Ph.D. Position

Understanding the Impact of Changes onto Software Systems
Institute of Software Systems Engineering
Johannes Kepler University, Linz, Austria

The big picture:

Modern complex systems are designed as systems of systems where subsystems (software and possibly hardware) interact with one another. The designing of such systems also necessitate the interaction among various stakeholders (e.g., software engineers, system engineers and electrical engineers) having diverse background collaborating with each other through the exchange of engineering artifacts (e.g., requirements models, design documents and code). Since engineers tend to use different tools to create these engineering artifacts[1], a typical problem arises in situations where one engineer changes an artifact (let's say a hardware component because of a safety concern) and these changes then have to be translated to dependent artifacts, often maintained by other engineers. This is one of the major sources of inconsistencies in requirements and design documents. If not handled in time, these inconsistencies trickle down to code as software defects.

The goal and research questions:

The main goal of this Ph.D. is to investigate mechanisms that ensure correct and trustworthy change propagation. For example, how to incorporate changes in requirements/models/code while making sure that all the related artifacts remain harmonious after those changes. What are impacts of such changes? Do all artifacts still remain traceable[2] after the changes? Can such a process be (completely) automated? Can we come up with generic patterns in this regard?

Research methods:

Techniques that this position could focus on include model/program analysis (e.g., static analysis), error detection/repair, verification (e.g., dynamic analysis) and more. Among the goals is to significantly extend the power and scalability of such techniques to real-world case studies. As an underlying technology, we would like to exploit the DesignSpace[3] as an underlying collaborative engineering platform. For background on papers, please look at:

- Automatically Detecting and Tracking Inconsistencies in Software Design Models by Alexander Egyed (https://ieeexplore.ieee.org/document/5432227)
- Computing Repair Trees for Resolving Inconsistencies in Design Models by Alexander Reder and Alexander Egyed (https://ieeexplore.ieee.org/document/6494921)
- Determining the Cause of a Design Model Inconsistency by Alexander Reder and Alexander Egyed (https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6560054)

Required expertise:

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[1] Andreas Demuth, Roland Kretschmer, Alexander Egyed, Davy Maes: Introducing traceability and consistency checking for change impact analysis across engineering tools in an automation solution company: an experience report. ICSME 2016: 529-538

[2] Catia Trubiani, Achraf Ghabi, Alexander Egyed, Exploiting traceability uncertainty between software architectural models and extra-functional results, Journal of Systems and Software, Volume 125, 2017, Pages 15-34

[3] Andreas Demuth, Markus Riedl-Ehrenleitner, Alexander Nöhrer, Peter Hehenberger, Klaus Zeman, Alexander Egyed: DesignSpace: an infrastructure for multi-user/multi-tool engineering. SAC 2015: 1486-1491

- A Master's degree in computer science or a closely related discipline
- Strong programming skills in Java or other languages
- Ability to work on own initiative and also as a part of a team
- English language proficiency, written and spoken

Application Instructions:
Applications should include a cover letter, CV, preferably also letters of reference, and a brief statement describing the applicant's research motivation in relationship to this topic. Electronic submissions are required. Review of applications will begin immediately and continue until suitable candidates are appointed.

Contact:
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Starting date: Spring/Summer 2019

About the Institution:
The JKU Institute for Software Systems Engineering is a 30+ people strong research institute that is ranked among the best in the world (e.g., recently Microsoft ranked JKU 16th in the world in software engineering). Research at the institute covers a wide area of software engineering from requirements to capture software, systems architecture, design and testing, to maintenance. Engineering is an inherently creative process that requires rigorous attention to details. However, engineering is also a collaborative, human centric process with adhoc activities. Engineering automations are few and rare – not just during programming but also during modeling, testing or maintenance.

About the Advisor:
Prof. Dr. Egyed received his Doctorate from the University of Southern California, USA and previously worked at Teknowledge Corporation, USA and the University College London, UK. He is most recognized for his work on software and systems design – particularly on variability, consistency, and traceability. Dr. Egyed has published over 200 refereed scientific books, journals, and conferences with over 6000 citations to date. He was recognized a Top 1% scholar in software engineering in Communications of the ACM, Springer Scientometrics, and Microsoft Academic Search. He was also named an IBM Research Faculty Fellow in recognition to his contributions to consistency checking.

Location: Linz, Austria
Website: http://isse.jku.at/