

# The Alan Turing Institute

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**2018–19**

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## Annual Report 2018–19

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## Our year

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**Howard Covington**  
Chair of Board of Trustees,  
The Alan Turing Institute

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### **Creating real world impact**

We have had yet another year of rapid growth and remarkable progress.

The Alan Turing Institute is a multidisciplinary institute formed through partnerships with some of the UK's leading universities. This innovative approach gives us access to expertise and skills in data science and AI that is unparalleled outside of a handful of large tech platforms. Our substantial convening power enables us to work across the economy: with large corporations, the public sector including government departments, charitable foundations and small businesses. These collaborations cut across disciplines and break through institutional boundaries. Collaboration and partnership are at the heart of what we do. Through our collaborations we can identify and prioritise real-world challenges and understand the needs of the users of data science and AI. Academic partnerships help us build high-quality research capacity across the UK and beyond. We already have exciting international research projects with partners in Finland, North America and New Zealand, among others.

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### **The Institute works hard to deliver impact**

We use outcome indicators and pathways to measure impact in our research areas. This helps us analyse our research and provide valuable information to our stakeholders so that we can demonstrate return on investment, economic and societal impact and advances in data science and AI.

Since 2016, researchers at the Institute have produced over 200 publications in leading journals and demonstrated early impacts with great potential. Some of the impacts are captured in this annual report and we are excited to see the translation of our data science and AI research into a real-world context.

We are witnessing a massive growth of data science and AI. We are also seeing important challenges and breakthroughs in many areas including safe and ethical AI, quantum computing, urban transport, defence, manufacturing, health and financial services. Across the Institute we are leading the public conversation in these areas and helping to realise the opportunities they offer. We have ambitious plans both to consolidate our early successes and extend our reach by driving innovation and impact, developing skills, increasing public engagement and positively influencing public policy.

In whatever we do, we will need to maintain the agility of a start-up. It is essential that we adapt the Institute's plans and priorities to respond to a constantly changing environment. To make sure we do this, the Institute's director, Sir Adrian Smith, is leading a review of our strategy. This will position us for our next leap forwards.

I would like to thank Adrian, and Sir Alan Wilson who served as interim CEO prior to Adrian's arrival, the Board of Trustees and all of our Turing colleagues for their enormous effort during the year.



**Sir Adrian Smith**  
Institute Director  
and Chief Executive,  
The Alan Turing Institute

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### Initial impressions

It has been a thoroughly enjoyable and eventful start as Institute Director and Chief Executive. The strength of the convening power the Institute has in bringing together world-class researchers, across a multitude of disciplines in a truly collaborative way inspires me. We have continued to grow and develop at a rapid pace over the last year furthering our reach outwards across academia, industry and government, as well as through new international collaborations.

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### Highlights of the year

Data science and AI hold the ability to revolutionise many areas, such as healthcare and engineering, so we were pleased to announce our collaboration with UCLH. Our newly established Health and Medical Sciences programme will deliver real innovation and impact across the whole NHS by supporting clinical decision-making. As well as new programme areas, I am pleased to see successes in our existing programmes, a notable example being the development of a digital twin of the world's largest, single-span 3D-printed steel bridge through the Data-Centric Engineering programme.

I believe it is the potential demonstrated by these early successes that saw the Institute securing £48 million of funding for two new major cutting-edge data science and AI research programmes through the UKRI Strategic Priorities Fund, which was announced in December 2018. With the addition of AI to our remit, we want to ensure AI is used in a safe and ethical way, with clear benefits to society.

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### Looking forward

This must be done collaboratively, and it was with great encouragement that the Institute became a founding member of the Ada Lovelace Institute, an independent research and deliberative body that will ensure data and AI works for people and society, announced in April 2018 as part of the Government's AI Sector Deal. In supporting the Institute's goals, we have continued to expand our reach internationally. In January 2019 for example we signed an agreement with three major Japanese research institutes in the fields of robotics, ethical use of data and medical research.

To ensure the best research outcomes, it is vital that AI works across the diversity of communities it will impact and so we are committed to improving diversity in STEM. In October the Institute hosted a two-day hackathon that brought together researchers, academics, entrepreneurs, practitioners, students and science communicators with four projects being awarded prize money to improve diversity within the STEM community.

As the Institute reflects on the release of the mid-term review from EPSRC, now is the time to take stock of how much has been achieved over the last three years and the journey still to come for the long-term positioning of the Institute. A key part of this will be the Institute's role in the wider UK government AI skills and talent package, of which the Turing AI Fellowships will be crucial in building the UK's leadership capability, driving forward ambitious research and ensuring that the UK can attract, retain, and develop world-leading research talent.

Finally, I would like to take this opportunity to thank everyone across the Institute and our wider partners for their enthusiasm, hard work and dedication over the last year. It has been a pleasure to witness first-hand the energy, cross-disciplinary working and collaborative spirit the Institute fosters and the impact this creates. I look forward to this continuing as we build the foundations for the long-term success and sustainability of the Institute.

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### Founding members

The Institute's founder partners are the universities of Cambridge, Edinburgh, Oxford, University College London and Warwick and the Engineering and Physical Sciences Research Council.

Answering a national need for investment in data science research, they formed the Institute as a joint venture in 2015, following an open competition run by the EPSRC.

Each founding university has appointed a Turing University Lead who acts as an interface between the Institute and the founder university.



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## 1.3 Outputs, impact and equalities

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### Outputs

The Institute has played a significant role in generating growing numbers of research outputs, particularly high-quality publications, influencing policy and, more broadly, engaging with stakeholders and beyond.

The Institute has a regular presence at discipline-specific events, including The Royal Statistical Society national conference and NeurIPS. We hosted an international roundtable of leaders in data science in conjunction with the Knowledge Discovery and Data Mining (KDD) conference, a premier research event within the field of data science.

The Institute's researchers are regularly invited to participate in panels across the UK and internationally. The Institute attended the New Scientist Live 2018 event, an example of the Institute's continuing aim to disseminate, engage and facilitate the exchange of knowledge with its stakeholders, related sectors and the wider public.

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### Impact

Turing researchers are publishing in an impressive disciplinary range of journals including computing, maths, statistics, physics, biosciences, economics, finance, law, ethics, social science, as well as AI, machine learning and robotics. Many of the most significant publications are available online via the Institute website.

Turing researchers have been active in influencing policy, advising government departments, training policy practitioners, providing evidence to parliamentary committees, as well as being members of advisory committees or by providing guidance to such committees. The results of some of these interactions include significantly influencing the creation of the government Office for AI, and the Centre for Data Ethics and Innovation, which has two Turing Fellows on its board.

There are already many promising developments arising from the Institute's research. These are captured in the research and innovation section of the annual report.

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### Equalities

Our diversity working groups are now in place developing individual action plans, networking and collaborating with partner and Knowledge Quarter organisations spanning several key themes:

- Attracting diversity
- Developing talent and public engagement
- Disability and mental health awareness
- Gender and LGBTQ+ equality
- Race and social economic equality chair

The Institute is now proudly a member of the Athena Swan Research Institute Advisory Group. And we have also set up our Athena Swan Self-Assessment Team, led by the Institute's director. We were delighted to appoint Professor Judy Wajcman to lead our new Women in Data Science and AI project, which intends to use research to inform concrete policy measures aimed at increasing the number of women in data science and AI.

The Institute has also delivered a range of events, workshops and talks. We hosted the inspiring Dr Sue Black OBE, regarded as one of the top 50 women in tech in Europe, a series of Techmums events, and the dynamic Gamechangers for Diversity in STEM, which focused on developing projects, networking and increasing diversity in STEM.

1.4 Turing trends and statistics

Number of interest groups

24

Numbers of new university-led projects

74

Number of participants taking part in Data Study Group events since last annual report

131

Research associates

32

Turing fellows

416

Turing lectures

8

Total events

206

Total event attendees

8,749

## 1.4 Turing trends and statistics

### YouTube growth

#### Views

**+90%**

#### Subscribers

**+66%**

#### Overall total watch time

**+83%**

#### Likes

**+97%**

#### Overall total views

**238,268**

#### Total subscribers

**5,045**

#### Total number of videos

**648**

### By number of views

The role of multi-agent learning in artificial intelligence research at DeepMind

**18,824 views**

The problem of governance in distributed ledger technologies  
Professor Vili Lehdonvirta, OII

**9,158 views**

High-dimensional learning and deep neural networks  
Professor Stéphane Mallat

**6,865 views**

Turing Lecture  
Data science for medicine

**6,720 views**

Time series modelling and state space models  
Professor Chris Williams, University of Edinburgh

**6,573 views**

### Top 5 Videos by watch time (mins)

The role of multi-agent learning in artificial intelligence research at DeepMind

**157,648**

Ethics in the age of information  
Professor Luciano Floridi

**65,795**

The problem of governance in distributed ledger technologies  
Professor Vili Lehdonvirta, OII

**65,019**

High-dimensional learning and deep neural networks  
Professor Stéphane Mallat

**64,946**

Turing Lecture  
Data science for medicine  
Mihaela van der Schaar

**53,489**

## 1.4 Turing trends and statistics

### Social media stats

For 1 April 2018 - 31 March 2019



Total followers:

**19,017**

New followers:

**8,441**  
(80% increase)



Total followers:

**4,642**

New followers:

**2,442**  
(111% increase)



Total followers:

**2,040**

New followers:

**971**  
(91% increase)

### Top 5 website pages:

% of total page views

1. Homepage

**14.7%**

2. Opportunities

**3.4%**

3. Events

**2.4%**

4. People

**1.6%**

5. Jobs

**1.4%**

### Top 5 YouTube viewer geographies



UK

**50%**

USA

**33%**

Germany

**4.5%**

India

**3.9%**

Canada

**1.9%**

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**1.5 Research mapping:  
Linking research, people and activities**

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**The Research mapping project:**

Revealing the intricate tapestry of research across the Institute is a complex and challenging task. But, by using data from the Institute's community, an ambitious new project is now shedding light on this and shaping our strategy.

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**Research mapping:**

- Supports data-driven strategic decisions
- Allows the researcher community to exploit the unique interdisciplinary and multi-institutional value of the Turing further
- Supports a shared appreciation of the world-leading research taking place across the Institute

At the heart of the project is the Research Mapping Framework (RMF). It's enabling the Institute to map and identify links between research, people and activities at the Institute, at every level from application domain to scientific expertise. The framework allows the community to develop collaborations, foster the Institute's multidisciplinary collaborative environment, and create the world-leading research and impact that the Institute is uniquely placed to achieve.

The Institute has worked to achieve collaborative and multidisciplinary research impact, making clear steps towards social and economic impact that is applied and translational.

The Institute has established impact and outcome indicators and pathways to research impact. In future, these will be used to analyse the Institute's research and provide valuable information to our stakeholders. This will be supported by the development and use of the research mapping tool.

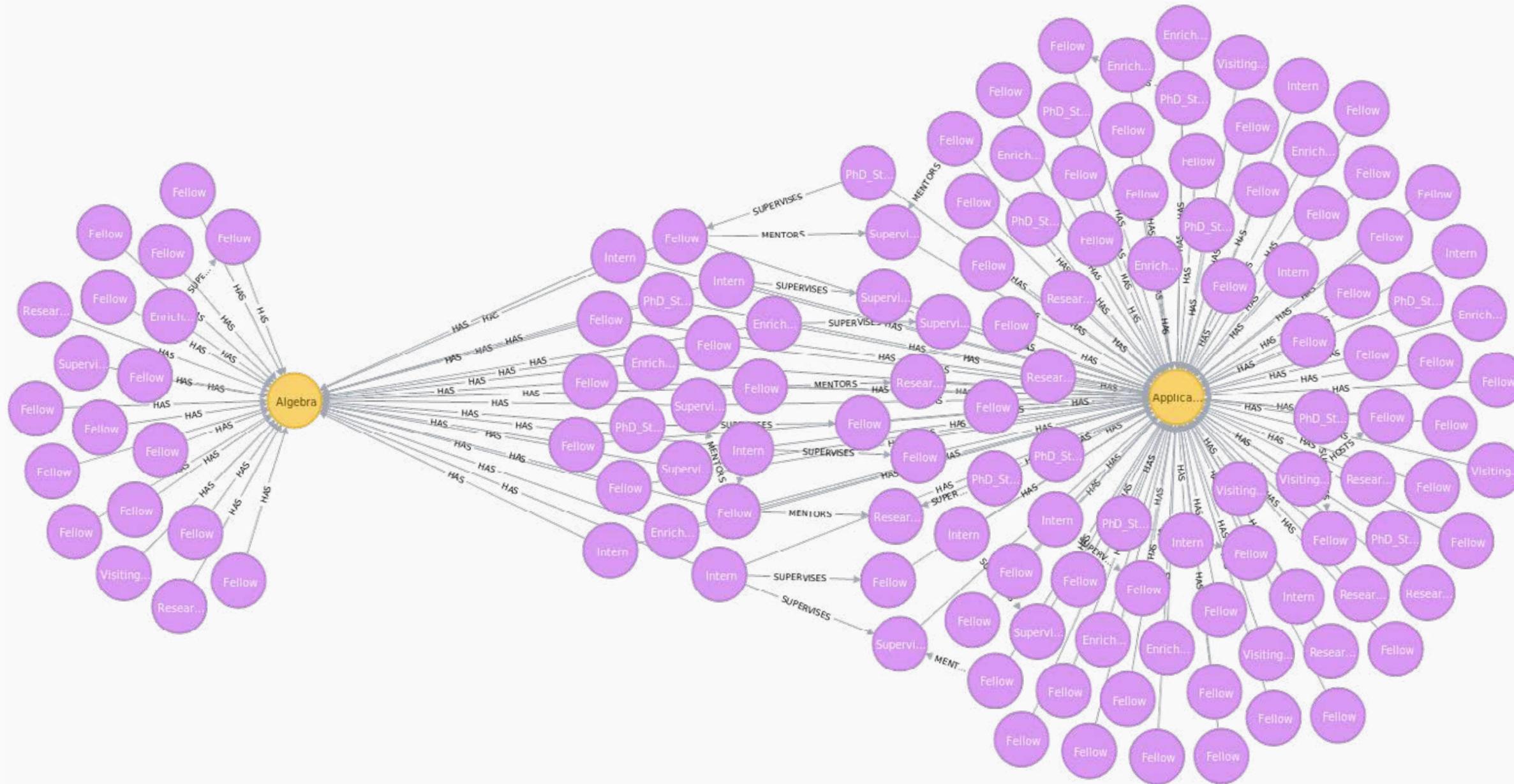
The Institute aims to demonstrate return on investment, economic and societal development and advancements in data science and AI.

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**Next steps**

Establishing the framework and analysing many sources of information, has helped us to identify five research principles – running through all research activities at the Institute. Conducting research with these principles in mind will allow the Institute to achieve its mission.

1.5 Research mapping:  
Linking research, people and activities



**Research Mapping Framework example:**  
Anonymised network graph depicting intersection of researchers with expertise in algebra and applications of machine learning



# 2

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## Research and innovation highlights

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**2.1** A clearer picture of London's air pollution

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**2.2** An ethical perspective: Analytics in policing

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**2.3** Research engineering:  
Connecting research to applications

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**2.4** Shelf seas and solitons

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**2.5** Dynamic demand forecasting:  
A collaboration with British Airways

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**2.6** Disaster response: A data-driven revolution

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**2.7** Putting AI into traffic control

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**2.8** Don't go with the flow, optimise it: Traffic

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**2.9** Working with Samsung to improve  
android game recommendations

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**2.10** Game-changing

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# 2.1

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## A clearer picture of London's air pollution

Achieving a clear, true picture of the ebb and flow of urban pollution is about as eye-wateringly difficult a task as you can imagine. But it's crucial that we do: a report commissioned by the Greater London Authority (GLA) estimated that more than 9,000 Londoners a year die early due to air pollution. Countless more suffer adverse health effects from particulates and poisonous gases. Big cities the world over are facing similar issues.

The Institute's researchers are working with the GLA to revolutionise urban pollution forecasting, by combining modern detection techniques with state-of-the-art machine learning and statistical methodology. "The goal is a 48-hour pollution forecasting system that anyone can use, a real time monitoring network that allows for high-resolution air quality forecasting," says Turing Fellow Theo Damoulas of the University of Warwick, who is leading the work. "Think of it as the air pollution channel instead of the weather channel."

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### So how is such a complex thing even possible?

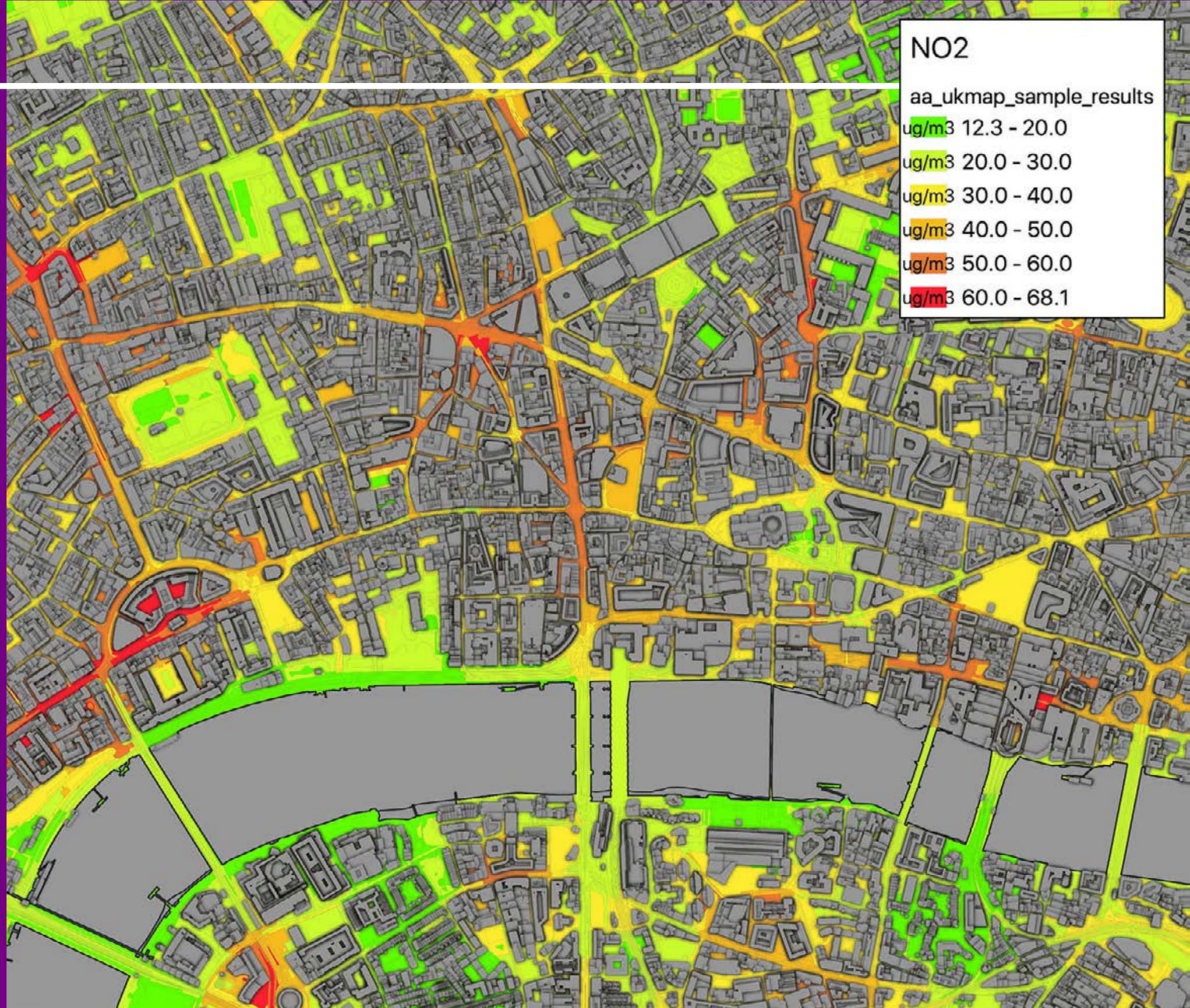
"We monitor real time data coming from multiple ground or remote sensor networks that currently measure or will measure air pollutants (such as the London Air Quality Network, Breathe London project, diffusion tubes, satellites, even roving Google cars) and combine it with city data on land use, road networks, traffic, and weather data." The project has also benefited from being part of navigation specialists Waze's Connected Citizens Program, which provides real time traffic data.

But it's what Damoulas and his team do with the data that counts: they bring it all together create a single, constantly evolving model of London's air pollution. "We call it evidence integration," he says. "Some people don't realise the difference between data and the ground truth. Data includes measurement errors, noise and uncertainty. We're untangling all of that to get to the actual knowledge."

This year, the Institute's data-centric engineering programme and the University of Warwick not only deployed their machine learning algorithms to synthesize disparate data sources and fuse sensor networks, but also mapped the "street canyons" in London that trap pollution, and derived new data sources for capturing levels of poisonous nitrogen dioxide across the city. They also detected and analysed the effects of London's congestion charges, optimised the location of sensor networks and will soon release forecasts and estimates of air pollution to help inform GLA policy.

Right now, the team is interested in analysing the effect of London's Ultra Low Emission Zone, which came into force in April 2019. "Will it just move air pollution to specific areas of the city, or to the outskirts? We'll see," says Damoulas.

2.1 A clearer picture of London's air pollution



Map of central London showing NO2 levels from air pollution sensor data being used by the research team

“We have unique access to the best data science and AI expertise in the country, strong leadership and a superb team of strategy and communication professionals. Everyone here helps to support and propel us.”

