Efficient Co-Evolution of Software Architectures and Artificial Intelligence Components

Highlights

- Novel approaches to analysing AI software
- Understanding evolution of AI software
- High potential for industrial impact of research

Overview

Artificial intelligence (AI) is pervading the world around us. It is the driving enabler for innovations and products from autonomous vehicles, to enhanced health care, to efficient crisis response, to simple things like recommending the right movie for inspiration. However, often AI does not deliver services alone but is embedded inside the architecture of software systems.

One great benefit of software is its means for adaptation. However, the embedding of AI components in software architectures introduces new challenges. AI components are often not easily adapted and changing interfaces might mean costly retraining of the AI or it might require the augmentation or creation of new datasets. Nevertheless, some evolution steps can be efficiently supported for AI components in software architectures. As an example, as part of the software of a self-driving car we might have an AI component that detects pedestrians, cyclists, and traffic lights. A software evolution step might change component interfaces to detecting dangers instead of the previously more detailed classification. Here the creation of new training data and costly retraining might not be necessary if we can compose the existing AI component with one that extracts dangers from classified objects.

This project aims to enable efficient co-evolution of software architectures and AI components by providing a catalogue of typical evolution patterns and to suggest suitable adaptations both on the software architecture level and on the AI level to make evolution more efficient. It is expected that this holistic view will be able to leverage techniques from software architecture and from AI that complement each other to provide timely answers to existing and emerging software evolution challenges.

The research will be evaluated in the context of autonomous vehicles in urban environments (see the department’s project DriverLeics https://ringert.blogspot.com/search/label/DriverLeics) and on a drone for search and rescue missions (also available at the department). We are building links with industrial partners in the area of autonomous driving to apply our research.
Methodology

Our research investigates the combination of (1) the underlying theory of software architectures, their composition mechanisms and evolution patterns, and (2) existing and future techniques for evolving AI components.

The project will establish necessary foundations and extend theories and algorithms. To ensure correctness and soundness of analyses, our theories and algorithms will be formalized and proven.

We are combining theories of architecture modelling, evolution, and artificial intelligence for addressing highly relevant challenges of software engineering. As such, it is important and expected that all techniques will be proven feasible by prototypical implementations and will be supported by meaningful evaluation, with companies and engineers from industry.

Critical Skills & Training Development provided:

- support for development in scientific writing, communication, and presentation
- collaboration with industry
- software development skills

Further Reading

1. An overview of evolution of software models; and a look at software architectures and their evolution (by first supervisor):

2. Techniques for adapting and correcting artificial intelligence components (by the proposed second supervisor):

Funding

This research project is one of a number of projects in the Department. It is in competition for funding with one or more of these projects. Usually the project which receives the best applicant will be awarded the funding.

Home/EU Applicants

This project is eligible for a fully funded College of Science and Engineering studentship which includes:

- A full UK/EU fee waiver for 3.5 years
An annual tax free stipend of £14,777 (2018/19)
Research Training Support Grant (RTSG)

International Applicants
This project is eligible for a fully funded College of Science and Engineering studentship which includes:

- A full international fee waiver for 3.5 years
- Research Training Support Grant (RTSG)

Application Instructions
The online application and supporting documents are due by Monday 21st January 2019.

Any applications submitted after the deadline will not be accepted for the studentship scheme.

References should arrive no later than Monday 28th January 2019.

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. CSE Studentship Form
7. English language qualification

Applications which are not complete by the deadline will not be considered for the studentship scheme. It is the responsibility of the applicant to ensure the application form and documents are received by the relevant deadlines.

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.

For more information, please visit our website at:
https://www2.le.ac.uk/colleges/scieng/research/postgraduate-opportunities/cse-2019/instructions