

**2nd Workshop on Software Quality, Analysis, Monitoring,
Improvement, and Applications**

**SQAMIA 2013
Program and Abstracts**

Novi Sad, September 2013.

This volume contains abstracts presented at the Second Workshop on Software Quality Analysis, Monitoring, Improvement, and Applications (SQAMIA 2013). SQAMIA 2013 was held during September 15-17, 2013, at the Department of Mathematics and Informatics, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia.

SQAMIA 2013 is a continuation of the successful event held in 2012. Previous workshop, the first one, was organized within the 5th Balkan Conference in Informatics (BCI 2012) in Novi Sad. In 2013 SQAMIA becomes standalone event in intention to become traditional meeting of the scientists and practitioners in the field of software quality.

The main objective of SQAMIA workshop series is to provide a forum for presentation, discussion and dissemination of the latest scientific findings in the area of software quality, and to promote and improve interaction and cooperation between scientists and young researchers from the region and beyond.

The SQAMIA 2013 workshop consisted of regular sessions with technical contributions reviewed and selected by an international program committee, as well as of invited talks presented by leading scientists in the research areas of the workshop.

SQAMIA workshops solicited submissions dealing with four aspects of software quality: quality analysis, monitoring, improvement and applications. Position papers, papers describing the work-in-progress, tool demonstration papers, technical reports or other papers that would provoke discussion were especially welcome.

In total, 13 papers were accepted and published in this proceedings volume. All published papers were double reviewed, and some papers received the attention of more than two reviewers. We would like to use this opportunity to thank all PC members and the external reviewers for submitting careful and timely opinions on papers.

Also, we gratefully acknowledge the program co-chairs, Tihana Galinac Grbac (Croatia), Marjan Heričko (Slovenia), Zoltan Horvath (Hungary), Mirjana Ivanović (Serbia) and Hannu Jaakkola (Finland), for helping to greatly improve the quality of the workshop.

We extend special thanks to the SQAMIA 2013 Organizing Committee and especially to its chair Gordana Rakić for her hard work, diligence and dedication to make this workshop the best it can be.

Finally, we thank our sponsors, the Provincial Secretariat for Science and Technological Development, Serbian Ministry of Education, Science, and Technological Development, and the Department of Mathematics and Informatics, Faculty of Sciences, University of Novi Sad, for supporting the organization of this event.

And last, but not least, we thank all the participants of SQAMIA 2013 for having made all work that went into SQAMIA 2013 worthwhile.

September 2013

Zoran Budimac, General Chair

Table of Contents

Program Overview	7
-------------------------------	---

Invited Session

Chairperson: Zoran Budimac

Theory On The Distributions And Predictive Capability Of Verification Faults.....	9
---	---

TIHANA GALINAC GRBAC

Department of Computer Engineering, Faculty of Engineering, University of Rijeka

More Than Types!	9
------------------------	---

ZOLTÁN HORVÁTH, MELINDA TÓTH, TAMÁS KOSZIK

**Department of Programming Languages and Compilers, Faculty of Informatics,
Eötvös Loránd University, Budapest**

Session: General topics of Software Quality

Chairperson: Hannu Jaakkola

<i>Software Engineering Solutions for Improving the Regression Testing Methods in Scientific Applications Development</i>	11
---	----

BOJANA KOTESKA and ANASTAS MIŠEV

University SS. Cyril and Methodius, Faculty of Computer Science and Engineering, Skopje

<i>Stability of Software Defect Prediction in Relation to Levels of Data Imbalance</i>	11
--	----

TIHANA GALINAC GRBAC and GORAN MAUŠA

Department of Computer Engineering, Faculty of Engineering, University of Rijeka

BOJANA DALBELO-BAŠIĆ

Faculty of Electrical Engineering and Computing, University of Zagreb

<i>Enhancing Software Quality in Students' Programs</i>	12
---	----

MIRJANA IVANOVIĆ

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

**STELIOS XINOGALOS Department of Applied Informatics, University of Macedonia,
Thessaloniki**

<i>Cultural Issues as a components of data modelling quality</i>	12
TATJANA WELZER, MARJAN DRUŽOVEC, MARKO HOELBL	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>Redefining software quality metrics to XML Schema needs</i>	13
MAJA PUŠNIK, BOŠTJAN ŠUMAK, MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
ZORAN BUDIMAC	
Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad	
<i>Documenting software architectures using UML</i>	13
FILIP PRENTOVIĆ	
GTECH, Belgrade	
ZORAN BUDIMAC	
Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad	