**Theo Damoulas**  
Turing Fellow

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## 2.1 A clearer picture of London's air pollution

With a better understanding of air pollution in a complex urban environment like London, it's possible to help design better transport policy interventions, help evaluate interventions, and reduce health impacts.

"It's exciting to see machine learning methods being developed and scaled up to bear on a 'big data'-scale problem with wide-reaching impact to the quality of life of Londoners," says Mark Girolami, Programme Director for the Institute's data-centric engineering group, which is funded by the Lloyd's Register Foundation. "Being part of the Turing has tremendous benefits for the project," says Damoulas. "We have unique access to the best data science and AI expertise in the country, strong leadership and a superb team of strategy and communication professionals. Everyone here helps to support and propel us."

The group has already published a raft of scientific papers on their algorithms, presenting them at prestigious machine learning conferences such as ICML and NeurIPS, and with the Institute's help, has established international collaborations with the University of Sydney's Centre for Translational Data Science and Data61, and the University of Hong Kong. "The tools we produce will help establish the most effective places to site future sensors, and help inform policymakers to make targeted interventions that reduce the levels of pollution in key areas and at key times," says Damoulas.

The next big thing, with support from the Institute's Research Software Engineering team, will be the delivery of that 48-hour pollution forecasting system, in a smartphone-friendly form that anyone can use. Government, local authorities and scientists are keen to get hold of these tools, but let's not forget about the people on the streets breathing the London air. Damoulas certainly hasn't. "There's been huge interest from the public," he says.

"I've received emails from parents worried about air pollution near schools, and from community pressure groups trying to measure the air pollution in their area so that they can push their local authorities to take action on pollution."

Knowledge is power, and access to accurate air pollution readings and forecasting, like those being developed at the Institute, will be an important part of the future of big cities.

# 2.2

## An ethical perspective: Analytics in policing

In November 2018, the Institute's Data Ethics Group, working with the Independent Digital Ethics Panel for Policing (IDEPP), published a co-authored report that had been commissioned by West Midlands Police in 2017 following a proposal for what is now called the National Data Analytics Solution (NDAS). A consortium of law-enforcement bodies led by West Midlands Police is working together on the NDAS project, a high-level design for how advanced analytics could be used, ultimately nationwide, by law enforcement to prevent some violent crimes before they happen, reduce criminality and protect the vulnerable, from modern slavery for example. Our report scrutinised the ethical dimensions of the proposed project.

Turing Fellow Charles Raab of the University of Edinburgh, a member of the Institute's Data Ethics Group and co-chair of IDEPP, led the team. "In the world of law enforcement, particularly in the United States, there can be an uncritical attitude about using analytical or predictive policing techniques. There are great concerns over, for example, the misidentification of people as likely criminals as a result of bias in the algorithms." Is the widespread use of analytical technology in the UK going to result in unfair surveillance or apprehension of individuals or groups? "Well, if the police get it wrong, think about the consequences, including stigmatisation, that go with that," says Raab. These are the sorts of questions his team worked closely with West Midlands Police to address. Our advisory report was welcomed by West Midlands Police as an impartial contribution to the development of NDAS.

Deputy Chief Constable Louisa Rolfe said: "We sought this independent review at a very early stage as we think an ethical approach should guide the development of this work. We thank IDEPP and the Data Ethics Group in The Alan Turing Institute for carrying out this work and we are considering all of their recommendations as we move forward with the project."

When New Scientist magazine covered the release of our report, it sought comment from Turing Fellow Sandra Wachter of the Oxford Internet Institute on the difficulty of assessing the accuracy of predictive analytics if those systems have caused police or social services to intervene pre-emptively. She responded: "How would I know that this actually makes the right decision? That's something that is very hard to measure."

"These are thorny issues, and with the rise of AI technology, the calls for its ethical use are growing," says Raab. "My recent contact with a range of police forces and government agencies suggest that ethics is very much on the agenda. There is a growing sense in law enforcement that they not only have to be ethical but have to be seen to be ethical and responsible in their use of AI."

As an authoritative, independent voice on ethics in data science and AI, it is the Institute's aim to continue shaping these conversations.

## 2.2 An ethical perspective: Analytics in policing



**“There are great concerns over the misidentification of people as a result of bias in the algorithms.”**

**Charles Raab**

University of Edinburgh, a member of the Institute’s Data Ethics Group and co-chair of IDEPP

“We thank IDEPP and the Data Ethics Group in The Alan Turing Institute for carrying out this work and we are considering all of their recommendations as we move forward with the project.”

**Deputy Chief Constable Louisa Rolfe**  
West Midlands Police

# 2.3

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## Research engineering: Connecting research to applications

The Research Engineering Group (REG) is a pool of professional research staff, deployed in support of research projects across the Institute. It supplies the high-level computing platforms that underpin research, applies the Institute's expertise to the data challenges provided by strategic and commercial partners – delivering real world impact – and also develops its own cross-cutting research programme in service of the Institute's challenge domains.

This year saw this crucial team more than double in size, to 21 members, and restructure accordingly. The REG's work is aligned with the Institute's key research challenges, which represent areas in which AI and data science can have a game-changing impact for science, society and the economy. The new team structure saw each of the senior REG researchers take responsibility for a challenge area, such as "Revolutionise healthcare" and "Make algorithmic systems fair, transparent, and ethical". The team also took on several additional support staff.

More widely, the REG grew collaborations with research engineering departments in our partner universities, such as the EPCC (formerly the Edinburgh Parallel Computing Centre) at the University of Edinburgh.

The team also worked with a growing number of public, private and third-sector partners, all the while honing its collaboration processes in order to deliver the increasing volume of Institute projects in an effective, mutually-enriching manner.

"The sheer breadth of research at the Institute demands equally broad skill sets to support them, and our increased capacity means we will be able to say 'yes' to more exciting projects," says Senior Research Software Engineer, May Yong, who was in charge of recruiting.

"Increased capacity is also good for the team members, who have greater opportunities to explore the technologies that interest them."

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### Research Engineering at the Institute consists of five areas:

- The management and development of a pool of research staff who can be deployed in support of research projects across the Institute
- The coordination of a network of research professionals at partner institutions, both university-based and commercial, into a collaborative virtual delivery team
- Provision of, and advanced support for, the computing platforms which underpin research
- The preparation for, and application of, Turing research to data challenges provided by strategic and commercial partners, delivering real world impact
- A cross-cutting and underpinning research programme on tools, practices and systems for applied data science and AI, in service of the Institute's other research programmes



REG is crucial in driving the impact of the Institute, making its research easily usable by a wide range of practitioners across academia, industry, government and the third sector. Working with practitioners, research engineering turns data challenges into research questions, and with academics and practitioners to realise cutting-edge research as professionally-usable software tools and to apply these to address real-world data science and modelling challenges.

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### **New ways of working on data science projects**

Research software engineers from the Institute's REG are the main developers of Wrattler, working closely with the principal investigators, Dr Tomas Petricek, University of Kent and Dr Charles Sutton, University of Edinburgh.

Wrattler is a new notebook system for data scientists. It is an open-source project, undergoing active development. And like other notebooks, Wrattler is a literate programming system that allows interleaving of text, code and outputs. Wrattler aids reproducible, exploratory data science by offering a number of novel features.

A close-up of a Bletchley Park Bombe, designed by Alan Turing and his colleagues to decipher German Enigma machine messages in WW2. Source: Flickr, Creative Commons.

First, Wrattler uses provenance analysis to track dependencies between cells and guarantees that data analyses are reproducible. When the contents of a code cell changes, Wrattler automatically invalidates outputs that depend on the modified cell.

It can then recompute outputs efficiently by reusing parts of a computation that have not changed. Secondly, Wrattler lets analysts perform simple data exploration tasks directly in the browser and gives them more immediate feedback, which is essential for quickly finding the right solution to data-wrangling problems.

Last but not least, Wrattler makes it possible to combine multiple programming languages in a single notebook. This lets data analysts use the best tool for a job, and also provides a platform for novel data science tooling research. The Institute is working on the project alongside researchers from the University of Kent and the University of Edinburgh.

According to Tomas Petricek, "Wrattler is enabling new ways of working on data science projects, learning directly from the challenges that the Turing data scientists face."

# 2.4

## Shelf seas and solitons

Shelf seas, the relatively shallow areas of water over the continental shelves, can experience powerful wind-and-tide-driven currents that can adversely affect floating infrastructure, such as offshore facilities for the oil and gas industry.

A combination of engineering, statistics and computing is helping to predict and mitigate better the hazards due to these conditions, courtesy of a unique collaboration between the Turing and the Industrial Transformation Research Hub for Offshore Floating Facilities (OFFshore ITRH) at the University of Western Australia (UWA).

The collaboration came about after the Institute's Programme Director for data-centric engineering, Mark Girolami, visited UWA's School of Mathematics and Statistics in late 2017. UWA statistician Ed Cripps introduced Girolami to the type of data-analytic problems he was working on in collaboration with the OFFshore ITRH, a multidisciplinary research team jointly funded by industry and the Australian Research Council to tackle critical engineering challenges faced by floating offshore oil and gas projects.

The challenge that the Turing jumped onboard with relates to internal ocean waves called "solitons", which travel in the interior of the ocean, where water layers of differing densities meet. The forces resulting from these waves can affect floating infrastructure, so the ability to predict them better has high economic value and would further improve safety.

Data was collected using a string of sensors to measure ocean density deployed through the water column in the ocean on Australia's North West Shelf, a region of intense oil and gas drilling and exploration. The idea was that water density readings taken over time, in conjunction with mathematical models of solitons, would be used to develop a predictive model of when solitons will occur. OFFshore ITRH had the oceanographic expertise they needed in UWA researchers Matt Rayson, Nicole Jones and Gregory Ivey, and UWA statisticians Ed Cripps and Andrew Manderson knew how to maximise the data's predictive power.

The computational expertise was supplied by Nick Barlow, former particle physicist and Senior Research Software Engineer at the Institute. Making predictions based on limited inputs means there is uncertainty inherent in the data.

To mitigate against this, Manderson and Rayson developed software that runs 500 simulations of soliton formation for every data time point to present a probabilistic characterisation of solitons that evolves with time. So many simulations would take too long if done one after another, so Barlow adapted the software to run in parallel across large numbers of CPUs, to bring the soliton prediction closer to real time.

## 2.4 Shelf seas and solitons



“This project is a great example of collaboration across continents and across disciplines,” he says. This year has seen aspects of the methodology accepted into the *Journal of Atmospheric and Oceanic Technology*, and presentations at industrial and academic forums were enthusiastically received. In addition to advancing knowledge in offshore engineering, physics, statistics and computing, the international team has built a probabilistic prediction model of solitons, which could be used to predict the likelihood of hazardous currents. “A future goal,” says Cripps, “is to accompany the scientific development with improved and deployable software products for practical use in industry.”

Barlow agrees: “Ultimately, we want to integrate the output from our system into prediction and decision-assisting tools at the fingertips of the people controlling floating offshore platforms.”

“A future goal is to accompany the scientific development with improved and deployable software products for practical use in industry.”

**Ed Cripps**  
UWA Statistician

# 2.5

## Dynamic demand forecasting: A collaboration with British Airways

“For machine learning researchers, getting access to big, real-world commercial data sets can be quite a challenge,” says Radka Jersakova, a Research Data Scientist at the Institute. That’s the bad news. The good news is that the Institute’s position as a bridge between academia and industry attracts big industry players into collaboration, bringing their precious data with them.

Major airlines generate colossal amounts of information across a spectrum of domains: logistics, flight information, asset movements, pricing, fuelling data, catering... you name it. So, we were delighted in 2017 when BA approached the Institute to tap into our data science expertise and co-develop some research ideas. In January 2018, a year-long joint project kicked off, led by Evelina Gabasova, a Senior Research Data Scientist at the Turing, and James Geddes, a Principal Research Data Scientist at the Institute who heads up the data science side of the Research Engineering Group.

The project’s aim was to develop bespoke machine learning techniques to improve BA’s dynamic demand forecasting, based on an enormous business data set of years’ worth of data. Commercial sensitivities mean we cannot reveal which aspect of BA’s business we focused on.

In the collaborative process, however, “BA was very open, and spent a lot of time explaining to us what was in the data, how it worked and so on,” says Jersakova, a team member in the Institute’s Research Engineering Group. “It was fantastic.”

Then the researchers got to work using machine learning to develop and test predictive models. “Our added value is that we used the Bayesian approach, which not only provides estimated forecasts, but also the level of confidence in those predictions,” says Jersakova. Later in the project, the new machine learning predictive algorithms went head-to-head with BA’s more traditional methods.

BA was pleased with how the collaboration panned out. “Working with the Institute was hassle-free and had none of the tensions of working with commercial consultants,” says Jack Bovey, Revenue Optimisation Manager at British Airways. “There was just a genuine desire to understand our challenges and help us think about new ways to tackle them.”

Working with sensitive commercial data requires high security. “The Institute has many collaborations with industry,” says Jersakova, “and the challenge from day one is always: how do you handle that data in a secure way, but flexibly enough that researchers can work with it effectively?”

This is where the work with BA fed into a major ongoing project at the Institute, to create “data safe havens” in the cloud. This work, led by James Hetherington, the Institute’s Director of Research Engineering, is combining the development of secure environments for the analysis of sensitive data sets with high-performance computing capability.

## 2.5 Dynamic demand forecasting: A collaboration with British Airways



The project makes use of the Microsoft Azure cloud platform, following Microsoft's sponsorship of the Institute with \$5 million in Azure credits in 2016. The pioneering framework developed in this project combines data security threat and risk profiles into five tiers, with varying protocols for dealing with the data at each level. As a result of the collaboration with BA, its dynamic forecasting capability was bolstered. "We would love to continue to develop the new method of forecasting," says Bovey, who hopes to see a "wider collaboration between BA and the Turing going forwards."

But it's not just BA that has benefited, of course. The collaboration helped the Turing gain further experience in developing the tools that data-rich industries will need if they are going to exploit the ongoing revolution in data science effectively.

“The Institute has many collaborations with industry, and the challenge from day one is always: how do you handle that data in a secure way, but flexibly enough that researchers can work with it effectively?”

**Radka Jersakova**

Research Data Scientist at the Institute

# 2.6

## Disaster response: A data-driven revolution

In a warming world, where extreme weather and natural disasters are becoming commonplace, disaster response needs a data-driven revolution. That's where Turing Fellow Steven Reece of the University of Oxford and his colleagues come in. At the NeurIPS conference in December, they picked up the best paper award for this research at a workshop entitled Machine Learning for the Developing World.

The work they presented is a system that uses a potent mix of crowd-sourcing, cutting-edge machine learning and neural networks to rapidly supply crucial intelligence to rescue organisations during natural disasters – helping them to allocate resources and potentially save many lives. The work was funded by the Institute's data-centric engineering programme and the UK Space Agency's International Partnerships Programme.

When disasters strike, such as devastating earthquakes or floods, the researchers use the Zooniverse crowd-sourcing platform to show online volunteers high-resolution satellite images of before and after the event. These people mark where changes have appeared, such as damaged buildings or flooded areas.

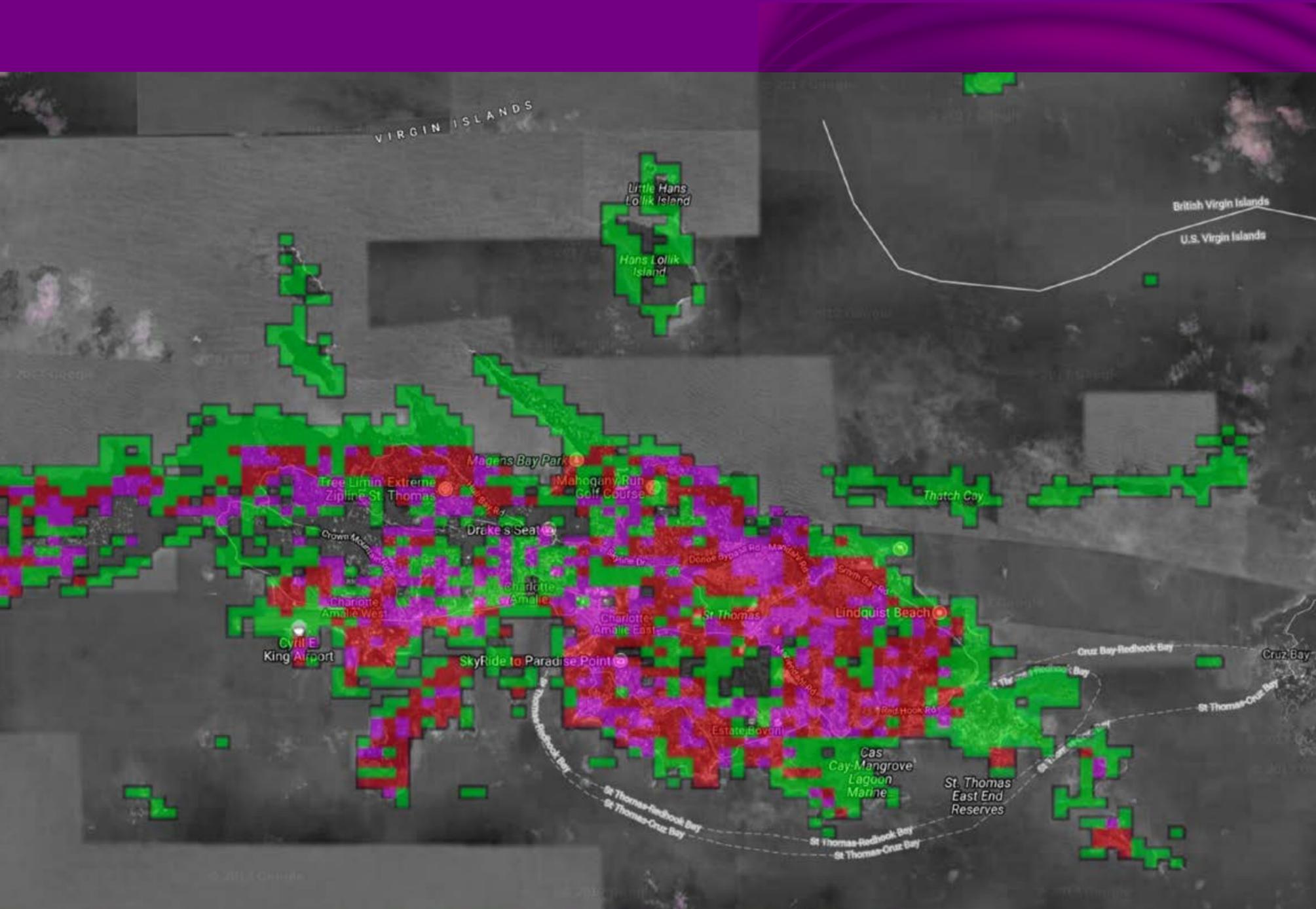
"You get lots of people working on this very rapidly, but they tend to come back with slightly different answers because, for example, some people are better than others at recognising damage," says Reece, who is also a Data-centric Engineering Fellow and Group Leader at the Institute.

"So we use machine learning to identify the 'consensus labels' – which data are the most accurate – using the wisdom of the crowds."

Rapidly creating "heatmaps" of where damage is worst is really helpful, as far as it goes: immediately following hurricanes Irma and Maria in 2017 in the Caribbean, these heatmaps were passed in a timely manner to the United Nations, the US Federal Emergency Management Agency and over 60 NGOs.

But Reece and his team are now taking their system to another level, by adding a neural network into the mix. While the human volunteers are rapidly labelling the changes in the satellite imagery, the neural network is busy learning how to do the job, training itself with the most accurate human data. Before long, the neural network is as good as the crowd.

## 2.6 Disaster response: A data-driven revolution



“We can use the trained neural network to label entire regions, or even entire countries, automatically.”

This is the work that garnered the conference prize. The potential humanitarian impact of this system is clear to see, and so it was important to the Institute that the code for the system be open source. When something is this beneficial to societies in peril, it would simply be wrong to keep it under wraps.

Heatmap showing the density of significant building damage in the US Virgin Islands from Hurricane Maria. Green = less than 20%, magenta = between 20 and 60% and red = more than 60%. These damage density intervals were requested by the project's disaster response partners.

# 2.7

## Putting AI into air traffic control

Flight movements above the UK are at a historic high and are forecast to increase by a further 50% over the next 15 years.

The technological advancement of air traffic control is a key challenge to providing the robust and resilient transport infrastructure the nation needs for the future.

So it is perfect timing for a new collaboration between the Turing and NATS (formerly National Air Traffic Services), which provides air traffic navigation to the aircraft in UK airspace.

Led by Evelina Gabasova, a Senior Research Data Scientist at the Institute, the aim of the project is to investigate how machine learning can be usefully applied to air traffic control.

“Collaborating with NATS gives us a unique insight into real-world challenges in a new area for machine learning research,” she says. Air traffic control is enormously complex. Controllers specify the trajectory of each aircraft in order to maintain a safe distance between them at all times, while getting them to their destinations. But after safety comes a wide range of secondary considerations, such as fuel efficiency, the number of control instructions issued, environmental impact and so on. This means looking into each flight’s potential future, predicting conflicts and issuing timely instructions. There are many sources of uncertainty, from aircraft mass to individual pilot behaviour and variations in weather conditions.

Any decision-making system applied in air traffic control has to account for these uncertainties while optimising for the other objectives.

The project is developing an open-source simulation platform for air traffic control, with a user-friendly interface. Automated AI agents inside the simulation will explore the outcomes of different air traffic control decisions. The research should ultimately contribute to new and better tools to aid air traffic controllers in the critical role they play as guardians of airborne souls, not only in the UK but also around the world.

