University of Southampton

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Research and Enterprise Magazine

RE:ACTION

The Art of Artificial Intelligence

A showcase of the breadth and depth of Southampton's world-leading AI related research and enterprise activity

EXPLORING THE FRONTIERS OF AI AND DATA SCIENCE

Welcome to the latest issue of *Re:action* magazine, a publication dedicated to bringing you the most cutting-edge research and innovation happening at the University of Southampton. In this edition, we delve into the fascinating realm of AI and data science, highlighting the university's exceptional expertise and contributions in this rapidly evolving field.

At the heart of our exploration lies the Web Science Institute, a pioneering hub of interdisciplinary research that examines the complex and transformative nature of the World Wide Web. With AI permeating every aspect of our online interactions, the Web Science Institute sheds light on the profound implications of AI in academia and society as a whole.

Drawing on the rich legacy of the legendary Alan Turing, the Turing Institute at Southampton continues to push the boundaries of AI research. It serves as a beacon of excellence, fostering collaboration between academia, industry, and government to address some of the most pressing challenges in AI and data science today.

The impact of AI reaches far beyond research institutions, as we witness its transformative influence in various domains. From the criminal justice system to digital health and biomedical engineering, AI's potential to revolutionize these areas cannot be understated. However, as we forge ahead, it is essential to recognize the imperative of maintaining a delicate balance between developing exciting AI applications and ensuring the safety and security of its users.

Within these pages, we delve into the complex issue of racial and gender bias in AI, shedding light on the challenges and potential solutions that can help build fair and equitable systems. We also shine a spotlight on Professor Gopal Ramchurn, whose groundbreaking work in multi-agent systems and human-computer interaction is pushing the boundaries of what is possible with AI.

Moreover, we explore the critical role played by the Centre for Trustworthy Autonomous Systems Hub, where researchers tackle the intricate task of imbuing autonomous systems with ethical decision-making capabilities. As the deployment of AI expands into driverless cars and other autonomous systems, ensuring their ethical foundations becomes paramount.

Last but not least, we invite you to discover the remarkable AI projects taking shape at the Winchester School of Art. Here, the intersection of creativity and technology gives rise to groundbreaking explorations in the world of art and design, demonstrating the profound impact of AI on our aesthetic experiences.

As you immerse yourself in the articles, interviews, and insights within these pages, we hope you gain a deeper appreciation for the incredible advancements and nuanced considerations that define the realm of AI and data science. Together, we can harness the transformative power of AI while upholding the values of safety, security, and ethical responsibility.

Enjoy this issue of *Re:action* magazine, and join us in shaping the future of AI and data science at the University of Southampton.

Professor Mark Spearing
Vice-President (Research and Enterprise)

PLEASE SEND US YOUR FEEDBACK

We are keen to receive your feedback about Re:action. If you have any ideas, comments or suggestions, please send them to **reaction@southampton.ac.uk**

Re:action is created by
Louise Payne and Kate Williams,
Research and Innovation Services

RIGHT TO REPLY

As many (some?) of you will have realised we have indulged in a little piece of experimental fun by asking ChatGPT to write the foreword to this edition of *Re:action*. It was given the direction:

Please write a foreword for Re:action magazine, in the style of the University of Southampton. This issue of the magazine is themed around AI and data science and the University of Southampton's expertise in this area. It will include articles on the Web Science Institute, Turing Institute at Southampton, AI in academia, AI and the criminal justice system, digital health and biomedical engineering, racial and gender bias in AI, Professor Gopal Ramchurn, the Centre for Trustworthy Autonomous Systems Hub, the ethics of AI (in driverless cars and other autonomous systems) and AI projects at Winchester School of Art. It must mention the balance needed between developing exciting AI and ensuring safety and security for users.

While my professional pride leads me to think (hope?) that my usual carefully polished pieces for *Re:action* are better written, and less flowery in their language, the AI does seem to have more than achieved the basic requirements for the brief.

It is also sobering to think that this was produced in milliseconds, whereas my reading of the issue's draft layout and crafting of the foreword typically requires the better part of an hour for each issue.

There is clearly considerable opportunity to improve productivity, even in a task that requires at least some creative thought. Nevertheless, I will not be delegating future writing tasks just yet...

I add my wish, alongside that of my new AI friend, that you have enjoyed this issue of *Re:action*. As always, feedback is much appreciated!

#TheReal Professor Mark Spearing
Vice-President (Research and Enterprise)

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"SOCIETY IS NOW AT THE POINT WHERE WE MUST LEARN QUICKLY TO REALISE THE AMAZING OPPORTUNITIES AI AFFORDS US, AT THE SAME TIME AS LEARNING TO MANAGE THE THREATS IT POSES."

Dame Wendy Hall is Regius Professor of Computer Science, Associate Vice President (International Engagement), and Executive Director of the Web Science Institute at the University of Southampton. She is a global pioneer in artificial intelligence and web science, from working with Sir Tim Berners-Lee while he invented the World Wide Web to leading the Government Review on the AI industry in the UK, Dame Wendy is at the forefront of the AI revolution.

"It is almost impossible at the moment to turn on the TV or click on a news site without seeing something about Artificial Intelligence. The boom in media interest comes from a realisation that what was once the stuff of futuristic Hollywood films is fast becoming a reality, and society is now at the point where we must learn quickly to realise the amazing opportunities AI affords us, at the same time as learning to manage the threats it poses.

AI has been a part of our everyday lives for longer than many of us realise, for example in its use by social media companies to increasingly personalise the information they feed us. More recently, this evolving technology has begun to move faster and reach further than ever before through applications such as ChatGPT.

AI is being used to revolutionise healthcare practices, transform the way we work and reshape approaches to education. These game-changing advances offer a wealth of potential and opportunities globally. But as a computer scientist who has been working in this area since AI was in its infancy and still largely a philosophical idea, I am very aware of the need for us to consider regulation and management. This is to ensure that the benefits outweigh the risks which, in the extreme, could include an existential threat to humanity.

University of Southampton

I was both an undergraduate and a postgraduate in mathematics at the University of Southampton in the 1970s and came back to the University as a member of academic staff in computer science in 1984. The University has been at the forefront of developments in computer science and AI for all those 39 years. We were among the first institutions to work on things like facial recognition technology and neural networks, and we have been offering an undergraduate programme in computer science and AI since the 1990s.

This fantastic legacy of world-leading research in AI at Southampton, coupled with the current cohort of first-class academics, researchers, and students, puts us firmly at the forefront of AI research and education both nationally and internationally. We are also very much part of the debate on AI governance and regulation as it continues to evolve and become increasingly important to society.

Government strategy

The Government Review I co-chaired with Jérôme Pesenti in 2017, addressed how to grow the AI industry in the UK to support economic growth. It was a milestone in the UK's approach to AI and led to a sector deal in AI that was valued at £1 billion by the Government, the Office for AI, AI Council, and the Turing Institute. The latter was also named the National Institute for AI as well as Data Science. We established skills and research programmes, work on data trusts, and a work programme to support the take

Dame Wendy Hall

up of AI in industry and government, building on the fabulous AI start-up culture we have in the UK.

In January 2021 a new AI Roadmap was published by the AI Council, an independent expert committee of which I was a member. Our roadmap led to the creation of a new AI strategy for the UK that led to the scaling up of Government investment in AI for the next ten years to attract talent, shape global markets and align global governance.

The work we are doing at the University of Southampton is very much aligned with that strategy, particularly when it comes to the rapid pace and evolution of the science, the technology, and its applications, and when it comes to approaches to ethics and social impacts.

Web Science Institute

As Government funding for AI research and innovation continues to increase, so must our mission to create systems that ensure full accountability, clear ethics, and transparency. We should be striving to ensure the best science sits alongside accessibility and inclusivity.

Our plans as part of the Web Science Institute aim to do that by having a focus on human-centred-AI – AI systems which aim to strengthen and enhance rather than replace human capabilities.

Media hype would have you believe that developments in generative AI, such as Bard and ChatGPT, will lead to job cuts in multiple areas of industry. The truth is, while it may be able to provide services to some industries, it is far more likely to make our work lives easier by freeing up the time used for tasks like analysing images or data and enabling humans to work on the more challenging aspects of roles.

At the Web Science Institute, we take a socio-technical approach to AI as we have done with our study of the Web ecosystem, marrying together the social and technical aspects of AI systems. Trust and trustworthiness, which tie into the human-centred approach, are at the heart of our research activity. We should be working towards a society that questions what it sees, asking if it makes sense, and testing those thoughts on other humans, not machines. We will only get to the stage of realising the full benefits of AI if, as a society, we have full confidence in the technologies and the science behind them, and in the governance and regulation that ensures AI systems, products and platforms are implemented and operated safely.

What next?

AI is an umbrella of technologies which are constantly evolving. We have recently seen news stories of a cyber-physical system that enabled someone to be able to walk again, using technology that can read brain waves and pick up the instructions that are being transmitted by the brain. We refer to this new technology as brain-computer interfaces and is a very different form of AI than neural networks and machine learning. They offer huge potential but the idea that machines could read our minds is very challenging and we must be ready to regulate such systems as they emerge. We need to ensure that the development of such systems is managed in a responsible and trustworthy way.

As this issue of *Re:action* goes to press, we are incredibly excited to announce that Southampton has won a £31million grant from UKRI to run the UK's Responsible and Trustworthy AI Hub. I am really looking forward to being part of the leadership team of the Hub to continue my own work in AI policy and governance, and to ensure the Southampton legacy of AI research and education continues into future generations.

I am passionate about teaching every student at the University about AI – the opportunities and the risks. We are planning an online module on AI for all students, especially non-STEM students, to make them aware of how AI might affect their work and personal lives in the future, and to encourage them to consider careers in AI in the broadest sense. Not everyone in AI must be a machine learning programmer. We need people from a diversity of disciplinary backgrounds – arts, humanities, social and medical sciences as well as science and engineering – to help us build AI systems that we can use to improve our lives in a responsible, trustworthy, and safe way. ”

LEADING THE CHARGE

The University of Southampton's position as a world-leading institution in the field of AI has never been more pronounced, and a key figure instrumental in Southampton's success is Professor Gopal Ramchurn.

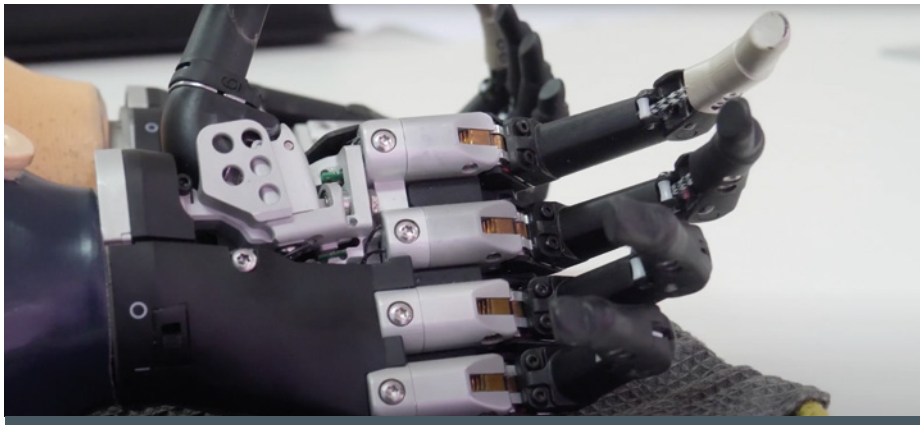
Professor Gopal Ramchurn

A Professor of Artificial Intelligence, Turing Fellow, and Fellow of the Institution of Engineering and Technology, Gopal is the Director of the UKRI Trustworthy Autonomous Systems hub and has recently been announced as the CEO for Responsible AI UK, a brand-new consortium, funded by a £31million investment from UKRI that will lead on the development of responsible artificial intelligence.

Sitting at the helm of both the hub and the consortium, Gopal will be uniquely positioned to use his expertise to drive forward both the agenda of trust in AI and the pressing issue of regulation and policy. He and colleagues will be able to bring together research into governance, trustworthiness and the socio-technical elements of AI for the global community's benefit.

SOUTHAMPTON LEADS UK PROJECT ON RESPONSIBLE AI

The University of Southampton and Professor Gopal Ramchurn are leading the charge for the UK to become an AI powerhouse by heading up a new consortium, Responsible AI UK, funded by a £31million investment from UK Research and Innovation (UKRI).



Click here to see:
UK plans to become AI powerhouse with £31million investment in University of Southampton-led project

Responsible AI UK (RAI UK) will lead on the development of responsible artificial intelligence, the multimillion-pound project brings together experts to create an international research and innovation ecosystem to develop trustworthy and secure AI that responds to the needs of society.

The £31million funding was awarded as part of a £52million investment, made by the Government to work across universities, businesses, public and third sectors and the public to pioneer responsible AI and fund new research to better understand and build trustworthy systems.

Gopal is the CEO for Responsible AI UK. He said: "We don't need to fear artificial intelligence, it will not threaten humanity but has enormous potential to influence how society operates in the future.

"AI should not only be technically safe and accountable, but its impact on its users, their wellbeing and rights, and the wider society needs to be understood for people to trust it. RAI UK will bring together experts from diverse disciplines and cultures from across the world to address the most pressing AI challenges in key sectors and ensure we all benefit from the productivity gains it promises to deliver."

Regius Professor of Computer Science Dame Wendy Hall, from the University of Southampton, said: "AI will change the way we live and work for the better – but an interdisciplinary approach to regulation and safe AI is vital.

"The UK can become the dominant force for responsible and trustworthy AI development and regulation with this £31million investment. The work undertaken by the Responsible AI UK team at the University of Southampton together with our partners across the UK and internationally will put the UK at the forefront of AI's future for the good of humanity."

The RAI UK consortium is led by the University of Southampton in collaboration with the University of Nottingham, King's College London, University of Cambridge, UCL, Swansea University, University of Belfast, and the University of Glasgow.

Find out more
www.rai.ac.uk

TRUSTWORTHY IN PRINCIPLE AND TRUSTED IN PRACTICE

The UKRI Trustworthy Autonomous Systems (TAS) Hub, based at Southampton, sits at the centre of the £33million UKRI Trustworthy Autonomous Systems programme, created to enable the development of autonomous systems 'that are both trustworthy in principle and trusted in practice by individuals, society and government' (UKRI).

Professor Gopal Ramchurn, Director of the TAS Hub, spoke to Re:action about establishing the Hub in 2020.

"Southampton has been a leader in AI since the early 2000s and hosts one of the largest AI research groups in the UK," said Gopal.

His own research into Responsible AI for applications such as energy systems and disaster management has won multiple awards, including the AXA Research Fund Award (2018). He set up the University's Centre for Machine Intelligence in 2018.

> "Southampton has been a leader in AI since the early 2000s and hosts one of the largest AI research groups in the UK."
>
> **Professor Gopal Ramchurn**

In September 2020 UKRI decided to award £12million to a consortium of the Universities of Southampton, Nottingham and King's College London, to establish the UKRI TAS Hub. Additional funding brought the total investment to £13.5million.

As well as driving the research programme, the TAS Hub coordinates six research nodes across the UK, bringing together expertise in areas ranging from computing and robotics to social sciences and the humanities, to deliver world-leading best practice for the design, regulation and operation of autonomous systems.

"We defined our guiding principles very early on," said Gopal.

Responsible innovation

"We have a strong element of responsible research and innovation. We ensure that all the research we do anticipates and addresses some of the negative consequences of AI-based systems. As we build these AI, we make sure that their impacts are reviewed and monitored," continued Gopal.

"We also make sure that all our teams and research conform to Equality, Diversity and Inclusion (EDI) guidelines: the research is inclusive, brings in a diversity of participants, research disciplines, and researchers.

"Lastly, everything we do looks to have an impact in the real world. All projects are interdisciplinary and involve an industry partner.

TAS Hub's researchers have looked at issues of trust in autonomous vehicles, autonomous systems in healthcare, education, and agriculture, drones and robots of different kinds. The Hub has generated hundreds of publications in a range of sectors.

Work with the creative industries to engage the public and inform the research, has seen plays staged and generated art that was exhibited at the National Gallery X.

"We recently built an installation called Cat Royale, in which three cats are looked after by a robotic arm, with their every need, from food to play, monitored by an algorithm and catered for," explained Gopal. "We survey the public's reaction as they observe the system interacting with the cats, which allows us to raise questions and build algorithms from the data we gather."