Session: Quality in the field of Development of Mobile Applications

Chairperson: Marjan Heričko

<i>The Mobile Product Line</i>	15
LUKA PAVLIČ	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>Mobile device and technology characteristics impact on mobile application testing</i>	15
TINA SCHWEIGHOFER and MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>Beta testing of Mobile Applications: A case study</i>	16
MATEJA KOCBEK and MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>Comprehensive testing of mobile applications</i>	16
MATEJA KOCBEK and MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>Using Object Oriented Software Metrics for Mobile Application Development</i>	17
GREGOR JOŠT, JERNEJ HUBER, MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	

Session: Tool Demonstration, Technical Reports, and Open Discussion Topics

Chairperson: Zoltan Horvath

<i>Transforming Low-level Languages Using FermaT and WSL</i>	19
DONI PRACNER and ZORAN BUDIMAC	
Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad	
<i>Two-dimensional Extensibility of SSQSA Framework</i>	19
JOZEF KOLEK, GORDANA RAKIĆ, MILOŠ SAVIĆ	
Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad	
<i>SSQSA Ontology Metrics Front-End</i>	20
MILOŠ SAVIĆ, ZORAN BUDIMAC, GORDANA RAKIĆ, MIRJANA IVANOVIĆ	
Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad	
MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>SSQSA Ontology Metrics Front-End</i>	20
MILOŠ SAVIĆ, ZORAN BUDIMAC, GORDANA RAKIĆ, MIRJANA IVANOVIĆ	
Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad	
MARJAN HERIČKO	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
<i>Towards new user interfaces based on gesture and sound identification</i>	21
KRISTJAN KOŠIČ, BOŠTJAN ARZENŠEK, MATEJ VOGRINČIČ, SAŠA KUCHAR	
Faculty of Electrical Engineering and Computer Science, University of Maribor	
MATEJ VOGRINČIČ	
University Medical Center Maribor	

Program Overview

	Sunday 15.9.	Monday 16.9.	Tuesday 17.9.
9:00-10:30		<p>Opening & Invited Session</p> <p><i>Chairperson: Zoran Budimac</i></p>	<p>Tool Demonstrations, Technical Reports & Discussion Topics</p> <p><i>Chairperson: Zoltan Horvath</i></p>
10:30-11:00		coffee break	coffee break
11:00-13:00		<p>General Topics on Software Quality</p> <p><i>Chairperson: Hannu Jaakkola</i></p>	<p>Final Discussion & Closing</p> <p><i>Chairperson: Tihana Galinac-Grbac</i></p>
13:00-14:00		lunch break	lunch break
14:00-16:00	Registration	<p>Quality of Mobile Application</p> <p><i>Chairperson: Marjan Heričko</i></p>	Committees Meeting
16:00-...		<p>Guided Tour & Dinner</p>	

Invited Session –

Chairperson: Zoran Budimac

TIHANA GALINAC GRBAC

Department of Computer Engineering, Faculty of Engineering, University of Rijeka

Theory On The Distributions And Predictive Capability Of Verification Faults

Software engineering is a relatively young discipline with just few general theories. General problem is in lack of industrial data, and/or inconsistently reported data and studies. Theory on the predictive capability of verification faults has been grounded by systematic approach for empirical research on fault distributions suggested by Fenton and Ohlsson followed by replications. Fault distributions are interesting because of their seemingly similar behavior across different environments. This talk summarizes our recent findings on fault distributions and the predictive capability of early verification on late detected faults. We will also discuss some novel findings related to the predictive capability and distributions of unit verification faults. The results are of particular importance for large scale complex systems that are developed in evolutionary fashion with majority of reused software.

ZOLTÁN HORVÁTH, MELINDA TÓTH, TAMÁS KOSZIK

***Department of Programming Languages and Compilers, Faculty of Informatics,
Eötvös Loránd University, Budapest***

More Than Types!

