University of Oxford Department of Computer Science

Job description and selection criteria

Job title	Senior Research Associate on FUN2MODEL: From FUNction-based TO MOdel-based automated probabilistic reasoning for DEep Learning
Division	MPLS
Department	Computer Science
Location	Wolfson Building, Parks Road, Oxford.
Grade and salary	Grade 8: Salary £40,792 – £48,677 p.a.
Hours	Full Time
Contract type	Fixed term for 3 years from 1st October 2019, with the possibility of extension
Reporting to	Professor Marta Kwiatkowska
Vacancy reference	141120
Additional information	Whilst the role is a grade 8 position, we would be willing to consider candidates with potential but less experience who are seeking a development opportunity, for which an initial appointment would be at grade 7 (Grade 7: £32,236 - £39,609 p.a.) with the responsibilities adjusted accordingly. This would be discussed with applicants at interview/appointment where appropriate.

The FUN2MODEL project

The Department of Computer Science, University of Oxford, is currently looking for outstanding candidates to fill three postdoctoral research positions, one of which is at a senior level, available from 1st October 2019 or as soon as possible thereafter on the five-year ERC Advanced Grant FUN2MODEL "From FUNction-based TO MOdel-based automated probabilistic reasoning for DEep Learning" (fun2model.org) led by Professor Marta Kwiatkowska, with Dr Dave Parker as an external collaborator. Two additional doctoral positions are also available.

The FUN2MODEL project aims to make advances towards provably robust 'strong' Artificial Intelligence. In contrast to 'narrow' AI perception tasks realised by deep learning, which are limited to learning data associations, and sometimes referred to as function-based, 'strong' AI aims to match human intelligence and requires model-based reasoning about causality and 'what if' scenarios, incorporation of cognitive aspects such as beliefs and goals, and probabilistic reasoning frameworks that combine logic with statistical machine learning.

The objectives of FUN2MODEL are to develop novel probabilistic verification and synthesis techniques to guarantee safety, robustness and fairness for complex decisions based on machine learning; formulate a comprehensive, compositional game-based modelling framework for reasoning about systems of autonomous agents and their interactions, capturing data inference, cognitive reasoning and affective aspects; and evaluate the techniques on a variety of case studies with the goal to ensure provably robust and beneficial multi-agent collaborations.

ERC (European Research Council) Advanced Grants provide long-term funding for exceptional leaders to pursue ground-breaking, high-risk projects, that have the potential to make a difference in people's everyday life and deliver solutions to some of our most urgent challenges.

The role

The post holder will be a senior member of the FUN2MODEL project team and will be expected to provide overall leadership for the development of probabilistic verification and synthesis methods, including software implementation and PRISM extensions; to integrate techniques developed by other members of the team; and to liaise with Dave Parker to coordinate PRISM development.

The main responsibility of the advertised post is to contribute to the FUN2MODEL project objectives as described above, with emphasis on data-centric modelling, coordination and reasoning for autonomous multi-agent systems, capturing cognitive and affective aspects. This includes causal reasoning based on Bayesian networks; game-theoretic methods and algorithmic schemes for coordination and collaboration; formalisation of provably robust and beneficial collaboration; extensions of PRISM modelling language and software; and relevant case studies.

The post holder will join an internationally leading research group of Professor Marta Kwiatkowska, who has an extensive track record in probabilistic verification and pioneering research on safety verification for neural networks and trust in human-robot collaborations. The group has presented their work at leading conferences in concurrency, verification, AI, and robotics (notably CAV, CONCUR, TACAS, IJCAI, AAAI and ICRA), with Professor Kwiatkowska receiving multiple keynote invitations and winning prestigious awards and fellowships. The post holder will have responsibility for: carrying out research as outlined above; collaborating with Professor Kwiatkowska and other members of the team; and

assisting with management of the project and project reporting, as required. The post holder will also have an opportunity to engage in teaching, to co-supervise PhD students associated with FUN2MODEL, and to provide guidance to junior members of the research group, including PhD and MSc students.

More information about Professor Kwiatkowska's research and PRISM model checker can be found here:

http://www.cs.ox.ac.uk/marta.kwiatkowska/
https://royalsociety.org/science-events-and-lectures/2018/11/milner-lecture/
https://www.prismmodelchecker.org/

Research topic	Data-centric modelling, coordination and reasoning for autonomous multi-agent systems, capturing cognitive and affective aspects
Principal Investigator / supervisor	Professor Marta Kwiatkowska
Funding partner	European Research Council

The division of responsibilities between the three research posts may be adapted following interview depending on the qualifications and experience of the candidates.

