UKRI AI Centres for Doctoral Training 2023
Summaries of successful outline proposals

This document details the 32 outline proposals which have been invited to submit full proposals for the UKRI Centres for Doctoral Training in Artificial Intelligence funding opportunity following panel meetings on 25-26 April 2023.

Summary of Successful Outline Proposals (ordered by grant number)

Grant ref	PI surname	UKRI AI Centre for Doctoral Training in …	Contact
EP/Y008782/1	Habli	Lifelong Safety Assurance of AI-enabled Autonomous Systems (SAINTS)	Ibrahim Habli ibrahim.habli@york.ac.uk
EP/Y00891X/1	Aarts	Next Generation in Artificial Intelligence, Machine Learning and Advanced Computing	Roz Toft r.toft@swansea.ac.uk
EP/Y008936/1	Vines	Responsible and Trustworthy in-the-world NLP	John Vines john.vines@ed.ac.uk
EP/Y008952/1	Hastie	Dependable and Deployable Artificial Intelligence for Robotics (D2AIR)	
EP/Y009126/1	Williams	AI for a Just Environmental Transformation (AI-JET)	
EP/Y009134/1	Black	Safe, Trusted and Responsible Artificial Intelligence (STaR-AI)	Elizabeth Black elizabeth.black@kcl.ac.uk
EP/Y009193/1	Wild	Multi-dimensional imaging: inclusive AI for the Arts and Sciences	Vivienne Wild vw8@st-andrews.ac.uk
EP/Y00924X/1	Parsons	Sustainable Understandable agri-food Systems Transformed by Artificial INtelligence (SUSTAIN)	
EP/Y009304/1	Ferryman	AI for SusTainablE EnviRonment, EneRgy and AgriFood (AI-TERRA)	James Ferryman j.m.ferryman@reading.ac.uk
EP/Y009320/1	Miller	A Digital and Sustainable Earth (DigiEarth)	Claire Miller Claire.Miller@glasgow.ac.uk
EP/Y009339/1	Stumpf	Human-centric Responsible AI System Development (Human RAISe)	
EP/Y009355/1	Alvarez Lopez	Decision Making for Complex Systems	Mauricio A Álvarez mauricio.alvarezlopez@manchester.ac.uk
EP/Y009363/1	Palmer	Artificial Intelligence for Molecular Exploration, Discovery, and Development	
EP/Y00938X/1	Taylor	AI enabled healthcare	
EP/Y009401/1	Gerding	AI for Sustainability	
EP/Y009452/1	Kanjo	Social Prescribing and Personalised Care	Eiman Kanjo eiman.kanjo@ntu.ac.uk

EP/Y009460/1	Simpson	Biomedical Innovation	Ian Simpson Ian.Simpson@ed.ac.uk
EP/Y009479/1	Barton	Scientific Machine Learning and Dynamical Modelling	David Barton David.Barton@bristol.ac.uk
EP/Y009487/1	Flach	Practice-Oriented Artificial Intelligence	Peter Flach Peter.Flach@bristol.ac.uk
EP/Y009509/1	Konstantinidis	Data Intensive Physical Systems	Nikos Konstantinidis n.konstantinidis@ucl.ac.uk
EP/Y009533/1	Stier	AI for the Environment (Intelligent Earth)	
EP/Y009592/1	Dixon	Artificial Intelligence and Music	
EP/Y009606/1	Wang	Discovery for Health - Next-generation Machine Learning for Accelerated Scientific Discovery in Health	Hui Wang h.wang@qub.ac.uk
EP/Y009614/1	Lawson	Citizen-Centred Artificial Intelligence	Selina Sutton selina.sutton@northumbria.ac.uk
EP/Y00969X/1	Bessant	AI for Drug Discovery	Emma Grant deri@qmul.ac.uk
EP/Y00972X/1	Vallati	Artificial Intelligence for Sustainable Transport	Mauro Vallati M.Vallati@hud.ac.uk
EP/Y009746/1	Hilton	AI for Digital Media Inclusion	Adrian Hilton a.hilton@surrey.ac.uk
EP/Y009754/1	Zhao	Artificial Intelligence for Offshore Renewable Energy and Hydrogen Technologies	Zhao, Xiaowei Xiaowei.Zhao@warwick.ac.uk
EP/Y009762/1	Ozcan	Trustworthy Responsible Artificial Intelligence	
EP/Y009819/1	Hogg	AI for Medical Diagnosis and Care	David Hogg D.C.Hogg@leeds.ac.uk
EP/Y009827/1	Shaw	Fundamental Physics and its Applications in Industry and Sustainability: DISCnet-AI	
EP/Y009843/1	Faisal	Digital Healthcare	

Grant Reference Number: EP/Y008782/1

Title: UKRI AI Centre for Doctoral Training in Lifelong Safety Assurance of AI-enabled Autonomous Systems (SAINTS)

Team:
- Professor Ibrahim Habli, University of York (PI)
- Dr Ana MacIntosh, University of York
- Dr Colin Paterson, University of York
- Professor Cynthia Iglesias Urrutia, University of York
- Professor Thomas Stoneham, University of York
- Dr Ioanna Iacovides, University of York
- Professor John McDermid, University of York
- Dr Jennifer Chubb, University of York
- Dr Phillip Morgan, University of York
- Dr Zoe Porter, University of York
- Professor Richard Wilson, University of York

Brief description of proposed work:

Realising the potential benefits of AI hinges on embracing the power of the technology to adapt in highly changing and uncertain socio-technical contexts. In many cases, this technology is safety critical where failures in, or due to, AI-based capabilities could directly lead to harm, often at a large scale. For example, an AI-enabled cancer screening service would need to evolve to cater for variations in regional clinical pathways and new advances in our understanding of pathogens. This evolution should occur while, crucially, ensuring that the adaptive AI system does not compromise patient safety or embody racially, or socio-economically, aligned health inequalities.

AI technologies evolve after their deployment either through periods of offline training or continual online learning. The sociotechnical contexts within which these technologies are used will also change. Human users will dynamically adapt their behaviours and organisations will adjust their policies and processes as they learn more about the actual performance, robustness and "intelligent" capability of these technologies. This will often shift the level of trust, responsibility and autonomy allocated to the AI-enabled functionality (e.g. from human supervised to fully autonomous driving features). With the significant increase of domains with AI-enabled Autonomous Systems (AI-AS) in deployment, there is a need for professionals with expertise not only in how these systems are safely designed, but also how the critical AI functions will remain safe over the course of their lifecycle, often in highly dynamic physical, social and regulatory environments.

To address this need, the UKRI AI CDT in Lifelong Safety Assurance of AI-enabled Autonomous Systems (SAINTS) will train 60 interdisciplinary researchers on the safe design and continual assurance of AI-AS. Based in a world-leading centre of excellence for safety assurance at the Institute for Safe Autonomy, this cohort of students will be equipped with the skills, knowledge and behaviours to manage the multi-faceted demands of AI-enabled safety-critical systems which continue to evolve after deployment and which function at varying levels of autonomy across their lifecycle. Supported by multidisciplinary supervision teams, the students will acquire diverse practical experiences with end users, industrial partners and safety regulators, to understand the complex, adaptive sociotechnical contexts in which the technology is deployed and will evolve. The industry experts in these teams will guide the students in developing these experiences into impactful collaborations.

SAINTS will equip the PhD students with the skills to advance responsible and trustworthy AI-AS and to define new standards of best practice. Safety is in some sense the ground zero of trust on which all subsequent acceptability of AI systems depends. An inherently unsafe AI-AS should not be trusted. AI-AS and their outcomes also need to be open to scrutiny from cross-disciplinary, human-centred perspectives. Through our multifaceted approach to safety, SAINTS will help establish the foundational socio-technical research that can improve AI systems against future failures, promote transparency and help hold to account those who might try to hide behind apparent system complexity.

Grant Reference Number: EP/Y00891X/1

Title: UKRI AI Centre for Doctoral Training in Next Generation in Artificial Intelligence, Machine Learning and Advanced Computing

Team:
- Professor Gert Aarts, Swansea University (PI)
- Dr Rhiannon Owen, Swansea University
- Professor Henning Flaecher, University of Bristol
- Dr Zoe Leinhardt, University of Bristol
- Professor Reyer Zwiggelaar, Aberystwyth University
- Dr Christine Zarges, Aberystwyth University
- Professor Jonathan Roberts, Bangor University
- Dr William Teahan, Bangor University
- Professor Stephen Fairhurst, Cardiff University
- Dr Leandro Beltrachini, Cardiff University

Brief description of proposed work:

The UKRI AI Centre for Doctoral Training for the Next Generation in Artificial Intelligence, Machine Learning and Advanced Computing (AIMLAC:NG) will train the next generation of doctoral researchers in applying and developing methods of AI, machine learning (ML) and computing. Bringing together researchers based at the universities of Swansea (lead), Aberystwyth, Bangor, Bristol and Cardiff, with external partners across industry and the public sector, a minimum of 55 doctoral researchers will be trained in analysing large data sets in two priority areas: Science & Research and Health & Social Care, underpinned by a firm basis in computer science and mathematics. Building on the expertise gained with our current AIMLAC CDT, the doctoral researchers will develop their skills via a bespoke cohort programme, covering training in technical, transferable and leadership skills, responsible innovation and trusted research, as well as governance and policy developments. External partners will work closely with the CDT to continuously develop the programme, advance AI governance and regulation in collaboration with the Welsh Government, and provide placements to our doctoral researchers, to apply learned skills in a complementary external environment. This will ensure AIMLAC:NG and its graduates will contribute successfully to the three pillars of the National AI Strategy.

The priority areas cover research activities in which very large data sets are created, observed and investigated, including data originating from international scientific facilities in particle physics and astronomy, climate dynamics, and health and social care, and for which AI/ML methods are supported by advanced computing techniques. By bringing these areas together in a cross-disciplinary environment, doctoral researchers are exposed to research and AI/ML methods outside their own discipline from day one, making it natural for them to communicate to peers and experts in other fields, while also completing a challenging PhD project on a globally relevant research question.

Specifically, the particle physics and astronomy theme addresses outstanding questions on the nature of fundamental interactions, dark matter, and the universe. These revolve around the Large Hadron Collider, with a data set of about 700 PB, where AI algorithms are needed for efficient and intelligent analysis; the Square Kilometre Array, which will be generating an Exabyte of raw data daily, with a need to implement efficient real-time AI/ML methods; and the Laser Interferometer Gravitational-Wave Observatory, requiring prompt identification and analysis of gravitational waves produced by merging neutron stars or black holes.

In climate research, AI methods will be developed to super-resolve small-scale features based on expensive, coarse-resolution physical simulations, to greatly speed up expensive components of physical models to increase their realism, and to identify key features in large datasets such as extreme weather systems.

In health and social care, finally, there is a plethora of data available, including population-scale, linked electronic administrative, demographic, imaging, health, multi-omic, and environmental data at the individual level. Methodological developments are required to better understand disease onset and development, with computer aided diagnosis used by clinical experts in disease assessment, and including identification of potential influential factors such as genetic, genomic, environmental, or social factors. Simulation based methods are needed to understand the impact of emerging health threats as well as the assessment of new health technologies, with the aim to develop a trustworthy health data ecosystem to act as the foundation for a new era of health data science.

To advance the AI ecosystem in the UK, AIMLAC:NG will engage with the broader UK AI environment, including the EPSRC AI Hubs and the other UKRI AI CDTs.

Grant Reference Number: EP/Y008936/1

Title: UKRI AI Centre for Doctoral Training in Responsible and Trustworthy in-the-world NLP

Team:
- Professor John Vines, University of Edinburgh (PI)
- Professor Mirella Lapata, University of Edinburgh
- Professor Ivan Titov, University of Edinburgh
- Professor Frank Keller, University of Edinburgh
- Professor Simon King, University of Edinburgh
- Dr Lachlan Urquhart, University of Edinburgh
- Professor Melissa Terras, University of Edinburgh
- Ms Nicola Osborne, University of Edinburgh
- Professor Ewa Luger, University of Edinburgh

Brief description of proposed work:

Natural Language Processing (NLP) is an area of AI that has grown rapidly and has quickly gone from technical experimentation in labs to large-scale deployments in-the-world. Each day there are new stories about the transformative potential of applications that are underpinned by NLP. For example, stories claiming that ChatGPT will change the way we search for information or produce new texts; or that the next generation of robo-advisers and chatbots will revolutionise service industries; or that Alexa and Siri will enable hands-free access to information through voice; or that text-to-image software like Midjourney will transform the creative industries.

NLP is not just at the vanguard of applied AI but also at the forefront of questions around trust and responsibility. When NLP applications are placed in-the-world, they come into direct contact with peoples everyday lives, get used in unexpected ways, and incur interactions that were not modelled in the lab. As NLP gets deployed outside the lab, many questions are raised about not just what can be done, but what should be done, with these technologies - with continued concerns around the ethics of language data, biases in datasets and models and the harms that this can create, and whether new applications may take away human agency and autonomy rather than empowering people. Because of the ways NLP sets out to utilise, and mimic, human language and communication, it poses especially complex socio-technical, design and legal challenges, and raises public debate about the implications of AI more broadly on society.

Our CDT will focus on training 50+ future leaders that represent a new generation of interdisciplinary experts that can ensure NLP systems are designed, implemented, deployed and adopted in responsible ways that are people-centred and trusted by society. We have established a new training programme that supports students to engage in cutting-edge research and practice related to the technical, social, design, and legal and regulatory challenges these technologies present. Core to our training is ensuring students come out with the required skills to co-create novel applications with users and are ready to collaborate in the interdisciplinary teams that will be needed to address complex socio-technical challenges.