Types in strongly typed languages can help avoid many programming errors. However, no matter how rigorous your type system is, many low quality or even faulty code fragments may remain unrevealed. In order to find and eliminate them, we need more sophisticated tools than static type checkers. Can these sophisticated, and henceforth rather complex tools be used in practice? This talk will give an affirmative answer. We illustrate the advantages and the practical applicability of RefactorErl, a static program analysis and transformation tool for Erlang. RefactorErl can help the programmer better understand the static and dynamic structure of the code base (a.k.a. grokking), find structures (e.g. call chains) that violate some existing requirements or standards, point out bad smells, and identify duplicated or overly complex code fragments. The tool was successfully used in analyzing large industrial telecommunication software.

Session: General topics of Software Quality –

Chairperson: Hannu Jaakkola

Software Engineering Solutions for Improving the Regression Testing Methods in Scientific Applications Development

BOJANA KOTESKA and ANASTAS MIŠEV

University SS. Cyril and Methodius, Faculty of Computer Science and Engineering, Skopje

LJUPČO PEJOV

University SS. Cyril and Methodius, Faculty of Natural Science and Mathematics, Skopje

The aim of this paper is to improve the testing process of scientific applications by proposing some software engineering solutions for regression testing. Given the fact that changes are a common part of the development of scientific applications the need for regression testing is essential. Concerning to improve the methods of regression testing the relationship between requirements and test case selection for regression testing is included as a relevant for improving the overall quality of the testing process. Special emphasis is given on the requirements' changes during the application development process and their impact on test case modifications. In addition, we also state the reasons for the implementation and the importance of the regression testing as a part of the verification process of scientific applications. In order to get more relevant results we made an interview with a scientist (chemist) about the regression testing practices in scientific applications. The conclusions and recommendations in this paper are based on the analysis of the results of a survey conducted among scientists in the HP-SEE project and the answers of the interview questions.

Stability of Software Defect Prediction in Relation to Levels of Data Imbalance

TIHANA GALINAC GRBAC and GORAN MAUŠA

Department of Computer Engineering, Faculty of Engineering, University of Rijeka

BOJANA DALBELO-BAŠIĆ

Faculty of Electrical Engineering and Computing, University of Zagreb

Software defect prediction is an important decision support activity in software quality assurance. Its goal is reducing verification costs by predicting the system modules that are more likely to contain defects, thus enabling more efficient allocation of resources in verification process. The problem is that there is no widely applicable well performing prediction method. The main reason is in the very nature of software datasets, their imbalance, complexity and properties dependent on the application domain.

In this paper we suggest a research strategy for the study of the performance stability using different machine learning methods over different levels of imbalance for software defect prediction datasets. We also provide a preliminary case study on a dataset from the NASA MDP open repository using multivariate binary logistic regression and forward and backward feature selection. Results indicate that the performance becomes unstable around 80% of imbalance.

Enhancing Software Quality in Students' Programs

MIRJANA IVANOVIĆ

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

STELIOS XINOGALOS

Department of Applied Informatics, University of Macedonia, Thessaloniki

This paper focuses on enhancing software quality in students' programs. To this end, related work is reviewed and proposals for applying pedagogical software metrics in programming courses are presented. Specifically, we present the main advantages and disadvantages of using pedagogical software metrics, as well as some proposals for utilizing features already built in contemporary programming environments for familiarizing students with various software quality issues. Initial experiences on usage of software metrics in teaching programming courses and concluding remarks are also presented.

Cultural Issues as a Components of Data Modelling Quality

TATJANA WELZER, MARJAN DRUŽOVEC, MARKO HOELBL

Faculty of Electrical Engineering and Computer Science, University of Maribor

Increasing demand for more and more complex data applications demands also high quality in data modeling. High level concepts, tools and techniques for a database design, development and retrieval with a final goal: better information quality is expected. One of new possibilities for higher quality are also cultural issues as a component for data modeling, where the cultural issue means not only country dependent parameters but also business and domain dependent cultural issues. As a consequence, data quality as well as information quality of information system using mentioned approach improves. In the paper the influence of cultural issues on the data modeling quality and influence of TQM as well as some of Deming's Fourteen Points will be presented and discussed in more details.

Redefining software quality metrics to XML Schema needs

MAJA PUŠNIK, BOŠTJAN ŠUMAK, MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

ZORAN BUDIMAC

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

The structure and content of XML Schemas, important and widely used document definitions, has a significant influence on the quality of XML data and XML technologies in general, therefore the quality of XML Schemas and accurate assessment of the quality is a fundamental research challenge in all fields of XML application. A good quality estimation of an XML schema can directly and indirectly lead to a higher efficiency of its usage, simplification of information solutions, efficient maintenance, and higher quality of data and business processes. This paper addresses challenges in measuring the level of XML schema quality by employing general software quality metrics.; A set of holistically defined and document-oriented metrics is proposed. Proposed XML Schema quality metrics base on existing software metrics, adapted according to needs of XML Schemas, addressing it mostly from a structural perspective.

