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A systematic mapping study of web application testing

Vahid Garousi [a,c,*], Ali Mesbah [b], Aysu Betin-Can [c], Shabnam Mirshokraie [b]

[a] Electrical and Computer Engineering, University of Calgary, Calgary, Canada
[b] Electrical and Computer Engineering, University of British Columbia, Vancouver, Canada
[c] Informatics Institute, Middle East Technical University, Ankara, Turkey

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ABSTRACT

Context: The Web has had a significant impact on all aspects of our society. As our society relies more and more on the Web, the dependability of web applications has become increasingly important. To make these applications more dependable, for the past decade researchers have proposed various techniques for testing web-based software applications. Our literature search for related studies retrieved 147 papers in the area of web application testing, which have appeared between 2000 and 2011.
Objective: As this research area matures and the number of related papers increases, it is important to systematically identify, analyze, and classify the publications and provide an overview of the trends in this specialized field.
Method: We review and structure the body of knowledge related to web application testing through a systematic mapping (SM) study. As part of this study, we pose two sets of research questions, define selection and exclusion criteria, and systematically develop and refine a classification schema. In addition, we conduct a bibliometrics analysis of the papers included in our study.
Results: Our study includes a set of 79 papers (from the 147 retrieved papers) published in the area of web application testing between 2000 and 2011. We present the results of our systematic mapping study. Our mapping data is available through a publicly-accessible repository. We derive the observed trends, for instance, in terms of types of papers, sources of information to derive test cases, and types of evaluations used in papers. We also report the demographics and bibliometrics trends in this domain, including top-cited papers, active countries and researchers, and top venues in this research area.
Conclusion: We discuss the emerging trends in web application testing, and discuss the implications for researchers and practitioners in this area. The results of our systematic mapping can help researchers to obtain an overview of existing web application testing approaches and indentify areas in the field that require more attention from the research community.

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* Corresponding author at: Electrical and Computer Engineering, University of Calgary, Calgary, Canada. Tel.: +1 403 210 5412.
E-mail addresses: vgarousi@ucalgary.ca, vahid@metu.edu.tr (V. Garousi), amesbah@ece.ubc.ca (A. Mesbah), betincan@metu.edu.tr (A. Betin-Can), shabnamm@ece.ubc.ca (S. Mirshokraie).

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1. Introduction

The Web has had a significant impact on all aspects of our society, from business, education, government, entertainment sectors, industry, to our personal lives. The main advantages of adopting the Web for developing software products include (1) no installation costs, (2) automatic upgrade with new features for all users, and (3) universal access from any machine connected to the Internet. On the downside, the use of server and browser technologies make web applications particularly error-prone and challenging to test, causing serious dependability threats. In addition to financial costs, errors in web applications result in loss of revenue and credibility.

The difficulty in testing web applications is many-fold. First, web applications are distributed through a client/server architecture, with (asynchronous) HTTP request/response calls to synchronize the application state. Second, they are heterogeneous, i.e., web applications are developed using different programming languages, for instance, HTML, CSS, JavaScript on the client-side and PHP, Ruby, Java on the server-side. And third, web applications have a dynamic nature; in many scenarios they also possess non-deterministic characteristics.

During the past decade, researchers in increasing numbers, have proposed different techniques for analyzing and testing these dynamic, fast evolving software systems. As the research area matures and the number of related papers increases, we feel it is important to systematically identify, analyze and classify the state-of-the-art and provide an overview of the trends in this specialized field. In this paper, we present a *systematic mapping* of the web application testing research work.

According to Petersen et al. [47], a systematic mapping (SM) is a method to review, classify, and structure papers related to a specific research field in software engineering. The goal is to obtain an overview of existing approaches, outlining the coverage of the research field in different facets of the classification scheme. Identified gaps in the field serve as a valuable basis for future research directions [39,36]. Results of SM studies can also be valuable resources for new researchers (e.g., PhD students) by providing a detailed overview of a specific research area [16].

There are major differences between SM studies and systematic literature reviews (SLR). Kitchenham et al. [39] report a comprehensive comparison of SM and SLR studies using the following seven criteria: goals, research questions, search process, scope, search strategy requirements, quality evaluation, and results. According to that report, the goal of a SM is classification and thematic analysis of literature on a software engineering topic, while the goal of a SLR is to identify best practices with respect to specific procedures, technologies, methods or tools by aggregating information from comparative studies. Research questions of a SM are generic, i.e., related to research trends, and are of the form: which researchers, how much activity, what type of studies. On the other hand, research questions of a SLR are specific, meaning that they are related to outcomes of empirical studies. For example, they could be of the form: Is technology/method A better than B? Unlike a SLR [37], finding evidence for impact of a proposed approach is not the main focus in a systematic mapping [47]. An SLR analyzes