Through these projects, the TAS Hub has, said Gopal, "created a community that understands what it means to do multi-disciplinary research, promoted the careers of younger academics, and supported people from minority backgrounds."

Responsive research

Community-formation is central to the TAS Hub's mission and has a direct impact on its research.

"We have not stuck to one fixed agenda from the beginning.

"Every year we run workshops with the hub and the nodes to define our research programme. This results in a very responsive way of doing research. For example, when we started, we developed a project to try to understand people's trust in COVID apps.

"We have responded to recent concerns around AI large language models, looking at the ethical or legal implications of using such models in different kinds of applications.

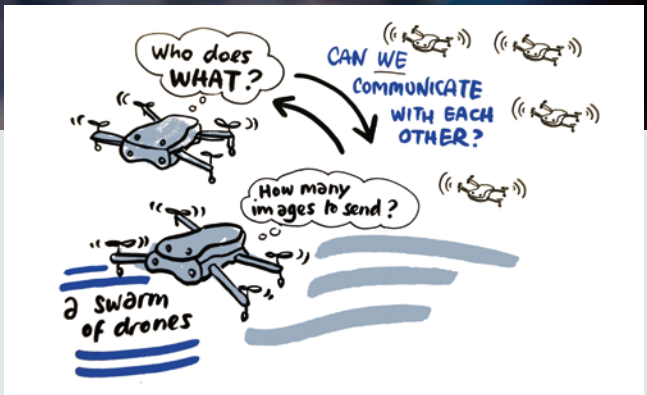
"And we have looked at questions around autonomous vehicles such as who is responsible when the vehicle transfers control from the car to the driver."

Shaping policy

As well as running a highly agile research programme and developing the research community, UKRI TAS Hub plays a central role in shaping government policy on trustworthy autonomous systems.

The team advises government departments and bodies including Department for Culture, Media and Sport, the Department for Transport and the Law Commission, helping to develop strategy and policy.

Find out more
www.tas.ac.uk
www.blasttheory.co.uk/catroyale



TAS HUB PROJECT

INTERACTION WITH SWARMS OF AUTONOMOUS SYSTEMS

Three projects led by Electronics and Computer Science Lecturer Dr Mohammad Soorati are looking at how a single human might have to interact with a large number of autonomous systems, or 'swarm', without becoming overwhelmed by their diversity and complexity.

We are becoming increasingly used to interacting with multiple intelligent devices at home and work.

"In Trustworthy Human Swarms Partnerships in Extreme Environments we looked at how a swarm of unmanned aerial vehicles (UAVs) and ground robots could respond to a disaster scenario alongside human first responders.

"In that scenario, we need the swarm to provide a quick insight into the situation and then send clear, concise information to the first responders to allow them to act.

"We looked at how a single operator can manage a large number of UAVs and prioritise their tasks so that they can explore the area efficiently. We developed algorithms to allocate positions to the UAVs automatically, and looked at how operators preferred to visualise the behaviour of the swarm depending on the situation."

The team created a simulation platform simple enough even for children to use. It won the Demo of the Year award at the 22nd International Conference on Autonomous Systems and Multi Agent Systems in June 2023.

In another study, XHS: eXplainable Human-swarm Systems, Mohammad leads a team looking at the interface between drone and operator to decide what needs to be displayed, how, when and why. The project involves more than 30 academics across the UK, as well as industry partners.

A TAS Hub team working with the University of Texas at Austin is now aiming to remove the interface altogether and create a brain-swarm interface by attaching novel durable sensors to the user's forehead to measure how they feel when operating swarms.

Find out more
www.tas.ac.uk/current-research-projects/trustworthy-human-swarm-partnerships-in-extreme-environments

www.tas.ac.uk/research-projects-2022-23/xhs-explainable-human-swarm-systems

TAS HUB PROJECT

TRUSTWORTHY AUDIO CAPTURE

Dr Jennifer Williams, Lecturer in Electronics and Computer Science, is looking at trust issues arising from audio capture.

We are surrounded by devices which capture audio, from smart watches and virtual assistants to audio-enabled vehicles. Audio capture may contain personal identity attributes of voice and speech; data which can be misused, highlighting issues of data protection, privacy, and security.

In Co-Design of Context-Aware Trustworthy Audio Capture researchers are asking how people's views and awareness of their own rights to privacy, security and trust, change in different scenarios.

"For example, an individual with a hearing disorder might use AI technology to help them navigate the world, and that technology might capture information about others in the vicinity. How might the people being recorded feel about that?" explained Jennifer.

"Or, for an individual who has a lot of voice data on the internet, who will have control of that data after they die?"

Conflicting views are emerging:

"People were uncomfortable with wearable devices like earbuds that have a recording capability, or about companies installing microphones at work, but if a blind person is using AI to read the environment for them, then people tend to make an exception."

The project aims to understand societal viewpoints of trust that can help tech companies and policymakers to increase protection of users and ensure their trust in technology.

Another study looked at perceptions of voice anonymisation technology, which can remove personally identifiable information, known as 'voice prints', from audio. Uses include enabling the sharing of large audio datasets such as medical databases for research purposes, by removing any sensitive information contained in recordings.

Companies, institutions and governments also use audio data.

"Removing age, gender, health conditions or even dysfluencies, can add an extra layer of protection for individuals," said Jennifer.

"This is a very new technology and one of the things that is being overlooked is the perception of the trustworthiness of it"

Researchers also believe that audio data could have potential as a diagnostic tool in Medicine. The TAME Pain project is looking for bio-acoustic markers of pain – indicators in a person's speech signal that they are experiencing pain – to help people who do not speak the language, who are non-verbal, and even children, to communicate their pain levels to doctors.

Find out more
www.tas.ac.uk/research-projects-2022-23/co-design-of-context-aware-trustworthy-audio-capture

SOUTHAMPTON: POWERING THE DEVELOPMENT OF WEB SCIENCE

The World Wide Web is the most complex piece of technology ever created. In thirty years, it has transformed the world, affecting every aspect of our lives by reshaping the way we do business, our social interactions, and our cultural expression.

> "In 1947, German refugee Professor Eric Zepler founded the Department of Electronics, Telecommunications and Radio Engineering, making Southampton one of the first universities in the world to recognise the importance of electronics."
>
> **Professor Leslie Carr**

The University of Southampton has been a driving force behind the development of Web Science, the interdisciplinary academic discipline which focuses on the study of the Web, its impact on society, and the underlying technological and social phenomena that shape its development and use.

"In 2004 we were talking to Tim Berners-Lee (inventor of the Web) about how we could see the Web starting to impinge on people's daily lives," explained Professor Leslie Carr, Web Science professor and Deputy Director of the Web Science Institute (WSI).

"At the time, most universities considered the Web as just a kind of computing over the internet, and saw no need for a separate academic discipline, but we felt that it was going to have a much greater impact."

In 2007, the University set up the Web Science Research Initiative with MIT. This led to EPSRC funding to establish the world's first Centre for Doctoral Training in Web Science, in 2009. Further EPSRC funding enabled a second Centre for Doctoral Training in Web Science Innovation, and the creation of the Web Science Institute in 2014.

As the WSI's tenth anniversary approaches, Leslie reflected on the "wild ride" keeping pace with the breakneck speed of development of the online world.

"In the early days of the Web, the debate was around intellectual property and copyright violation" he explained, "but the race to develop networks and personal devices, and ever-more sophisticated apps, drove individuals to make more and more data available to tech giants like Google, Facebook, and Twitter.

"The desire to mine these huge data sets for valuable information has fuelled the development of machine learning and AI. Now, computing is more about understanding the patterns, structure and information hidden in this data."

As Web platforms have expanded their scope and influence, the discussion has, says Leslie, shifted to concerns about these corporations appropriating and controlling our data. A highly agile discipline, Web Science has expanded to include the role of data in society and the development of human-centred AIs.

Contemplating why the University of Southampton has remained at its epicentre, Leslie said:

"Southampton had two important things in its favour.

"The first is a pioneering record in the field of computing. In 1947, German refugee Professor Eric Zepler founded the Department of Electronics, Telecommunications and Radio Engineering, making Southampton one of the first universities in the world to recognise the importance of electronics.

"Forty years later, we were one of the first British universities to begin teaching Computer Science as a degree."

"The second factor," said Leslie, "is that Southampton has the pre-conditions for successful inter-disciplinary work in spades.

"Academic curiosity, combined with a high level of collegial participation, means that interdisciplinary interactions thrive here."

WEB SCIENCE INSTITUTE

The University's Web Science Institute (WSI) combines expertise in Web Science, Data Science and Artificial Intelligence (AI) to explore the challenges and opportunities the web brings to society, from issues around privacy, intellectual property and data rights, to trust in AI.

Led by Professor Dame Wendy Hall and Deputy Directors Professor Leslie Carr and Professor Pauline Leonard, the WSI draws together 168 academics from across social, computational, and natural sciences, humanities, medicine, health, business, and law, for inter-disciplinary research into the online environment.

The WSI coordinates the University's membership of the Alan Turing Institute and is a founding member of the global Web Science Trust network of 22 web science labs.

Key areas of research include web science, digital futures, open data, open science, social machines, data trusts, digital governance, online health, and human-centred AI.

The WSI's world-leading expertise influences public policy around the role of the Web, Data and AI in society. Dame Wendy Hall's 2017 report, 'Growing the artificial intelligence industry in the UK', resulted in Government backing and funding to develop the UK's AI industry.

Collaborations with industry partners have included Google, IBM, Elsevier, Digital Catapult, and the Cabinet Office. The WSI pioneered an undergraduate degree in Web Science, alongside its masters and doctoral programmes, as well as offering MOOCS, and aims to be amongst the first to offer online degrees.

Each year the WSI runs several stimulus funding calls, to accelerate research and knowledge exchange and enterprise (KEE).

Find out more
www.southampton.ac.uk/research/institutes-centres/web-science-institute

Hannah Williams, Photo © Oliver Gestin

WSI STIMULUS FUND PROJECT

LOVE LETTERS (WITH AI)

Composer Dr Benjamin Oliver from Music is leading an interdisciplinary team exploring creative applications of AI to generate song texts.

"I approached soul singer Hannah Williams to collaborate on a song cycle, then ChatGPT landed. After experimenting a little, I found the generic quality of the content generated by ChatGPT frustrating," said Benjamin.

With WSI funding, he formed a new research team including Professor Will May (English) and Dr Shoaib Jameel (ECS). They developed LovelaceGPT, a new AI text generation model which creates first-person love texts.

"I've been setting these texts to music for Hannah to perform, accompanied by Riot Ensemble. It has been exciting to find unconventional musical materials that bring them to life in my new work, 'Love Letters'".

Love Letters (with AI) premieres in Southampton and London in July.

Find out more
www.benolivermusic.com/2023/01/love-letters-with-ai

WSI PILOT RESEARCH PROJECT

COUNTER-TERRORISM AND 'DIGITAL HUMAN TRAFFICKING'

Dr Gina Vale and Dr Avi Boukli from Criminology are working with Professor Leslie Carr to investigate human trafficking victimhood and its role in terrorism offending.

In a recent landmark case of a 14-year-old British girl, terrorism charges were dropped after she was found to be a victim of human trafficking. Despite no physical movement, her international online communications on forums and with individuals linked to terrorism were considered to be human trafficking under the Modern Slavery Act 2015.

The case prompted questions about the defence of human trafficking for other individuals (particularly minors) facing terrorism charges. The project is highlighting a crucial research and policy gap between counterterrorism and 'digital human trafficking'.

Find out more
www.southampton.ac.uk/research/projects/counter-terrorism-digital-human-trafficking

WSI STIMULUS FUND PROJECT

EXAMINING CHATGPT: THE ACADEMIC TURING TEST

Professor Leslie Carr is working with Professor Christian Bokhove (Education) and Dr David Baxter (Business), to assess the performance of ChatGPT under real University assessment conditions.

"We are doing a comparison of students' answers to exam questions and ChatGPT's answers," explained Leslie. "Assessors are marking them, without knowing there are any Chat GPT answers, and we will see how well it scores.

"We are looking forward to being able to report confidently on the results."

AI IN HIGHER EDUCATION: GETTING THE BALANCE RIGHT

As well as his roles at the University, Professor Leslie Carr also performs stand-up comedy about the Web and AI, and hosts 'AI DIY', a light-hearted podcast. Here he considers the implications of AI for higher education.

"In the podcast, 'AI DIY', we ask our guests – researchers and comedians – "What sort of AI would you like to see?" Most of them come up with a vision of an AI that's 'got your back', something that will be your 'wingman' – technology that genuinely supports the user, rather than competing with them.

In developing a Digital Strategy, the University is asking, 'What does an AI-supported university look like?'

The vision that is emerging is one where all the data that the institution holds about a student, on their academic performance, their attendance, their timetable and so on, is married up with the potential that AI offers to engage with, understand and support individuals.

My vision for a future University app might be like a virtual mentor: prompting a student to hand in coursework or attend a lecture, linking them to information resources or professional support, suggesting a call with their tutor, but also helping them to balance their study and their personal life. It could be equally useful for early career researchers or professors – helping them keep up with the latest research, stay on top of communications from UKRI, and making sure that they take time out. I see an AI that provides emotional and practical support, that helps develop better learning and lifestyle habits.

On the question of how developments like ChatGPT might impact education, the University needs to develop a nuanced approach. A simple ban on students using AI in their University work is, unfortunately, already unworkable because AI is embedded into Google and many tools that students already use.

Generative AIs, or large language models (LLMs), such as ChatGPT or Google's Bard, are predictive text generators. Their capabilities are astonishing – they can summarise the latest ideas in a particular area and produce a report for you – but to characterise them as the same as the independent thinking, creative, problem-solvers that we want our students to be, is mistaken.

Now that students have access to these tools, as an institution we must think carefully about what we give credit for. For too long we have conflated someone producing a well-crafted essay with someone with a high level of intellectual capability. Now, we must consider giving more credit for skills like knowledge-gathering, evaluation, argumentation and synthesis.

We need to be considered and deliberative in our response to this issue, and we need to respond quickly, but I am confident that we can.

We came to terms with calculators, with spelling checkers and grammar checkers. We responded to the pandemic by prioritising the university experience and making sure that we were not disadvantaging students. We need to monitor the situation and think about holding on to the important parts of the learning experience."

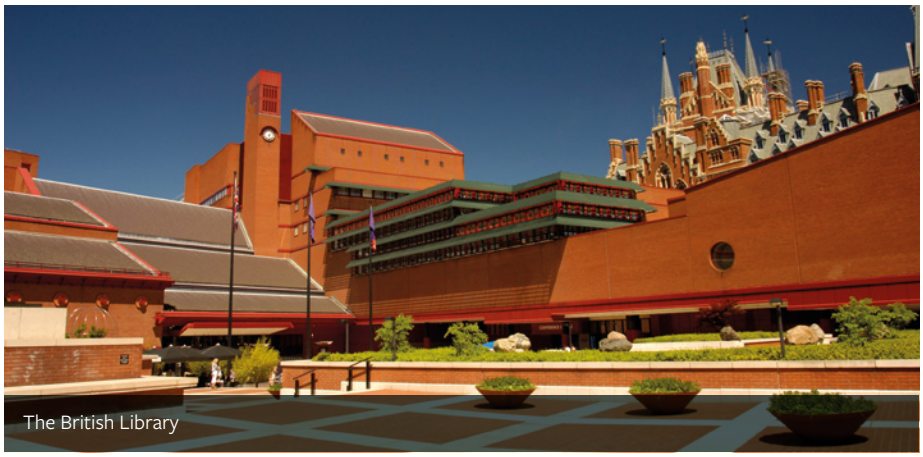
"My vision for a future University app might be like a virtual mentor: prompting a student to hand in coursework or attend a lecture, linking them to information resources or professional support, suggesting a call with their tutor, but also helping them to balance their study and their personal life."

Professor Leslie Carr

THE TURING INSTITUTE

Viewed by many as the creator of modern computing, Alan Turing was integral to the development and realisation of theoretical computer science and artificial intelligence. Named in his honour, The Alan Turing Institute is the UK's national centre for data science and AI and the University of Southampton has been a proud member for the past five years.