The CDT provides a unique training environment by bringing together academics across the University of Edinburgh who are extensively engaged in NLP and human-centred data and AI research: (i) experts in the technical foundations of NLP and language models within the Institute for Language, Cognition and Communication; (ii) experts in human-computer / human-data / human-AI interaction, visualisation and interaction design, and technology regulation design within the Institute for Design Informatics; (iii) experts in speech technologies in the Centre for Speech Technologies; and (iv) experts in AI ethics and accountability within the Centre for Technomoral Futures. Our students will benefit from being co-located in dedicated facilities within the new Edinburgh Futures Institute (EFI). EFI is the University's £170m data-driven innovation hub focused on interdisciplinary, challenge-based research and societal impact - with trainees embedded within its vibrant data-led research community.

Embedded throughout is close collaboration with industrial, public and non-profit partners. Partners provide contributions to the training of students by setting contexts and problems to work on, by hosting internships and groups of students working on Applied Innovation Projects, and offer non-academic career pathways for graduates. Our partners include leading national and international organisations with a direct interest in building research capacity in trustworthy and responsible NLP, including: DeepMind, Meta, Google, Naver Labs, Amazon, IBM, Microsoft, BBC R&D, Philips, abrdn, SkyScanner, Smart Data Foundry, Mozilla, CodeBase, The Data Lab, ScotGov.

Grant Reference Number: EP/Y008952/1

Title: UKRI AI Centre for Doctoral Training in Dependable and Deployable Artificial Intelligence for Robotics (D2AIR)

Team:
- Professor Helen Hastie, Heriot-Watt University (PI)
- Dr Ronald Petrick, Heriot-Watt University
- Professor Subramanian Ramamoorthy, University of Edinburgh
- Dr Ekaterina Komendantskaya, Heriot-Watt University
- Dr Fernando Auat Cheerin, Heriot-Watt University
- Dr Adam Stokes, University of Edinburgh
- Professor Barbara Webb, University of Edinburgh
- Dr J. Michael Herrmann, University of Edinburgh

Brief description of proposed work:

For robotics and Artificial Intelligence (AI) to make a difference in our homes and workplaces, we need to ensure these technologies are safe, dependable and trustworthy. While AI methods are finding increasing adoption within robotics, much of this technology was not originally designed with safety and other human-centred requirements in mind. Examples of potential use cases include AI assistants and robots in the home for healthy and independent living that can naturally converse and collaborate safely; and robots that can sense and interact in their environment for manufacturing and construction, and in challenging and extreme environments. Making AI suitable for such dependable and deployable products will require a new way of thinking.

We propose a CDT entitled Dependable and Deployable Artificial Intelligence for Robotics (D2AIR - pronounced 'dare'). The primary priority area of the D2AIR CDT is 'Responsible and Trustworthy AI', and our primary cross-cutting theme is 'AI for Increasing Business Productivity'. These form the two defining axes - "Dependability" and "Deployability" in D2AIR. Through D2AIR, a talent pipeline will be built of graduates who can think in new ways around researching, designing, building and deploying dependable and safe robotics and AI solutions. This pipeline will increase productivity, catapulting the UK as a world-leader in trustworthy robotics and AI technologies.

D2AIR will reside at the Edinburgh Centre for Robotics (ECR). This Centre is formed of Heriot-Watt University (HWU) within the departments of Computer Science, Engineering and Psychology and the University of Edinburgh (UoE), within the schools of Engineering and Informatics. The Centre encompasses the full spectrum of connected and overlapping robotics and AI disciplines, applied to a diverse range of sectors, including health and wellbeing, assisted living, agriculture, manufacturing and energy. ECR is home to world-leading research with over £150M in research funding, sourced by its 70+ academic staff. Recent joint funded projects include EPSRC projects ORCA Hub (£16M), CogMHear (£3.26M) and FEATHER (£1.1M). ECR has hosted two highly successful EPSRC CDTs in Robotics and Autonomous Systems (CDT-RAS), directed by Prof. Hastie, which will act as the foundations on which D2AIR will be built. D2AIR also builds on the current UKRI £33M Trustworthy Autonomous Systems (TAS) Programme, where the D2AIR Directors are both Node PIs, specialising in trustworthy Human Robot Interaction (HRI) (Hastie) and Governance and Regulation (Ramamoorthy).

Key to success for D2AIR will be its close links to industry, for which we have over 80 project partners. The National Robotarium is a joint initiative between HWU and UoE and, along with the Bayes Centre, forms the translational arm of ECR. The National Robotarium and the Bayes Centre house state-of-the art testing and development facilities for robotics and AI research, together with over £15M of robotics equipment (including £9M from EPSRC capital grant). The students will work in the National Robotarium, on the HWU campus, with impact engineers, business executives, and project managers. Industry project partners will be embedded within this ecosystem. They will define real-world problems for our students to address, providing cash and direct in-kind support for PhD studentships, software and hardware, as well as bespoke training and consulting. Through the National Robotarium, we are uniquely positioned to test AI solutions in real-world conditions, including physical testbeds such as rugged moonscapes and fields for agri-robotics, as well as living labs for HRI, including fully accessible living quarters. Students will have access to this 'living lab pipeline' for simulating and testing their solutions, working towards the goal of full deployment.

Grant Reference Number: EP/Y009126/1

Title: UKRI AI Centre for Doctoral Training in AI for a Just Environmental Transformation (AI-JET)

Team:
- Professor Hywel Williams, University of Exeter (PI)
- Professor Sarah Hartley, University of Exeter
- Professor Timothy Lenton, University of Exeter
- Professor Kevin Gaston, University of Exeter
- Dr Federico Caprotti, University of Exeter
- Professor Peter Challenor, University of Exeter
- Professor Richard Everson, University of Exeter
- Professor Sabina Leonelli, University of Exeter
- Professor Catriona Mckinnon, University of Exeter
- Dr Ben Lambert, University of Exeter
- Dr Benno Simmons, University of Exeter
- Dr Ernesto Schwartz-Marin, University of Exeter

Brief description of proposed work:

A green transformation is needed to deliver governmental, corporate and civil commitments on climate change and biodiversity. Artificial intelligence (AI) is a vital enabling technology, which can stimulate innovation and support decision-making. Yet systemic change brings both opportunities and risks - AI solutions to environmental problems must prioritise equity, fairness and justice, alongside technical innovation. The UKRI AI CDT in Artificial Intelligence for a Just Environmental Transformation (AI-JET) will train students in the computational and mathematical skills, interdisciplinary knowledge and critical thinking needed to develop AI technologies that are good for the environment and good for society.

Environmental justice, fairness and equity will be embedded throughout the AI-JET CDT, alongside responsible innovation, ethics and data governance. Cohort-based interdisciplinary research will prioritise three environmental challenge domains: (i) AI for carbon & climate; (ii) AI for energy, decarbonisation & urban sustainability; (iii) AI for ecosystems, sustainable agriculture & biodiversity. Three foundational training streams will prepare the students for research: (i) AI, machine learning & data science; (ii) Data justice, governance & ethics; (iii) Environmental concepts & challenges. Three advanced methods training streams will provide tools for student research projects: (i) Digital twins & decision support; (ii) Data fusion, sensors & observations; (iii) Knowledge co-production & digital entrepreneurship. A cohort approach will deliver the necessary breadth, recruiting from diverse academic backgrounds, valuing industry and public sector experience, and fostering a collaborative approach. A mindset of continuous improvement will engage students in training throughout their PhD. Enrichment and social activities, including hackathons, retreats, partner-led workshops and an interdisciplinary seminar series, will help establish a vibrant research community.

AI-JET will be led by male and female Co-Directors with a rotating chair. Senior academics will champion each environmental challenge and advanced methodology, leveraging their networks to engage external partners. The environmental challenge domains match areas of strength at Exeter with many world-leading academic supervisors available. Early/mid-career academics will receive funded time to lead training activities. A centre manager and administrator will handle operational tasks and integration with wider University of Exeter infrastructure. Dedicated research software engineering support will help students access local and national computing facilities.

AI-JET is open to all with required academic ability and will maintain representation of protected characteristics with active policies on recruitment and visibility in leadership. A diverse cohort will help build an inclusive environment where everyone feels supported to perform at their best. Staff mentoring (with dedicated EDI and pastoral leads) and peer support (e.g. buddy systems, group learning) will ensure that all students are nurtured in a supportive environment.

Climate change, biodiversity loss and many other environmental challenges continue to be critical for the security and prosperity of the UK, creating a massive national need for trained researchers that can exploit new digital technologies to deliver solutions. Each challenge and training activity will be co-created with external partners to ensure relevance and knowledge transfer. Partner organisations will promote "real world" problem-solving and employability, with every student expected to undertake a placement and/or partner-led project. The AI-JET CDT will benefit the South West with strong place-based relationships, while a deliberate focus on policy-related and solutions-

driven research will benefit many national stakeholders, offering value to the UK economy and enabling substantive progress on environmental goals.

Grant Reference Number: EP/Y009134/1

Title: UKRI AI Centre for Doctoral Training in Safe, Trusted and Responsible Artificial Intelligence (STaR-AI)

Team:
- Dr Elizabeth Black, King's College London (PI)
- Professor Alessandra Russo, Imperial College London
- Dr Francesco Belardinelli, Imperial College London
- Dr Dalal Alrajeh, Imperial College London
- Dr Albert Meroño Peñuela, King's College London
- Dr Martim Brandao, King's College London
- Dr Caitlin Bentley, King's College London
- Professor Paul Luff, King's College London
- Professor Dan Hunter, King's College London

Brief description of proposed work:

AI technologies are ever more prevalent; they shape our society and impact individuals, and there is hope they can help address societal challenges like the climate crisis. However, there is also concern about the potential risks of AI systems and their impacts on our lives. There is global recognition of the need for AI systems that are safe (so that we have some assurances about their behaviour) and trusted (so that we have well-placed confidence that AI decisions are appropriate and uphold societal values) and that are developed in a responsible manner (so that potential implications are carefully anticipated and controlled, with input from diverse perspectives). Yet, there is a shortage of skilled individuals who can realise the full potential of AI: UKRI's Transforming our World with AI report highlights the need for people who can collaborate effectively across disciplines, whose technical skills are complemented with a broad awareness of the key societal issues relating to AI adoption and who are able to meaningfully consider these issues when developing and deploying AI technologies. The UKRI AI Centre for Doctoral Training (CDT) in Safe, Trusted and Responsible AI (STaR-AI) will train a new generation of AI professionals who: have technical expertise in developing AI systems that are safe and trusted; are able and committed to consider the impact of AI as a fundamental part of the R&D process; and are equipped to understand and mitigate any potential social, ethical, environmental and legal implications, collaborating across disciplines as necessary.

Techniques in AI can be broadly divided into data-driven and symbolic/model-based. While data-driven techniques use data to learn patterns or behaviours, or to make predictions, symbolic approaches use explicit models to represent and reason about knowledge. Symbolic AI is thus particularly well-suited to ensuring safety and trust: providing a shared vocabulary on which to base understanding; more easily supporting explanations, verification and guarantees for correctness and safety; and allowing more meaningful user collaboration and interaction with AI systems. While data-driven AI approaches such as deep learning have seen significant advances, they tend to be more difficult to explain and to analyse in terms of their safety and trustworthiness. Alongside the surge in popularity of data-driven AI, it is crucial that we also develop the UK skills base in complementary symbolic approaches to AI, which can help in the development of safe and trusted AI systems.

STaR-AI will develop graduates with expertise in both data-driven and symbolic AI, who will also be trained in how these approaches can be combined in hybrid systems that exploit the advantages and counter the weaknesses of each approach. This core technical training will be complemented with the skills and knowledge needed to appreciate the implications of AI (including Social Science, Law and Philosophy) and to expose them to diverse application domains (such as Finance, Health, Logistics and Security). Students will be trained in responsible research and innovation methods, engaging with the public to help ensure the societal relevance of their research, and will be trained in how to maximise the impact of their work. The CDT will work with a range of industrial partners, from both private and public sectors, to ensure relevance with industry and application needs, and to expose students to multiple perspectives, techniques, applications and challenges. Personalised training plans will provide support to open up the CDT to students without computer science backgrounds and students will be trained in techniques for effective collaborations. Multidisciplinary supervision teams and activities such as a group project and hackathon will give students experience of working across disciplines and exposure to real-world industry challenges.

Grant Reference Number: EP/Y009193/1

Title: UKRI AI Centre for Doctoral Training in Multi-dimensional imaging: inclusive AI for the Arts and Sciences

Team:
- Professor Vivienne Wild, University of St Andrews (PI)
- Dr Rita Tojeiro, University of St Andrews
- Dr Silvia Paracchini, University of St Andrews
- Professor Andrea Di Falco, University of St Andrews
- Dr David Harris-Birtill, University of St Andrews
- Dr Douglas Gillespie, University of St Andrews
- Dr Catherine Eagleton, University of St Andrews
- Dr Stefan Pulver, University of St Andrews

Brief description of proposed work:

It is widely recognised that there is a national need to expand AI-methods into new disciplines and industries, while increasing the diversity of people who can exploit them. At the same time, we live in an existential climate crisis, and the expansion of the AI industries must become part of the solution, not an addition to the problem. Our community-led interdisciplinary CDT will be built on principles of inclusion and social responsibility, with an extensive widening participation programme to attract and support students from under-represented groups.

