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Performance evaluation based on system modeling using Statecharts extensions

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Abstract

This paper presents two extensions for Statecharts: the Stochastic Statecharts, which use the original statecharts notation with a minor modification in the formal semantics and the Queuing Statecharts, which do not follow the pure Statecharts notation, but a join between Statecharts and queuing network representations. Some basic elements of Statecharts are redefined such as events and conditions, besides some concepts referring to the dynamic system behavior. The specification approaches show the basic behavior of a generic queuing system

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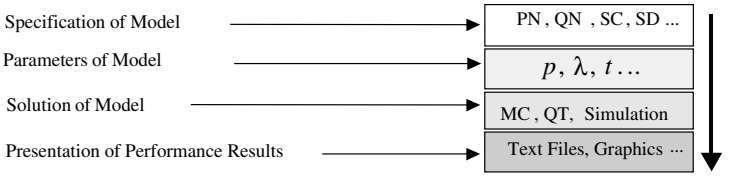
by means of templates and standard events. It is presented the PerformCharts, a new simulation environment based on Statecharts specification, which allows model solution using either Markov chains or the Network Simulator (NS).

Keywords: Performance evaluation; Statecharts; Queuing systems; Markov chains; Systems modeling

1. Introduction

There are many different reasons to look carefully at performance evaluation of systems in general. Normally, decision-makers have to investigate when their systems will saturate in order to find the best way to avoid or at least to delay its occurrence. Depending on the system this can be based on the knowledge of very experienced system managers, but a better option is always to look for a systematic performance evaluation of the system. Performance evaluation can be realized following several techniques broadly grouped into measuring and modeling techniques. Usually, measurements, benchmarking and prototyping fall into the category of measuring; these techniques are very useful when investigating existing systems, i.e. systems that have already been built, providing accurate information for their performance evaluation and analysis. Modeling is also used for providing performance evaluation and analysis and can be applied to both existing and under-project systems. A modeling process usually starts with a high-level specification (either graphical or non-graphical) and ends up with the presentation of performance measurements. These performance measurements come from the solution of the model and this can be produced by means of both analytical and simulation solutions. An Analytical approach associates the system specification to a mathematical model such as Markov chains or queuing theory. On the other hand, a Simulation approach takes to the construction of a computer program that reproduces the system behavior, according to the model specification. Fig. 1 shows the phases defined for the modeling process.

Models of actual systems are generally complex as they involve parallelism, synchronization and interdependence of subsystems. They are normally named *reactive systems* as they are based on the occurrence of events according to external or



PN (Petri nets), QN (Queuing Networks), SC (Statecharts), SD (State-transition Diagrams)
p (Probabilities), λ (Rates), *t* (Time)
MC (Markov chains), QT (QueuingTheory).

Fig. 1. Phases of a modeling process.