Professor Peter Smith



The British Library

As the Institute launches a new way of working for 2023 and the topic of AI reaches fever pitch, Re:action spoke to Professor Peter Smith, Professor of Social Statistics within Social Statistics & Demography, who has been a Turing fellow and the Turing University academic lead for Turing@Southampton throughout their partnership so far.

"The international expertise of Southampton in AI and data science was the driving force behind the University becoming a partner of The Alan Turing Institute back in 2018," explained Peter. "The Institute and its collaborating universities undertake research that tackles some of the biggest challenges in science, society and the economy – applying this research to real-world problems and helping to make the UK the best place in the world for data science, AI research, collaboration and business."

All of the University's Turing-related activities are coordinated by Southampton's Web Science Institute (see page 11). These include running engagement activities and administering fellowships, projects, and cohort activities.

The benefits of partnering with this prestigious organisation can be felt across the university.

Peter said: "From secondments to Fellowships and student enrichment, to innovative pilot projects, being a part of the Institute and having access to its networks and resources has undoubtedly strengthened our capabilities in the field of AI and data science.

"Southampton currently has 35 Turing Fellows including myself, who contribute to new ideas, drive collaborative projects, secure external funding and provide research expertise. The Fellows come from across all our five faculties, and we have a real drive for multidisciplinary working. We have also established a Turing@Southampton Early Career Researcher community who run regular networking events."

This year, the Institute introduced a new way of working, as explained by Donna Brown, Director of Academic Engagement based at the Turing Institute's headquarters at the British Library: "We are pleased to have launched the new UK-wide university network of data science and AI expertise via the Turing University Network. The network will help enable the Turing's role as a national convener, creating opportunities for meaningful collaborations that will address societal challenges affecting us all. It will also help build skills for the future and further the public conversation around data science and AI.

"The search for new techniques must be regarded as carried out by the human community as a whole."

Alan Turing

Susan Davies

"Southampton have been a much-valued university partner to the Institute for the past five years. Being part of the network will provide more opportunities for meaningful collaboration across the data science and AI landscape. Having access to a wider community will hopefully accelerate research, impact and innovation."

Find out more
www.southampton.ac.uk/the-alan-turing-institute/index.page

or email Susan Davies at sdd1@soton.ac.uk to be added to the mailing list for future events.

PROFESSOR BEN MACARTHUR

Professor Ben MacArthur, from Medicine, Mathematics and the Institute for Life Sciences (IfLS), was appointed Deputy Programme Director for Health and Medical Science in 2020 to help shape the strategy and implementation of the Turing's Health programme which aims to explore how we can use data to improve our understanding of human disease and improve the care we can give people.

He said: "I was delighted to take on this role at a time when modern developments in data science have the power to transform healthcare. The Turing is at the forefront of these developments." In 2022 he was appointed Director of AI for Science and

Government, a major Turing Institute integrated research programme with a goal to deploy AI and data science in priority areas to support the UK economy. In 2022 he additionally became the coordinating director of the Turing Research and Innovation Cluster in Digital Twins – a new initiative that seeks to democratise access to digital twin technology by providing open and reproducible computational and social tools freely accessible to the UK research and innovation communities.

PROFESSOR ADAM SOBEY

Professor Adam Sobey has been appointed to lead The Alan Turing Institute-Lloyd's Register Foundation's (LRF) growing programme in data-centric engineering (DCE).

As Programme Director, Adam will be responsible for leading the research programme, building on its core challenges, and working with industry to deploy data-centric engineering techniques to real-world problems.

Adam is a Professor in the Maritime Engineering group at the University of Southampton, and previously Group Lead for Marine and Maritime in the DCE programme of The Alan Turing Institute.

JOSEPH EARLY

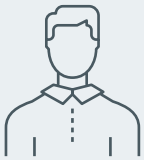
Joseph Early was selected as Southampton's first Turing Doctoral Student in 2019, benefiting from the combined strength and expertise of the University and the Turing.

His research focuses on understanding and explaining the decision-making of complex AI systems. Now towards the end of the Doctoral scheme, Joseph is currently undertaking a six-month internship with Amazon before returning to the Turing to complete his PhD. He said: "My time at the Turing has offered many varied opportunities. I have collaborated with different universities on applications of AI to healthcare, climate and law, and co-founded the Turing's Entrepreneurship Interest Group."

TRAINING THE MINDS OF THE FUTURE

Southampton is home to the Machine Intelligence for Nano-Electronic Devices and Systems (MINDS) Centre for Doctoral Training, which is one of 16 centres of excellence for research training in Artificial Intelligence funded by UK Research and Innovation.

37 INTEGRATED PHD STUDENTS



52 INDIVIDUAL ACADEMIC SUPERVISORS

from across ECS, Engineering, Maths, Physics

EXTERNAL SUPERVISORS

from National Oceanography Centre, Rutherford Appleton Labs, University of Warwick, King's College London, Edinburgh University and Brescia University

This £5 million initiative to provide four-year, fully funded PhD opportunities for up to 60 pioneering students, has a unique focus on research that lies at the interface between algorithmic AI techniques and hardware to enable AI.

Professor Tim Norman is Head of the School of Electronics and Computer Science and is the UKRI MINDS CDT Director, he explained: "The area of research between technique and hardware is critically important for future smart infrastructure and industries where AI can add value to both performance and productivity. We welcome students from various backgrounds, ranging from those with industry experience to recent graduates, as well as related fields including maths and physics – the bringing together of this variety of cohort makes for a melting pot of ideas and knowledge which can result in some groundbreaking research."

MINDS CDT's research is centred around four themes:

- Nanoelectronic Technologies for AI – novel hardware technologies to enable AI techniques to operate at a fraction of the power required in current devices
- Embedded AI – techniques to embed AI and machine learning models in low power devices and to manage their security
- Task-Optimised Devices and Systems – how to optimise the interface between tasks performed in hardware and those in software
- Agent-Based Adaptive Systems – novel techniques to decentralise AI such that infrastructures and systems can operate at scale, optimise performance, and work with people effectively

Find out more
www.mindscdt.southampton.ac.uk

NEW DIRECTION

In January this year, the University's Centre for Machine Intelligence (CMI), was officially relaunched with new research themes and a new director.

Dr Haiming Liu, Associate Professor within the School of Electronics and Computer Science, took up the helm as director and has been steering the Centre and its academics to deliver on the ever-important issue of impact.

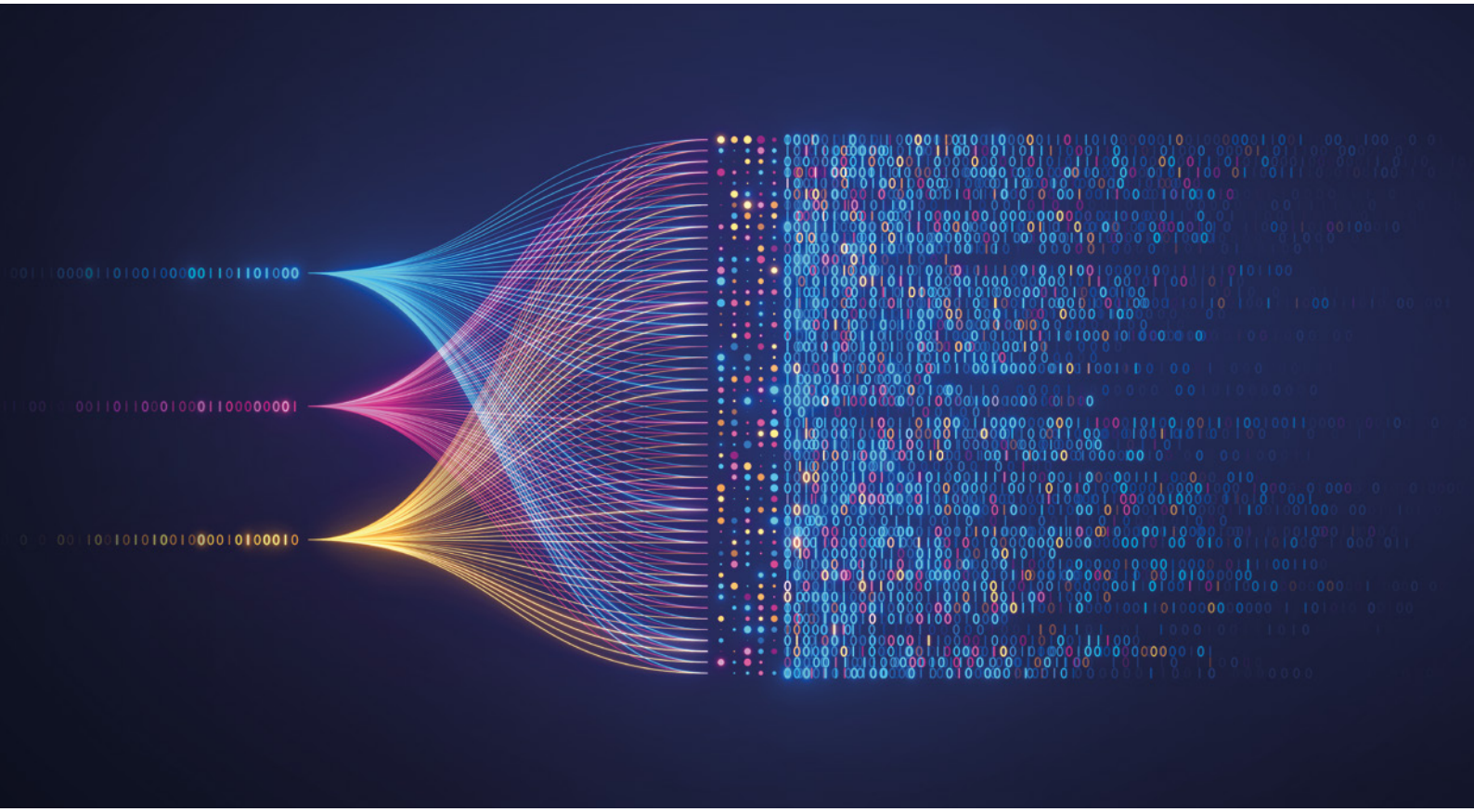
"Within the CMI, we bring together researchers and practitioners with the aim of delivering the impact of machine intelligence to society," Haiming explained. "We have a particular focus on research related to enterprise-based applications of AI, such as user-centered information, access solutions, ethical, unbiased, responsible and inclusive AI solutions, decentralized machine learning solutions for enterprise search, digital health, digital humanities and engineering."

Established in 2017, the CMI's new objectives for 2023 and beyond centre around collaboration and awareness raising.

"We are championing industrial collaborations, from consultancy and PhD sponsorship, to internships, KTPs and catalyst opportunities," said Haiming. "The CMI plays a vital role in connecting people together to offer impactful solutions and innovation for machine intelligence. We want to create a hub for academics, practitioners, and students to discuss and collaborate on Machine Intelligence research. We welcome visits and are happy to meet to discuss research and business problems and solutions".

Dr Haiming Liu

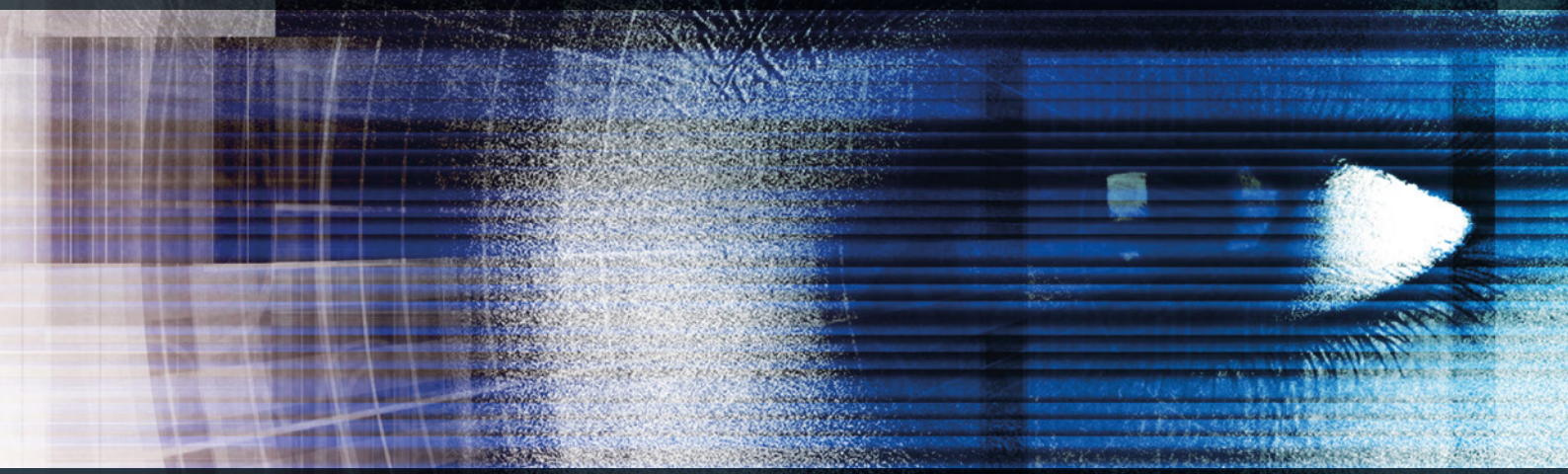
Find out more
www.cmi.ecs.soton.ac.uk



"Over recent years, compelling evidence has exposed the racism and sexism embedded in many contemporary applications of AI."

Professor Paulline Leonard

IS AI REINFORCING INEQUALITY?



Through her part in the TAS Hub Trustworthy Human Robot Teams project and an intensive review of AI research, Professor Pauline Leonard is exploring questions about the role of technology in augmenting social inequalities, discrimination and injustice.

"The key question, from my point of view as a sociologist, is 'How can we design and trust AI to deliver social aims of equality, fairness and social justice'," commented Pauline, sociology professor and Executive Director of the Web Science Institute (WSI).

AI is taking root in almost every aspect of our lives, increasingly playing a part in determining the outcomes of mortgage, credit, job and welfare applications, as well as less consequential activities such as searching on Google, ordering the weekly shop or tracking your morning run.

We might assume that such technology is objective and neutral and even that machine-driven systems might be capable of correcting bias and discrimination, yet a growing body of evidence suggests otherwise.

"The COVID pandemic accelerated our reliance on online technologies in every aspect of our lives," said Pauline, "and through an increasing number of stories in the media, it highlighted the way that AI was impacting differently on different social groups, particularly in terms of unequal outcomes. In many cases, it was racial identity which was unequally treated."

This led Pauline to conduct a review of issues of AI bias.

"Over recent years, compelling evidence has exposed the racism and sexism embedded in many contemporary applications of AI," she explained. In particular, data-driven Automated Decision Making (ADM) technologies, which make decisions through, for example, algorithms or rules based on correlations between datasets, have been shown to embed bias.

ADMs are now widely used in the United States and are spreading rapidly to Europe. Yet research has shown that many ADMs have bias built into their very design: certain systems deny loans, mortgages and credit cards to minorities; profile non-white faces as more likely to commit crimes; preferentially select white candidates or those with traditionally Western names for recruitment; refuse, in an AI-judged beauty contest, to identify any woman as beautiful who did not have a white face; and even fail to recognize non-white skin, making self-driving cars more likely to drive into Black pedestrians and soap dispensers more likely to release soap onto white hands.

"Many of the ADM systems currently in use default human beings to a white-based physiognomy," commented Pauline. "They are naturalising whiteness as a dominant social identity and reinforcing inequalities. The impact can be life-changing."

Pauline's research has shown that bias infuses AI at every stage: from design to outcomes and user experiences.

AI's 'white guy problem'

The first issue, explained Pauline, is what has been described as AI's 'white guy problem': the lack of diversity amongst AI designers, coders, engineers, and programmers, as well as those in charge of 'Big Tech'.

In 2018/2019 only 2.5 per cent of Google's workforce was Black and 3.6 per cent were Latinx. At the same time, Facebook and Microsoft respectively reported that 4 and 5 per cent of the workforce was Black, and 6 per cent was 'Hispanic'.

This is compounded by gender. In academia, less than 20 per cent of AI faculty hires and PhD recipients are women; while in industry, women comprise just 15 per cent of Facebook's staff and 10 per cent of Google's. Half of the women who enter the sector eventually leave it.

A 2019 report concluded that the gender gap in computing is worse now than in the 1960s.