The CDT focus of "multi-dimensional imaging" provides a common theme with which we can expand the reach of AI into a wide range of research domains. Most modern real-world datasets are inherently multi-dimensional, encoding comprehensive information about, e.g., structure, composition, and time-dependent phenomena. However, limitations in computational resources and analysis methods mean that these datasets are often reduced to simpler forms prior to analysis, inevitably losing information. AI-informed methods provide transformative new opportunities to efficiently extract the relevant information, yet their promise remains largely untapped, in large part due to the need for users to be expert in both the complex AI-methods and the complex datasets. Our CDT will fill this need.

New multi-dimensional imaging analysis methods unlocked by our Centre will underpin activities across the priority areas of Science and Research, Health, Environment and Energy and the Creative Industries. Our management and supervisory teams comprise researchers in Physics & Astronomy, Maths, Computer Science, Medicine, Psychology & Neuroscience, Biology, Art History, History, and Libraries and Museums. The Centre is designed to collide disciplines constructively to encourage new insights and breakthroughs through applications of methods tried and tested in one domain, to entirely new datasets. Critically, as we cross-pollinate ideas across disciplinary boundaries, we will instil in students the need to consider thoughtfully the ethical and environmental consequences of the work that they do.

Our widening participation strategy includes a fully funded summer Gateway to Postgraduate studies programme, aimed to support a diverse cohort of students from minoritized groups in applied AI research. However, there is significant evidence that even earlier intervention is required to retain minoritized groups in STEM subjects. Therefore, we will run a fully funded summer research programme tailored for minoritized students in their 1st or 2nd year of undergraduate studies. CDT students and staff will drive the creation and iterative improvement of our widening participation programmes, to ensure that commitment to underserved communities lies at the very roots of the CDT.

Our cohort will include numerate graduates from all STEM fields. Core training will involve pre-existing computer science and domain specific courses, alongside bespoke deep-dive courses in the latest advanced automated data analysis methods for multi-dimensional imaging. The enhanced vertically integrated training programme will foster a cohesive, collaborative approach amongst students of all levels and disciplines. The CDT is designed to create a 'cohort for life' - a sense of shared purpose and mission which will link our alumni together as they continue their careers in AI across the world.

Our CDT will be unconventional, led by a community of AI-users, expert in their individual domains, yet driven by a desire to make AI-based technology accessible and sustainable for future generations. Our students will tackle pressing problems in diverse disciplines, both during the CDT and in the future, helped by the strong and long-lasting links forged during the course of the programme.

Grant Reference Number: EP/Y00924X/1

Title: UKRI AI Centre for Doctoral Training in Sustainable Understandable agri-food Systems Transformed by Artificial INtelligence (SUSTAIN)

Team:
- Professor Simon Parsons, University of Lincoln (PI)
- Professor Elizabeth Sklar, University of Lincoln
- Professor Louise Manning, University of Lincoln
- Dr Georgios Leontidis, University of Aberdeen
- Professor Peter Smith, University of Aberdeen
- Professor Walter Michie, University of Strathclyde
- Dr Christos Tachtatzis, University of Strathclyde
- Professor Chris Creevey, Queen's University of Belfast
- Professor Ilias Kyriazakis, Queen's University of Belfast
- Mrs Kate Smith, University of Lincoln

Brief description of proposed work:

The agri-food system has a profound impact on the economic and environmental well-being of our society. Agri-food accounts for around 25% of all global greenhouse gas (GHG) emissions, and underpins the Food and Drink sector, which is the largest manufacturing sector in the UK, with a GVA of £28B. Creating a sustainable agri-food sector while ensuring food security is challenging. It will need us to: reduce the environmental impact of food production and cut food waste; cut GHG emissions and sequester carbon to reach Net Zero; enhance animal welfare; reduce pharmaceutical and chemical inputs, thus reducing pesticide and antimicrobial resistance; understand the interconnection between animal health, human health and the environment; and maintain biodiversity. At the same time, the output of the agri-food system needs to be nutritious, affordable and safe.

In such a complex system, no single technology is likely to prove sufficient to drive sustainability on its own. However, a sustainable agri-food system can be achieved with help from a suite of artificial intelligence (AI) technologies. SUSTAIN imagines an agri-food system where data-driven AI transforms the production of crops (selective harvesting and weeding through precision agriculture) and raising of animals (livestock monitoring, reducing animal methane emissions and improving animal welfare); enhances plant and animal breeding (AI informed genomics); stabilises supply chains (mechanism design and agent-based modelling); reduces food waste and loss (supply and demand matching) and enables fairer sharing of economic gains and understanding of environmental impacts (ethical and trustworthy AI). All of the underlying methods need to be understandable by humans so that the decisions reached are trusted (explainable AI through neuro-symbolic and cognitive modelling).

To wield the power of AI in this way, we need a new generation of researchers. They need to not only understand the technology in detail, but also understand in depth the area of agriculture that their AI is applied to. That is the only way that they will be able to transform the agricultural sectors in which they work, not just in theory but--more importantly--in practice. These researchers can only be trained by a truly multidisciplinary PhD programme, one that combines the expertise of soil, plant and veterinary scientists with that of AI scientists, engineers and social scientists, and one that teaches ethical, responsible and sustainable practices for the development and delivery of AI solutions. This is the unique and innovative programme of PhD research and development that SUSTAIN will provide.

SUSTAIN brings together an interdisciplinary mixture of researchers and teachers from four universities that are leaders in soil, plant and veterinary research, fundamental and applied AI research, and research into the use of AI to improve agriculture. Together, we will train 60 PhD students, 40 funded by UKRI and 20 funded by industry and the universities themselves. Each student will receive a solid grounding in the basics of agriculture and AI and will pick more advanced topics from a wide range of specialities taught by the four institutions. Students will have flexibility to determine their own educational path, including the choice of their PhD project, will work with two supervisors from different universities and will have chances to visit all four universities during their programmes. Students will be given a carbon budget for their studies, to create and put into their own research practise environmentally responsible ways to conduct, deliver and communicate AI research. All students will have opportunities to work with our industrial partners, visit international collaborators and explore the possibilities of entrepreneurship, strengthening and broadening their academic journey.

Grant Reference Number: EP/Y009304/1

Title: UKRI AI Centre for Doctoral Training in AI for SusTainablE EnviRonment, EneRgy and AgriFood (AI-TERRA)

Team:
- Professor James Ferryman, University of Reading (PI)
- Dr Grace Deepa Senapathi, University of Reading
- Professor Theodore Shepherd, University of Reading
- Professor Matthew Piggott, Imperial College London
- Dr Rossella Arcucci, Imperial College London
- Professor Julie McCann, Imperial College London

Brief description of proposed work:

Sustainability in the environmental, energy and agri-food sectors are critical to averting climate-driven social and ecological disasters. Spatiotemporal changes in land and climate are irrevocably interlinked: agriculture and the energy sector must adapt and build resilience to climate change, which requires tailoring weather and climate prediction and anticipating extreme events; changes in agricultural practice and energy management are imminently needed to reach net zero targets, but simultaneously need to address other challenges such as biodiversity decline and ensuring food security, which requires understanding uncertainty and risk in environmental models. Artificial Intelligence (AI) is of utmost importance in quantifying, analysing and predicting impacts over space and time.

In response to these challenges the University of Reading and Imperial College London have joined forces to create the UKRI AI Centre for Doctoral Training in AI for SusTainablE EnviRonment, EneRgy and AgriFood (AI-TERRA).

Students in the AI-TERRA CDT will receive innovative cohort-based PhD training in generic and bespoke advanced AI skills, to tackle these challenges. Students will develop cross-cutting theory, develop novel AI methods and models to assimilate, analyse and manage big data, and apply the theory, methods and models to inform and tackle real world projects in weather and climate, energy and agri-food applications co-created and co-supervised with our diverse range of interdisciplinary partners. Moreover, students will evaluate the impact of their solutions, as well as implications of AI application, within the wider AI-TERRA sustainability landscape.

The PhD students will publish their findings in high impact journals and convey their research to a wide audience. Pastoral care and Equality, Diversity and Inclusion (EDI) are at the centre's core. Students will be equipped with skills in entrepreneurship and commercialisation to fully take up opportunities stemming from their research and innovation.

The AI-TERRA CDT students will graduate with substantial, interdisciplinary experience in applying cutting-edge AI to challenging and urgent sustainability challenges, and will have developed the teamwork, communication, management and leadership skills needed for a successful career.

Grant Reference Number: EP/Y009320/1

Title: UKRI AI Centre for Doctoral Training in A Digital and Sustainable Earth (DigiEarth)

Team:
- Professor Claire Miller, University of Glasgow (PI)
- Dr Rachel Opitz, University of Glasgow
- Dr Jethro Browell, University of Glasgow
- Professor Surajit Ray, University of Glasgow
- Dr Oliver Stoner, University of Glasgow
- Professor Joemon Jose, University of Glasgow
- Professor Janine Illian, University of Glasgow
- Dr Jessica Enright, University of Glasgow
- Dr John Shi, University of Glasgow
- Professor Marian Scott, University of Glasgow

Brief description of proposed work:

The UKRI AI Centre for Doctoral Training (CDT) in a Digital and Sustainable Earth (DigiEarth) will be a world-leading postgraduate training centre, committed to developing a new generation of innovators with the Artificial Intelligence (AI) and cross-disciplinary expertise required to understand and transform interconnected systems for environment and energy, and sustainable agriculture and food. Leveraging emerging AI methods to address critical challenges across these linked systems is a global strategic priority. The national skills gap in AI for these domains is such that our graduates (trained to the highest international standards) would be highly sought by our external partners, and by public and private sector institutions across the world to drive forward the sustainability and net zero agenda. DigiEarth will work closely with related CDTs, networks, AI Hubs, and the Turing Institute to produce 50+ highly skilled graduates and hence address acute skills-shortages.

To train graduates in the hybrid data and disciplinary skills needed, the DigiEarth CDT will assemble experts in environmental, social, and bio-physical dynamics, experts in the AI methods essential to study these systems, and industry, public and third sector leaders positioned to identify real-world needs and put novel approaches into practice. Through the cohort approach, DigiEarth graduates will gain experience in a broader set of methodologies than is feasible through subject-specific training and will obtain an understanding of AI (and ethical considerations) across interfaces and traditional disciplinary boundaries. Graduates will be trained to devise innovative solutions dealing with multiple scales, new diverse data streams and multiple sources of uncertainty, preparing them to fill key leadership roles, advance scientific knowledge, and deliver real world benefits. Supporting the career pathways for graduates, and delivering impact from research, are core priorities of the CDT.

The DigiEarth CDT will be led by the University of Glasgow (UofG) providing high-level training in foundational and advanced AI, responsible innovation, professional skills, ethics and impact matched with cutting-edge, transformative PhD research projects, co-created with our partners. DigiEarth management includes: world-leading experts in AI and data science methods (across machine learning, data science, statistics, computing science) with experience of applications across the domains of environment, energy, sustainable agriculture and food, together with specialists in these domains, all with extensive experience of PhD supervision, interdisciplinary teams, and non-academic partnerships. The CDT leaders will be supported by the established UofG CDT Hub and the Centre for Data Science and AI. The DigiEarth consortium brings together 28 DigiEarth UK and international non-academic partners providing strong coverage of key players across a range of science/policy/industry areas (including: Agrivation, Biomathematics and Statistics Scotland, Beko plc, Glasgow City Council, National Oceanographic Centre, Open Climate Fix, Scottish Environment Protection Agency). DigiEarth projects will address challenges across energy transition, sustainability and net zero, and climate change impacts and will have a supervisory team comprising an AI specialist, an application domain specialist, and an external partner to embed user-engagement.

DigiEarth is a genuinely transdisciplinary training programme connecting world-leading AI specialists, external partners and collaborators working at the cutting-edge of data science and/or environmental domains to train and deliver the next generation of international leaders in this space.

Grant Reference Number: EP/Y009339/1

Title: UKRI AI Centre for Doctoral Training in Human-centric Responsible AI System Development (Human RAISe)

Team:
- Dr Simone Stumpf, University of Glasgow (PI)
- Professor Bridgette Wessels, University of Glasgow
- Dr Mark Wong, University of Glasgow
- Dr Monika Harvey, University of Glasgow
- Dr Yunhyong Kim, University of Glasgow
- Professor Alessandro Vinciarelli, University of Glasgow

Brief description of proposed work:

Artificial intelligence (AI) is advancing rapidly and there are now many systems in use that affect people's work and everyday lives, including chatbots, intelligent agents and recognition systems. While there is substantial focus on fundamental AI research, there has been a persistent failure to consider the socio-technical context of AI systems, leading to untrustworthy AI applications. Hence, there have been increasing calls from government and industry for human-centric approaches that ensure responsible AI development processes for deploying trustworthy AI applications in the real world that have a positive effect on work and society. The Human RAISe CDT will draw on the world-leading expertise of a wide network of academics from across disciplines at University of Glasgow (UofG) to tackle these challenges and create a unique training scheme.

Currently there are very limited opportunities for learning the skills necessary for human-centric responsible AI systems development. All too often their development is siloed into one discipline, only involving AI experts. Involvement from other disciplines is often an afterthought rather than interwoven into the development of AI applications. What is needed is a new kind of expert who understands both the technical capabilities and limitations of AI whilst having the skills and knowledge to take human behaviour and interactions and organisational and societal contexts into account. Our CDT will train these interdisciplinary experts to develop and deploy responsible and trustworthy AI by combining expertise and skills drawn from Computer Science, the Social Sciences, Medical and Life Sciences, and the Arts.

To do this we will leverage the world-leading expertise and track record from across UofG, drawing in academics from AI, human-computer interaction, science and technology studies, sociology, urban studies, politics, law, information studies, management, psychology and philosophy. In conjunction with external organisations including Microsoft Research, Nokia Bell Labs, National Library of Scotland, NHS National Services Scotland, Public Health Scotland, Scottish AI Alliance and others, we will design and deliver a unique training programme that addresses key research questions focusing on making AI applications human-centric, trustworthy and responsible.

