



NUFFIELD DEPARTMENT OF
CLINICAL NEUROSCIENCES

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UNIVERSITY OF
OXFORD

Job title	Postdoctoral Researcher in Neuromorphic Engineering
Division	Medical Sciences Division
Department	Nuffield Department of Clinical Neurosciences (NDCN)
Location	Brain Network Dynamics Unit, Mansfield Road, Oxford, OX1 3TH
Grade and salary	Research Grade 7: £40,178 - £48,700 per annum A less experienced candidate may be appointed at Research Grade 6 (£36,360 – £42,434 per annum), with a commensurate adjustment in either the essential criteria, responsibilities or duties.
Hours	Full time
Contract type	Fixed term for 2 years
Reporting to	Rafal Bogacz, Professor
Vacancy reference	189419

Research topic	Hardware implementation of the predictive coding model
Principal Investigator / supervisor	Rafal Bogacz
Project team	Jeff Shainline, Jeff Chiles, Jeff Beck, Matt Cox, and Maryada (Great Sky)
Project web site	https://www.mrcbndu.ox.ac.uk/groups/bogacz-group https://www.greatsky.ai/
Funding partner	Great Sky
Recent publications	Song, Y., Millidge, B., Salvatori, T., Lukasiewicz, T., Xu, Z., & Bogacz, R. (2024). Inferring neural activity before plasticity as a foundation for learning beyond backpropagation. <i>Nature Neuroscience</i> , 27(2), 348-358. Shainline, J. M. (2021). Optoelectronic Intelligence. <i>Applied Physics Letters</i> , 118, 160501.



The role

The postholder will develop an implementation of a model of information processing in the brain, called predictive coding, in hardware employing superconducting computational circuits. The research will employ mathematical analysis and computer simulations to investigate how the predictive coding model can be adjusted so it can be implemented in the neuromorphic hardware, while preserving the computational advantages of the model.

Predictive coding is a brain-inspired model which learns with fewer examples than traditional artificial neural networks, used in artificial intelligence (AI). Therefore, it has a potential to speed up training of AI models. However, simulating this model on current digital computers is slow, as they are not optimized for the computations which predictive coding requires. By contrast, the new hardware developed by Great Sky performs computations in a fundamentally different way, which is compatible with the requirements of the predictive coding model. Implementing predictive coding on this hardware will unlock the advantages of predictive coding, resulting in faster and more energy-efficient training of AI.

The postholder will be co-supervised by Rafal Bogacz from University of Oxford and Jeff Shainline from Great Sky. The post holder will work as a part of an interdisciplinary team including computational neuroscientists studying learning in brain networks in Oxford, and will collaborate with engineers developing neuromorphic hardware at Great Sky. The post holder will also be a member of a research group of Professor Rafal Bogacz, and based in the Brain Network Dynamics Units, which includes an interdisciplinary community of neurobiologists, engineers and computational scientists.

This is a fixed-term post, with an initial probationary period.

Responsibilities

- Adapt existing and develop new formulations of predictive coding model that are compatible with a hardware implementation.
- Prepare working theories on how the model can be implemented using fundamental hardware elements and analyse qualitative and/or quantitative data from a variety of sources, reviewing and refining theories as appropriate.
- Carry out collaborative projects with colleagues in partner institution (Great Sky), and research groups. Simulate the proposed implementation using Great Sky's existing, open-source hardware simulator and refine the implementation based on the obtained results.
- Communicate obtained results to other members of the research team in Oxford and Great Sky (via online meetings and visits to Colorado), and refine the implementation based on the obtained feedback. Act as a source of information and advice to other members of the group on methodologies or procedures.
- Collaborate with the Great Sky hardware team to select an appropriate set of circuits and network to instantiate in hardware to prove the concept is working correctly.
- Work closely with the team at Great Sky to map the predictive-coding implementation to a physical circuit layout (the actual chip will be fabricated by the Great Sky team).
- When the chip returns from the foundry, work closely with the Great Sky team to measure the physical circuit. The Great Sky team will be responsible for conducting the measurements, but your input will be critical to interpreting the results and determining whether the algorithm is functioning correctly on the chip.



- Manage own academic research and administrative activities. This involves small scale project management, to co-ordinate multiple aspects of work to meet deadlines.
- Contribute ideas for new research projects.
- Develop ideas for generating research income, and present detailed research proposals to senior researchers.
- Collaborate in the preparation of research publications, and book chapters.
- Present papers at conferences or public meetings.
- Represent the research group at external meetings/seminars, either with other members of the group or alone.

