Turing Enrichment Scheme
2021/22 Yearbook
The Turing’s Enrichment scheme offers PhD students the opportunity to enhance their research by widening their networks and broadening their knowledge and skills through collaboration.

In 2021/22 our largest cohort of 76 Enrichment students joined the Turing.

For the first time, students were based across three locations (Turing’s London office, in Leeds, within the Leeds Institute for Data Analytics (LIDA) and in Bristol, within the Jean Golding Institute (JGI)), each location providing its own unique value, resources and academic community.

The cohort started during the tail-end of the Covid pandemic. In spite of the uncertainty and challenges of this time, the cohort became a valuable part of our community, making the most of collaboration opportunities and inspiring through their diverse research, from participating in Data Study Groups, attending as well as presenting in AI UK 2022, to contributing to Turing projects, such as the “Data Science and AI for Music”, the “Environmental Data Science Book” and the DECOVID project.

We’re impressed by how your cohort seized the opportunities available to develop not only your research, but also to develop as researchers. We hope you continue to feel part of the Turing community and look forward to hearing from you in your next steps.

Academic Services Team
Georgia Koumara, Samantha Selvarajah, and Tomas Chandler

For our cohort, the PhD experience has been plagued (literally!) with cancellations, restrictions, and isolated working. Our 2021-22 Enrichment placements brought some hope in times of uncertainty, and a much-needed chance to build the networks and collaborations that lie at the heart of impactful and enjoyable research. As the COVID-19 vaccinations were being distributed, our cohort seized the opportunity to meet new people and find community in our shared experiences. Many moved to London from across the UK, even with the threat of repeated lockdowns and separation from family and friends. Despite cancellations, continuously changing restrictions, and weeks of working from home, we slowly integrated into the Alan Turing Institute community.

We had to take a lot of initiative to run our own digital social events and create our own opportunities to build up our network for all Enrichment students. Engaging through Turing Interest Groups, research programmes, Zoom games and speed dates, and online training courses, we made our digital tools work for us. Eventually, mercifully, we transitioned to hybrid working and began to map the 2D faces with whom we had already spent hours talking, to our new 3D friends. In addition to a successful Christmas party that brought the majority of our cohort under one roof for the first time, the rest of the year was populated by many after-work pub trips, with the precise time at which “after work” began turning out to be rather malleable to our collective daily motivation.

Our lunchtime discussions in the office kitchen gradually morphed into semi-formalised lunch and learn sessions, broadcast over Zoom, where each week one of us would present our research or other topic of interest, followed by a group discussion where we shared expertise and advice on tackling unsolved problems. We also reached out to external speakers as the lunchtime talk tradition evolved, and our seminar from DeepMind engineers proved to be a highlight that attracted attendees from across the Turing community.

Our cohort was incredibly diverse, both personally and in our research areas. From our digital and physical meet-ups, it was clear we originated from across the globe by nationality and ethnicity. As we discussed our research the applications covered a vast range, including but (definitely) not limited to urban noise analysis, medical drug discovery, cyber security, animal tracking from space, urban planning, hate speech analysis, cleaning pictures of stars and galaxies, and network speeds. Some of the cohort were more theory than application-based, improving the algorithms or models in areas such as reinforcement learning, fairness, explainability, ontologies, and anomaly detection. On paper we seemed to have little overlap between students, but through socialising and growing our network at the Turing, these overlaps grew into more collaborations, papers, and reciprocal inspirations.

From various discussions, we are confident this placement enriched all of our PhDs in unforeseen, beneficial ways. It has been an absolute pleasure being this cohort’s representatives.

To the future students at the Turing: Use this time to attend as many events as you can in person! You never know who you will meet at every event at the Turing and what inspiration or opportunity can arise from a simple conversation over coffee or juice or any of the delicious drinks in the fridge (remember to say thanks to Otis!). Be active; be present. You are an essential part of this amazing community now.

We wish you all the best of luck with the remainder of your PhDs!

2021-22 Enrichment Community Champions and Student Representatives

Tom Bewley, Kate Highnam, Rachael Pirie, and Peter Strong
Note:
The following students were also part of the 2021/22 Enrichment cohort:

Charlie Pilgrim (University of Warwick), Chaoyi Lu (University of Dublin), Christopher Parsonson (University College London), Edward Cunningham (University of Warwick), Jack Doyle (University of Southampton), James Fulton (University of Edinburgh), Laura Fritsch (University of Oxford), Marios Kalomenopoulos (University of Edinburgh), Michael Smith (University of Hertfordshire), Paula Martin-Gonzalez (University of Cambridge), Premdeep Gill (University of Cambridge), Rafiah Patel (City, University of London), Rebecca Green (Kings College London), Riccardo Barbano (University College London), Samuel Bell (University of Cambridge), Seng Ah (Michelle) Lee (University of Cambridge), Shishir Rao (University of Oxford), Woojung Kim (University of Warwick).
Adam Ó Conghaile, University of Cambridge

Project title
Topology in Logic and Algorithms

Supervisors
Professor Anuj Dawar

Main outcomes of my research
A new understanding of how the mathematics of topology can be used to overcome known limitations of current neural networks and new algorithms based on this approach. In particular, my research has led to the creation of a new family of topological algorithms for the problem of constraint satisfaction which occurs throughout Computer Science and Machine Learning. This is an important step on the way to understanding the maximum amount of information that can be efficiently extracted from data. In future, these algorithms could be used to extend the expressive power of graph neural networks in all applications.

