Keynote

Model-driven Analytics with Models@run.time: The Case of Cyber-Physical-Systems

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Bits and bytes are governing an increasing number of areas in our lives and businesses. The exploration and simulation of what might happen and which action can be triggered is a fundamental part of intelligent systems such as smart grids, smart buildings, smart homes and any cyber-physical system. This new intelligence is supported by machine learning algorithms that, based on past data and runtime data, model the behavior of the system to predict its evolution. Recommendation systems, autonomous decision-support, prescriptive simulations have to be both scalable and highly accurate at runtime. It is paramount to develop new decision support services that should (at least partly) relieve the users from the overwhelming load of information and the growing number of decisions to be taken in time. In that perspective, model-driven engineering offers a bridge between the knowledge of experts who best know which data are relevant, and the monitoring and control of software components and sensors. The presentation is about how MDE, and specifically models@run.time, may become an enabler for designing and deploying easily domain-specific, scalable analytics for heterogeneous sources of timed data. Some problems still have to be solved and I will introduce some of them. Cyber-physical systems continuously analyze their surrounding environment and internal state, which together we refer to as the context of a system, in order to adapt itself to varying conditions. To yield accurate predictions, such systems not only rely on single numerical values, but also need structured data models aggregated from different sensors. Therefore, building appropriate context representations is of key importance. Over the past few years the models@run.time paradigm has shown the potential of models to be used not only at design-time but also at runtime to represent the context of cyber-physical systems, to monitor their runtime behavior and reason about it, and to react to state changes. However, reasoning about such contexts is a complex and time critical activity that needs to leverage near real-time analytics together with big data methods to quickly process the massive amount of data measured by these systems. Current modeling techniques do not allow to face all needed features for reasoning, such as distribution, large-scale and near real-time response time. In this talk I present two concepts that might push the limits of models@run.time for near-real time analytics a little further: 1) stream-based, distributed models and 2) historized models. I will present our results based on a real application on a smart grid scenario in joined work with the main electrical grid provider of Luxembourg.

Yves Le Traon *is professor at University of Luxembourg, in the Faculty of Science, Technology and Communication (FSTC). His domains of expertise are related software engineering and software security, with a focus on software testing and model-driven engineering. He received his engineering degree and his PhD in Computer Science at the "Institut National Polytechnique" in Grenoble, France, in 1997. From 1998 to 2004, he was an associate professor at the University of Rennes, in Brittany, France. During this period, Professor Le Traon studied design for testability techniques, validation and diagnosis of object-oriented programs and component-based systems. From 2004 to 2006, he was an expert in Model-Driven Architecture and Validation in the EXA team (Requirements Engineering and Applications) at "France Télécom R&D" company. In 2006, he became professor at Telecom Bretagne (Ecole Nationale des Télécommunications de Bretagne) where he pioneered the application of testing for security assessment of web-applications, P2P systems and the promotion of intrusion detection systems using contract-based techniques. He is currently the head of the Computer Science Research Unit at University of Luxembourg. He is a member of the Interdisciplinary Centre for Security, Reliability and Trust (SnT), where he leads the research group SERVAL (SEcurity Reasoning and VALidation). His research interests include software testing, model-driven engineering, model based testing, evolutionary algorithms, software security, security policies and Android security. The current key-topics he explores are related to Internet of things (IoT) and Cyber-Physical Systems (CPS), Big Data (stress testing, multi-objective optimization, analytics, models@run.time), and mobile security and reliability. He is author of more than 140 publications in international peer-reviewed conferences and journals.*