Ph.D. in Information Technology:

Ho, and Teimourikia Final Dissertations

DEIB Seminar Room

February 7th, 2017

10.00 am

First Ph.D. presentation and discussion:

Nguyen Thi Thao HO – XXIX Cycle

Towards Sustainable Solutions for Applications in Cloud Computing and Big Data

Advisor: Prof. **Barbara Pernici**

Abstract:

The rapid growth of energy consumption and consequently the CO2 emission of ICT sector in the era of Cloud Computing and Big Data have raised serious concerns about their environmental impact. Recent research in energy efficiency has been focused on reducing the energy consumption, and state-of-the-art techniques have been emphasized on optimizing power and energy consumption at hardware and infrastructure levels of data centers. The research goal of this thesis is to look for new opportunities to further improve energy efficiency at the level of applications in the context of Cloud Computing and Big Data. Particularly, this research proposes to tackle the energy efficiency problem from two different angles: the possibility to reduce the energy consumption of applications and the potential to reduce the amount of data to be processed. Adopting both modeling-based and experimental-based techniques, the first approach proposes analytical models to estimate the energy consumption of cloud-based applications and quantify the energy consumed per job. The models are built based on cloud infrastructure's and application's parameters and are validated experimentally using a real cloud infrastructure. The energy per job metric is used as the main driver to analyze energy consuming behaviors of applications and to assess possibilities to improve their energy efficiency.

Through the selected case studies, we demonstrate that application's energy efficiency can be further improved at the application level through their execution configurations and/or through optimizing load distribution. As a final result, the proposed method provides a means to both application's users and cloud infrastructure's providers to actively control and optimize the energy usage of cloud-based applications. In the second proposal, the thesis proposes a novel approach for energy efficiency in the context of Big Data by considering the potential to reduce data volume. In particular, data volume reduction can be achieved through identifying and removing irrelevant data with respect to user's goals. As the final results, a novel

metric called data value is proposed to represent the valuable level of data, and a generic energy-efficient framework utilizing this value is proposed. The inference of the data value is also demonstrated by using data correlation technique.

Second Ph.D. presentation and discussion:

Mahsa TEIMOURIKIA – XXIX Cycle

Co-Engineering Safety and Security in Risk-Prone Smart Work Environments

Advisor: Prof. **Mariagrazia Fugini**

Abstract:

Safety and security are two risk-driven aspects that are usually tackled separately. The importance of considering safety and security as dependent aspects and co-engineering them together as cyber-security is highlighted with the advent of Internet of Things (IoT) which has a direct or indirect effect on how safety and security are managed in critical environments.

As an emerging technology, IoT, has provided a promising opportunity in the appearance of Industry 4.0 and Smart Work Environments (SWEs). As with all new technologies, SWEs introduce various issues and opportunities. On one hand, as more devices are getting integrated in the IoT technology, SWEs become more and more vulnerable to the security threats. And hence new approaches should be proposed to protect the sensitive and critical resources in the SWEs. On the other hand, the IoT technology provides the chance to acquire ambient and monitoring data to be exploited to identify and treat the risks related to safety. While this is an advantage to protect persons' safety, the security policies should allow the treatment of the risks when necessary by adapting to the safety-related context in each situation.

In this thesis, the security and safety of the risk-prone SWEs are tackled.

Starting with safety, a run-time risk management methodology is proposed that exploits an automated risk assessment process that is developed considering the commonly adopted risk assessment techniques in the industry. In addition, an ontology is designed and developed to extract safet knowledge in a computer-readable way. Coming to security, a risk-adaptive Access Control (AC) model based on Attribute-Based Access Control (ABAC) is developed considering hierarchical safety-related contexts. Upon receiving risk descriptions, based on the designed meta-rules, the AC system adapts the security rules to allow risk treatment.

PhD Committee:

Prof. **Franca Garzotto** - DEIB

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