Documenting software architectures using UML

FILIP PRENTOVIĆ

GTECH, Belgrade

ZORAN BUDIMAC

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

As software systems become large and more complex, focus on main design issues is shifted from algorithms and data structures. Software architecture, which represents high-level organization of software system, brings whole new set of design issues: overall system organization, global control structures, communication protocols, data access and synchronization, as well as choosing between different design solutions. In this paper, ways of using UML to document component and connector views are described. Following elements of component and connector view will be described using UML: components and component types, connectors and connector types, ports, roles, systems and properties.

Session: Quality in the field of Development of Mobile Applications –

Chairperson: Marjan Heričko

The Mobile Product Line

LUKA PAVLIČ

Faculty of Electrical Engineering and Computer Science, University of Maribor

In this paper we present the challenges during the simultaneous development of multiple mobile application versions with different sets of functionalities. Some of them are core, the other optional, and the third alternative. One of the indicated appropriate solutions is the approach of software product lines. In this paper we presents practical experiences during the product line implementation in the case of mobile applications for the Android operating system. It has at least six to eight different versions simultaneously available. Among others, these are freely available version, paid version, development, test and demonstration version. We also offer certain versions for the BlackBerry phones, some mobile application components share common functionalities with a portal server.

Mobile device and technology characteristics impact on mobile application testing

TINA SCHWEIGHOFER and MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

Mobile technologies have a significant impact on processes in ICT, including software development. Within mobile technologies a new type of software has emerged: mobile applications. Nowadays, the concept of mobile applications is widely known and the development of mobile applications is more and more widespread. One of the most important parts of mobile application development is mobile applications testing. The testing process has always been very important and crucial in the software development cycle, which is why testing constitutes an important aspect of software development. An appropriate testing procedure significantly increases the quality level of the developed product. With mobile application development testing, new challenges associated with mobile technologies and device characteristics, have arisen. Some examples of these challenges are: connectivity, convenience, touch screen technology, context awareness, supported devices, etc... It is important that we adequately address these challenges and perform an appropriate mobile application testing process, resulting in a high quality product without critical defects that could cause quality issues or the unwanted waste of human or financial resources. In this paper, we will present a mobile application

testing process. We will indicate the important parts and especially emphasize the challenges related to mobile devices and technology features and properties.

Beta testing of Mobile Applications: A case study

MATEJA KOCBEK and MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

Beta testing is the last stage of testing, and normally involves sending the product for beta testing and real-world exposure outside the company. Beta testing is often preceded by a round of testing called alpha testing. Beta testing can be considered a form of external user acceptance testing. Software in the beta phase will generally have many more bugs in it than completed applications, as well as speed and performance issues that may still cause crashes or data loss. Beta testing is the first opportunity to get real feedback from target customers. The launch of a mobile application is especially crucial because it is the single biggest opportunity to get an application discovered in the mobile markets. In this article, the beta testing of mobile applications is presented. Our aim is to identify the optimal number of testers, who can reveal the majority of errors and mistakes during beta testing. The findings were obtained through the case study research method.

Comprehensive testing of mobile applications

MATEJA KOCBEK and MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

Beta testing is the last stage of testing, and normally involves sending the product for beta testing and real-world exposure outside the company. Beta testing is often preceded by a round of testing called alpha testing. Beta testing can be considered a form of external user acceptance testing. Software in the beta phase will generally have many more bugs in it than completed applications, as well as speed and performance issues that may still cause crashes or data loss. Beta testing is the first opportunity to get real feedback from target customers. The launch of a mobile application is especially crucial because it is the single biggest opportunity to get an application discovered in the mobile markets. In this article, the beta testing of mobile applications is presented. Our aim is to identify the optimal number of testers, who can reveal the majority of errors and mistakes during beta testing. The findings were obtained through the case study research method.

