

The Alan Turing Institute

2017–18



Annual Report 2017–18

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The last decade has seen a dramatic rise in computer power, an explosion in data, and scientific break-throughs, as in deep learning and neural networks. Together, these advances have led to the emergence of data science and the resurgence of artificial intelligence — ‘machines that think’, as imagined in Alan Turing’s landmark research paper published in 1950.

The role of the Turing is to foster these sciences and grow them in order to change the world for the better.

We have three ambitious goals:

Advance world-class research

Innovate and develop world-class research in data science and artificial intelligence that supports next generation theoretical developments and is applied to real-world problems, generating the creation of new businesses, services, and jobs.

Train the leaders of the future

Train new generations of data science and AI leaders with the necessary breadth and depth of technical and ethical skills to match the UK’s growing industrial and societal needs.

Lead the public conversation

Through agenda-setting research, public engagement, and expert technical advice, drive new and innovative ideas which have a significant influence on industry, government, regulation, societal views, or which have an impact on how data science and artificial intelligence research is undertaken.

2017–18 highlights

- Strengthening our research capability with new international Fellows, social scientists, data scientists and software engineers
- Expanding our university network from five to thirteen
- Becoming the national institute for artificial intelligence
- Research programmes breaking new ground in science, policy and business
- New partnerships and collaborations driving real-world impact
- PhD students taking the lead in Institute activities
- Events, engagement and expertise shaping the national conversation
- A new set of research challenges articulating areas in which data science and AI can have a game-changing impact for science, society and the economy

Turing Fellows

Total 147

+54

Research Fellows

Total 19

+3

Doctoral studentships awarded in the 2017/18 cohort

17 on an enrichment placement

+33

New Research Software Engineers and Data Scientists

Total 11

+7

New Rutherford Visiting Fellows

10

Research Associates

14

New research publications added to the website

Total 138

+97

YouTube views including livestreams

Total 126k

+127%

New university partners

Total 13

+8

Participants taking part
in three Data Study Group events

200+

People through our doors for events
and workshops

5,300+

Increase in the number of applications
for our doctoral studentship places

+49%

Total weeks Visiting Researchers spent at the Institute
Eight researchers from five countries

122

Economic and Social Research Council Fellows

2

Interns

21

Interest groups
Total 17

+6

The new interest groups

- Privacy-preserving data analysis
- Data science and digital humanities
- Logic for data science
- Urban analytics
- Data science for sports, activity and well-being
- Online machine learning

35+

A sample

- Probabilistic numerics
- Inverse problems
- Mean-field games and interacting particle systems
- Free energy landscapes for big data
- Numerical analysis of sampling algorithms
- Adaptive Markov chain Monte Carlo methods
- Large transport systems
- Electric vehicle charging
- Clean air in London
- A digital twin of the world's first 3D printed steel bridge
- Estimating system health from streaming sensor data
- Statistical techniques for engineering with advanced materials
- Nature inspired routing for resilient networked systems
- Complexity twin for resilient ecosystems
- Enhancing critical ecosystems
- Reliability computation
- Delivering enhanced through-life nuclear asset management
- Modelling resilience of ageing structures
- Safety of offshore floating facilities
- Data-driven geoscience
- Global urban analytics for resilient defence
- Mean field games for cyber security
- Scalable topological data analysis
- Computational modelling of civil wars
- Evaluating homomorphic encryption
- Adversarial machine learning
- Understanding online hacking forums
- Distributed training for machine translation
- Anomaly detection to combat fraud
- Technology and labour markets
- Immigration and labour markets
- Production networks and growth forecasts
- Regional evolution of economic activity
- Capturing complex data streams
- Improving cystic fibrosis healthcare

Howard Covington
Chair at The Alan Turing Institute

Even by the standard of technology start-ups we have had an exceptionally fast-paced year. We have quadrupled our scale and ambition by adding a further eight university partners to our five founding universities and expanding our core mission to become the UK's national institute for artificial intelligence as well as data science. Let me warmly welcome our new partners — the Universities of Birmingham, Bristol, Exeter, Leeds, Manchester, Newcastle, Queen Mary University London and Southampton — and thank our excellent executive team for rising to the enormous demands that this rapid growth has brought with it.

We have much to do to leverage the exciting and unique research platform that we have created. But the direction of travel is clear. Through our university partners we have direct access to several thousand of the country's smartest research minds in maths, computing, artificial intelligence (AI), ethics and social sciences. This gives us a unique opportunity to forge collaborations across universities, across disciplines and with commercial, government and institutional partners. We will use this formidable convening power to encourage and lead cutting-edge research in AI and data science, to produce prototypes of algorithms and products that can be fed into the UK's economy and to generate a rich stream of highly trained AI and data science experts who will become tomorrow's leaders in their fields. Judging by the tremendous energy that pervades the Institute, we will rise to all of these challenges.

I would like to thank my colleagues on the Institute's Board of Trustees, who provide invaluable direction and advice. In particular I would like to thank Pete Grindrod and John Aston, who retired from the Board this year, for their great help in the Institute's start-up years. I would also like to welcome Patrick Wolfe, Tom Melham and Frank Kelly who joined the Board during the year.

Finally, Sir Alan Wilson, our chief executive, comes to the end of his two-year term in September, to be succeeded by Sir Adrian Smith. Alan has done a fabulous job and I would like to thank him greatly on behalf of the Board, all our partners and our academic community.

Alan Wilson
CEO at The Alan Turing Institute

I am grateful to our Chair for his thanks in his foreword, and indeed for his support and that of the Board during my tenure as CEO.

It has been an enormous privilege and opportunity for me — both challenging and enjoyable. It has also put me on a steep learning curve. As a researcher, I work in building mathematical and computer models of cities. This field itself is being transformed by 'big data' and increased computing power, and it also represents the kind of 'prior knowledge' that technology entrepreneur Mike Lynch has argued has to be effectively connected to machine learning algorithms. My journey up the learning curve has brought home to me the scale of the potential of data science and artificial intelligence for industry, the public and third sectors.

The role of Turing as the national institute involves us unpicking the elements of the challenges and this potential and identifying our role in contributing to the success of the UK in the field. We have to have a fundamental research base at the front line — both to contribute significant discoveries in method but also to have an articulated awareness of what is possible in application. This leads us to be ambitious in all our fields of application: ranging from medicine — revolutionising healthcare, AI for science and humanities and areas such as defence, finance, and government along with cross-cutting themes such as the ever-more important ethics, fairness and transparency agenda. We also need to meet a different kind of challenge: to be simultaneously ambitious and realistic.

There is a tremendous amount of both hope and hype around AI. Reaping the benefits requires hard thinking and much sweat. Being realistic means being able to advise on possible timescales of advancement in different fields — a different kind of research question.

This report highlights many achievements. We have made enormous progress as an Institute in the last year and I would like to thank the staff of the Institute, of our partner universities, and of our industry, public sector and third sector partners for the hard work that has brought about these achievements. And finally, to wish my successor, Adrian Smith, well when he takes over in September. I will then resurrect myself as a researcher!

Part 1

Our year

- | | |
|-----------|--|
| 1. | Scaling up our research capability |
| 1.1 | Turing Fellows |
| 1.2 | Research Fellows |
| 1.3 | Studentships |
| 1.4 | Research engineering |
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| 1.13 | Ensuring ethical research |

2017/18 has seen major acceleration in The Alan Turing Institute's research — the consolidation and growth of our programmes, the launch of exciting projects, and agenda-setting publications attracting academic, industry and policy attention.

In recognition of our success to date, we have accepted eight new university partners to join our network and expanded to become the national institute for data science and artificial intelligence.

1.1

Turing Fellows

The Institute has an extraordinary network of academic excellence in its Turing Fellows, a group of senior academics from a diverse range of disciplines who spend a portion of their time working on research at the Institute.

In the course of the past year, the Institute has assigned new Turing Fellowships to recognise researchers already collaborating with us on projects and has appointed Fellows in areas of priority research.

In 2017/18, the Institute worked with the first cohort of Fellows to review their experience to date, with findings reporting strong collaboration across universities and disciplines, as evidenced in the broad membership of the Institute's interest groups.

1.2

Research Fellows

The cohort of full-time post-doctoral Research Fellows based at the Turing have made major contributions to the Institute, taking leadership roles in Data Study Groups and Institute committees, and collaborating to deliver impactful research.

They also play a critical role in enriching the Institute's research community. A notable collaboration between two Research Fellows and two Turing Fellows produced a paper on 'counterfactual fairness', which proposes a technical test for algorithmic bias, and has attracted considerable academic and policy attention.

1.3

Studentships

The Institute has a vibrant and growing student community. In 2017, the studentship model was adapted in order to enable more students to visit the Turing to upskill in data science and AI.

Our Enrichment Scheme, which offers doctoral students the opportunity to spend a year at the Institute working on data science, was made more flexible, enabling students to join for shorter time periods. Students entering in the newly modelled scheme will start in autumn 2018.

1.4

Research engineering

The Institute's Research Engineering Group has grown to 11 full-time posts. James Hetherington, founding Head of Research Software Engineering group at UCL, was appointed to lead the team, joining the Institute full-time in July 2018.

The team has recruited data scientists as well as software engineers, ensuring the Institute has the resources to both engage with industry and government and support in-house researchers to turn their research into impact.

1.5

Social sciences

In order to boost collaboration between the social sciences and data science, in summer 2017, and in partnership with the Economic and Social Research Council, we held a call for social scientists to join the Institute as Fellows. Two Economic and Social Research Council Fellows were appointed in December 2017.

Ganna Pogrebna, from the University of Birmingham, is exploring how behavioural science can improve machine-learning algorithms to make better predictions about urban well-being.

The Economic and Social Research Council Fellowship call will be repeated in 2018/19.

Alison Heppenstall, from the University of Leeds, is leading a project exploring the underlying social processes in smart city data.

1.6

Visiting Researchers

The Institute's Visiting Researcher programme enables academics from the UK and around the world to visit the Institute on a short-term basis to work on specific research projects. In 2017/18, we welcomed eight researchers from the USA, Italy, Norway, the Netherlands and the UK to the Institute as part of the programme.

Altogether, the researchers spent 122 weeks at the Turing. They investigated a range of projects, including early warning systems to assist the initial assessment of patients attending Accident & Emergency and analysing the UK Web Archive to detect how words change their meaning over time.

1.7

Rutherford Visiting Fellows

Ten international fellows joined The Alan Turing Institute in 2018 as part of the government's Rutherford International Fellowship Programme that brings highly skilled researchers to the UK.

The Turing is one of several world-class institutions in the UK identified as a destination for these significant fellowships. The Programme pledges more than £100 million over the next four years to support the provision of fellowships for international research talent.

The Turing Rutherford Visiting Fellowships were awarded to early-career and senior researchers who began their 6-12 month placements in February 2018. The Fellows are drawn from Canada, China, Finland, France, Germany, Pakistan, Turkey and the USA. Their research interests cover a broad range of areas core to the Institute's strategic research areas including health, security, data-centric engineering, humanities, social sciences and machine learning.

I feel at home here. The Turing has such an incredible sense of cross-disciplinary scholarship, research excellence, and collaboration. It is definitely the future of science and I am extremely lucky to be a part of it.

Ganna Pogrebna
Economic and Social Research
Council Fellow

1.8

National institute for artificial intelligence

Data science and artificial intelligence are both long-standing areas of science which have experienced a major resurgence thanks to increases in computer power, the ability to capture and make sense of data, theoretical breakthroughs such as those in neural networks and deep learning, and industry investment.

What's more, the skills used in mathematical modelling, computer science and statistics can also be applied to data science and artificial intelligence. And many of the foundational tools and methods related to data science underpin machine learning and artificial intelligence.

In recognition of this natural overlap, in November 2017, Professor Dame Wendy Hall and Jérôme Pesenti published a report, *Growing the Artificial Intelligence Industry in the UK*, which recommended that The Alan Turing Institute should become the national institute for artificial intelligence, adding to the data science remit with which we were created. This recommendation was endorsed by the government in November 2017 as part of its Industrial Strategy, which identifies artificial intelligence as one of the leading industries that is core to the UK's scientific and economic success.

In February 2018, the Institute recruited a Programme Director for Artificial Intelligence, Adrian Weller, to lead our research in this area, building on the foundational strengths in AI and machine learning across our university network. The Institute will recruit up to two co-directors to support Adrian's role.

1.9

Working internationally

During 2017/18, we kick-started a number of international collaborations and engagements, both via project collaborations and invitations for international researchers to work with us. Looking ahead, we recognise that engaging internationally will be critical to ensuring that the UK's strengths in data and AI have global impact.