“Working together with our Institute colleagues we are investigating new approaches to address our most foundational and complex challenges in air traffic control,” says Ben Carvell, Concept Lead at NATS. “Their dedication has been reflected in the impressive progress made by both the core research team and the Data Study Groups, and we look forward to seeing where this collaboration can take us.”

# 2.8

## Don't go with the flow, optimise it: Traffic

“Britain is on the verge of a transport revolution,” declared Transport Secretary Jesse Norman in the UK government report entitled ‘Future of Mobility: Urban Strategy’, published in March 2019. “Radical new technologies are emerging that within a generation will transform everyday journeys.”

And not a moment too soon. The world's cities are growing: by 2030, 60% of the world's population will be urban, according to a UN prediction. This relentless growth not only brings traffic congestion, but also unique mobility challenges: modern phenomena such as ridesharing platforms like Uber, and same-day delivery fleets, dramatically affect traffic patterns in ways that traditional traffic management systems are ill-equipped to deal with. But pioneering data science, led by the Institute and its partners, aims to offer novel solutions. “Optimising flow within mobility systems with AI” is an 18-month, £650,000 collaboration between the Institute and the Toyota Mobility Foundation (TMF), and part of the Turing's urban analytics programme. It is led by Institute Fellows Damon Wischik at the University of Cambridge and Neil Walton at the University of Manchester, under Sir Alan Wilson, former Institute Director and Chief Executive, and now Director, Special Projects.

The project aims to help the UK transform its conventional traffic management systems into optimised, AI-powered systems that cities manage in real time across many types of mobility. It has three goals: to develop a machine learning system for traffic-light optimisation; to devise new ways for fleet operators and city planners to work together,

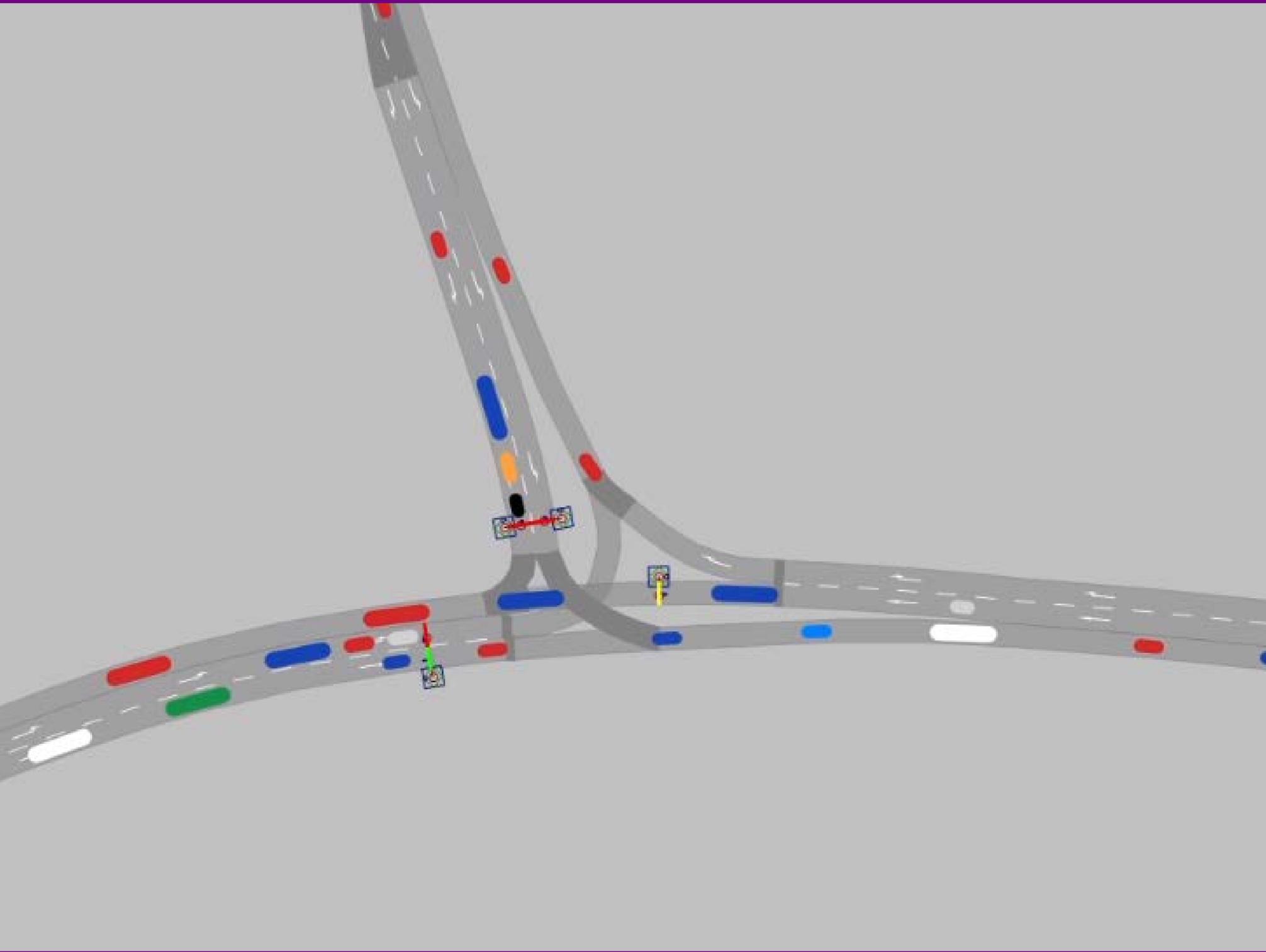
for example by pricing appropriately and sharing data about congestion; and to build an interactive data-mobility toolkit to monitor and predict traffic behaviour and simulate planning scenarios.

“Transport planners are often data-poor, or their data is siloed,” Walton explains. “The data-mobility toolkit we are making will enable planners, who are typically not trained in data science, to easily access, visualise and manage their transport data.” Such a system could help city planners prepare for the future and manage current conditions, optimising energy consumption and boosting system resilience.

The Institute's Programme Manager for Artificial Intelligence, Aida Mehonic, says the Toyota Mobility Foundation sought out the Turing because of its unique position at the interface of academia, industry and government. “TMF is not so interested in the typical approach of mainly publishing papers; they're interested in prototype tools, collaborating with transport authorities on their adoption, and overall in translating research into impact at a higher level of technological readiness.”

“Over the course of our collaboration, the Turing has become a trusted mobility partner,” says William Chernicoff, Senior Manager, Global Research & Innovation at TMF. “We have benefited from the Turing's parallel leadership in equity and privacy research combined with TMF's focus and experience deploying tailored mobility solutions that benefit all sectors of society.”

## 2.8 Don't go with the flow, optimise it: Traffic



This year, the project has forged collaborative links across the UK's transport ecosystem, including the Transport Systems Catapult and the Transport Research Laboratory. Its leaders' expertise has been sought by the Department for Transport: they were part of a roundtable discussion on emerging mobility technologies, chaired by the government's Chief Scientific Adviser, Sir Patrick Vallance. "In terms of influencing government policy and forming partnerships," says Walton, "the Turing name brings a certain amount of street cred, enabling higher-level conversations".

PTV Vissim simulator screenshot:  
Using bespoke programming from the Institute team, and in conjunction with a neural network, the simulation helps decide how signal control at the junction shown should be best operating.

# 2.9

## Working with Samsung to improve android game recommendations

Recommender systems are being used to address a diverse set of problems, from generating film recommendations to shopping suggestions.

In a six-month collaborative project with Samsung Research UK that originated from the May 2017 Data Study Group, Institute researchers aimed to build a recommender system to provide better game recommendations on the Game Launcher Platform of Samsung Galaxy devices.

Whilst maintaining close contact, both parties worked on creating separate recommender tools to be able to compare the performance of different methodologies on solving the given problem. The Institute's researchers developed a hybrid deep learning model that utilised text-based 'auxiliary information' in the form of descriptions of the mobile games being recommended. Merve Alanyali, a Research Associate at the Institute during the project, says, "The project was a great opportunity to work on real world, hands-on challenges arising in the commercial arena. We got full support from the Samsung Research UK team and I immensely enjoyed the fruitful brainstorming meetings we had."

The project was successfully completed in January 2019, with submission of a report and complete code files alongside a final meeting with Samsung Research UK. The code generated could be applied to any recommendation problem where auxiliary text-based data exist.



# 2.10

## Game-changing

Why did Kirstie Whitaker move from a postdoctoral fellowship at the University of Cambridge to become a Turing Research Fellow? “It’s a bit wild here,” she says. “The Turing showed me the strong possibility of building the world that I want to see.”

Whitaker’s scientific worldview can be summed up in a word: openness. At the Institute, she is pioneering open science, diversity and inclusion, citizen science, and particularly the sharing and reproducibility of research. “That’s the main principle of a project that I run, called The Turing Way. It’s a handbook for reproducible data science which anybody can contribute to and anybody can use. It’s entirely community-run; it’s all shared under open licences.”

Whitaker champions openness and inclusivity not only in the way science itself is done, but also in the approach to people. Women, ethnic minorities, LGBTQ+ individuals and people with disabilities working in science, technology, engineering and mathematics (STEM) are more likely to experience professional isolation, sexual harassment, bullying and discrimination. In 2018, Whitaker saw an opportunity to address this. When several researchers approached her and the Institute to see if they would support an event promoting diversity, Whitaker threw her considerable passion and scientific events experience into designing a two-day hackathon called “Gamechangers for diversity in STEM”. About 100 people applied to take part in the September event, and 40 were selected.

“It was a very ‘meta’ project for the Turing,” says Whitaker, “because it highlights the Institute’s convening power: everybody who came was already an expert in inclusion.” The group included highly committed researchers, academics, entrepreneurs, students and science communicators from across the UK. They came together at the Turing not only to tackle the enduring lack of diversity in STEM but also, crucially, develop novel solutions.

The event was opened by the Co-Founder of CognitionX, the AI advice platform, and Chair of the UK government’s AI Council, Tabitha Goldstaub, who drew attention to the under-representation of women across AI and the implications for the development of AI-based products and services. Also playing a key role was award-winning physicist Jess Wade, well known for her stellar advocacy for women in STEM and one of Nature’s “10 people who mattered this year” in 2018.

The hackathon was a fresh and dynamic forum. The main aspect was two days spent systematically workshopping new ways to boost representation and cultivate safe, inclusive working environments for students, researchers and scientists from all social groups and minority backgrounds. Was Whitaker worried it wouldn’t gel? “I wasn’t nervous, it was exciting” she says. “You need some appetite for risk if you’re actually going to try to do something new.”



After two intensive days of high-energy deliberation, knowledge exchange and creativity, participants developed nine ambitious projects to reverse the lack of diversity in STEM. In the final plenary session on Saturday afternoon each group pitched to a selection of judges and investors in the hope of winning their support, and one of several prize funds, provided by sponsors including HSBC and Accenture.

**Participants described Gamechangers as:**

“A diversity workshop on steroids: interdisciplinary, intersectional... pretty incredible!” and “A magical blend of social equity and science.” One mentoring scheme emerged aimed at schoolchildren in the most deprived or inaccessible communities. It was judged a powerful vehicle for tackling the under-representation of girls and young people from minority groups and socially deprived backgrounds. “My favourite project is the ‘Scientists are Human’ initiative,” says Whitaker. “They now have this blog, Twitter account, and manifesto of kindness in science.” They are fostering wellbeing among scientists by promoting the fact that scientists are real-life, multidimensional individuals, and sharing inspiring stories from a diverse range of people.

“It was the first event of its kind: inviting people from under-represented groups to work together to create evidence-based solutions to promote, maintain and celebrate diversity.”

**Jess Wade**

Award-winning physicist

## 2.10 Game-changing



In the spirit of inclusivity, Whitaker and the organising team are now looking to create a template for such events for others to follow.

“We have the documentation of how we selected people, the application process, and how we ran it... We aim to make that material available for anyone wanting to run their own Gamechangers-style event.”

So the truth is that Whitaker has no problem with traditions, just so long as she’s the one creating them according to her principles of openness and inclusivity. Principles wholeheartedly shared at the Institute.

**“Gamechangers was an awesome way to unite academic activists campaigning for equality from around the UK.”**

**Jess Wade**

Award-winning physicist one of Nature’s ‘10 people who mattered this year’ for 2018



# 3

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## Partnerships and collaboration

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  - 3.6** An international perspective

# 3.1

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## Relationships and collaborations

By nurturing existing relationships and identifying new opportunities for collaboration, the Institute continues to continue to grow in its remarkable role as a convenor of diverse organisations and groups across domains.

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### Collaboration

2018 saw the start of an 18-month collaboration between the Institute and Toyota Mobility Foundation (TMF), part of the Institute's new urban analytics programme. The project aims to help the transformation of conventional traffic management systems into optimised, AI-powered systems that cities can manage in real time across many types of mobility. The collaboration is wide-ranging and influential: the team has initiated relationships with leading transport authorities and organisations, while the project leaders were called in to advise the Government Office for Science on the future of mobility.

TMF approached the Institute because they want to see cutting-edge research in data science and AI being put into practice, generating real benefits for transport authorities in their day-to-day work. Beyond the production of influential research papers, they are interested in seeing the Institute develop software prototypes and tools, and the rapid translation of research into practice.

In the health domain, our collaboration with the British Heart Foundation strengthened this year. In December 2018, we awarded joint funding totalling over £550,000 to six new research projects which aim to generate data science solutions with the potential to transform how heart and circulatory conditions are diagnosed and treated. The Institute's collaboration with NHS National Services Scotland's Information Services Division (NHS NSS), which began with a Data Study Group challenge in late 2017, has deepened this year. The NHS NSS Information Services Division challenged the Institute's researchers to evaluate a decision-support tool used by GPs across Scotland to predict patients at risk of admission and readmission to emergency care. The insights that emerged led NHS NSS to commission substantial follow-on collaborative research which will complete at the end of 2019. This opportunity to work closely with a range of stakeholders in Scottish public health is paving the way for a larger programme of impactful engagement with the Institute's health programme. Early indications are that cancer waiting times and anti-microbial resistance will be among the areas to benefit from data-centric innovation.

The Institute has many high-level relationships with regulatory and governmental bodies, enabling the Institute to inform the national conversations around data science and artificial intelligence. The government's new CDEI is a case in point.



Its remit is to identify the measures needed to strengthen and improve the way data and AI are used in the UK, so it is fitting that its independent-expert board members include Turing Fellow and Chair of our Data Ethics Group, Luciano Floridi, and the Institute's Programme Director for AI, Adrian Weller.

Understanding the operations and output of automated decision-making systems is a matter of ever-increasing importance for both business and wider society, so this year, as part of the Institute's public policy programme, the Institute worked with the Information Commissioner's Office to develop a framework for explaining the processes, services, and decisions delivered by AI.

The sky's no limit for the challenges that data-centric engineering the Institute will take on, with the support of our strategic partner, Lloyd's Register Foundation. A new project has taken off with NATS, which provides air-traffic navigation to UK airspace. The number of flights is climbing steeply, so the technological advancement of air traffic control is crucial. The collaboration is investigating how machine learning can be usefully applied to air traffic control and developing an open-source simulation platform to aid NATS. The Institute also concluded a successful year-long partnership with British Airways, developing a dynamic demand forecasting model, and the Institute has now joined forces with Rolls-Royce to develop next-generation AI, specifically for use in industrial applications.

The global economy loses trillions of pounds annually through fraud. The Institute continued its work with Accenture this year, using pioneering data science to improve the detection of fraud and money laundering. "If you have some model of what you expect financial transactions to look like, you can then measure the difference between the graph you observe and what you expect," explained Andrew Elliot, a Turing Research Associate, in a video produced by The International Compliance Association and ITN News. "Fundamentally, these sort of methods would allow you to flag suspicious transactions, and then have humans look at them and hopefully stop them earlier and faster and more efficiently than the current systems."

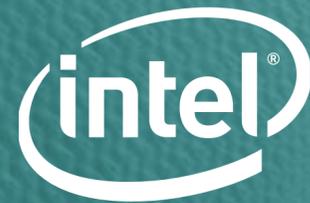
Entire sectors of industry are waking up to the opportunities hidden in their data, and realising they need new expertise. "Companies of all sizes face a shortage of talent in data science and artificial intelligence. It is vitally important to their innovation to find ways to embed new skills into their organisations," says Christine Foster, the Institute's Managing Director for Innovation. The Institute will continue to engage stakeholders on how it can change the landscape and, where appropriate, develop our collaborations into future strategic partnerships.

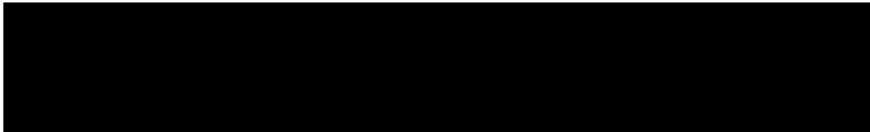
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**Strategic partnerships**

Our strategic partners are part of what sets the Institute apart from universities and other research organisations, and drives our innovation and impact.

As well as delivering programmes of research, the partnerships seek to build meaningful connections between academic excellence, and industry and government challenges.





# 3.2

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## Strategic partner update

The Institute's unique position at the interface of academia, industry, third sector and policy distinguishes it from other research institutions. In addition, it creates a wealth of potential collaborative opportunities for our dynamic relationships with our strategic partners. This year, the Institute has focused on further developing our existing partnerships, and their impact, while pursuing ever more ambitious new alliances in our priority areas.

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### Supporting clinical decision-making

The Institute announced a breakthrough partnership that could help solve some of the everyday challenges experienced by the NHS. The Institute embarked on a programme of work with UCLH to harness the power of data science and AI to support clinical decision-making to make services safer, quicker and more efficient. The goals of the partnership include improving the flow of patients through A&E departments and boosting the efficiency of cancer referrals.

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### Addressing challenges in finance, cyber security and beyond

Through our strategic partnership with HSBC, the Institute continues to develop an advanced programme of research in data science and AI working to solve challenges in finance and economics. In November, in collaboration with the Office for National Statistics (ONS), we announced funding for nine projects aimed at generating new research in economic data science, as part of the Turing-HSBC-ONS Economic Data Science Awards 2018.

The projects, awarded a total of £750,000, combine world-leading science with the potential for high impact outside academia, for example in business and policy.

The Institute's strategic partnership with the UK government defence and security community incorporating GCHQ, the Ministry of Defence and the Defence Science and Technology Laboratory (Dstl) continues apace. One of the highlights emerging from the partnership this year involves research into how our sensitive personal data can be utilised to its fullest potential without compromising privacy, using "homomorphic encryption". In December 2018, both the Dstl and the government's National Cyber Security Centre (NCSC) provided the Institute's experts with real world data and challenges for one of our five-day Data Study Groups.

Our strategic relationship with Lloyd's Register Foundation also continues to grow, led from the Institute's data-centric engineering programme. This year has seen new industry collaborations emerge and the coming to fruition of the programme's established research relationships, with major partners including Rolls Royce, NATS and British Airways.

“Thanks to strong leadership, a great team, far-sighted partners and strong institutional support, data-centric engineering is becoming recognised well beyond the programme.”

**Ruth Boumphrey**  
Director of Research for  
Lloyd's Register Foundation

# 3.3

## Continuing the expansion of our university network

### Our university network

Engaging with universities across the UK is an important part of our role as a national institute. It stems from our recognition that for data science and AI to reach its potential, we need to pursue the biggest, most ambitious research collaborations possible.

Back in November 2017, we encouraged calls for expressions of interest which resulted in Leeds, Manchester, Newcastle, Birmingham, Exeter and Queen Mary University of London becoming university partners. Each university was chosen on the basis that they bring particular strengths in data science and AI which complement and add to existing research expertise within the Institute's network (which includes our founding members of Cambridge, Edinburgh, Oxford, Warwick and UCL).

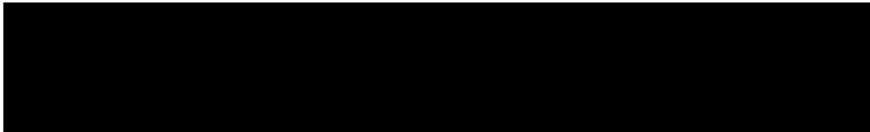
In April 2018, the Institute publicly announced that Bristol and Southampton universities had formally joined the Institute, and we are delighted to welcome them onboard. The Institute now has 13 university partners. We remain in conversation with the universities who contacted us as part of our call for expressions of interest and, while there is continued interest in becoming a university partner with the Institute, we are also seeking to define more flexible membership models, to help advance our mission to be truly national.

This year has seen us consulting with and embedding university partners within our existing networks and structures, and continuing to play a key role in the Institute's governance. With Turing University Leads on our Research Innovation Advisory Committee, which meets six times a year, actively representing the long-term interests of the Institute's university partners and advising the Executive Team and Board of Trustees on strategy. One area of focus this year has been onboarding new Turing Fellows, with the number of fellows growing. A major priority for 2019/20 will be bringing together researchers across the networks to enhance collaborative working, and to kick-start new research programmes and projects.



“I am delighted that the University of Southampton has become a member of The Alan Turing Institute. This is a reflection of the excellence of our research here at Southampton and the potential our academics offer to bring new expertise and opportunities to the Institute.”

**Professor Mark Spearing**  
Vice President, Research and  
Enterprise, Southampton University



# 3.4

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## Collaboration highlights

This year saw the Institute's existing collaborations grow and a range of new ones begin.

In December 2018, the Turing and the BHF awarded funding totalling over £550,000 to six new research projects which aim to generate data science solutions with the potential to transform how we diagnose and treat certain cardiovascular conditions.