Using Object Oriented Software Metrics for Mobile Application Development

GREGOR JOŠT, JERNEJ HUBER, MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

Developing and maintaining software for multiple platforms can be challenging. So, scheduling and budget planning, cost estimation, software debugging, software performance optimization etc. is required. In traditional software, this can be achieved using software metrics. The objective of our article was to examine whether the traditional software metrics are appropriate for measuring the mobile applications' source code. To achieve this goal, a small-scale application was developed across three different platforms (Android, iOS and Windows Phone). The code was then evaluated, using the traditional software metrics. After applying the metrics and analysing the code, we obtained comparable results, regardless of the platform. If we aggregate the results, we can argue that traditional software metrics can be used for mobile applications' source code as well. However, further analysis is required, in light of a more complex mobile application.

Session: Tool Demonstration, Technical Reports, and Open Discussion Topics –

Chairperson: Zoltan Horvath

Transforming Low-level Languages Using FermaT and WSL

DONI PRACNER and ZORAN BUDIMAC

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

There are many known problems in software maintenance, especially in cases where the available code is for whatever reason given only in low level executable versions. This paper presents a possible approach in understanding and improving such programs by translating it to an existing language WSL that enables the user to do formal, mathematically proven transformations of the resulting code. Such transformations can be done manually, but great improvements in the structure of the program can also be achieved by automatic scripts. Two prototype tools are presented that translate a subset of x86 assembly and a subset of Java bytecode, illustrated by examples showing the transformation process.

Two-dimensional Extensibility of SSQSA Framework

JOZEF KOLEK, GORDANA RAKIĆ, MILOŠ SAVIĆ

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

The motivation to improve systematic application of software analysis tools by improving characteristics of software analysis tools originates from important aspects of modern software development regarding complexity and heterogeneity; importance of analysis and control during this process; need to keep consistency of the followed results. During the identification of the factors affecting these process we identified two important characteristics of supporting tools: extensibility and adaptability. In this paper describe extensibility of the Set of Software Quality Static Analyzers (SSQSA) in two directions: to support new programming language and to support new analysis algorithm.

SSQSA Ontology Metrics Front-End

MILOŠ SAVIĆ, ZORAN BUDIMAC, GORDANA RAKIĆ, MIRJANA IVANOVIĆ

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

SSQSA is a set of language independent tools whose main purpose is to analyze source code of software systems in order to evaluate their quality attributes. The aim of this paper is to present how a formal language that is not a programming language can be integrated into the front-end of the SSQSA framework. Namely, it is explained how the SSQSA front-end is extended to support OWL2 which is a domain-specific language for the description of ontological systems. Such extension of the SSQSA front-end represents a step towards the realization of a SSQSA back-end which will be able to compute a hybrid set of metrics that reflect different aspects of complexity of ontological descriptions.

SSQSA Ontology Metrics Front-End

MILOŠ SAVIĆ, ZORAN BUDIMAC, GORDANA RAKIĆ, MIRJANA IVANOVIĆ

Department of Mathematics and Informatics, Faculty of Science, University of Novi Sad

MARJAN HERIČKO

Faculty of Electrical Engineering and Computer Science, University of Maribor

SSQSA is a set of language independent tools whose main purpose is to analyze source code of software systems in order to evaluate their quality attributes. The aim of this paper is to present how a formal language that is not a programming language can be integrated into the front-end of the SSQSA framework. Namely, it is explained how the SSQSA front-end is extended to support OWL2 which is a domain-specific language for the description of ontological systems. Such extension of the SSQSA front-end represents a step towards the realization of a SSQSA back-end which will be able to compute a hybrid set of metrics that reflect different aspects of complexity of ontological descriptions.

Towards new user interfaces based on gesture and sound identification

KRISTJAN KOŠIČ, BOŠTJAN ARZENŠEK, MATEJ VOGRINČIČ, SAŠA KUCHAR

Faculty of Electrical Engineering and Computer Science, University of Maribor

MATEJ VOGRINČIČ

University Medical Center Maribor

The relatively low price of devices that enable capture of 3D data such as Microsoft Kinect will certainly accelerate the development and popularization of a new generation of user interaction in the business application domain. Although the application interfaces and libraries that make it easier to communicate with these devices continue to be in the process of developing and maturing, they can still be used for the development of business solutions. In addition, gestures and sounds provide more natural and effective ways of human-computer interaction. In this paper we present an overview and a basic comparison of the available sensing devices together with the experience gained during the development of solution ADORA, which main purpose is to assist surgeons with the help of contactless interaction.