Review of Doctoral Thesis

Author of the Thesis: Mgr. Marek Polák
Title: Evolution and Adaptability of Complex Applications
Author of the Review: Doc. RNDr. Irena Holubová, Ph.D. (thesis supervisor)

General Description
The thesis consists of 10 chapters covering 212 pages altogether. The first chapter provides an introduction and motivation for the problems solved in the rest of thesis and explains which aspects are solved in which parts of the text and respective papers. The second chapter introduces the target area. Author’s proposals are described in the following six chapters which correspond to conference/journal papers accepted at recognized events. The ninth chapter provides and extensive experimental study of the implemented solution. The tenth chapter sums up the achievements of the thesis and outlines future work.

The structure of the text conforms to principles and requirements on the structure of a scientific thesis. The author has studied and used an appropriate number of bibliography sources quoted in the thesis. It is an evidence of the deep theoretical knowledge and very good orientation in the problems discussed in the text.

The word processing of the thesis is adequate. The usage of different fonts and structure of the text is proper and helps the reader in a better orientation. There are also numerous figures, listings and examples which help the reader to understand the ideas. The thesis fulfils the general formal requirements at a very good level.

In general, the author proved the ability to prepare a sound and explanatory research text describing the solutions of the selected problem with all appropriate parts.

The Topic of the Thesis
Efficient management of evolution and propagation of changes is an important research area and a complex problem. Many real-world applications thus rely on a skilled administrator who performs all the changes and manages all the consequences manually. However, in a complex application involving tens of schemas in different formats, respective distinct query languages and storage strategies, it is a highly difficult and error-prone task. Thus a (semi-)automatic management of changes which ensures both correctness and completeness of the process is a necessary solution.

The tool DaemonX proposed, implemented and enhanced in the thesis is based on a verified idea of the Model-Driven Architecture and supports several levels of abstraction of the modelled system connected via respective mapping. Thus, it enables to cover virtually any model (as proven by its extension to relational model, REST API model or business process model), including models of distinct query languages (as shown by its support of XPath and SQL). The modularity of the system enables further extensions to other models. (For example, currently it is being extended towards the area of schema-on-demand NoSQL document databases within a Master thesis under my supervision.)

Such a robust system, providing the ability to model a complex application from different views represented by different data models, also brings many new research challenges, such as reverse engineering or undo/redo management. In the former case it is necessary to be able to integrate existing schemas to the evolution management system DaemonX. In the latter case the system must enable correct and user friendly processing of undo/redo operations which can have complex consequences when modelling multiple mutually mapped data models.
In all the cases the solutions were proposed generally and verified using implementation within DaemonX. On the other hand, the tool can be further extended and thus it provides a platform for further research. Its current capabilities were extensively experimentally tested using a non-trivial real-world use case.

In general, the author of the thesis has performed a good orientation and wide knowledge of different parts of the target areas from both practical and theoretical aspects. He has studied and solved the target problems from several points of view and within several research teams and projects, namely the XML and Web Engineering Research Group, the GACR project Handling XML Data in Heterogeneous and Dynamic Environments, and his own GAUK project Evolution and Adaptability of Complex Applications.

Author’s Contributions
The main author’s contributions are related to the implementation and consequent extension of the DaemonX project (which was implemented as a student SW project at the Faculty of Mathematics and Physics of the Charles University and Marek Polák was a member of the team) and the related area of evolution and change management. In his Master thesis he has extended the tool towards propagation of changes to XPath queries. The following papers extended the tool in other directions (relational model, undo/redo management, mapping of schemas, REST API management etc.) and provided various experimental studies of both particular extensions and the whole system. The extensions were chosen in order to show the versatility of the original idea of DaemonX (i.e. distinct data models, query models, or a service model), as well as complexity of the solution (covering aspects like reverse engineering or undo management). The resulting tool provides a unique robust solution.

Author’s Publications
The publications covered in the thesis involve 1 journal paper with impact factor, 8 papers published at refereed international conferences, and 1 paper published at a refereed international workshop. Most of the papers directly form the content of the thesis.

Conclusion
In my opinion, the thesis of Marek Polák undoubtedly fulfils all the conditions for gaining the Ph.D. degree in Computer Science; therefore it is recommended.

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