Summary of the 10th International Workshop on Models@run.time

Sebastian Götz[1], Nelly Bencomo[2], Gordon Blair[3], and Hui Song[4]

[1] Technische Universität Dresden, Germany
sebastian.goetz@acm.org
[2] Aston University, United Kingdom
nelly@acm.org
[3] Lancaster University, United Kingdom
gordon@comp.lancs.ac.uk
[4] SINTEF, Norway
hui.song@sintef.no

Abstract. The 10th anniversary of the workshop Models@run.time was held at the 18th International Conference on Model Driven Engineering Languages and Systems. The workshop took place in the city of Ottawa, Canada, on the 29th of September 2015. The workshop was organized by Sebastian Gtz, Nelly Bencomo, Gordon Blair and Hui Song. Here, we present a summary of the discussions at the workshop and a synopsis of the topics discussed and highlighted during the workshop. The workshop received the award for the best workshop at the MODELS 2015 conference out of 18 workshops in total. The award was based upon the organization, program, web site timing and the feedback provided by the workshop participants.

Keywords: Models@run.time, Reflection, Distributed Systems, Self-adaptive Systems

1 Introduction

Throughout the last decade, the workshop series has provided a podium for various topics focusing on the fundamentals and applications of run-time models. The main goal of the workshop has been to further promote cross-fertilization between researchers from different communities, including core research areas such as model-driven software engineering, software architecture, computational reflection, adaptive systems, autonomic and self-healing systems, and requirements engineering, but also application-centric research areas such as cyber-physical systems, Internet of Things, and Big Data.

In preparation of the 10th anniversary of the workshop, we reflected upon the progress of models@run.time as a research topic [1]. A key finding was the increasing number of tracks at major conferences (especially MODELS) focusing on models@run.time. As a result, for the tenth anniversary, we focused on the topics of interest which still are in an early phase of research and, by this, provided a specific podium for early ideas on models@run.time.

In consequence, this year the workshop was attended by at least thirty six (36) researchers from different communities throughout the day, whereof at least seventeen (17) actively participated in the discussions until the end of the workshop.

This year, eight (8) out of thirteen submitted papers were accepted and presented, resulting in an acceptance rate of 62%. They are published in this post-workshop proceedings. In addition, as in the last two years, the main conference had a special track on models@run.time, where 3 further papers on models@run.time were accepted and presented.

2 Workshop Format and Session Summaries

The workshop comprised four (4) sessions, which were structured into: a keynote session focused on reflecting about the past, present and future of the topic, a session on new insights addressing the fundamentals of models@run.time, a session on new ideas of how and where to apply models@run.time and a session on new dimensions focusing on novel, challenging problems.

To ensure lively discussions at the workshop, we decided to keep the talks short and, besides a 1-2 minute question round after each presentation, encouraged longer discussions at the end of each session. The goal of these discussion rounds was to reflect upon all the papers presented in the respective session and, consequently, to connect and/or compare the approaches. This concept turned out to be very effective.

2.1 Reflection of the Past Decade by Betty Cheng

The first session, which had the most concurrent participants throughout the day, comprised an opening talk by Nelly Bencomo and a keynote by Betty H. C. Cheng, who gave the keynote 10 years ago at the first edition of the workshop and reflected upon the last 10 years of her work in the area of models@run.time. The key insights given by her talk clearly show the need to continue research on models@run.time by pointing out several open challenges to be addressed. The most prominent challenge pointed out was the demand to manage uncertainty as models are by definition incomplete (being an abstraction) and monitoring information is typically unreliable. Also, the question was raised, how to identify how much information is to be covered in a model to sufficiently support adaptation. Finally, another open challenge, which was discussed, addressed the inconsistencies in and between runtime models of distributed systems. There were also discussions about the need of more inclusion of research areas such as evolutionary computation and genetic algorithms.

2.2 Session in New Insights

This session covered new insights on the fundamentals of models@run.time and started with a talk by Kirste Bellmann and Christopher Landauer on “System

Development at Runtime" based upon their self-modeling approach, which was put in context to the application areas of health care, space missions and military applications. The following talk by Arnor Solberg on "Using Adaption Plans to Control the Behavior of Models@run.time" focused on the need and an approach to adapt the adaption logic itself using workflow descriptions. The third and final talk of this session by Mahdi Derakhshanmanesh "On the Need for Extended Transactional Models@run.time" tackled the special need of the causal connection between the real system and its runtime model to support the concept of transactions.

These three topics (self-modeling, adapting adaption logic and transactions for the causal connection) challenge the fundamentals of models@run.time by questioning whether the current way of realizing approaches based upon models@run.time are sufficient to address the need to build complex systems. The first talk proposes the distinction between runtime models and self-models, where the former describe the current state of the system and the latter the capabilities of the system in it's current context. The second paper proposes to explicitly describe how the adaptation logic is to be adapted while the system is running and, thus, introduces a new type of model required to realize systems using models@run.time. Finally, the third paper proposes to introduce transactional concepts to realize the causal connection between a running system and its runtime models to avoid a variety of problems related to the concurrent use of them. In this context, the demand for sophisticated versioning mechanisms for runtime models as well as timed and historized runtime models has been pointed out in the discussions.

2.3 Session on New Ideas

The third session covered three presentations, whereof two questioned the way how runtime models should be represented and all three showed novel areas of application for models@run.time.

