* ones.

Next, the third paper, entitled *"Component Reconfiguration in Presence of Mismatch"* and authored by Carlos Canal and Antonio Cansado, discusses how to reconfigure systems in which components present mismatch and are *not* designed with reconfiguration capabilities. In particular, this work identifies the requirements for achieving run-time component substitution and defines interchangeability notions under *behavioural* adaptation.

The fourth paper, entitled *"Realizability and Dynamic Reconfiguration of* Chor *Specifications"* has been authored by Nima Roohi and Gwen Salaün. This paper presents solutions to check if a certain service choreography is realizable and if a specific *reconfiguration* can be applied dynamically to the software system. The paper uses Chor as choreography specification language and proposes an encoding of Chor into the FSP process algebra in order to

check the realizability of the choreography.

Finally, the paper entitled *"Model-Based Dependable Composition and Monitoring of Self-Adaptive Services"*, authored by Javier Cubo, Carlos Canal, and Ernesto Pimentel, presents an approach based on self-adaptive and error recovery techniques. The proposal uses a *model-based* mechanism to formalise Service-Oriented Architectures in order to decrease the cost of their maintenance and evolution.

The guest editors wish to thank Professor Matjaz Gams for providing us with the opportunity to edit this special issue on Autonomic and Self-Adaptive Systems. Finally, the editors would also like to thank both the authors of the papers for their contributions and all the referees for their critical and valuable comments. All their efforts helped to ensure the high quality of the material presented in this special issue.

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