Professor Pauline Leonard

"Work on Trust, Bias and effective governance is absolutely central to what we're doing. Through the socio-technical approach of the Web Science Institute and the TAS Hub, computer scientists work alongside social scientists, philosophers, and lawyers, to debate these ethical questions every day."

Professor Paulline Leonard

Artificialising bias

The second problem, a consequence of the first, is what Pauline labels 'artificialising bias.' The concept, which she developed, aims to capture the way that AI and AI tools might embed bias through their very usage and development, through their design and also their outcomes.

"We need to ask the question, what are the consequences of having an artificially selected 'bunch of young white guys' designing technologies?" continued Pauline.

"Who you recruit becomes who designs the technologies, and if you only have a very narrow section of the population designing how AI can be used in, for example, welfare benefits or women's health, they won't necessarily have the right kind of experience to inform the use of those AI's, leading to biased outcomes.

"I describe these AI designs as engaging in a project of 'artificialising bias' as their social outcomes are routinely constructed to artificially bolster white, male, middle-class privilege, marginalising Black and ethnic minority women in particular."

The uses and direction of the development of technology reflect the priorities of the holders of social and economic power. The evidence shows that those with the power to design and build digital systems can reflect their values and visions of the world in the decisions these systems make.

Zappy the robot cleaner

A third bias inflecting AI became evident to Pauline during research funded by the UKRI TAS Hub. Trustworthy Human Robot Teams was a multi-disciplinary project with the University of Nottingham and Kings College London, which looked at how humans and AI, in the form of robots, could work together in the context of industrial cleaning.

"The project began during COVID when, in some settings, industrial levels of sanitation were essential. Involving machines allows ultra-violet light to be used, so robots are a possible way forward," explained Pauline.

Computer scientists and engineers at Nottingham developed a prototype cleaning robot, known as 'Zappy'. The project considered the effectiveness of the robot's cleaning and how it would be received and trusted.

Pauline examined the responses of human industrial cleaners.

Many of the male cleaners were excited by the idea of working with a robot, drawing on science fiction films in their responses. Some raised concerns about what would happen if Zappy went out of control.

"While the men looked forward to a more technological future, the women tended to be much more cautious," said Pauline.

The female cleaners were concerned that Zappy would not be as skilled as a human,

would not be flexible or mobile enough to get into small spaces or have the fine motor skills that much cleaning demands.

"That Zappy was interpreted more positively by men is an interesting reflection of the fact that in industrial cleaning, male cleaners dominate, whereas in domestic cleaning women dominate," commented Pauline. "Industrial cleaning is seen as tougher and more masculine, whereas domestic cleaning is thought of as cleaning toilets and other people's food spills. It is interesting how both the design and the responses of the human cleaners reflect larger structural differences in the workplace.

"Where some of my previous research had identified how race was an embedded structural inequality in some AIs, the outcomes of this work highlighted the role of gender.

"It became clear that 'bias' – our pre-conceived judgments, attitudes and experiences, which are often drawn from powerful social stereotypes, of skill, ability and appropriacy as to who does what – penetrates all aspects of the AI process," said Pauline.

Bias in AI must not go unchallenged

This recognition of AI as a racial, gendered and classist system of governance that can reassert, renew, and normalise existing bias, must not go unnoticed or unchallenged. The good news is that activists and academics are increasingly exposing injustices and arguing that the reliance of key institutions of governance on ADM systems in the distribution of essential services is a human rights issue.

The University of Southampton is uniquely well-placed to address this issue.

"Work on Trust, Bias and effective governance is absolutely central to what we're doing," commented Pauline. "Through the socio-technical approach of the Web Science Institute and the TAS Hub, computer scientists work alongside social scientists, philosophers, and lawyers, to debate these ethical questions every day."

Find out more
www.southampton.ac.uk/research/projects/trustworthy-human-robot-teams

Professor Pauline Leonard's review of AI research will be published in the *Routledge International Handbook of New Critical Race and Whiteness Studies'*, R. Andreasson et al; Routledge, 2023.

'Zappy' the industrial cleaning robot prototype
This photo was edited using Photoshop Beta generative AI to remove background clutter

ROUTE TO SUSTAINABILITY

Seeing electric vehicles (EVs) on the road is the norm in 2023, and the popularity of this more sustainable mode of transport is clear. However, the hundreds of thousands of electric vehicle owners in the UK are still facing one major frustration when it comes to longer journeys and it is all to do with uncertainty around charging up.

Dr Elnaz Shafipour Professor Seb Stein

Researchers at Southampton are seeking to address this problem by developing an app which uses AI to provide electric vehicle drivers with the optimal charging stops for their journey needs and requirements. Dr Elnaz Shafipour, a Research Fellow in the School of Electronics and Computer Science, working on citizen-centric AI systems explained, "We are aiming to address the problem of range anxiety and encourage the further uptake and use of electric vehicles by making it easier to plan longer journeys."

evtonomy

The app is named evtonomy, because it gives EV drivers autonomy over their charging experience. The AI platform transforms the EV driving experience by focusing on the needs and preferences of the user rather than just displaying basic information on the location of charging points.

World-leading AI expert and Turing Fellow Professor Seb Stein developed the app with Elnaz: "We surveyed over 1,200 EV drivers, asking them about their experience of charging on long journeys. The survey revealed that over a third were dissatisfied. We saw this as a real opportunity to utilise AI to address that need in the market and drive motivation to use EVs.

"But we wanted it to be more than just a GPS system. Our app works to help drivers find charging stops based on their preferences. They can choose between high speed versus low cost, and personalised routes are offered accordingly, based on factors such as charging speed, predicted queuing time, and facilities with a summary of total cost and total time provided, so they can make a choice."

"I really think AI and computer science have the potential to help us reach net zero, but the AI must take a human-centred approach."

Professor Seb Stein

Citizen-centric

Seb has a Turing AI Acceleration Fellowship on Citizen-Centric AI systems. Within that, he and his team are looking at how AI can address big societal challenges like sustainability, while putting the citizen at the heart of these systems.

"I really think AI and computer science have the potential to help us reach net zero, but the AI must take a human-centred approach," he outlined. "As such, within our app, we learn a driver's preferences from their interactions and previous choices. This then helps us make better, personalised recommendations over time."

Find out more and sign up for an early trial of the app
www.evtonomy.com

As the application of AI technologies to enhance and inform the use of geospatial data rapidly increases, experts at Southampton are working to fill the skills gaps between AI and geospatial experts.

FILLING THE GAP

"Geospatial Data is everywhere and AI is being used to automate existing processes, create new geospatial products, and inform decision-making," explained Professor Jadu Dash, Director of Southampton Geospatial. "The key challenge now is to skill up people who can process geospatial data with AI and machine learning technologies."

Southampton Geospatial brings together the university's interdisciplinary expertise in geospatial science. It aims to connect Southampton's geospatial expertise with industry, government, and charity partners globally, to offer tools such as geospatial datasets, modelling capabilities and sensing equipment, that enable nations and agencies to benefit from the insights that geospatial data offers.

"We are really focused on developing the talent pipeline and training the next generation of experts who can understand the power of both AI and geospatial technology and who can communicate that to policymakers," said Jadu. "There is real opportunity for the collaboration between geospatial data and AI to unlock untapped potential in the datasets we're using and improve efficiencies in the use of that data."

Professor Jadu Dash

As well as inputting into the new undergraduate and postgraduate degrees in AI and Computer Science the University has launched for 2023/24 (see page 32), Southampton Geospatial is working closely with the Governments Geospatial Commission, an expert committee that sets the UK's geospatial strategy and promotes the best use of location data, to address the skills gap.

"In May this year we hosted the Commission at Southampton and explored with them, and other stakeholders who create, analyse and use geospatial data, what the future training needs might be in light of advancements in modern AI and machine learning," outlined Jadu.

Thalia Baldwin, Director of the Geospatial Commission, Nigel Clifford, Deputy Chair and Rebecca Reid, Skills, Capabilities and Innovation Policy Lead, led a panel at the event with stakeholders from Arch AI, Sonardyne, Alcis, ELM, the National Oceanography Centre, Innovate UK, and Ordnance Survey.

There was positive discussion around the role of the university in providing research and development foundations for further developments in data, products and technology and the value of long-lasting collaborations through various mechanisms such as joint PhD studentships.

"Southampton Geospatial's work in utilising AI and machine learning demonstrates the importance of a multidisciplinary approach to provide solutions to many of the global challenges we are already focusing on in Geospatial such as environmental change, energy use and health inequality," explained Jadu. "I would like to thank our experts who are facilitating that approach including Professor Jonathon Hare, in Electronics and Computer Science, Professor Marika Taylor in Mathematical Sciences, Professor Jo Slater-Jefferies from the National Biofilms Innovation Centre and Professor Blair Thornton from Engineering and Physical Sciences."

The University already has several research projects which demonstrate the benefits of applying AI technology to geospatial data. And was recently mentioned as an exemplar of an institution working to fill the skills gap in the Government's UK Geospatial Strategy 2030.

Find out more
www.southampton.ac.uk/research/institutes-centres/southampton-geospatial

IMPROVING MALARIA BEDNET DISTRIBUTION

Much of the global malaria burden is experienced by countries in sub-Saharan Africa, and in these regions, insecticide-treated bednets (ITNs) are a key tool in reducing malaria morbidity and mortality.

ITNs are typically distributed in mass door-to-door campaigns where the goal is to reach 100% of households in a local area. Yet the lack of comprehensive maps or geospatial datasets related to settlements, infrastructure, and population in this region makes achieving this goal particularly challenging. However, ITN campaigns are increasingly making use of GPS-enabled smartphones or tablets, providing a unique data source and opportunity to optimise future campaigns.

Democratic Republic of Congo (DRC) has the second-largest number of malaria cases of any country globally. A project led by Heather Chamberlain, Senior Enterprise Fellow, is utilising geospatial analysis to identify the locations of spatial anomalies in ITN distribution in the DRC.

Heather and her team are analysing a combination of high-resolution geo-located datasets on population, settlements, and households in a malaria-endemic region. They are utilising advanced data analysis and machine learning approaches to identify statistically significant spatial/temporal groupings of households in the ITN campaign. These results will compare the observed household distribution with the expected distribution by leveraging the high-resolution data on population and settlements developed by WorldPop (see page opposite). The ratio of observed to expected will help to quickly highlight deviations of over- or under-coverage.

All discoveries from the analysis will be passed to the local teams coordinating the ITN distribution for review and decision on any further action required. This is expected to help to improve the coverage of ITN distribution, enabling more households to receive potentially lifesaving bednets.

MEASURING THE COVID-19 IMPACT TO INDIAN FISHERIES

Over three billion people worldwide rely on wild-caught and farmed fish as their primary source of protein, and nearly 60 million people work in fisheries and aquaculture. Fish provides food security for low-income coastal communities in many developing countries.

The viability of marine fisheries as a long-term resource is in jeopardy. Not only are many of the world's stocks already fully exploited, overexploited, or depleted, but the COVID-19 pandemic has posed an additional systemic shock that threatens the livelihoods of low-income fishers, including women and migrant workers.

In India, which has the world's second-largest population, the impact of COVID-19 has been immense on fishing communities, but questions remain regarding the full extent. Research is needed to quantify the response of these communities to the pandemic so that lessons can be learnt of how resilient India is to 'shocks' to natural resource exploitation.

Paul Kemp, Professor of Ecological Engineering, is leading an interdisciplinary research project which uses machine learning to interrogate satellite remote sensing images to quantify the activity of small-scale artisanal vessels, those that are not equipped with Remote Electronic Monitoring systems. Using satellite images from pre- and during the COVID-19 'waves' and lockdowns, Paul's team will ascertain the impact of COVID-19 health policies on the fishing activity of local low-income fishing communities.

The results can be compared with those of an ongoing project led by Dr Bindi Shah, Associate Professor in Sociology, involving social scientists, that is documenting the impact of COVID-19 on Indian fishers using traditional social survey techniques. This will allow the project teams to 'ground-truth' the results of the geospatial investigation.

MOVESCAPES

Movement is a fundamental feature of animal life, and increased data is being gathered on movements using tracking devices attached to animals. A key assumption in the studies of animal movements is that the spatial movement paths (or 'tracks') of animals reflect different behavioural states. By detecting these behavioural states in tracking data, behaviours across land- and seascapes can be predicted and mapped, creating *movescapes* that reveal how animals use areas.

These *movescapes* will be particularly informative and valuable for the understanding and management of marine ecosystems, which are under immense pressure from growing human impacts.

Using large datasets on the movements of marine vertebrates such as marine mammals, Dr Ryan Reisinger in Ocean and Earth Science and Professor Adam Prügel-Bennett in Electronics and Computer Science, aim to develop and apply machine learning methods to define and predict these *movescapes*. In their current project in partnership with CLS, a subsidiary of the French Space Agency, Ryan and Adam are utilising the Argos dataset and using an interdisciplinary approach across ecology, oceanography and computer science to explore the creation and application of a semi-supervised workflow that uses big data and machine learning approaches to do this.

WORLDPOP

Population mapping is essential for governments to ensure adequate and appropriate resource allocation for healthcare, welfare, crisis management and development, and to ensure that no one is left behind.

The interdisciplinary WorldPop research group is highly skilled in mapping population distributions. The group relies on data from satellites and other geospatial data to inform its work. Layers of these data and on-the-ground sources provide WorldPop researchers with detailed information to build estimations and maps of population numbers.

The population mapping that WorldPop undertakes relies on AI in multiple ways. Key inputs to the group's population models are recent maps of buildings, but until recently these have been difficult to obtain. However, the development of AI algorithms for recognising buildings from satellite imagery is allowing the group to map them rapidly. Additionally, AI methods are enabling the group to recognise informative patterns in these building maps, identify which buildings are likely to be residential and improve the population mapping methods themselves.

WorldPop Director Andy Tatem, Professor of Spatial Demography and Epidemiology, explained: "There are some countries that have not done a population census in decades, and there are also many countries that were supposed to do a census in 2020 or 2021, but couldn't because of COVID-19. A major recent focus of our work is on supporting governments with rapid population mapping built on AI-derived data to fill those gaps.

"In a few countries, estimates from WorldPop have been used where a census has been conducted, but certain areas couldn't be included because they were inaccessible due to insecurity or limited access. We have been able to provide them with a way to fill those data gaps accurately, and this information is used as official statistics to allocate aid and determine representation in parliament."

The WorldPop team works with an array of satellite image providers, governments, UN agencies and donors, including the Bill & Melinda Gates Foundation. They also collaborate with Google, Facebook and Microsoft on AI-derived building maps and estimating population dynamics. The group recently won the International Geospatial Innovation Award from Ordnance Survey's Geovation initiative for their work on population mapping.

Find out more
www.southampton.ac.uk/research/groups/world-pop

AI IN CRIMINAL JUSTICE

With a criminal justice system in the UK that is overstretched, and at times under-resourced, it is no wonder the use of computer-generated algorithms to assist with policing is growing in popularity across the country.

But how are these data-driven decision-making algorithms created and do they always work? Dr Pamela Ugwudike, Associate Professor of Criminology at the University of Southampton, led a research project looking at how to identify bias in algorithms being used to facilitate predictive policing.

"Predictive policing algorithms process collected data to forecast future crime risks based on pre-defined, expected patterns," explained Pamela. "There are a variety of such algorithms, some focus on location, so the emphasis is on where to police. Others are more individualised, so their priority is who to police."

Working with colleagues in Electronics and Computer Science, Mathematics and Software Engineering, Pamela and the research team focused their work on predictive policing algorithms that forecast crime risks via spatiotemporal analysis of crime patterns.

"Modelling historical data such as police recorded crime data, as well as geospatial, temporal, environmental and other data to identify crime risk locations, lies at the core of predictive policing algorithms," said Pamela. "With the exponential rise in the availability of 'big data', recent versions of such algorithms process volumes of data to forecast crime risk areas, moving the focus away from solely identifying hotspots to predicting and pre-empting future crime locations."

Advocates and commercial vendors often portray the models as scientific tools for predicting crime risks and allocating scarce police resources effectively. According to one American-based vendor, PredPol (now rebranded as Geolitica, predictive policing algorithms can provide 'cost-effective and well-targeted crime prevention'

"We put this theory to the test," explained Pamela. "We created and tested a computational model that replicates the published PredPol algorithm. We ran large-scale tests of the model using statistically

"Predictive policing algorithms process collected data to forecast future crime risks based on pre-defined, expected patterns. There are a variety of such algorithms, some focus on location, so the emphasis is on where to police. Others are more individualised, so their priority is who to police."