The first paper, presented by Johannes Mey, on "Using Reference Attribute Grammar-Controlled Rewriting for Energy Auto-Tuning", proposed to represent the runtime model as a reference attribute grammar and to use controlled rewriting to reason upon and change this runtime model in a more scalable way compared to EMF-based approaches. The idea has been shown to be feasible for the application area of energy-optimizing software systems.

Following this first presentation, Sebastian Götz proposed in his talk on "Models@run.time for Object-Relational Mapping Supporting Schema Evolution" to use Prolog fact bases as another alternative to represent runtime models, which enables the use of logic programming to reason upon and change the runtime model. The benefit of using this approach was highlighted for the application area of enterprise software.

Finally, Lorena Arcega proposed in her talk on "Leveraging Models@run.time to Retrieve Information for Feature Location" an approach in the application area of feature detection aiming at improved software maintenance.

2.4 Session on New Dimensions

The last session started with two presentations, which pointed out novel dimensions of models@run.time, followed by a long discussion round, which is summarized in the next section.

The first presentation was given by Sebastian Götz on "Managing Distributed Context Models Requires Adaptivity too" and discussed different ways how runtime knowledge captured in the individual context models of a distributed system can be exchanged between the participants.

The second and final presentation, given by Joel Greenyer, entitled "Scenarios@run.time–Distributed Execution of Specifications on IoT-connected Robots", proposed to use executable scenario specifications for system testing.

2.5 Discussion on Current State and Prospects of Models@run.time

To summarize and conclude the workshop, we used the last hour of the workshop for an open discussion on the current state and the prospects of models@run.time. A first question posed to the audience was: "What has worked and where has models@run.time been shown to be working and what are the hard issues that still exist?".

For the first category on "what has worked", three key statements came out from the discussion. First, the audience had the impression that models@run.time has been successfully and effectively applied in many small scale scenarios as, e.g., the application to a local smart grid in Luxembourg [2]. Second, approaches using models@run.time have offered excellent results when applied in the area of self-adaptive systems, autonomous computing, self-organized systems and other types of systems based upon a feedback loop. Finally, the characteristic of models@run.time to reveal the system's state and data explicitly was pointed out as highly beneficial as it improves the understandability and, consequently, manageability of systems for end users (e.g., by providing an easier to grasp level of abstraction for debugging a model-based application).

On the other hand, the discussions clearly showed that the topic models@runtime still offers many open research questions and challenges to be addressed. First among all, the applicability of models@run.time to large scale systems has been pointed out throughout the workshop, starting with the keynote by Betty Cheng. In this context, a next highlighted challenge is the application to distributed systems, where multiple systems have their own runtime model. Particularly, challenges arise due to the fact that these models are typically incomplete and partial by definition (abstraction) as well as due to the time required to keep the runtime models and the actual systems in synchronization. In consequence, the uncertainty about statements encoded in runtime models is yet another important challenge to be further investigated in future work. Another, closely connected challenge is the demand for real-time capabilities and the concept of transactions for the causal connection between the running system and its runtime model. A concrete problem arising from the lack of such concepts is model consistency in distributed systems. Here, multiple questions

remain unanswered. How to ensure model consistency among multiple runtime models of systems operating in the same environment? Is it really necessary to be consistent at all points in time? Is it possible at all to be consistent at all points in time? Can we characterize the degree of consistency required for selected applications? Is it possible to identify an equilibrium between consistency and correctness?

A promising direction pointed out by the participants of the workshop to address the aforementioned problems, questions and challenges is the application of bio- or socially-inspired techniques (e.g., evolutionary algorithms, genetic programming, bio-mimetic computing, etc.).

Finally, the community formulated the need for common testbeds and case studies to enable comparability between approaches. In this years edition we called for "artifacts", aiming to collect common testbeds made by the community. Unfortunately, no artifacts have been submitted this time.

3 Conclusion

The tenth edition of the international workshop on models@run.time was again very well visited (36+ participants with 17 active participants, who stayed the whole day) and, also, was very well perceived by the MODELS community. The 10th edition of the workshop was honored by an award for the best workshop at this years MODELS conference, where models@run.time has been selected out of 18 workshops in total, mostly based upon the feedback provided by the workshop participants.

The trend of submissions remained low (10+), but almost unchanged compared to the last 2 years. One of the reasons for the low number of submission may be the maturity of models@run.time as a research topic, due to which many papers are submitted to conferences like MODELS and SEAMS and journals like SoSyM. Also, MODELS 2015 offered 18 events running during 3 days, what increases the chances that attendees spread their attention and efforts through the different events. Nevertheless, the high number of participants and the active discussions at the workshop show that there still is considerable need to continue the workshop.

Throughout the last ten years, the workshop was constantly co-located to the MODELS conference and, consequently, mainly attracted participants from the modeling community. However, as models@run.time has shown to be be well applicable to self-adaptive and autonomous systems, next year a special edition of the workshop will also take place at ICAC[5]. This special edition will have "self-aware computing systems" as its theme. In addition, we plan to continue the workshop at the MODELS conference.

[5] http://st.inf.tu-dresden.de/MRT16-ICAC

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References

1. Sebastian Götz, Nelly Bencomo, and Robert France. Devising the future of the models@run.time workshop. *SIGSOFT Softw. Eng. Notes*, 40(1):26–29, February 2015.
2. Thomas Hartmann, Francois Fouquet, Gregory Nain, Brice Morin, Jacques Klein, and Yves Le Traon. Reasoning at runtime using time-distorted contexts: A models@run.time based approach. In *(SEKE'14) 26th International Conference on Software Engineering and Knowledge Engineering*, 2014.