Novel Approaches in Dependable Computing

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The complexity of systems and the way they work together will require new approaches for their development and operation, since conventional deterministic approaches may not be sufficient for enabling the provision of services expected from these systems. Several new approaches have emerged recently from different areas, such as, biologically inspired computing, agent technology, and software engineering, just to mention a few. Whether these approaches are able to meet the stringent requirements usually associated with dependable computing is still open to debate. Hence this Panel, which aims to discuss the promises and challenges of novel approaches for dependable computing. Next, in order to set the context of this Panel, some of these approaches are briefly presented.

Biology has been the inspiration of several computational intelligence approaches, such as, neural networks, genetic algorithms, artificial immune systems, etc [3]. The latter in particular, which is now receiving more attention, are adaptive systems inspired by theoretical immunology and observed immune functions, principles and models, which are applied to problem solving [5]. For example, in the context of dependability, the metaphor of the immune system has been initially associated with fault tolerant computing [1], and computer security [7]. Another biologically inspired initiative is autonomic computing, which is being promoted by IBM. The challenge of autonomic computing systems is of building and deploying computing systems that regulate themselves and remove complexity from the lives of administrators and users. Although biologically inspired computational approaches have been successfully employed in several engineering artifacts, they have nevertheless been used with more caution in system that have more stringent dependability requirements [8].

From software engineering, several efforts have been made for providing mechanisms for monitoring and controlling the actual execution of a system through its architectural model, thus allowing self-healing/self-repair of the system at higher levels of abstraction. One of these initiatives relies on extending existing architectural styles by incorporating constraints that capture the desired behavior of the system [4]. Another initiative in this area is based on the explicit representation of the interactions between components in terms of cooperation/coordination connectors that are able to capture different configurations of the system [6, 2].

Planetary computing is another industrial initiative, which is being promoted by HP Labs, and which aims into creating a new model of computing to develop and manage vast IT resources. The goal is to obtain an infrastructure on demand that is scalable, flexible, economical, and always available. At the core of this infrastructure is a data center control system that should be self-monitoring, self-healing and self-adapting.

A major motivation underlying most of the above approaches is the provision of an effective means for these systems to cope with changes at design and run time. The concerns with design time are related to the ability of building new systems from existing ones without incurring into high development costs. While the concerns with run time are related to the capability of a system to adapting to changes that occur in its operating environment. For both cases, at least for some of the above mentioned approaches, it is assumed that they rely on some learning capabilities. These capabilities should provide the basis for the system employing these novel approaches to adjust its structure/behavior to new needs, without any human intervention. Although the learning capabilities might enable a system to react to unexpected circumstances, it also removes the predictability aspect from its behavior, which is critical on some dependable systems. If this is the case, the question to be asked is whether these learning capabilities can be trusted? If not, how to protect the system against potential undesirable decisions?

Another trend that has been observed in the application of these new approaches is the move from closed to open systems, where the scope of the problem domain is not so clearly identified. Borrowing the IBM slogan that states that "a million enterprises having a billion people using a trillion devices", the issues that need to be raised are whether these new technologies are scaleable, and how these systems should be structured for these new approaches to be effective?

The Panel will discuss these and other issues when describing the potential of novel approaches for building and operating dependable computing systems.

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