“Developing the funding call and selecting the projects involved a close partnership”, says Catherine Lawrence, the Institute's Senior Programme Manager. “BHF provided their expert cardiovascular researchers, we provided our data scientists and AI experts. It was a truly combined effort.” The Institute and BHF then co-created a workshop in February 2019 to explore further opportunities for data science in cardiovascular research as part of a second call for research awards.

“The application of data science research methods has the potential to revolutionise the way cardiovascular disease is diagnosed and treated,” said Chris Holmes, Programme Director for Health and Medical Science at the Institute.

“The impact of this work is not only far-reaching but could potentially save lives.” The pairing of cardiovascular investigators with data scientists is a powerful one.

Another collaboration highlight has been with our strategic partner HSBC and the ONS. In November, we announced funding for nine new projects aimed at driving research in economic data science, as part of the Turing-HSBC-ONS Economic Data Science Awards 2018.

Economic data science is an emerging field designed to harness the scale and scope of the economic data now available to us. In total, the projects were awarded £750,000, and they aim to combine world-leading science with the potential for high impact outside academia, for example, in business or policy.

The projects include research into the effects of peer influence on social networks and its impact on financial decisions, exploring if positive and negative sentiment in the news has an effect on economic growth, and using machine learning to understand the needs of the gig economy workforce.

### 3.4 Collaboration highlights



**“The UK is blessed with many world-class heart and circulatory disease researchers, but, as we enter the era of digital medicine, there’s a growing need to foster excellence in applying data science solutions to cardiovascular problems.”**

**Metin Avkiran**

Associate Medical Director, BHF

“ONS is taking advantage of the data revolution to better understand the economy and our society,” said Tom Smith, Managing Director of the ONS Data Science Campus. “New sources of data, and techniques such as AI and machine learning are available for us to work with to deliver better statistics, and therefore better decisions for the UK.”

The principal investigators involved are all researchers based at one of the Institute’s partner universities, and the research will take place within the Institute’s finance and economics programme, overseen by Programme Director Lukasz Szpruch: “I am delighted to join the Turing as these new projects are launched, and as we enter an exciting time when the remit of the programme is expanded to include finance, risk, cybersecurity and blockchain technology.”

“This cutting-edge research will help us all to better understand how our economies and societies are changing.”

**Rakshit Kapoor**  
Group Chief Data Officer, HSBC

# 3.5

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## Applying data science and AI expertise across disciplines

The Institute currently spearheading cutting-edge data science and AI research following a significant government funding boost announced in December 2018. The £48.8m UKRI Strategic Priorities Fund (SPF) award is channelled through the Engineering and Physical Sciences Research Council (EPSRC) and the Arts and Humanities Research Council (AHRC) and focuses across the spectrum of UKRI research areas.

Through the SPF, the Institute is now leading two ambitious areas of research: the first to undertake and apply AI research with the goal of transforming four key areas of science, industry and government, and the second a pioneering collaboration with the arts and humanities community using data science and AI to analyse the human impact of the industrial revolution. This is already being carried out jointly with the British Library and other partners.

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### AI for science and government

Attracting this new investment represents a great achievement for the Institute and we are actively involving researchers from our university network, as well from other universities across the UK, and collaborating with numerous government departments. Excitingly, the research traverses numerous disciplines, and is addressing key challenges to the UK economy and society.

Institute researchers have begun to work across some of these areas with government departments, such as the Home Office and the Ministry of Justice, as well as the Biotechnology and Biological Sciences Research Council (BBSRC), Medical Research Council (MRC), Natural Environment Research Council (NERC) and the Science and Technology Facilities Council (STFC). Areas include:

- engineering and urban planning, through ‘digital twins’, digital replicas of physical and social systems
- health, through machine learning’s detection and diagnosis of illness, and personalised medical treatment
- the physical and life sciences, through applying AI to the vast amounts of data generated by scientific research
- criminal justice, through developing the tools as well as the ethical foundations to prevent crime and improve the criminal justice system’s operation

These areas are underpinned by cross-cutting research providing high-quality tools, methodologies and systems that are informed by, and address the needs of, real research challenges.

These research activities link to and are led by several of our programme directors. In the year ahead, we will continue to grow the activity of the recently launched Data Science for Science and Urban Analytics programmes through this investment.



UK Research  
and Innovation

In addition to the upgrade of the Joint Academic Data Science Endeavour (JADE), the largest graphics processing unit (GPU) facility in the UK which the SPF investment has enabled, the commissioning of a supercomputer resource at Harwell, with STFC, will provide the capacity to support research outcomes in one thematic area supporting another. For example, the original aspiration of taking our learnings from health and applying them to the justice system in order to rehabilitate offenders better.

Alan Wilson, the Institute's Director of Special Projects, was instrumental in shaping this ambitious research agenda, said: "The Institute is an ideal hub for addressing these pressing issues and we're thrilled to be able to dive into applying our data science and AI expertise across disciplines and academic boundaries."

This activity aligns with the Institute's programme areas and are being delivered through our existing structures in collaboration with our university partners and other delivery partners.

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#### Living with machines

The Institute, the British Library and researchers from four universities (Exeter, University of East Anglia, Cambridge and Queen Mary University of London), were awarded £9.2 million from the UKRI's Strategic Priorities Fund for Living with Machines, a research project led by the Arts and Humanities Research Council that will take a fresh look at the history of the Industrial Revolution using data-driven approaches.

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#### Living with machines has four key aims:

- to facilitate new historical findings about the effects of the mechanisation of labour on the lives of ordinary people during the long nineteenth century
- to provide new ways of marshalling the UK's growing number of digitised historical texts and documents
- to develop innovative computational models, tools, code, and infrastructure that will be transferable to other research projects
- to achieve this through radical collaboration, shaping a new domain of inquiry that challenges discipline-specific assumptions about how we ask and answer research questions, and how we share our research outcomes

While the project is still in the early stages, it has already reached several milestones. Five 'laboratories' have been established around the project's key themes: sources, language, time and space, communities and integration, infrastructure and interfaces. Each laboratory produced a proposal for initial experiments and projects, the results of which will be revealed at a workshop in October 2019. Corpus building has begun, identifying additional sources beyond the British Library that will aid research, as well as commissioning new digitisation from the British Library's holdings to supplement existing data.

The Living with Machines website will launch in summer 2019, featuring regular blogs and news about latest findings, publications and activities and later this year, early findings will be presented.

# 3.6

**“I am excited about this strategic partnership between FCAI and The Alan Turing Institute, the world’s foremost data science and AI research set-up, as it gives us the opportunity to jointly further Turing’s unique and world-changing legacy in finding solutions to challenging problems around us by applying data science and AI to the most valuable resource, data, for common good and better services to us all.”**

**Professor Kimmo Kaski**

(former Academy Professor and Dean of the School of Science at Aalto University) Turing Rutherford Fellow

## An international perspective

The Institute’s researchers work across disciplines and beyond borders, delivering impact and seeking solutions to real world problems.

Collaborating on an international scale, the Institute continues to convene the brightest and best minds in the global data science and AI community.

In January 2019, during a UK visit of the Japanese Prime Minister, Abe Shinzo, the Institute agreed to collaborations with three major Japanese research institutes on AI and robotics research.

Agreements have been made with the National Institute of Advanced Industrial Science and Technology, one of the largest research institutes in Japan focusing on bridging the gap between research ideas and commercialisation, the National Institute of Informatics, an inter-university academic research institute working to advance research and development in informatics-related fields, and the RIKEN Center for Advanced Intelligence Project, funded by the Japanese government to advance AI technologies and explore their ethical, legal and social impact.

Joint activities will include researcher exchange placements, developing joint research proposals and spearheading networking and knowledge-exchange activities. Three days of workshops will take place in Autumn 2019, in London and Edinburgh, to identify the first collaborative projects. The events programme includes a reception at the Japanese Embassy in London.

“Japan is renowned for its world-leading work in robotics, and the UK, given its established excellence in AI research, is well-placed to collaborate and bring together these two exciting research communities,” says Sethu Vijayakumar, Programme Co-Director for AI and Robotics at the Institute, who specialises in machine learning for robotics. This initiative will address key data science and machine learning challenges that arise around the deployment of robotics and autonomous systems and AI, areas in which the Institute’s scientists provide proven leadership.

“The UK is a world leader in AI and data and the unrivalled tech hub of Europe. By working closely with a country at the cutting-edge of AI like Japan, we can make sure we remain global leaders in developing tomorrow’s technology to boost investment, grow our economy, improve people’s lives, and support our long-term plan for the NHS.”  
Secretary of State for Digital, Culture, Media and Sport, Jeremy Wright.

In collaboration with researchers in Singapore, the Institute is now exploring possible ways of working on joint projects in a range of areas, including healthcare, transportation, finance and security. This year a delegation of Institute researchers participated in a workshop with researchers from the Institute for Infocomm Research, part of Singapore’s impressive Agency for Science, Technology and Research (A\*STAR), which has led to several scoping projects involving A\*STAR as well as researchers from National University of Singapore and other institutions in Singapore.

## 3.6 An international perspective



Also, alongside the University of Sydney's Centre for Translational Data Science, the Institute is collaborating on joint research projects of strategic importance to the UK and Australian economy, including criminology, air quality and geosciences.

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### A New Commitment

The Finnish Center for Artificial Intelligence (FCAI) signed a memorandum of understanding (MoU), with the Institute. This formally created an ambitious agreement centred around the Institute's data-centric engineering programme, funded by the Lloyd's Register Foundation.

In July 2018, the Institute signed a new agreement with the DATAIA Institute, an organisation dedicated to data science, artificial intelligence and society, based in France.

Announcing the agreement, then-Digital Secretary, Matt Hancock, said: "I am delighted to see a new agreement has been signed today between the UK's Alan Turing Institute and France's DATAIA. Both doing vital work in data science and AI and this is the first stage in a closer working relationship. Together with a new commitment by our two governments to strengthen ties in AI and data, we will help our world-leading digital administrations better serve their citizens." Working with DATAIA means sharing expertise and pursuing collaborative research in areas of shared interest and enables researcher exchanges and joint workshops and funding calls.

"Our objectives through DATAIA are the development of a responsible and safe AI to foster data-driven innovation that respects human values while increasing the economic competitiveness of our industries. We have a vision and objectives aligned with our colleagues of The Alan Turing Institute, who recognise the importance of interdisciplinary approaches to effective economic and social innovation." Nozha Boujemaa, Director of the DATAIA Institute.

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### Looking Ahead

The Institute continues to enable new opportunities for international visitors and leading researchers, while enabling our researchers to collaborate with centres of excellence overseas. We are particularly focused on developing research with a translational impact.

The Institute is now in the process of developing its international strategy. We are exploring new collaborations in diverse places, while seeking to build on our mission to champion UK talent on the global stage: our Research and Innovation Advisory Committee will consider and advise our Institute Director and Chief Executive Adrian Smith, on this.



# 4

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## Engagement, outreach and skills

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**4.1** An engaging year

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**4.2** Connecting with industry

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**4.3** Public engagement highlights

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**4.4** Engaging with government  
and shaping the future  
of public policy

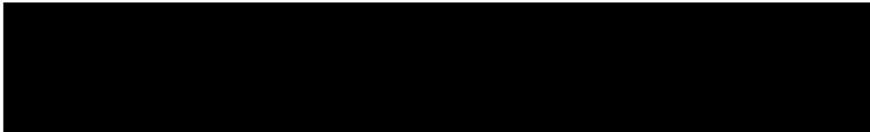
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**4.5** The next generation  
of leaders in data  
science and AI

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**4.6** Meeting the challenges:  
2019 and beyond

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# 4.1

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## An engaging year

From raising the profile of data science and the Institute's brand among the public, policy makers and industry, to boosting our researchers' capacity to collaborate and advance their work, the 200+ events run by the Institute this year have provided crucial focal points for the Institute's activities.

The Institute and its university network continue to grow, and so has our geographical reach, with the proportion of our events taking place outside London doubling this year.

The Institute is particularly proud of its work on creating a culture of equality, diversity and inclusion, not just by creating initiatives in this area, but also in reflecting this in our core research projects and events programme. And it's paying off. For example, although women are under-represented in STEM-related fields, we were gratified to note that the numbers of men and women attracted to our events approached parity this year.

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### From coding kids to tech mums

One example of impact is a unique event the Institute presented in Newcastle with #techmums, a social enterprise that teaches mothers technology skills, builds their confidence and encourages them into education, entrepreneurship and employment. The event, in collaboration with our partner Newcastle University, featured a Turing Lecture with Sue Black OBE.

Sue is well known not only for being an award-winning computer scientist and UK government adviser, but also as an activist and passionate social entrepreneur. The event focused on women who felt outside of the tech bubble, with the aim of inspiring and encouraging them to learn about data science and consider technology in their future. It was also attended by group of schoolchildren, and received a tweet of encouragement from mathematician Rachel Riley, co-host of Channel 4's countdown.

In September, the Institute convened 40 highly committed researchers, academics, entrepreneurs, practitioners, students and science communicators from across the UK for a two-day hackathon to tackle the enduring lack of diversity in STEM and develop practical solutions. This was our most diverse event yet, in terms of gender, age, ethnicity and academic backgrounds.

Committed to leading the public conversation around data science and AI, this year our events have increased and diversified, including exhibiting at national events such as the award-winning festival of science, New Scientist Live 2018. Attended by more than 30,000 science-hungry individuals of all ages, this was an excellent environment in which to engage with the public. With our partner, the University of Bristol, we distributed 3,000 items of branded merchandise and engaged in over 1,000 conversations with interested attendees.

## 4.1 An engaging year



This year we also looked to inspire the next generation. In January the Institute took part in a STEM fair at KidZania, an “indoor city for kids” at Westfield shopping centre in London. For two days, we held 30-minute classes aimed at 7 to 14-year-olds for over 100 children.

The interactive, fun classes explored artificial intelligence in the children’s everyday lives, encouraged them to ask questions, and taught them how to spell their names in binary code. Since this event, Kidzania has adopted the activity on a long-term basis, offering further exposure to the Institute.

The Turing Lectures, our flagship academic event series, had a strong year, with eight high-profile thought leaders inspiring audiences of hundreds in person and thousands more online. Highlights include a lecture from Jeff Sachs, “probably the most important economist in the world”, according to The New York Times. Our recording of his talk has been viewed on the Institute’s YouTube channel more than 3,000 times.

Other speaker highlights include Catherine Mayer, bestselling author and co-founder and President of the UK’s Women’s Equality Party, who took part in one of the Institute’s Data Debates, held in collaboration with the British Library. The Institute ran six Data Debates last year, which reached over 600 people across industry, the public, academia and policy. These social commentary panels explored controversial, thought-provoking topics such as the future of work, AI in warfare, justice and online trolling.

“We have striven this year to make our events as inclusive and accessible as possible and seen dramatic changes in our audiences as a result,” says Jessie Wand, Senior Events and Engagement Coordinator. “We will press on until everyone in the UK has access to knowledge of – or a career in – data science and AI.”

In the year ahead, the Institute will also continue to develop its role as a national, and international, influencer. “We aim to be the organisation that balances the data science conversation,” says Joanna Stacey, the Institute’s Head of Events and Engagement. Part of that means pushing to reach different audiences and extending the Institute’s reach across the UK by making fuller use of its university partners as locations for events.

We will also generate new ways to engage with the public, business and policy makers, such as developing shareable resources online and offline, and aim to become the go-to body to provide expert analysis when news in our sphere breaks.

Finally, 2020 will see the launch of the Institute’s first national conference on AI, further positioning the Institute as the UK’s academic leader in AI.

# 4.2

## Connecting with industry

The Institute continues to break new ground with business through its research, and our event activity this year has supported this aim, engaging widely with industry and bringing new collaborations to life.

In January 2019, in line with establishing the Institute as a thought leader in how data science and AI will affect business, the founding Chair of the Institute, Howard Covington presented a Turing Lecture entitled “Glimpsing our AI Future”. This business-intelligence lecture took place in the City of London, for a mostly corporate audience. Covington predicted the dramatic changes AI will bring to our world and discussed how the business and technology communities can seize the opportunities they offer. He also gave a more intimate, invite-only presentation at the Turing to business leaders from 30 or so FTSE100 companies.

Another way we engaged with industry this year was by conducting a consultation to understand better the needs of UK SMEs in AI and data science, and what support the Institute is best placed to provide. We sought submissions from SMEs from and across all sectors, ranging from grassroots to established businesses, universities (particularly the Turing’s 13 university partners) and third-sector organisations and government-funded organisations. More than 50 companies and support providers took part. The participants argued strongly that SMEs provide a critical pathway for innovation to enter the market and revealed a huge unmet need for data science talent, R&D engagement and the development of a more SME-friendly research ecosystem.

The vast majority of the participants want the Institute to develop an offering to service the SME community.

The Institute also had a presence at industry events, including CogX, the annual “Festival of AI and Emerging Technology” in London, where the Institute showcased its research for the festival’s 15,000 attendees as a sponsor of the research stage. In 2019, we are taking a higher-profile role as official hosts of the Turing Research Stage.

Our vibrant Data Study Groups (DSGs) saw over a dozen organisations coming to the Turing as “challenge owners” with compelling data science problems they wanted help to tackle. “It’s a wonderful initiative because the researchers who bring their talent to attack these data problems are true innovators, ranging from PhD students and early career researchers to leading academics in their field,” says Sebastian Vollmer, Director of Data Study Groups at the Turing.

“Amnesty International, the National Cyber Security Centre... We’ve solved problems for so many interesting companies, and brought in new data science talent to do so,” says Joanna Stacey, the Turing’s Head of Events and Engagement. “The Institute’s Data Study Groups remain one of the Institute’s shining lights.”

## 4.2 Connecting with industry



The Institute has also found a way to make Data Study Groups available more widely. The Institute and Digital Catapult are allies in the effort to make the UK the best place in the world for data science and AI research, collaboration and business, so this year we launched a formal collaboration to support start-ups and scale-ups headquartered or operational in London to develop their innovative ideas. Together the two institutions will provide support for nine companies to participate as challenge owners in any one of the Institute's DSG held between December 2018 and March 2020.

Two SMEs, Player LENS and Spend Network, have already benefited from working with the Institute's researchers on their unique data-driven challenges.

# 4.3

## Public engagement highlights

All aspects of the Institute's activities contribute to shaping the public conversation about data science and AI, and public engagement is a key component. This year, the Institute's public engagement programme has taken off, moving in new directions and to more locations. Not only have we stepped up our public engagement across the board, bringing our focus to greater diversity, we have also introduced seed-funding calls to enable the passionate advocates among the Institute's UK network of researchers to fund their own public-engagement initiatives within their universities.

About 9,000 people attended events hosted by the Institute this year, with tens of thousands more coming into contact with the Institute through sponsored events, science festivals and more. We held eight of our flagship Turing Lectures, and diversified our offering. This meant including lectures targeted specifically at a public audience, with more accessible language and a focus on "real world" issues.

Creating flexibility in both the format and locations of the lectures increased the diversity of attendees beyond a largely academic audience. Examples of this include the Turing Lecture by Sue Black OBE, held in Newcastle, and another with BuzzFeed Editor, Craig Silverman, held at the headquarters of the Guardian in London. Silverman's accessible talk, about how the media manipulates information, was eagerly attended by a younger, media-focused audience.

Continuing our commitment to leading the public conversation and engaging with the national digital skills agenda, we commissioned a Turing Lecture with Black and an associated workshop in Newcastle upon Tyne, dubbed "If I can do it, so can you". The events sought to inspire women who felt alienated from technology to embrace the opportunities it presents. As a direct result of the event, funding and facilitators were procured to start an ongoing digital skills workshop in Newcastle, contributing to widening participation work in this area.

This year, once again in collaboration with the British Library, the Institute created six data debates that convened diverse panels of thought leaders, scientists, policy makers, wunderkinds and other authorities in their fields. The accessible topics of these lively public discussions, moderated by author and BBC Radio 4 presenter Timandra Harkness, included the future of work in an AI-powered world, online trolling, data and inequality and cyberattack. Each debate, held in the British Library's Knowledge Centre Theatre, was also recorded for the Institute's YouTube channel.

## 4.3 Public engagement highlights

**“The resources provided to the interns and the activities organised by The Alan Turing Institute were truly exceptional: I have been at a few top research institutions in Europe and had never seen anything like this!”**

**Alessandra Cabassi**

University of Cambridge

Turing intern, summer 2018

We are proud of this year’s engagement with younger audiences, particularly through our presence in September at New Scientist Live, in partnership with the University of Bristol. The UK’s biggest science festival has a fantastic buzz about it, and a large proportion of its 30,000+ visitors are enthusiastic young people and schoolchildren.

Then in January, we took a more targeted approach, aiming to inspire 7 to 14-year-olds by running interactive, fun classes in AI at a STEM fair at KidZania in London.

Finally, the Institute’s social media reach has grown considerably. This includes over 20k followers on Twitter, for example, with substantial increases in engagement from followers year-on-year. Endorsements and retweets from influential stakeholders such as government ministers and departments, not to mention celebrity scientists and mathematicians, have also boosted the Institute’s online influence.

This year, our YouTube channel, full of Turing Lectures, talks and seminars, racked up 112,000 views.

“I’ve been thrilled with the dramatic growth in the Institute’s public engagement work this year,” says the Institute’s University Liaison Director for Warwick, Graham Cormode, who chairs the Institute’s events and engagement steering group. “And it’s encouraging to see so many interactive activities proposed and led by the Turing’s diverse academic community.”

