

THE UNIVERSITY OF MANCHESTER
PARTICULARS OF APPOINTMENT
FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE
(JOB TITLE)

VACANCY REF: SELECT-0000

Salary: Grade 6 £32,816 to £40,322 per annum (according to relevant experience)

Hours: Full Time

Duration: Fixed term 11 months from commencement of contract

Location: Oxford Road, Manchester

Enquiries about the vacancy, shortlisting and interviews:

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BACKGROUND

First-order theorem proving is one of the earliest research areas within AI and formal methods. It remains of key interest in part due to the convenience of the language of first-order logic for expressing various kinds of knowledge and capturing different problems. As a result, the language is used extensively in many application areas including program analysis and verification of software and hardware, security, specification, semantic Web, database systems, computer algebra, symbolic computation and others.

This project concerns the Vampire theorem prover developed in Manchester. Over the last 15 years Vampire has emerged as the world-leading theorem prover for first-order logic, and more recently, theory reasoning. This world-leading status is demonstrated by a long track record of world champion titles in the CASC competition, winning 48 titles in total. Vampire has won the main division every year since 2002 and has won the theory division for the last three years, since entering for the first time in 2015. Vampire enjoyed similar success in the SMT competition, winning in a number of divisions each year since entering for the first time in 2016. Vampire currently comprises about 200k lines of C++ code and includes recent contributions related to program analysis co-implemented with the group of Prof. Laura Kovacs at TU Vienna.

Recently we have been focusing on extending Vampire's ability to reason with both quantifiers and theories (such as arithmetic and datatypes). Such problems are central to applications of

theorem proving in program analysis and software verification. One key development in this research was the development of AVATAR, a new architecture for first-order theorem provers allowing for the integration of an SMT solver into Vampire for ground theory reasoning. Another recent addition is that of theory instantiation and unification with abstraction. Continuing this research in theory reasoning is the focus of this project.

Overall Purpose of the Job

This role will consider some of the following research directions:

- Novel heuristics for theory axiom reasoning
- Experimentally motivated extensions to the Superposition calculus for theory reasoning
- Collaborative reasoning between first-order theorem provers and SMT solvers e.g. extensions of the AVATAR modulo SMT architecture
- New approaches for theory instantiation and theory-aware unification

New theory will be supported and motivated by practical implementation in the Vampire theorem prover. This research will also be carried out within the context of the application of such techniques within program analysis and verification tools.

Key Responsibilities, Accountabilities or Duties

The range of duties will include:

- Development of new theory and methodologies
- Implementation of new techniques within the Vampire theorem prover (C++)
- Writing scientific articles based on the research results
- Attending international meetings to present research results
- Collaborate with colleagues internationally
- Work independently when required
- Plan and manage own research activity in collaboration with others.

There may be opportunities for the applicant to be involved in either teaching or supervision related activities as appropriate and in agreement with the line manager.

Person Specification

Essential:

- Have, or be about to obtain, a PhD in a relevant area
- Excellent knowledge in first-order Logic
- Good knowledge of SMT solving or decision procedures for various data types
- Ability and willingness to work with applications, such as program analysis and verification
- Excellent communication and interpersonal skills
- Ability to work independently and as part of a team
- Ability to present in both written and oral publications

Desirable:

- Implementation experience within the context of first-order theorem proving or SMT solving
- Experience working with tools for program analysis or verification