Being a Turing Enrichment student
To broaden my academic horizons far beyond my own field by learning from and working with people from a wide range of backgrounds.

At many institutions, theoretical computer scientists, such as myself, are frequently grouped together with other members of a “Theory” group despite working on the theory for very different areas of computer science. At the Turing, I had a wonderful opportunity to think outside of this particular box and to work with people who understand the real problems to which my theory may have applications. In particular, I got to speak to people already applying topological methods to data science and to understand the challenges and limitations they have found in practice - both in implementing topological solutions and in communicating them to wider audiences. This could only have happened at the Turing and has already greatly influenced the direction of my future work on this project.

Alberto Caron, University College London

Project title
Bayesian Learning in the Counterfactual World

Supervisors
Ioanna Manolopoulou, Gianluca Baio

Main outcomes of my research
My research mainly involves combining the two fields of Machine Learning and Causality, with particular focus on Probabilistic Machine Learning and Bayesian Nonparametric methods. I work on methodology and extensions of Causal Machine Learning algorithms for Off-Policy Learning and for predicting Individualized Treatment Effects (ITE). Estimation of the effects of an intervention at an individual level is of interest in many disciplines (precision medicine, socio-economic sciences, personalized marketing, etc.) where learning heterogeneous response, in order to design highly-personalized optimal policies, is crucial.

Impact of my work
I have so far two journal papers and a conference paper, with an additional one under review. Causal/Counterfactual Learning algorithms are very powerful tools in every applied discipline where highly personalized decision-making is crucial (precision medicine, socio-economic sciences, education science, etc.)

Being a Turing Enrichment student
I mainly have built an incredible network with both students and fellows, that I am sure will translate into interesting collaborations in the future. I have also benefitted particularly from Turing talk, seminars and training courses to boost my research agenda
Alexander Lyttle, University of Birmingham

Project title
Hierarchically Modelling Many Stars

Supervisors
Dr Guy R. Davies, Professor Amaury Triaud

Main outcomes of my research
My research area is in the asteroseismology (study of stellar oscillations) of solar-like stars. We can detect these oscillations by measuring the brightness fluctuations of the star over time and decomposing these into characteristic frequencies. These carry information about the density of the star and its internal composition. Asteroseismology has hugely improved the precision of mass, radius and age estimated by comparison to computational stellar models. These help us further understand the evolution history of the Milky Way and exoplanet systems. I am researching machine learning methods to improve the inference of these fundamental parameters with asteroseismology.

Impact of my work
We produced a new method for determining the mass, radius, age and chemical composition of stars using a hierarchical Bayesian statistical model. This enabled us to encode information about the population of stars into the inference of individual parameters. Modelling stars one-by-one is slow and typically involves interpolating a dense grid of simulated stars. We trained a neural network on these simulations to more quickly and intelligently learn the map from fundamental parameters to observables. As a result, we improved the precision of stellar masses and ages, and broke the degeneracy between helium abundance and parameters governing stellar convection. Ultimately, better stellar parameters lead to an improved understanding of our place in the Milky Way, where we came from and where we are going.

Being a Turing Enrichment student
My time as an Enrichment student began with engaging in the Turing Community Week where I discovered the exciting research being carried out at the Turing. During this week, I learnt to communicate my research to a wider, non-specific audience. It gave me the confidence to explore other research areas and share ideas with the wider community. However, I noticed that there was no astrophysics-specific research group at the Turing. Towards the end of the scheme I collaborated with other Turing fellows in supporting the application for a Space Science Interest Group. This exposed me to the growing astronomy community at the Turing and gave me contacts for future research and collaboration.

Following the Turing Way handbook has helped me develop more open, reproducible science and code. Meanwhile, I improved my coding skills using the online courses and handbooks offered by the Turing, such as Research Software Engineering with Python. As a result, I developed an open-source Python package to go with my research and contributed to several others in the open-source community. The ethos at the Turing has also inspired and influenced others I have collaborated with, leading to more open science and code development in our research area.

Andrea Luppi, University of Cambridge

Project title
Complex yet Resolved: Time, Frequency, and Information Decomposition Approaches to Brain Function and Human Consciousness

Supervisors
Dr Emmanuel Stamatakis, Professor David Menon

Main outcomes of my research
My PhD in neuroscience focused on the similarities and differences between the various ways that the brain can become unconscious. I have developed a neurobiologically realistic model of the effects of anaesthesia on brain activity. This approach revealed that anaesthesia changes brain dynamics in a way similar to what occurs in the brains of brain-injured patients suffering from a disorder of consciousness. Crucially, since the effects of anaesthesia are only temporary, this means that we can now obtain mechanistic insights about how the brain emerges from unconsciousness: the first step towards personalised medicine models to treat patients.

Being a Turing Enrichment student
My time at the Turing exposed me to a broad range of research: some of it was far beyond my own area of expertise, and showed me how researchers in other fields think about their discipline, and how they all draw from the same machine learning and data science tools in such different ways. I found this very inspiring, as it helped me view my own approach not as the default, but as a deliberate choice. On the other hand, it was striking to discover that some of the challenges I had been facing have already been resolved in different fields, but under a different name. Not only did I save much time by not having to reinvent the wheel; this experience also made me realise just how much untapped synergy there is between fields of science. I also benefited tremendously from the support of the Turing’s Academic Mentors, who provided advice from perspectives I could not have otherwise considered: not only academia, but also business and industry. This has been invaluable in shaping my outlook on my future career.

