University of Oxford Department of Computer Science

Job description and selection criteria

Job title	Research Assistant on Unifying Theories of Generic Programming
Division	MPLS
Department	Computer Science
Location	Wolfson Building, Parks Road, Oxford.
Grade and salary	Grade 7: Salary £30,434 – £37,394 p.a.
Hours	Full Time
Contract type	Fixed term for 6 months
Reporting to	Dr. Ralf Hinze
Additional information	This vacancy is for internal applicants only

Introduction

The University

The University of Oxford is a complex and stimulating organisation, which enjoys an international reputation as a world-class centre of excellence in research and teaching. It employs over 10,000 staff and has a student population of over 22,000.

Most staff are directly appointed and managed by one of the University's 130 departments or other units within a highly devolved operational structure - this includes over 6,500 'academic-related' staff (postgraduate research, computing, senior library, and administrative staff) and over 2,700 'support' staff (including clerical, library, technical, and manual staff). There are also over 1,600 academic staff (professors, readers, lecturers), whose appointments are in the main overseen by a combination of broader divisional and local faculty board/departmental structures. Academics are generally all also employed by one of the 38 constituent colleges of the University as well as by the central University itself.

Our annual income in 2012/13 was £1,086.9m. Oxford is one of Europe's most innovative and entrepreneurial universities: income from external research contracts exceeds £436.8m p.a., and more than 80 spin-off companies have been created.

For more information please visit www.ox.ac.uk/staff/about_the_university.html

MPLS Division

The Mathematical, Physical, and Life Sciences Division (MPLS) is one of the four academic divisions of the University.

Oxford is widely recognised as one of the world's leading science universities. In the 2008 UK Research Assessment Exercise over 70% of research activity in MPLS was judged to be world-leading (4*) or internationally excellent (3*), and Oxford was ranked first in the UK across the mathematical sciences as a whole.

The MPLS division's ten departments and three interdisciplinary units span the full spectrum of the mathematical, computational, physical, engineering and life sciences, and undertake both fundamental research and cutting-edge applied work. We have over 6,000 students and research staff, and generate over half of our funding from external research grants. Our research addresses major societal and technological challenges and is increasingly interdisciplinary in nature. We collaborate closely with colleagues in Oxford across the medical sciences, social sciences and humanities, as well as with researchers from around the world.

For more information, please visit:

http://www.mpls.ox.ac.uk/

Department of Computer Science

The Department of Computer Science was established in 1957, making it one of the longest-established Computer Science departments in the country. It is one of the UK's leading Computer Science Departments (ranked first in a number of international rankings). The Research Excellence Framework (REF) in December 2014 resulted in 74 members of the Department having 53% of their research activity ranked in the top category of 4* (world-leading). Overall, we received an average of 3.34 across the department (3* being internationally excellent). A significant majority of the Department are active in externally sponsored research, with both government and industrial funding. At present there are 69 members of academic staff and almost 100 research staff.

The Department has close links with government, industry, and other departments within the University. Among the latter are Mathematics, Engineering, Physics, Statistics and a number of life sciences departments. The Department is housed across multiple sites within the University's South Parks Road Science area, facilitating strong collaborative links with research groups and institutes in closely allied areas (including the Oxford Internet Institute and the Oxford e-Research Centre). This is an essentially inter-disciplinary activity which is at present attracting major funding from a number of sources. At present the Department holds over £50m in external research contracts.

Research in the Department is currently managed in seven themes:

- *Programming Languages and Software Engineering* (led by Professor Jeremy Gibbons, and including Professor Jim Davies) works on a wide variety of areas including model-driven development, functional programming, and static analysis;
- *Security* (led by Professor Bill Roscoe) specialises in cybersecurity (Professor Sadie Creese leads a new Cybersecurity Centre), protocol analysis, trusted computing, networking, and human-centred computing;

- *Automated Verification* (led by Professor Marta Kwiatkowska) covers probabilistic and software model checking (Professor Daniel Kroening), time and concurrency (Professor Joel Ouaknine, Professor James Worrell, and Professors Roscoe and Lowe), and hardware (Professor Tom Melham);
- *Computational Biology* (led by Professor David Gavaghan, and including Professors Kevin Burrage, Helen Byrne, and Blanca Rodriguez) is one of the world's leading groups building computational models of biological systems, and is particularly well-known for its work on the heart;
- *Foundations, Logic and Structures*, (leader Professor Samson Abramsky) which includes groups working on quantum information and computation (Professors Samson Abramsky and Bob Coecke), game semantics and verification (Professor Luke Ong), and constraints (Professor Peter Jeavons);
- *Information Systems* (led by Professor Ian Horrocks, and including Professors Michael Benedikt, Nando de Freitas, Boris Motik, Georg Gottlob, and Michael Wooldridge) has groups working on databases, knowledge representation and reasoning, multi-agent systems, and computational linguistics (Professor Stephen Pulman);
- *Algorithms* (led by Professor Leslie Ann Goldberg, and including Professors Paul Goldberg and Elias Koutsoupias) covering computational complexity, algorithmic game theory, and constraint satisfaction.