A priority for 2018/19 will be to develop a strategy for international engagement which supports our remit and goals, and which champions UK talent on the global stage.

1.10

Expanding our university network

In our previous annual report, we outlined our intention to expand the Institute's university network, in recognition of our national remit and in order to enable us to undertake the broadest, most impactful research possible.

The move to enable more universities to join the Turing network began with a call for expressions of interest in November 2017. Eight universities — Birmingham, Bristol, Exeter, Leeds, Manchester, Newcastle, Queen Mary University of London and Southampton — are now set to join as new university partners.

The call for universities interested in collaborating with us remains live and we are seeking to define more flexible ways for universities to engage with the Institute.

A priority for 2018/19 will be to build on the initial research outcomes involving our founder members, and to integrate research excellence from our new university partners, enabling cross-disciplinary research programmes across all our partners.

University partners



Our vision is for the UK to become the best place in the world for businesses developing and deploying AI to start, grow and thrive, and to realise all the benefits the technology offers.

The Alan Turing Institute, with its routes into both the technical and ethical implications of AI and data, and the strengths of its growing university network and links to industry and government, is the right place for leadership in AI to be centred.

We are delighted that the Turing has embraced this new area of national leadership.

Professor Dame Wendy Hall

Co-Chair of Growing the Artificial Intelligence Industry in the UK

1.11

Our Scientific Advisory Board

In June 2017, we hosted the inaugural visit of the Institute's Scientific Advisory Board — seven leaders in data science from around the world who visited the Institute over a two-day period. This first visit focused on introducing the members to the Institute and presenting the research interests and projects emerging from our first academic year.

During the visit, a range of researchers presented their work, and the Board spoke to students, viewed demonstrations of software and applications and delivered a series of sell-out talks to a public audience.

In their final report the Scientific Advisory Board provided a range of interesting recommendations relating to the Institute at this early stage in its development. The Board's advice has contributed to aspects of the Institute's work in building a diverse research community, recruiting more data scientists and prioritising research areas.

1.12

Equality, Diversity and Inclusion

In November 2017, we launched our Equality, Diversity and Inclusion initiative. The launch event, led by CEO Alan Wilson and Institute Trustee Wendy Tan White, outlined the different aspects of diversity and the essential role it plays in delivering excellence in business and research.

Since the launch, the Institute has recruited a group of diversity champions drawn from the research and business teams. Early activities include building networks with diversity consultants in partner organisations, launching a work placement scheme with CamdenAbility and training staff in disability awareness.

In addition, the Institute's Programme Committee has approved a funding call for proposals for research into lack of representation of women in data science and artificial intelligence, and we are proud to be hosting a branch of the UK's Women in Data Science conference in April 2018.

1.13

Ensuring ethical research

In 2017, the Institute launched its Ethics Advisory Group. The group has reviewed proposals for Data Study Groups and Turing internships that pinpoint the ethical and social implications of the choices researchers make, for example, around which datasets to use and which techniques to employ.

In 2018/19, the group intends to build on this early success by promoting best practices and highlighting considerations for data science and AI research, both through the Institute's internal channels, and by contributing to broader debates around research ethics in academic and public settings.

2. Science

- 2.1 Manage security in an insecure world
- 2.2 Design computers for the next generation of algorithms
- 2.3 Deliver safer, smarter data-centric engineering
- 2.4 Revolutionise healthcare
- 2.5 Shine a light on our economy
- 2.6 Make algorithmic systems fair, ethical and transparent
- 2.7 Foster government innovation
- 2.8 Supercharge research in the science and humanities
- 2.9 Research engineering

The Turing is a remarkable place to do research. They have created a space where people can come together to discuss matters both great and small, with the time to explore and indulge lines of thought that might otherwise have been forgotten. I believe this to be the key to building multi-disciplinary collaborations; giving people the time to connect naturally with each other. It is these opportunities that I find so exciting, and being located at the Institute gives me a front-row seat to cutting-edge science.

Ben Tagger

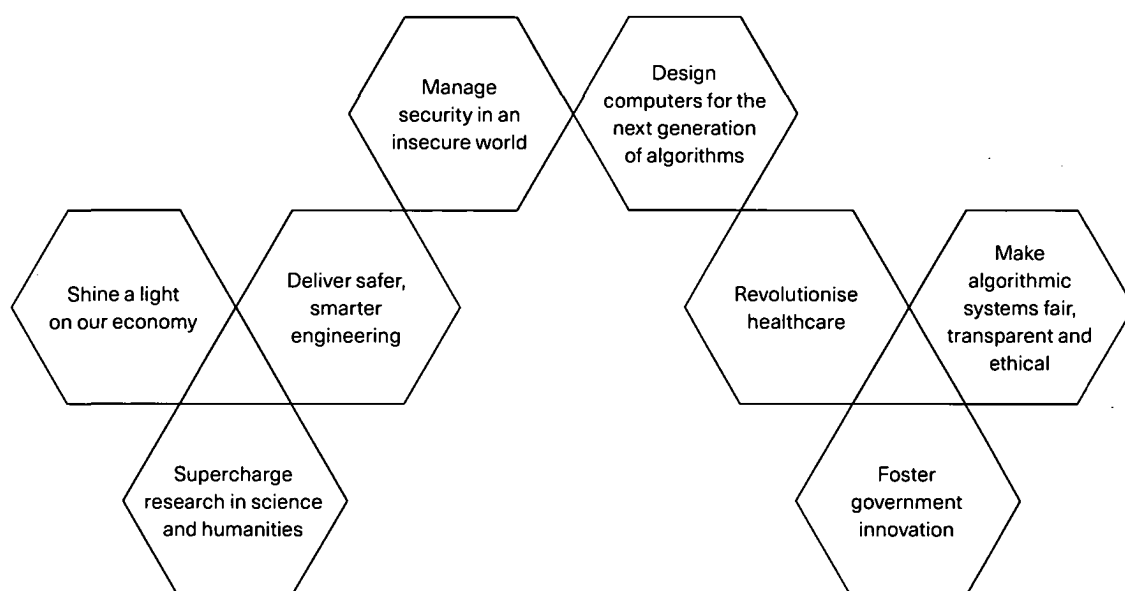
Visiting Researcher at the Turing
from UK Government

A significant development in 2017/18 has been the drive to evolve our strategic priority research areas into 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.

This process was kick-started with more than 40 researchers and partners taking part in a workshop in summer 2017.

The resulting eight challenges will be used to motivate research and activities at the Institute as we move into 2018/19, drawing on our network of universities and collaborators.

The challenges



These challenges are representative of broader areas of applied science which the Turing works in, and will not be led by the Turing alone, but depend on significant collaboration and partnerships.

New challenges, for example in cities and environmental science, will be considered as progress is made and new priorities and technologies emerge.

The challenges are supported by the broad range of research strengths and capability in the Institute:

- System architecture
- Security and robustness
- Core statistics: complex structure in data
- Machine learning and artificial intelligence
- Mathematical modelling of complex systems
- Understanding human behaviour
- Ethics in data science and artificial intelligence

Challenge 1

Manage security in an insecure world

The ever-changing ways in which we can communicate and interact with one another present government, organisations and individuals with a set of dynamic and challenging tasks for security, privacy and trust.

At The Alan Turing Institute, our goal is to develop new analytic technology and tools that can help us to manage security in an insecure world, and ensure that skills, methodologies, and expertise in this space remain at the cutting edge of data science and AI research.

In summer 2017, Programme Director Mark Briers launched three challenges to drive research within this challenge at the Institute:

- how to prevent and respond to urban security threats
- how to integrate information systems to improve cyber security
- how to use data science to understand complex social systems.

These three challenges are supported by two theoretical and methodological advancements from across the wider data science spectrum — improving intelligent data systems and building privacy and trust.

These priority research areas were devised in collaboration with our strategic partners, GCHQ and the Defence Science and Technology Laboratory (Dstl) and Joint Forces Command in the MOD, and represent the areas in which data science can have the most impact in real-world defence and security scenarios.

The defence and security programme has supported three flagship projects in support of these challenges — artificial intelligence for data analytics, security in the cloud, and global urban analytics for resilient defence.

In addition, in autumn 2017, the programme ran a seed-funding call to source short-term projects designed to provoke and test innovative proposals from across the Turing network. The successful projects included research into the understanding of key actors in online hacking forums, adversarial machine learning and mean-field games.

A major success of the programme in 2017/18 has been the growth of the research community. Following visits to partner universities, there is a growing network of expertise involved in the programme and attending regular meet-ups at the Institute. Reflecting the core programme goal of upskilling government partners in the latest data science techniques, several researchers from the government have been embedded in the Institute as Visiting Researchers, providing a direct line between real-world challenges and cutting-edge science.

Altogether, the programme has submitted seven papers for publication, and generated four software tools, which our government partners are scoping for real-world use.

Sample projects

Artificial intelligence for data analytics

The vision for this project is to develop systems that help to automate 'data wrangling': the process of organising, cleaning and preparing data to be processed by machine learning algorithms, which typically takes up around 80% of a given data science project.

This is particularly pertinent in a security setting, when the race to analyse data can often come at high stakes and under time pressures, but is equally applicable across many other different domains, for example healthcare, government or finance.

It is hoped that the tools developed through the programme could revolutionise the speed and efficiency of data science tasks, thus reducing the time taken to produce actionable intelligence.

In 2017/18, the team recruited three post-doctoral researchers and hosted a two-day workshop to amass research talent from across the Turing network and beyond. The project has submitted a paper to a high-impact conference on the subject of data quality analysis, and open-sourced two software components.

Security in the cloud

Ensuring the privacy of data is among the most compelling research challenges of our time. This project, which was awarded funding by our defence and security partners in 2017, explores whether a safe haven for data sharing and storage could be built within cloud computing.

For defence and security partners, this project has clear benefits: the ability to handle data privacy outside data centres, in an encrypted cloud environment. It too has the potential for cross-cutting impact.

In 2017/18, researchers in the Institute collaborated with Imperial College London to create a modified version of the Linux kernel library, which interacts with hardware-based encryption, providing a solid technical foundation on which to produce secure big data tools. To achieve this, they worked with Intel, who provided the computing infrastructure to enable the system to be tested.

Can algorithms predict conflict?

An algorithm building on the latest network science and modelling techniques, developed by Turing Fellow Weisi Guo, is able to predict to a high degree of accuracy where conflict may break out on a global scale.

Funding for the project, undertaken in collaboration with Institute CEO Alan Wilson, was awarded through the defence and security programme in 2017/18, and will enable more datasets to be absorbed into the project. Using evidence from this model as to where 'choke points' occur in our geographical and topological landscape, the ambition is to help governments and policy makers to predict and actively mitigate outbreaks of conflict.

The focus of 2017/18 has been on developing and communicating a vision and strategy for the defence and security programme, working alongside our partners to identify areas in which we can deliver short-term operational value, and initiating a number of potentially game-changing projects.

Mark Briers

Programme Director for Defence and Security

Challenge 2

Design computers for the next generation of algorithms

The explosion of data science and AI wouldn't have been possible without advances in computer power and specialist hardware and software, in addition to algorithmic developments over the past few years.

The driver behind this challenge is to continue to adapt and refine computer technology in order to meet the needs of the next generation of algorithms and data scientists. Improved computing performance will also enable data scientists to design more complex and powerful algorithms, creating a virtuous circle of technology supporting and informing innovation.

In partnership with Intel, the programme funded a project in cancer diagnostics in AI with the University of Warwick and has advanced two ambitious projects in training neural networks and co-designing algorithms and computer architecture.

The programme has also grown a hardware architecture team at the Institute's facilities in the University of Edinburgh so that new algorithms developed by The Alan Turing Institute feed into the design of Intel's future generations of microprocessors.

Significantly, the programme is set to launch a computer cluster at the University of Edinburgh, further enabling large-scale computing to be undertaken for research across the Institute. The cluster will also provide a data safe haven, providing a platform for the Institute to securely share sensitive personal or commercial data for research within its other programmes including health, economic data science, and defence and security. This marks a step-change in how the Turing can use and access computing facilities, and enables research outputs from one programme to drive benefits across the Institute.

Sample projects

Distributed training for machine translation

Neural networks have huge potential for a wide range of applications, amongst them machine-led translation. Training these networks in different languages takes significant time and resources, which can be reduced by distributing the training across multiple machines. This project, led by Turing Fellow Kenneth Heafield, aims to make this training process, and the related hardware, better at translating millions of words of online text.