### Engagement highlights

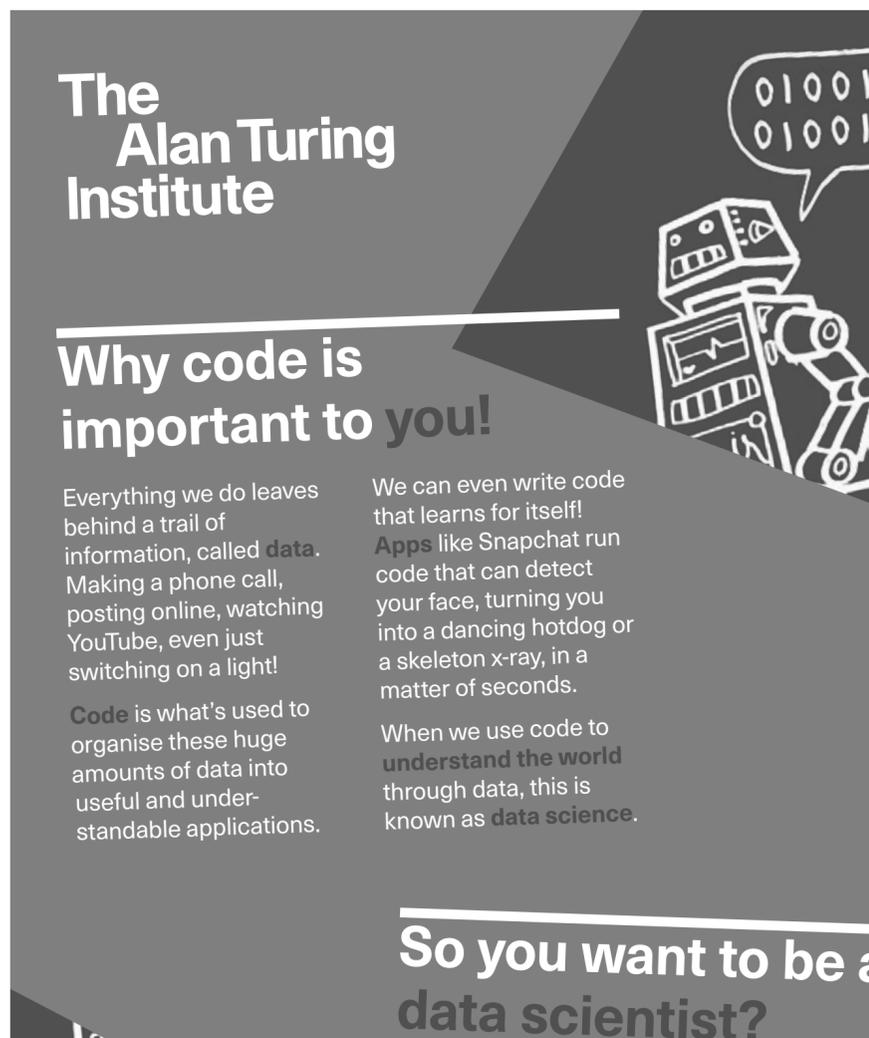
The Turing Lecture Series

Jeff Sachs, ‘Probably the most important economist in the world’.

Eighty years after Alan Turing launched the digital age, the revolutionary consequences continue to unfold. The changes are so relentless and powerful that they have given rise to competing utopian and dystopian narratives. According to one view, smart machines will usher in unparalleled productivity, prosperity, longevity, and leisure time.

The competing view? Smart machines will crush workers, drive wealth to the top 0.0001% of the population and end privacy once and for all. To explore these potential futures, the Turing was delighted in October to host a talk by Jeff Sachs, “probably the most important economist in the world”, according to The New York Times. Sachs is the Director of the Center for Sustainable Development at Columbia University in New York City and a Research Fellow with DeepMind Ethics & Society, among many other things.

The talk, which was followed by a Q&A session, was free and open to the public, with hundreds of people in attendance. Following an introduction from Adrian Weller, the Institute’s Programme Director for Artificial Intelligence, Sachs argued that both the bright and dark futures are theoretically possible, and that the outcome will depend not on the technology itself but on how we govern it.



**The Alan Turing Institute**

**Why code is important to you!**

Everything we do leaves behind a trail of information, called **data**. Making a phone call, posting online, watching YouTube, even just switching on a light!

**Code** is what’s used to organise these huge amounts of data into useful and understandable applications.

We can even write code that learns for itself! **Apps** like Snapchat run code that can detect your face, turning you into a dancing hotdog or a skeleton x-ray, in a matter of seconds.

When we use code to **understand the world** through data, this is known as **data science**.

**So you want to be a data scientist?**

## 4.3 Public engagement highlights



**“Unlike during the Cold War when governments largely stimulated and controlled the development of new technologies for defence application, AI technologies are being driven by academic and industry researchers and public interest. We need to have more conversations like this which bring together all stakeholders with an interest in the future of AI.”**

**Kathleen M. Vogel**  
Turing Rutherford Visiting Fellow

Rapid advances in AI and related technologies will replace workers, drive up the wages for some groups while driving down wages for others, Sachs explained, and will tend to increase inequalities of market earnings. But his takeaway message was that the benefits of the digital revolution can be broadly shared if we act with foresight, ethics, and appropriate strategies regarding taxation, intellectual property, education, and governance. The Institute is the perfect place for these crucial conversations.

### **AI robotics and conflict**

With robotics and AI already being employed in conflict situations, the Institute convened an audience of experts to explore the likely effects on conflict of the trends in AI, robotics, economics, data and society. The event, one of many major successes across the programme was delivered by Lt. Col Alan Brown (MoD) with invited guests from academia industry, and government.

Event organiser Kathleen M. Vogel, Turing Rutherford Fellow, and Turing Fellow Jack Stilgoe of UCL are developing a follow-up event at the Institute, potentially to examine the social implications of AI technologies for the future defence and security workforce, by learning from lessons of computation/information sciences from the disciplines of history and the social sciences.

# 4.4

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## Engaging with government and shaping the future of public policy

The Institute's research is focused around a number of ambitious challenges which represent areas in which AI and data science can have a game-changing impact for science, society and the economy. These challenges are representative of broader areas of applied science in which the Institute works. This year, significant collaboration and partnership activity has enabled progress across our thriving programmes, projects and challenges, with new opportunities emerging.

A year on from the launch of the public policy programme, the Institute is uniquely positioned to help improve government use of data science and AI for the greater good.

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### Programme Director appointments

Helen Margetts (Professor of Society at the Oxford Internet Institute) was appointed Programme Director in May 2018. Helen also sits on the Home Office Scientific Advisory Council, the UK Government Digital Economy Council and was appointed to the Ada Lovelace Institute's board in 2018. She received the Friedrich Schiedel Prize from the Technical University of Munich for research leadership in Technology and Politics in November 2018, an OBE in January 2019 in recognition of her services to social and political sciences, and was appointed to the John W Kluge Chair in technology and society in the Library of Congress in March 2019.

**Helen Margetts**  
Programme Director  
for Public Policy  
and Turing Fellow



In July 2018, Dr Cosmina Dorobantu took up the role of Deputy Programme Director. Cosmina also sits on the Trade and Economy Panel at the Department for International Trade and is an Independent Expert for the European Commission.

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### Research challenges

The public policy programme launched in May 2018 with the aim of tackling two sets of research challenges, covering the technical as well as the ethical aspects of data science for policy:

- Using data science and AI to inform policy-making and improve the provision of public services
- Building the ethical foundations and contributing to policy that governs the use of data science and AI

A core team with a social science background now oversees the programme activities. The academic expertise of the programme's core team ranges from philosophy and law to economics and international relations.

In a year of rapid progress, the programme met with hundreds of policy makers, representing more than 80 organisations, from local councils and police forces to central government departments, regulators, and international organisations.



The programme is now home to more than 20 research projects, involving over 60 academic researchers from 10 universities and is making great strides towards tackling each set of research challenges.

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**Using data science and AI to inform policymaking and improve public services**

Data science and AI can provide policy makers with unprecedented insight: from identifying policy priorities by modelling complex systems and scenarios, to evaluating hard-to-measure policy outcomes.

These technologies can also harness the government's huge data reserves to improve the design and provision of public services. Helen Margetts and Cosmina Dorobantu laid out these possibilities in *Nature* in March 2019.

In the past year, the public policy programme advised hundreds of policy makers on the expertise and tools they need to develop in order to design effective public policy. The programme also contributed key inputs to the digital government inquiry launched by the House of Commons' Science and Technology Committee, by submitting written evidence. Helen Margetts also provided oral evidence in January 2019. Apart from contributing to the government's digital strategy, the programme also set up several strands of work:

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**Improving the criminal justice system with the Ministry of Justice, Home Office and the Police**

As part of the Institute's SPF award, the public policy programme is exploring the use of data science and AI, and the ethics of using these technologies in the criminal justice system. Work is well underway on two foundational projects. The first is to map the criminal justice data landscape, investigating potential data linkages between the rich and heterogenous data sources across government departments and police agencies. The second is to build an ethical framework for the use of data science and AI in criminal justice. Several other projects will explore a broad range of topics, from identifying and preventing hate speech online to modelling police demand and combatting modern slavery.

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**Helping governments reach the UN Sustainable Development Goals**

Prioritising policy targets and strategies is a daunting task for any government. Simultaneous objectives, a multitude of options, unexpected implementation inefficiencies, and complex interdependencies between policies all need to be considered. An ambitious research project led by Turing Research Fellow Dr Omar Guerrero used agent computing to develop analytic methods that can inform governments on how to prioritise public policies while accounting for the complex nature of socioeconomic development. In the coming year, Guerrero will collaborate with UNDP to advise the federal government of Mexico on the policy priorities needed to reach the UN's Sustainable Development Goals.

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## 4.4 Engaging with government and shaping the future of public policy

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### **Building the ethical foundations and contributing to policy that governs the use of data science and AI**

The public policy programme works alongside the Institute's Data Ethics Group to develop the ethical foundations for the use of data science and AI in policymaking, with the aim of securing the benefits and addressing the risks these technologies pose. Key projects include:

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### **Increasing the number of women in data science and AI**

The past year saw the groundwork laid for one of the programme's most important projects: 'Women in data science and AI'. Led by Professor Judy Wajcman, the project will conduct research to inform concrete policy measures aimed at increasing the number of women in data science and AI. The project will consider, among other topics, the ways in which the gender imbalance

shapes both the research agenda and the applications of digital technologies.

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### **Working with the Information Commissioner's Office**

Following recommendations in the government-commissioned independent review *Growing the artificial intelligence industry in the UK*, the public policy programme has been working with the ICO to develop a framework for explaining the processes, services, and decisions delivered by AI. The Institute and ICO have made great strides in the past year towards building this, and actions include running a series of citizen juries to establish the public's views as well as delivering a series of roundtables to collect feedback from researchers, industry representatives and practitioners on the juries' results. The views from the juries and roundtables will be incorporated into the framework and final guidance will be published in October 2019.

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### **Advising the Centre for Data Ethics and Innovation (CDEI)**

The public policy programme has been instrumental in advising the UK government's CDEI. Over the past year, the programme has been in constant dialogue with the Centre, providing extensive comments and guidance on the setup, remit and research work of CDEI. In response to the public consultation launched by the UK government in summer 2018, the Institute submitted extensive guidance which focused on two areas that the Institute is particularly well suited to advise on: how the new Centre should work, and which issues in data ethics it should focus on.



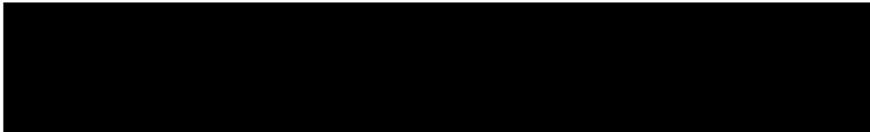
**Shaping NHS' code of conduct for data-driven health and care technology**

The Institute's Data Ethics Group engaged with the NHS to work towards a comprehensive and ethical approach to the use of data science in the healthcare sector. In particular, the Data Ethics Group provided expert opinions and feedback to the NHS code of conduct for data-driven health and care technology, officially launched in February 2019. The Code is intended to form the basis for the NHS's long-term strategy of developing, procuring and deploying data-driven tools. The use of digital technologies in health is a crucial issue at the heart of UK society and the Institute is eagerly anticipating developing future iterations of the code to help promote an efficient, accurate, accessible and ethical modern healthcare system.

**Making policy for AI with the European Commission's Joint Research Centre (JRC)**

The public policy programme has been working internationally. The programme has been praised by the European Commission for its support and input into its JRC flagship policy report on AI launched in December 2018. Cosmina Dorobantu sat on the editorial board for the report and delivered a keynote speech to senior EU policy makers discussing why they should embrace data-intensive technologies. *Artificial Intelligence: A European Perspective* is the first AI policy report ever written from a European stance. It addresses the European and international landscape on AI, its potential impact on work and education, as well as a series of issues including sustainable computing architectures, strategies for data, and legal and ethical issues.





# 4.5

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## The next generation of leaders in data science and AI

The Institute is committed to developing a new generation of leaders in data science and AI with the breadth and depth of technical and ethical skills that they need to meet the fast-evolving demands of UK industry and society.

Within the Institute they are encouraged to build bridges between disciplines and with our industry partners to achieve the collaborative, multidisciplinary approach that represents the future of research.

The Institute also plays a pivotal role in shaping the discussions about the UK's data skills gap and works with like-minded organisations to increase data skills for all. We continue to support the development of a national workforce ready and able to take full advantage of the ongoing Fourth Industrial Revolution.

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### **Doctoral students: Diversity boost**

Our commitment to training the data science leaders of tomorrow means that our students must not only be experts in their disciplines, but also need a clear vision of the potential impact of their work in the diverse reality of the "real world". Diversity in research interests, specialist skills and life experience are the fundamentals of promoting a healthy interdisciplinary research environment. This year we expanded our university network from five partners to 13, and asked the partners to keep both academic excellence and diversity at the forefront of their minds when putting forward their stand-out doctoral candidates.

The cohort of PhD students arriving in October 2019 we will be representatives of all 13 universities. This year, for example, we will be welcoming a qualified lawyer aiming to work on the ethics and policy of data science, through to astrophysicists coming to work on big data problems. The wide range of backgrounds and expertise coming together in the Institute's doctoral programme provides a rich environment for all involved.

Our current crop of Institute doctoral students has also been busy making waves. David Butler, a third-year student, gained a place on the summer internship at NASA's Ames Research Center in Mountain View, California. David was using logical programs to analyse the safety of NASA's unmanned aircraft. Closer to home, third-year Helen Oliver won the prize for "Best Innovator" at the Oxbridge Women in Computer Science conference 2018 for her presentation of a novel method that used fictional storytelling workshops to inspire new styles of wearable technology.

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### **Enrichment studies: Creating a buzz**

The Institute's Enrichment Scheme is a key feature of the Institute's offer, and gives the student population a real buzz. Enrichment students are already established in their PhD research elsewhere and want to come the Institute for the unique networking opportunities that our diverse community provides, while also accelerating their research. Students can apply to work at the Institute for a period of 6 to 12 months. Last year, we received 37 applications and offered 22 places.

This year our applications more than doubled. Clearly, the word is out, helped in part by our increased involvement in recruitment events targeted at under-represented groups.

Our enrichment students exemplify the Institute's multidisciplinary research environment. This year, we have seen students working on projects such as identifying patterns of Islamophobia, modelling brain behaviour, the dynamics of innovation, and understanding uncertainty in artificial intelligence.

The scheme also continues to provide an attractive option for the UK's science funding councils and other university groups. A kindred spirit of the Institute, Ireland's Insight Centre, funded by Science Foundation Ireland, now sends students to the Institute.

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**Turing Data Science Classes: Listening and delivering**

Not only do students benefit from the excellent research environment at the Institute, they also and have access to a wide programme of data science classes, delivered by Turing Fellows and industry partners. A highlight this year was a 30-hour course in research software engineering, delivered by the Institute's Research Engineering team, led by the Director of Research Engineering at the Institute, James Hetherington. It was designed in response to a request from the students to have more applied training. This comment, from an anonymous feedback form, sums it up: "Great content, well taught. The material was useful,

important, well structured, and interactive. Live coding can be a real gamble, but James H pulled it off".

Our data science classes also introduce Institute's students to the extensive resources available to them, such as Microsoft's Azure cloud computing platform, so that they can supercharge how they do their research. The Institute wants its students to see the entrepreneurial possibilities in their ideas, so this year Turing Fellow Panos Panagiotopoulos, of Queen Mary, University of London's School of Business and Management, stepped up and delivered a grass-roots training session to inspire students and help them elevate their thinking beyond the walls of the Institute.

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**Internships: A transforming approach**

Over the summer of 2018, the Institute's internship programme hosted 20 early career researchers, paired together to work on ten novel projects, while immersing themselves in the Institute's premier data science community.

These projects included "Uncovering hidden cooperation in democratic institutions", which exploited newly available big data on voting behaviour in the US Supreme Court and the United Nations General Assembly to reveal, among other things, examples of realpolitik in action. Another project, "Listening to the crowd: Data science to understand the British Museum's visitors", addressed some of the challenges of hosting over 6 million people every

year. Two interns delved into a rich set of qualitative visitor data, and uncovered actionable insights that helped the museum hone its offering.

The year ahead will see the Institute take a new approach to internships: we will focus on our role as a national convener, connecting the best in doctoral-student talent with industry partners on specific projects for which the students' expertise is highly valued. To this end, we are setting up a network to curate industry job opportunities for doctoral-level interns.

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**Data skills taskforce: Delivering change**

The UK's Data Skills Taskforce, set up with help from the government's Department for Digital, Culture, Media & Sport, Tech Partnership and Accenture, was brought into being to address the challenges of building a UK workforce skilled in data science.

Our Institute Director and Chief Executive Adrian Smith, is co-chair of the Taskforce, along with Ray Eitel-Porter, Managing Director of Accenture Digital. A key government aim is to raise awareness of the value of data for UK businesses, highlight the opportunities of the data revolution and provide information on how companies can identify and capitalise on these opportunities.

This year the Taskforce commissioned a government and industry-funded project, with the Institute's Matthew Forshaw serving as its Data Skills Policy Leader, to develop a platform to help small to medium-sized businesses

develop their data science capabilities, work to quantify the UK data skills gap, and consider how to close that gap. The tool will help business embrace data technology.

The Institute's deep involvement in national initiatives like these is something that sets the Institute apart from academia.

# 4.6

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## Meeting the challenges: 2019 and beyond

The Institute's research is focused around a number of ambitious challenges which represent areas in which data science and AI can have a game-changing impact for science, society and the economy. These challenges are representative of broader areas of applied science in which the Institute works. This year, significant collaboration and partnership activity has enabled progress across our thriving programmes, projects and challenges, with new opportunities emerging.

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### AI for understanding our changing polar environments and global impact

Polar scientists at the British Antarctic Survey (BAS), together with the Institute, are developing new AI algorithms to monitor and understand how the large expanses of ice over the polar regions are changing. These extreme and hostile environments support local populations and wildlife, and reflect sunlight back out into space, keeping our planet cool and regulating global weather patterns.

One of the greatest challenges facing global society is sea-level rise. These rises are already affecting the severity and frequency of storm surges, which displace people from their communities. New AI methods are being developed to detect changes automatically in iceberg calving and motion which could provide new insight into the dynamics and sea-ward flow of the massive Antarctic ice sheet, helping us understand its contribution to sea-level rise.

In addition, BAS scientists and the Institute are developing new AI methods to learn the complex interconnectedness of large-scale climate phenomena and sea-ice variability, to help reduce uncertainties in future climate predictions. Bringing together AI expertise from the Institute with BAS polar scientists, plus increased access to satellite and climate data, is enabling novel approaches which will deliver new understanding of the Earth's polar regions and climate system.

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### Probabilistic numerics: The heart of modelling

Scientific applications often use numerical methods to model dynamic systems, including biological ones. Such models typically consist of mathematical equations and offer a precise version of what is happening. But reality is not precise. It is filled with uncertainty, particularly at the cellular level, so there is always a difference between the real, physical system and its model's approximation. Probabilistic numerical methods work to quantify uncertainty, and then build it into models, making them closer to reality, and therefore much more useful. In October 2018, Turing Fellow Chris Oates, a Data-centric Engineering Group Leader based at the Newcastle University, started work on a two-year project in collaboration with researchers including Marina Riabiz and Steven Niederer of King's College London's Cardiac Electro-Mechanics Research Group, to apply statistical and data science tools to models of the heart.

**“Over the last few years, new high-resolution satellite sensors have led to a massive jump in the size of our data archives. To help explore and discover the signatures of environmental change stored in these data it is crucial that AI engineers and environmental scientists work together to leverage the power of AI algorithms.”**

**Dr Scott Hosking**

Environmental Data Scientist, British Antarctic Survey



The new project, jointly funded by the BHF and the Institute, is investigating the variability of the activity of proteins that regulate chemical signals in heart muscle cells.

This variability at a single-cell level should be taken into account when modelling an entire heart. Technically speaking, this challenge is a “non-linear, high-dimensional problem”, says Riabiz. “The new statistical methodologies tailored to this problem could then be applied to similar problems in medicine and engineering.”

This project is a multidisciplinary collaboration between Pawel Swietach’s “wet” lab at the University of Oxford, which provides the data, KCL’s bioengineering department, based at St. Thomas’ Hospital, London, and the Institute. In the short term, the methods under development are applicable to simulations of cardiotoxicity, and the identification of potential drug targets. Longer term, these approaches will feed into patient-specific modelling to include uncertainty-quantification estimates when guiding treatments, selecting patients, optimising drug dosing and designing medical devices.

Such work on computational cardiac models is increasingly being used in translational projects. The research group’s previous projects, funded by the BHF and the EPSRC, are now attracting funding from commercial partners including Siemens, Boston Scientific, Pfizer and Roche.

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### **Deepening our understanding of the economy**

The finance and economics programme’s vision is to develop cutting-edge methods to foster financial innovation and deepen our understanding of the economy, to benefit society at large. The programme was re-launched in October 2018, expanding significantly to tackle challenges across four strategic themes: machine learning in finance, behavioural data science, sustainable finance, and economic data science.

