Job description and selection criteria

Job title	Senior Research Associate on New Approaches to Approximability of Satisfiable Problems
Division	MPLS
Department	Computer Science
Location	Wolfson Building, Parks Road, Oxford.
Grade and salary	Grade 8: £45,585 - £54,395 p.a. with the potential to under-fill at Grade 7 with salaries in the range of £36,024 - £44,263 p.a.
Hours	Full Time (flexible options can be considered)
Contract type	Fixed term contract until 31 December 2025 with a start date of 1 January 2024
Reporting to	Professor Standa Zivny
Vacancy reference	166191
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 (£36,024 - £44,263 p.a.) with the responsibilities adjusted accordingly. This would be discussed with applicants at interview/appointment where appropriate.

The role

Constraint satisfaction problems (CSPs) have driven some of the most influential developments in theoretical computer science, from NP-completeness to the PCP theorem to semidefinite programming algorithms to the Unique Games Conjecture. The mathematical structure of tractable decision CSPs, as well as exactly solvable and approximable Max-CSPs, is now known to be linked to certain forms of higher-order symmetries of solution spaces. While the Unique Games Conjecture has been extremely influential in sharpening our understanding of inapproximability of CSPs, much less is known about approximability of problems that are *satisfiable*.

This post is concerned with approximability of satisfiable CSPs. A classic example is the approximate graph colouring problem, whose complexity is still open despite sustained effort

since the 1970s. A very recent line of work on *promise* CSPs proposed a framework for studying such problems under one umbrella and initiated the first steps.

The goal of this project is to unleash the full power of the new framework: to develop novel approaches for proving hardness, to devise new algorithmic paradigms, and to attack major open problems, such as the graph colouring problem.

Research topic	New Approaches to Approximability of Satisfiable Problems
Principal Investigator / supervisor	Professor Standa Zivny
Funding partner	University of Oxford

Responsibilities

The post holder will work with the Principal Investigator, Professor Standa Zivny to investigate one or more of the following:

- algorithms for and computational complexity of CSPs;
- categorial and topological approaches for CSPs;
- convex relaxations for CSPs;
- algorithms for edge CSPs and graph factor problems (generalisations of maximum (weighted) matchings).

The post holder will be expected to:

- Develop research questions within a specific context, conduct individual research, analysing detailed and complex qualitative and/or quantitative data from a variety of sources, and generate original ideas by building on existing concepts.
- Regularly write research articles at a national level for peer-reviewed journals, book chapters, and reviews. Present papers at national conferences, and lead seminars to disseminate research findings.
- Agree clear task objectives, organise, and delegate work to other members of the team and coach other members of the group on specialist methodologies or procedures.
- 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.
- Assistance in the supervision of post-graduate students working on related projects.
- The postholder may 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

- Hold a PhD/Dhil in Computer Science or related mathematical discipline, with a first degree in Computer Science or a related mathematical discipline
- Strong publication record and familiarity with the existing literature and research in the field as witnessed by published peer-reviewed work (according to the experience of the candidate) in the area of algorithms, complexity, constraint satisfaction, optimisation, mathematics, or a related area
- Excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings.
- Ability to contribute ideas for new research projects
- Knowledge of computational complexity and mathematics relevant to the study of constraint satisfaction.

Desirable

- Postdoctoral research experience;
- Experience of working in collaborative or interdisciplinary environments;
- Expertise in one or more of the following:
    - computational complexity;
    - linear programming relaxations;
    - semidefinite programming relaxations;
    - algebraic methods in constraint satisfaction;
    - topological methods in combinatorics / constraint satisfaction.

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). Our Computer Science and Informatics submission to the UK Research Excellence Framework (REF) in December 2021 resulted in 81% of research activity ranked as 4* (world-leading) and the rest ranked as 3* (internationally excellent). A significant majority of the Department are active in externally sponsored research, with both government and industrial funding. At present, there are 73 members of academic staff and 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 life sciences. 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). At present, the Department holds over £50m in external research contracts.

Research in the Department is currently managed in ten themes:

- *Algorithms & Complexity Theory, led by Professor Leslie Ann Goldberg,* 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, led by Professor Michael Wooldridge,* focuses on theoretical foundations of AI, multiagent systems, deep learning, reinforcement learning ,and computational linguistics;
- *Automated Verification, led by Professor Marta Kwiatkowska,* investigates theory and practice of formal verification and correct-by-construction synthesis for software and hardware systems;
- *Computational Biology & Health Informatics, led by Professor Blanca Rodriquez ,* is concerned with computational approaches for biomedical research and healthcare innovation;
- *Human-Centred Computing, led by Professor Nigel Shadbolt,* includes human-computer interaction, social computing, and the worldwide web;
- *Data and Knowledge, led by Professor Ian Horrocks,* includes databases, knowledge representation and reasoning;
- *Programming Languages, led by Professor Sam Staton,* includes functional programming, program analysis, and programming language foundations;
- *Quantum, led by Professor Jonathan Barrett,* focusses on quantum computing including quantum software, causality in quantum theory, quantum cryptography and foundations of quantum computing;
- *Security, led by Professor Ivan Martinovic,* specialises in cybersecurity, protocol analysis, systems security, trusted computing, and networking.
- *Systems, led by Professor Niki Trigoni,* focusses especially on cyber physical systems. We plan to substantially broaden our research in systems to complement our existing research areas.

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 should explain how you meet 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).

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.

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 departments.

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 be notified of the progress of your application by automatic emails from our e-recruitment system. **Please check your spam/junk mail** regularly to ensure that you receive all emails.

Important information for candidates

Pre-employment screening

Please note that the appointment of the successful candidate will be subject to standard pre-employment screening, as applicable to the post. This will include right-to-work, proof of identity and references. 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/.

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. From 1 October 2017, 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

University Club and sports facilities

Membership of the University Club is free for all University staff. The University Club provides 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 international staff

The University offers support and advice to international staff, including 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/.

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.

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 to settle into Oxford and to provide them with an opportunity to meet people in the area. See www.newcomers.ox.ac.uk.

Childcare

The University has excellent childcare services with 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.

Family-friendly benefits

The University subscribes to My Family Care service through which staff are eligible to register for emergency back-up childcare and adultcare services, a 'speak to an expert' advice service and a wide range of guides and webinars through a website called the Work+Family space.
See: www.admin.ox.ac.uk/personnel/staffinfo/benefits/family/mfc/.

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/.

Additional benefits

Staff can enjoy a range of other benefits and discounts, including free entry to the Botanic Gardens and University colleges, and discounts at University museums.
See www.admin.ox.ac.uk/personnel/staffinfo/benefits.