The CDT will train a new generation of experts who will take a leading place in government, industry and academia to ensure that future AI systems contribute to society and work alongside humans. The CDT will recruit 53 students into a 4-year programme which is structured into a 1-year integrated Masters, balancing courses from all involved disciplines. Years 2-4 will then be focused on students carrying out their own research with interdisciplinary perspective within 4 themes:

- Creating and supporting trustworthy human-AI collaboration in AI applications

- Developing responsible AI applications that address equality, diversity and inclusion

- Ensuring the privacy and security of responsible and trustworthy AI

- Deploying responsible and ethical innovation methodologies and processes

Grant Reference Number: EP/Y009355/1

Title: UKRI AI Centre for Doctoral Training in Decision Making for Complex Systems

Team:
- Dr Mauricio Alvarez Lopez, The University of Manchester (PI)
- Dr Anna Scaife, The University of Manchester
- Professor Julia Handl, The University of Manchester
- Dr Richard Allmendinger, The University of Manchester
- Professor Samuel Kaski, The University of Manchester
- Dr Wei Pan, The University of Manchester
- Dr Anirbit Mukherkee, The University of Manchester
- Dr Carl Ek, University of Cambridge
- Professor Mateja Jamnik, University of Cambridge

Brief description of proposed work:

This CDT will focus on challenging aspects of developing, deploying and assessing AI and data-driven solutions for semi or complete automation of real-world systems. Such systems usually involve several decision-making agents, including humans, and typically require coordinating hundreds to thousands of decisions. The CDT will specialise in training a new generation of AI researchers with the theoretical and practical skills to develop and test new machine learning models and approaches that can efficiently cope with uncertainty in complex systems. The CDT understands systems in a broader sense, including multi-agent systems in robotics, supply chain management and sports teams, to systems in scientific domains such as astronomy and molecular biology.

A consortium between the University of Manchester and the University of Cambridge will lead the CDT. It will bring together researchers in machine learning with a strong track record in developing methodologies and applying these to real-world data and domain scientists with a strong track record of data-driven learning. The consortium has significant experience in the type of translational AI research that is at the core of the CDTs vision. The team is a balanced mix of AI experts, from Turing World-Leading Researcher Fellows to early-career rising stars, domain experts from selected fields of science, decision scientists, and a diverse set of companies. The priority area for the CDT will be Science and Research, starting with three fields of research, physics, biotechnology and materials science, and generalizing the solutions to decision-making broadly in complex systems. We will train the students with the relevant knowledge and skills such that the CDT will also contribute to AI for increasing business productivity as a cross-cutting theme.

PhD projects will be cocreated between AI specialists and domain experts. During their first year, students will receive foundational training in AI and ML, relevant training in the specific field of research related to the student's project, and research training through individual and group projects. From the second year and throughout their programme, students will have access to a wider training experience in entrepreneurship and public engagement. At the same time, students will engage in cohort training activities, including journal clubs and a yearly conference. Furthermore, students will benefit from the strong institutional support around Responsible Research and Innovation and Equality, Diversion and Inclusion already in place at both Universities.

Grant Reference Number: EP/Y009363/1

Title: UKRI AI Centre for Doctoral Training in Artificial Intelligence for Molecular Exploration, Discovery, and Development

Team:
- Dr David Palmer, University of Strathclyde (PI)
- Professor William Kerr, University of Strathclyde
- Professor Christopher Tuttle, University of Strathclyde
- Professor Alison Nordon, University of Strathclyde
- Professor Feng Dong, University of Strathclyde
- Dr Blair Johnston, University of Strathclyde
- Dr Marc Reid, University of Strathclyde
- Dr Tahereh Nematiaram, University of Strathclyde

Brief description of proposed work:

The UKRI AI Centre for Doctoral Training in Artificial Intelligence for Molecular Exploration, Discovery and Development (AIMED2) will train the next generation of "digital chemists" with synergistic skills in artificial intelligence, chemistry, and business, enabling creative innovation across the scales of chemical development. Bringing together AI and chemistry leaders from the University of Strathclyde and 17 external partners from 9 industrial sectors, AIMED2 represents a vision of research and training that spans all scales of chemical discovery and development to focus on three key challenges for AI in the chemical sciences whose solutions would enhance UK innovation and productivity. The co-creation of AIMED2 between academia and industry has been motivated by the UK's urgent economic need for chemists with advanced digital literacy. AI is a key enabling technology for the chemical sector, but a lack of skills in the UK chemical workforce is "the greatest barrier to industrial digital technology adoption" according to government and industry reviews. Since the chemicals sector is the UK's second largest manufacturing industry, contributing over £30 billion of value to the economy in 2021, research and training programs are required to sustain and grow the UK's future prosperity.

AIMED2 will focus on the following three grand challenges for AI that are important across the chemical sciences: (i) Discovery and Development of Functional Molecules and Materials - the ability of AI to efficiently generate and explore vast chemical spaces will be exploited to accelerate discovery and development of high-value substances that would improve standard of life, including new pharmaceuticals, food substances, and energy materials; (ii) Analysis of Complex Chemical Systems - the ability of AI to recognise patterns in complex experimental data will be leveraged to develop new methods of detecting and monitoring chemical changes for applications across the chemical sciences, from detecting cancer to optimizing chemical reactions; (iii) Artificial Chemical Intelligence - chemistry-inspired AI will be developed to interpret chemical theory to become more accurate, robust, generalisable, and trusted. The three grand challenges present opportunities to chemists and new challenges to AI researchers. AIMED2 will provide a collaborative and multi-disciplinary environment to facilitate the solution of these problems. Having AI researchers and chemists working together will ensure that the AI solutions work on real-world chemical data, agree with chemical theory, benefit business decision making, and meet the needs of the chemistry community.

AIMED2 will train 60 doctoral students using a cohort-based approach designed to provide all of the technical and personal skills required for them to become future leaders in digital chemistry, from science to business to leadership skills. The co-creation of AIMED2 between academia and industry has brought together companies from several chemical sectors to provide a vibrant multi-disciplinary research and training environment where researchers learn to communicate with scientists from different fields. Every doctoral student will have two supervisors, one from an AI background and one from an experimental chemistry background, ensuring that AIMED2 produces researchers with the skills necessary to innovate in both domains, and across scales of chemical development. For industry-facing projects, one additional supervisor will be from an external partner. AIMED2 will integrate digital, local, CDT-wide and secondment-based training, using both supervisor-led and peer-to-peer learning, to create a personalised training programme for each student. AIMED2 will be hosted at the University of Strathclyde, with students making regular visits or strategic secondments to industrial partners. Each student will obtain a Postgraduate Certificate in Researcher Professional Development and a PhD.

Grant Reference Number: EP/Y00938X/1

Title: UKRI AI Centre for Doctoral Training in AI enabled healthcare

Team:
- Professor Paul Taylor, University College London (PI)
- Dr Kate Ricketts, University College London
- Dr Kezhi Li, University College London
- Dr Pearse Keane, University College London
- Dr Ivana Drobnjak, University College London
- Professor Parashkev Nachev, University College London
- Dr Stephen Harris, UCL Hospitals NHS Foundation Trust
- Dr Adam Dubis, University College London

Brief description of proposed work:

What is AI-enabled healthcare?

Research in artificial intelligence or AI explores how computers can be programmed to perform complicated tasks. The field is often also referred to as 'machine learning' because these programs learn to detect patterns in data. This is useful in healthcare because modern medicine generates enormous amounts of data, often too much for humans to make sense of. The NHS, for example, performs over 40 million scans every year. Researchers also have access to the DNA of hundreds of thousands of patients, the medical records of millions of patients as well as data from fitbits and smartphones. AI can analyse all these kinds of data to identify potential new drugs, or spot signs of disease in X-rays, but also to solve urgent problems in the management of the NHS, like predicting how many patients will need to be admitted tonight from our local A&E.

Why do we need a centre for doctoral training in digital healthcare?

To realise the promise of AI-enabled healthcare, we must train researchers so that they understand the data and how to program the computers to process it. We need to have close collaborations between researchers in AI and researchers in health, but also with the doctors and nurses who best understand the problems that we are trying to solve. We also want companies to be involved, since most solutions will need to be developed commercially to be widely adopted. Only a centre for doctoral training can provide this. We believe that this will work best if it is a 'multidisciplinary' centre, in which people with different backgrounds and qualifications work on joint projects and learn from each other.

What will the centre do?

The CDT will be a partnership between UCL, three world-leading NHS hospitals, other healthcare practitioners, patients and companies. It will recruit 10 students a year for five years. Some will be doctors but most will be computer scientists and engineers. Students will study for four years; the first year will be a mix of teaching and research; the remaining three will focus on a research project. All students will spend time working in a hospital or other healthcare organisation, to gain a better understanding of health work and how systems are used. All will have the opportunity to spend time in industry to understand how commercial software is developed.

What is different about our proposal?

1.   UCL not only a world-leading university for research in AI but also home to more research in medicine and the biomedical sciences than any other. There is a dedicated Institute of Health Informatics, which conducts research using large collections of data.

2.   Three of the world's most famous hospitals, UCLH, Moorfields and Great Ormond Street, will be partners. Our students will be able to use unique datasets because our partner hospitals have installed sophisticated computers making it easier for doctors to record information, and some have built special systems alongside them that will help our students develop AI programs safely and make it easier to get them into routine use.

3.	We want to make sure that all patients benefit equally from our research. We will make sure that the data we use and the programs we write are fair and that no one ends up being discriminated against because of their race or gender. We also want to make sure that students from all backgrounds and communities have an equal chance to be accepted as students in the centre.

4.	We will involve patients in the life of the centre. We need to get patients and practitioners involved in the design of our projects if the research is to be relevant and so people can have confidence in AI-enabled healthcare systems and services. All our students will be taught about responsible research and innovation and be trained to think carefully about the effects of their work and its value for society.

Grant Reference Number: EP/Y009401/1

Title: UKRI AI Centre for Doctoral Training in AI for Sustainability

Team:
- Professor Enrico Gerding, University of Southampton (PI)
- Dr Vahid Yazdanpanah, University of Southampton
- Dr Regina Frei, University of Southampton
- Dr Selin Ahipasaoglu, University of Southampton
- Dr Stephanie Gauthier, University of Southampton
- Professor Sebastian Stein, University of Southampton
- Dr Dimitra Georgiadou, University of Southampton

Brief description of proposed work:

Environmental sustainability is one of the greatest challenges the world is facing, with many organisations and countries including the UK setting ambitious targets to reduce emissions and waste, and increase renewable energy production. Technologies such as artificial intelligence (AI) are seen as a key enabler to achieve these targets. The CDT will address this need by training future leaders in the application of AI to engineer a more environmentally sustainable future. Crucially, the students will not only have a fundamental understanding of AI; they will be able to identify the opportunities where sustainability challenges can be addressed using these tools, as well as understanding the business and social implications and needs. Stakeholder meetings and follow-up surveys have identified this type of system-level thinking as one of the key training requirements besides technical ability. Indeed, without considering people, profit, and planet together, solutions are unlikely to be adopted on a wide scale. Further to that, our unique selling point is that students will be trained with a view to directly respond to industry/societal challenges, whose input will be constantly updated from our large pool of non-academic stakeholders.

Together with our network of stakeholders, we have identified 4 themes as the focus for the research: (1) Sustainable Operations and Circular Economy, (2) Sustainable Transport and Logistics, (3) Energy and Buildings and (4) Sustainable AI. The first 3 themes deal with specific application areas where AI can improve environmental sustainability. For example, AI can be used to make transport more efficient, particularly if autonomous vehicles allow a rethink of what future cities and vehicle use will look like. In the more immediate future, energy use can be more efficient and clean through effective management of electric vehicle charging, battery storage, local energy production, and behaviour change. Theme 4 deals with hardware, software, and social/business solutions to deal with the sustainability of AI itself. For example, v.3 of ChatGPT is estimated to have cost an equivalent of over 550 tons of CO_2 to train. This can be addressed by building low-powered hardware and algorithms, and understanding the quality/cost trade offs. Interdisciplinary projects and projects that span multiple themes are particularly encouraged.

Sustainability is a core theme of our training approach, which has a range of sustainability-themes cohort activities, including innovation camps, hackathons and outreach activities, as well as regular team exercises where sustainability practices in organisations are scrutinised, re-scoped and improved. The aim is to produce a sustainability mindset whilst creating a collaborative team spirit and have an immediate impact in the operations within organisations. In addition, equality, diversity and inclusion is embedded throughout the CDT, from recruitment activities, to training of the management and supervisory team, as well as accommodating students with diverse backgrounds through a flexible training approach. Throughout, ethical considerations will be at the forefront, and students will be trained around responsible innovation.

Whilst there are compulsory modules which are bespoke to the CDT, a range of optional modules from 3 faculties are offered throughout the CDT duration to supplement any gaps in knowledge. These range from technical subjects such as machine learning and embedded devices, to economics, business and supply chain management. In addition, an extensive range of online and short training workshops will be available, from software carpentries for data analysis and software engineering principles, to training around policy (e.g., how to engage with government and writing policy documents) and commercialisation. These training and cohort-building activities provide students with more than a PhD, and significantly enhance their employability.