For more information please visit: http://www.cs.ox.ac.uk/

Summary of the University's Equal Opportunities Policy

The policy and practice of the University of Oxford require that all staff are afforded equal opportunities within employment. Entry into employment with the University and progression within employment will be determined only by personal merit and the application of criteria which are related to the duties of each particular post and the relevant salary structure. In all cases, ability to perform the job will be the primary consideration. Subject to statutory provisions, no applicant or member of staff will be treated less favourably than another because of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

Job description

Research topic	Unifying Theories of Generic Programming
Principal Investigator / supervisor	Dr. Ralf Hinze
Funding partner	EPSRC

Generic programming (GP) is a technique that exploits the inherent structure that exists in data, where this structure can be used to automatically produce efficient and flexible algorithms that can be adapted to suit different needs. Furthermore, generic programs ensure that the structure of the data itself plays a central role in maintaining the correctness of these algorithms.

This project centres on datatype-generic programming (DGP), which exploits the rich type system of purely functional languages like Haskell to express the parametrisation of programs by datatypes. The last two decades have witnessed a number of approaches to DGP, differing in convenience, expressiveness and efficiency. The work on theoretical

approaches can be split into roughly two overlapping periods: the first was sparked by the Algebra of Programming, which concentrates on an algebraic approach to programming using concepts from category theory, and the second might be characterised by the use Generic Haskell where the simply-typed lambda calculus is used to represent Haskell's rich types.

The aim of this project is to build upon previous work in this field and significantly advance the state of the art of generic programming and thus programming in general, with the following objectives:

- *Theory*— generalising and unifying the two major approaches to GP;
- *Specification*— exploring novel approaches for the specification of generic programs;
- *Reasoning* — providing the infrastructure for reasoning about generic programs, concisely and precisely;
- *Application*— demonstrating that GP has far-reaching and important applications.

The vision of this project is to develop a unifying theory of generic programming to inform the design of future programming languages, by bringing together the advantages of previous work into a coherent whole.

Overview of the role

Responsibilities/duties

- Undertake research in the field of Generic Programming
- Create libraries that demonstrate the use of Generic Programming
- Manage own academic research and administrative activities. This involves small-scale project management in order to co-ordinate multiple aspects of work to meet deadlines.
- Collaborate in the preparation of research papers for publication in the scientific literature.
- Adapt existing and develop new scientific techniques.
- Test hypotheses and analyse scientific data from a variety of sources, reviewing and refining working hypotheses as appropriate.
- Develop ideas for generating research income, presenting detailed research proposals to senior researchers.
- Present papers at conferences or public meetings.
- Act as a source of information and advice to other members of the group on scientific procedures and experimental techniques.
- Participation in regular meetings with colleagues in Oxford and elsewhere
- Help with the organisation of seminars and workshops
- Assistance in the supervision of post-graduate students working on related projects.
- The postholder will have the opportunity to teach. This may include lecturing, small-group teaching, and tutoring of undergraduates and graduate students.
- The postholder will carry out any other duties as are within the scope, spirit and purpose of the job as requested by their line manager or the Principal Investigators.

Selection Criteria

Essential:

- A PhD (or very close to completion) in Computer Science or a related subject
- A documented track record of the ability to conduct and complete research projects, as witnessed by published peer-reviewed work (according to the experience of the candidate)
- A strong background in functional programming
- A strong background in generic programming
- Ability to manage own academic research and associated activities
- Ability to contribute ideas for new research projects and research income generation
- Good team-working skills
- Excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings.

Desirable:

- A good knowledge of datatype-generic programming
- Experience of using either Agda or Coq
- A good knowledge of category theory
- Experience of independently managing a discrete area of a research project
- Experience of actively collaborating in the development of research articles for publication

Working at the University of Oxford

For further information about working at Oxford, please see:

http://www.ox.ac.uk/about_the_university/jobs/research/

Salary and Benefits

The post, which is a full time appointment, is funded by EPSRC and is available for up to 6 months, has a salary on the University grade 07S scale (currently £30,434 - £37,394 p.a.). This includes membership of the University Superannuation Scheme (USS) and has an annual leave entitlement of 38 days per year (inclusive of all public holidays and university closed periods).

How to apply

If you consider that you meet the selection criteria, click on the **Apply Now** button on the 'Job Details' page and follow the on-screen instructions to register as a user. You will then be required to complete a number of screens with your application details, relating to your skills and experience. When prompted, please provide details of two referees and indicate whether we can contact them at this stage. You will also be required to upload a CV and supporting statement. The supporting statement should describe what you have been doing over at least the last 10 years. This may have been employment, education, or you may have taken time away from these activities in order to raise a family, care for a dependant, or travel for example. Your application will be judged solely on the basis of how you demonstrate that that you meet the selection criteria outlined above and we are happy to

consider evidence of transferable skills or experience which you may have gained outside the context of paid employment or education.

Please save all uploaded documents to show your name and the document type.

All applications must be received by **midday** on the closing date stated in the online advertisement.