



MATHEMATICAL INSTITUTE
ANDREW WILES BUILDING

Job Description and Selection Criteria

Job title	Postdoctoral Research Associate in Rough Path Theory for Applications (up to 3 posts)
Division	Mathematical, Physical and Life Sciences
Department	Mathematical Institute Oxford
Location	Mathematical Institute, Andrew Wiles Building, Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG. And our London Hub*
Grade and salary	Grade 7: £41,636 - £47,779 per annum
Hours	Full time. The successful candidates are expected to spend at least 50% of their time in the Department of Mathematics in Oxford and one or two days a week at The Alan Turing Institute in London or Imperial-X (in particular, to attend the liaison meetings of the team).
Contract type	Fixed-term (24 months/2 years)
Reporting to	Terry Lyons, Sam Morley and Blanka Horvath
Vacancy reference	188754



Additional information	These are full-time positions that cannot be held concurrently with any other substantive post without the explicit permission of the Head of Department. These positions are subject to 12-month probationary periods. These posts are funded by the Engineering and Physical Sciences Research Council (EPSRC) as part of the Programme Grant '<i>High order mathematical and computational infrastructure for streamed data that enhance contemporary generative and large language models</i>' (DataSig II) (PLEASE NOTE: Applicants are responsible for contacting two of their referees and making sure that their letters are sent to references@maths.ox.ac.uk by the closing date.)
Research topic	DataSig II
Principal Investigator / supervisor	Terry Lyons
Project team	Thomas Cass (Imperial), Hao Ni (UCL), Blanka Horvath (Oxford) and Sam Morley (Oxford)
Project web site	https://datasig.ac.uk/
Funding partner	The funds supporting this research project are provided by Engineering and Physical Sciences Research Council
Recent publications	See www.datasig.ac.uk/papers for more preprints and publications.

The role

Applications are invited for up to two Postdoctoral Research Associates at the Mathematical Institute, University of Oxford. The positions are funded by the EPSRC as part of the Programme Grant *High order mathematical and computational infrastructure for streamed data that enhance contemporary generative and large language models* (DataSig II – see <http://www.datasig.ac.uk>) and will be part of this multi-university research group (Imperial College London, University College London, and the University of Oxford), with a hub in London currently located at The Alan Turing Institute.

Through collaboration between leading mathematicians and domain scientists, the Programme is redefining how streamed data is modelled and processed, creating a powerful and generic set of mathematical and computational tools for the analysis of complex multimodal data streams, it is a sign of its viga that these positions in part replace our PDRA Ben Walker https://scholar.google.com/citations?user=VXkZ_h4AAAAJ&hl=en who recently secured €3M of non-dilutive funding from SPRIND to form the start-up in this area.

A particular emphasis of this position is that the successful candidate is expected to work with the Oxford team members on mathematical and computational foundations to develop signature methods and rough path techniques in relation with Large Language Models and Generative AI. Building on advances in rough path theory and machine learning, the project seeks to develop next-generation stream-to-stream models, including controlled contextual differential equations (CCDEs) and signature-based transformers, to enable efficient, robust, and interpretable data analysis across a wide range of applications.

Key technical themes of the project include:

- **Abstracting Transformer and Structured State Space Models:** Developing novel architectures to handle continuous, rough, and non-uniformly sampled data streams; and the design of hybrid models combining transformer and SSS Models, the effect of changing calculation precision.
- **Enhanced Data Representation:** Creating efficient, low-dimensional representations of complex data for faster and more accurate learning
- **Anomaly Detection:** Designing scalable, representation-invariant methods for real-time detection of anomalies and outliers in data streams
- **Scalable Computation:** Extending high-performance tools such as RoughPy to enable GPU- and FPGA-accelerated processing of large-scale streamed data

Application domains include finance (e.g., risk modelling, synthetic data generation), cybersecurity (e.g., malware and anomaly detection), and digital content authentication.

It is anticipated that the postholders will make significant contributions to the mathematical foundations and play an active part in the wider development of the project, interacting creatively with the DataSig II team members. The project will involve working closely with the leadership team of the DataSig II Programme – the principal investigator, Terry Lyons FRS (Oxford), and the co-investigators, Thomas Cass (Imperial), Blanka Horváth (Oxford), Sam Morley (Oxford), and Hao Ni (UCL).

The successful candidates are expected to spend at least 50% of their time in the Department of Mathematics in Oxford and one or two days a week in London at our hub (in particular, to collaborate in meetings of the team); they will actively engage with the investigators and generally be enthusiastic and committed full-time postdoctoral researchers in the team. Travel costs to and from London will be covered by the grant.