“My time at the Turing exposed me to a broad range of research: some of it was far beyond my own area of expertise.”
Andreea Avramescu, University of Manchester

Project title
Data-driven optimisation of the development and delivery of personalised medicine biopharmaceuticals

Supervisors
Richard Allmendinger, Manuel Lopez-Ibanez

Main outcomes of my research
My current research draws on tools from operations research and machine learning to guide the optimisation of the manufacturing tasks and delivery strategies of personalised medical products. These revolutionary treatments re-engineer the patient’s own cells and are capable of treating genetic and progressive disorders, such as last stage cancer. The novelty of the products places them at the juncture of multiple existing healthcare supply chains and thus their commercialisation lacks appropriate and holistic optimisation models. Identifying setups and processes that are cost-efficient, sustainable, flexible and allow for on-time delivery of products in personalised vein-to-vein supply chains.

Impact of my work
Personalised therapies are currently used only when other treatment options are not feasible anymore. This approach is implemented mainly due to their logistical challenges which lead to high costs and lengthy delivery times. Our work is looking at finding supply chain strategies that can manufacture and deliver individualised medicine at an affordable cost for society. Reducing the prices of these products and their shelf-life related challenges is one of the key elements in allowing breakthrough therapies to become widely available.

Being a Turing Enrichment student
While being an Enrichment student I was part of multiple research groups which considerably improved my ability to work as part of large teams. To give an example, I worked closely with Dr. Emma Karoune and Dr. Kirstie Whitaker, as well as 2 other Enrichment students as part of the DECOVID project. Our main responsibility was to help the analytics teams in maintaining and checking the reproducibility of their analysis in the Data Safe Haven.

I also participated in multiple training courses, such as Research Software Engineering with Python and Data Science and AI educators’ programme. As currently I am working as a Lead Instructor this course was incredibly useful, not only for my teaching related activities as part of my PhD, but also for the broader scope of my career.

Andrew Mitchell, University College London

Project title
Predictive Modelling of Complex Urban Soundscapes: Enabling an engineering approach to soundscape design

Supervisors
Professor Jian Kang, Dr Phil Symonds

Main outcomes of my research
My research at the Turing has resulted in a series of new resources and tools to enable researchers to study how people perceive the soundscapes of urban public spaces. First we created and openly published an international database of soundscape assessments paired with audio recordings, videos, and environmental data. Second, I developed a new open source Python package to analyse and visualise this data in new ways. Finally, I developed a computational model which aims to predict how people perceive urban soundscapes (whether they are pleasant, annoying, calm, etc.) based on measurable data. All of these tools lay the foundation for advancing beyond urban noise control to instead designing healthier and better sounding cities.

Impact of my work
Being a Turing Enrichment student
The main benefit of being a Turing Enrichment student was how much it exposed me to open data and open science practices. As a result of my time at the Turing, I was able to make sure not only that our journal papers were published open access, but that all of our data and analysis tools were made openly available. The resources at the Turing, particularly the Research Software Engineering course and the Tools, Practices, and Systems group, gave me the tools I needed to drastically improve my own programming and the level of transparency and reproducibility in my work. Personal guidance from TPS and the Turing Way was what enabled me to turn our research group’s data into an international database which can be used and built upon by future researchers, rather than languishing just in our own data servers. The highlight of my research that came out of the Turing was taking what I’d learned in the RSE course to turn my messy and inscrutable research code into a package which could actually be published and used by others.
Arnaud Dyevre, London School of Economics

**Project title**
Essays on Firm Heterogeneity

**Supervisors**
Xavier Jaravel (LSE), Benjamin Moll (LSE)

**Main outcomes of my research**
The distribution of firm sales and employment is vastly more unequal than the distribution of income: a few large “superfirms” account for a disproportionate share of sales, assets and employment in every national economy.

In my research, I study the determinants of inequality between firms and the consequence of this inequality for long-term growth and market concentration.

**Impact of my work**
During my time at the Turing, I have published an article about the role of firms' global investments on the local growth of the domestic economies where they invest. (Crescenzi, R., Dyèvre, A., & Neffke, F. (2022). Innovation catalysts: how multinationals reshape the global geography of innovation. Economic Geography, 1-29.).

I am also currently engaged in collaborative projects with the central banks of Rwanda, Uganda and Belgium about the role of firm-to-firm production networks in growth. I expect these two projects (Rwanda/Uganda and Belgium) to deliver policy-relevant outputs. Finally, I am using HMRC’s administrative data to study the impact of migration on firm-level performance in the UK. The close collaboration with HMRC will lead to policy-relevant outputs as well.

**Being a Turing Enrichment student**
Being able to take part in the Turing’s daily activities has been a unique opportunity to expand my horizons research-wise. I have benefited tremendously from the Economic Data Science online seminars and from interactions with researchers in the group. Turing researchers’ skillsets are typically very different from mine and I have learned a lot from them about graph theory and causal machine learning.

Benjamin Wallis, University of Leeds

**Project title**
Change in the ice speed and mass balance of the Antarctic ice sheet from satellite observatory

**Supervisors**
Dr Anna E. Hogg, Professor David Hogg

**Main outcomes of my research**
I used satellite remote sensing data to study glaciers in Antarctica. Using computer vision techniques, I measure ice speed, surface elevation change, terminus change and meltwater plumes. With this data, I investigate dynamic changes in Antarctica’s ice and aim to improve our understanding of how Antarctica responds to the climate.