The machine translation group at the University of Edinburgh has so far collected 236 TB of text — partly drawn from trawling the internet, partly from EU parliamentary transcripts — in the following languages: Czech, Danish, French, Italian, Mandarin, Polish, Portuguese and Spanish.

The long-term aim of the project is to inform Intel about specific aspects of their hardware that would make them better at dealing with neural network analysis.

Co-designing algorithms and computer hardware

In this five-year project, scientists at the Institute are working to address the technical challenges of data science, through co-designing computer hardware and software. Hardware will be designed to suit the needs of data science algorithms, which will similarly be designed to suit the capabilities of the hardware. The research, once complete, promises to dramatically increase the speed and efficiency of data-driven computing tasks and will provide Intel with the tools to build the next generation of computer processors and high performance systems.

In 2017/18, the project has dramatically improved the performance of a critical and pervasive communication operation in distributed AI algorithms using the Intel Omni-Path communication architecture. In tandem, it has investigated mechanisms for reducing the intensity of this communication via algorithmic modifications in the context of deep learning.

Cancer pre-diagnostics with AI

In this project launched in May 2017, scientists at the University of Warwick's Tissue Image Analytics Laboratory worked with the Institute to create a large digital repository of a variety of tumour and immune cells found in thousands of human tissue samples, and to develop algorithms to recognise these cells automatically.

The project seeks to improve a model for computers to recognise cellular distinctions associated with various grades and types of lung cancer by using artificial intelligence frameworks such as TensorFlow running on Intel® Xeon® processors.

The long-term aim of the project is to create a model that will eventually be useful in diagnosing many types of cancer — creating more objective results, lowering the risk of human error and aiding oncologists and patients in their selection of treatments.

Data science and AI require the deployment of very computationally intensive algorithms. The pressure they exert on systems and underlying architectures is only set to grow as we tackle larger and more complex problems. An important goal of this programme is to improve our understanding of how the most powerful algorithms should inform the next generation of computers.

Anthony Lee
Programme Director for Data Science at Scale

2.3

Challenge 3

Deliver safer, smarter engineering

In 2017/18, the Institute's data centric engineering programme, in partnership with the Lloyd's Register Foundation, grew in ambition, scope and scale.

The programme now has 38 associated researchers, including 11 full-time post-doctoral researchers. Programme Director Mark Girolami has been awarded a Royal Academy of Engineering Research Chair, further strengthening the programme's ties with the broader sector.

In July 2017, the programme was part of a successful funding bid to EPSRC (Engineering and Physical Sciences Research Council) for £4.2 million. The funding is for the Institute to work with the University of Strathclyde and engineering firm Babcock on a project to make nuclear assets safer and more reliable.

A major focus has been on building partnerships and relationships. Team members presented at key conferences including The Institute of Engineering and Technology, EngFest, the Royal Society and the Royal Statistical Society. They co-hosted two workshops with the Statistical and Applied Mathematical Sciences Institute and new research projects have been built in collaboration with the Greater London Authority, Siemens, National Rail and Thames Water, among others. A February 2018 workshop, 'Mean field games', attracted a Fields Medallist, Pierre Louis-Lyon, to speak.

In addition, the programme has kick-started its international collaborations.

For example, a partnership is in development with the Australian Research Council Centre of Excellence in Offshore Structures at the University of Western Australia. Researchers from the Institute and Western Australia are working on a joint project, co-funded by Shell and Woodside, to assess the impact that single waves have when they crash against major structures like a ship's hull.

Sample projects

Modelling the world's largest 3D-printed metal structure

In a city of over 1,000 bridges, one new structure to be installed across an Amsterdam canal in 2018 will have a crucial difference — it will be the world's largest 3D-printed metal structure, and the first ever 3D-printed metal bridge.

This audacious project requires considerable scientific and engineering expertise to ensure the bridge is properly built and safe for pedestrians and cyclists. It is also a fantastic opportunity to learn about the living properties of this structure — how it responds to temperature, weight and traffic over time — so that this data can inform the next generation of 3D-printed structures.

Scientists working on the Institute's data-centric engineering programme formed a partnership with MX3D, the company 3D printing the bridge, and other international partners in summer 2017 to turn the bridge into a living laboratory for research.

In the first months of the project, they designed a sensor network to cover the bridge and started to build a finite element model — a 3D computer model to test the strain and durability of the bridge — which is being used to inform its design. Once built, the same model will serve as a digital twin bridge that is constantly monitored and feeds in data about its performance 24 hours a day.

The bridge is due to be installed in 2019. The research undertaken by the Institute's team will provide a long-term test-case for the durability of 3D-printed structures and mark a world-first in engineering.

Tackling air pollution in the capital

7.9 million Londoners live in areas that don't meet the World Health Organization's air quality guidelines.

In a new collaboration as part of the Mayor of London's plans to tackle the capital's toxic air quality, researchers from the Institute have signed an agreement with the Greater London Authority to set up sensor networks around the city to link up traffic and air pollution data. Turing Fellow Theo Damoulas was appointed to lead the project in October 2017, and in the months since, the team has recruited another partner, Waze — the app used by taxi drivers to share traffic updates in the capital.

It is hoped that this data science project will play an important role in measuring changes in London's air quality. The project makes up an important part of the programme's mission to improve safety in large engineering systems such as city networks and transport.

Blockchain — for engineering?

September 2017 saw the launch of *Distributed ledger technologies for engineering: hype or hope?* — a new report exploring how distributed ledgers, or 'blockchains', typically associated with financial applications such as the bitcoin digital currency, could be applied to the engineering sector. Findings include the potential to use blockchains to improve the transparency of transactions.

More than 60 stakeholders attended a launch at the Institute to hear author Gary Pogson reveal the report's findings. The report, published jointly with the Lloyd's Register Foundation, has since been read online and in print over 600 times.

The Turing is driving a step-change in engineering. We have embarked on world-first projects, grown our team and built several new partnerships, and begun a number of international collaborations.

Mark Girolami

Programme Director for Data-centric Engineering

2.4

Challenge 4

Revolutionise healthcare

Research and industry have long been focused on the potentially transformative effects of using data science and AI in healthcare. AI and data science will improve the detection, diagnosis, and treatment of illness. It will optimise the provision of services, and support health service providers to anticipate demand and deliver improved patient care.

Health was established as a priority research area for the Institute at our inception in 2015, and 2017/18 has been spent establishing capability, kick-starting collaborations and launching ambitious research projects.

We appointed a Programme Director for Health, Chris Holmes, who started in April 2018. The appointment is made jointly with Health Data Research UK (HDR UK) in order to facilitate direct collaboration and scientific leadership between the two national centres.

Sample projects

Cardiovascular Data Science Awards

Despite the potential for life-changing impact, there is little track record of experts in cardiovascular medicine and data science working together.

In an effort to close this gap, in March 2017, the Institute hosted a joint workshop with the British Heart Foundation exploring opportunities for data science in cardiovascular research.

The event, attended by around 100 scientists from a diverse mix of institutions and organisations, led to a joint funding call for research projects launched in August 2017. The call invited cardiovascular researchers and Turing Fellows to devise innovative project ideas together which could improve understanding and treatment of heart and circulatory conditions.

From 20 applications, the partners awarded funding to six projects which will begin in 2018.

Cystic Fibrosis Trust

There are more than 10,000 people in the UK with cystic fibrosis — a life-limiting genetic condition which causes a wide range of challenging symptoms affecting the whole body.

In May 2017, the Cystic Fibrosis Trust entered into a partnership with Turing Fellow Mihaela van der Schaar to share a set of anonymised patient records from the UK Cystic Fibrosis Registry. These represent 99% of those in the UK living with cystic fibrosis.

The project, which builds on Mihaela's existing work in personalised medicine, aims to use machine-learning techniques to train a system to learn from this historical data in order to make reliable predictions and create a method of generating personalised risk scores for people with cystic fibrosis.

Unlike current practices, a data-driven model for cystic fibrosis treatment could provide a full risk profile for various timescales and potential treatments, as well as take into account multiple competing and potential adverse events for an individual. The ambition is for the project to enable people with cystic fibrosis and their clinical teams to tailor treatments and other activities to effectively manage the condition.

Early results from the research show that using these methods could result in a 35% potential improvement in the referral accuracy for lung transplants, which for many people with cystic fibrosis may become the only remaining treatment option.

In 2018/19, Mihaela and the Cystic Fibrosis Trust team will undertake further validation and testing.

Data science for mental health

In January 2018 The Alan Turing Institute and University of Oxford launched a new collaboration bringing together the fields of psychiatry and data science, thanks to seed-funding from the Turing.

This project seeks to address mental health disorders such as bipolar disorder, a brain disorder that causes unusual shifts in mood, energy, activity levels and individuals' ability to carry out daily tasks. It will analyse existing audio and textual datasets of recorded speech of people with mood disorders.

The funding has enabled the project to recruit for a new researcher to work across the University of Oxford's psychiatry department and The Alan Turing Institute. The project will be led by Turing Fellow Terry Lyons.

Health data

Due to its sensitive and personal nature, accessing health data for research is a challenge.

In September 2017, the Institute's Data Study Group team managed access for six research challenges and their associated datasets, including 1.8 million anonymised patient records from NHS Scotland, to be used by researchers to create new data science outputs.

Establishing this mechanism for working with health data is an important step and the Institute aims to advance this further over the coming year, in partnership with other organisations.

2.5

Challenge 5

Shine a light on our economy

Our economy involves complex networks of relationships and transactions, from international trade flows and everyday spending decisions to supply chain connections and employment arrangements. Together, these drive the economic well-being of individuals, the performance of companies and the policy options open to government.

The aim of the Institute's economic data science research programme, in partnership with HSBC, is to apply data science and AI techniques to shine a light on how the economy works, and to use this insight to explore challenges of national and international importance.

In 2017/18, the programme focused on building a community around this emerging area of research. A series of visits to universities took place in winter 2017 and a start-up workshop held in September 2017 brought together professionals from academia, industry and government. The programme also funded a PhD studentship and explored an inaugural doctoral work placement at HSBC, with the ambition of increasing the number and range of both of these in future years.

This groundwork led to the launch of three programme challenges in early 2018:

- how to analyse new economic activity data
- the changing nature of work
- machine learning for economic data

In February 2017, the programme launched an Economic Data Science Awards scheme with HSBC and the Office for National Statistics, offering up to £150,000 and unique collaboration opportunities, for projects in economic data science which combine world-class science with the potential for high impact on policy. Project proposals will be assessed by a reviewer community and independent expert panel including senior representatives from the Cabinet Office, Treasury, the Department for Work and Pensions, HMRC and the Bank of England.

In 2018/19, the programme will focus on developing the outcomes of the funding call and consolidating early strengths.

Sample projects

Technology and labour markets

New technologies are predicted to replace a large segment of labour tasks, and with current debates about the potential impacts of AI on the future of work, now is the time to look at historical data to determine the potential effects of labour-saving technologies.

This project, led by Turing Research Associate Miguel Morin, looks at modelling the adoption of computers since the middle of the 20th century. It explores their impact on production and jobs, alongside the effects of cheaper electricity in the US over the 20th century, which marked another step-change in labour-saving.

Early results from the research suggest that electricity caused the use of labour-saving devices to increase, which in turn made labour more productive. Employment and the share of income paid to labour fell, and there was no effect on output. The effects were stronger in US states in which the Great Depression was more severe. This is consistent with the view that firms used a recession as an opportunity to replace workers with electrical machinery.

The programme aims to apply this research to the current discussions around how artificial intelligence will impact on the current labour market, supporting policy makers and industry as we shape our future world.

Immigration and labour markets

Migrants are often blamed for harming the labour market outcomes of the local citizen population. However, it's unclear whether this is true, or if the opposite is the case.

In this project Turing Fellow Sevi Rodriguez Mora will explore how these factors play out in the short and long run by utilising new data science techniques. The results will shed light on what impact migration has on labour markets and allow for appropriate policy responses to be developed.

Challenge 6**Make algorithmic systems fair, transparent and ethical**

2017/18 has seen the world wake up to the potential risks of using algorithms in sensitive areas of public life. Reports of bias and discrimination, and an ongoing debate about the accountability and explainability of machine decisions, led to a government-led enquiry into algorithmic decision-making, and calls for an ethical framework for AI in the Prime Minister's speech at Davos in 2018.

The Alan Turing Institute is at the forefront of research into ethics and machine learning transparency, through its interest group led by Adrian Weller, Programme Director for AI, and our Data Ethics Group chaired by Luciano Floridi. Together, they provide ethical and technical responses to this scientific and societal problem.