Dr Pamela Ugwudike

representative, biased and unbiased synthetic crime data, as well as crime data from the police Application Programming Interface.

"Algorithms such as PredPol offer an approach supported by the 'near repeat' thesis, which emphasises that crime events follow a predictable pattern and each crime occurrence heightens the risk of another crime in close proximity if a deterrent such as police presence is not introduced," Pamela outlined.

The 'near repeat' thesis also suggests that if left unaddressed, a crime event signals to potential offenders that the benefits of crime outweigh the risks.

Upon testing the algorithm, it became clear to Pamela and the team that the version of PredPol tested had self-reinforcing properties that may stem from the assumptions it makes about predictable crime patterns and human behaviour.

"We identified a vicious cycle. The tested algorithm ignored fluctuations in background crime rates and repeatedly predicted high crime risks in locations with enhanced crime records caused by increased policing.

"So, feedback loops were being generated in the algorithm. It repeatedly targeted the same areas with higher recorded crimes than others, even after crime rates returned to their normal levels."

The team explored the reason for this outcome, and found that the algorithm was modelled on the 'near repeat' thesis which assumes that a crime incident would trigger a nearby crime shortly after the initial event

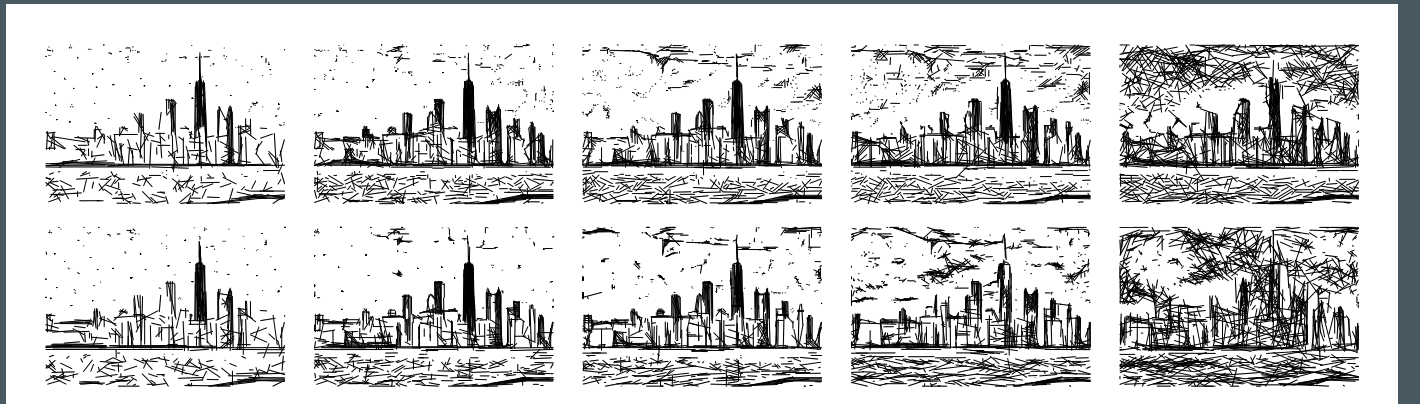
This assumption can explain why it continuously targeted the same areas for high-risk predictions.

"This creates various problems, not only in the fact that police resources are not being evenly distributed in a region or area, it also has criminal justice implications in that the locations receiving increased police presence can become labelled as chronically criminogenic.," said Pamela. "This can then lead on to broader social implications. Residents can become vulnerable to negative profiling and disproportionate or even unwarranted criminalisation and penalisation.

"This project has been important because it has contributed to the creation of a framework for comparing data-driven predictive models on different datasets to identify biases that should be addressed," outlined Pamela. "I personally do not have a dystopian view of AI technologies; they have the capacity to improve human wellbeing in many ways. But as our study shows, those deployed by justice systems can produce unintended consequences and it is important to work towards addressing problems such as biases to design fair and trustworthy technology."

Find out more
www.southampton.ac.uk/research/groups/institute-of-criminal-justice-research

STATE OF THE ART



Perceptions of the Windy City in 1,000 lines

Hours of fun can be had playing a furious game of Pictionary with family and friends. Someone drawing objects, unable to speak, whilst teammates frantically shout out hilarious suggestions of what they think they see on the paper. The scientific name for this family fun is 'a referential communication game' and work by Southampton Professor of Machine Learning, Jonathon Hare, explores machines that can learn to communicate with one another by drawing in this way

"Pictionary works for humans because we have all learned how to draw in a way that other humans can understand," explained Jonathon. His work with, Daniela Mihai, then a PhD student, explores how machines can learn to play similar drawing games.

Language versus image

To date, studies on communication emergence in multi-machine games have focused on exploring a language-based communication channel, with messages represented by token sequences which are akin to words in human languages.

"Machine-generated communication of this nature can be difficult for a human to interpret because the words used by the machine might not map to words or concepts used or understood by humans," said Jonathon. "In this project, we propose a direct and potentially self-explainable means of transmitting knowledge: sketching." They reformulated the traditional referential game to one where one machine sketches a given photo and the second machine then guesses, based on the drawing, the corresponding photo from a set of images.

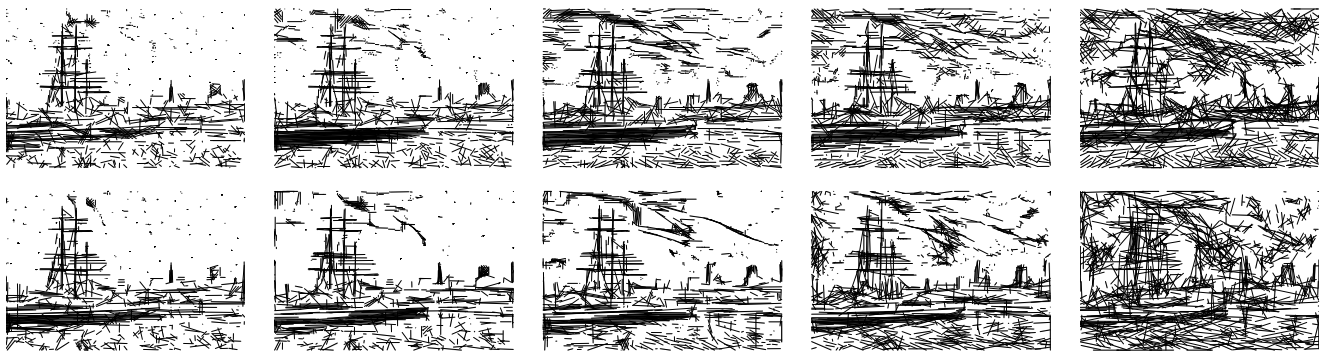
Professor Jonathon Hare

Evidence suggests early humans were able to communicate by drawing, long before developing the various stages of written language. This leads to the question, of whether drawing is a more natural way of starting to study emergent communication and if it could lead to better-written communication later?

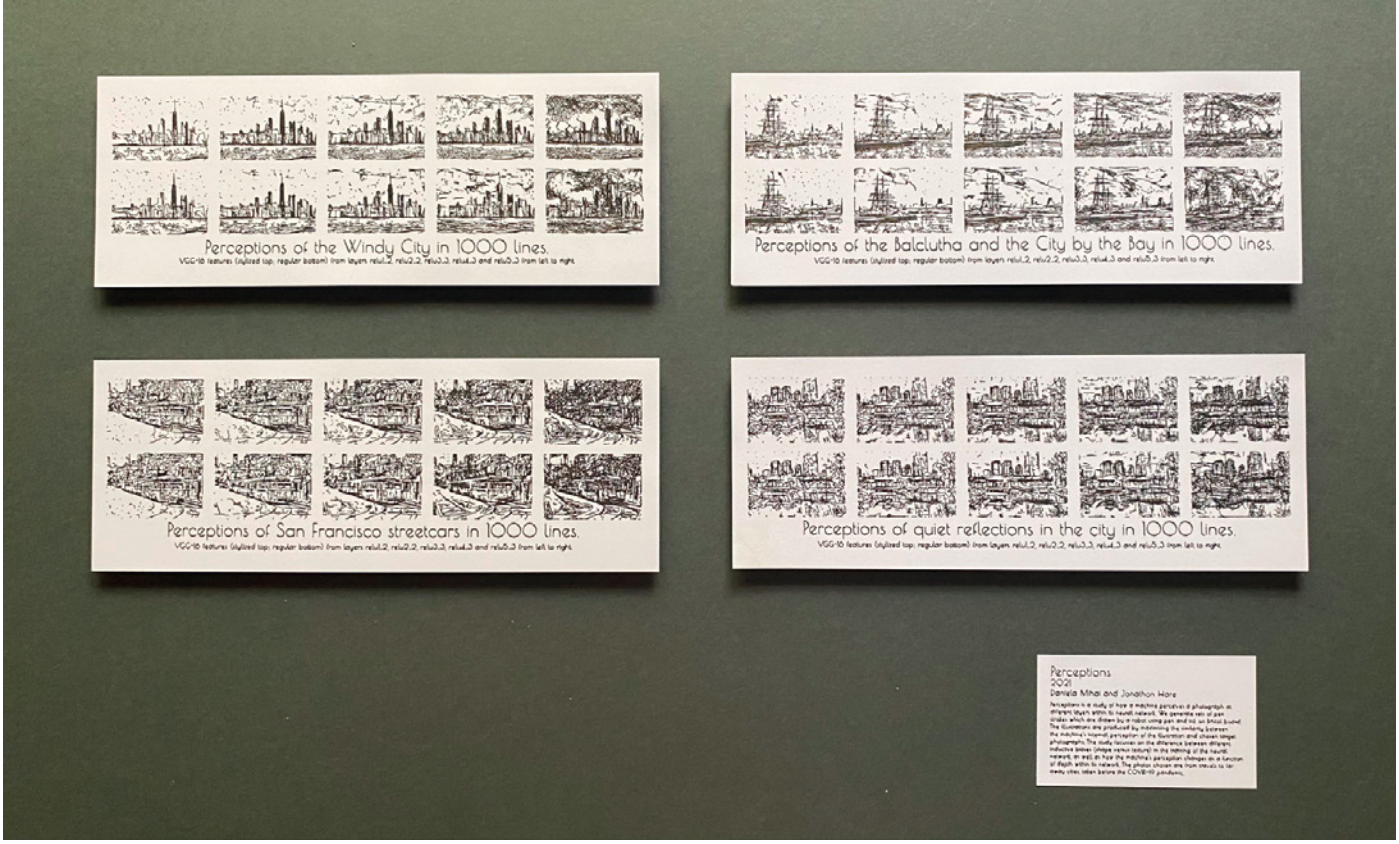
Perceptions

"We called our study *Perceptions* because we looked at how a machine perceives a photograph at different layers within its neural network, which is a mathematical computing system modelled on the way nerve cells fire in the human brain," said Jonathon. Sets of pen strokes are generated which are drawn by a robot using pen and ink on Bristol board. The illustrations are produced by maximising the similarity between the machine's internal perception of the illustration and chosen target photograph.

Their machine is built around a multi-layered neural network which can be fed with visual data. Different layers of the network incrementally perceive different types of



Perceptions of Balclutha and the City by the Bay in 1,000 lines



information. The early layers tend to capture information about areas of light and dark, texture and edges, and the later layers capture more information about shape and the types of objects in the image. This is similar to the way the human visual system is believed to work.

The machine can be shown a photograph, and it will then try to work out what set of pen strokes would produce an 'imagined' illustration that would produce the same patterns of neural activity as the photograph did. Once this imagined illustration has been created in the machine's memory, the machine then turns it into a set of instructions that control a drawing robot that can move a pen around a piece of paper.

The study looked at how sketches changed when the different layers of neural networks were used for comparing the illustration and the photo. It asked the question; what the effect was of making the machine draw by matching activation patterns only from select layers of its neural network?

On display

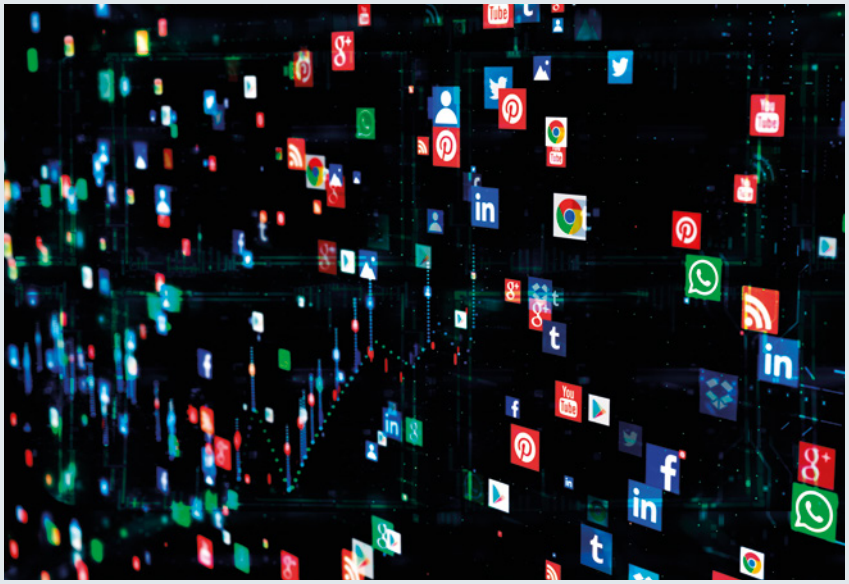
The resulting images created by the machines in Jonathon and Daniela's work were chosen to be displayed at the NeurIPS Machine Learning for Creativity and Design Workshop. The work on communicating by drawing was selected for presentation at the prestigious thirty-seventh Conference on Neural Information Processing Systems Conference.

The NeurIPS Workshop brings together researchers and artists to address the technical issues and challenges of applying the latest machine learning models and techniques to creativity and design, whilst considering the broader sociocultural and political issues that surround this area of research.

"The photos chosen for *Perceptions* are from travels to faraway cities by me, taken before the COVID-19 pandemic," explained Jonathon. "We were thrilled they were selected to go in the gallery for the workshop and even more thrilled when we were asked to do an oral presentation for our work on communication, being one of only 70 papers selected from over 9,000 submitted."

Find out more
www.southampton.ac.uk/about/faculties-schools-departments/school-of-electronics-and-computer-science

Perceptions of quiet reflections in the city in 1,000 lines



"We called our study Perceptions because we looked at how a machine perceives a photograph at different layers within its neural network, which is a mathematical computing system modelled on the way nerve cells fire in the human brain."

Professor Jonathon Hare

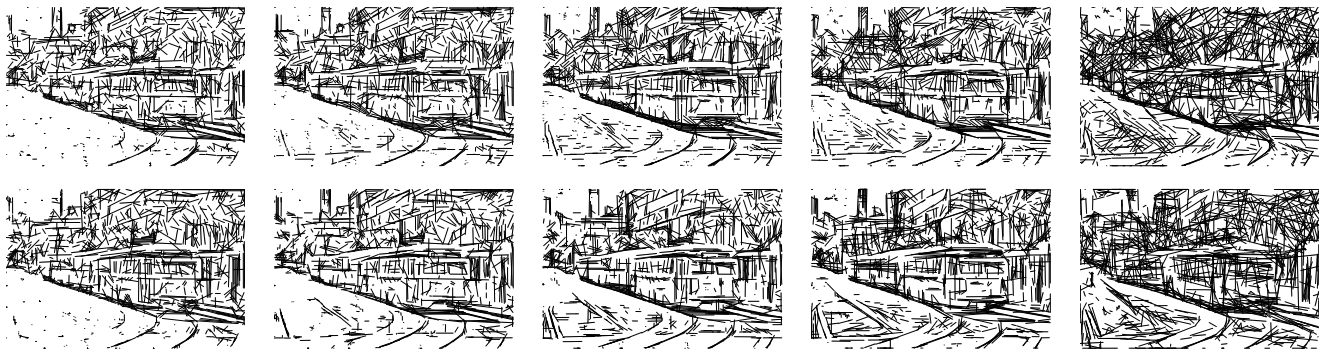
DEGREES IN AI

Jonathon, in addition to his role in Machine Learning, is Deputy Head of School in Electronics and Computer Science. Working with colleagues Professor David Thomas and Dr Danesh Tarapore, they have written two new undergraduate degrees and two new Masters in Artificial Intelligence and Computer Engineering.

