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AN ANALYSIS MODEL TO EVALUATE WEB APPLICATIONS QUALITY USING A DISCRETE-EVENT SIMULATION APPROACH

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ABSTRACT

The architectural design can be considered the earliest specification of any software. When the architectural components are used to describe a simulation model, the architecture can be used as a vehicle to estimate the behavior of the final product. In this paper, an analysis model to evaluate web applications quality is proposed. The approach mix an ontological perspective to understand quality properties and an adaptation of Discrete Event System Specification (DEVS) formalism to develop the set of simulation models required to represent the software architecture.

1 INTRODUCTION

Cloud computing (CC) environments can be studied from two perspectives: infrastructure and application. At application level, the software architect defines Web Applications (WA). Usually, this definition is based on architectural patterns. In order to estimate the quality properties of a software product, several authors applied simulation techniques over Architectural Designs (AD). Recently similar strategies were used at CC infrastructure level. However, all the approaches designed use only one or two quality properties. Then, an holistic analysis effort is required in order to study WA behaviors from a quality perspective.

When simulation techniques are applied to CC application architectures, two main concerns arise: i) Quality properties definition (that is, which quality properties should be measured? how these properties are related? which indicators must be used?). ii) Simulation Models (SM) deployment (that is, which formalism to use? how many SM should be designed? how the models are linked?). The objective of this work is to provide a software engineering perspective that helps to estimate WA quality using the architecture as a vehicle to create a Full Analysis Model (FAM). The FAM uses the AD to structure the SM according to the quality properties required to estimate the behavior of the final product. As a result, the simulation outputs represents software measures. These measures are useful to evaluate quality (required versus estimated) in order to adjust the AD in an early stage of the development.

2 ONTOLOGICAL SCHEME SPECIFICATION TO DOCUMENT QUALITY PROPERTIES

In order to define a document that helps to describe quality properties linked to a software product, a Quality Scheme (QS) based on ISO/IEC 25010 was defined. By using a QS instance, the development team will increase the quality visibility and understanding. Also, the final customer will be aware of the strategies used to guarantee its satisfaction.

The QS definition uses an ontology composed by three semantic models: quality semantic model (QSM), metric semantic model (MSM) and software semantic model (SSM). The links between models were formally defined, considering that: i) A software metric (from MSM) is useful to estimate a quality attribute (from QSM) and, ii) A quality attribute (from QSM) describes a software component (from SSM). Each model includes a set of SWRL (Semantic Web Rule Language) rules that allows inferring new knowledge and verifying the integrity of the instances created from it. Also, a set of SPARQL (SPARQL Protocol and RDF Query Language) queries was developed in order to obtain information about the instances. The final ontology was implemented in OWL 2 (Ontology Web Language 2) using Protégé. A detailed description of the QS definition and its implementation is given at Blas et al. (2017a).

Taking into account that WA are software products, a QS instance was specified in order to define its main quality properties (Blas, Gonnet, and Leone 2016). Although different WA may have different quality concerns, the core of the QS developed can be used as guideline in a new definition.

3 SM DEPLOYMENT: WA COMPONENTS AND ENVIRONMENT

The QS definition allows identifying the data required in order to evaluate quality. If this data is available, the ontology can be used to estimate the measurement values of each metric and quality attribute defined. Combining the AD with a simulation technique, the data could be obtained from SM outputs. However, the SM should not be built by the architect because the modeling process can affect its vision of the product. If the set of architectural elements is defined, a SM can be derived applying transformation rules.

Following this approach, WA architectural components and its connections were defined in the metamodel presented in Blas et al. (2015). Also, a software modeling tool to develop valid AD based on this metamodel was developed. When SM are derived from AD, the connections between models reflect dependencies between components. However, given that events are influenced by WA requests, each system-input event may not involve all connections (that is, only a specific set of SM must process it). Then, to manage the complexity of events flow, an adaptation of DEVS formalism was designed. The Routed DEVS (RDEVS) formalism uses routing information to accept/deny events. A simulation model will only accept an input event if and only if: i) the sender is an authorized model; ii) its identifier is in the list of authorized receptors. The core of RDEVS is to abstract the event flow in order to simplify the simulation models. A full description of RDEVS adaptation is detailed in Blas et al. (2017b). All architectural SM were developed using RDEVS.

Given that RDEVS and DEVS models can be combined, the WA environment (i.e. user behavior) was designed using DEVS and workflow models (Blas, Gonnet, and Leone 2017c).

4 CONCLUSIONS AND FUTURE WORK

The FAM proposed allows designers to analyze the impact of architectural changes on WA quality. A future research is to attach CC infrastructure models to the FAM allowing a deeper analysis of the AD.

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