We are seeking strong candidates with a solid mathematical background, excellent programming skills, and a proven track record in modern data science or machine learning. A background in mathematics, machine learning, generative AI, or related areas is essential. The successful candidates will be expected to contribute to the core technical themes of the project by developing novel algorithms, establishing rigorous theoretical foundations, and validating the proposed methodologies on large and complex real-world datasets.

Responsibilities

The successful candidate will be expected to:

- Actively support and work closely with the leadership team to achieve the objectives of the Programme.
- Manage own academic research and shared administrative tasks responsibly. This involves coordinating multiple aspects of one's work with other members of the team and meeting deadlines.

- Adapt existing research methodologies and develop new methods and materials with the objective of achieving international quality research outputs focused on the goals of the Programme.
- Prepare and challenge working theories through the analysis of qualitative and/or quantitative data from a variety of sources. Obtain empirical data where needed.
- Collaborate and contribute ideas for new research directions. Carry out collaborative projects with colleagues and partners of the DataSig II Programme.
- Develop ideas for generating research income and support the team in their collaborations and partnerships.
- Write and collaborate in the preparation of research publications, book chapters, computer code,... as appropriate.
- Identify opportunities, attend and present papers at national/international meetings and conferences.
- Present current research at internal seminars and help to create a vibrant research environment
- Act as a source of information and advice to other members of the group on methodologies or procedures.
- Represent DataSig II at external meetings.
- Monitor and report on their activities and assist in the preparation of any reports that DataSig II produces

It is the policy of the Mathematical Institute to give all PDRAs the opportunity to teach, where the conditions of the grant allow this, and to require teaching if there is a departmental need. Such teaching, if undertaken, will not exceed 3 hours per week for 24 weeks of the year and additional remuneration will be paid. It will normally be delivered as classes, but it might also involve giving lectures or college tutorials.

Selection criteria

Essential selection criteria

- To have, or be close to completing, a PhD (or equivalent) in Mathematics or a field related to the Programme
- Willingness and ability to work effectively with a team of researchers and across disciplines to contribute towards the Programme's aims and objectives.
- Demonstrate they can actively engage with and enhance the broader Programme team
- Clear evidence of outstanding promise and originality in research linked to the role and Programme, with a good publication record, commensurate with career stage
- Excellent written communication skills, including the ability to write clearly and succinctly for publication, present research proposals and results, and represent the research group at meetings
- Experience with contemporary computational software (PyTorch, JAX, etc.) and facilities (e.g. cluster computing and HPC)
- High-level innovative and analytical capability tied to the Programme objectives; especially to identify, develop and apply concepts, techniques and methods in these contexts
- Ability to exercise initiative and judgement in carrying out research tasks, to organise own work independently and prioritise work in response to deadlines
- Ability to keep accurate records of research results and activity

Desirable selection criteria

- Ability to assess resource requirements and deploy them effectively
- Willingness and ability to report and present work to a wider community

- Bringing diversity of approach to the Programme

Pre-employment screening

If you are offered the post, the offer will be subject to standard pre-employment checks. You will be asked to provide: proof of your right-to-work in the UK; proof of your identity; and (if we haven't done so already) 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 for which you may need us to make appropriate adjustments.

Please read the candidate notes on the University's pre-employment screening procedures at: <https://www.jobs.ox.ac.uk/pre-employment-checks>.

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 and we rank first in the UK for university spin-outs, and in recent years we have spun out 15-20 new companies every year. 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.

The Mathematical Institute

The Mathematical Institute, as Oxford's Department of Mathematics is known, is one of the leading mathematics departments in the world. Our mathematical research, impact and environment were all ranked first in the UK in the 2014 Research Excellence Framework exercise, a government review of research in all UK universities. The Mathematical Institute is the focus of research into both fundamental mathematics and its applications, and our inclusive nature and overall size are key factors in the provision of an outstanding research environment for our members. The large number of faculty, postdocs and students in the Mathematical Institute, all supported by excellent facilities, allows us to maintain a critical mass in research groups encompassing a wide spectrum of mathematics, while our integrated nature fosters collaboration between fields. We also host a large number of academic visitors. Our web pages (www.maths.ox.ac.uk) provide comprehensive information about all of our activities.

The research activities of the Institute as a whole can be gauged from the web pages of the research groups and centres within the Institute (www.maths.ox.ac.uk/research). The range of our research interests is well reflected by the profile of our faculty as listed at www.maths.ox.ac.uk/people. Many members of the Institute have received prestigious prizes and other special recognition for their work; some recent examples can be found at www.maths.ox.ac.uk/news/awards-and-prizes.