The Institute's research excellence in this area led to the recommendation in Professor Dame Wendy Hall and Jérôme Pesenti's AI review that we work with the Information Commissioner's Office to develop a framework for explaining AI decisions. This recommendation was reiterated in the government sector deal for artificial intelligence and work on this project will be progressed in 2018/19.

Sample projects

A model for testing algorithmic bias

Four Turing researchers came together to discuss the question "Could we build a method to model unfair algorithmic biases?". The result was a research paper published in April 2017, 'Counterfactual fairness', which proposed new methods to analyse the fairness of algorithms and see whether they contain hidden discrimination, such as in race or gender.

The team was invited to give a presentation at Neural Information Processing Systems (NIPS), one of the world's premier machine learning conferences, in November 2018. In a year of record-breaking submissions for the conference, only 40 of the 3,000+ submitted papers were selected for this kind of presentation.

The group is working and engaging with policy makers, lawyers and investigative journalists, whilst refining and improving its methods. The use of causal methods in fairness has influenced many other researchers in the field to follow suit.

Machine learning is beginning to make many life-changing decisions, such as who to accept to law school, where to send police officers and whether to give out loans. If the data used to train these algorithms contains societal biases against certain races/genders or other minority groups, then the algorithm will as well.

In our paper, we propose a method to model unfair biases which allow us to interrogate the causes of unfairness in the data underlying algorithmic decision-making.

Matt Kusner
Research Fellow

A right to explanation

Turing researchers published a paper identifying that the items in the General Data Protection Regulations (GDPR) relating to companies explaining the decisions made by algorithms, were not adequately legally binding.

In 2017/18, this issue grew in scale and in February 2017, the House of Commons Science and Technology Committee called for an inquiry into algorithmic decision-making. In November 2017, Turing Fellow and lead author of the paper Sandra Wachter appeared before the committee to provide evidence.

Sandra and Research Fellows Brent Mittelstadt and Chris Russell also published a paper in November 2017 which proposed a feasible technical method in which individuals could be given meaningful, easily understandable explanations of how highly complex algorithmic systems have generated decisions about them.

In February 2018, the Article 29 Working Party, the official EU body that is providing expert guidance on how the GDPR should be implemented, cited the work of Sandra Wachter and her colleagues in their final recommendations on *explaining algorithms*. The work also has the potential to have wider impact on accountability and trust in AI systems in general.

Challenge 7**Foster government innovation**

Government has fostered and embraced important advances in technology, from early adoption of large-scale computer systems in the 1960s, to critical investment in the iPhone and the internet. Today, government is a major holder of data, which data science and AI can harness to improve the design and provision of public services as well as to inform policy-making across all levels of government.

Over 2017/18, the Institute has scoped opportunities to work with several areas of government. We have recruited a Programme Director for Public Policy, Helen Margetts, Turing Fellow at the University of Oxford, who started in May 2018. We have also recruited a Policy Fellow, Cosmina Dorobantu, who will build research collaborations between the Institute and policy makers.

In 2018/19, the goal of the public policy programme will be to work alongside policy makers to explore how data-driven public service provision and policy innovation might solve long running 'wicked' policy problems and to develop the ethical foundations for the use of data science and artificial intelligence in policy-making.

The aim of the programme is to develop research, tools and techniques that have a positive impact on the lives of as many people as possible.

Sample projects

Understanding human behaviour with online data

Turing Fellows Suzy Moat and Tobias Preis have engaged with the Office for National Statistics' Data Science Campus on new research to investigate whether online data could complement traditional measurements of human behaviour and thereby inform better decision-making. The project has involved the development of new collaborations with governmental departments and partners and the first published outputs are expected later in 2018.

In addition, in support of our training mission, the ONS Data Science Campus will co-fund five PhD places in the coming academic year to work on areas of mutual research interest in data science for the public good.

The ethics of using analytics in policing

In 2018, the Institute's Data Ethics Group, working with the Independent Digital Ethics Panel for Policing, issued a co-authored report commissioned by West Midlands Police regarding a proposal for a project involving intensive use of data sources and analytical techniques in pursuit of law enforcement objectives. The response, which scrutinised the ethical implications of the proposed project, was welcomed by West Midlands Police as an impartial contribution to the development of the National Analytics Solution.

Challenge 8

Supercharge research in science and humanities

From electron microscope images to thousands of digitised manuscripts, laboratories and research institutes generate colossal amounts of data.

As a result, they face considerable challenges in processing and analysing this data. There is a major opportunity to use data science and AI to advance knowledge across the science and humanities, helping to supercharge research and ensuring that the UK's centres of excellence keep pace with cutting-edge AI and data-driven tools.

In 2017/18, the Institute began collaborative projects with two partners, and kickstarted exploratory discussions with the following organisations: Centre for Environment, Fisheries and Aquaculture Science, the Francis Crick Institute, Genomics England, Hartree Centre, the Rosalind Franklin Institute, Square Kilometre Array, UK Biobank and the Wellcome Trust.

Sample projects

Diamond Light Source

In 2017, we began a research collaboration with Diamond Light Source, the UK's national synchrotron science facility, which generates colossal amounts of data using the UK national synchrotron facility and electron microscopes.

A scoping workshop in November 2017 enabled Diamond Light Source to present potential problems and bottlenecks in their current workflows which could be improved with data science and AI methods. We are developing a proposal to kick-start this collaboration, between the Institute, Diamond Light Source and the Science and Technology Facilities Council, in Autumn 2018.

It will include at least three research projects:

- developing methods to allow for correlative imaging between optical, electron and x-ray imaging techniques
- using machine learning based techniques to study structural changes on surfaces over time
- developing neural networks with the aspiration of improving CryoEM single particle image analysis to create a 3D model.

The British Library

The British Library is a data-rich organisation, generating digital assets with the same speed at which it acquires the nation's printed publications.

In 2017/18, researchers in the Institute collaborated with the Library to bring data science and AI expertise together with the nation's digital collections.

Researchers from the British Library's Qatar Foundation programme have collaborated with Turing Fellow Terry Lyons and Turing Doctoral student Daniel Wilson-Nunn to host an international conference at the Institute in March 2018 exploring how machine learning can be used to read Arabic or other derived scripts.

Linked to this collaboration, the Institute is taking part in a competition which aims to use handwritten text recognition technologies to find a solution for accurately and automatically transcribing historical Arabic scientific handwritten manuscripts.

2.9

Research engineering

The software engineers and data scientists within the Research Engineering Group aim to bridge the gap between science and real-world applications. They provide a standing taskforce for Turing researchers to collaborate with on impactful research, and to date have contributed to 20 projects across the Turing network.

The group has strong links with research software engineering and data science teams across the sector, especially in the partner universities.

In March 2017, the team organised and hosted an international workshop on Research Software Engineering for Data Science held at the Institute and funded by EPSRC (Engineering and Physical Sciences Research Council).

In 2018/19, the team will work with partners to establish a scalable network of staff data scientists and research software engineers for the delivery of real-world impact from research code.

Sample projects

Making simulations simpler

Simulations are a useful part of many professionals' and academics' toolkits, particularly in engineering, but not everyone has the specific skills and coding knowledge needed to run and visualise them quickly and easily.

Software engineers at the Institute, in collaboration with partners at Imperial College and UCL, developed a user interface which aims to make the simulation process more user-friendly, for both academic and industrial communities. The tool works as part of a pipeline that includes seamless, secure connection to supercomputer clusters.

Proof-of-concept of the user interface was demoed at an industry showcase at Imperial College in September 2017, with positive feedback from industry partners. The team is now developing an enhanced prototype with the ultimate goal of having an application that industrial partners can use as part of their day-to-day business.

Coram

Working with the children's charity Coram, researchers at the Institute are exploring how data collected on children in care can be modelled and visualised to help inform the decisions of local authorities.

There is a wealth of data available in relation to children in proceedings or pre-proceedings, as well as those in care, and when used creatively there is potential for better decision-making and allocation of resources through expert analysis.

National Cyber Security Centre

The National Cyber Security Centre (NCSC) supports improvements in the security of public sector websites by identifying vulnerabilities and providing mitigation advice.

Domain Discovery is an in-development service which supports that work by helping the NCSC better understand the public sector's real internet footprint, wider than .gov.uk, through building a catalogue of domains that are likely registered and used by government. The Alan Turing Institute's Research Engineering team has been researching methods to automatically identify domains that belong to the UK government.

**As both researchers and practitioners,
we bring research code out of the academy
and into the world, while using our experiences
from the interface to engineer a new way
of doing research.**

James Hetherington

Director of Research Engineering

3. Partnerships and collaborations

3.1 Growing the team

3.2 Strategic partnerships

3.3 New collaborations

3.4 Data Study Groups

3.5 Public policy

3.6 Informing policy makers

3.7 Data governance

3.8 Working with the information
Commissioner's Office

Artificial intelligence is attracting growing amounts of corporate investment, and as the technologies develop, the potential value that can be unlocked is likely to grow. So far, however, only about 20% of AI-aware companies are currently using one or more of its technologies in a core business process or at scale.

The AI frontier: Applications and value of deep learning

McKinsey Global Institute, April 2018

Academia has a track record of supporting research and development of new products and new techniques. The emergence of data science and AI represent a new frontier in scientific and technological innovation, and there remains great potential impact in many sectors of industry, third sector and government.

The Turing, as the centre of a connected network of world-class academic expertise, has an important role to play as a trusted partner in this rapidly-changing scientific landscape.

To date, we have been approached by over 150 organisations seeking data science and AI support. An important activity in 2017/18 has been assessing this interest, building a team to meet the needs of external collaborators and kick-starting partnerships where there is a real-world need and a compelling scientific problem.

A strength of our partnerships and collaboration activities is their flexibility: ranging from one-week Data Study Groups to multi-year research programmes and targeted research projects. In 2018/19, we will create even more flexible models of engagement suitable for the largest multi-nationals and the most modest SMEs.

3.1

Growing the team

Christine Foster joined the Institute as Managing Director for Innovation in November 2017. Christine is responsible for forging connections between the Institute's science activities and partner needs as well as extending our reach into industry. Christine brings business acumen from the likes of Virgin Media, American Express, a fin-tech start-up and more.

The Institute has also recruited two Business Development Managers, responsible for working with interested businesses and other organisations to scope and deliver collaborative research projects.

3.2

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.

The focus for 2017/18 has been on embedding our strategic partnerships in the Institute, boosting programme activities and leveraging the Turing network to enable knowledge exchange across partners and new collaborations.

Strategic partners



HSBC	<p>The strategic partnership with The Alan Turing Institute is proving the value that external relationships bring to our global bank. We are exploring the potential for closer engagement on research projects, and are especially delighted to be an active partner in the Turing-HSBC-ONS Economic Data Science Awards 2018. We believe these awards represent an excellent opportunity to develop an industry-academia pipeline for the next generation of quality data scientists. The awards additionally provide an opportunity for HSBC to work more closely with researchers whom we may invite to collaborate and innovate on data science projects within our business.</p>	<p>The partnership facilitates HSBC to be part of a collaborative data science community that is delivering on thought leadership through high-impact white papers. Finally, it offers us the ability to engage with talent pools of data scientists who could play key roles in our bank of the future.</p> <p>Rakshit Kapoor Group Chief Data Officer, HSBC</p>
Intel	<p>The collaboration with The Alan Turing Institute helps us to understand future requirements for processors and systems, to direct our innovation and to optimise our products. The Institute is an excellent partner. Through its university network, we have access to top scientists and young talent.</p>	<p>Working with Turing researchers and embedded Intel architects, we can address the full vertical stack from the application down to the instruction level. Good examples of this approach are the recent results on deep neural network training with reduced arithmetic precision, and on graph analytics applications.</p> <p>Karl Solchenbach Intel, Director Data Center Pathfinding Europe</p>
Lloyd's Register Foundation	<p>2017/18 was a milestone year for our programme as Programme Director Mark Girolami grew the programme and set out his vision. We are thrilled that he has established a large team and built engagements with multiple industry partners. The programme has raised the profile of both the Institute and the Lloyd's Register Foundation as thought leaders in this space, and we are on the cusp of seeing a whole new discipline emerge with associated journals, standards and training. It is particularly rewarding to see Mark Girolami awarded a Royal Academy of Engineering Research Chair position, a sign that data-centric engineering is recognised at the highest level in the sector.</p>	<p>Looking forward, the programme will grow significantly in the next year and we hope to see further examples of impact in data-centric engineering felt in industry and internationally.</p> <p>Ruth Boumphrey Director of Research, Lloyd's Register Foundation</p>
UK Government Defence and Security Community	<p>The spirit of collaboration and partnership at The Alan Turing Institute has demonstrated several success stories this year, with many exciting collaborations. The expanding research network has brought together scientists in different research disciplines, and opened up new applications for data science and machine learning to Defence.</p>	<p>We look forward to working with The Turing Institute to apply advances in artificial intelligence and machine learning to our most difficult problems.</p> <p>Professor Hugh Durrant-Whyte Chief Scientific Adviser for the Ministry of Defence</p>

The collaboration is orientated to enable the Turing to publish its findings and code resulting from its own research advances, allowing the research community to be properly accredited and benefit from advances relevant to their field. In adopting this approach, NATS benefits from improvements offered by academic peer review, keeping a strong connection to leading edge research.