Selection criteria

Essential

- Education and training: Hold, or be close to completing, a relevant PhD/DPhil or equivalent in electronic engineering, computational neuroscience, machine learning or physics.
- Relevant experience: Development of neuromorphic hardware, or computational models of brain circuits, or artificial neural networks.
- Possess sufficient specialist knowledge in the discipline (including proficiency in programming) to work within established research programmes.
- Previous experience of contributing to publications/presentations. Demonstrable record of originality, creativity and productivity in research, including first-author publications.
- Ability to manage own academic research and associated activities
- Ability to contribute ideas for new research projects and research income generation
- Excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings

Desirable

- Experience of independently managing a discrete area of a research project
- Experience of actively collaborating in the development of research articles for publication

Pre-employment screening

Standard checks

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. If you have previously worked for the University we will also verify key information such as your dates of employment and reason for leaving your previous role with the department/unit where you worked. 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.

Medical Sciences Division

The Medical Sciences Division is an internationally recognized centre of excellence for biomedical and clinical research and teaching, and the largest academic division in the University of Oxford. World-leading programmes, housed in state-of-the-art facilities, cover the full range of scientific endeavour from the molecule to the population. With our NHS partners we also foster the highest possible standards in patient care.

For more information visit: www.medsci.ox.ac.uk

The Nuffield Department of Clinical Neurosciences

The Nuffield Department of Clinical Neurosciences (NDCN), led by Prof Kevin Talbot, has over 400 staff and 150 postgraduate students. NDCN has an established research and teaching portfolio with a national and international reputation for excellence.

NDCN is based in high quality research and clinical facilities in the West Wing of the John Radcliffe Hospital, alongside the Department's world-class Wellcome Centre for Integrative Neuroimaging (WIN) and the Weatherall Institute of Molecular Medicine (which houses 3 of our research groups), and provides the ideal facilities to translate research from bench to bedside. In keeping with the award of NIHR Comprehensive Biomedical Research Centre status, to a partnership between Oxford University and the Oxford Radcliffe Hospitals NHS Trust, we have developed a highly integrated and interdisciplinary environment in which research, teaching, clinical training and clinical care interact. This enables us to establish new approaches to the understanding, diagnosis and treatment of brain diseases. To this end the Department fosters collaborations worldwide and warmly welcomes visiting scientists, clinical fellows and students.

For more information visit: www.ndcn.ox.ac.uk



The Department comprises six sections:

Brain Network Dynamics Unit

The BNDU is directed by Professor Peter Magill and is exceptionally multidisciplinary, integrating research programmes that span clinical, experimental and computational neuroscience. The Unit's collective goal is to understand and exploit the moment-to-moment interactions between nerve cells that are critical for brain functions, with a special focus on the brain circuits underlying movement and memory.

For more information visit: www.bndu.ox.ac.uk

Nuffield Division of Anaesthesia

NDA is led by the Nuffield Professor of Anaesthetic Science, Bruce Bickard. The NDA is committed to the development and maintenance of internationally competitive research programmes in global anaesthesia and surgery; pain and consciousness; respiration and hypoxia; adult and neuro-intensive care; simulation and human factors training.

For more information visit www.nda.ox.ac.uk

Division of Clinical Neurology

DCN is led by Professor David Bennett. DCN is committed to the development of research programs that improve understanding of the nervous system in health and disease.

For more information visit www.dcn.ox.ac.uk

The Oxford Centre for Integrative Neuroimaging

OxCIN is a multi-disciplinary neuroimaging research facility led by Professor Karla Miller. OxCIN aims to bridge the gap between laboratory neuroscience and human health, by performing multi-scale studies spanning from animal models through to human populations. It focuses on the use of Magnetic Resonance Imaging (MRI) for neuroscience research, along with related technologies such as Transcranial Magnetic Stimulation, transcranial Direct Current Stimulation, MEG and EEG. OxCIN has core locations at the John Radcliffe Hospital (FMRIB), Warneford Hospital (OHBA) and University Science area (BSB).

For more information visit <https://www.oxcin.ox.ac.uk/>

Nuffield Laboratory of Ophthalmology

NLO is led by Professor Russell Foster, who leads the Sleep & Circadian Neuroscience Institute. NLO pursues scientific and clinical research into a range of areas related to vision, the eye and circadian neuroscience.

For more information visit www.nlo.ox.ac.uk

Centre for the Prevention of Stroke & Dementia

CPSD is led by Professor Peter Rothwell. The centre carries out research that increases understanding of the causes of cerebrovascular disease. Its aims are to improve prevention of stroke and dementia by earlier diagnosis, more reliable prognostication, and more effective use of existing preventive treatments in routine clinical practice.

For more information visit www.cpsd.ox.ac.uk



Working at NDCN

NDCN actively promotes a healthy work life balance amongst employees through a number of family friendly policies. See <https://hr.admin.ox.ac.uk/staff-benefits> for further information.