The Mathematical Institute moved into the purpose-built Andrew Wiles Building in the University's Radcliffe Observatory Quarter in September 2013. As well as providing offices for all staff and graduate students, it houses a range of other facilities available to members of the department, including the Whitehead Library, a large range of meeting rooms, teaching spaces, lecture rooms, and social spaces, and a small laboratory for carrying out table-top experiments. For more information, see www.maths.ox.ac.uk/about-us.

Teaching is central to the life of the Mathematical Institute and we have around 900 undergraduates on course, some on joint courses with other departments. We teach around 250 students each year across five taught master's degree courses, and have over 250 doctoral students in residence at any one time. Our doctoral programme always attracts the best research students from across the world, and we have a broad mentoring and training programme.

The Mathematical Institute strives to ensure that all staff and students are given the opportunities and support they need to achieve their potential. We are committed to equality of opportunities and to advancing women's careers. We support staff returning from long-term absence with teaching relief, offer flexible working arrangements, and the department sponsors University nursery places to support the priority allocation of childcare to our staff. Further information about family support can be found below under University Benefits, Terms and Conditions. Our [Equality, Diversity & Inclusion Committee](#)¹ contributes to many aspects of our work.

As part of the department's commitment to openness, inclusivity and transparency, we strongly encourage applications from all who consider they meet the requirements of the post, and particularly from women and ethnic minorities.

We have a number of family-friendly policies, such as the right to apply for flexible working, hybrid working, and support for staff returning from periods of extended absence.

For more information on the Mathematical Institute, please visit: www.maths.ox.ac.uk

The Mathematical Institute holds a silver Athena Swan award to recognise advancement of gender equality: representation, progression and success for all.

The Mathematical, Physical, and Life Sciences Division

The Mathematical, Physical, and Life Sciences (MPLS) Division is one of the four academic divisions of the University. 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. MPLS is proud to be the home of some of the most creative and innovative scientific thinkers and leaders working in academe. We have a

¹ The Mathematical Institute was a founding supporter of the London Mathematical Society's Good Practice Scheme (www.lms.ac.uk/women/good-practice-scheme). We have held an Athena SWAN Silver Award since 2016.

strong tradition of attracting and nurturing the very best early career researchers who regularly secure prestigious fellowships.

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 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. 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/>

* DataSig II meets at least weekly at it's London Hub, which is currently is in The Alan Turing Institute in the British Library

How to Apply

Applications are made through our online recruitment portal. Information about how to apply is available on our Jobs website <https://www.ox.ac.uk/about/jobs/explore-our-careers/applications-process/how-to-apply>.

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

You will also be required to upload the following:

- **A curriculum vitae**
- **A list of publications**
- **A statement of research interests**
- **A supporting statement**

The supporting statement must 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).

Please upload all documents **as PDF files** with your name and the document type in the filename, quoting vacancy reference **188754**.

Applicants are responsible for asking two of their referees to send their reference letters DIRECTLY to the HR Administrator email: references@maths.ox.ac.uk by the advertised closing date. Referees are asked to clearly state the applicant's name and vacancy ID: 188574. in the subject line of the email. Please note that only two references will be considered. Referees should preferably not all be from the same institution. Whenever possible one referee should be the applicant's current, or most recent, supervisor.

All applications must be received by **12.00 noon** UK time on **the advertised closing date for this post**.

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).

DATA PROTECTION: All data supplied by applicants will be used only for the purposes of determining their suitability for the post, and will be held in accordance with the principles of the Data Protection Act 1998 and the department's data protection policy.

<https://www.maths.ox.ac.uk/members/policies/data-protection/statement>

Due to the large volume of recruitment that the department administers we are unable to provide feedback to non-shortlisted applicants.

If you need help

Help and support is available from: <https://hrsystems.admin.ox.ac.uk/recruitment-support>

If you require any further assistance please email recruitment.support@admin.ox.ac.uk.

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:

<https://compliance.admin.ox.ac.uk/job-applicant-privacy-policy>. The University's Policy on Data Protection is available at: <https://compliance.admin.ox.ac.uk/data-protection-policy>.

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: <https://hr.admin.ox.ac.uk/the-ejra>

For **existing** employees, any employment beyond the retirement age is subject to approval through the procedures: <https://hr.admin.ox.ac.uk/the-ejra>

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 <https://hr.admin.ox.ac.uk/staff-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 <https://www.sport.ox.ac.uk/>.

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 <https://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 <https://staffimmigration.admin.ox.ac.uk/visa-loan-scheme>

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 <https://hr.admin.ox.ac.uk/my-family-care>

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 <https://childcare.admin.ox.ac.uk/>

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 <https://edu.admin.ox.ac.uk/disability-support>

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 <https://edu.admin.ox.ac.uk/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