**Impact of my work**
My work has shown previously unobserved seasonal speed changes on the Antarctic Peninsula’s western coastline, which show how glaciers in this region are sensitive to climate on short timescales. Understanding the factors which control ice discharge from Antarctica is crucial in accurately projecting future sea-level rise.

**Being a Turing Enrichment student**
During my time on the Enrichment scheme I have developed my use of deep-learning computer vision techniques. This includes work to detect glacial sediment plumes, which I presented at a poster session at the UK Antarctic Science Conference.

I have also been much more involved with outreach and EDI initiatives while a being Turing Enrichment student, including Polar Impact’s Polar Portals campaign which is supported by the Turing.
Chang Luo, University of Edinburgh

Project title
Company Relational Modelling via Graph Neural Networks

Supervisors
Tiejun Ma, Mihai Cucuringu

Main outcomes of my research
My research area focuses on modelling data-driven company relationships in a quantised way. Since real-world company relationships are complex and dynamic, in order to effectively capture and model them, we treat the task as a two-folded problem: 1) Relational network reconstruction, and 2) Relation factor extraction.

Relational network reconstruction adapts the state-of-the-art graph neural network techniques to model the message propagation and information diffusion processes between real-world company events. Relation factor extraction replies on natural language processing and matrix analysis technique to calculate quantised relation factors among companies.

Impact of my work
The core methodology and research outcome could contribute to related downstream decision-making processes. For instance, policy makers and public service departments from the economic sectors could therefore calculate quantized relational factors between firms, working as real-time inputs to the macroeconomic analysis models. Investment funds and FinTech firms can benefit from the relational modelling technique and build financial networks from their perspectives to effectively utilise both spatial relationship information and temporal financial statistics for predictions and decision support.

Being a Turing Enrichment student
Being a Turing Enrichment student along with the cohort is an extraordinary experience. It opens a window to me allowing me to feel the fabulous kingdom of big data and explore the various advanced mathematical and statistical techniques built on it.

For me, the most valuable support I gained from the Turing comes from the open-minded people. As we come from different research fields, with different knowledge backgrounds, every unique talk can spark the fire of inspiration, providing different angles of views towards my research questions. All of these owe to the naturally collaborative environment provided by the Alan Turing Institute. It is truly the great place for inter-disciplinary research.

Through the close collaboration with my Turing mentors, I feel amazed that how quickly my PhD research difficulties begin to fall into the right place. Not only their expertise guides me to shape my research solutions, but also their ways of tackling problems, and their lifetime experience inspire me to keep on the right track of my future.

David Massegur, University of Southampton

Project title
Deep Learning for Multiphysics Modelling and Optimisation in Aerospace Applications

Supervisors
Andrea Da Ronch, John Shrimpton

Main outcomes of my research
Development of machine learning and deep learning technologies to improve the computational efficiency of numerical simulations related to real-world applications in aerospace field. High-fidelity computational fluid dynamics (CFD) solvers are computationally expensive and impractical for the highly demanding design processes in the aerospace industry. Artificial intelligence, and more precisely deep learning, has the potential of inferring mathematical models to predict highly complex phenomena from data. The idea is the develop fit-for-purpose deep learning frameworks that can replicate the CFD simulation turnaround but with a significant computing cost saving.

Impact of my work
With a machine-learning based aeroelastic solver of a wing section flying in transonic regimes, a computing saving of over 95% was obtained on new simulations. Including the generation of training data, the total saving was over 40%. Another project involved a convolutional autoencoder for the prediction of ice accretion on a wing section across the envelope of condition seen during flight. New icing simulations can be completed within seconds rather than days. With significantly faster aerodynamics simulations, the number of design iterations can be increased which will lead to significantly more refined aerospace products.

Being a Turing Enrichment student
Thanks to the Enrichment scheme I had access to the training courses offered to us. To highlight the research software engineering course, which significantly improved my knowledge in python, github, anaconda and other crucial packages. The writing articles course was very helpful to improve my academic writing skills, which differs significantly from usual practice in my previous professional experience. The interest groups are very useful to have access to seminars regarding the topics relevant to your research. Last but not least, for me the highlight of my enrichment placement is engaging as a co-organiser of the ‘Physics-Informed Machine Learning Meets Engineering Seminar Series’. This has help me to learn how to organise seminars, search the most important researcher names related to such interesting topic, host them, learn their work, learn the state-of-the art in this topic and ultimately interact with them to learn new directions to explore in my research. I am really glad to be a co-organiser and would like to continue so.
Elias Galiounas, University College London

Project title
Battery state estimation and prognosis using machine learning

Supervisors
Rhodri Jervis, Paul Shearing

Main outcomes of my research
Battery management software is mostly concerned with the estimation of latent variables, such as the state-of-charge and state-of-health of battery cells and packs. My research aims to combine novel measurement techniques with data-driven algorithmic implementations to produce accurate and robust estimates of such variables. Input data can take the form of sound waves pulsed through batteries, electrochemical impedance spectra recorded with specialist equipment, or time series of battery operation signals. A multiplicity of modelling approaches from the domain of machine learning and beyond are being explored to model populations of battery cells and forecast their degradation trajectories.