Grant Reference Number: EP/Y009452/1

Title: UKRI AI Centre for Doctoral Training in Social Prescribing and Personalised Care

Team:
- Professor Eiman Kanjo, Nottingham Trent University (PI)
- Professor Xiao Ma, Nottingham Trent University
- Professor Clifford Stevenson, Nottingham Trent University
- Professor Ahmad Lotfi, Nottingham Trent University
- Professor Sergey Saveliev, Loughborough University
- Professor Farid Meziane, University of Derby
- Dr Philip Quinlan, University of Nottingham
- Professor Shigang Yue, University of Leicester
- Professor Eef Hogervorst, Loughborough University
- Professor John Hunt, Nottingham Trent University
- Professor Richard Emes, University of Nottingham
- Professor Chris Greenhalgh, University of Nottingham

Brief description of proposed work:

The demand for Social Prescribing (SP) is rapidly increasing in the UK. As per the long-term plan set by NHS, every GP practice in England will have access to an SP link worker by 2023/24, with a target of referring 900,000 people by then. Despite this, there are several challenges associated with providing SP services, including unmanageable workloads for link workers, inadequate transportation networks, and the absence of a single governing body overseeing all efforts.

The CDT is of national priority as it tackles urgent challenges to alleviate the strain on the NHS. It achieves this by expanding preventative, pre-emptive, and direct interventions, reducing health inequalities, and reaching vulnerable individuals and communities through the use of AI, data management, and a Community-Embedded Entrepreneurial approach via a novel Venture Building program. These challenges are identified through long-term co-creation-driven engagement with the SP community, which includes representatives from the British Social Prescribing Academy and its representative in the East Midlands, along with local NHS hospitals, Integrated Care Systems, and local authorities and LEPs.

This CDT is also a regional priority as it will aid in addressing the data science skills gap in the region. It will do so by training a pool of talented individuals to become the next generation of experts in fields such as data science, AI, digital healthcare technologies, data management, psychology, social science, and public policy. This will contribute to the co-creation of an open, connected, and integrated SP ecosystem empowered by AI.

We have brought together five key East Midlands universities, namely Nottingham, Loughborough, Leicester, and Derby Universities, led by Nottingham Trent University, to create an internationally leading program. Leading experts from the East Midlands universities, supported by a large pool of partners across Nottingham, Leicester, Derby, and Loughborough cities and their surrounding areas, will contribute to the co-creation of an AI-empowered SP ecosystem. This CDT is supported by 30 student scholarships from the five universities and a 25% contribution from industrial partners.

This program incorporates novel social prescriber and shared decision-making algorithms, data sharing and movement, resource planning, and promotes a regional community-informed approach to non-medical support and resources. We will develop AI-powered recommender systems and language models to suggest suitable SP options for patients based on their unique needs and preferences. The system considers the patient's medical history, demographics, lifestyle factors, and social determinants of health to provide personalized recommendations for services such as exercise programs, community groups, and mental health support, along with information on how to access them.

The training program will not only embrace Responsible Innovation and Responsible AI but also set an example for best practices nationally and internationally, especially in areas concerning trust, privacy, transparency, missing data, accountability, and inclusion.

Furthermore, the CDT will incorporate a unique Venture Building program aimed at empowering the productization of each project into a Minimum Viable Product (MVP) and testing the MVPs through implementation in the real world.

We are dedicated to upholding the principles of EDI. Our management team is comprised of a diverse group of individuals, including the PI (a female from a BAME background) and CO-Is from seven distinct cultures. To ensure students' well-being and welfare across the five universities, we will form a Pastoral Care Committee that will work closely with the doctoral school and support services at each institution and through monthly sprints at the project team level and quarterly sprints at the CDT level. Additionally, students will receive training in leadership and Responsible AI & Innovation.

Grant Reference Number: EP/Y009460/1

Title: UKRI AI Centre for Doctoral Training in Biomedical Innovation

Team:
- Dr Ian Simpson, University of Edinburgh (PI)
- Dr Diego Oyarzún, University of Edinburgh
- Dr Miguel Bernabeu Llinares, University of Edinburgh
- Professor Sotirios Tsaftaris, University of Edinburgh
- Professor Nicholas Mills, University of Edinburgh
- Dr Ava Khamseh, University of Edinburgh
- Professor Athanasios Tsanas, University of Edinburgh
- Dr Michael Gutmann, University of Edinburgh
- Dr Luciana D'Adderio, University of Edinburgh

Brief description of proposed work:

The greatest challenge to realising the potential of artificial intelligence in biomedicine is its translation to real-world use. Our vision is to create an AI Centre for Doctoral Training in Biomedical Innovation (AI4BI) to produce inter-disciplinary researchers with both technical skills and domain knowledge, and with experience delivering innovation into the public and private sectors. To achieve this, we need to train researchers who can successfully design, develop, and implement AI approaches in partnership with external stakeholders such as the UK National Health Services, pharmaceutical, and biotechnology companies.

Our research will focus on the largest application areas for AI in biomedicine; 1.) biomedical imaging - AI can be used to detect regions of interest in images such as X-rays, MRI scans, Ultrasounds, or retinal scans that can help clinicians decide on approaches for surgery or treatment with specific drugs. 2.) biomedical engineering - AI can be used to aid the design of medicines and vaccines and to improve structural and molecular simulations of biological processes helping researchers to understand mechanisms of disease and drug action. 3.) biomedical & health informatics - AI methods are well suited to integrating diverse data such as genomic, medical record, imaging, and sensor data at scale into predictive models that are more informative than those created from a single data source. 4.) genomic medicine - AI has the potential to capture causal relationships between people's clinical features and their genomic sequences which is central to efforts to predict and diagnose disease and its causes. The successful development and adoption of novel AI technologies in all of these application areas has the potential to revolutionise our understanding of disease, accelerate the development of new treatments, and improve the diagnosis and treatment of patients.

The UK has a world- leading environment for biomedical research and innovation and has some of the most advanced and highly regarded health services and systems in the world. For us to realise the potential of AI in this domain as envisioned in the governmental UK National AI Strategy (2021) and UK Life Sciences Vision (2021) we need to address critical skills shortages that have been identified by the BBSRC, MRC, and the Association of British Pharmaceutical Industries in computational and digital skills. This CDT will play a significant role in increasing the number of early career researchers that have those skills and who are quipped to ensure that the AI tools and methods they develop are widely adopted.

Our CDT will adopt a 4-year PhD programme with integrated study where core skills are taught using cohort-based approaches, supplemented by a flexible elective programme of advanced courses in biomedical, clinical, computational, statistical, and mathematical topics. Most assessed learning will take place over the first two years with students able to pick-up additional courses tailored to any emerging needs in the third year. We will run a complimentary training and activities programme in transferable skills, responsible research innovation, ethics, and public outreach. All PhD projects will involve an external partner ensuring that research is well aligned with societal and commercial needs. Students will undertake a group research project to develop inter-disciplinary working skills, facilitate peer-peer learning, and strengthen the cohort effect and a 3-month research placement project with an external partner. They will be able to take part in the "Venture Builder Incubator" programme where they will develop entrepreneurial skills whilst embedded in their research projects. We have designed our programme to maximise the ability of students from different academic backgrounds to transition effectively into applied AI researchers and for them to benefit from the inter-disciplinary experience, skills, and ideas of other cohort members.

Grant Reference Number: EP/Y009479/1

Title: UKRI AI Centre for Doctoral Training in Scientific Machine Learning and Dynamical Modelling

Team:
- Dr David Barton, University of Bristol (PI)
- Dr Dandan Zhang, University of Bristol
- Dr Laurence Aitchison, University of Bristol
- Professor Richard Wilson, University of Bristol
- Dr Conor Houghton, University of Bristol
- Dr Sabine Hauert, University of Bristol

Brief description of proposed work:

Machine learning (ML) now reaches into every area of our lives, from the TV programme recommendations on our favourite streaming platform to fraudulent transaction detection by our bank. However, there are significant limitations to pure-ML solutions, especially within science and research. For example, consider within-day prediction of network road traffic. For large cities, historical traffic data exists, but many external factors (e.g., roadworks, weather events, government policy, human behaviour) change during data collection, making pure-ML-based prediction doomed to fail. In safety-critical applications, for example, the analysis of nuclear reactors or the use of driverless cars, the problem of explainability is key - we must be confident that our algorithms will behave as expected, even when presented with unusual circumstances - trust that is difficult to establish with pure-ML solutions. When designing new engineered materials, creating and testing experimental samples is extremely expensive, meaning that there is very limited data that pure-ML algorithms can learn from, severely limiting their usefulness.

Fortunately, classical scientific methods have established laws that govern behaviour, at least approximately, that can help out: these include rules governing traffic queue propagation and the equations describing nuclear physics or multiscale brain models. We call this dynamical modelling. The key point is that dynamical modelling can complement the broad power of machine learning.

This centre for doctoral training is focused on this broad-ranging scientific question: how can we best fuse machine learning and dynamical modelling to solve real-world problems in science and engineering? In essence, how can we get the best of both worlds? And how can this approach drive progress in important economic and societal topics such as renewable energy, neuroscience, robotics, social medicine, and climate science?

To answer this scientific question, we have an educational vision grounded in innovative training techniques, which is aided by an organisational vision that promotes industrial engagement, open science, and diversity in people and thinking.

Grant Reference Number: EP/Y009487/1

Title: UKRI AI Centre for Doctoral Training in Practice-Oriented Artificial Intelligence

Team:
- Professor Peter Flach, University of Bristol (PI)
- Dr Paul Marshall, University of Bristol
- Dr James Cussens, University of Bristol
- Dr Raul Santos-Rodriguez, University of Bristol
- Dr Oliver Ray, University of Bristol
- Dr Conor Houghton, University of Bristol
- Dr Martha Lewis, University of Bristol
- Dr Edwin Simpson, University of Bristol
- Dr Nirav Ajmeri, University of Bristol
- Professor Andrew Charlesworth, University of Bristol
- Dr Zahraa Abdallah, University of Bristol
- Dr Telmo Silva Filho, University of Bristol

Brief description of proposed work:

Our mission is to train the next generations of AI innovators, equipping them with the expertise and skills to co-design and build practice-oriented AI systems for science and research domains of key national importance including health, environment and energy, and creative industries. Our innovative, cohort-based training programme will deliver highly trained PhD graduates with the transferable skills to deliver impact while solving societally important problems in responsible ways.

While fully autonomous artificial intelligence dominates today's headlines in the form of large language models, self-driving cars and human-level game play, the key AI challenges of tomorrow are posed by the need for a deeper cooperation and alignment between AI systems, AI practitioners and domain experts, the latter being the source of both relevant case-specific knowledge and requirements with regards to functionality, robustness, transparency, accountability and fairness for a given application. In other words, we need AI experts with the ability to act as a bridge between domain experts and AI technology. While this could be addressed by training AI experts that focus on specific domains, we argue that developing the ability to work across application areas in science and research will give the UK the competitive advantage to adapt to future developments such as emerging disciplines and economic sectors. In close conversation with our industry partners, we thus identified Practice-Oriented Artificial Intelligence (PrO-AI) as a core sub-discipline of AI where the need for and deficit in skills is abundantly evident, while being homogeneous enough to have intellectual integrity and be explored and researched within the context of a single CDT. The most important aspects of the bespoke training programme are:

- Practice projects will be run in collaboration with CDT partners (academic and industry) and across CDT cohorts to offer a deep dive into an application domain. Students will liaise with domain experts to get an understanding of their expertise, expectations and success criteria. Exploring different domains will allow the students to acquire the transferable skills that will be key when moving between domains in their future careers.

- In parallel the students will take the Foundations of Practice-Oriented AI, a highly personalised module which is delivered together with an academic mentor to gauge each student's knowledge and identify areas where further study is necessary. The module first covers data-driven AI, knowledge-intensive AI and human-AI interaction, to then move to human-centred and participatory methodologies to bring those AI techniques into practice, as well as the legal and ethical context to innovate responsibly and in a manner beneficial to society.

- Other requirements from stakeholders include: the ability to design and implement complete end-to-end systems in a responsible way; acquiring depth in domain-specific subjects without sacrificing AI breadth; the ability to work (and learn to lead) in teams of people with diverse skill sets; an entrepreneurial mindset; and being "AI ambassadors" who are able to inspire but also to manage expectations through their in-depth understanding of the strengths and weaknesses of different AI techniques.

The PrO-AI training programme is designed to achieve the above by strongly emphasising cohort-based training, starting from physical co-location and strengthened by in-built collaboration across cohorts so that senior students are involved in mentoring their juniors. In summary, the PrO-AI training programme pulls together the University of

Bristol's proven track record in doctoral AI training and its unique and comprehensive strengths in AI and health, environment and energy, and creative industries, to deliver highly trained AI innovators that will be equipped with skills to deliver the impact that the UK demands from AI in practice.

Grant Reference Number: EP/Y009509/1

Title: UKRI AI Centre for Doctoral Training in Data Intensive Physical Systems

Team:
- Professor Nikolaos Konstantinidis, University College London (PI)
- Professor Marc Deisenroth, University College London
- Professor Sarah Spurgeon, University College London
- Professor Serge Guillas, University College London
- Dr Maria Perez-Ortiz, University College London
- Dr François-Xavier Briol, University College London
- Dr Anasuya Aruliah, University College London
- Professor Jason McEwen, University College London
- Dr Tim Scanlon, University College London
- Dr Michel Tsamados, University College London
- Mrs Elizabeth De-Ben Rockson, University College London

Brief description of proposed work:

The AI-DIPS CDT will combine UCL's world-leading expertise in theoretical and applied AI to deliver a unique research training programme that will address major challenges in some of the world's most data-intensive research fields in Physical Sciences. This cohort-based research training in cutting-edge AI techniques and domain-specific knowledge will produce first-class AI experts, with a strong quantitative background and grounding in formal and practical AI, who can deploy their expertise across multiple areas, addressing the large shortage of skills and maximising the benefits of AI in society.