For further information about the project or for informal discussions about suitability, please contact Marta Kwiatkowska (marta.kwiatkowska@cs.ox.ac.uk).

Responsibilities

- Provide leadership in the relevant research aspects of the project, developing research questions within a specific context, conducting individual research, analysing detailed and complex qualitative and/or quantitative data from a variety of sources, generating original ideas, and co-ordinating multiple aspects of work to meet deadlines.
- Develop, establish and pursue appropriate scientific techniques, research methodologies and experimental protocols.
- Initiate publication of research results in top ranking journals and leading conferences. Regularly write research articles for high impact peer-reviewed journals, book chapters, and reviews. Present papers at international and national conferences, and lead seminars to disseminate research findings.
- Develop software in the area of probabilistic verification/synthesis, safety/robustness guarantees for neural networks, autonomous multi-agent systems, symbolic AI and model checking methods (SAT, SMT) and/or game-theoretic techniques.
- Assist with management of the project and project reporting, as required, including organising project meetings and workshops.
- Agree clear task objectives, organise, and delegate work to other members of the project team and coach other members of the project on specialist methodologies or procedures, as necessary.
- Raise research funds through grant applications, and manage own area of a larger research budget.

- Share responsibility for shaping the research group's plans and the writing of group-funding applications for new research projects.
- Liaise with funding bodies and provide information to project stakeholders and represent the project and/or research group at external meetings/seminars, either with other members of the team or alone.
- Carry out collaborative projects with team/group members and other research groups.
- Act as a source of information and advice to other members of the group on scientific protocols and experimental techniques.
- Represent the project and/or research group at project meetings and external meetings/seminars, either with other members of the group or alone.
- Assist in the supervision of postdoctoral researchers and post-graduate students working on related projects.
- Member of departmental committees advising on scientific and management matters for the department.
- The post holder may have the opportunity to teach. This may include lecturing, small-group teaching, and tutoring of undergraduates and graduate students.
- The post holder 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.

Pre-employment screening

All offers of employment are made subject to standard pre-employment screening, as applicable to the post.

If you are offered the post, you will be asked to provide proof of your right-to-work, your identity, and we will contact the referees you have nominated. You will also be asked to complete a health declaration (so that you can tell us about any health conditions or disabilities so that we can discuss appropriate adjustments with you), and a declaration of any unspent criminal convictions.

We advise all applicants to read the candidate notes on the University's pre-employment screening procedures, found at: www.ox.ac.uk/about/jobs/preemploymentscreening/.

Hazard-specific / Safety-critical duties [delete if not appropriate] See: www.admin.ox.ac.uk/personnel/recruit/preempcheck/compulsorychecks/medical

This job includes the following hazards or safety-critical activities which will require successful pre-employment health screening through our Occupational Health Service before the successful candidate will be allowed to start work:

- Lone Working
- Driving on University business
- Travel outside of Europe or North America on University Business

Selection Criteria

Essential

- Hold a PhD in computer science, mathematics or related discipline and post-qualification research experience.
- An excellent 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).
- Possess sufficient specialist knowledge of and demonstrable experience of: foundations of machine learning or statistics, probabilistic modelling/verification, and concurrency/multi-agent systems.

- Proven experience of software development in relevant areas, such as verification and symbolic AI (SAT, SMT, etc), statistical inference or statistical model checking, numerical methods, constraint solving and optimisation.
- Proven ability to raise research funds through making grant applications.
- Ability to independently plan and manage a research project, including a research budget.
- Excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings.

Desirable

- Knowledge of neural networks and Bayesian methods.
- Familiarity with human-robot interaction.
- Experience of project management and supervising staff.
- Experience of managing a research budget.
- Experience of making grant applications.

About the University of Oxford

Welcome to the University of Oxford. We aim to lead the world in research and education for the benefit of society both in the UK and globally. Oxford's researchers engage with academic, commercial and cultural partners across the world to stimulate high-quality research and enable innovation through a broad range of social, policy and economic impacts.

We believe our strengths lie both in empowering individuals and teams to address fundamental questions of global significance, while providing all our staff with a welcoming and inclusive workplace that enables everyone to develop and do their best work. Recognising that diversity is our strength, vital for innovation and creativity, we aspire to build a truly diverse community which values and respects every individual's unique contribution.

While we have long traditions of scholarship, we are also forward-looking, creative and cutting-edge. Oxford is one of Europe's most entrepreneurial universities. Income from external research contracts in 2016/17 exceeded £564m and we rank first in the UK for university spin-outs, with more than 130 companies created to date. We are also recognised as leaders in support for social enterprise.

Join us and you will find a unique, democratic and international community, a great range of staff benefits and access to a vibrant array of cultural activities in the beautiful city of Oxford.