Impact of my work
It is widely accepted that the electrification of major energy-consuming sectors is environmentally meaningful, with the electrification of transport currently leading the way. Batteries are the dominant energy storage solution for electric vehicles, but rare events of catastrophic battery failure have caused a level of scepticism among end users. This can be alleviated, in part, by redundantly estimating the state-of-charge using an independent signal produced by ultrasonic probing. An implementation of this approach using deep-learning has been demonstrated in my research, as part of a broader toolbox of intelligent battery monitoring methods. These collectively also aim to extend the lifetime of battery assets to minimise replacement costs, accelerate their uptake and contribute towards the goal of net zero emissions by 2050.

Being a Turing Enrichment student
Through my engagement with the Turing I was introduced to a very energetic community of researchers with a shared enthusiasm about computation, artificial intelligence and data science. The many discussions I had with them were the most significant part of my learning experience, and introduced me to a range of methods and tools that would have taken multiple times longer to come across by other means. The variety of research done at the Turing also encouraged me to explore cross-disciplinary ideas, and broadened my view of what a career in research could look like in the future. I also had the opportunity to undertake structured training in software engineering and to participate in a collaborative data study group tackling problems seen in industry. I use the skills acquired through these activities daily. I am grateful for the welcoming environment that the institute provided, and for the opportunity to interact with an inspiring student cohort.

Emilia Vestesson, University College London

Project title
The use of electronic health records data to improve antimicrobial use in children

Supervisors
Joe Standing, Neil Sebire, Adam Steventon

Main outcomes of my research
Antimicrobial resistance is a global health emergency and there is a need to optimise antimicrobial use in hospitals. Whether to prescribe an antimicrobial, and which to choose, is complicated as treatment starts before an organism is identified. Therefore, patients may receive antimicrobials when the cause of the symptoms is not due to an infection, and patients with infectious causes may receive the wrong antimicrobial initially. This PhD will focus on the use of data from electronic health records to improve antimicrobial use in children.

Impact of my work
My first study evaluated whether antimicrobial use at a specialist children’s hospital increased inappropriately during the first year of the COVID-19 pandemic. By using robust statistical methods I was able to help the hospital understand how antimicrobial prescribing was affected by the pressure brought on by the pandemic. In the future I am looking at the antibiotic prescribing in remote GP consultation, which has the potential to inform the use of remote consultations in primary care.

Being a Turing Enrichment student
The Enrichment scheme helped me remember the value in talking to people from outside my field. I have enjoyed many conversations with other students and staff about a range of topics that gave me a new perspective. My thinking around research has also been influenced by Responsible Research and Innovation weeklong course that I attended. This course helped me think about the importance of really thinking through the implications of my own and other’s research.

“The Enrichment scheme helped me remember the value in talking to people from outside my field.”
Fabian Gunzinger, University of Warwick

Project title
Essays in Financial Behaviour

Supervisors
Neil Stewart

Main outcomes of my research
I use large datasets, insights from behavioural science, and methods from econometrics, causal inference, and machine learning to study human behaviour in the wild. In my PhD, I’m using transaction-level data from a money management app to study how people save and spend their money.

Impact of my work
First and foremost, the aim of the PhD is to contribute to a better understanding of how people manage their money. Ultimately, however, I hope that the work can be useful in building tools that make it easier for people to achieve their financial goals.

Being a Turing Enrichment student
Being a Turing Enrichment student has provided me with the wonderful opportunity to work in a fantastic working environment surrounded by like-minded people from many different backgrounds. My conversations with Tim Hobson from the Research Engineering team have forever changed the way I think about and design my data validation pipelines, while casual chats with fellow students have motivated me to learn more about new research methods and thus permanently enriched my research toolbox.

Gabriel Jones, University of Oxford

Project title
Artificial Intelligence in High-Risk Pregnancies: Deeper Learning through Cardiotocography

Supervisors
Manu Vatish, Christopher Redman, Yarin Gal

Main outcomes of my research
My research area is focussed on developing artificial intelligence models for the identification of at-risk pregnancies using the fetal heart rate (cardiotocography; CTG). CTGs are the commonest investigation performed during pregnancy worldwide, however human interpretation of this complex signal is sub-optimal. Human accuracy at identifying high-risk pregnancies using CTG has been estimated at between 50-60%. This frequently results in avoidable adverse outcomes for the baby. My research develops AI-driven clinical tools that can accurately evaluate these signals and identify babies at risk of an adverse outcome.

Impact of my work
Throughout my time at the Alan Turing Institute, I have developed several predictive models capable of interpreting fetal heart rate signals and determining whether the baby is likely to experience a high-risk outcome following pre-term delivery. These models appear to substantially outperform humans at this task. This is particularly important, as complications arising from pre-term birth are the leading cause of death in children under 5 years of age globally. These models could be deployed on current CTG devices across different regions and could be implemented into low-resource settings at low cost.

Being a Turing Enrichment student
My time at the Alan Turing Institute has been greatly enriched by the people, environment and resources available. The courses offered have been paramount in developing my understanding of machine learning while the experts across the institute have been a great source of inspiration and refinement for the goals of my PhD. The regular training opportunities and seminars at the Turing have opened my eyes even further to the world of AI and its potential to tackle important global challenges.
Georgina Mathlin, Queen Mary University of London

Project title
Evaluating effectiveness of open prison services within the Offender Personality Disorder pathway. What drives success and failure in open prison services for high risk offenders?

Supervisors
Mark Freestone, Hannah Jones, Carine Lewis

Main outcomes of my research
An estimated 4.4% and 13% of the general population meet the criteria for a personality disorder diagnosis (Coid, 2003). Within the criminal justice system, personality disorder is overrepresented with an estimated 65% of male prisoners meeting the criteria (Fazel & Danesh, 2002). Research has shown that treatment and intervention with this population are possible, but research is generally methodologically poor (Warren et al., 2003).