The main focus areas of the CDT are climate modelling, nuclear fusion and fundamental physics. These are amongst the most data-intensive fields of research, have a significant overlap in the underlying science and share common challenges. As such, they will benefit from a synergistic approach in developing and deploying novel AI techniques to address those challenges, including: (a) reliable uncertainty quantification for decision making in highly complex environments; (b) resource-efficient algorithms to capture complex underlying phenomena for modelling large-scale processes; (c) encoding domain knowledge into learning algorithms, such as physics-informed and geometric machine learning (ML); and (d) development of domain-specific model interpretability methods to extract new insights about underlying phenomena. By tackling these challenges, our students will develop invaluable AI skills that are highly transferable and apply to multiple fields.

Our programme will address two UKRI priority areas: "Science and research" and "Environment and energy", as well as the cross-cutting priority theme "Application of AI to government policy and public services". Our CDT's research, training and partnership structure provide a unique framework for addressing the AI skills needs in these areas. Our vision is fully aligned with the recommendations of the National AI Strategy to deliver high-impact AI research in application domains and to enable graduates in STEM fields other than Computer Science to become AI experts. All our partners from industry, government and the third sector, as well as researchers from other fields, have shown enthusiastic support for this proposal and have unanimously highlighted that the need for trained researchers able to exploit AI techniques in these areas is large and unmet, which our CDT will address.

Our students will go through a bespoke, cohort-based training programme in key aspects of research software engineering, advanced statistics and Machine Learning, with the addition of domain-specific courses according to the individual student and research project needs. This core training will be complemented with dedicated training workshops, such as in responsible innovation, sustainability, communications and entrepreneurship. In addition to their PhD research project, every student will undertake, as part of their training, a 3- to 6-month placement, with one of our Knowledge Exchange partners in various ``AI for sustainability'' projects. Through this work, our students will influence policy and contribute to the UK's net-zero strategy.

We will strive to maintain an inclusive and supportive research culture, which puts the wellbeing of the CDT students and staff at the heart of the programme and enables every individual to flourish according to their talents and reach their maximum potential. We will also put special emphasis on widening participation activities, to offer research experience opportunities for students from underrepresented groups and/or disadvantaged backgrounds, both at high-school and at undergraduate level, and help transform science inclusivity, inspire students and teachers, and ignite our CDT students' leadership potential.

Grant Reference Number: EP/Y009533/1

Title: UKRI AI Centre for Doctoral Training in AI for the Environment (Intelligent Earth)

Team:
- Professor Philip Stier, University of Oxford (PI)
- Dr Hannah Christensen, University of Oxford
- Professor Tarje Nissen-Meyer, University of Oxford
- Dr Louise Slater, University of Oxford
- Dr Roberto Salguero-Gomez, University of Oxford
- Professor Yee Teh, University of Oxford
- Professor Stephen Roberts, University of Oxford
- Professor Andrew Markham, University of Oxford

Brief description of proposed work:

Earth is facing numerous existential environmental challenges, including crises in climate, biodiversity, and pollution. Urgent advances in environmental science are hampered by our inability to analyse ever-increasing volumes of environmental data and generate robust models for predictions. In contrast, Artificial Intelligence (AI) has experienced a series of dramatic breakthroughs that are transforming key science areas. We must urgently capitalise on these breakthroughs to confront and resolve our environmental crises.

However, environmental scientists remain ill-prepared to take advantage of the advancements in data sciences, while data scientists lack the domain knowledge to tackle frontier environmental challenges. This creates a bottleneck for UK leadership in science, innovation, and entrepreneurship in this emergent space. Hence, a strong interdisciplinary training need exists at the interface between the environment and AI.

The Intelligent Earth CDT will deliver a targeted, cohort-based training programme, equipping a new generation of doctoral students to tackle some of the most pressing environmental issues using AI through five closely connected themes: (1) Climate, (2) Biodiversity, (3) Natural hazards, (4) Environmental solutions, and (5) Fundamental AI research on complex environmental data.

The Intelligent Earth CDT will be intrinsically interdisciplinary, with each student project supported by two supervisors, one from an environmental science department and one from an AI department. Each student will have an external advisor from one of the non-academic partners, who will serve as host for a secondment. This setup will provide an unrivalled student experience and create crucial UK interdisciplinary capacity.

The CDT will deliver a targeted interdisciplinary cohort-based training programme with two entry streams, one for highly numerate candidates from environmental science backgrounds and the other for environmentally driven candidates from computer science, data science, mathematics, statistics, or physics backgrounds. The programme will combine taught courses in environmental and data sciences, research projects, transferable skills training and interdisciplinary research seminars, with the active involvement of our non-academic partners. The teaching model for all courses is tailored towards training graduate students to become independent researchers with a high degree of transferable skills: after introductory core lectures, students will be introduced to the corresponding AI tools, frameworks, and environmental datasets (provided in a cloud-based setting) in advanced courses. Students will work in interdisciplinary groups, applying the taught material to tackle grand challenges in environmental science with AI supported by peer learning. Cross-cohort group work will be accompanied by tutorials and will be formally assessed, with the aspiration to jointly author journal or conference publications.

Co-creation across disciplines and sectors is at the core of the programme, facilitated by a strong set of industrial and non-academic partners, as detailed in the case for support.

The in-depth training programme will train a new generation of quantitative environmental data scientists who are equipped to make substantial contributions in environmental and data sciences, as well as prepared for a wide range of career paths, having received dedicated training in enterprise and innovation.

Grant Reference Number: EP/Y009592/1

Title: UKRI AI Centre for Doctoral Training in Artificial Intelligence and Music

Team:
- Professor Simon Dixon, Queen Mary University of London (PI)
- Dr Emmanouil Benetos, Queen Mary University of London
- Professor Mark Sandler, Queen Mary University of London
- Dr Mathieu Barthet, Queen Mary University of London
- Dr Charalampos Saitis, Queen Mary University of London
- Mr Michaela MacDonald, Queen Mary University of London
- Dr Ekaterina Ivanova, Queen Mary University of London
- Dr Gyorgy Fazekas, Queen Mary University of London
- Professor Nick Bryan-Kinns, Queen Mary University of London

Brief description of proposed work:

The UKRI AI Centre for Doctoral Training in Artificial Intelligence and Music (AIM) will train a new generation of researchers who combine state-of-the-art techniques in Artificial Intelligence (AI), machine learning and signal processing with cross-disciplinary understanding of music to deliver groundbreaking original research and impact within the UK Creative Industries (CI) and cultural sector.

The core area of this CDT is Music Informatics, which involves the use of intelligent information processing methodologies to understand and model music, and to develop tools and services for creation, distribution and interaction with music and music-related information. The proposed research focus is structured along three themes:

1. Music understanding - machine listening and intelligent signal processing for data-driven and knowledge-driven modelling of music perception, cognition, and preference;

2. Intelligent and immersive interfaces - embedded intelligence for performing, producing, learning and experiencing music; applications of music AI to health, wellbeing and extended reality;

3. Computational creativity - automated composition, arrangement, expressive performance, music production and neural audio synthesis.

Evidence of the national need for highly skilled graduates in AI, and specifically related to the CI sector, is overwhelming. The UK's National AI Strategy (2021) identifies AI as "central to our development as a global science and innovation superpower" and "central to how we drive growth and enrich lives". The AI Council's AI Roadmap (2021) reports that AI could produce a "10% increase in UK GDP in 2030", and urges support for more PhD places in AI, citing "unmet demand to justify a five to tenfold increase in places compared to the numbers in the AI Review" of 2017.

For the specific application area of this bid, the Creative Industries sector is a substantial part (6%, or £116bn GVA) of the UK's economy and employs more than two million people. Bazalgette's "Independent Review of the Creative Industries" highlights their "central importance to the UK's productivity and global success," and notes the particular importance of the music industry (£4.4bn GVA). The Creative UK Group's 2021 report on the UK Creative Industries cites "venture capitalists investing record amounts into UK businesses that bring creative skills together with technologies such as Artificial Intelligence," but this opportunity for growth will be stifled without a supply of high-quality graduates.

The CDT will take a cohort-based approach, drawing on a supervisory team of 34 academics led by QMUL's Centre for Digital Music (C4DM), a world-leading research group in the area of music and audio technology with a strong track record in doctoral training. The entire training approach, from the strategic focus to the topics of individual PhD projects, will be guided by C4DM's network of 35 industrial partners, ranging from large companies and public corporations to a vibrant network of SMEs including several successful QMUL spin-out companies. Each PhD student will undertake a personalised programme of research supported by specialist taught modules, industrial secondment, expert mentoring, and skills training.

The AIM CDT benefits from a substantial institutional investment in the QMedia Studios (£3M), including a professional audio recording studio and state-of-the-art motion capture equipment and the Creative Engineering Hub (£3M), featuring maker spaces and rapid fabrication equipment. QMUL will provide 10 studentships, while industry support currently totals £1.3M of cash contributions and £2.6M of in-kind contributions. AIM builds on QMUL's outstanding track record in this interdisciplinary area, while bringing a new focus to the opportunities and challenges of artificial intelligence in the creative industries.

Grant Reference Number: EP/Y009606/1

Title: UKRI AI Centre for Doctoral Training in Discovery for Health - Next-generation Machine Learning for Accelerated Scientific Discovery in Health

Team:
- Professor Hui Wang, Queen's University of Belfast (PI)
- Professor Roger Woods, Queen's University of Belfast
- Professor Frank Kee, Queen's University of Belfast
- Professor Mauro Paternostro, Queen's University of Belfast
- Professor Adele Marshall, Queen's University of Belfast
- Professor Ultan Power, Queen's University of Belfast
- Professor Gary Hardiman, Queen's University of Belfast
- Dr Paul Mullan, Queen's University of Belfast
- Professor Amy-Jayne McKnight, Queen's University of Belfast
- Professor Stella Martin, Queen's University of Belfast

Brief description of proposed work:

Though the utilisation of AI across healthcare markets is still at a fledgling stage, the potential for AI to become common practice in healthcare, drug discovery, and medical diagnostics is massive, with each of these markets expected to grow by ~25-45% over the next 5-10 years to become multi-billion-pound industries worldwide. This expansive growth is premised on there being a pipeline of skilled workers with the capability to understand and make use of complex data generated by sensors, medical imaging, and multiomics technologies, to develop new technologies that bring drugs to the market more quickly or diagnose disease more quickly, improving time-to-treatment and time-of-treatment, to name a few.

Machine learning (ML) is the key technology to unleash this potential. ML is capable of discovering correlations from large data sets, which unpins successful AI applications such as ChatGPT. ML is however much less capable of discovering causal relations, hypotheses or signatures, which are important for research and innovation especially in health. Thus, this CDT aims to consolidate three types of discovery, which have previously only been studied in isolation, into a single machine learning centred framework, discovery AI (DAI), enabling:

1. Causality discovery - a fundamental goal of science allowing causal learning from data to infer causality for intervention emulation and assessment, which underpins understanding and treatment of disease.

2. Signature discovery - characterisation of objects (e.g., diseases, outcomes of therapeutic interventions) using explainable machine learning for disease prevention / detection and medical imaging.

3. Hypothesis discovery - hypothesis generation based on knowledge models (e.g., GPT or knowledge graphs) and logical reasoning to discover knowledge gaps and new lines of enquiry for understanding mechanisms of diseases/interventions, drug repurposing.

This DAI vision can only be tackled by a large team working in "sprint", so we propose to bring together outstanding researchers, postgraduate researchers (PGRs), and 3rd sector representatives across AI and health. To this end, we have co-created this CDT alongside our network of 16 industry partners, including multinationals (e.g., Microsoft, Randox, Portrai, Galen, DELL, Roche, ThermoFisher, Illumina), SMEs (e.g., Analytics Engines, Exploristics, Equal1, Oosto, Blokbio); and civic bodies/ public sector organisations (e.g., HIRANI, HSC-NI, PHA, Catalyst NI, Isaac Newtown Institute) across several key UK sectors including pharma, diagnostics, medical imaging, computing, data analytics, and quantum tech. All 60 students on the programme will have industry or public sector involvement, whether through direct sponsorship/collaboration or via placements.

This CDT will endow a new generation of PGRs with the unique skills required to advance AI-led scientific discovery and apply it to Health. PGRs who leave this CDT will have a unique, comprehensive expertise in both discovery AI and biomedical science, to be able to develop and deploy tools that accelerate our understanding, detection, prevention, and treatment of disease. In addition, acquired soft skills will enable them to solve problems creatively and to design and implement innovative solutions, with an in-depth understanding of ethical and privacy concerns in handling sensitive health data, responsible research and innovation, environmental sustainability, and equality, diversity, and inclusion. By exploiting this expertise, plus the considerable potential of extensive health datasets in

Northern Ireland (NI), the leading entrepreneurial track record of Queen's University Belfast, existing links with the Turing Institute, and the potential offered by the recently-established NI AI Centre, we will establish a regionally based, but nationally excellent cluster in AI research and innovation.