In November the Institute announced a total £750,000 in funding for nine new projects aimed at driving research in economic data science, as part of the Turing-HSBC-ONS Economic Data Science Awards 2018. The Institute has started building relationships with additional external partners including the Bank of England, the Financial Conduct Authority (Turing Fellow Lukasz Szpruch, Programme Director for Finance and Economics, is a member of the FCA’s Academic Advisory Board), the Monetary Authority of Singapore and the Louis Bachelier Institute in Paris.

Through breakfast briefings with the heads of research of leading investments banks, the Institute is scoping projects in machine learning in finance. The Institute is also linking with Nesta’s Finance Innovation Lab to set up collaboration in the area of open financial infrastructure, which aims to improve access, reduce costs, and increase innovation in financial services.

**“The past twelve months has seen over 750 Defence and Security related professionals visit the Institute to interact with our research community, and each other, across a variety of topics, including: fake news, predicting instability, cryptographic approaches to privacy-enhancing technology, online hate speech, robotics and conflict, ethics in defence, statistics in cyber security, understanding the government’s web presence, data wrangling, synthetic data generation, cyber-attacks, data and inequality, microlocal analysis, and much more. We’ve completed 27 research projects, resulting in at least 24 papers and software artefacts, helping to create impact across several areas.”**

**Mark Briers**

Programme Director for Defence and Security

In the first week of April 2019, the Institute published an authoritative new report, Artificial Intelligence in Finance, by Bonnie Buchanan, a professor of economics and finance at Seattle University and Editor in Chief of The Journal of Risk Finance. The landscaping report laid out how AI is transforming the financial services industry.

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#### **Improving the public’s health**

The Turing’s involvement in the public health domain in Scotland began with a single Data Study Group (DSG) project in 2017. NHS National Services Scotland’s Information Services Division challenged the DSG participants to evaluate the SPARRA decision support tool, used by GPs across Scotland to predict patients at risk of admission and readmission to emergency care. The insights gained over that week of very focused work led NHS NSS to commission substantial follow-on collaborative research which will complete at the end of 2019. The aim of this further work is to improve the predictive nature of the SPARRA tool through a variety of data science approaches, improving the identification of patients at risk.

The project has also provided a valuable opportunity to work closely with a broad range of stakeholders in Scotland, paving the way for a broader and more impactful engagement with the Turing’s Health Programme. A much larger programme of work has been scoped which will ensure that data-centric innovation in Scottish public health and social care builds on and contributes to wider initiatives across the UK.

Early indications are that cancer-treatment waiting times and anti-microbial resistance will be among the earliest areas of focus. “The innovative use of data is a key tool in achieving the ambition for Scotland to be a world leader in improving the public’s health,” says Scott Heald, Associate Director in NHS NSS who is championing the partnership with the Institute. “Developing strong partnerships is crucial for achieving this ambition, which is why our work with The Alan Turing Institute is so important and rewarding.”

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#### **Predicting the function of human genes**

The human genome contains about 20,000 protein-coding genes, and of these approximately 30% still have no known function, including many that are well conserved (and therefore probably important) in model organisms like flies or worms that have been extensively studied by biologists. However, some information is available for all human genes from genome-wide analysis of features such their expression levels in different tissues, their conservation in different species, and the subcellular location of the protein product of the gene. The aim of the project is to investigate the value of machine learning for predicting the function of a gene from what is known about it from publicly available, genome-wide databases. There have been some successes using this approach to look for new components of known pathways, but it has not been attempted on a large scale.

**“I firmly believe that the use of AI methods, applied to large data sets, will become a dominant research methodology across the whole range of science and humanities. The Institute is in a unique position to help make this happen. Together with partner universities, national labs and international institutions the Institute is developing truly interdisciplinary projects, bringing expertise in data science and AI to bear on major research questions. It is exciting to be part of this scientific revolution alongside international research facilities, such as the British Antarctic Survey, the John Innes Centre, the Met Office and Diamond Light Source. We have seen the early stages of impact in projects ranging from citation cartels, to climate change and modern imaging techniques in microbiology.”**

**Turing Fellow Jon Rowe**

Programme Director, Data Science for Science.

Thus we would use genes of known shared function to train a machine learning system to predict whether or not two proteins act in the same process. Applying this across all pairs of genes from humans will hopefully assign those of unknown function to known processes, or to isolated clusters that could reveal previously unknown biological process. This information would be of value to both fundamental biological research, and also to clinical genetics, where an increasing number of inherited diseases are being found to be caused by defects in genes whose function is unknown and thus possible routes to treatment are unclear.

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#### **Computer Vision**

‘Computer Vision and Machine Learning in 4D Materials Science’, is led by Biao Cai at the University of Birmingham. The project is now focusing on using machine learning methods to analyse and correctly interpret 4D (3D plus time) big data. This data is collected by high speed X-ray tomography available from synchrotrons such as the Diamond Light Source, the UK’s national synchrotron science facility, located at the Harwell Campus of Science, Technology and Innovation in Oxfordshire. A benchmark case has been carried out, which saw Cai study the coupled growth of crystals during solidification of an aluminium alloy of industry importance, with the help of machine learning.

In the future, the project aims to apply 4D imaging, coupled with machine learning and simulation, to tackle key challenges in the materials industry, allowing fast determination of optimal materials processing trajectories and enabling controllability in digital manufacturing.

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#### **Seeing the unseen**

Understanding how the body responds to hazardous materials is the first step towards mitigating the potential harm they pose.

The advent of modern, high-throughput sequencing technology such as RNAseq has provided new insights into the changes that occur in response to these substances within the basic units of life: individual cells. This challenge was based around using modern analytical methods to identify variations in the cellular response at different time points within controlled experiments following exposure to a variety of dangerous substances (for example from plague, to toxins and hazardous chemicals). With the goal of identifying a series of protein precursors or patterns that would be suitable for subsequent evaluation as biomarkers to aid diagnosis, triage and/or treatment in the event of an exposure to a hazardous material.

**“The adoption of artificial intelligence methods in the financial services industry is opening the door to robust data-driven decision processes, a better understanding of the needs of their customers and, if used appropriately, will ultimately result in more resilient and trustworthy financial systems. It is a privilege to lead the programme that offers trusted scholarly thought leadership empowering positive disruption of the financial system.”**

**Turing Fellow Lukasz Szpruch**  
Programme Director, Finance and  
Economics, and Data Services

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### **Web domain discovery**

At present not all government online services are centrally mapped. Now, a method being developed at the Institute could improve the cyber security profile of these government services. The proposed solution iterates between a discovery step, where new candidate websites are added to a pool, and a classification step, where candidates are classified into government or not (or other categories of interest). A dynamic Institute DSG explored ways to learn domain representations based on the contents of websites and their links in the web-graph, using deep learning techniques. Potentially, the Web Domain Discovery project could find services currently not included in existing central maps, and the underlying methodology would constitute a step towards creating a scalable unified approach for identifying topics of interest on the web.

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### **Designing better architecture in high-performance computing**

In a high-performance computing (HPC) environment, such as a data centre with hundreds or thousands of interconnected computers, well-designed algorithms and architectures allow huge data analysis tasks to be performed. While these systems operate well for some computing needs, they often run at less than half their full capacity for many data science and machine learning tasks.

Turing Fellow Peter Boyle has been working in collaboration with Intel to co-design better architecture for their HPC systems. Training multi-layered neural networks on HPC architectures requires optimised communication between cores in the architecture. Taking an existing benchmark algorithm as a starting point, Boyle explains how “with help from Intel engineers we managed to enable more cores to drive a network at the same time, improving bandwidth and resulting in a tenfold improvement in speed”.

The code that this work produced is now shipped as standard in Intel products. Another output of the collaboration looked at how to rethink the way data is formatted in HPC to work better for data science and machine learning problems. Boyle and his collaborators experimented with different ways of representing data in the standard 16-bit ‘floating point’ format, until they found an optimal solution that improves on current industry standard. These outputs are helping both Intel improve their products and services, and data scientists improve the efficiency with which they can manage and analyse massive datasets.

Karl Solchenbach, Director of Exascale Labs Europe at Intel, explains, “If you can do the same calculation with the same accuracy with 16 bits rather than the previous standard 32 bits, that’s great. It saves you half the memory, it makes the calculations much faster, and you can save silicon space in hardware.”

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## Part 2

### Trustees' and strategic report

The Trustees present their annual and strategic report together with the consolidated financial statements for the charity and its subsidiary for the year ended 31 March 2019.

The financial statements comply with the Charities Act 2011, the Companies Act 2006, and the Statement of Recommended Practice (SORP) applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK (FRS102) which became effective in January 2015.

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## Legal and administrative information

The Charity is registered and is a company limited by guarantee governed by its Articles of Association dated 26 March 2015.

Company Number: 09512457 Charity Number: 1162533

### Directors/Trustees

The subscribers/directors of the charitable company (the Charity) are its Trustees for the purposes of charitable law and throughout this report are collectively referred to as the Trustees. The Trustees serving during the year and since the year end were as follows:

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### Trustees

**Howard Covington**  
Chair

**Stephen Jarvis**  
Appointed  
10 September 2018

**Frank Kelly**  
Appointed  
7 September 2017

**Richard Kenway**

**Julie Maxton**

**Thomas Melham**

**Wendy Tan-White**

**Pam Thomas**  
(resigned  
3 September 2018)

**Neil Viner**

**Patrick Wolfe**

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### Key management

as at 31 March 2019

**Adrian Smith**  
Institute Director

**Jonathan Atkins**  
Chief Operating Officer

**Donna Brown**  
Director of Academic  
Engagement

**Allaine Cerwonka**  
Director of  
Academic Research

**Christine Foster**  
Managing Director  
for Innovation

**Nicolas Guernion**  
Director of Partnerships

**James Hetherington**  
Director of Research  
Engineering

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### Programme Directors

as at 31 March 2019

**Mark Birkin**

**Mark Briers**

**Mark Girolami**

**Chris Holmes**

**Anthony Lee**

**Helen Margetts**

**Jonathan Rowe**

**Lukasz Spruch**

**Adrian Weller**

**Alan Wilson**

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### Registered Office

The British Library  
96 Euston Road,  
London, NW1 2DB

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### Auditors

Kingston Smith LLP  
Chartered Accountants  
Devonshire House,  
60 Goswell Road, London,  
EC1M 7AD

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### Bankers

Barclays Bank UK PLC  
Leicester,  
Leicestershire, LE87 2BB

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### Solicitors

Bates Wells Braithwaite  
10 Queen Street, Place,  
London, EC4R 1BE

Veale Wasbrough Vizards  
24 King Willian Street,  
London, EC4R 9AT

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## Structure, governance and management

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### Our legal structure

The Alan Turing Institute was founded in March 2015 as a registered charity (1162533) and company limited by guarantee (09512457).

The Institute is governed by its Articles of Association that were adopted on incorporation on 26 March 2015. The Articles of Association establish the governance of the Institute as the responsibility of the Board of Trustees who are Directors of the company and are its Trustees for the purposes of charitable law.

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### Purpose of the charity and main activities

As the national institute for data science and artificial intelligence, the charitable object of the Institute, as set out in its Articles of Association, is the furtherance of education for the public benefit particularly through research, knowledge exchange, and public engagement, in the fields of data sciences. In 2017, as a result of a government recommendation, the Institute added artificial intelligence to its remit. The Institute has power to do anything which is calculated to further its object or is conducive and instrumental in doing so. In particular, the Institute's ambitions are to:

- produce world-class research in the foundations of data science and artificial intelligence
- have a transformative impact on the way that data and algorithms are used in the economy, in government, and in society
- educate and train data scientists

The Trustees confirm that they have paid due regard to the Public Benefit Guidance published by the Charity Commission, including the guidance Public benefit: running a charity (PB2), in shaping their aims and objectives for the year and in planning their future activities.

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### Related parties

The Institute's Founder Members are the Engineering and Physical Sciences Research Council (EPSRC) and the Universities of Cambridge, Edinburgh, Oxford, University College London (UCL), and Warwick. The Founder Members have entered into a joint venture agreement which establishes the basis on which funding will be made available to the Institute.

On 1 April 2018, the Institute entered into 5-year partnership agreements with eight additional universities: Birmingham, Bristol, Exeter, Leeds, Manchester, Newcastle, Queen Mary University of London and Southampton.

The Institute has a wholly owned subsidiary, Turing Innovations Limited (company registration number 10015591) which exists to manage trading activity. Any surplus funds generated by this subsidiary will be transferred to the Institute as Gift Aid.

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## Structure, governance and management

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### Board composition and responsibilities

The Institute is governed by its Board of Trustees whose members are also its Directors. The Board of Trustees has been established in accordance with the terms of the Joint Venture Agreement between the six Founder Members (Founder), dated 31 March 2015.

The Board composition is determined as follows:

- each Founder may appoint one Trustee
- Founders may, by a unanimous decision, select and appoint an Independent Trustee who acts as Chair of the Board and may from time to time remove and replace such Independent Trustee by a unanimous decision of the Founders
- the appointed Trustees may appoint further Independent Trustees such that, so far as possible, the total number of Trustees on the Board at any particular time will be an odd number
- the Trustees appointed by the Founders must always form a majority of the Board and may from time to time remove and replace independent Trustees

Biographies of all Trustees are available at [turing.ac.uk/people/governance](https://www.turing.ac.uk/people/governance)

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### Organisational management and responsibilities of the Board

The Institute has a clear organisation structure with documented lines of responsibility and authority.

The Institute's Board of Trustees is responsible for setting the aims and strategic direction of the Institute. Trustees set the Institute's strategy, establish funding policies, monitor risks, approve the annual budget and expenditure targets, and monitor actual and forecast financial results.

The Trustees also develop and agree the overall strategy and policies related to research, knowledge and public engagement, in the fields of data science and artificial intelligence.

Trustees meet formally as a Board with the senior management team up to six times a year. In addition, Trustees attend at least one away day and undertake further meetings as and when needed. The senior management team also provides Trustees with regular reports on the Institute's financial position, current activity, organisational news or significant issues affecting the Institute.

Sir Adrian Smith was appointed as Institute Director and Chief Executive in early 2018 and formally joined on 17 September 2018. Adrian took over from Sir Alan Wilson who served as interim CEO from October 2016.

The senior management team, led by the Institute Director, is responsible for the day-to-day management of the Institute's operations and activities. The Institute Director is responsible for appointing senior managers. The senior management team is also responsible for implementing the strategy and policies agreed with Trustees and reporting on its performance to the Board.

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### Committees

The Institute is supported by a range of committees, whose members include Trustees, the Institute Director, representatives from the Founder Members, Programme Directors and other individuals with appropriate expertise.

The following committees report directly to the Board of Trustees:

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#### Audit Committee

This committee is a delegated body of the Board of Trustees, responsible for audit, finance and risk management. This committee reviews the effectiveness of the Institute's internal control framework and risk management process and compliance with reporting requirements.

It monitors the terms of appointment and the work of the external auditors and receives and reviews audit reports. It monitors the full external audit process and resulting financial statements, including overseeing the terms of appointment of the external auditors.

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## Structure, governance and management

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### Nomination Committee

This committee is responsible for all aspects of the appointment of new non-Founder Trustees to the Board of Trustees. It also has responsibility for monitoring boardroom diversity and makes recommendations on appointments within the Audit and Remuneration Committees in consultation with the chairs of those committees.

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### Remuneration Committee

This committee advises the Board of Trustees and oversees the preparation of policies and procedures in respect of salaries, emoluments, and conditions of service. In line with these approved policies and procedures, the committee approves the total remuneration package for the Chair of the Institute, the Institute Director and those senior staff reporting directly to the Institute Director. The criterion for setting pay is the market rate taking into account industry standards.

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### Research and Innovation Advisory Committee

As defined by the joint venture agreement, this committee supports the Institute Director in the preparation of the Institute's scientific and innovation strategy. It supports the Institute with research and training programmes and reports appropriately to the Institute's stakeholders.

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### Scientific Advisory Board

This is an independent group made up of international experts in academia, industry and government. This group provides strategic advice to the Institute's Board of Trustees and executive team on its scientific research programme.

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### Strategic Partners' Board

This group advises the Board of Trustees on the content and translation of research generated at the Institute and collaborates across the Institute and its partners to identify new opportunities.

The Trustees will set up other committees, as necessary, to provide assistance to the Board.

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### University Partners' Board

This group advises the Institute Director on the research direction of the Institute, the Institute's relationship with its university partners and the higher education landscape as it relates to data science and AI.

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### Recruitment and appointment of Trustees

The Nominations Committee undertakes an open recruitment process, recommends new candidates for appointment when necessary, and ensures appropriate recruitment and succession plans are in place for non-Founder appointed Trustees.

On appointment, each Trustee completes a declaration of interests form which is held within a register of interests which is monitored and updated on a regular basis and reviewed annually. Their related party transactions are disclosed in greater detail in note 23 to the financial statements later in this report. All conflicts are actively managed through early identification of potential areas of conflict and appropriate action taken where necessary.

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### Trustee induction and training

There is a tailored induction programme for new Trustees that includes a programme of meetings with the Executive Team and other Trustees. New Trustees are provided with a Trustee Information Pack which includes initial information about the Institute and its work, a copy of the previous year's Annual Report and Accounts, a copy of the Institute's Articles of Association, a copy of the joint venture agreement, information about their powers as Trustees of the Institute and a copy of the Charity Commission's guidance, The essential trustee: what you need to know, what you need to do. Additionally, Trustees are invited to and encouraged to attend short training sessions to familiarise themselves with their duties as Trustees of the Institute.

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## Structure, governance and management

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### Equality and diversity

It is the Institute's policy to provide equal opportunities to job applicants and employees. The Institute recognises that everyone should be treated with respect and dignity and that a working environment must be provided which is free of any form of discrimination, harassment, bullying or victimisation. In addition, the Institute's site at the British Library provides access arrangements in order to allow unrestricted employment of individuals who have special access needs. The Institute is committed to the effective implementation of this policy and will not condone any form of discrimination, whether engaged by employees or by third parties who interact with the organisation.

The Institute has established an Equality, Diversity and Inclusion Working Group to drive its work in this area.

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### Financial review

The Institute is funded through grants from its Founder Members, university partners and from strategic and other partnerships. Income of £39.4m has been received during the year. Expenditure of £30.1m has been incurred in the year. Surplus of £9.3m has been transferred to reserves and will be used to fund research and Institute costs during 2019/20 and beyond.

The Institute is now in its fourth year of operations. Two full years of research have been completed and the Institute is halfway through its third year. Research challenges have been identified and Programme Directors are in place.

Eight new universities joined the Institute in 2018, which has increased the number of researchers and programmes and are now contributing to the Institute's continued success.

During the year, the Institute successfully bid for and was awarded two large grants totalling £48.8m over 5 years from UK Research and Innovation's (UKRI) Strategic Priorities Fund.

The Institute was also awarded an initial £8.5m for Turing AI Fellowships as part of the Government's Autumn 2018 Budget statement.

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### Fundraising

The charity does not engage in fundraising activities with the general public and no donations are sought from the public. Costs of raising funds in the financial statements relate to sourcing of new institutional funders.

The Institute does not use third parties to assist with fundraising and the charity received no complaints in this year regarding its fundraising practices.

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### Grant-making policy

The Institute's grants will be subject to outputs being appropriately recorded and assessed. Data held will be in line with the grant guideline requirements issued by UK Research and Innovation.

Fundamental principles have been established and adopted by the Institute. These are as follows:

- the Institute will award grants that are in line with the charitable object of the organisation
- the Institute intends to assess grants bi-annually to ensure compliance with the terms of the grant
- the Institute expects to assess the progress of each grant within three months of the end of the grant period

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### Investment policy

The investment policy is, at this stage, confined to the management of short-term liquid funds. The investment principle is to achieve the secure investment of excess cash resources of a short-term nature.

Assets are protected by investing with approved counterparties. Investments are risk-averse and non-speculative, and the Institute places no income reliance on interest earned.

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## Structure, governance and management

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### Reserves policy

The Institute reviews its reserves policy each year, taking account of its planned activities and the financial requirements for the forthcoming period. The Trustees believe that the charity should have access to reserves appropriate to the scale, complexity and risk profile of the Institute.

To cover any shortfall in grants and to maintain the financial viability of the Institute, reserves are currently set at the equivalent of 3 to 6 months of operating costs.

In 2015, the Engineering and Physical Research Council awarded a grant of £42m to the Institute to carry out its charitable objectives. This grant was split between operating resource of £22m and capital of £20m. The full value of the operating resource grant has been received by 31 March 2019. The remaining capital grant expires on 31 March 2022.

The Institute's unrestricted General Fund as at 31 March 2019 was £17.3m. This includes £11.3m of funding held to cover future years' financial commitments, £2m of funds designated by the Board for the Institute's Safe and Ethical AI programme, with the balance, £4m, being in line with the above reserves policy.

As at 31 March 2019, the Institute holds £5.6m of restricted reserves. This is after allowance has been made for future years' commitment under current researcher grant awards amounting to £4.4m.

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### Remuneration policy

The Institute is committed to ensuring a proper balance between paying staff (and others who work for the Institute) fairly to attract and retain the best people for the job with the careful financial management of our charity funds. The Remuneration Committee oversees the overall remuneration of staff and specifically key management. The Remuneration Committee assumes the responsibilities of remuneration within the Institute.