The Offender Personality Disorder Pathway (OPD Pathway), an initiative by the UK Ministry of Justice and NHS England, provides psychologically informed services for high-risk offenders who are likely to have a diagnosis of personality disorder (Joseph & Benefield, 2012). Five open prisons with OPD services, known as Pathways Enhanced Resettlement Service (PERS), focus on high-risk offenders who have a high likelihood of either reoffending or being returned to a secure prison environment.

The research question: “Do open prison PERS reduce failures for offenders on the OPD pathway and what factors are involved with the successful progression through PERS?” will be answered from a series of quantitative and qualitative studies, culminating in an emergent causal model.

Impact of my work
The results of the project will impact service delivery, as well as develop knowledge of causal factors associated with successful transition into the community for high risk offenders.

Being a Turing Enrichment student
Being an Enrichment student exposed me to many different projects and areas of research I had not experienced before. One of these areas was a different way of considering ethics in my research field, for example, if we can understand who may benefit more or less from a service, how do we make sure that information isn’t used to exclude people and cause harm. I was able to develop my understanding of epidemiology further, by collaborating with the Turing/RSS Health Data Lab on a literature review for the covid mobility stream.

Giuseppe Degan Di Dieco, University of Bristol

Project title
Probabilistic models for predicting bridge riverine flood-induced failures

Supervisors
Dr Maria Pregnolato, Dr Andre Ramos Barbosa, Dr Mark Hobbs

Main outcomes of my research
My research area applies statistics techniques to classify riverine bridges according to their performances. Bridges with different geometries can be grouped into classes when they present similar performances in terms of damages induced by riverine floods. These bridge classes are used by infrastructure owners to insure assets against likely future damages, which otherwise will not have the needed money to repair or substitute a damaged bridge. Therefore, knowing how many bridges are going to be damaged in a given timeframe is of primary importance.

Impact of my work
At first, my work highlighted the lack of failure probability data for machine learning applications, thus raising a reproducibility issue in the damage model community. Subsequently, my research presented the effects of epistemic uncertainties on damage models, which was neglected before. The real-world impact will be to consider both aleatory and epistemic uncertainties in making damage predictions, thus improving asset retrofit decision-making and improving budget allocation.

Being a Turing Enrichment student
Being an Enrichment student has been legendary, like a journey that makes the traveler and not vice versa. I became more conscious of “what doing research” means, and the ethics behind it. I arrived at The Turing alone, and I leave it with friends and colleagues. I did not expect to find a friendly, creative, and vibrant environment, where to code, sketch and play the guitar. At The Turing, I also met Dr Mark Hobbs, a PostDoc, who accepted to be my Enrichment supervisor, and wrote with me a stand-up comedy story, an AI UK poster, and we are writing a conference paper at the moment. I will always be grateful to have met him on a daily basis in the past year. I am also grateful to Dr Lawrence Bull for his book suggestions and code help, and to the REG team for the code help and football matches. It is a goodbye and not a farewell.
Hannah Nicholls, Queen Mary University of London

Project title
Machine learning prioritisation of cardiovascular disease genes following genome-wide association study

Supervisors
Dr Claudia Cabrera, Professor Michael Barnes, Professor Sir Mark Caulfield

Main outcomes of my research
Using applied machine learning approaches to better understand the genetics of complex cardiovascular diseases. Genome-wide association studies have identified thousands of genes associated with cardiovascular diseases, requiring further triaging of most likely causal disease genes and variants. This presents an opportunity to develop a machine learning gene prioritisation method, creating a stronger evidence-based gene ranking for further study.

Impact of my work
Future impact could be a reliable and accessible tool for genetic hypothesis generation post-GWAS.

Being a Turing Enrichment student
From working on the DECOVID project I developed skills I would not have otherwise had exposure to (namely database management, technical skills such as PostgreSQL and GitLab, and teamwork/collaboration on an interdisciplinary and multi-institutional project) – which has also widened my research interests and impacted how I have been considering my future research career. On this project, I also got to work within a team of Enrichment students, allowing me to build a network not only with experts on the project but also with peers that I otherwise would not have had the chance to meet due to the pandemic.

Heather Selley, University of Leeds

Project title
Measuring ice speed in Antarctica at high resolution using synthetic aperture radar satellite data

Supervisors
Anna Hogg, Andrew Shepherd

Main outcomes of my research
The main outcomes of my research are the ability to conduct image analysis and extract the features of ice shelves in Antarctica using a variety of methods. This allows us to investigate how structures, such as crevasses, have developed over the last 40 years using the satellite record. Mapping these structures and how they change helps illuminate the response of ice shelves to climate forcings (any factors that affect the Earth’s climate, such as warming air and ocean temperatures). This in turn helps improve our knowledge of Antarctica’s behaviour and potential future contribution to sea-level rise.

Being a Turing Enrichment student
The Turing Enrichment scheme has allowed me to engage with a completely new, vibrant research community and expand my network. Working with people with such diverse research specialisms resulted in me explaining my work in different ways improving my communication skills and gaining different perspectives on my work. It also highlighted the importance of a collaborative and cross-discipline approach to my research. Coming from a non-data science background the workshops and seminars by the Turing have provided me with a best practice example for data science research and the importance of replicability in research.

