Automated Model Learning from Software Evolution

Highlights

- Efficient learning of behaviour changes in software updates
- Exploiting commit types in making effective model updates
- Direct application in industrial practice, in collaboration with British Telecom

Overview

Software is being increasingly used to control critical autonomous systems. Establishing trust in such systems involves using rigorous and explainable techniques to assess their safety. Model-based software engineering provides a powerful means in this respect: it gives us the basis for mathematical rigorous analysis, of which the results are explainable by translating the reasoning process into understandable natural / graphical language. Using models is a well-established approach to understand and validate existing software and develop new systems.

Model-based techniques rely on the presence of models for analysing and steering the development of software products. In practice, however, these models are often absent or outdated due to a number of factors, e.g., reuse of legacy software, limited resources allocated for maintaining software artefacts, and software evolution. Model-learning is a promising recent research area that aims to automatically construct models of software and systems by interacting with them at their interface level.

The goal of this project is to mine different patterns of software evolution (e.g., changes in repositories) and use them to learn up-to-date models of software behaviour for further analysis. The main challenge is to devise a novel model-learning technique that, inspired by the detected patterns of evolution, effectively anticipates behavioural changes and focuses on them rather than learning the whole product behaviour from scratch. This is a scientifically worthwhile goal as learning about software evolution (both in terms of evolution in time and in features) is much understudied. Moreover, this is a practically relevant problem considering the increasing trend of using evolving and self-adapting software in autonomous systems and the need for establishing trust in them through model-based techniques.

The expected outcome of the project will feed into a workflow to support model-based software development. This research agenda is inspired by the actual and urgent demand expressed by the software engineering research team at our industrial partner British Telecom. The project will provide an exciting opportunity to work with industrial data and evaluate the techniques on industrial-scale systems.

Level | PhD
--- | ---
First Supervisor | Dr José Miguel Rojas
Second Supervisor | Prof Mohammad Reza Mousavi
Application Closing Date | 27th February 2020
Subject Areas | ICT
| Digital Economy
| Manufacturing the Future
Methodology

We will review the literature of mining changes in software repositories [1]. Subsequently, we will build an inventory of software evolution patterns and their effect on behavioural models (e.g., extended finite state machines) [2]. We will develop extensions of automata learning algorithms (e.g., Angluin’s L*) to support software evolution following up on our earlier research regarding learning about software evolution in time and features [3, 4].

To compare and understand existing and mined models we will use combinations of syntactic and semantics differencing [5] that reveal changes and their impact on software systems.

We will evaluate the usefulness of learned models, computed differences, and generated explanations involving engineers working on industrial software projects and using well-established empirical methods [6, 7].

All research tasks will be supported by data provided by our partner British Telecom and we will evaluate our outcomes (techniques and tools) on their software repositories.

Further Reading


Funding

This research project is fully funded.

Home/EU Applicants

This project is eligible for a fully funded EPSRC studentship which includes:

- A full UK/EU fee waiver for 3.5 years
- An annual tax free stipend of £15,285 (2020/21)
- Research Training Support Grant (RTSG)
Application Instructions

The online application and supporting documents are due by **Thursday 27th February 2020**.

Applicants are advised to apply well in advance of the deadline, so that we can let you know if anything is missing from your application.

**Required Materials**

1. Online application form
2. Two academic references
3. Transcripts
4. Degree certificate/s (if awarded)
5. Curriculum Vitae
6. EPSRC Studentship Form
7. English language qualification *(If English is not your first language)*

All applications must be submitted online, along with the supporting documents as per the instructions on the website.

Please ensure that all email addresses, for yourself and your referees, are correct on the application form.

**Online application form**

*Deadline : 27th February 2020*

Please refer to the application advice and link to the Apply Button on the [EPSRC Studentships webpage](#).

**Research Proposal/Proposal Statement**

Please list the supervisor, code and title of the project you are applying to. You will also be required to upload the [EPSRC Studentship form](#) when prompted for the Personal Statement upload.

If you are applying for more than one project, please email your additional EPSRC Studentship form to [Csepgr@leicester.ac.uk](mailto:Csepgr@leicester.ac.uk)

**Funding**

Select 'Studentship' and then 'EPSRC' from the dropdown menu.

**Application Timeline**

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<tr>
<td>27th February 2020</td>
<td>Deadline for online application and supporting documents</td>
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<tr>
<td>13th March 2020</td>
<td>Interview invitations to be sent out</td>
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<td>25th – 27th March 2020</td>
<td>Interview days</td>
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<td>31st March 2020</td>
<td>Informal offers to be made</td>
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<td>15th April 2020</td>
<td>Deadline for acceptance of informal offers</td>
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Applying Early
Although the deadline is 27th February, we advise you to apply early so we can advise you of any delay with your application such as missing documents etc.

Online Application Advice
- Check all the email addresses you have entered are correct before submitting.
- Check you have uploaded the CSE Studentship Form in place of your personal statement.

Once You Apply
Once you have submitted your online application form, and uploaded your supporting documents, a copy will be sent to the school for review.