Launching in the 2024/25 academic year, these trailblazing degrees for Southampton are designed to focus on how to build and understand Artificial Intelligence to equip the next generation of computer scientists.

"Our new Bachelor and Masters degrees are essential to the education landscape here at Southampton as AI, data-driven and machine learning technologies are at the forefront of our daily lives and become increasingly prevalent in automating processes across many domains of modern life," said Jonathon.

"We have an excellent track record with the current degrees we offer in this area, and as our expertise grows in the research field of AI and computer science, so we can expand our teaching and enable students to benefit from the world-class knowledge we have here at Southampton."



Perceptions of San Francisco streetcars in 1,000 lines

"We aim to open up the public conversation between AI and the Arts, to unlock a critical conversation through creative engagement with AI," said Winchester School of Art's Professor Sunil Manghani.

CREATIVE CONVERSATIONS

Above: Professor Sunil Manghani

Right: Professor Ed D'Souza

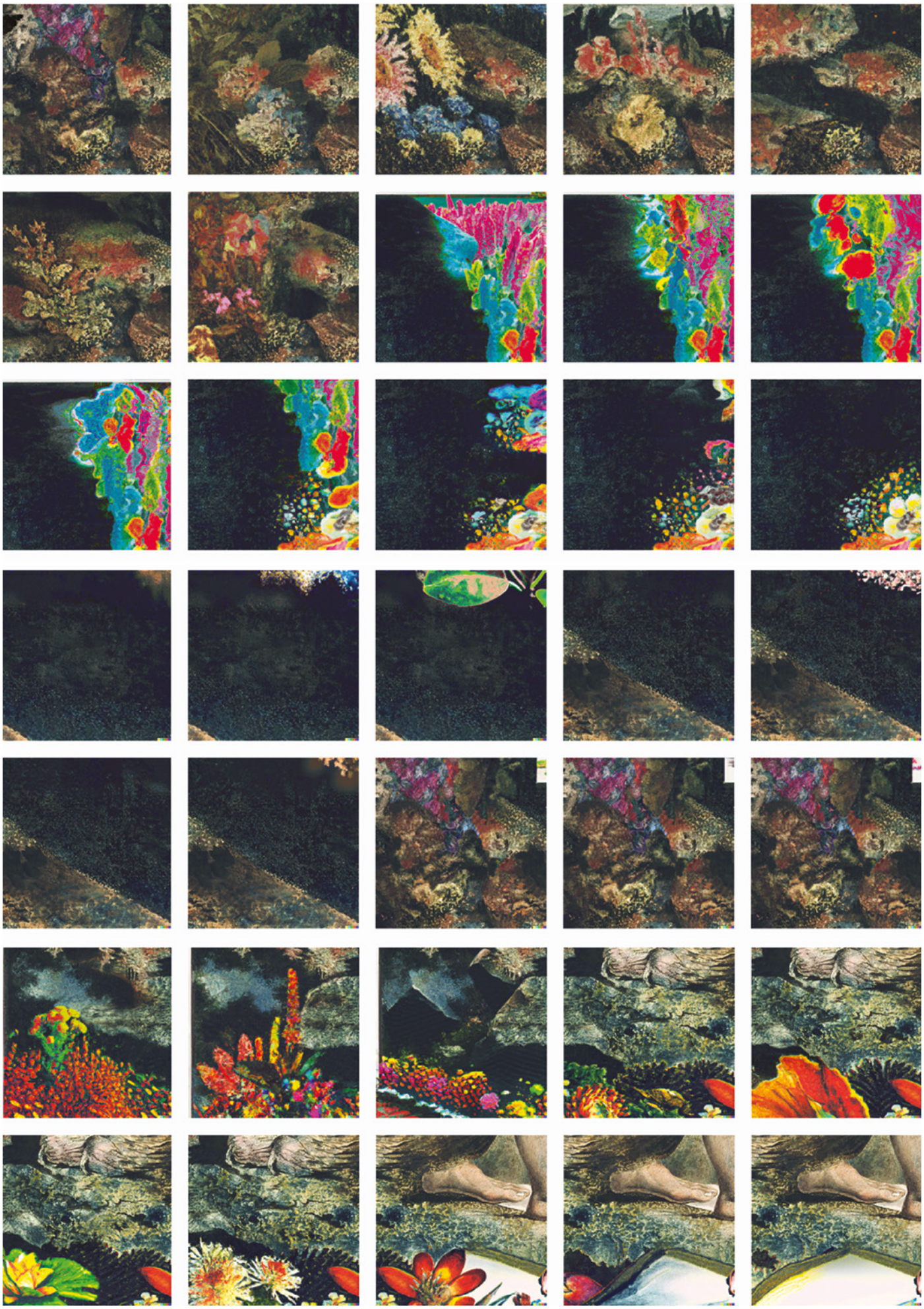
Opposite: Sequence of image results based on text prompting using image diffusion software from a detail of William Blake's image *Newton*.

Sunil is at the forefront of the School's developing expertise in 'AI and the Arts'. He is Professor of Theory, Practice and Critique and sits on the Academic Advisory Board of the University's Web Science Institute.

As a Fellow of the Alan Turing Institute and member of its AI and Arts Interest Group, Sunil has been revisiting Structuralism as a framework to explore the absence of memory or cultural context when we use generative AI. The mid-Twentieth Century structuralist movement has been defined as 'the search for the underlying patterns of thought in all forms of human activity'.

Collaborating with Tate Britain, Sunil and Professor Ed D'Souza are investigating the opportunities that AI might offer to marginalised groups. Ed, who is Professor of Critical Practice and co-director of Winchester School of Art (WSA)'s Social Practices Lab, is also looking at the potential for visualising 'big data' to unlock valuable social impacts.

Together, this work is about "questioning the whole archive" that AI and large language models are trained on, explained Sunil. In both projects 'social practice' – art which focuses on engagement through human interaction or social discourse – offers what Sunil describes as "making as inquiry", or "learning through making, through collaboration, through needing to solve problems"



SOCIALLY USEFUL

"Everyone talks about AI and data in terms of economic impact, but it can also be something socially useful," said Ed. "We are interested in the impact that freeing up data, which is collected from us all but mainly used for commercial purposes, might have on everyday people and issues."

'Mapping Social Impact' is a new project using mapping technology to aggregate data on social enterprises, projects, activities, people, and organisations in Winchester and Southampton. By developing a map interface, where people can input search terms on, for example, environmental groups or healthy eating, "you allow people to visualise that data, see where things are happening and understand how it could be useful to them," continued Ed.

"You can start to add different data sets, such as health data, to show areas of deprivation and where there are resources that could be brought to bear to develop projects or improve access."

Creative, collaborative solutions to developing interfaces can allow the public to more easily engage with complex data. 'Smart data' can be visualised to allow for meaningful engagement with communities, places, issues, needs and services.

MAKING MEMORIES

"Claude Lévi-Strauss was one of the central figures of structuralism," explained Sunil. "Through his work on myths, he identified that, although the characters, context and form of stories might change, there were certain elements that recurred across cultures."

"Lévi-Strauss spent hours in the New York Public Library, with the components of stories on index cards, which he would move around on wooden boards to work out what the common elements, or 'invariants' were. He could track them across thousands of myths," continued Sunil. "In one of his essays, he said, "imagine what I could do if I had IBM equipment", meaning a computer.

"That line came back to me when I was thinking about my Turing Fellowship. Lévi-Strauss was doing a form of pattern recognition, a sort of handmade artificial intelligence. AI large language models (LLMs) are doing a very similar operation, but over many more parameters."

LLMs and image generation AIs are machine-learning neuro networks trained on billions of parameters to predict what should come next, based on probability. They can create articulate, plausible new texts or images, but they lack the means to navigate what Sunil refers to as a "cultural archive".

"When humans talk, we tend to be referring to specifics or to someone. AI can evoke the notion of a person in a sentence, but a few sentences later, it is just a new iteration of that person, there is no substantive connection," continued Sunil. "That creates a strange feeling when you're using these LLMs: they make perfect sense, but they don't seem to have any memory."

Working with colleagues at the Alan Turing Institute, Sunil has been analysing myths and trying to train an AI on these data sets to disaggregate stories and understand the significance of certain elements, in the same way that Lévi-Strauss did.

"We are trying to give the AI this sense of memory, or what I call a 'second order signification system', in the way it makes meaning," said Sunil.

"If AI could start to make sense of stories and hold on to key components, you are giving it an ability to find connections and make inference. If it can hold a larger contextual reading of a situation, generative AI models can start to produce more meaningful outputs."

Find out more
https://structuralism.ai

Right Clipdrop AI-generated artwork, extending from William Blake's *Newton*, created at the 'Beyond the Frame' workshop

Opposite left William Blake, *Newton* (1795–c.1805). Held in the Tate Collection.

Opposite right Clipdrop AI-generated artwork, extending from William Blake's *Newton*, created at the 'Beyond the Frame' workshop

BEYOND THE FRAME WITH TATE BRITAIN

Questions of representation and diversity have been discussed in art for some time and are, increasingly, also being raised in the context of AI.

For a public art collection such as Tate Britain, engaging with their local community and young people who may be disenfranchised from art and culture is a priority. A collaboration with Winchester School of Art, 'Electronic Life', is using AI to address both issues.

The Tate invited Professor Sunil Manghani and Professor Ed D'Souza to collaborate with the Tate Collective Producers to develop a series of public workshops. This group of 16-25-year-olds from the museum's local area is involved in programming, including the renowned 'Late at Tate' events.

With the Collective, the Tate and industry partner Stability AI, Ed and Sunil developed the idea of inviting visitors to use AI imaging software to manipulate digital versions of works in the newly rehung Tate collection, to engage with the art and ask questions about representation. Stability AI provided free access to their software, which allows the user to 'clean up' or 'uncrop' sections of an image or add new elements using text prompts.

The first event, *'Beyond the Frame'*, took place in June as part of the LGBTQIA+ *Queer and Now* festival and included an artist's talk from Whiskey Chow, a Queer artist invited to use the software to produce new works on queer identity.

"I am interested in the kind of affordances that technology might give, enabling marginalised groups to connect, express themselves and engage," explained Ed.

Text prompt interfaces are allowing people to use AI without having technical knowledge. In being able to use the skills they do have, in language, imagination and creativity, "AI can be emancipatory," continued Ed.

The project aims to build AI capabilities in the Tate Collective Producers and the museum staff and, by inviting the visitors to use the technology, to diversify the public conversation and foster new stakeholders in AI.

A key theme emerging is that of representation within large language models (LLMS).

LLMs 'learn' by scraping the internet for data. This means they learn from the 'majority data' that they find there, so that the experiences of marginalised groups can be lost.

"The Tate Collective Producers, a very diverse group of young people, found it hard to be able to describe some of their cultural experience through the AI software," explained Ed.

"One of the Producers was trying to describe the Notting Hill Carnival, but the software lacked the understanding of the language she was using and was unable to visualise the diversity of people for her."

Stability AI sent a developer to learn from the young people's experiences of using the platform. It is this kind of dialogue with AI that Sunil and Ed want to promote.

"There is a need for more diversity and engagement with AI and LLMs to enrich these models," noted Ed. "The more diverse the people who can engage, the more diverse the data feeding into these models."

This project will also feature in next year's Kochi Biennale, India.

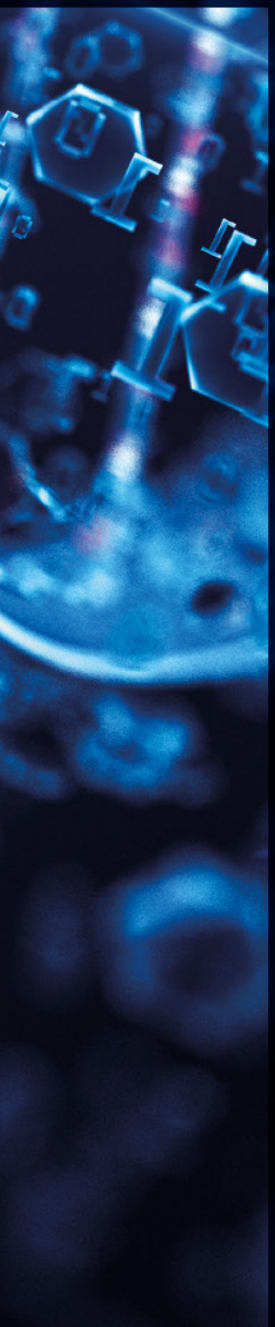
Find out more
www.tate.org.uk/whats-on/tate-britain/queer-and-now-2023/beyond-the-frame

"We are able to offer a unique research vision that is unparalleled anywhere, one that contains the biomedical engineering required for health sensor creation, through to the data generation, and later usage for monitoring, control and behaviour change."

Professor Adriane (Age) Chapman

The AI revolution has never been more prevalent in the medical and health domain than it is now.

THE HEALTH REVOLUTION



University of Southampton interdisciplinary experts are leading the charge by combining our world-leading strengths in the medical and health sciences field together with our cutting-edge work in electronics and computer science, to create the Digital Health and Biomedical Engineering Research Group.

This new collaboration of experts will undertake innovative research from sensors to data to decisions to address societally important challenges in personal health, public health, medicine, and digital health infrastructure.

"Insight from our health and clinical colleagues here at the University combined with a governmental desire to improve the efficiency of care to reduce costs, have led us to identify a range of topics for which this research group, that encapsulates both engineering and sociotechnical research, is a perfect fit," explained Professor Adriane (Age) Chapman, Professor in Electronics and Computer Science, the Group's lead academic. "We are interested in advances made in single cell analytics, disease prevention, rapid clinical diagnostics, rehabilitation, digital intervention, and behavioural intervention, all of which bring AI and machine learning techniques into a clinical setting.

"This is a critically important research area, for both the University and our society. Digital health can only be driven by advances in electronics and computer science as the enabling technologies underpinning health transformation," outlined Age. "Which is why we are so well placed as a university to be at the forefront of advancing digital health."

Age has worked closely with clinical practitioners and other health deliverers for many years to understand their needs, refine the related research and apply it.

Professor Adriane Chapman

"There is a healthy appetite for technology-centred support and resources from our local and regional trusts to trusts UK-wide and internationally," said Age. "We are able to offer a unique research vision that is unparalleled anywhere, one that contains the biomedical engineering required for health sensor creation, through to the data generation, and later usage for monitoring, control and behaviour change."

Southampton is already undertaking projects in this sphere with resounding success.

HEARING HELP

Neural networks are machine learning and AI's inspired way of mimicking the human brain and the way biological neurons signal to one another. They have been highly successful in solving many complex tasks in the domain of computer vision, natural language processing and speech processing.

Dr Jagmohan Chauhan

Dr Jagmohan Chauhan, Lecturer in Computer Science, is planning to work with hearing aid users to develop neural networks that can run on various tiny medical devices and medical implants. This will allow users to enjoy advantages such as data privacy which comes from running neural networks completely on a device and not offloading to an external entity such as the cloud. It will also improve accuracy as neural networks have been highly accurate in solving complex tasks due to the ability to learn effective representations from raw data.

"This is not an easy task as these networks are notorious for requiring a larger number of computational resources which are usually absent on tiny devices," explained Jagmohan. "My research tries to address this challenge by developing novel neural network algorithms that are energy efficient, computationally inexpensive and run completely on the device. These low-power solutions will result in reducing the carbon footprint of neural networks contributing to more sustainable and greener AI."

RIDING THE RADIO WAVE

Shelly Vishwakarma from the School of Electronics and Computer Science, is working to explore innovative approaches that prioritise prevention over treatment when promoting healthy living and enabling independent living for older individuals.

Shelly Vishwakarma

"My focus is on revolutionising in-community health and well-being programmes by developing hardware and software frameworks for radio frequency sensing technology. This technology allows non-intrusive and privacy-preserving monitoring of individuals' activities and movements," explained Shelly. "Wi-Fi signals are all around us, and they bounce off objects, including humans. By harnessing these ambient radio frequency signals emitted from Wi-Fi transmissions and their reflections from individuals, we can monitor their physical activity and movements to understand lifestyle patterns and habits that may contribute to health problems. This information can be used to develop personalised prevention strategies and provide targeted guidance for individuals to adopt healthier habits, reducing the risk of developing chronic diseases."