It also supported my development as a researcher, from improving my technical skills to personal development, alongside the financial security provided. It gave me many opportunities to engage with things outside of my research field, such as mental health first aider training, wellbeing workshops and simply being a very welcoming, inclusive and supportive community. It gave me the opportunity to present to the Turing community in the catch-up and chair a session for the first time at the research showcase. The Turing Enrichment scheme has been invaluable for the progress of my PhD and as a researcher.
Hin Ting Frankie Cho, University of Exeter

Project title
Probabilistic models for predicting bridge riverine flood-induced failures

Supervisors
Professor Brett Day, Professor Jonathan Rhodes

Main outcomes of my research
How to use limited land resources for multiple competing needs is a critical current policy question. Committing to reach “Net Zero” greenhouse gas emissions by 2050, e.g. the UK government have pledged to plant 30,000 hectares of trees every year. But where should those trees be planted? Changing land uses has multiple consequences relating to flows of ecosystem services and agricultural outputs. Identifying good configurations of land-use is confounded by structural and statistical uncertainty in the models used to predict land-use change outcomes and uncertainties over future conditions. My research applies methods of stochastic optimisation (SO), robust optimisation (RO) and distributionally-robust optimisation (DRO) to account for those uncertainties in identifying efficient spatial landscape configurations under competing objectives.

Impact of my work
The outcomes of my research has been presented in a workshop on Landscape Decisions attended by Defra (Department of Environmental and Rural Affairs) to inform them how climate and economic uncertainties affect optimal decision-making for woodland planting in the UK and the need of using data science approaches such as stochastic optimisation to identify woodland planting configurations that hedge against risks arising from uncertainty. If implemented, my research will make new woodlands created to meet Net Zero targets less likely to fail due to climate change and robustly deliver co-benefits to mankind.

Being a Turing Enrichment student
My experience in the Turing Enrichment through activities hosted by the “Turing Way” not only showed me the importance of producing reproducible and well-documented science, but also introduced practical ways to make it happen. During the enrichment scheme I have been exposed to tools such as version control that save important research time in doing so. Moreover, I put these ideas in practice in active collaboration sessions with other Turing colleagues during hackathons that allow me to test and refine my understanding of open science principles before bringing it to my colleagues in my research group, enabling a shift in how my colleagues approach reproducibility and transparency in our collaborative work.

Hope Kent, University of Exeter

Project title
School to Prison Pipelines: Examining pathways into the justice system for vulnerable young people

Supervisors
Professor Huw Williams, Professor George Leckie, Professor Lee Hogarth, Dr Rosie Cornish

Main outcomes of my research
My research interests are around using statistical modelling (particularly multi-level modelling) in large administrative datasets to understand criminalisation of people with neurodisabilities. In my PhD, I am looking at linked Ministry of Justice and Department of Education data to understand criminalisation of children and young adults, with a particular focus on those with neurodisabilities and Looked After Children. I am also interested in data ethics, and in cumulative risk theory as applied to vulnerable children and adolescents to predict outcomes such as school incompletion or exclusion, and contact with the criminal justice system.

Impact of my work
I work closely with Do-IT solutions, who implement screening for neurodisability on entry to prison. We have just begun a project screening children in Pupil Referral Units, which could be rolled out on a larger scale if successful. I have also collaborated with PINK concussions, CIABIG, and the GLEPHA neurodisability SIG who all advocate for change in policy and practice in the criminal justice system.

Being a Turing Enrichment student
Being a Turing Enrichment student has enabled me to make new research connections and develop a supportive network of academics with experience working with the datasets I am using. I have deepened my understanding of research ethics and the ethical implications of using data in public health contexts. My research ideas have been challenged and evolved to make the focus of my research projects stronger, and I have had support with writing up my results as papers.

“Being a Turing Enrichment student has enabled me to make new research connections and develop a supportive network of academics.”
Ilaria Manco, Queen Mary University of London

Project title
Bridging Audio and Language in Music Understanding Models

Supervisors
Emmanouil Benetos, George Fazekas, Elio Quinton

Main outcomes of my research
My research area is multimodal deep learning for music informatics, with a focus on developing audio-linguistic models to help machines understand and reason about music. By using insights from signal processing, natural language processing and other areas of machine learning, my work focuses on developing methods to extract information from multiple data modalities with the aim of learning representations that can bridge the gap between human and machine understanding of music.

Impact of my work
Some of the findings from my research have been integrated as prototypes in industry applications, showing the potential of more general-purpose machine models that can be pre-trained and then applied to several different tasks of interest to businesses in the music analysis domain. All my research projects have also always been associated with open-source code which has been widely reused and expanded on by the community and has sometimes instigated new research and creative applications.

Being a Turing Enrichment student
Being a Turing Enrichment student has been beneficial to my research in two ways: firstly, widening my research network, particularly to include researchers working in different fields, has taught me how to more effectively explain my work to non-experts and find relationships among techniques used in different fields; secondly, I have had the opportunity to discuss and get advice on how to design a research project which required expertise in NLP and user studies, which would have been difficult to access without the help of the Turing network.

Iman Bilal, University of Warwick

Project title
Capturing diverse opinions and explaining models through summarisation (Tentative)

Supervisors
Professor Rob Procter (University of Warwick & The Alan Turing Institute), Professor Maria Liakata (QMUL, University of Warwick, The Alan Turing Institute)

Main outcomes of my research
My work is focused on the domains of Natural Language Processing and Machine Learning. In particular, I am interested in automatic summarisation methods to capture opinions on microblogs and to enhance interpretability of prediction models.