Richard Cannon

Research and Development Team Lead
NATS — UK Air Traffic Services Provider

3.3

New collaborations

Accenture and Turing Alliance for Data Science

In October 2017, we collaborated with Accenture to develop next generation data science and AI tools to improve the detection of fraud and money laundering. The first in a series of projects carries out a proof-of-concept study for detecting anomalies in networks.

As well as developing new tools to help detect fraud, the project aims to drive theoretical advances which could be applied in a range of other settings, for example, intrusion detection for cyber security, detecting faults in safety monitoring systems, and potentially detecting other forms of criminal activity such as modern slavery.

British Airways

British Airways is collaborating with The Alan Turing Institute on a research project that began in January 2018. We are working together to examine some of the airline's commercial data to help with forecasting.

British Airways' expertise as the largest international carrier in the UK and the Institute's power to convene the UK's academic excellence in the field of data science offers exciting opportunities for collaboration and real-world application.

Cystic Fibrosis Trust

In a new collaboration with the Cystic Fibrosis Trust, Turing researchers have access to an anonymised extract of UK CF Registry data with the aim of improving treatment plans for people living with this life-limiting condition. The Registry is a secure centralised database managed by the Cystic Fibrosis Trust, which holds consented health data from over 99% of the people with cystic fibrosis across the UK.

NHS Scotland

The Institute is helping NHS Scotland to improve how they use data science in their daily operations. The availability of high-quality datasets in Scotland makes it eminently addressable.

This project, which grew out of involvement in a Turing Data Study Group, is intended to be a precursor to a more strategic, long-term and transformational engagement between the Institute and NHS National Services Scotland. This complements other Turing activity in Scotland, stemming from our partnership with the University of Edinburgh and links with the Edinburgh Parallel Computing Centre and underlines our commitment to support data science in Scotland.

British Heart Foundation

In autumn 2017, the British Heart Foundation and the Institute ran a competition for the jointly-funded BHF-Turing Cardiovascular Data Science Awards. Funding was awarded with the goal of promoting multi-disciplinary research which could generate data science solutions to problems in cardiovascular research.

Cray

Through a collaboration between Cray, Intel, and The Alan Turing Institute, global supercomputer leader Cray Inc. provided a Cray® Urika®-GX system to Turing researchers hosted at the University of Edinburgh in April 2017. This agile software environment provides a dedicated analytics hardware platform, which enables the development of advanced applications across a number of scientific fields including engineering and technology, defence and security, smart cities, financial services and life sciences. Researchers are currently testing its capability and potential to handle big data and computationally demanding methodologies.

Microsoft

In October 2016, Microsoft pledged \$5 million of Azure cloud computing credits to support Turing researchers. The collaboration provides access to cutting-edge cloud technologies to help supercharge and speed up research at the Institute.

Two Turing doctoral students, Merve Alanyali and Chanuki Seresinhe, both from University of Warwick, used AI and deep neural networks to analyse millions of online photos with Azure. Their findings are providing deep insights into human emotions, providing an understanding of what makes us happy, angry and frustrated.

Turing Fellow Kenneth Heafield from the University of Edinburgh was able to use thousands of Azure graphics processing units for particularly challenging machine translation work.

In October 2017, the Institute collaborated with Microsoft on two video case studies featuring Merve and Chanuki, showcasing Turing research to a global audience.

NATS — UK Air Traffic Services Provider

The Alan Turing Institute is working with NATS, a leading air traffic management and solutions company, to better understand how the field of artificial intelligence could work with the uncertainty inherent in air traffic management, in which humans currently excel at time-critical, operational decision-making. The collaboration, part of the Turing-Lloyd's Register Foundation Programme for Data-Centric Engineering, seeks to understand and explore the gap between human and AI performance in this domain and propose strategies for how this state-of-the-art technology could be used within air traffic management.

3.4

Data Study Groups

A Data Study Group is a five-day 'collaborative hackathon' which aims to find data science solutions to real-world problems. These week-long events allow organisations, industries, charities and others to work with the Institute in a unique and unhampered setting. Several have led to wider and deeper collaborations stemming from opportunities spotted during these intensive weeks.

The success of the Data Study Groups in 2017/18 has been evidenced by their growth and maturation. We now hold three events a year, and in order to support the development of the Data Study Group programme, the Institute appointed Sebastian Vollmer, Turing Fellow and Associate Professor at the University of Warwick, as Director of Data Study Groups. His leadership is underpinned by a team from across the Turing network, including Research Fellows, PhD students and the business team.

The May and December 2017 Data Study Groups focused on industrial collaboration. The September 2017 Data Study Group was themed on health and well-being, with support from Microsoft via access to their Azure cloud.

Sample projects

Alleviating pressures on A&E services

Clinicians from Queen's Hospital worked with researchers in our September 2017 Data Study Group to develop a tool which could enable A&E nurses to safely prioritise and highlight patients with time-critical conditions such as stroke, sepsis and heart attack.

The group of researchers working on this challenge developed an algorithm that will generate diagnostic options based on clinical variables and the free text nurses have inputted into the deep learning network.

After an appropriate pilot trial within clinical grounds, it is anticipated that the algorithm will be embedded into the hospital's IT systems.

Better prediction of emergency hospital admissions

NHS Scotland challenged researchers in the Turing's September 2017 Data Study Group to develop a methodology that would more accurately predict the risk of a patient being admitted to hospital as an emergency in the next 12 months.

After five days, the multi-disciplinary group of eight came up with a model which improved risk calculation scores based on historic patient data. Feedback from NHS Scotland indicated that this new model already performs better than existing methods, despite being a preliminary test case.

Improving code quality

The Defence Science and Technology Laboratory (Dstl) challenge for Turing researchers in the December 2017 Data Study Group was to find a machine-learning solution that could help improve tools for understanding code quality. A direct benefit of this would be greater control of the growth of bugs in new big systems. This is an area sparse in research and Dstl's aim was to begin to drive solutions.

The preliminary work to shape a solution benefited from the range of experience contributed by the diverse group members, prompting a representative of Dstl to comment: "I don't think one person or discipline in isolation could have achieved this."

The Data Study Group week was one of the best experiences I've had working with external suppliers of any kind in my eight years in the Ministry of Defence.

Matt
Dstl

Data science is definitely the solution — my expectations have been surpassed.

Working with a group of researchers thinking so deeply about the challenge was definitely the highlight of the collaboration. The way they critiqued the existing problem and came up with a solution was phenomenal.

Sam Oduro
Senior Information Analyst
NHS Scotland Information Services

3.5

Public policy

The Institute has a national responsibility to engage with the UK government and feed into policy debates around data science and AI.

2017/18 saw growth in the Institute's visibility in government and policy debates and contributions to six calls for evidence on diverse subjects including AI, political polling and infrastructure.

2018/19 will see the Institute's policy remit expand further, following key appointments including a Programme Director for Public Policy, Helen Margetts, and a Policy Fellow, Cosmina Dorobantu.

3.6

Informing policy makers

The Turing has participated in a number of parliamentary calls for evidence and reports in 2017/18, bringing cutting-edge research into government decision-making and discourse. A number of Turing researchers have also briefed parliamentarians privately.

Algorithmic decision-making

The House of Commons Science and Technology Committee made a call for evidence in February 2017 and a group of Turing researchers submitted findings. They proposed the need for further investment for research into the technical, ethical and legal challenges surrounding algorithms in decision-making, in which consideration of the interplay between automated and human decision-making will be crucial. Turing Fellow Sandra Wachter gave oral evidence to the committee in November 2017.

Artificial intelligence

The Institute led a diverse response to a House of Lords Select Committee inquiry on Artificial Intelligence launched in July 2017. The Institute's Programme Director for Defence and Security, Mark Briers, was invited to speak to the committee in November 2017, during the first panel of a session entitled 'What are the dangers of artificial intelligence?'. The discussion included the UK's capability to protect against the impact of AI on cyber security, and whether the law is sufficient to prosecute those who misuse AI for criminal purposes.

Data for the public good

Researchers from the Institute's data-centric engineering programme submitted evidence to the National Infrastructure Commission's Data for the Public Good report, which examined the opportunities that these new innovations present and made recommendations to increase open data sharing to make the most of them. The resulting report recommended that the Institute takes a leading role in developing digital twin technology in the UK.

Political polling and digital media

The Institute responded to a House of Lords Select Committee call for evidence in July 2017 which sought to understand the impact of polls on voters and politicians, and their influence on politics and how we are governed.

Computational modelling

Institute CEO Alan Wilson contributed to a report from the Government Office for Science and the Council for Science and Technology on computational modelling. The report aims to demystify computational modelling, demonstrate the UK's capabilities and make recommendations as to how the UK can take full advantage of the opportunities offered by advances in modelling capability.

3.7

Data governance

Turing researchers contributed to a Royal Society and British Academy report on data governance, published in June 2017, which highlighted the need for agreed ethical frameworks and codes of practice for the use of new technologies including data science.

To devise a solution to issues outlined in the report, the Institute spent nine months working in partnership with the Nuffield Foundation and a number of other leading organisations.

In March 2018, we jointly announced the creation of the new £5 million Ada Lovelace Institute. The first of its kind in the UK, the Ada Lovelace Institute will:

- convene diverse voices to build a shared understanding of the ethical questions raised by the application of data, algorithms and artificial intelligence.
- initiate research and build the evidence base on how these technologies affect both society as a whole, and different groups within it.
- promote and support ethical practices that are deserving of public trust.

Alongside the Institute, the contributing partners are the Royal Statistical Society, the Nuffield Council on Bioethics, the Wellcome Trust, the Royal Society, the British Academy, techUK and Omidyar Network's Governance & Citizen Engagement Initiative.

3.8

Working with the Information

Commissioner's Office

An independent review, *Growing the artificial intelligence industry in the UK*, carried out by Professor Dame Wendy Hall and Jérôme Pesenti, recommended that The Alan Turing Institute work with the Information Commissioner's Office (ICO) to develop a framework for explaining the processes, services and decisions delivered by AI.

The Institute has welcomed this recommendation, and in conjunction with the ICO, has started work on creating this framework.

4. Skills

4.1 Doctoral student successes

4.2 Enrichment student successes

4.3 Statistics

4.4 Turing data science classes

4.5 Internship programme

4.6 Data Skills Taskforce

Data science and artificial intelligence research relies on a specific set of technical skills and competencies.

The significant industry, government, and academic demand for these skills creates a supply problem.

We are committed to taking a leading role in training the next generation of leaders in these sciences, supporting the UK to realise its industrial ambitions. We will also upskill the professional community, developing a programme of executive education and upskilling government and industry through our research programmes and partners.

I'm grateful for having been able to set up and coordinate an interest group on Data and Inequality together with my supervisor. We've set up a series of seminars featuring leading scholars and development industry practitioners reflecting on the influence of the ever-increasing presence of data on processes of development and inequality. Opportunities like this allow me to enrich my studies through opening a dialogue with industry and policy communities and to ensure that my research generates impact beyond academic publishing.

Sanna Ojanperä
First year doctoral student

4.1

Doctoral student successes

Training the next generation of data scientists is core to our purpose as a national institute. Our doctoral scheme has seen growing interest, with applications for our doctoral studentship applications growing by 49% between 2017 and 2018.

A strength of the Turing doctoral scheme is enabling researchers to interact with one another across disciplines and at different stages of their academic career. This peer-to-peer support and multi-disciplinarity is an important piece of the doctoral process at the Institute.

As we have grown, we have refined the breadth of skills needed for what will make a successful data scientist. We have a highly diverse programme of training in which we allow students to gain a variety of skills with opportunities to work on diverse projects. There is also a diversity of funding for studentships — from the Economic and Social Research Council and the Office for National Statistics as well as the Institute's strategic partners — which has allowed us to recruit the best candidates internationally. We look forward to welcoming our new university partners and an even more diverse set of PhDs and projects.