Shelly's approach offers some key advantages over traditional sensing technologies, such as intrusive cameras or wearable sensors, which are limited by environmental constraints, privacy concerns, comfort, and battery life.

"Our ultimate goal is to develop a SMART (Smart Monitoring and Reporting Technology) healthcare system that is non-invasive, meaning it doesn't require any procedures that could be uncomfortable or intrusive," outlined Shelly. "This system would use personalised apps on smartphones or other devices to keep track of a person's health and behaviours over a long period, right from the comfort of their own home. The information collected through this monitoring system would be analysed and turned into actionable clinical insights. Healthcare professionals could use the data to make informed decisions about a person's health and provide personalised recommendations or interventions if needed."

By developing this non-invasive and innovative healthcare monitoring solution, Shelly aims to empower individuals to take charge of their health and well-being. It would allow for long-term monitoring of behaviours and health indicators, helping to detect any potential issues early on and providing personalised guidance for maintaining a healthy lifestyle.

Zehor Belkhatir

PRACTISING PRECISION

'One size fits all' is not a phrase that can be applied to the treatment of cancers. An important mantra for clinicians when prescribing treatment schedules to patients is "individual patients are different, and diseases are inherently heterogeneous," explained Zehor Belkhatir, Lecturer in Electronics and Computer Science. "My research interest is about personalised cancer therapy which consists of administering the right drug for the right cancer type to the right patient at the right time."

Carcinogenesis, the formation of a cancer in the cells, is a complex, variable, diverse process, and measured data about exactly how it happens is sparse which renders its control or eradication a challenge.

"My research work consists of developing a quantitative and computational therapeutic decision-making tool to support clinicians and healthcare specialists in oncology," said Zehor. "The quantitative model is sought to be personalised, dynamic and capable of identifying optimal cancer treatment strategies, in terms of treatment type, timing and concentration for individual patients under considerable uncertainty.

"I am using hybrid techniques that combine mathematical control modelling techniques and machine learning. For the question of identifying and predicting anti-cancer drug responses in cell lines, myself and colleagues have developed a robust and interpretable machine learning-based predictive model that accounts for both genomic and cheminformatic drug features and also considers the prior structure and clustering of the cancer cell lines and the structurally diverse drugs."

Zehor's project has already led to better predictions and identified plausible biological processes associated with drug responses.

"The next step for my research is to address the issue of what is, and how to decide upon, the optimal dynamic scheduling of cancer treatment for a particular drug," outlined Zehor. "To answer this question, we will use techniques from control engineering theory, which is a branch of applied mathematics that has the objective of driving the behaviour of a given system to a desired state independently of external disturbances."

The aim is to design a computational control algorithm that runs dynamically and adapts treatment policies as observations of the state of cancer are made available; the control system will decide about the best treatment dosage and timing under some pre-defined constraints of the decision process.

If the findings of using feedback control techniques in oncology are successful, Zehor envisions that this will inform the design of future pre-clinical experiments and clinical trials in the future.

BEATING THE BIAS

Artificial Intelligence is already in use in the health system, from training doctors to improving imaging and image analysis. As advances are made in AI, the technology is being applied to health-related problems closer to the clinician-patient interaction.

The technology itself is dependent upon historical data, and what is obtainable from the patient, and there are known disparities within the health system for women and minorities. How then, do we use these tools in a clinical context appropriately, to help the clinician make faster, more correct decisions for the patient's health, while also protecting against biases in the data and automation bias from the users?

"Through a mix of computer science and sociotechnical research and driven by implementations of real systems, we are looking at where problems arise and how to mitigate them."

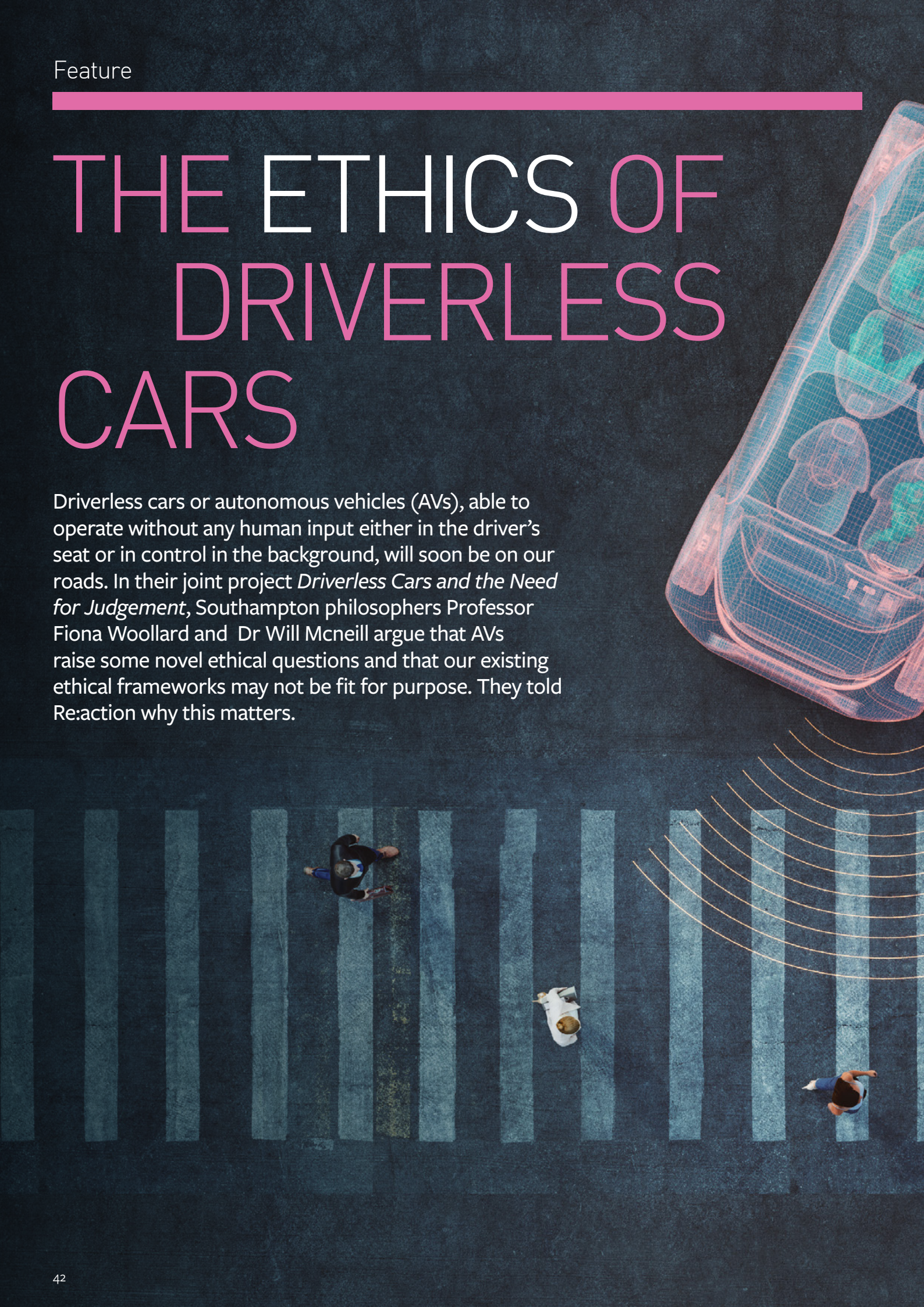
Professor Adriane (Age) Chapman

Professor Age Chapman is working with a team to undertake a data-centric approach, which has identified how automated systems with some human interpretation can exacerbate disparities experienced by minority communities, and they are considering how to expand this investigation into the health context.

"Through a mix of computer science and sociotechnical research and driven by implementations of real systems, we are looking at where problems arise and how to mitigate them. From here, we can extend existing trustworthy autonomous frameworks within the healthcare ecosystem," explained Age. "The Southampton Biomedical Research Centre, Data Health and Society theme revolves around these issues."

THE ETHICS OF DRIVERLESS CARS

Driverless cars or autonomous vehicles (AVs), able to operate without any human input either in the driver's seat or in control in the background, will soon be on our roads. In their joint project *Driverless Cars and the Need for Judgement*, Southampton philosophers Professor Fiona Woollard and Dr Will Mcneill argue that AVs raise some novel ethical questions and that our existing ethical frameworks may not be fit for purpose. They told Re:action why this matters.



> "Correct moral judgments cannot be reached simply by applying an algorithm that could be programmed in advance from a human ethical theory."
>
> **Professor Fiona Woollard**

"It is inevitable that driverless cars will have to make life and death decisions," said ethicist Fiona.

"Suppose a driverless car could only avoid killing five pedestrians by swerving into one. Or suppose it can only avoid killing a pedestrian by putting the occupants of the car in danger."

As well as wanting AVs that try to avoid crashing, we need systems that will respond to an inevitable crash in the best possible way.

The question of how to equip driverless cars with the ability to make these judgement calls often focuses on which moral system to programme them with, and how that might be achieved. This presents a problem:

"Almost all contemporary moral theories recognise the essential role of judgment," continued Fiona. "Correct moral judgments cannot be reached simply by applying an algorithm that could be programmed in advance from a human ethical theory."

The ethics of driverless cars

Ethics, explained Will, does not deal in algorithms:

"Utilitarianism, for example, says that the action is best that delivers the greater good. So, I need to try and maximise the good, but what counts as the good and what counts as me maximising it?

"Now I have to make up my own mind; use my own judgement.

"We want driverless cars that are capable of employing judgement, but we haven't captured what it would be to always make the ethical decision. We can't give an algorithm for it."

An alternative to programming in 'judgement' algorithms is to use artificial neural networks, a type of machine learning. These AIs are trained on vast data sets to 'discover' their own algorithms, based on the inputs they are given. This can include developing the ability to use an artificial equivalent of judgement. They are more reliable, particularly for perception systems enabling feature recognition, essential in driverless cars.

The problem is that we cannot explain why they arrive at the decisions that they do.

"Artificial neural networks don't provide an acceptable way to regulate the ethical decisions of driverless cars," said Will, "because they are computational black boxes: we would be unable to control, or even to know, the basis for their decisions."

This is the opacity or explainability problem in artificial intelligence. Fiona and Will argue that it creates a dilemma.

Dr Will Mcneill

> "We want driverless cars that are capable of employing judgement, but we haven't captured what it would be to always make the ethical decision."
>
> **Dr Will Mcneill**

"If you go for the reliable driverless car with its opaque judgement system, you will get fewer problems, but when there are problems, when someone dies, you cannot explain it or learn from it," commented Will.

"Or you can choose a transparent system, where you do know why it makes its decisions because you programmed the algorithm but, because it lacks judgement, it will make decisions that we don't like."

We need to weigh up how much we care about intelligibility, justice and learning for the future, and how much we care about reliability.

An All Party Parliamentary Group on AI recommended, in 2018, that safety critical systems should always be completely transparent but, commented Will, "we need to recognise that doing so undermines reliability."

Fiona and Will believe that a compromise that allows elements of opacity in some systems may be the answer. In medical use cases such as cancer detection, for example, machine learning AI is proving to be more effective than humans at spotting cancer in scans, but in such instances human oversight is integral.

In driverless cars there is no such human involvement. We may need to accept a transparent system, where we understand the decision making, despite the impact on reliability. Safety concerns could be mitigated, they argue, by imposing restrictions such as limiting speed, or confining the use of AVs to dedicated lanes. Given the move away from cars towards more sustainable alternatives, there is also an argument that "we just don't have driverless cars," said Will.

While these are keys issues to be considered by AI developers and policymakers, it is also important that the public is aware of what is at stake.

"We are not just making decisions about the most efficient way to achieve some goal," said Fiona. "We are deciding what our ethics should be like, what we value, and how we should trade off different values. This should not be decided behind closed doors by 'experts', but should be a public conversation."

THE RESPONSIBILITY GAP

Who should we hold responsible when a driverless car causes harm?

The car's developer? The owner? What about the vehicle itself, if it has been designed to make its own judgements?

In her recently published paper 'The New Trolley Problem: Driverless Cars and Deontological Distinctions', Professor Fiona Woollard explored what, if any, moral agency can be attributed to driverless cars.

A moral agent is a person who has the ability to discern right from wrong and to be held accountable for their own actions. Moral agents have a moral responsibility not to cause unjustified harm.

In previous technology, no matter how sophisticated, the decision maker was always human. With AI, the decision maker is the AI.

"This is where AI feels different from other technology," commented Fiona. "The decision maker and the moral agent are no longer one and the same."

Fiona's research asks how we can expand existing ethical frameworks to the behaviour of driverless cars, or negotiate new ethical concepts.

Find out more
www.fionawoollard.weebly.com/driverless-cars.html

THE BLACK BOX PROBLEM

Dr Will Mcneil is an epistemologist and philosopher of mind with an interest in opacity and explainability in artificial systems. In his research project 'Neural Networks and explanatory opacity', Will is exploring the 'Black Box Problem'.

In classical computing the programmer knows what the content is of the computer because they programmed it. In a machine learning or artificial neural network AI system, the programmer does not give the system its content. The content emerges from the training of the system.

Demis Hassabis, (DeepMind founder) described what has become known as the 'Black Box Problem' (The Telegraph 14.05.2018):

"We roughly know what it is doing but not specifically 'this bit of code is doing this' and for safety critical systems...you would want to know why a decision was made."

Will explained:

"In some senses we know everything about these systems, and vastly more than we know about our own brains: we know every mathematical computation, we know all the inputs, we know all the training data, but we do not know how individual inputs are transformed into specific outputs and why they are getting good results."

His research is examining what exactly it is that we do not understand about these systems.

Professor Fiona Woollard

"This is where AI feels different from other technology. The decision maker and the moral agent are no longer one and the same."

Professor Fiona Woollard

NEWS IN BRIEF

CLOSING THE 'POVERTY DATA GAP' WITH MACHINE LEARNING AND INTEGRATION OF SURVEY AND GEOSPATIAL DATA

The first of the UN's 17 Sustainable Development Goals is to 'end poverty in all its forms everywhere'. To begin to do so, we need to understand where it occurs and how it evolves.

"Traditional approaches to poverty measurement at geographically granular levels rely on combining household surveys and census data, which are costly, collected infrequently and subject to disruption, leading to gaps in data," explained Nikos Tzavidis, Southampton Professor of Statistical Methodology.

In research funded by the Foreign, Commonwealth & Development Office, ESRC, and the World Bank, Nikos is working on the use of machine learning algorithms and large quantities of geospatial data to measure poverty and inequality.

"By integrating remote sensing data with survey data, machine learning algorithms can be used to predict extreme poverty, reduce the reliance on costly census data, improve the geographical coverage, and the frequency with which that data is updated.

"These methods can enable the production of official poverty statistics that reflect what is happening on the ground at the moment of interest and guide targeted policies."

Nikos's work is already informing poverty assessment research by the World Bank in countries around the world.

Professor Niko Tzavidis

THE UNIVERSITY OF SOUTHAMPTON HAS BEEN AWARDED ITS FIRST-EVER VIRTUAL KNOWLEDGE TRANSFER PARTNERSHIP GRANT FROM INNOVATE UK

Dr PK Senyo

Working with Greyfly.ai, a start-up that specialises in the development of Artificial Intelligence solutions to transform project management and increase their chances of success, Dr PK Senyo, Dr Nicholas Dacre and Dr Ming-Wei Hsu, are focused on building transparency and trust in AI solutions to stimulate growth in project management.

Greyfly.ai's current flagship solution is the Intelligent Project Prediction (IPP) tool, which uses advanced AI algorithms to provide executives with valuable insights and predictions about the outcomes of both ongoing and new projects. This powerful tool helps customers make informed decisions, minimise risks and costs, and avoid costly delays. This drives intelligent interventions and saves millions of pounds in overspending and rectifications.

The team from Southampton is developing an Explainable AI (XAI) Interface to explain the features that contribute to a project prediction and thereby the root cause of project failure.

"The project will develop natural language processing tools to automatically process project data for prediction," explained PK. "As far as we are aware, there is no current application of XAI in project management, so we are aiming to fill this gap in the market."