The University of Oxford is a member of the [Athena SWAN Charter](#) and holds an institutional Bronze Athena SWAN award. The Department of Clinical Neurosciences holds a departmental Silver Athena award in recognition of its efforts to introduce organisational and cultural practices that promote advancement of gender equality: representation, progression and success for all.

The post-holder should consider the environmental impact of their activities where relevant (e.g. energy use, waste, travel, procurement) and take reasonable steps to minimise this impact in line with University policies and guidance.

How to apply

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

As part of your application you will be asked to provide details of two referees and indicate whether we can contact them now.

You will be asked to upload a CV and 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.

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

If you currently work for the University please note that:

- as part of the referencing process, we will contact your current department to confirm basic employment details including reason for leaving
- although employees may hold multiple part-time posts, they may not hold more than the equivalent of a full time post. If you are offered this post, and accepting it would take you over the equivalent of full-time hours, you will be expected to resign from, or reduce hours in, your other posts(s) before starting work in the new post.

Information for internal candidates

If you currently work at the University, please note that:

- as part of the referencing process, we will contact your current department to confirm basic employment details including reason for leaving and information about your performance.
- although employees may hold multiple part-time posts, they may not hold more than the equivalent of a full time post. If you are offered this post, and accepting it would take you over the equivalent of full-time hours, you will be expected to resign from, or reduce hours in, your other posts(s) before starting work in the new 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).

If you need help

Application FAQs, including technical troubleshooting advice is available at:

<https://staff.web.ox.ac.uk/recruitment-support-faqs>.

Non-technical questions about this job should be addressed to the recruiting department directly: recruitment@ndcn.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 online recruitment portal 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 very senior research posts at **grade RSIV/D35 and clinical equivalents E62 and E82** of 30 September before the 70th birthday. The justification for this is explained at: <https://hr.admin.ox.ac.uk/the-ejra>.

For **existing** employees on these grades, 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 other grades 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

The University of Oxford is committed to equal opportunity, and to being a place where everyone belongs and is supported to succeed. We recognise how the diversity of our community enriches our ability to deliver on our academic mission.

We welcome applications from individuals from all backgrounds, including those under represented within higher education. No applicant or members of staff shall be unlawfully discriminated against on the basis of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

Employment with the University and progression within employment will be determined according to personal merit and the application of criteria related to the duties and conditions of the post. In all cases, the primary consideration will be the ability to perform the job.

As stated in the University's Equality Policy and Equality, Diversity and Inclusion Strategic Plan, our commitment to equality and diversity goes hand in hand with our commitment to academic freedom and free speech.



Benefits of working at the University

Employee benefits

University employees enjoy 38 days' paid holiday, generous pension schemes, flexible working options, travel discounts including salary sacrifice schemes for bicycles and electric cars and other discounts. Staff can access a huge range of personal and professional development opportunities. See

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

Employee Assistance Programme

As part of our wellbeing offering staff get free access to Health Assured, a confidential employee assistance programme, available 24/7 for 365 days a year. Find out more at

<https://staff.admin.ox.ac.uk/health-assured-eap>

University Club and sports facilities

Membership of the University Club is free for University staff. It 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 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 dependants. See <https://staffimmigration.admin.ox.ac.uk/visa-loan-scheme>

Family-friendly benefits

We are a family-friendly employer with one of the most generous family leave schemes in the Higher Education sector (see <https://hr.web.ox.ac.uk/family-leave>). Our Childcare Services team provides guidance and support on childcare provision, and offers a range of high-quality childcare options at affordable prices for staff. In addition to 5 University nurseries, we partner with a number of local providers to offer in excess of 450 full time nursery places to our staff. Eligible parents are able to pay for childcare through salary sacrifice, further reducing costs. See <https://childcare.admin.ox.ac.uk/>.

Supporting disability and health-related issues (inc menopause)

We are committed to supporting members of staff with disabilities or long-term health conditions, including those experiencing negative effects of menopause. Information about the University's Staff Disability Advisor, is at <https://edu.admin.ox.ac.uk/disability-support>. For information about how we support those going through menopause see <https://hr.admin.ox.ac.uk/menopause-guidance>

Staff networks

The University has a number of staff networks including for research staff, BME staff, LGBT+ staff, disabled staff network and those going through menopause. Find out more at <https://edu.admin.ox.ac.uk/networks>

The University of Oxford Newcomers' Club

The University of Oxford Newcomers' Club is 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.

Research staff

The Researcher Hub supports all researchers on fixed-term contracts. They aim to help you settle in comfortably, make connections, grow as a person, extend your research expertise and approach your next career step with confidence. Find out more at <https://www.ox.ac.uk/research/support-researchers/researcher-hub>

Oxford's Research Staff Society is a collective voice for our researchers. They also organise social and professional networking activities for researchers. Find out more at <https://www.ox.ac.uk/research/support-researchers/connecting-other-researchers/oxford-research-staff-society>

