Ph.D. in Information Technology: Thesis Defenses

February 19th, 2019

Room Conferenze "Emilio Gatti" – 10.00 am

Mersedeh SADEGHI - XXXI Cycle

"A Model-centered Solution for Taming the Heterogeneity of Smart Devices"

Advisor: Prof. **Luciano Baresi**

Abstract:

Recent progress of Internet of Things (IoT) technologies has led to a competitive market and heterogeneity of communication protocols, large diversity of smart device types, and multitude of widely used Application Programming Interfaces (API) and standards. Even if, these advancements enhance the development of IoT domains including smart spaces, they intensify the interoperability challenge. In other words, the co-operability of smart devices is compromised by the numerous enabling technologies. Smart spaces are becoming more tightly bounded to the technology and standard proffered by their underlying frameworks.

This Phd thesis aimed to provide a comprehensive solution for tackling the heterogeneity of smart devices and technologies and allow developers to integrate them seamlessly. The proposed solution is centered around the definition of a unique model, called TDeX, to support the uniform description of diverse smart devices. The model extends TD (Thing Description), proposed by W3C, and adds information about context and access rights, along with the elements to create device-agnostic GUIs to interact with the devices. TDeX then enables two additional contributions: a model-driven solution for the creation of GUIs that automatically adapt to changes in the context of fruition and access rights, and a REST middleware infrastructure, called M4HSD, that governs the interaction with the different devices and exposes them as TDeX instances. Finally, the integration of different instances of M4HSD allows for the composition of different domains and thus for the definition of user-centered smart environments that go beyond physical proximity. The validation of proposed solutions has been carried out on both real appliances and simulated environments.

Carlo BERNASCHINA – XXX Cycle

"Tools, Semantics and Work-flows for Web and Mobile Model Driven Development"

Advisor: Prof. **Piero Fraternali**

Abstract:

Web enabled mobile devices are becoming more and more ubiquitous in our lives. Application development for these devices opens newer and newer challenges. Model Driven Development was proposed as a solution

able to reduce complexity and enhance productivity. This methodology was, and is still, not broadly adopted due to a proven, or perceived, high advantages/costs ratio making it difficult to reach a break-even point. The goal of the research presented in this thesis is to propose tools, semantics and work-flows aimed at reducing the costs of Model Driven Development, especially in the field of web and mobile applications. We will focus on tooling, by presenting an agile model transformation framework enabling the introduction of the Model Driven methodology in existing tools or the bootstrapping and rapid iterative development of new environments. We present a formal semantics for the Interaction Flow Modeling Language, focused on web and mobile applications, having has objective a simple tool independent interpretation of IFML models enabling tools interoperability. We present an on-line tool for the rapid prototyping of web and mobile applications, showing how the proposed framework and semantics can be easily integrated together to produce a production ready Model Driven environment. We eventually present a Model and Text co-evolution work-flow which facilitates the interaction between code generators and human developers, by treating the application source code as the central artifact and the code generator as a virtual developer, i.e., yet another member of the team. The experimental results show how the proposed methodology can reduce both the amount of work needed to obtain a production ready application and the level of expertise required in the process.

Lorenzo AFFETTI – XXXI Cycle

"New Horizons for Stream Processing"

Advisor: Prof. **Gianpaolo Cugola**

Abstract:

With his thesis, Mr. Lorenzo Affetti investigates distributed stream processors' lack of a standardized execution semantics and proposes interesting future directions to model some aspects of their behavior. In order to accomodate the new central role that stream processors are playing in modern software stacks, Mr. Affetti proposes a solution for their integration with database management systems by extending their model of computation with transactional behavior.

Marco BALDUINI – XXX Cycle

"On the Continuous and Reactive Analysis of a Variety of Spatio-Temporal Data"

Advisor: Prof. **Emanuele Della Valle**

Abstract:

In recent years, an increasing number of situations call for reactive decisions making process based on a heterogeneous streaming data. In this context, the urban environment results particularly relevant because

there is a dense network of interactions between people and urban spaces that produces a big amount of spatio-temporal fast evolving data. Moreover, in a modern city there is a multitude of stakeholders who are interested in reactive decisions for urban planning, mobility management, tourism, etc. Within the scope of this work, we concentrate our effort in the creation of an holistic conceptual model to represent multiple heterogeneous spatio-temporal data and in the development of a streaming computational model to support reactive decisions. We created and formally verified FraPPE ontology, a conceptual model that bridges the gap between the data engineers and visual data analysts in modeling spatio-temporal data and enabling space, time, and content analysis by exploits digital image processing terms. Moreover, we developed RIVER, a streaming computational model inspired by two principles: everything is a data stream and continuous ingestion. RIVER is built around the idea of Lazy Transformation: a system that implements RIVER postpones data transformations until it can really benefits from them. Last, but not least, we verified and validated in real urban environments different vertically and horizontally scalable implementations of RIVER.

Michele GUERRIERO – XXXI Cycle

"Model-Driven Engineering for Privacy-Aware Data-Intensive Applications"

Advisor: Prof. **Elisabetta Di Nitto**

Abstract:

This thesis presents a novel model-driven engineering approach to design, develop and deploy privacy-aware data-intensive applications (DIAs). A UML-based modeling language for DIAs is presented and it is shown how it can be used to automatically develop and deploy DIAs. It is then proposed an approach for specifying, enforcing and monitoring privacy policies in DIAs. The research contributions of this thesis have been evaluated through case and user studies as well as through benchmarking, showing their general and practical applicability.

PhD Committee:
Prof. **Elisabetta Di Nitto**, DEIB
Prof. **Oscar Corcho**, Universidad Politecnica de Madrid
Prof. **Leonardo Mariani**, Universita' di Milano Bicocca