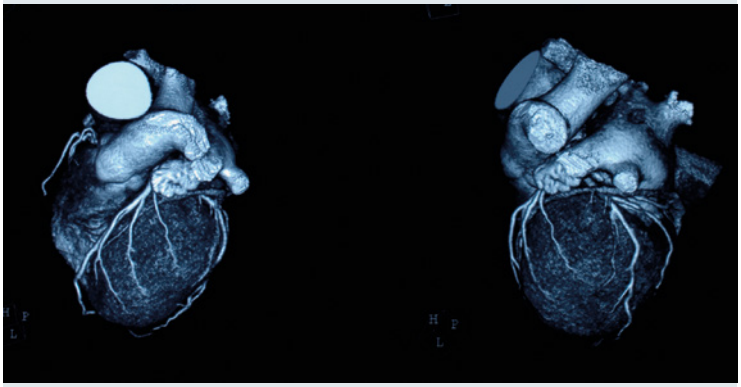
Dr Ben Mills

LASER FOCUSED

Dr Ben Mills has been honoured with the prestigious The Association of Industrial Laser Users (AILU) Innovation Award for his groundbreaking research in AI-driven laser machining, which has revolutionised the integration of lasers in various industries. This distinguished award recognises individuals who have made outstanding lifetime contributions to the industrial use of lasers in the UK.

Ben, Principal Research Fellow at the Optoelectonics Research Centre, was awarded for his outstanding work in combining AI and laser technology. He is highly skilled in using lasers to cut materials and has developed computer models that accurately predict how the materials will appear after laser cutting. These models have gained international recognition for their accuracy.

Ben's groundbreaking research sets new standards in the field and has the potential to greatly improve the efficiency and effectiveness of lasers in various industries. His expertise and innovative approach will be instrumental in integrating this groundbreaking technology into the UK industry, driving progress in industrial applications.



SAVING HEART PATIENTS' LIVES WITH MACHINE LEARNING

Dr Alain Zemkoho

Subcutaneous Implantable Cardioverter-Defibrillators (S-ICDs) are used for the prevention of sudden cardiac death triggered by ventricular arrhythmias. However, they are not suitable for every patient and can cause harm to a minority.

A collaboration between Southampton mathematicians and medical doctors, led by Associate Professor of Maths, Dr Alain Zemkoho, has used machine learning to develop a convolutional neural network (CNN) based software tool to automatically monitor patients over a long period to enable reliable and descriptive heart screenings to assess their eligibility for S-ICD implantation.

Work is ongoing to expand the tool and conduct a larger scale trial for use in hospitals so cardiologists can begin making better-informed decisions for their patients.

"The potential for the tool is very high. We hope it can make a difference to people and improve their health outcomes," said Alain.

RESEARCH AWARD HIGHLIGHTS

FACULTY OF ARTS AND HUMANITIES

Prof Will May; School of Humanities
Diverse Capacities: building a knowledge exchange network for creative industries in the Solent
AHRC; £80,554 over 12 months

Professor Genia Schönbaumsfeld, Department of Philosophy, Faculty of Arts and Humanities
The Ethics of Doubt – Kierkegaard, Scepticism and Conspiracy Theory
ERC Advanced Grant 2022 (UKRI Frontier Research Guarantee); £2,085,320.82 over 60 months

Prof Mark Cornwall; School of Humanities
Surveillance and the Czech Security Police: Prague in 1989
British Academy; £9,227 over 18 months

Dr Vanissa Wanick Vieira and Dr YuanYuan Yin, Associate Professor; Art & Media Technology Department – Winchester School of Art
KTP with Stewart Signs
Innovate UK; £133,230 over 28 months

Dr Duygu Candarli; School of Humanities
Comparability of IELTS Academic Writing Tasks and Graduate-Level Multimodal Writing Tasks at Universities in Turkey, UK, and USA
IDP Education Ltd; £11,935 over 6 months

FACULTY OF ENGINEERING AND PHYSICAL SCIENCES

Prof Senthil Murugan Ganapathy; Zepler Institute
Electro-Optical Amorphous Niobate for Photonic Integrated Circuits
European Commission; £37,793 over 12 months

Dr Tasmiat Rahman; ECS
Bifi UK: Investigation of bifacial and sun-tracking systems for high latitude, and high diffuse climates
EPSRC; £419,438 over 36 months

Dr Ben Anderson; School of Engineering
Local area energy resillience through consumer assets (SIF Discovery Project)
Office of Gas and Electricity Market; £28,403 over 3 months

Dr Ben Anderson; School of Engineering
Maximising consumer and network benefits from grant-funded Low Carbon Technologies (LCTs) (SIF Discovery Project)
Office of Gas and Electricity Market; £56,270 over 3 months

Dr Jack Denny; School of Engineering
A high resolution blast pressure sensor system using fibre optic distributed acoustic sensing
Royal Society; £42,630 over 15 months

Dr Anil Madhusudhanan; School of Engineering
Experimental Research on Energy Efficiency of Autonomous Electric Vehicles
Royal Society; £69,120 over 15 months

Dr Steve Taylor; IT Innovation Centre, Digital Health and Biomedical Engineering Research Group, ECS
TELEMETRY: Trustworthy Methodologies, Open knowledge & Automated Tools for Security Testing of Software, Hardware & Systems
European Commission; £429,656 over 36 months

Dr Zhiwei Hu; School of Engineering
Influence of complex turbulent shear flow on vibroacoustic noise radiation from railway wheels and track
Royal Society; £12,000 over 24 months

Prof Paul White; School of Engineering
Project MARLIN (Maritime, Acoustic, Realtime, Learning, Information and Notification)
Innovate UK; £218,296 over 24 months

Prof Yannis Ieropoulos; School of Engineering
Microbial Hydroponics for nutrient recovery and utilisation (Mi-Hy)
European Commission; £653,152 over 48 months

Dr Ahmad Atamli; ECS
IOTEE: Securing and analysing trusted execution beyond the CPU
EPSRC over 36 months

Prof Jeremy Frey; Chemistry
Plant selection and breeding for Net Zero
UK Research and Innovation; £254,639 over 24 months

Dr Yongqiang Liu; School of Engineering
Artificial Intelligence Enabling Future Optimal Flexible Biogas Production for Net-Zero
EPSRC; £368,169 over 23 months

Dr Alex Dickinson; School of Engineering
Prosthetic Pixel Printing
EPSRC; £21,999 over 9 months

Prof Gopal Ramchurn; ECS
Responsible AI UK
EPSRC; £31m over 60 months

Dr Indu Bodala; ECS
KTP with First Step Trust
Innovate UK; £148,722 over 27 months

Dr Indu Bodala; ECS
KTP with First Step Trust
First Step Trust; £60,823 over 27 months

Prof David Thomas; ECS
SONNETS: Scalability Oriented Novel Network of Event Triggered Systems
EPSRC; £2,453,689 over 60 months

Dr Callum Littlejohns; Zepler Institute
SiN for Quantum Computing
Innovate UK; £139,883 over 18 months

Dr George Williams; Chemistry
Polymer-prodrug conjugates for improved chemotherapy
Wessex Medical Research; £19,984 over 24 months

Dr Ysobel Baker; Chemistry
A new class of RNA degrading therapeutic oligonucleotides
Wessex Medical Research; £19,785 over 12 months

Dr Rafael Mestre Castillo; New Frontiers Fellow, School of Electronics and Computer Science (ECS)
A framework for research, application, and governance of bio-hybrid robotics: plotting a path to responsible research and innovation
ESRC; £290,390 over 24 months

Dr Callum Littlejohns; Zepler Institute
Photonic Integrated Circuit Bootcamp
Innovate UK; £99,853 over 18 months

Dr Simon Blainey; School of Engineering
Future of Strategic Transport Modelling
Hampshire County Council; £13,800 over 3 months

Prof Jeremy Frey; Chemistry
Adapting Green Solvents through Predicting Reaction Outcomes with AI/Machine Learning
EPSRC; £191,954 over 48 months

FACULTY OF ENVIRONMENTAL AND LIFE SCIENCES

Dr Lynn Calman; School of Health Sciences
Unreached - the impact of financial insecurity and socioeconomic deprivation on people at the end of life
Marie Curie Cancer Care; £149,783.69 over 24 months

Dr Andrew Lawrence; Biological Sciences
A corrin conundrum: Is vitamin B12 required for its own biogenesis?
BBSRC; £252,325 over 18 months

Dr Verena Klein; Psychology
Exploring cross-cultural differences in women's objectification and its consequences for relationship satisfaction. Going Global Partnerships Reconnect Travel Grant
British Council; £11,686 over 12 months

Dr Jeff Thompson; Biological Sciences and The School of Ocean and Earth Science
Unraveling the genomic and molecular toolkit for complex skeletal characters
Royal Society; £33,472 over 12 months

Prof Alberto Naveira Garabato; Ocean and Earth Science
Carbon export over the mid-Atlantic ridge
Natural Environment Research Council (NERC); £102,451 over 42 months

Prof Martin Solan; Ocean and Earth Science
Toward enabling sustainable expansion of offshore wind while protecting marine benthic biodiversity and functioning (BEcoWIND)
Natural Environment Research Council (NERC); £1,052,650 over 48 months

Dr Angus Wann; Biological Sciences
Integrating mechanical forces – a cellular mechanodampener
BBSRC; £982,831 over 36 months

Prof Anne-Sophie Darlington; School of Health Sciences
EORTC QLQ-PAN26 questionnaire
European Org for Research & Treatment of Cancer; £24,076 over 18 months

Dr Robert Holland; Geography and Env Science
Supergen Bioenergy Hub
EPSRC; £16,045 over 12 months

Dr Rosalind Coggon; Ocean and Earth Science
URF Renewal
Royal Society; £591,588 over 36 months

Prof Emma Roe; Geography and Env Science
Understanding microbial risks in low moisture Ready-to-Eat food supply chains
BBSRC; £85,734 over 12 months

Research award highlights

Dr Sien van der Plank; Geography and Env Science
Poole Together: Junior Coastal Scientists Monitoring Programme
Natural Environment Research Council (NERC); £10,000 over 9 months

Dr Alison Cribb; Ocean and Earth Science
Ecosystem engineers, resilience, and climate change through Earth history
Royal Commission for the Exhibition of 1851; £128,663 over 36 months

FACULTY OF MEDICINE

Dr Claire Jackson; Clinical and Experimental Sciences
Purification of a PCD Cell Line
AAIR Charity; £4,000 over 12 months

Dr Emily Swindle; Clinical and Experimental Sciences
The Implication of Mast Cell Mediators on Airway Barrier Properties in Severe Asthma
AAIR Charity; £5,422 over 3 months

Dr Cornelia Blume; Human Development and Health
EVOM Manual Epithelial Volt Ohm Meter and 3x STX4 EVOM Electrodes with removable Blades for TER measurements
AAIR Charity; £5,045 over 12 months

Dr Kate Greenwell; Primary Care, Population Science and Medical Education
Development and Feasibility Trial of iSupport-PD, a Digital Intervention for carers of people with Parkinson's and cognitive impairment
National Institute of Health Research; £346,911 over 30 months

Dr Jennifer Dewing; Clinical and Experimental Sciences
TIMP-3 Proteinopathy: A Novel Mechanism in Age-Associated Neurodegenerative Diseases
Alzheimer Society Fellowship; £218,100 over 36 months

Dr Jay Amin; Clinical and Experimental Sciences
Blood-brain barrier permeability, inflammation, and clinical progression in Alzheimer's disease
Alzheimer's Society; £193,194 over 36 months

Dr Anna Selby; School of Clinical and Experimental Sciences
Reducing Asthma Exacerbations by using Short-Acting Beta Agonist Prescription Alerts to Target High Risk Children: Patient and Public Involvement and Feasibility Work
AAIR Charity; £1,380 over 18 months

Prof Gareth Griffiths; Cancer Sciences
CRUK Core: Southampton Clinical Trials Unit
Cancer Research UK; £5,504,897 over 60 months

Prof Rohan Lewis; Professor of Placental and Integrative Physiology, Human Development and Health
The placental barrier and the fetal exposome: exploring the mechanisms underlying fetal exposures
BBSRC; £473,173 over 36 months

Dr Jorn Lakowski; Clinical and Experimental Sciences
Investigating cone photoreceptor migration using stem cell derived retinal organoids
BBSRC; £576,196 over 36 months

Dr Anna Selby; School of Clinical and Experimental Sciences
Reducing Severe Asthma Exacerbations by Using Prescription Alerts for Excessive Reliever Inhaler Use to Target High Risk Children: A Randomised Controlled Trial
National Institute of Health and Care Research; £349,391 over 36 months

Dr Aravinthan Varatharaj; Clinical and Experimental Sciences
Study Using Neurovascular Longitudinal Insights to Guide Head injury Treatment
Ferblanc; £22,270 over 36 months

Prof Tracey Sach; Primary Care, Population Science and Medical Education
Proactive against reactive therapy for the prevention of lichen sclerosus exacerbation and progression of disease – a pragmatic, parallel group randomised controlled trial with embedded economic evaluation and process evaluation (PEARLS)
National Institute for Health and Care Research.; £145,833 over 57 months

Prof Simon Crabb; Cancer Sciences
Genotype of Urothelial cancer: Stratified Treatment and Oncological outcomes (GUSTO): Phase 2 study
National Institute of Health Research; £38,895 over 72 months

Dr Ella Baker; Human Development and Health
Understanding the anti-inflammatory actions of pinolenic acid, a sustainable alternative to EPA and DHA
Wessex Medical Research; £15,100 over 24 months

Dr Jodie Ackland; Clinical and Experimental Sciences
Using triple RNASeq to investigate macrophage-bacterial-viral interactions during co-infection
Wessex Medical Research; £19,878 over 24 months

Dr Colleen Deane; Human Development and Health
Using metabolomics to uncover novel biological markers of, and targeted nutritional interventions to offset, age-related musculoskeletal decline
Wessex Medical Research; £19,600 over 24 months

Prof Roxi Carare; Clinical and Experimental Sciences
Brain Clearance: A Translational Approach Towards Understanding and Therapy
LEDUCQ FOUNDATION FOR CARDIOVASCULAR RESEARCH; £628,567 over 60 months

Prof Salim Khakoo; Clinical and Experimental Sciences
Validation of NOTUM as a target for NK cell therapy
Cancer Research UK; £174,441 over 18 months

Dr Melanie Smith; Human Development and Health
Development of a strategy to isolate and characterise stem cell derived exosomes
Biochemical Society; £3,897 over 12 months

Mr Jay Self; Clinical and Experimental Sciences
High-throughput drug screening to identify novel targets for OCA1 treatment
National Organization for Albinism and Hypopigmentation; £18,349 over 12 months

FACULTY OF SOCIAL SCIENCES

Prof Jonathan Havercroft; Social Sciences
The Policing Protest Project: An Analysis of Public Assembly Rights and Anti-Riot Technology in the U.K., U.S.A., and Brazil
The British Academy Knowledge Frontiers Grant 2023; £158,231.45 over 24 months

Dr Matt Ryan; Social Sciences
The Politics of Urban Regime Contestation in the Spanish New Municipalist Wave, 2015-19
European Commission; £1,222 over 24 months

Dr Alain Zemkoho; Mathematical Sciences
The mathematics of Stackelberg games in machine learning: constructing categories towards powerful algorithms
EPSRC; £72,787 over 12 months

Dr Lizzie Reed; Social Sciences
Finding Queer TikTok: LGBTQ youth, knowledge and online space
British Academy; £9,697 over 12 months

Dr Jayeeta Bhattacharya; Social Sciences
Partially functional quantile regression models: specification testing, efficient estimation, and practical implementation
British Academy; £9,707 over 24 months

Dr PK Senyo; Southampton Business School
Innovations for financial inclusion in Nigeria and the United Kingdom: How can emerging technology empower financially strained populations?
British Academy; £31,246 over 6 months

Dr Vasilis Stroggilos; Southampton Education School
(FELLOWSHIP Lorenzo Ciletti) Maximising the awareness and impact in policy and practice of a multi-method research exploring the classwork of primary-school teaching assistants
ESRC; £109,330 over 12 months

Dr Patrick Beullens; Southampton Business School
LHMSD (Liquid Hydrogen Mobile Storage and Dispensing)
Innovate UK; £93,095 over 18 months

This list encompasses a selection of awards logged with University of Southampton Finance from March to May 2023 that are not considered commercially sensitive.

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