Grant Reference Number: EP/Y009614/1
Title: UKRI AI Centre for Doctoral Training in Citizen-Centred Artificial Intelligence

Team:
- Professor Shaun Lawson, Northumbria University (PI)
- Professor Pamela Briggs, Northumbria University
- Dr Kyle Montague, Northumbria University
- Dr Reem Talhouk, Northumbria University
- Professor William Gaver, Northumbria University
- Professor Wai Lok Woo, Northumbria University
- Professor Longzhi Yang, Northumbria University
- Dr Marion Oswald, Northumbria University
- Dr Dawn Branley-Bell, Northumbria University
- Professor Robert Wilson, Northumbria University

Brief description of proposed work:

Artificial Intelligence (AI) is rapidly changing the way people live and work. From education and healthcare to purchasing goods and services, AI is transforming daily life. However, much of the conversation about AI has been focused on the benefits to businesses and governments, rather than the impact on citizens. Such narratives suggest a vision where citizens play a passive role, on the periphery of AI developments and receiving trickle-down benefits, rather than occupying a central role as co-designers of a future AI-enabled society and economy. We argue that such a vision for AI is not yet sufficiently inclusive and, moreover, could result in systems and services that, at best, fail to realise opportunities for societal and individual good and, at worst, create harm, exacerbate mistrust in technology, and perpetuate existing and create new forms of inequalities and division. To reconcile the transformative potential of AI with citizens' concerns and rights, there is a need to build workforce capability to design AI systems that prioritize citizens' needs and aspirations.

The Centre for Doctoral Training (CDT) for Citizen-Centred AI (CCAI) aims to train doctoral students to work at the interface between human and machine intelligence, becoming skilled in citizen-centred approaches to the design, development, implementation, governance and evaluation of AI technologies. Our vision for CDT student experience prioritizes practical training in inter-disciplinary skills, incorporates practice-based industry and community placements, and is built upon a foundational ethos of personal and professional development. Students will be trained in inter disciplinary skills including software design, development, data management, and ethical use of data and algorithms combined with a range of design approaches, including interaction, critical and speculative design and action-research techniques. Attention will also be given to cultural, economic, legal, and social responsibility, including potential divisive implications of AI. All research will be co-created with a range of external stakeholders and we envisage example areas of application to include democracy, employment and automation, healthcare, civics, ageing, welfare, social media, environment and migration.

The CDT will be designed to accommodate a diversity of professional and disciplinary student backgrounds, career paths, and personal circumstances. Particular emphasis will be placed on pastoral care and wellbeing of all students. Finally, the CDT for CCAI is also rooted in a place-based civic mission. The North East of England, where it is located, has some of the worst statistics in England and Wales for unemployment, low pay, disability rates, household deprivation, health, child poverty, and digital exclusion. The CDT will provide place-based training that recognizes and responds to deprivation, optimizing opportunities for student-led knowledge exchange that could generate social and economic benefit across diverse communities.

Grant Reference Number: EP/Y00969X/1

Title: UKRI AI Centre for Doctoral Training in AI for Drug Discovery

Team:
- Professor Conrad Bessant, Queen Mary University of London (PI)
- Professor Gregory Slabaugh, Queen Mary University of London
- Professor Michael Barnes, Queen Mary University of London
- Professor Viji Draviam, Queen Mary University of London
- Professor Claude Chelala, Queen Mary University of London
- Professor Geoffrey Barton, University of Dundee
- Dr Gabriele Schweikert, University of Dundee

Brief description of proposed work:

Developing new medicines is a long and expensive process. It currently costs $1.3bn on average to bring a new drug to market. Unfortunately, this process of drug discovery is becoming more challenging, as drugs for more easily addressed diseases have already been discovered, while harder ones remain. As a result, drug discovery costs are growing at an estimated 15% per year. This trajectory is widely seen as unsustainable. However, artificial intelligence (AI) is poised to transform the process of drug discovery. By leveraging large datasets, AI can unravel complex relationships, behaviours, and genetic factors driving disease. AI can also search for drugs in the vast space of possible chemical structures. In addition, AI can evaluate and optimise potential drug candidates to maximise their impact in treating a disease, and can separate patients based on predicted drug response to ensure that each patient get the right drug (personalised medicine).

The pharmaceutical industry is now investing AI, with large companies growing AI capability in the UK and new UK SMEs emerging. However, as highlighted in a 2022 report by the Association of the British Pharmaceutical Industry, there is a major skills shortage as demand for scientific researchers with data skills is far exceeding supply. This challenge is confirmed by our CDT partner companies like Exscientia, GSK, and MSD, who enthusiastically see PhD training in AI for Drug Discovery (AIDD) as essential to support this rapidly growing sector of the UK bioeconomy.

We propose a Centre for Doctoral Training (CDT) in AI to build UK capacity in AI-based drug discovery science. Our CDT will train a next generation of PhD researchers equipped with interdisciplinary skills in AI and associated computational techniques applied to biology, chemistry and medicine. Interdisciplinarity is paramount, as existing AI programmes often graduate PhDs with strong AI skills but limited knowledge of biology, chemistry and medicine; and science or medicine PhDs usually lack advanced AI skills.

Currently, Queen Mary is running the only AIDD PhD program in the UK, led by Exscientia, funded by the BBSRC Collaborative Training Partnerships scheme. This programme is funding 21 PhD students with intakes during the years 2022-2024. In this UKRI proposal, we will leverage best practices from the BBSRC programme and scale it up, expanding to research topics within the EPSRC and MRC remit. This proposal adds the University of Dundee, bringing world class complimentary expertise, more high quality datasets, and additional supervisory capacity.

Our UKRI AIDD CDT will provide rich cohort-based training. As well as a formally assessed training programme, the CDT will hold a yearly AIDD Winter School delivered by industry and academic researchers, along with hands-on active learning activities. The CDT will also hold a yearly AIDD Summer Symposium, showcasing work by our PhD students. The event will be open to students from other doctoral training programs like the BBSRC LIDo program as well as researchers from The Alan Turing Institute and Crick Institute. The CDT will have dedicated AIDD activities, including training in computational methods and a journal club. Each student will have individualised training for any unique development needs, leveraging resources available at respective universities and external programs such as those offered by Software Sustainability Institute and Software Carpentry, national HPC resources and The Alan Turing Institute.

Our CDT will embed EDI throughout all aspects of its operation, training and external engagement. We will strive to increase diversity and create an inclusive community while promoting inclusivity in training and partnerships. We aim to establish a diverse and inclusive environment that respects and values all members. We will also identify common barriers and share best practices to foster new insights to promote inclusion and diversity.

Grant Reference Number: EP/Y00972X/1

Title: UKRI AI Centre for Doctoral Training in Artificial Intelligence for Sustainable Transport

Team:
- Professor Mauro Vallati, University of Huddersfield (PI)
- Professor Felipe Meneguzzi, University of Aberdeen
- Professor Brian Logan, University of Aberdeen
- Professor Nir Oren, University of Aberdeen
- Professor Lu Liu, University of Leicester
- Professor Kevin Tansey, University of Leicester
- Professor Ashiq Anjum, University of Leicester
- Dr Tianhua Chen, University of Huddersfield
- Professor Richard Hill, University of Huddersfield
- Professor Simon Parkinson, University of Huddersfield

Brief description of proposed work:

The reach the ambitious goals of the UK net-zero strategy, it is essential to decarbonise transport. Artificial Intelligence plays a pivotal role in transport decarbonisation, since it can support the crucial shift towards multimodal and sustainable transport by optimising routes and increasing efficiency, resilience, and reliability. However, current AI-based approaches lack an holistic understanding of the transport field, and focus on specific aspects hence limiting the impact deployed solutions can have in the wider field. There is a crucial need for experts in AI with an understanding of the wider transport field, to ensure the decarbonisation of the sector and the achievement of the 2050 net-zero goals. This CDT aims at fulfilling this gap, by exposing students to the main pillars of sustainable transport and to the differences in transport modalities at regional and national levels, and by supporting them with world-leading AI experts.

The CDT is a collaboration between the Universities of Huddersfield, Aberdeen, and Leicester, and a range of partners including SMEs working on the deployment of AI systems in traffic control (Simplifai), traffic authorities (TfGM, Leicester), companies controlling airports and harbours (Aberdeen Airport and port), and companies working on logistic and energy supply (Ricardo, Schlumberger, DSTL). The CDT will equip students with the necessary background on AI, and will support them with trainings for exploring multiple potential future careers, including entrepreneurship, industrial, and academic. The students will also be in the best position to leverage on strong links provided by the Connected Places Catapult, the 3M Buckley Innovation Centre, and a number of research institutes focusing on different aspects of mobility and sustainable transport.

To ensure an all-round experience, the students will have the possibility to visit international research centres, to spend time at the involved institutions, and to do secondments with the CDT partners.

Grant Reference Number: EP/Y009746/1

Title: UKRI AI Centre for Doctoral Training in AI for Digital Media Inclusion

Team:
- Professor Adrian Hilton, University of Surrey (PI)
- Professor James Bennett, Royal Holloway, University of London
- Professor Sabine Braun, University of Surrey
- Professor Yi-Zhe Song, University of Surrey
- Dr Andrew Rogoyski, University of Surrey
- Professor Polly Dalton, Royal Holloway, University of London
- Ms Amanda Murphy, Royal Holloway, University of London
- Ms Angela Chan, Royal Holloway, University of London

Brief description of proposed work:

Our vision is to train future creative industry leaders to realise the potential of AI to enable intelligent digital media services designed to be inclusive for all. Future media, driven by the growth opportunities of personalisation, will intelligently adapt to individual interest, demographics and accessibility needs to increase audience engagement and reduce barriers to inclusion. This CDT will combine Surrey's world-leading expertise in people-centred AI, with RHUL StoryFutures' track-record of innovation in next generation digital media to (1) establish a unique creative industry hub for high-quality training in AI, inclusive design and creative skills, and (2) catalyse UK leadership in media inclusion for the whole UK population and beyond.

Digital media together with streaming internet delivery and consumer devices has transformed the way we access and consume mass-media from books through to podcasts, radio, TV, film, the web and interactive entertainment. Access to digital media is central to the way we live, work and play, providing our primary interface for education, health, entertainment, retail, finance, communication and government services. Creating digital media services that are personalised, inclusive and accessible for all is essential for societal equality and a business necessity to increase engagement for diverse audiences, with the 'Purple pound' alone valued at over £274bn per year in UK consumer spending. This CDT will forge an innovative model of training for a new generation of creative industry professionals to lead the creation of future AI-enabled intelligent media services designed with inclusion for all at their heart.

Personalisation of media for diverse audiences is a major driver for global creative industry growth (4.3% CAGR), with the UK positioned as the leading player in Europe ideally placed to become a key global hub. AI has the potential to transform all forms of digital media from today's pre-defined fixed one-size-fits-all content to intelligent media that dynamically adapts to individual preferences and accessibility needs for diverse audiences, such as choice of language for health guidance, or news content for all ages. UK creative industry growth is severely limited by access to individuals with key AI and creative skills.

This CDT will train 80+ PhD researchers with people-centred AI, inclusive design and creative skills to lead the creative industry transformation to intelligent media services which will enable social inclusion for all and position the UK to be a global leader in future inclusive media.

Equality, Diversity & Inclusion: Inclusion forms an explicit focus of this CDT which seeks to overcome barriers to inclusion at all levels. This requires a diverse, inclusive and open research training environment to shape future AI enabled media to be equitable for all. To promote best-practice all leaders, supervisors and students will participate in EDI training, Cohort training, teamwork and leadership skills will actively promote inclusive behaviour and awareness of the importance of inclusion and diversity in AI. Recruitment will be proactively managed, building on best-practice, to encourage diversity and tackle unconscious bias, building on RHUL StoryFutures track record of over 25% of 8000 participants from minority ethnic backgrounds and 19.5% of StoryTrails trainees identifying as disabled. The CDT leadership team provides representation of different career stages from early career to established, 50% of our leadership team identify as female, 25% ethnic minority and 12.5% with a declared disability. The Surrey PAI MSc in AI, with 100-150 students/annum, is a multi-disciplinary programme which provides a pathway for recruitment of students with diverse academic foundations and experience (arts, law, business health, social and engineering sciences). PhDs will be supported to become ambassadors for the promotion of Ethics and Inclusion in AI.

Grant Reference Number: EP/Y009754/1

Title: UKRI AI Centre for Doctoral Training in Artificial Intelligence for Offshore Renewable Energy and Hydrogen Technologies

Team:
- Professor Xiaowei Zhao, University of Warwick (PI)
- Professor Nilay Shah, Imperial College London
- Professor Nigel Brandon, Imperial College London
- Professor Juergen Branke, University of Warwick
- Dr Ahmet Oztireli, University of Cambridge
- Professor Mark Girolami, University of Cambridge
- Dr Hongyang Dong, University of Warwick
- Professor Carola-Bibiane Schönlieb, University of Cambridge
- Professor Li Ran, University of Warwick
- Professor Mirko Kovac, Imperial College London

Brief description of proposed work:

Offshore renewable energy (ORE) - including wind, wave and tidal energy-and hydrogen technologies (including ammonia) are essential to achieving net zero. These sectors are of national importance. They are also interlinked. As large-scale deployment of ORE gathers pace, new low-carbon energy carriers are required to achieve large-scale storage and integration, and hydrogen technologies are emerging candidates. However, the dramatic development of ORE and hydrogen is outpacing development of technologies for their design, operation, monitoring, and maintenance. Conventional methods in these key aspects are no match for growing system complexities and big data in operation. For example, wake effects (aerodynamic impact of upstream wind turbines on downstream ones) degrade the performance of conventional control strategies, cutting wind farm energy production by 5-20%. AI offers a suite of new opportunities for meeting these challenges. The similarity between the system characteristics of ORE and hydrogen also allows the dual application of AI methodologies. For example, similar complex aero/hydrodynamics and thermodynamics give rise to similar modelling and simulation problems, while shared partially-observable and grey/black-box features present similar barriers to prediction and control. AI offers unique advantages in multi-scale data mining, multi-scenario system complexity handling, and data-powered decision-making and control, which can unlock the full potential of both ORE and hydrogen. Currently there is a shortage of highly skilled scientists and engineers in this area and a lack of understanding that integrates the different scientific aspects of AI crucial to its effective application to ORE and hydrogen technologies.