Formal consideration of remuneration matters takes place annually, usually at the Committee's March/April meeting, however, they may also be considered at other meetings if ad hoc issues arise during the year. The Committee does not have full delegated authority to approve all matters relating to remuneration and any recommendation or decision must be ratified by the Board of Trustees. The Institute discloses all payments to Trustees and the number of staff with a total remuneration of £60,000 and above in accordance with the Charity Commission's Statement of Recommended Practice 2015 (SORP).

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### Risk management

Significant risks to which the Institute and Turing Innovations Limited are exposed to are reported formally to the Audit Committee, the Board of Trustees and the Board of Directors of Turing Innovations Limited via the Institute's risk register. The Institute has a formal attitude to risk management with a framework embedded within the business that supports the identification and effective management of risk across the Institute. The senior management team is responsible for managing and reporting risk in accordance with the Institute's risk management policy and standards while the Trustees have the ultimate risk responsibility.

Examples of risks that the Institute currently faces include:

- The continued economic instability and political change (including Brexit) impacting the funding of research and access to talent by the Institute and its university partners
- A breach of data security, malicious or otherwise
- Inadequate resources available to fulfil its national role
- Inability to meet the expectations of its increased number of funding partners
- Inability to demonstrate real-world impact against its emerging research challenges

The Board of Trustees and the Board of Directors of Turing Innovations Limited seek to ensure that these risks are mitigated, so far as is reasonably possible, by actions taken by the Institute's senior management team.

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## Structure, governance and management

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### This mitigation includes:

- Prudent financial management of the Institute such that it can react to changes in external funding in an agile, controlled manner
- Working with funding bodies and Government to secure longer-term funding
- Implementing robust security processes, both physical and virtual
- Building a network of delivery partners to increase the Institute's capacity for engaging with industry and delivering translational impact
- Appointing an international Scientific Advisory Board and creating a University Partner Board that will provide feedback enabling our impact to be monitored and subsequent direction of travel to be amended if necessary

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### Trustees' responsibilities statement

The Trustees are responsible for preparing the Trustees' annual report and the financial statements in accordance with applicable law and regulations.

Company law requires the Trustees to prepare financial statements for each financial year. Under that law, the Trustees have elected to prepare the financial statements in accordance with United Kingdom Accounting Standards (United Kingdom Generally Accepted Accounting Practice, GAAP) including FRS 102 – The Financial Reporting Standard Applicable in the UK and Ireland. Under company law, the Trustees must not approve the financial statements unless they are satisfied that they give a true and fair view of the state of affairs of the charity and the result for that year. In preparing these financial statements, the Trustees are required to:

- select suitable accounting policies and then apply them consistently
- comply with applicable accounting standards, including FRS 102, subject to any material departures disclosed and explained in the financial statements
- state whether a Statement of Recommended Practice (SORP) applies and has been followed, subject to any material departures which are explained in the financial statements
- make judgements and estimates that are reasonable and prudent
- prepare the financial statements on a going concern basis unless it is inappropriate to presume that the charitable company will continue in business

The Trustees are responsible for keeping adequate accounting records that are sufficient to show and explain the Institute's transactions, disclose with reasonable accuracy at any time the financial position of the Institute and enable them to ensure that the financial statements comply with the Companies Act 2006. They are also responsible for safeguarding the assets of the Institute and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities. Trustees are responsible for the maintenance and integrity of the corporate and financial information included on the Institute's website.

Legislation in the UK governing the preparation and dissemination of financial statements may differ from legislation in other jurisdictions.

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## Structure, governance and management

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### Disclosure of information to the auditor

The Trustees who held office at the date of approval of this Trustees' annual report confirm that, so far as they are each aware, there is no relevant audit information of which the Institute's auditor is unaware.

Each Trustee has taken all the steps that they ought to have taken as a Trustee to make themselves aware of any relevant information and to establish that the Institute's auditor is aware of that information.

Kingston Smith were re-appointed as auditors by the Board of Trustees in June 2017 for a three-year term.

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### Signatory

The Trustees' annual report is approved by the Trustees of the charity. The strategic report, which forms part of the annual report, is approved by the Trustees in their capacity as directors in company law of the charity.



**Howard Covington**

Chair

19 June 2019

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**Part 3**  
Financial statements

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**Independent auditor's report to the  
members of The Alan Turing Institute**

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**Opinion**

We have audited the financial statements of The Alan Turing Institute for the year ended 31 March 2019 which comprise the Group Statement of Financial Activities, the Group Summary Income and Expenditure Account, the Group and Parent Charitable Company Balance Sheets, the Group Cash Flow Statement and notes to the financial statements, including a summary of significant accounting policies. The financial reporting framework that has been applied in their preparation is applicable law and United Kingdom Accounting Standards, including Financial Reporting Standard 102 The Financial Reporting Standard applicable in the UK and Republic of Ireland (United Kingdom Generally Accepted Accounting Practice).

In our opinion the financial statements:

- give a true and fair view of the state of the group's and the parent charitable company's affairs as at 31 March 2019 and of the group's incoming resources and application of resources, including its income and expenditure, for the year then ended;
- have been properly prepared in accordance with United Kingdom Generally Accepted Accounting Practice; and
- have been properly prepared in accordance with the requirements of the Companies Act 2006

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**Basis for opinion**

We conducted our audit in accordance with International Standards on Auditing (UK) (ISAs(UK)) and applicable law. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the audit of financial statements section of our report. We are independent of the charitable company in accordance with the ethical requirements that are relevant to our audit of the financial statements in the UK, including the FRC's Ethical Standard, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

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**Conclusions relating to going concern**

We have nothing to report in respect of the following matters in relation to which the ISAs (UK) require us to report to you where

- the trustees' use of the going concern basis of accounting in the preparation of the financial statements is not appropriate; or
- the trustees have not disclosed in the financial statements any identified material uncertainties that may cast significant doubt about the group's and parent charitable company's ability to continue to adopt the going concern basis of accounting for a period of at least twelve months from the date when the financial statements are authorised for issue

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**Independent auditor's report to the  
members of The Alan Turing Institute**

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**Other information**

The other information comprises the information included in the annual report, other than the financial statements and our auditor's report thereon. The trustees are responsible for the other information. Our opinion on the financial statements does not cover the other information and, except to the extent otherwise explicitly stated in our report, we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial statements, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or our knowledge obtained in the audit or otherwise appears to be materially misstated. If we identify such material inconsistencies or apparent material misstatements, we are required to determine whether there is a material misstatement in the financial statements or a material misstatement of the other information. If, based on the work we have performed, we conclude that there is a material misstatement of this other information, we are required to report that fact.

We have nothing to report in this regard.

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**Opinions on other matters prescribed  
by the Companies Act 2006**

In our opinion, based on the work undertaken in the course of the audit:

- the information given in the strategic report and the trustees' annual report for the financial year for which the financial statements are prepared is consistent with the financial statements; and
- the strategic report and the trustees' annual report have been prepared in accordance with applicable legal requirements

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**Matters on which we are required to report by  
exception**

In the light of the knowledge and understanding of the group and parent charitable company and its environment obtained in the course of the audit, we have not identified material misstatements in the trustees' annual report.

We have nothing to report in respect of the following matters where the Companies Act 2006 requires us to report to you if, in our opinion:

- the parent charitable company has not kept adequate and sufficient accounting records, or returns adequate for our audit have not been received from branches not visited by us; or
- the parent charitable company's financial statements are not in agreement with the accounting records and returns; or
- certain disclosures of trustees' remuneration specified by law are not made; or
- we have not received all the information and explanations we require for our audit

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**Independent auditor's report to the members of The Alan Turing Institute**

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**Responsibilities of trustees**

As explained more fully in the trustees' responsibilities statement set out on page 82, the trustees (who are also the directors of the charitable company for the purposes of company law) are responsible for the preparation of the financial statements and for being satisfied that they give a true and fair view, and for such internal control as the trustees determine is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the trustees are responsible for assessing the group and parent charitable company's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the trustees either intend to liquidate the group or parent charitable company or to cease operations, or have no realistic alternative but to do so.

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**Auditor's responsibilities for the audit of the financial statements**

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs (UK) will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with ISAs (UK) we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purposes of expressing an opinion on the effectiveness of the group and parent charitable company's internal control

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**Independent auditor's report to the members of The Alan Turing Institute**

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**Auditor's responsibilities for the audit of the financial statements** (continued)

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the trustees
- Conclude on the appropriateness of the trustees' use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the group and parent charitable company's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the group or parent charitable company to cease to continue as a going concern
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the group to express an opinion on the consolidated financial statements. We are responsible for the direction, supervision and performance of the group audit. We remain solely responsible for our audit report

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

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**Use of our report**

This report is made solely to the charitable company's members, as a body, in accordance with Chapter 3 of Part 16 of the Companies Act 2006. Our audit work has been undertaken so that we might state to the charitable company's members those matters which we are required to state to them in an auditor's report and for no other purpose. To the fullest extent permitted by law, we do not accept or assume responsibility to any party other than the charitable company and charitable company's members as a body, for our audit work, for this report, or for the opinions we have formed.



**Shivani Kothari**  
Senior Statutory Auditor

For and on behalf of:  
Kingston Smith LLP  
Statutory Auditor  
27 June 2019

Devonshire House  
60 Goswell Road  
London  
EC1M 7AD

**Consolidated Statement  
of Financial Activities**

Incorporating an income and expenditure  
account. For the year ended 31 March 2019.

	Note	2019 General Funds £	2019 Restricted Funds £	2019 Total Funds £	Restated 2018 Total Funds £
<b>Income and endowments</b>					
Donations	2	-	-	-	58,361
Other trading activities		-	2,187,187	2,187,187	1,325,445
Investment income					
Gross interest		24,083	-	24,083	7,345
Charitable activities					
Grant income	3	17,281,954	19,905,649	37,187,603	17,194,591
<b>Total Income</b>		<b>17,306,037</b>	<b>22,092,836</b>	<b>39,398,873</b>	<b>18,585,742</b>
<b>Expenditure</b>					
Raising funds	4	934,000	-	934,000	522,537
Charitable activities					
Education and research	5	1,243,822	27,888,902	29,132,724	11,979,497
<b>Total Expenditure</b>		<b>2,177,822</b>	<b>27,888,902</b>	<b>30,066,724</b>	<b>12,502,034</b>

**Consolidated Statement  
of Financial Activities**

Incorporating an income and expenditure  
account. For the year ended 31 March 2019.

	<b>Note</b>	<b>2019 General Funds £</b>	<b>2019 Restricted Funds £</b>	<b>2019 Total Funds £</b>	<b>Restated 2018 Total Funds £</b>
Net income/(expenditure) for the year before transfers	8	15,128,215	(5,796,065)	9,332,149	6,083,708
Transfers between funds	19	(6,281,764)	6,281,764	-	-
<b>Net movement in funds</b>		<b>8,846,451</b>	<b>485,699</b>	<b>9,332,149</b>	<b>6,083,708</b>
Reconciliation of Funds Balance brought forward at 1st April 2018 (restated)		8,499,153	5,071,903	13,571,056	7,487,348
<b>Balance carried forward at 31st March 2019</b>	20	17,345,604	5,557,601	22,903,205	13,571,056

**Balance sheet — Group and charity**

At 31 March 2019.

	Note	Group 2019 £	Restated Group 2018 £	Charity 2019 £	Restated Charity 2018 £
<b>Fixed Assets</b>					
Tangible assets	13	2,166,850	2,155,047	2,111,243	2,074,727
Intangible assets	14	37,822	54,633	-	-
Investments	15	-	-	1	1
		<b>2,204,672</b>	<b>2,209,680</b>	<b>2,111,244</b>	<b>2,074,728</b>
<b>Current Assets</b>					
Debtors	16	9,747,251	4,481,283	8,240,719	3,745,103
Cash at bank and in hand		32,649,679	16,462,211	32,622,920	16,356,355
		<b>42,396,930</b>	<b>20,943,494</b>	<b>40,863,640</b>	<b>20,101,458</b>
<b>Creditors</b>					
Amounts falling due within one year	17	(16,261,178)	(4,734,762)	(15,067,244)	(4,263,637)
<b>Net Current Assets</b>		<b>26,135,752</b>	<b>16,208,732</b>	<b>25,796,396</b>	<b>15,837,821</b>

**Balance sheet — Group and charity**

At 31 March 2019.

	Note	Group 2019 £	Restated Group 2018 £	Charity 2019 £	Restated Charity 2018 £
<b>Creditors</b>					
Amounts falling due in more than one year	18	(5,437,219)	(4,847,356)	(5,437,219)	(4,847,356)
<b>Net Assets</b>		<b>22,903,205</b>	<b>13,571,056</b>	<b>22,470,421</b>	<b>13,065,193</b>
<b>Funds</b>					
Restricted funds	20	5,557,601	5,071,903	5,557,601	4,566,040
Unrestricted funds					
Designated funds	19	2,000,000	-	2,000,000	-
General funds	19	15,345,604	8,499,153	14,912,820	8,499,153
<b>Total Funds</b>		<b>22,903,205</b>	<b>13,571,056</b>	<b>22,470,421</b>	<b>13,065,193</b>

The financial statements of The Alan Turing Institute were approved and authorised for issue by the Board of Trustees on 19 June 2019 and signed on its behalf by:


**Howard Covington**

Chair

**The Alan Turing Institute**

Company number - 09512457

The notes on pages 94 to 127 form part of these financial statements.

## Consolidated Statement of Cash Flows

For the year ended 31 March 2019.

	2019 £	Restated 2018 £
<b>Cash flows from operating activities</b>		
Net income for the year	9,332,149	6,083,708
Adjustments for:		
Depreciation of tangible fixed assets	957,312	708,093
Amortisation of intangible fixed assets	16,811	12,608
Interest received	(24,083)	(7,345)
Loss on disposal of tangible fixed assets	1,318	-
Increase in debtors	(5,265,968)	(3,725,662)
Increase in creditors	12,116,279	214,981
<b>Net cash generated by operating activities</b>	<b>17,133,818</b>	<b>3,286,383</b>

	2019 £	Restated 2018 £
<b>Cash flows from investing activities</b>		
Purchase of tangible fixed assets	(970,433)	(933,479)
Interest received	24,083	7,345
<b>Net cash from investing activities</b>	<b>(946,350)</b>	<b>(926,134)</b>
Change in cash and cash equivalents in the period	16,187,468	2,360,249
Cash and cash equivalents at beginning of period	16,462,211	14,101,962
<b>Cash and cash equivalents at end of the period</b>	<b>32,649,679</b>	<b>16,462,211</b>

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**Notes to the financial statements**

For the year ended 31 March 2019.

1.

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**Accounting Policies**

A summary of the principal accounting policies adopted, judgements and key sources of estimation uncertainty, is set out below.

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**Basis of Preparation**

The financial statements have been prepared in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102). The Charitable Company and its subsidiary is a public benefit group for the purposes of FRS 102 and therefore the Charity also prepared its financial statements in accordance with the Statement of Recommended Practice applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (The FRS 102 Charities SORP), the Companies Act 2006 under the provision of the Large and Medium-sized Companies and Groups (Accounts and Reports) Regulations 2008 (SI 2008/410) and the Charities Act 2011.

The financial statements are prepared in sterling, which is the functional currency of the charity. Monetary amounts in these financial statements are rounded to the nearest pound.

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**Going Concern**

The trustees have assessed whether the use of going concern basis is appropriate and have considered possible events or conditions that might cast significant doubt on the ability of the charitable company to continue as a going concern. The trustees have made this assessment for a period of at least one year from the date of the approval of these financial statements. In particular, the trustees have considered the charitable company's forecasts and projections and have taken account of pressures on income. After making enquiries, the trustees have concluded that there is a reasonable expectation that the charitable company has adequate resources to continue in operational existence for the foreseeable future. The charitable company therefore continues to adopt the going concern basis in preparing its financial statements.

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**Group Financial Statements**

These financial statements consolidate the results of the Charity and Turing Innovations Limited, its wholly owned trading subsidiary on a line by line basis. A separate Statement of Financial Activities and Income and Expenditure Account are not presented for the Charity itself as the Charity has taken advantage of the exemptions afforded by section 408 of the Companies Act 2006. The net income of the charity was £9,405,229 (2018: £6,786,787).

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**Notes to the financial statements**

For the year ended 31 March 2019.

1.

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**Income**

All income is recognised when there is entitlement to the funds, the receipt is probable and the amount can be measured reliably.

Donations and grants, including grants in respect of major items of refurbishment, improvements or the purchase of fixed assets are recognised in the Statement of Financial Activities when receivable. Where income is received in advance of meeting any performance-related conditions there is not unconditional entitlement to the income and its recognition is deferred and included in creditors as deferred income until the performance-related conditions are met.

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**Cost of Raising Funds**

The cost of raising funds consists of the direct costs of raising funds and an apportionment of overhead, support and governance costs.

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**Cost of Charitable Activities**

Costs of charitable activities include costs directly associated with research activities and an apportionment of overhead, support and governance costs.

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**Gifts In Kind**

Where goods are provided to the charity as a donation that would normally be purchased from suppliers this contribution is included in the financial statements as an estimate based on the value of the contribution to the charity.

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**Expenditure**

Expenditure is included in the Statement of Financial Activities on a accruals basis, inclusive of any VAT which cannot be recovered. Expenditure is recognised once there is a legal or constructive obligation to transfer economic benefit to a third party, it is probable that a transfer of economic benefits will be required in settlement and the amount of the obligation can be measured reliably.

Grants payable are payments made to third parties in the furtherance of the charitable objects of the Charity. Unconditional grant offers are accrued once the recipient has been notified of the grant award and its payment is probable. Grant awards that are subject to the recipient fulfilling performance or other conditions are accrued when the recipient has been notified of the grant and either the performance condition is met or any remaining unfulfilled condition attaching to the grant is outside of the control of the Charity.

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**Tangible Fixed Assets and Depreciation**

Depreciation of tangible fixed assets is calculated to write off their cost or valuation less any residual value over their estimated useful lives as follows:

Leasehold Land and Buildings:	Term of lease
Fixtures, fittings and fittings:	5 years
IT Equipment:	3 to 5 years

Tangible fixed assets costing more than £1,000 are capitalised.

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**Notes to the financial statements**

For the year ended 31 March 2019.

# 1.

## 1.(i)

Useful Economic Lives: The annual depreciation charge for property, plant and equipment is sensitive to change in the estimated useful economic lives and residual value of assets. These are reassessed annually and amended where necessary to reflect current circumstances.

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**Intangible Fixed Assets and Amortisation**

Amortisation of intangible fixed assets is calculated to write off their cost or valuation less any residual value over their estimated useful lives as follows:

Software	3-5 years
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Intangible fixed assets costing more than £1,000 are capitalised.

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**Fund Accounting**

General unrestricted funds are those available for use at the discretion of the trustees in furtherance of the general objectives of the charity and which have not been designated for other purposes.

Restricted funds are funds which are to be used in accordance with specific restrictions imposed by donors or which have been raised by the charity for particular purposes.

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**Cash and Cash Equivalents**

Cash and cash equivalents include cash in hand, deposits held at call with banks and other short-term liquid investments with original maturities of three months or less.

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**Financial Instruments**

Basic financial instruments are measured at amortised cost other than investments which are measured at fair value.

With the exceptions of prepayments and deferred income all other debtor and creditor balances are considered to be basic financial instruments under FRS 102. See notes 16, 17 and 18 for the debtor and creditor notes.

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**Employee Benefits**

The costs of short-term employee benefits are recognised as a liability and an expense.

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**Critical Accounting Estimates and Areas of Judgement**

In preparing financial statements, it is necessary to make certain judgements, estimates and assumptions that affect the amounts recognised in the financial statements. The following judgements and estimates are considered by the trustees to have most significant effect on amounts recognised in the financial statements.

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Donations**

	<b>2019</b>	<b>2019</b>	<b>2019</b>	<b>2018</b>
	<b>Unrestricted</b>	<b>Restricted</b>	<b>Total</b>	<b>Total</b>
	<b>£</b>	<b>£</b>	<b>£</b>	<b>£</b>
Other	-	-	-	58,361
	-	-	-	<b>58,361</b>

In 2018 £3,333 of donations received related to restricted funds.

**2.**

## Notes to the financial statements

For the year ended 31 March 2019.

# 3.

<b>Grants income</b>				
	<b>2019 Unrestricted £</b>	<b>2019 Restricted £</b>	<b>2019 Total £</b>	<b>2018 Total £</b>
<b>Research Councils</b>				
EPSRC	7,000,000	1,200,000	8,200,000	9,394,250
EPSRC - Strategic Priorities Fund	-	5,013,780	5,013,780	-
AHRC - Strategic Priorities Fund - Living with Machines	-	1,487,485	1,487,485	-
<b>University Partners</b>				
Founder University Partners	-	5,000,000	5,000,000	5,000,000
Other University Partners	8,000,000	-	8,000,000	-
<b>Strategic Research Partners</b>				
HSBC	-	6,826	6,826	1,000,000
Intel	-	516,076	516,076	585,276
Lloyd's Register Foundation	-	3,853,091	3,853,091	-
<b>Other research grants</b>				
	2,281,954	2,828,391	5,110,345	1,215,065
	<b>17,281,954</b>	<b>19,905,649</b>	<b>37,187,603</b>	<b>17,194,591</b>

In 2018 grants received totalling £11,021,826 related to restricted funds.