Over the past academic year, a first-year Turing doctoral student, Sanna Ojanperä, has been awarded the 'Future of work' Fellowship from the Organisation for Economic Co-operation and Development (OECD). The scheme aims to promote innovative research that enables policy makers across member countries to better respond to labour issues.

Sanna has also received seed-funding from the Institute to host a series of seminars on data and inequality.

Similarly, doctoral student Corinne Cath co-hosted a public event bringing together experts in AI, ethics and the law.

Finally, our growing alumni community will strengthen current students' experiences as they can tap into this rich resource for expertise and advice on future career progression. We aim to join people up to learn from one another and demonstrate the impact an excellent data science education can have on skills and preparedness for the modern job market.

Being able to talk with students from a range of disciplines over coffee fosters an interdisciplinary culture hard to match.

Corinne Cath

Second year doctoral student

The Alan Turing Institute has provided generous support to my work, not only in terms of a very prestigious studentship but also access to collaborators at Intel whose valuable feedback has led to the publication of my conference paper in 2017.

Edward Chuah

Second year doctoral student

Being at the Turing has provided me the means to take my research to another level. Not only did I learn how to apply deep learning models in my research at a rapid pace, thanks to my Turing colleagues, I also managed to create my own deep learning algorithm to predict the beauty of our surroundings.

This research was published in Royal Society Open Science and was well-received by the press and policy makers, resulting in a policy brief written to a Member of Parliament who was very interested in what this research might mean for public policy.

Chanuki Seresinhe
Enrichment student

4.2

Enrichment students' successes

The Turing Enrichment Scheme offers students currently enrolled on a doctoral programme the opportunity to join us for up to 12 months to boost their skills, grow their network and work alongside Turing researchers.

In order to boost students during their PhDs, we have modified our Enrichment Scheme this year to make it more flexible. In our latest recruitment round, we gave the option to start at different points in the academic year, so students can now join the Turing at a time that most benefits and enriches their research. In addition, we are now offering the opportunity to join us for shorter-term placements of 6 or 9 months in order to enable more researchers to benefit from the scheme.

The success of the scheme relies on Enrichment Scheme students immersing themselves in the Turing community, and early evidence suggests significant gains for the student experience during their time here.

4.3

Statistics

2018

	Applications	Places awarded
Doctoral	304	17
Enrichment	37	22

2017

	Applications	Places awarded
Doctoral	204	16
Enrichment	36	17

4.4

Turing data science classes

To date, the Institute has delivered 26 classes on core data science topics including social data science, tools and techniques, and systems. These were determined by the Institute's Training Steering Group, as part of a formalised schedule of training.

The classes are aimed at first year doctoral students but are open to all. The majority of classes were also livestreamed with recordings posted on the Turing YouTube channel.

In 2018/19, a priority for the Institute's Researcher Development and Training team will be to diversify the training provided, and to develop the Turing student experience.

4.5

Internship programme

The Institute's internship programme, which takes place each summer, invites early career researchers (typically PhD students) to contribute to defined research projects, share knowledge, and be part of a data science community of leading researchers.

Continuing the success of last summer's internship programme, during summer 2017, the Institute hosted 21 doctoral students as interns working on nine separate projects set by a variety of organisations.

Sample projects

Siemens

An internship project with Siemens Industrial Turbomachinery focused on predictive monitoring of gas turbine engines to continuously assess the health of the system.

It centred on developing the tools and knowledge to deliver more efficient maintenance schedules, avoiding the consequences related to unexpected failures, and improving the resilience of these complex engineering structures for a safer society.

National Grid

In a project provided by the National Grid, three interns from the University of Oxford, University of Sheffield and Newcastle University were tasked with providing new and improved methods for forecasting wind and solar generation output in the UK.

The interns undertook weekly visits to the Electricity National Control Centre, familiarising themselves with the Grid's computer systems, database and internal workings.

They implemented methods and produced code. For wind generation, this was using a 'Gaussian process' method, and for solar generation, a chain of different methods using machine learning and computational statistics were used.

Before the internship began, we often couldn't see the wood for the trees when trying to understand some of the problems we were experiencing. Now with the help of our hard-working and intelligent intern, we are finally gaining valuable insight into previously unrecognised relationships.

Tony Latimer

Group Manager — Remote Diagnostics and Services, Siemens Industrial Turbomachinery Ltd

Everyone was extremely helpful and collaborative. It was excellent working on a project with clear impact on people's lives.

Bernardo Perez Orozco

Intern, University of Oxford

4.6

Data Skills Taskforce

The Data Skills Taskforce was set up with the help of the Department for Digital, Culture, Media and Sport, Tech Partnership and Accenture in response to a report written by Nesta called *Analytics Britain* in 2015, which identified a gap for a single body to address the challenges of building a data science skilled UK workforce.

The Taskforce will seek to advise government and interact with all the stakeholders in the skills pipeline — schools, colleges, universities and the providers of continuous professional development.

In 2017, The Alan Turing Institute became a leading supporter of the Data Skills Taskforce. Future plans include a web portal that will showcase reports and activities about digital skills and a call for pioneering projects that it can support to demonstrate best practice.

The digital revolution is here and if the UK is to become a leader in the digital world, then data skills and know-how have to be at the heart of that mission. Put very simply, without data, there's no digital.

Ray Eitel-Porter

Chair of the Data Skills Taskforce and Managing Director Accenture Digital, Applied Intelligence Lead UK & Ireland

5. Engagement

5.1 Event highlights

5.2 Sharing our events with the world

5.3 Our YouTube channel 2017/18

One of our goals as a national institute is to lead the public conversation around data science and AI. We achieve this in part through giving our people a platform to interrogate these topics and explore these challenges in a vibrant environment.

Our events and engagement activities not only provide experts with an opportunity to learn from one another, they also provide a forum for wider engagement and public feedback and debate.

In 2017/18, over 5,300 people came through the doors of The Alan Turing Institute at its headquarters within the British Library in London, engaging with us through our wide range of events.

Event highlights

Turing Lectures

Turing Lectures are flagship events held throughout the course of the year, shining a spotlight on internationally renowned data science and AI experts.

We held seven Turing Lectures last year, all of which showed high levels of engagement. Highlights included Jon Skeet from Google, Lenore and Manuel Blum from Carnegie Mellon, and Sandy Pentland from MIT. Sandy Pentland's lecture, on better living through trusted data, received media coverage in the Financial Times.

Professor Dame Wendy Hall delivered a highly popular Turing Lecture entitled *AI through the looking glass*, which argued that everything is not as it first appears, just as Alice experiences on her famous journey. From this perspective, Hall examined why we need to take a socio-technical approach to every aspect of the evolution of AI in society. She discussed how the UK might position itself in light of the AI Review, which was undertaken as part of the UK government's Industrial Strategy.

AI for Social Good

Our AI for Social Good symposium was held at The Royal Society. It gathered speakers from the world of AI research to discuss challenges and explore how new research and development could provide technical AI solutions to ensure that AI best serves society.

During the one-day event held in February 2018, several researchers demonstrated their practical AI applications and how they are currently being used to enhance and augment our experiences for the better.

Challenges and opportunities in data science

In June 2017, our Scientific Advisory Board members gathered to present their work representing the latest developments in data science. This high-level group of researchers and science practitioners brought together a formidable programme of expertise, and this event saw over 200 people attend in person.

Data Debates

We have collaborated on three Data Debate events with the British Library. The aim of the debates is to bring together a diverse range of thinkers, including scientists, policy makers, authors and historians, to debate an issue important to data science and society.

A Data Debate in June 2017 brought together experts in health data to explore how advances in research could keep pace with privacy concerns.

The second in September was on the use of data in public life, specifically looking at politics, featuring Turing Fellow Helen Margetts and speakers from the Information Commissioner's Office and the Bureau of Investigative Journalism.

The November Data Debate was on the subject of AI and science fiction and explored whether the reality of AI comes close to the visions of popular sci-fi.

French Tech London

A first of its kind, the Institute hosted the Franco-British AI conference, a joint event with French Tech London in January 2018. This was a vital moment to bring together leading scientists, entrepreneurs and organisational leaders from France and the UK to compare best practice and identify ways to work together to produce an environment in which AI can flourish. The event was led by Turing Fellow Adrian Weller, Jérôme Pesenti and French MP and Fields Medallist Cédric Villani.

The Institute also took part in a reciprocal event held in Paris in March 2018.

Cheltenham Science Festival

We participated in the Cheltenham Science Festival through our sponsorship of a panel event on algorithmic decision-making. In 2017, over 40,000 people attended this major science event.

CognitionX

Six Turing researchers took part in themed panels over two days at CognitionX in London, the world's first innovation exchange and awards conference. They explored the impact of AI on business, society and government as well as responsible governance of these technologies.

Industry breakfast briefings

Two breakfast briefings were held on the topics of machine learning in business and what data science can do for executives. We also worked with London Business Angels and The City of London Corporation to co-host an AI-themed pitch event as part of our Angels in The City Programme. Start-ups and early-stage investment-ready companies based in and around London presented to a group of investors.

5.2

Sharing our events with the world

Our video library, shared via our YouTube channel, is an invaluable resource for a global audience to learn from our world-renowned speakers. These videos help us to amplify the great work of our researchers and visitors.

We livestream or record our events and have produced just under 250 videos in 2017/2018. Over the past year, our channel has seen phenomenal growth as well as positive feedback about the value of this resource to the wider data science community and beyond.

Events held 1 April 2017–31 March 2018

Event type	Number of events
Workshops and conferences	75
Industry conference sponsorships	17
Turing Lectures	7
Business engagement	6
Data Study Groups	4
Seminars	33
Total	142 (5,326 people through the door)

Just wanted to say thank you for the quality content. I am a DS Masters student and learnt so much from your recordings/streams.

Benedikt Wagner
via Twitter

5.3

Our YouTube channel 2017/18 Most popular videos

By number of views

Professor Mihaela van der Schaar
Turing Lecture: Data science for medicine

3,776 views

Professor Ben Shneiderman, University of Maryland
Turing Lecture: Algorithmic accountability

2,497 views

Professor Mark Handley, UCL
Meltdown and Spectre

1,807 views

Dr Giorgio Orsi
Outside Insight:
The Meltwater data science platform

1,292 views

Richard Evans, DeepMind
Learning explanatory rules from noisy data

834 views

By watch time

Professor Mihaela van der Schaar
Turing Lecture: Data science for medicine

31,153 mins

Professor Mark Handley, UCL
Meltdown and Spectre

24,416 mins

Symposium — livestream
AI for social good

18,618 mins

Professor Ben Shneiderman, University of Maryland
Turing Lecture:
Algorithmic accountability

18,026 mins

Alex 'Sandy' Pentland, MIT
Better living through trusted data

7,720 mins

Our YouTube channel 2017/18 Top five viewer geographies

1. UK

39%

2. USA

19%

3. Germany

4.4%

4. Canada

2.6%

5. India

2.4%

Views
including livestreams

+ 127%

Subscribers

+ 119%

Number of videos

+ 135%

Views
including livestreams

126k

Subscribers

3.1k

Number of videos

435

Total watch time

1 year
264 days

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 2018.

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.

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:

Trustees**Howard Covington**

Chair

John Aston

Resigned 30 June 2017

Peter Grindrod

Resigned 31 January 2018

Frank Kelly

Appointed 7 September 2017

Richard Kenway**Julie Maxton****Thomas Melham**

Appointed 15 February 2018

Wendy Tan-White**Pam Thomas****Neil Viner****Patrick Wolfe**

Appointed 11 May 2017

Key management**Alan Wilson**

Chief Executive Officer

Jonathan Atkins

Chief Operating Officer

Andrew Blake

Research Director

Resigned 31 March 2018

Donna Brown

Director of Academic Engagement

Ian Carter

Head of IT

Allaine Cerwonka

Interim Director of Academic Engagement

Emma Cook

Head of Finance

Christine Foster

Managing Director for Innovation

Nicolas Guernion

Director of Partnerships

James Hetherington

Director of Research Engineering

Sophie McIvor

Head of Communications

Clare Randall

Head of HR and Operations

Programme Directors

as at 31 March 2018

Mark Briers**Mark Girolami****Anthony Lee****Adrian Weller**

Registered Office

The British Library
96 Euston Road
London, NW1 2DB

Auditors

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

Bankers

Barclays Bank UK PLC
Leicester
Leicestershire, LE87 2BB

Solicitors

CMS Cameron McKenna Nabarro Olswang LLP
90 High Holborn
London, WC1V 6XX

Structure, governance and management

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.