For more information please visit www.ox.ac.uk/about/organisation

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 UK 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 ten themes:

- *Algorithms & Complexity Theory* focusses on determining the inherent difficulty of computational problems, classifying problems according to this inherent difficulty, and designing and analysing algorithms that use computational resources as efficiently as possible;
- *Artificial Intelligence & Machine Learning* focuses on theoretical foundations, multiagent systems, deep learning and computational linguistics;
- *Automated Verification* investigates theory and practice of formal verification and correct-by-construction synthesis for software and hardware systems;
- *Computational Biology & Health Informatics* is concerned with computational approaches for biomedical research and healthcare innovation;
- *Cyber-Physical Systems* is focusing on intelligent and autonomous sensor systems with applications in positioning, healthcare, environmental monitoring and smart cities;
- *Foundations, Structures and Quantum* embraces interdisciplinary research, and has a particular interest in structural foundations of quantum computation;
- *Human-Centred Computing* covers human-computer interaction, social computing and world-wide web;
- *Information Systems* covers databases, knowledge representation and reasoning;
- *Programming Languages* covers functional programming, program analysis, and programming language foundations;
- *Security* specialises in cybersecurity, protocol analysis, systems security, trusted computing, human-centred security, and networking.

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

The Mathematical, Physical, and Life Sciences Division (MPLS)

The Mathematical, Physical, and Life Sciences (MPLS) Division is one of the four academic divisions of the University. Oxford is widely recognised as one of the world's leading science universities. The disciplines within the MPLS Division regularly appear at the highest levels in world rankings. In the results of the six-yearly UK-wide assessment of university research, REF2014, the MPLS division received the highest overall grade point average (GPA) and the highest GPA for outputs. We received the highest proportion of 4* outputs, and the highest proportion of 4* activity overall. More than 50 per cent of MPLS activity was assessed as world leading.

The MPLS Division's 10 departments and 3 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. Our research addresses major societal and technological challenges and is increasingly focused on key interdisciplinary issues. We collaborate closely with colleagues in Oxford across the medical sciences, social sciences and humanities, and with other universities, research organisations and industrial partners across the globe in pursuit of innovative research geared to address critical and fundamental scientific questions.

MPLS is proud to be the home of some of the most creative and innovative scientific thinkers and leaders working in academe. Our senior researchers have been awarded some of the most significant scientific honours (including Nobel prizes and prestigious titles such as FRS and FR.Eng) and we have a strong tradition of attracting and nurturing the very best early career researchers who regularly secure prestigious fellowships. The Division is also the proud holder of eight Athena Swan Awards (4 Silver and 4 Bronze) illustrating our commitment to ensure good practice and to encourage women in science at all levels in the division.

We have around 6,000 students and play a major role in training the next generation of leading scientists. Oxford's international reputation for excellence in teaching is reflected in its position at the top of the major league tables and subject assessments. MPLS academics educate students of high academic merit and potential from all over the world. Through a mixture of lectures, practical work and the distinctive college tutorial system, students develop their ability to solve major mathematical, scientific and engineering problems.

MPLS is dedicated to bringing the wonder and potential of science to the attention of audiences far beyond the world of academia. We have a strong commitment to supporting public engagement in science through initiatives including the Oxford Sparks portal (http://www.oxfordsparks.net/) and a large variety of outreach activities; these are crucial activities given so many societal and technological issues demand an understanding of the science that underpins them. We also endeavour to bring the potential of our scientific efforts forward for practical and beneficial application to the real world and our desire is to link our best scientific minds with industry and public policy makers.

For more information about the MPLS division, please visit: http://www.mpls.ox.ac.uk/

How to apply

Before submitting an application, you may find it helpful to read the 'Tips on applying for a job at the University of Oxford' document, at www.ox.ac.uk/about/jobs/supportandtechnical/.

If you would like to apply, click on the **Apply Now** button on the 'Job Details' page and follow the on-screen instructions to register as a new user or log-in if you have applied previously. Please provide details of two referees and indicate whether we can contact them now.

You will also be asked to upload a CV and a supporting statement. The supporting statement must describe how you would contribute to the project and explain how you meet each of the selection criteria for the post using examples of your skills and experience. This may include experience gained in employment, education, or during career breaks (such as time out to care for dependants). *If you are using the application form with inbuilt supporting statement there is no facility for applicants to attach documents so this paragraph should be removed.*

Your application will be judged solely on the basis of how you demonstrate that you meet the selection criteria stated in the job description.

