Challenges and Approaches for the Assessment of Micro-Service Architecture Deployment Alternatives in DevOps

A tutorial presented at ICSA 2020

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***Abstract*—The goal of this tutorial is to provide an overview of challenges and approaches for architecture/dependability assessment in the context of DevOps and microservices. Specifically, we present approaches that employ operational data obtained from production-level application performance management (APM) tools, giving access to operational workload profiles, architectural information, failure models, and security intrusions. We use this data to automatically create and configure architecture assessments based on models, load tests, and resilience benchmarks. The focus of this tutorial is on approaches that employ production usage, because these approaches provide more accurate recommendations for microservice architecture dependability assessment than approaches that do not consider production usage.**

We present an overview of (1) the state-of-the-art approaches for obtaining operational data from production systems using APM tools, (2) the challenges of dependability for DevOps and microservices, (3) selected approaches based on operational data to assess dependability. The architecture assessment focus of this tutorial is on scalability, resilience, survivability, and security. Particularly, we present a demo of the automated approach for the evaluation of a domain-based scalability and security metric assessment that is based on the microservice architecture ability to satisfy the performance requirement under load and/or intrusions. We illustrate the approach by presenting experimental results using a benchmark microservice architecture.

***Index Terms*—micro-service architectures, operational profile, security intrusions**

I. Title

Assessment of Micro-Service Architecture Deployment Alternatives in DevOps

II. Summary

The ubiquity of CI/CD and DevOps processes have created new challenges for the application of scalability assessment approaches that are based on operational profile specifications. In addition, once scalability issues are uncovered, there is a need to identify the failed component(s) and provide recommendations for scalability improvements.

The goal of this tutorial is to provide an overview of challenges and approaches for architecture/dependability assessment in the context of DevOps and microservices. Specifically, we present approaches that employ operational data obtained from production-level application performance management (APM) tools, giving access to operational workload profiles, architectural information, failure models, and security intrusions. We use this data to automatically create and configure architecture assessments based on models, load tests, and resilience benchmarks. The focus of this tutorial is on approaches that employ production usage, because these approaches provide more accurate recommendations for microservice architecture dependability assessment than approaches that do not consider production usage. We present an overview of (1) the state-of-the-art approaches for obtaining operational data from production systems using APM tools, (2) the challenges of dependability for DevOps and microservices, (3) selected approaches based on operational data to assess dependability. These selected approaches based can be fully integrated with DevOps CI/CD pipelines. In addition, model-based survivability applications to software architecture are also shown.

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III. Topic Description

1) description of the topic - DevOps is an emerging software engineering paradigm that aims for fast feedback cycles between software changes in development and bringing these changes into production.
2) the state of the art in the topic - The increased development speed and complexity impose various challenges to dependability assessment. However, this context also

provides great opportunities, such as enabling access to extensive operational data obtained from continuous monitoring in production, which is a core DevOps principle.

3) the intended audience – the tutorial is self-contained and accessible to Architects, Developers, Performance Testers, and Software Reliability Engineers (SRE). No specific background is required, in addition to ICSA related background.
4) relevance for ICSA - Architecture CI/CD, DevOps, Microservices are very important topics to the software architecture community, and have been ICSA topics for several years.
5) take-away messages - (i) tutorial attendees will learn how to exploit operational data for continuous assessment of the microservice architectures they work on, (ii) architecture researchers will be exposed to model-based survivability assessment of high-availability architectures.
6) history of the tutorial - Related/shorter versions of the tutorial, keynotes, and related papers were presented in several venues, among them: ICPE 2013, ISSRE 2014, ICPE 2017, ITC 2017, ISSRE 2017, ICPE 2018, ECSA 2018, ISSRE 2019.

IV. Implementation

- the duration of the proposed tutorial – half day,
- a preliminary schedule of events including estimated times:
    1) Part 1 (90 minutes): (a) obtaining operational profiles using APM tools, and, (b) challenges of continuous dependability assessment in microservice architectures,
    2) Part 2 (90 minutes): selected approaches for continuous architecture assessment using operational profiles and survivability modeling.
- a detailed description of what the tutorial will cover - The tutorial agenda is as follows:
    1) Introductions and agenda (10m)
    2) Introduction to Dependability, Operational Profile Data, and DevOps (40m)
    3) Obtaining Operational Profile Data Using APM Tools (40m)
    4) Coffee Break
    5) Selected Approaches Based on Representative Load Testing (25m)
    6) Applications Related to Scalability Assessment (30m)
    7) Model-based Survivability Evaluation Approaches (30)
    8) Summary and Conclusions (5m)
- a justification of the tutorial for the expected audience - The expected audience will learn how to apply automated scalability assessment based on operational data to the systems they work on.
- an explanation of how the tutorial will be conducted – the tutorial will consist mostly of lectures. There is one demo planned to demonstrate the scalability assessment cockpit. The notes will consist of the pdf of the slides.

V. The Presenter Background section

Alberto Avritzer received a Ph.D. in Computer Science from the University of California, Los Angeles, an M.Sc. in Computer Science for the Federal University of Minas Gerais, Brazil, and the B.Sc. in Computer Engineering from the Technion, Israel Institute of Technology. He is the founder and CEO of Esulabsolutions, Inc., which specializes in software scalability, security and survivability assessment of large industrial systems. He served as Lead Performance Engineer at Sonatype. He held a Senior Member of the Technical Staff in the Software Engineering Department position at Siemens Corporate Research, Princeton, New Jersey for 11 years, where he published extensively on monitoring and management of mission-critical systems for survivability. Before moving to Siemens Corporate Research, he spent 13 years at AT&T Bell Laboratories, where he developed tools and techniques for performance testing and analysis. He spent the summer of 1987 at IBM Research, at Yorktown Heights. His research interests are in software engineering, particularly software testing, monitoring and rejuvenation of smoothly degrading systems, and metrics to assess software architecture, and he has published over 70 papers in journals and refereed conference proceedings in those areas (http://dblp.dagstuhl.de/pers/hd/a/Avritzer:Alberto). He is a Senior Member of ACM.

This tutorial audience have varied in the range of 10-20 attendees.

The author has presented related tutorials at the following venues:

- LADC 2013 - Rio de Janeiro, Brazil, with D. S. Menasche
- ICPE 2013 - Prague, Czech Republic with Anne Koziolek and D. S Menasche
- ISSRE 2014 - Naples, Italy with K. Trivedi and D.S Menasche
- ICGSE 2014 - Shanghai, China
- ICGSE 2015 - Ciudad Real, Spain, with M. Paasivaara, J. Noll, S. Beecham and D. Menasche
- ISSRE 2017 - Toulouse, France, with K. Trivedi
- ICPE 2018 - Memphis, TN, USA, with A. van Hoorn
- ISSRE 2019 - Berlin, Germany, with B. Russo