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.

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.

The Institute has recently partnered with eight new 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.

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 30 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/leadership/

Structure, governance and management

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.

In January 2018, the Founders gave their unanimous approval to appoint Sir Adrian Smith as Institute Director. Sir Adrian will take up the post in September 2018 and until this time, Sir Alan Wilson remains in place as the Chief Executive Officer.

The senior management team, led by the Chief Executive Officer/Institute Director, is responsible for the day-to-day management of the Institute's operations and activities. The Chief Executive Officer/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.

Committees

The Institute is supported by a range of committees, whose members include Trustees, the Chief Executive Officer/Institute Director, representatives from the Founder Members, and other individuals with appropriate expertise. The following committees report directly to the Board of Trustees:

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.

Commercial Development Board

This group provides assistance to the Chief Executive Officer/Institute Director and the Board of Trustees in building engagement with industry, charitable foundations, and individuals, in furtherance of the charitable object of the Institute.

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.

Programme Committee

As defined by the joint venture agreement, this committee supports the Chief Executive Officer/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.

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 Chief Executive Officer/Institute Director, the Research Director and those senior staff reporting directly to the Institute Chief Executive Officer/Institute Director. The criterion for setting pay is the market rate taking into account industry standards.

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.

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.

Structure, governance and management

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 22 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.

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.

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.

In 2017, the Institute set up an Equality, Diversity and Inclusion Working Group to drive its work in this area.

Financial review

The Institute is funded through grants from its Founder Members and from strategic and other partnerships. Income of £18.6m has been received during the year. Expenditure of £11.5m has been incurred in the year. A surplus of £7.1m has been transferred to reserves and will be used to fund research and Institute costs during 2018/19 and beyond.

The Institute is moving from its start-up phase to one of increased scale. A full year of research has been completed and the Institute is half way through its second year. Research challenges have been identified and published. Eight new universities have been selected and will join the Institute in 2018, increasing the number of researchers and programmes that will contribute to the Institute's success.

In recognition of its successful start-up the Institute was awarded Independent Research Organisation status in the autumn of 2017, affording the Institute eligibility to apply to UK Research and Innovation (UKRI) and similar bodies for research programme funding independently of its core grants.

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.

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.

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.

Structure, governance and management

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

As at 31 March 2018, the general unrestricted funds of £8.5m include £4.0m of advanced funding received in respect of future years.

The Engineering and Physical Sciences Research Council (EPSRC) has awarded a grant of £42m to enable the Institute to carry out its charitable objectives. This grant is split between operating resource of £22m and capital of £20m. The grant may not be used for any other purpose without the prior written consent of EPSRC. The first drawdown notice in respect of this grant was issued in December 2015 and the grant expires on 31 March 2022. Drawdowns have been made in accordance with the agreed payment schedule through the fiscal year. The annual budget is prepared in consultation with EPSRC and sets out the amount of the grant to be paid to the Institute in the next financial year, and the payment profile for that financial year, with the intention that the profiled payments over the financial year will accord with the Institute's cash flow requirement.

As at 31 March 2018, the Institute holds £7.4m of restricted reserves. This is after allowance has been made for future years commitment under current researcher grant awards amounting to £3.4m.

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).

Risk management

Significant risks to which the Institute and Turing Innovations Limited are exposed 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, impacting the funding of research at the Institute and/or reducing the Institute's ability to find additional strategic partners thereby impacting the Institute's longer term financial sustainability.
- A breach of data security including from cyber-attacks.
- Non-compliance with the recently introduced general data protection regulation (GDPR).
- Inadequate resources available to fulfil its increased role as the national centre for artificial intelligence.
- Unsuccessfully managing the expectations of its increased number of university partners.
- Not delivering 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. This mitigation includes:

- Prudent financial management of the Institute such that it can react to changes in external funding in an agile, controlled manner.
- Robust security processes, both physical and virtual.
- A comprehensive GDPR compliance programme engaging third-party experts where appropriate.
- Building a programme in artificial intelligence that leverages the expertise that exists in our widening network of university partners.
- Building a network of delivery partners to increase the Institute's capacity for engaging with industry and revising our fellowship model to ensure that the Institute can fully engage on a national and international level.
- 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.

Structure, governance and management

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.

The 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.

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.

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

20 June 2018

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

Opinion

We have audited the financial statements of The Alan Turing Institute for the year ended 31 March 2018, 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 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 2018 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.
- have been properly prepared in accordance with the requirements of the Companies Act 2006.

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.

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 when:

- the Trustees' use of the going concern basis of accounting in the preparation of the financial statements is not appropriate.
- 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 12 months from the date when the financial statements are authorised for issue.

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.

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

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.

**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.
- the strategic report and the Trustees' annual report have been prepared in accordance with applicable legal requirements.

**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 strategic report and the Trustees' annual report.

We have nothing to report in respect of the following matters which 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.
- the parent charitable company's financial statements are not in agreement with the accounting records and returns.
- certain disclosures of Trustees' remuneration specified by law are not made.
- we have not received all the information and explanations we require for our audit.

Responsibilities of Trustees

As explained more fully in the Trustees' responsibilities statement set out on page 96, 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.

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

**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.
- 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.

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.

Kingston Smith LLP

Shivani Kothari
Senior Statutory Auditor

For and on behalf of
Kingston Smith LLP
Statutory Auditor
20 June 2018

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 2018

	Note	2018 General funds £	2018 Restricted funds £	2018 Total funds £	2017 Total funds £
Income and endowments					
Donations	2	55,028	3,333	58,361	76,466
Other trading activities		–	1,325,445	1,325,445	166,096
Investment income					
Gross interest		7,345	–	7,345	4,686
Charitable activities					
Grant income	3	6,172,765	11,021,826	17,194,591	15,500,000
Total income		6,235,138	12,350,604	18,585,742	15,747,248
Expenditure					
Raising funds	4	522,537	–	522,537	383,726
Charitable activities					
Education and research	5	4,124,358	6,812,292	10,936,650	12,886,006
Total expenditure		4,646,895	6,812,292	11,459,187	13,269,732

Consolidated Statement of Financial Activities
Incorporating an income and expenditure account
For the year ended 31 March 2018

	Note	2018 General funds £	2018 Restricted funds £	2018 Total funds £	2017 Total funds £
Net income for the year before transfers	8	1,588,243	5,538,312	7,126,555	2,477,516
Transfers between funds	19	1,406,646	(1,406,646)	–	–
Net movement in funds		2,994,889	4,131,666	7,126,555	2,477,516
Reconciliation of funds					
Balance brought forward at 1 April 2017		5,504,264	3,313,342	8,817,606	6,340,090
Balance carried forward at 31 March 2018	20	8,499,153	7,445,008	15,944,161	8,817,606

Balance sheet — Group and charity
At 31 March 2018

	Note	Group 2018 £	Group 2017 £	Charity 2018 £	Charity 2017 £
Fixed assets					
Tangible assets	13	2,155,047	1,969,660	2,074,727	1,830,806
Intangible assets	14	54,633	27,242	-	-
Investments	15	-	-	1	1
		2,209,680	1,996,902	2,074,728	1,830,807
Current assets					
Debtors	16	4,481,283	755,621	3,745,103	589,524
Cash at bank and in hand		16,462,211	14,101,962	16,356,354	14,101,962
		20,943,494	14,857,583	20,101,458	14,691,486
Creditors					
Amounts falling due within one year	17	(3,780,708)	(3,123,982)	(3,309,583)	(2,957,886)
Net current assets		17,162,786	11,733,601	16,791,875	11,733,600

Balance sheet — Group and charity
At 31 March 2018

	Note	Group 2018 £	Group 2017 £	Charity 2018 £	Charity 2017 £
Creditors					
Amounts falling due in more than one year	18	(3,428,305)	(4,912,897)	(3,428,305)	(4,912,897)
Net assets		15,944,161	8,817,606	15,438,298	8,651,510
Funds					
Restricted funds	19	7,445,008	3,313,342	6,939,145	3,147,246
Unrestricted funds General funds	20	8,499,153	5,504,264	8,499,153	5,504,264
Total funds	20	15,944,161	8,817,606	15,436,298	8,651,510

The financial statements of The Alan Turing
Institute were approved and authorised for issue
by the Board of Trustees on 20 June 2018 and
signed on its behalf by:


Howard Covington
Chair

The Alan Turing Institute
Company number 09512457

The notes on pages 107 to 129 form part
of these financial statements.

Consolidated statement of cash flows
For the year ended 31 March 2018

	2018 £	2017 £
Cash flows from operating activities		
Net income for the year	7,126,555	2,477,516
Adjustments for:		
Depreciation of tangible fixed assets	708,093	273,082
Amortisation of intangible fixed assets	12,608	-
Interest received	(7,345)	(4,686)
Increase in debtors	(3,725,662)	(681,838)
(Decrease) /increase in creditors	(827,866)	7,701,724
Net cash generated by operating activities	3,286,383	9,765,798
Cash flows from investing activities		
Purchase of tangible fixed assets	(933,479)	(2,088,301)
Purchase of intangible fixed assets	-	(27,242)
Interest received	7,345	4,686
Net cash from investing activities	(926,134)	(2,110,857)
Change in cash and cash equivalents in the year	2,360,249	7,654,941
Cash and cash equivalents at the beginning of the year	14,101,962	6,447,021
Cash and cash equivalents at the end of year	16,462,211	14,101,962

Notes to the financial statements

For the year ended 31 March 2018

1.

Accounting policies

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

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. 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.

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 Charity 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 Charity therefore continues to adopt the going concern basis in preparing its financial statements.

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 £6,786,787 (2017: £2,311,420).

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.

Expenditure

Expenditure is included in the Statement of Financial Activities on an 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 object 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 attached to the grant is outside of the control of the Charity.

Expenditure allocations

During the year, the Charity has adopted a new method for expenditure allocations, which is based on both staff time and floor space. For consistency, 2017 allocations have been restated but there is no change to the overall expenditure total.

Notes to the financial statements

For the year ended 31 March 2018

1.

Accounting policies (continued)

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.

Cost of charitable activities

The cost of charitable activities includes costs directly associated with research activities and an apportionment of overhead, support and governance costs.

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.

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 (i) 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.

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 (i) as follows:

Software: 3-5 years

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

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.

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 3 months or less.

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.

Employee benefits

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

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.

(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.

Notes to the financial statements
For the year ended 31 March 2018

2.

Donations

	2018 Unrestricted £	2018 Restricted £	2018 Total £	2017 Total £
Intel	-	-	-	76,466
Other	55,028	3,333	58,361	-
	55,028	3,333	58,361	76,466

In 2017, all donations received related to restricted funds.

3.

Grant income

	2018 Unrestricted £	2018 Restricted £	2018 Total £	2017 Total £
EPSRC	6,000,000	3,394,250	9,394,250	9,250,000
University of Cambridge	–	1,000,000	1,000,000	1,000,000
University of Edinburgh	–	1,000,000	1,000,000	1,000,000
University of Oxford	–	1,000,000	1,000,000	1,000,000
University College London	–	1,000,000	1,000,000	1,000,000
University of Warwick	–	1,000,000	1,000,000	1,000,000
Accenture	–	182,000	182,000	–
Ana Leaf Foundation	–	170,000	170,000	–
British Airways — IAG	–	167,700	167,700	–
Department for Business, Energy and Industrial Strategy	–	335,783	335,783	–
HSBC	–	1,000,000	1,000,000	1,000,000
Intel	–	585,276	585,276	–
Scottish Enterprise	–	–	–	250,000
Other	172,765	186,817	359,582	–
	6,172,765	11,021,826	17,194,591	15,500,000

In 2017, grants received totalling £7,500,000 related to restricted funds.

Notes to the financial statements
For the year ended 31 March 2018

4.

Cost of raising funds

	2018 Total £	2017 Total £
Cost of raising funds	522,537	383,726
	522,537	383,726

5.

Cost of charitable activities

				2018
	Grants payable £ See over	Other direct costs £	Support costs £ Note 6	Total £
Research	2,930,470	4,954,929	2,759,975	10,645,374
Workshops and conferences	–	291,276	–	291,276
	2,930,470	5,246,205	2,759,975	10,936,650
	Grants payable £ See over	Other direct costs £	Support costs £ Note 6	Total £
Research	6,602,028	3,847,453	2,300,229	12,749,710
Workshops and conferences	–	136,296	–	136,296
	6,602,028	3,983,749	2,300,229	12,886,006

5.