Please upload all documents **as PDF files** with your name and the document type in the filename. (*Customise this statement to confirm the document(s) you would like the applicant to attach, but make sure that you keep the reference to PDF. See section 1.4 of QRG REC01 Creating a Vacancy (Recruitment and Personnel) for guidance on selecting the appropriate application form).*

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

Information for priority candidates

A priority candidate is a University employee who is seeking redeployment because they have been advised that they are at risk of redundancy, or on grounds of ill-health/disability. Priority candidates are issued with a redeployment letter by their employing department(s).

If you are a priority candidate, please ensure that you attach your redeployment letter to your application (or email it to the contact address on the advert if the application form used for the vacancy does not allow attachments).

Should you experience any difficulties using the online application system, please email recruitment.support@admin.ox.ac.uk. Further help and support is available from www.ox.ac.uk/about_the_university/jobs/support/. To return to the online application at any stage, please go to: www.recruit.ox.ac.uk.

Please note that you will receive an automated email from our e-recruitment system to confirm receipt of your application. **Please check your spam/junk mail** if you do not receive this email.

Important information for candidates

Data Privacy

Please note that any personal data submitted to the University as part of the job application process will be processed in accordance with the GDPR and related UK data protection legislation. For further information, please see the University's Privacy Notice for Job Applicants at: www.admin.ox.ac.uk/councilsec/compliance/gdpr/privacynotices/job/. The University's Policy on Data Protection is available at: www.admin.ox.ac.uk/councilsec/compliance/gdpr/universitypolicyondataprotection/.

The University's policy on retirement

The University operates an Employer Justified Retirement Age (EJRA) for all academic posts and some academic-related posts. The University has adopted an EJRA of 30 September before the 69th birthday for all academic and academic-related staff in posts at **grade 8 and above**. The justification for this is explained at: www.admin.ox.ac.uk/personnel/end/retirement/acrelretire8+/.

For **existing** employees, any employment beyond the retirement age is subject to approval through the procedures: www.admin.ox.ac.uk/personnel/end/retirement/acrelretire8+/.

There is no normal or fixed age at which staff in posts at **grades 1–7** have to retire. Staff at these grades may elect to retire in accordance with the rules of the applicable pension scheme, as may be amended from time to time.

Equality of Opportunity

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. No applicant or member of staff shall be discriminated against because of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

Benefits of working at the University

Employee benefits

University employees enjoy 38 days' paid holiday, generous pension schemes, travel discounts, and a variety of professional development opportunities. Our range of other employee benefits and discounts also includes free entry to the Botanic Gardens and University colleges, and discounts at University museums. See www.admin.ox.ac.uk/personnel/staffinfo/benefits.

University Club and sports facilities

Membership of the University Club is free for all University staff. The University Club offers social, sporting, and hospitality facilities. Staff can also use the University Sports Centre on Iffley Road at discounted rates, including a fitness centre, powerlifting room, and swimming pool. See www.club.ox.ac.uk and www.sport.ox.ac.uk/oxford-university-sports-facilities.

Information for staff new to Oxford

If you are relocating to Oxfordshire from overseas or elsewhere in the UK, the University's Welcome Service website includes practical information about settling in the area, including advice on relocation, accommodation, and local schools. See www.welcome.ox.ac.uk.
There is also a visa loan scheme to cover the costs of UK visa applications for staff and their dependents. See www.admin.ox.ac.uk/personnel/permits/reimburse&loanscheme/.

Family-friendly benefits

With one of the most generous family leave schemes in the Higher Education sector, and a range of flexible working options, Oxford aims to be a family-friendly employer. We also subscribe to My Family Care, a service that provides practical advice and support for employees who have caring responsibilities. The service offers a free telephone advice line, and the ability to book emergency back-up care for children, adult dependents and elderly relatives. See www.admin.ox.ac.uk/personnel/staffinfo/benefits/family/mfc/.

Childcare

The University has excellent childcare services, including five University nurseries as well as University-supported places at many other private nurseries.
For full details, including how to apply and the costs, see www.admin.ox.ac.uk/childcare/.

Disabled staff

We are committed to supporting members of staff with disabilities or long-term health conditions. For further details, including information about how to make contact, in confidence, with the University's Staff Disability Advisor, see www.admin.ox.ac.uk/eop/disab/staff.

Staff networks

The University has a number of staff networks including the Oxford Research Staff Society, BME staff network, LGBT+ staff network and a disabled staff network. You can find more information at www.admin.ox.ac.uk/eop/inpractice/networks/.

The University of Oxford Newcomers' Club

The University of Oxford Newcomers' Club is an organisation run by volunteers that aims to assist the partners of new staff settle into Oxford, and provides them with an opportunity to meet people and make connections in the local area. See www.newcomers.ox.ac.uk.