Reliable and Failure Type-Aware Component-Based Software Systems

Mohammad Zulkernine and Atef Mohamed
School of Computing, Queen's University, Kingston, Canada
{ mzulker, atef}@cs.queensu.ca

Abstract

Component-based technologies are increasingly proving efficiency in current software applications. The enormous expansion of these applications has increased the demands for reliable component-based technologies. Depending on different viewpoints and assumptions, a component takes various definitions and forms. As a result, numerous reliability works that involve varieties of the underlying strategies, objectives, and parameters are proposed for component-based software system reliability. Most of the existing reliability work on fault avoidance, fault tolerance, and fault forecasting techniques regard different types of failures equally. By considering different failure types equally, these techniques disregard various criticality levels or severities of different failures. In practice, component failures vary with respect to their criticality levels. In this tutorial, we present the latest technology of component-based software and provide a comparative analysis of the latest efforts on its reliability. We show the status of failure type-awareness in these efforts. We also present several techniques for enabling failure type-awareness in software decomposition, design diversity, and reliability assessment. The tutorial will discuss the underlying assumptions and research goals of the current reliability efforts and highlight the open issues for future research. It will also allow the guidance for enabling failure-type awareness in the future reliability mechanisms. The tutorial is exceptionally relevant to the fault tolerance and reliability assessment researchers and practitioners, and software designers.

1- Presenters

Dr. Mohammad Zulkernine is an Associate Professor in the School of Computing of Queen's University, Canada, where he leads the Queen's Reliable Software Technology (QRST) research group. He received his Ph.D. from the University of Waterloo, Canada, where he belonged to the university's Bell Canada Software Reliability Laboratory. His research focuses on methods and tools for reliable and secure software, automatic software monitoring, and intrusion detection. Dr. Zulkernine's research projects are funded by a number of provincial and federal research organizations of Canada along with some industry partners such as Bell Canada.

Dr. Zulkernine teaches software reliability and security related courses both in academia and industry and has extensive publications in these areas. In 2009, he taught a course on software reliability and security at the IBM Toronto Labs. Dr. Zulkernine spearheaded the organization and creation of the IEEE Workshop Series on Security, Trust, and

Privacy for Software Applications. He was the workshop and tutorial co-chair of the International Conference on Privacy, Security, and Trust in 2008. He has frequently served on the program committees of COMPSAC, DSN, ACM SAC, ESSoS, and QSIC, as well as a number of other international conferences and workshops on software and security engineering.

Dr. Zulkernine is a senior member of the IEEE, a member of the ACM, and a licensed professional engineer of the province of Ontario, Canada. More information about his research and teaching can be found at http://www.cs.queensu.ca/~mzulker.

Atef Mohamed is currently a senior Ph.D. student in the School of Computing, Queen's University, Canada, where he is a member of the Queen's Reliable Software Technology (QRST) research group. Mr Atef is an expert in component reliability and has a number of publications in this area. He has over 12 years of industry experience with respect to large scale software development, management, and training. . Mr. Atef has taught number of courses for in industry environment in the area of information technology. His research interests include software reliability assessment, fault tolerance, and component-based software systems. More information about his research and publications can be found at http://www.cs.queensu.ca/~atef.

2- Duration

The tutorial is intended for half day (3-4 hours) duration.

3- Intended audience

The tutorial is targeted at two groups of audience.

• **Fault tolerance and reliability assessment researchers and practitioners**
Both fault tolerance and reliability assessment researchers will find the tutorial informative for discovering the latest advanced techniques and highlighting the open issues and limitations of these techniques. Fault tolerance researchers will be able to compare and contrast their techniques and parameters with respect to the abstraction levels and assumptions about component definitions and specification details. Fault tolerance practitioners will be able to select the potential solutions that handle fault tolerance of component-based software applications while allowing failure type awareness. Reliability assessment researchers and practitioners will be able to enable failure type-awareness in their future reliability assessment techniques and practices.

• **Software designers**
Software designers will learn some tools to incorporate reliability in their architectural design decisions and will learn how failure type-awareness can be employed to appropriately select the decomposition level of the software according to different failure criticalities.

4- Difficulty level and required background

The difficulty level of the tutorial is intermediate. We assume that the audience has basic knowledge about software engineering and component based technologies. However, they do not require background knowledge on fault tolerance and reliability assessment.

5. Content description

The tutorial is structured into three major and equal parts. The first part provides introductory and background information related to component-based software systems and software reliability. This information involves component characteristics and definitions. It also involves an overview of the state-of-the-art component technologies. With respect to software reliability, we will show the reliability definition and describe its attributes. We will discuss the main reliability impairments of components and their classifications, and we will show the details and contributions of the reliability means for component-based software.

In the second part, we will present taxonomy and a comparative analysis of the latest efforts on the component-based software system reliability in three major categories: fault-tolerance, reliability assessment, and reliable design and operational activities. For each category, we provide a comparative study of the proposed approaches, discuss the strengths and weaknesses, and show how they integrate and contribute towards building dependable component frameworks. We compare and contrast the existing techniques considering their assumptions with respect to component definition and specification details. We also show some open issues and limitations of the existing work.

In the third part, we introduce the concept of failure type-awareness and show its status in the existing research. We show the motivations with some illustrative examples. We discuss the methodology of enabling failure type-awareness in various reliability aspects of component-based software systems. We provide the details of failure type-awareness in the software system decomposition, software system architectural design, and software system reliability assessment. Finally, we provide a summary and conclude the tutorial.