Cost of charitable activities

Analysis of grants payable

	2018 £	2017 £
Analysis of institutions receiving grants		
University of Cambridge	771,707	1,254,081
University of Edinburgh	722,437	1,145,575
University of Oxford	188,776	1,574,471
University College London	227,064	1,429,305
University of Warwick	683,939	1,198,596
Imperial College London	274,909	–
Other	61,638	–
	2,930,470	6,602,028

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.

6.

Support costs

	2018 £	2017 £
Travel and subsistence	17,808	12,672
Office costs	16,842	8,386
Rent, rates and service charge	133,853	134,350
Repairs and maintenance	3,352	3,804
Subscriptions	18,080	5,499
Staff costs	1,725,900	1,508,211
Staff training and hospitality	37,986	16,812
Recruitment	62,118	171,472
Telecommunications	9,989	8,284
Computer running costs	124,522	17,230
Legal fees	90,361	151,370
Other professional fees	191,566	47,865
Consultancy	19,285	58,118
Depreciation	99,523	15,576
Amortisation	12,608	-
Insurance	5,689	8,882
Marketing	59,381	32,481
Foreign exchange loss/(gain)	74,691	(23,433)
Sundry costs	11,020	5,038
Governance costs (see note 7)	45,401	117,613
	2,759,975	2,300,229

Notes to the financial statements
For the year ended 31 March 2018

7.

Governance costs

	2018 £	2017 £
Auditor's remuneration:		
Audit of the financial statements	16,742	12,600
Other services	16,227	3,338
Legal and professional fees	12,432	101,675
	45,401	117,613

8.

Net income

	2018 £	2017 £
Net income is stated after charging:		
Depreciation	708,093	273,082
Amortisation	12,608	-
Operating lease rentals	101,664	633,258
Auditor's remuneration:		
Audit of the financial statements	16,742	12,600
Other services	16,227	3,338

9.

Staff costs

	2018 £	2017 £
Staff expenses includes the following employee costs:		
Wages and salaries	3,147,132	1,324,212
Social security costs	339,773	154,105
Other staff costs:		
Contractors	556,841	626,636
Secondments	489,865	1,145,338
Pension costs	215,508	77,917
	4,749,120	3,328,208

Key management and employed programme directors include those involved in executive decision-making and are listed on page 2. Their total employee benefits in the year amounted to £1,254,224 (2017: £1,224,717).

Included in the above costs are termination payments to five individuals totalling £61,136 (2017: £nil).

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

	2018	2017
£60,000 - £69,999	7	-
£70,000 - £79,999	1	2
£80,000 - £89,999	2	1
£90,000 - £99,999	1	-
£140,000 - £149,999	2	1
£150,000 - £159,999	1	-
£220,000 - £229,999	-	1

Notes to the financial statements

For the year ended 31 March 2018

10.

Trustees' payments

Howard Covington received remuneration totalling £18,000 (2017: £18,000) during the year for the purpose of being Chair of the Charity. No other Trustee received any remuneration or emoluments.

Five Trustees received travelling and accommodation expenses during the period totalling £3,204 (2017: 3 trustees, £8,537).

11.

Employees

	2018	2017
<hr/>		
The average number of employees by function were:		
Executive	5	4
HR, Operations and Finance	10	6
Communications and events	9	5
Research and training	28	8
IT	4	1
Policy	3	1
Business partnerships	8	2
	67	27

12.

Taxation

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.

13.

Tangible fixed assets — group

	Leasehold improvements £	Equipment and machinery £	Total £
Cost or valuation			
At 1 April 2017	1,529,892	715,231	2,245,123
Additions	532,774	400,705	933,479
Transfer to intangible fixed assets	—	(39,999)	(39,999)
At 31 March 2018	2,062,666	1,075,937	3,138,603
Depreciation			
At 1 April 2017	161,438	114,025	275,463
Charge for the year	425,391	282,702	708,093
At 31 March 2018	586,829	396,727	983,556
Net book value			
At 31 March 2018	1,475,837	679,210	2,155,047
At 31 March 2017	1,368,454	601,206	1,969,660

13.

Tangible fixed assets — charity

	Leasehold improvements £	Equipment and machinery £	Total £
Cost or valuation			
At 1 April 2017	1,529,892	576,377	2,106,269
Additions	532,774	400,705	933,479
At 31 March 2018	2,062,666	977,082	3,039,748
Depreciation			
At 1 April 2017	161,438	114,025	275,463
Charge for the year	425,391	264,167	689,558
At 31 March 2018	586,829	378,192	965,021
Net book value			
At 31 March 2018	1,475,837	598,890	2,074,727
At 31 March 2017	1,368,454	462,352	1,830,806

14.

Intangible fixed assets — group

	Software £
Cost or valuation	
At 1 April 2017	27,242
Transfer from tangible fixed assets	39,999
At 31 March 2018	67,241
Amortisation	
At 1 April 2017	—
Charge for the year	12,608
At 31 March 2018	12,608
Net book value	
At 31 March 2018	54,633
At 31 March 2017	27,242

15.

Investments in subsidiaries — charity

Investment in subsidiary
£

Cost

At 1 April 2017 and 31 March 2018

1

The investment represents 100% of the share capital of Turing Innovations Limited, a company incorporated in England & Wales, company number 10015591. The following is an extract of its results for the 13-month period to 31 March 2018:

	2018 £
Income	1,491,542
Expenditure	(985,678)
Net income	505,864
Total assets	1,646,312
Total liabilities	(1,140,448)
Net assets	505,864

Included in the results for the 13-month period noted above, is income and a profit of £166,096 generated in March 2017 and consolidated in the Institute's 31 March 2017 financial statements.

16.

Debtors

	2018 Group £	2017 Group £	2018 Charity £	2017 Charity £
Trade debtors	4,201,579	675,448	2,796,076	509,352
Prepayments and accrued income	257,114	71,500	257,114	71,500
Intercompany	-	-	669,323	-
Other debtors	22,590	8,673	22,590	8,672
	4,481,283	755,621	3,745,103	589,524

Trade debtors above are measured
at amortised cost.

Notes to the financial statements
For the year ended 31 March 2018

17.

Creditors: amounts falling due within one year

	2018 Group £	2017 Group £	2018 Charity £	2017 Charity £
Trade creditors	485,461	359,047	485,461	192,951
Taxation and social security	505,771	70,816	240,682	70,816
Grant creditors	1,078,299	1,499,942	1,078,299	1,499,942
Accruals and deferred income	1,695,602	1,141,546	1,489,566	1,141,546
Other creditors	15,575	52,631	15,575	52,631
	3,780,708	3,123,982	3,309,583	2,957,886

18.

Creditors: amounts falling due in more than one year

Grant creditors	3,428,305	4,912,897	3,428,305	4,912,897
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19.

Restricted funds

	At 1 April 2017 £	Income £	Expenditure £	Transfers £	Balance 31 March 2018 £
a. EPSRC capital fund	829,454	3,394,250	(419,319)	(690,000)	3,114,385
b. Research fund	89,561	5,003,333	(4,941,924)	50,468	201,438
c. Lloyd's Register Foundation fund	887,084	–	(446,905)	(118,482)	321,697
d. HSBC fund	985,595	1,000,000	(112,188)	(10,282)	1,863,125
e. Scottish Enterprise fund	250,000	–	(71,238)	–	178,762
f. Intel Corporation fund	116,541	585,276	(312,171)	(62,700)	326,946
g. British Airways fund	–	167,700	–	(19,036)	148,664
h. Accenture fund	–	182,000	(12,132)	–	169,868
i. Ana Leaf Foundation fund	–	170,000	–	–	170,000
j. Rutherford Fellows fund	–	335,783	(37,941)	–	297,842
k. Other	–	186,817	(221,295)	180,896	146,418
Charity restricted	3,158,235	11,025,159	(6,575,113)	(669,136)	6,939,145
l. Turing Innovations Limited defence and security fund	155,107	1,325,445	(237,179)	(737,510)	505,863
Consolidated restricted total	3,313,342	12,350,604	(6,812,292)	(1,406,646)	7,445,008

Notes to the financial statements

For the year ended 31 March 2018

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.

- a. The EPSRC capital fund was granted by the Engineering and Physical Sciences Research Council for the purposes of capital expenditure on its premises. The transfer to unrestricted funds has been authorised by the funder to cover office rent costs.
- b. The Research fund represents amounts received from the Charity's members that must be directly spent on research activities.
- c. The Lloyds Register Foundation fund will finance a research programme that supports data-centric engineering.
- d. The HSBC fund will finance a research programme that supports collaboration in economic data science.
- e. The Scottish Enterprise fund will support the expansion of research activities in Scotland.
- f. The Intel Corporation fund will finance data science research and its application.
- g. The British Airways fund will finance research in data science and AI underpinning revenue management computational challenges.
- h. The Accenture fund will finance research in next generation data science and AI capabilities to address key challenges faced by large business and government organisations in security, fraud and risk.
- i. The Ana Leaf Foundation fund will finance research in health-related projects, particularly support for PhD students and research software engineers.
- j. The Rutherford Fellows fund will finance ten international researchers until 31 March 2019.
- k. These funds include numerous grants from companies such as NATS, Samsung, and NHS Scotland. Each has a specified purpose.
- l. The defence and security fund will finance the Institute's defence and security research programme.

19.

Restricted funds (continued)

	At 1 April 2016 £	Income £	Expenditure £	Transfers £	Balance 31 March 2017 £
a. EPSRC capital fund	613,906	1,250,000	(175,452)	(859,000)	829,454
b. Research fund	3,564,384	5,000,000	(8,474,823)	-	89,561
c. Lloyd's Register Foundation fund	999,297	-	(112,213)	-	887,084
d. HSBC fund	-	1,000,000	(14,405)	-	985,595
e. Scottish Enterprise fund	-	250,000	-	-	250,000
f. Intel Corporation fund	138,931	76,466	(98,856)	-	116,541
g. GCHQ Defence and security fund	-	166,096	(10,989)	-	155,107
	5,316,518	7,742,562	(8,886,738)	(859,000)	3,313,342

20.

Analysis of net group assets between funds

	Unrestricted £	Restricted £	Total £
At 31 March 2018			
Tangible fixed assets	1,956,282	198,765	2,155,047
Intangible fixed assets	(1)	54,634	54,633
Net current assets	6,542,872	10,619,914	17,162,786
Long term creditors	–	(3,428,305)	(3,428,305)
	8,499,153	7,445,008	15,944,161
At 31 March 2017			
Tangible fixed assets	1,748,637	221,023	1,969,660
Intangible fixed assets	–	27,242	27,242
Net current assets	3,755,627	7,977,974	11,733,601
Long term creditors	–	(4,912,897)	(4,912,897)
	5,504,264	3,313,342	8,817,606

Notes to the financial statements
For the year ended 31 March 2018

21.

Financial commitments

The Charity was committed to making the following total payments under non-cancellable operating leases as at 31 March 2018.

	2018 £	2017 £
Payments due		
Within 1 year	689,617	689,617
Between 2 and 5 years	1,609,106	2,298,723
	2,298,723	2,988,340

22.

Related parties

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 year end.

	Grant expenditure awarded £	Grant income received £	Re-charged expenditure £	Year end debtor/ (creditor) £
Current year to 31 March 2018				
Engineering and Physical Sciences Research Council	–	9,394,250	36,819	(22,151)
University of Cambridge	659,005	1,000,000	34,118	(17,018)
University of Edinburgh	729,416	1,000,000	16,613	59,738
University of Oxford	119,234	1,000,000	24,600	205,512
University College London	169,875	1,000,000	117,201	(46,820)
University of Warwick	677,613	1,000,000	–	126,944
	2,355,143	14,394,250	229,351	306,205

Notes to the financial statements
For the year ended 31 March 2018

22.

Related parties
Continued

	Grant expenditure awarded £	Grant income received £	Re-charged expenditure £	Year end debtor/ (creditor) £
Prior year to 31 March 2017				
Engineering and Physical Sciences Research Council	–	9,250,000	71,363	–
University of Cambridge	1,254,081	1,000,000	58,305	(27,224)
University of Edinburgh	1,145,575	1,000,000	94,484	(4,838)
University of Oxford	1,574,471	1,000,000	125,413	239,470
University College London	1,429,305	1,000,000	415,584	45
University of Warwick	1,198,595	1,000,000	102,301	–
	6,602,028	14,250,000	867,450	207,453

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

Transactions with subsidiary

During the year, the parent charity re-charged staff and other costs of £748,499 (2017: £nil) to the subsidiary company, Turing Innovations Limited. At the year end, Turing Innovations Limited owed The Alan Turing Institute £669,323.

23.

Company status

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.

The Alan Turing Institute

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