This CDT will train researchers, engineers, and innovators to develop cutting-edge AI innovations for ORE and hydrogen, and ultimately for green energy, cutting their cost and improving their efficiency, resilience, reliability, stability, and safety. The CDT will deliver a 4-year integrated PhD training and research programme. It will foreground the industry experience elements of the training offered in recognition of the need for rapid innovation in this crucial sector. In addition to their research projects, in year 1, students will receive fundamental interdisciplinary cohort training through purpose-designed taught modules. Research and soft-skills training will be delivered over the whole duration of studentships following best practice in student recruitment and PhD topic selection, benefitting from leading facilities and industrial secondment and mentoring, cohort-based peer-to-peer events, tailored support for students' long-term development and diverse career paths, and attention to wellbeing and EDI (equality, diversity and inclusion) aspects.

The CDT brings together ten investigators from seven departments at the University of Warwick, University of Cambridge and Imperial College London with outstanding reputations in ORE, AI and hydrogen research. It adds a further 30 leading academics to its supervision pool. It will create a world-leading interdisciplinary research training network with a scope encompassing control and optimisation, ORE, hydrogen, AI, robotics, applied mathematics, data science, smart grids, and computer vision. In partnership with 25+ industrial partners, the CDT will address the urgent need in the UK for talented innovators and researchers with cutting-edge, interdisciplinary knowledge in ORE, AI and hydrogen technologies, and thus lay the foundations for the UK to thrive in green energy. It aligns with the UK's Net Zero Strategy, UK Hydrogen Strategy, and National AI Strategy, as well as the UKRI AI CDT priority on Environment and Energy, and cross-cutting theme on AI for increasing business productivity. It aligns too with EPSRC priorities on Engineering Net Zero and AI; and Digitalisation and Data: Driving Value and Security.

Grant Reference Number: EP/Y009762/1

Title: UKRI AI Centre for Doctoral Training in Trustworthy Responsible Artificial Intelligence

Team:
- Professor Ender Ozcan, University of Nottingham (PI)
- Professor Bernd Stahl, University of Nottingham
- Professor Christian Wagner, University of Nottingham
- Dr Alexa Spence, University of Nottingham
- Professor Andrew Smith, University of Nottingham
- Professor Elvira Perez, University of Nottingham
- Professor Lucelia Rodrigues, University of Nottingham
- Dr Nicholas Watson, University of Nottingham
- Professor Praminda Caleb-Solly, University of Nottingham
- Professor Richard Hyde, University of Nottingham
- Dr Sarah Martindale, University of Nottingham

Brief description of proposed work:

We will train a cohort of 60 PhD students as a new generation of AI thought leaders and professionals, equipping them to realise the potential of AI in strategic UK Priority Sectors, with the critical skills to explore, advocate for, and advance the role of social, ethical and regulatory issues in AI development. Our students in collaboration with more than 40 external partners will be trained to develop and apply AI techniques designed from the ground up to deliver against the principles of trustworthiness and responsibility to help tackle the challenges of the 21st century and beyond.

Across the world, the current AI research emphasis remains primarily on advancing the performance of existing AI models, paired with an increasing desire to enhance the explainability and accountability of AI. The Trustworthy Responsible Artificial Intelligence (TOLERANCE) CDT is designed to move beyond today's approaches and train the next generation of AI professionals and thought leaders in the design and development of AI techniques with the capacity to deliver against complex socio-technical requirements spanning performance, trustworthiness, and responsibility. TOLERANCE training will sensitise students to the potential and the pitfalls of AI, and equip them with the technical and broader skills to help lead the development and deployment of trustworthy and responsible AI solutions. Driven by the research and innovation needs of the industry, public sector, and third-sector partners, TOLERANCE will explore challenges from UK priority sectors including creative industries; financial services; health and well-being, and infrastructure developing towards net zero (e.g., transportation, food).

Building on our experience of developing rounded and technically skilled subject experts, we commit to the added value from the cohort-based and practice-led approach to delivering a multidisciplinary training programme in a diverse and inclusive research environment, supporting peer-to-peer learning, intra-cohort cohesion, inter-cohort experience sharing, and engagement opportunities with our external partners, leading to diverse and flexible career tracks for our graduates.

We will run a four-year multidisciplinary training programme that will

- provide focused technical training in cutting-edge AI techniques and technologies, and cover core and advanced topics in trustworthy and responsible AI,

- equip students with the skills to identify and articulate human, societal, ethical, and legal challenges in AI, and transfer this insight into the design of AI techniques and technologies,

- empower individual students with broad and tailored skills based on their experience and challenge from a sector that their research is addressing, reflecting their future career plans,

- facilitate collaboration and teamwork at every stage of our programme,

- leverage purposely designed sector-led micro-cohort-based training, grouping students with heterogeneous skills but a shared sector, aiding students to value and benefit from diverse views across sectorial contexts,

- ensure our students complete their PhD on time and deliver impact.

Our external partners will support PhD co-design, provide resources to our students, host placements (internships/visits), set industry-led challenges via sprint projects (and evaluate them), and more. Our programme will be complemented by three annual events, each paired with activities supported by our partners:

- week one conference (industry day) for our students to showcase their work (e.g., placement reports, research publications, impact plans) to the alumni, external partners, and broader community

- all-hands retreat (networking event) focusing on well-being and targeted professional skills training delivered by (guest) speakers from industry and academia (e.g., entrepreneurship, commercialisation, mindfulness, career advice)

- programme review (advisory board) for improving the training programme.

Grant Reference Number: EP/Y009819/1

Title: UKRI AI Centre for Doctoral Training in AI for Medical Diagnosis and Care

Team:
- Professor David Hogg, University of Leeds (PI)
- Professor Vania Dimitrova, University of Leeds
- Mr Owen Johnson, University of Leeds
- Professor Geoff Hall, University of Leeds
- Professor Ann Morgan, University of Leeds
- Dr Nishant Ravikumar, University of Leeds
- Professor Galina Velikova, University of Leeds
- Dr Kieran Zucker, University of Leeds
- Professor Darren Treanor, Leeds Teaching Hospitals NHS Trust

Brief description of proposed work:

Artificial Intelligence (AI) is advancing rapidly, most recently with systems capable of generating high quality natural language and images from statistical models trained on vast collections of text and image data. A broad range of AI methods, including deep learning, spatio-temporal reasoning, process optimisation, synthetic data, digital twins, and autonomous systems, are being developed with potential impact on our lives and the world we live in.

The UK has recognised as a national priority the urgent need to exploit AI in human health, where data is being created from digital health systems, including medical images (e.g., tissue slices, MRI), patient generated data, genetic profiles, and the health records used by GPs and hospitals. In future, AI can be embedded within these digital health systems to automatically identify those at risk of chronic illness before symptoms appear, suggesting changes in lifestyle and treatment that would reduce long-term risk. It could greatly speed-up and increase the reliability of diagnostic services such as pathology and radiology. It could help doctors and patients select the most appropriate care pathway based on personal history and clinical need. Such improvements will lead to better care, improved quality of life of patients and carers, and more cost-effective use of resources in the NHS.

Our Central for Doctoral Training (CDT) has operated a highly effective model since 2019, training the future researchers who will lead on this transformation. Our students come from a variety of science, engineering and health backgrounds, including clinicians. They are diverse in terms of gender, ethnicity and other protected characteristics. When they graduate from the Centre after four years, they will have the core AI knowledge and skills, coupled with real-world experience of responsible innovation in the health sector, to unlock the immense potential of AI within the health domain.

The City of Leeds has developed into the home of the NHS in England. The University of Leeds and the Leeds Teaching Hospitals Trust (LTHT), working with key national partners from the NHS and industry, provide the ideal environment for training this next generation of thought leaders. Our ecosystem of partners will contribute directly to the training of students, including giving guest talks, presenting assignments motivated by real-world health challenges and opportunities, and participating in the supervision of PhD research projects. The Centre will embed patient engagement in all PhD projects and events, working with an innovative bespoke CDT patient panel.

Our graduates will become international leaders in academia and industry, helping to ensure the UK remains at the forefront in health research, clinical practice and commercial innovation.

Grant Reference Number: EP/Y009827/1

Title: UKRI AI Centre for Doctoral Training in Fundamental Physics and its Applications in Industry and Sustainability: DISCnet-AI

Team:
- Dr Kate Shaw, University of Sussex (PI)
- Professor James Geach, University of Hertfordshire
- Professor Sebastian Oliver, University of Sussex
- Professor Eram Rizvi, Queen Mary University of London
- Professor Stephen Serjeant, The Open University
- Professor Robert Crittenden, University of Portsmouth
- Professor Stefano Moretti, University of Southampton

Brief description of proposed work:

UKRI AI Centre for Doctoral Training in Fundamental Physics and its Applications in Industry and Sustainability: DISCnet-AI

The UK government's R&D People and Culture strategy "aims to put science, research and innovation at the centre of our prosperity, our health and wellbeing, our mission to achieve net zero, and our place in the world". It recognises that "we need to unleash a new wave of talent: attracting, developing and retaining diverse people with the right skills, working in an environment that nurtures and gets the best out of everyone".

The UKRI AI Centre for Doctoral Training in Fundamental Physics and its Applications in Industry and Sustainability: DISCnet-AI, is to deliver 84 exceptional physicists equipped with the skills required for the UK to address sustainability challenges and to keep the UK at the forefront of international physics research.

The consortium of six world-leading universities are at the forefront on many of the biggest and most complex experiments in the world such as the Large Hadron Collider at CERN, international Neutrino Oscillation experiments, and the James Webb Space Telescope. The team is led by:

Dr Kate Shaw, Experimental Particle Physics, University of Sussex, Data Science and AI, Open Science.

Prof Seb Oliver, University of Sussex, Sussex Astronomy, Extragalactic Astronomy, Far Infrared Space Telescope Surveys, Applications of Data Science,

 (DISCUS and DISCnet Director).

Prof Stefano Moretti, University of Southampton, SHEP & RAL PPD, Particle Physics Phenomenology, Theory & Experiment (NExT Institute Director).

Prof James Geach, University of Hertfordshire, Astrophysics Observation, Data Science, Director of the Centre of Data Innovation Research.

Prof Stephen Serjeant, Open University School of Physical Sciences (OU SPS), Observational Extragalactic Astrophysics.

Prof Eram Rizvi, Queen Mary University of London, Experimental Particle Physics, Turing Fellow, AI and Data Science.

Prof Robert Crittenden, University of Portsmouth, Institute of Cosmology & Gravitation, Large scale structure, Dark energy, Early Universe.

Our experiments create huge and complex data sets which raise many analytical challenges to exploit and interpret the data that can only be solved with original AI techniques. The skills and experience acquired by working in these research environments include becoming leading experts in cutting edge computational, analytical, & AI skills,

applying these to develop advanced data-driven approaches well suited to a wide range of urgent industry data-driven needs.

Our experience of working with industry, public sector and charitable organisations with the successful STFC-funded DISCnet CDT, is that skills of physicists are a vital part of the diverse skills needed by organisations to tackle their research and innovation challenges, especially to achieve net zero and the UN Sustainable Development Goals (SDGs). Representing around 10% of the best UK physics community we also know that addressing the challenges at the frontiers of physics requires an evolution of the physicists' skills to be adept with the latest AI techniques.

Working with our public and private sector partners we will identify new AI challenges that address the net zero or SDG agenda and that can be tackled by our students in around 100 3-month research placements. These placements will train the students to work in interdisciplinary and non-academic teams and further broaden their skills. Our sustainability focus is also expected to increase our appeal to a more diverse set of applicants.

Our graduates will thus have a unique combination of traditional physics skills in problem solving, rigour and integrity, experience in large multi-national collaborations, advanced understanding and practical skills in the latest AI technology, experience in applying those skills to the both the largest scientific data sets, and some of the messiest real-world data.

Grant Reference Number: EP/Y009843/1

Title: UKRI AI Centre for Doctoral Training in Digital Healthcare

Team:
- Professor Aldo Faisal, Imperial College London (PI)
- Professor Jonathan Weber, Imperial College London
- Professor Mauricio Barahona, Imperial College London
- Professor Ara Darzi, Imperial College London
- Professor Anil Bharath, Imperial College London
- Professor Deborah Ashby, Imperial College London
- Professor Jeremy Levy, Imperial College London
- Professor Jennifer Quint, Imperial College London
- Dr Sonali Parbhoo, Imperial College London
- Dr Hamed Haddadi, Imperial College London

Brief description of proposed work:

The UKRI AI CDT in Digital Healthcare (DigitalHealth CDT) will build on our established to create a world-leading centre for PhD training of the next-generation innovators in AI applied to Digital Healthcare. Using AI in healthcare will provide more accurate decisions faster, while reducing suffering, waiting times and costs across society helping to address the pressing unmet health & care needs. To effectively apply AI to the healthcare sector, we require to develop AI that is patient-ready, which addresses the challenges particular to the ethical, legal and regulatory requirements for healthcare. Including these aspects are key due to the immediate impact AI in Digital Health can have on the life and health of users. The NHS alone requires 10,000 data & AI people over the next 5 years, and thus there is a need for patient-ready AI specialists that can apply their skills in this heavily regulated domain. To address this need, we propose to train in total 100 PhD students and at least 5 clinical PhD Fellows in five cohorts. These PhDs will represent a new generation of diverse AI researchers with backgrounds ranging from computer science to design engineering and clinical medicine that can develop and deploy seamlessly across disciplinary boundaries to deliver health and care. We have teamed up with 3 NHS Trusts and clinical institutions to enable involvement and on-site research & development of our students projects as well as over 20 PhD studentships contributed by the vibrant Digital Health industry in the UK.