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Cost of raising funds**

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	<b>2019</b>	<b>2018</b>
	<b>Total</b>	<b>Total</b>
	<b>£</b>	<b>£</b>
Cost of raising funds	934,000	522,537
	<b>934,000</b>	<b>522,537</b>

**4.**

**Notes to the financial statements**  
For the year ended 31 March 2019.

**5.**

**Cost of charitable activities**

**2019**

	<b>Grants Payable (See below)</b>	<b>Other Direct Costs</b>	<b>Support Costs (Note 6)</b>	<b>Total</b>
	<b>£</b>	<b>£</b>	<b>£</b>	<b>£</b>
Research	16,994,804	7,054,021	4,653,721	28,702,546
Workshops and conferences	-	430,178	-	430,178
	<b>16,994,804</b>	<b>7,484,199</b>	<b>4,653,721</b>	<b>29,132,724</b>

**2018 Restated**

	<b>Grants Payable (See below)</b>	<b>Other Direct Costs</b>	<b>Support Costs (Note 6)</b>	<b>Total</b>
	<b>£</b>	<b>£</b>	<b>£</b>	<b>£</b>
Research	3,973,317	4,954,929	2,759,975	11,688,221
Workshops and conferences	-	291,276	-	291,276
	<b>3,973,317</b>	<b>5,246,205</b>	<b>2,759,975</b>	<b>11,979,497</b>

## Notes to the financial statements

For the year ended 31 March 2019.

# 5.

In accordance with FRS 102, these financial statements account for the full expected cost of research grants awarded by the Institute within each financial year. The contractual terms of these grants can include durations of up to 36 months in length.

## Analysis of grants payable

	2019 £	2018 £
<b>Analysis of institutions receiving grants</b>		
The British Library	350,000	-
Imperial College London	1,421,191	274,909
Queen Mary University London	624,948	-
Science and Technology Facilities Council	741,041	-
University College London	1,721,824	570,249
University of Birmingham	654,818	-
University of Cambridge	1,945,660	927,409
University of Edinburgh	1,165,485	728,993
University of Leeds	892,590	-
University of Manchester	372,786	-
University of Newcastle	367,927	-
University of Oxford	3,568,929	743,961
University of Southampton	255,504	-
University of Warwick	1,697,870	666,158
Other	1,214,231	61,638
	<b>16,994,804</b>	<b>3,973,317</b>

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**Notes to the financial statements**

For the year ended 31 March 2019.

**6.**

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**Support costs**

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	<b>2019</b>	<b>2018</b>
	<b>£</b>	<b>£</b>
Travel and subsistence	43,285	17,808
Office costs	73,571	16,842
Rent, rates and service charge	569,455	133,853
Repairs and maintenance	4,191	3,352
Subscriptions	89,514	18,080
Staff Costs	1,788,474	1,725,900
Staff training and hospitality	39,403	37,986
Recruitment	56,860	62,118
Telecommunications	19,563	9,989
Computer running costs	530,168	124,522
Legal fees	264,411	90,361
Other professional fees	155,417	191,566
Consultancy	172,041	19,285
Depreciation	758,445	99,523
Amortisation	16,811	12,608
Insurance	31,660	5,689
Marketing	42,084	59,381
Foreign exchange loss/(gain)	(42,543)	74,691
Sundry costs	7,344	11,020
Governance costs (see note 7)	33,570	45,401
	<b>4,653,721</b>	<b>2,759,975</b>

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Governance costs**

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	<b>2019</b>	<b>2018</b>
	<b>£</b>	<b>£</b>
Auditor's remuneration:		
Audit of the financial statements	14,315	16,742
Other services	4,705	16,227
Legal and professional fees	14,550	12,432
	<b>33,570</b>	<b>45,401</b>

**7.**

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Net income/(expenditure)**

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	<b>2019</b>	<b>2018</b>
	<b>£</b>	<b>£</b>
<hr/>		
<b>Net income is stated after charging:</b>		
<hr/>		
Depreciation	957,312	708,093
<hr/>		
Amortisation	16,811	12,608
<hr/>		
Operating lease rentals	859,909	686,918
<hr/>		
Auditor's remuneration		
Audit of the financial statements	14,315	16,742
Other services	4,705	16,227

**8.**

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**Notes to the financial statements**

For the year ended 31 March 2019.

**9.**

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**Staff costs**

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	<b>2019</b>	<b>2018</b>
	<b>£</b>	<b>£</b>
<hr/> <b>Staff expenses includes the following employee costs:</b> <hr/>		
Wages and salaries	4,767,732	3,147,132
Social security costs	537,579	339,773
Other staff costs		
Contractors	454,037	556,841
Secondments	830,345	489,865
Pension costs	429,789	215,508
	<b>7,019,482</b>	<b>4,749,119</b>

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Key management personnel include those involved in executive decision making and are listed in Part 2 of this report. The total employee benefits of the charity's key management personnel was £2,268,024 (2018: £1,254,224).

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Included in the above costs are termination payments to 0 individuals totalling £nil (2018: 5 individuals totalling £61,136).

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Staff costs (Continued)**

During the year the following  
number of employees received  
emoluments in excess of £60,000:

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	<b>2019</b>	<b>2018</b>
£60,000- £69,999	7	7
£70,000- £79,999	2	1
£80,000- £89,999	5	2
£90,000- £99,999	-	1
£110,000- £119,999	1	-
£140,000- £149,999	-	2
£150,000- £159,999	2	1
£180,000- £189,999	2	-

9.

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**Notes to the financial statements**

For the year ended 31 March 2019.

# 10.

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**Trustees' payments**

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Howard Covington received remuneration totalling £29,000 (2018: £18,000) during the year for the purpose of being Chairman of the Charity. No other trustee received any remuneration or emoluments.

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Three trustees received travelling and accommodation expenses during the period totalling £3,060 (2018: five trustees, £3,204).

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Employees**

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	<b>2019 Number</b>	<b>2018 Number</b>
<hr/>		
<b>The average number of employees by function were:</b>		
Executive	7	6
HR, Finance & Operations	17	10
Communications and Events	11	9
Research and Research support	57	30
Information Technology	5	4
Business partnerships	12	8
	<b>109</b>	<b>67</b>

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**Notes to the financial statements**

For the year ended 31 March 2019.

**12.**

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**Taxation**

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The charity is entitled to certain tax exemptions on income and profits from investments and surpluses on any trading activities carried on in furtherance of the charity's primary objectives.

**Notes to the financial statements**

For the year ended 31 March 2019.

**13.****Tangible fixed assets — Group**

	Leasehold Improvements £	Equipment and Machinery £	Total £
<b>Cost or valuation</b>			
At 1 April 2018	2,062,666	1,075,937	3,138,603
Additions	571,665	398,768	970,433
Disposal	(1,395)	-	(1,395)
<b>At 31 March 2019</b>	<b>2,632,936</b>	<b>1,474,705</b>	<b>4,107,641</b>
<b>Depreciation</b>			
At 1 April 2018	586,829	396,727	983,556
Charge for the year	534,788	422,524	957,312
Eliminated on disposal	(77)	-	(77)
<b>At 31 March 2019</b>	<b>1,121,540</b>	<b>819,251</b>	<b>1,940,791</b>
<b>Net Book Value</b>			
<b>At 31 March 2019</b>	<b>1,511,396</b>	<b>655,454</b>	<b>2,166,850</b>
<b>At 31 March 2018</b>	<b>1,475,837</b>	<b>679,210</b>	<b>2,155,047</b>

**Notes to the financial statements**

For the year ended 31 March 2019.

**13.****Tangible fixed assets — Charity**

	Leasehold Improvements £	Equipment and Machinery £	Total £
<b>Cost or valuation</b>			
At 1 April 2018	2,062,666	977,082	3,039,748
Additions	571,665	398,768	970,433
Disposal	(1,395)	-	(1,395)
<b>At 31 March 2019</b>	<b>2,632,936</b>	<b>1,375,850</b>	<b>4,008,786</b>
<b>Depreciation</b>			
At 1 April 2018	586,830	378,192	965,022
Charge for the year	534,788	397,810	932,598
Eliminated on disposal	(77)	-	(77)
<b>At 31 March 2019</b>	<b>1,121,541</b>	<b>776,002</b>	<b>1,897,543</b>
<b>Net Book Value</b>			
<b>At 31 March 2019</b>	<b>1,511,395</b>	<b>599,848</b>	<b>2,111,243</b>
<b>At 31 March 2018</b>	<b>1,475,836</b>	<b>598,890</b>	<b>2,074,726</b>

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Intangible fixed assets — Group**

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	<b>Software £</b>
<hr/>	
<b>Cost or valuation</b>	
<hr/>	
At 1 April 2018 and 31 March 2019	67,241
<hr/>	
<b>Amortisation</b>	
<hr/>	
At 1 April 2018	12,608
Charge for the year	16,811
<hr/>	
<b>At 31 March 2019</b>	<b>29,419</b>
<hr/>	
<b>Net Book Value</b>	
<hr/>	
<b>At 31 March 2019</b>	<b>37,822</b>
<hr/>	
<b>At 31 March 2018</b>	<b>54,633</b>

14.

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**Notes to the financial statements**

For the year ended 31 March 2019.

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**Investments in subsidiaries**

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	<b>Investment in Subsidiary £</b>
<hr/> <b>Cost</b>	
At 1 April 2018 and 31 March 2019	1

The investment represents 100% of the share capital of Turing Innovations Ltd, a company incorporated in England & Wales, company number 10015591. The following is an extract of its results for the year to 31 March 2019:

	<b>2019 £</b>
Income	2,187,187
Expenditure	(1,834,723)
<b>Net income</b>	<b>352,464</b>
Total assets	2,775,112
Total liabilities	(2,342,329)
<b>Net assets</b>	<b>432,783</b>

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**Notes to the financial statements**

For the year ended 31 March 2019.

**16.**

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**Debtors**

	<b>Group 2019 £</b>	<b>Group 2018 £</b>	<b>Charity 2019 £</b>	<b>Charity 2018 £</b>
Trade debtors	9,029,033	4,201,579	6,374,109	2,796,076
Tax and social security	-	-	289,828	-
Prepayments and accrued income	691,071	257,114	691,071	257,114
Intercompany	-	-	858,564	669,323
Other debtors	27,147	22,590	27,147	22,590
	<b>9,747,251</b>	<b>4,481,283</b>	<b>8,240,719</b>	<b>3,745,103</b>

Trade debtors above are measured  
at amortised cost.

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**Notes to the financial statements**

For the year ended 31 March 2019.

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**Creditors: amounts falling due within one year**

---

	<b>Group 2019 £</b>	<b>Restated Group 2018 £</b>	<b>Charity 2019 £</b>	<b>Restated Charity 2018 £</b>
Trade creditors	641,887	485,461	641,887	485,461
Taxation and social security	593,505	505,771	194,732	240,682
Grant creditors	12,791,130	2,032,353	12,791,130	2,032,353
Accruals and deferred income	2,162,953	1,695,602	1,367,792	1,489,566
Other creditors	71,703	15,575	71,703	15,575
	<b>16,261,178</b>	<b>4,734,762</b>	<b>15,067,244</b>	<b>4,263,637</b>

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Creditors: amounts falling due in more than one year**

---

<b>Group 2019 £</b>	<b>Restated Group 2018 £</b>	<b>Charity 2019 £</b>	<b>Restated Charity 2018 £</b>
5,437,219	4,847,356	5,437,219	4,847,356

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**Notes to the financial statements**  
For the year ended 31 March 2019.

19.

**Unrestricted funds**

	<b>At 01.04.18 £</b>	<b>Income £</b>	<b>Expenditure £</b>	<b>Transfers £</b>	<b>Balance 31.03.19 £</b>
General Fund	8,499,153	17,306,037	(2,177,822)	(8,714,548)	14,912,820
Designated funds					
Safe and ethical AI fund	-	-	-	2,000,000	2,000,000
<b>Charity Total</b>	<b>8,499,153</b>	<b>17,306,037</b>	<b>(2,177,822)</b>	<b>(6,714,548)</b>	<b>16,912,820</b>
Turing Innovations Limited	-	-	-	432,784	432,784
<b>Group Total</b>	<b>8,499,153</b>	<b>17,306,037</b>	<b>(2,177,822)</b>	<b>(6,281,764)</b>	<b>17,345,604</b>

2018/19 designated funds includes donations from Aphorism Foundation (£1m) and DeepMind Technologies Limited (£1m). Both donations are unrestricted, and the Institute intends to use them in support of its data science and AI research, in line with its charitable objectives. It is expected that these amounts will be spent within 5 years.

	<b>At 01.04.17 £</b>	<b>Income £</b>	<b>Expenditure £</b>	<b>Transfers £</b>	<b>Balance 31.03.18 £</b>
General Fund	5,404,264	6,235,138	(4,646,895)	1,406,646	8,399,153

**Notes to the financial statements**  
For the year ended 31 March 2019.

20.

		<b>Restricted funds</b>				
		<b>Restated At 01.04.18 £</b>	<b>Income £</b>	<b>Expenditure £</b>	<b>Transfers £</b>	<b>Balance 31.03.19 £</b>
a	EPSRC Capital fund	3,114,385	1,200,000	(450,593)	(859,909)	3,003,883
b	EPSRC - AI for Science, Government and Health fund	-	5,013,780	(4,139,021)	-	874,758
c	AHRC - Living with Machines fund	-	1,487,485	(1,153,579)	-	333,906
d	Lloyd's Register Foundation fund	321,697	3,853,091	(2,212,569)	-	1,962,219
e	HSBC fund	1,863,125	6,826	(357,392)	-	1,512,559
f	Intel Corporation fund	326,946	516,076	(182,841)	-	660,182
g	University partner research fund	(2,171,667)	5,000,000	(15,420,714)	8,000,000	(4,592,382)
h	Other research fund	1,111,554	2,828,391	(2,137,469)	-	1,802,476
	<b>Charity restricted</b>	<b>4,566,040</b>	<b>19,905,649</b>	<b>(26,054,179)</b>	<b>7,140,091</b>	<b>5,557,601</b>
i	Turing Innovations Limited- GCHQ - Defence and Security	505,863	2,187,187	(1,834,723)	(858,327)	-
	<b>Consolidated restricted total</b>	<b>5,071,903</b>	<b>22,092,836</b>	<b>(27,888,902)</b>	<b>6,281,764</b>	<b>5,557,601</b>

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**Notes to the financial statements**

For the year ended 31 March 2019.

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**Restricted funds (continued)**

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Restricted reserves are in line with the expectations of the Board and are reflective of the early stage of both the specific activities that they will fund and of the Institute itself.

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**a** The EPSRC capital fund was granted by the Engineering and Physical Sciences Research Council for the purposes of capital expenditure on Turing premises. The transfer to unrestricted funds has been authorised by the funder to cover office rent costs.

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**b** The EPSRC AI and Data Science for Science, Engineering, Health and Government was awarded from UKRI's wave 1 Strategic Priorities Fund to develop technologies of AI that underpin various economic sectors.

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**c** The AHRC Living with Machines fund was awarded from UKRI's wave 1 Strategic Priorities Fund to devise new methods of applying data science and AI to historical resources.

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**d** The Lloyds Register Foundation fund will finance a research programme that supports data-centric engineering.

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**e** The HSBC fund will finance a research programme that supports collaboration in finance and economics.

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**f** The Intel Corporation fund will finance data science and its application.

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**Notes to the financial statements**

For the year ended 31 March 2019.

**20.**

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**Restricted funds (continued)**

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**g** The university partner research fund is the unspent amount received from the Charity's university partners to fund future research activity.

The fund is currently in deficit by £4,592,382. This has arisen due to a timing difference, with multiyear expenditure grants for research fully accrued in the current and prior year but income to fund these due to be recognised in future years. The fund is expected to return to a positive balance in 2019/20 thanks to future committed income. Accordingly no transfer has been made in the 2018/19 financial statements to set the restricted fund balance to £nil.

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**h** Other research fund represents various research grants from charities, business and government departments to fund specific research collaborations.

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**i** The defence and security fund will finance the Institute's data-driven defence and security programme.

**Notes to the financial statements**

For the year ended 31 March 2019.

**Restricted funds (continued)**

	<b>At 01.04.17 £</b>	<b>Income £</b>	<b>Restated Expenditure £</b>	<b>Transfers £</b>	<b>Restated Balance 31.03.18 £</b>
a EPSRC Capital fund	829,454	3,394,250	(419,319)	(690,000)	3,114,385
d Lloyd's Register Foundation fund	887,084	-	(446,905)	(118,482)	321,697
e HSBC fund	985,595	1,000,000	(112,188)	(10,282)	1,863,125
f Intel Corporation fund	116,541	585,276	(312,171)	(62,700)	326,946
g Founder university partner research fund	(1,240,697)	5,003,333	(5,984,771)	50,468	(2,171,667)
h Other research fund	250,000	1,042,300	(342,606)	161,860	1,111,554
<b>Charity restricted</b>	<b>1,827,977</b>	<b>11,025,159</b>	<b>(7,617,960)</b>	<b>(669,136)</b>	<b>4,566,040</b>
i Turing Innovations Limited- GCHQ - Defence and Security	155,107	1,325,445	(237,179)	(737,510)	505,863
<b>Consolidated restricted total</b>	<b>1,983,084</b>	<b>12,350,604</b>	<b>(7,855,139)</b>	<b>(1,406,646)</b>	<b>5,071,903</b>

**20.**

**Notes to the financial statements**

For the year ended 31 March 2019.

**21.****Analysis of net group assets between funds**

	<b>Unrestricted £</b>	<b>Restricted £</b>	<b>Total £</b>
<b>At 31 March 2019</b>			
Tangible fixed assets	2,097,368	69,482	2,166,850
Intangible fixed assets	-	37,822	37,822
Net current assets	15,248,236	10,887,516	26,135,752
Long term creditors	-	(5,437,219)	(5,437,219)
	<b>17,345,604</b>	<b>5,557,601</b>	<b>22,903,205</b>
<b>At 31 March 2018 (restated)</b>			
Tangible fixed assets	1,956,281	198,766	2,155,047
Intangible fixed assets	-	54,633	54,633
Net current assets	6,542,872	9,665,860	16,208,732
Long term creditors	-	(4,847,356)	(4,847,356)
	<b>8,499,153</b>	<b>5,071,903</b>	<b>13,571,056</b>

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**Notes to the financial statements**  
For the year ended 31 March 2019.

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**Financial commitments**

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The charitable company was committed to making the following total payments under non-cancellable operating leases as at 31 March 2019:

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	<b>2019</b>	<b>2018</b>
	<b>£</b>	<b>£</b>
<b>Payments due:</b>		
Within one year	940,777	689,617
Between 2 and 5 years	1,661,400	1,609,106
	<b>2,602,177</b>	<b>2,298,723</b>

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**22.**

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**Notes to the financial statements**

For the year ended 31 March 2019.

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**Related parties**

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During the year the following transactions were undertaken with the members of the charity. Other than the amounts noted below, no amounts were due or payable at the period end.

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**Current year to 31/03/2019**

	<b>Grant expenditure awarded £</b>	<b>Grant income received £</b>	<b>Re-charged expenditure £</b>	<b>Period end Debtor/(creditor) £</b>
Engineering and Physical Sciences Research Council	-	13,213,780	-	-
University of Cambridge	1,945,660	1,000,000	87,198	(2,324)
University of Edinburgh	1,165,485	1,000,000	56,817	(4,613)
University of Oxford	3,568,929	1,000,000	268,839	117,414
University College London	1,721,824	1,000,000	149,518	(12,755)
University of Warwick	1,697,870	1,000,000	211,997	250,000
	<b>10,099,768</b>	<b>18,213,780</b>	<b>774,369</b>	<b>347,722</b>

**23.**

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**Notes to the financial statements**

For the year ended 31 March 2019.

**23.**

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**Related parties (Continued)**

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**Prior year to 31/03/2018**

	<b>Grant expenditure awarded £</b>	<b>Grant income received £</b>	<b>Re-charged expenditure £</b>	<b>Period end Debtor/(creditor) £</b>
Engineering and Physical Sciences Research Council	-	9,394,250	36,819	(22,151)
University of Cambridge	927,409	1,000,000	34,118	(17,018)
University of Edinburgh	728,993	1,000,000	16,613	59,738
University of Oxford	743,961	1,000,000	24,600	205,512
University College London	570,249	1,000,000	117,201	(46,820)
University of Warwick	666,158	1,000,000	-	126,944
	<b>3,636,770</b>	<b>14,394,250</b>	<b>229,351</b>	<b>306,205</b>

The re-charged expenditure relates to staff time, administration and workshop costs.

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**Transactions with subsidiary**

During the year the parent charity re-charged staff and other costs to the subsidiary company, Turing Innovations Limited of £808,205 (2018: £748,499).

During the year Turing Innovations Limited made a gift aid distribution to the Alan Turing Institute of £425,543 (2018: £nil).

At the year end Turing Innovations Limited owed The Alan Turing Institute £858,567 (2018: £669,323).

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**Notes to the financial statements**

For the year ended 31 March 2019.

**24.**

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**Company status**

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The charity is a company limited by guarantee. In the event of the charity being wound up, the liability in respect of the guarantee is limited to £1 per member of the charity.

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**Notes to the financial statements**

For the year ended 31 March 2019.

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**Prior year adjustment**

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	<b>Surplus for the year ended 31 March 2018</b>	<b>Funds brought forward 1 April 2017</b>	<b>Total prior year adjustment</b>
As previously stated	8,817,606	6,340,090	
Restatement of prior year			
(a) Studentship accruals	(1,042,847)	(1,330,258)	(2,373,105)
<b>As restated</b>	<b>7,774,759</b>	<b>5,009,832</b>	<b>(2,373,105)</b>

- 
- (a) Upon review of documentation in the year, it was noted that commitments made in respect of studentships in prior years had not been fully accrued. All commitments outstanding at the start and end of the prior year have now been included in these accounts, as above.

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**Meetup**

The-Alan-Turing-Institute-Meetup

**Design**

Red&White

redandwhitestudio.com

**Photography**

On pages 14, 16, 18, 20,  
21, 23, 25, 26, 28, 29, 31,  
32, 34, 35, 37, 39, 42, 44,  
46, 49 and 54

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