Impact of my work
Social media has become a field of interest to policy makers and social scientists who track important unfolding events on platforms such as Twitter. My work has applications in digital journalism and could be of assistance in the process of filtering and analysing huge volumes of unstructured data.

The second application I am interested in is the interpretability of machine learning techniques. These tools are widely used, however recent advancements in deep learning disabled the transparency of model decisions. Thus, it is vital to improve the balance between model explainability and performance.

Being a Turing Enrichment student
My research network has expanded thanks to my Enrichment scheme. My supervisors and I are now collaborating with Turing academics Professor Julia Iwe, Dr Elena Kochkina and Dr Adam Tsakalidis on a project meant to enhance transparency in NLP applications. This future direction of work is part of the Turing-funded course “Building Transparent AI Systems Explaining their Decisions in Natural Language for Human-in-the-Loop Applications” proposed by my supervisors. Along with them and our collaborators, I will initially work on providing an explainability component to their existing models. These models cover diverse domains meant to support solutions for important problems on social media: rumour verification & mental health.

Additionally, my time at the Turing has enabled me to get more training in data science and remote resource managing.
**Isabella Deutsch, University of Edinburgh**

**Project title**
Bayesian Estimation of Hawkes Processes in Retail Analytics and Beyond

**Supervisors**
Gordon Ross

**Main outcomes of my research**
Imagine the following: you want to get yourself a new pair of shoes, you don’t quite know yet which ones, so you walk into a store. On the shelves you see two pairs from the same brand. In the end, you will walk out with one of them, and not the other. Why did you make this decision? Buying one product instead of another is what we call “Product Cannibalisation” and I set out to uncover, understand, and predict product cannibalisation in the fashion retail space using mathematical models called “Hawkes Processes”.

**Impact of my work**
I work with a complex, yet versatile, mathematical model called Hawkes process and the impact of my research is twofold. Firstly, it contributes to a better understanding of Hawkes processes and thus makes them easier to use for anyone in all areas of application, from retail analytics to retweets on Twitter. Secondly, I examine how these Hawkes processes can be used to understand product cannibalisation, casting this concept into a statistical foundation to aid business intelligence.

**Being a Turing Enrichment student**
The opportunities for engagement and networking the Turing Enrichment scheme provided were second to none. From “Lunch and Learn” seminars to taking part in the AI UK conference (as a presenter, facilitator, and panel discussant), there were so many experiences that substantially enhanced my studies. Moreover, I appreciated the diverse training and support on offer for Enrichment students. For example, I received funding to present my work at the International Society for Bayesian Analysis World Meeting in Canada this year!

As I was based at the Leeds Institute for Data Analytics (LIDA) at the University of Leeds I had access to a fantastic community there as well. One of my personal highlights from the Enrichment Scheme was the presentation I gave to David Westhead’s research group at the LIDA. The audience came from a medicine and health background, which led to excellent cross-disciplinary discussions and innovative ideas for further applications of my model. Crucially, this gave me a new perspective on my research.

Altogether, through the Enrichment scheme I was able to receive world-class training, I expanded my (research) horizon, and became part of the extraordinary community the Turing is fostering.

**Janosch Haber, Queen Mary University of London**

**Project title**
Word Sense Distance and Similarity Patterns in Regular Polysemy

**Supervisors**
Massimo Poesio, Julian Hough, Pat Healey

**Main outcomes of my research**
My research focuses on polysemes, words with multiple but closely related interpretations. I investigate how our brain represents and processes these words, and whether that is replicated in their encoding in deep contextualised language models. I’m particularly interested in the notion of under-specification - cases where a word’s meaning is not fully resolved - and how this can improve the efficiency of our language processor while it complicates computational representation. My next project is applying insights gained from my research on ambiguous words to improve the detection of less obfuscated toxic language in user-generated content.

**Impact of my work**
My research uniquely combines aspects of linguistics, neuroscience, psycho-linguistics and computational linguistics - disciplines that often appear to work on similar issues without much interaction. I therefore hope that my work will help to identify untapped potential for increased collaboration. In terms of application, I hope my work will be valuable in improving the assessment and development of neural language models, leading to a more explainable approach to entity recognition, entity tracking and offensive language detection.

**Being a Turing Enrichment student**
Through the Turing Enrichment scheme I got to meet a number of brilliant people dedicated to developing responsible AI solutions for today’s and tomorrow’s big issues. I really enjoyed thinking about more practical applications of (my) research, and our conversations ultimately tipped the balance towards a career path in industry - starting as a research scientist in a local start-up focused on the automatic detection of toxic language.

“Through the Turing Enrichment Scheme I got to meet a number of brilliant people dedicated to developing responsible AI solutions for todays and tomorrows big issues.”
Main outcomes of my research
My research focuses on understanding authorship features of malware which has allegedly been created by advanced persistent threat (APT) groups and whether it is possible to identify any trends between various different malware using authorship techniques or if alternative methods are needed. This is a difficult problem and requires building credible ground truth datasets and understanding the limitations of disassembling malware binaries and identifying which features to use and learn for building reliable models. Furthermore, it is made even harder as malware authors try to evade attribution by using several techniques (e.g. obfuscation) to hide their identity!

Impact of my work
Public attribution of malware is used to seek justice, apply political pressure and enforce sanctions to deter cyber-attacks. This currently requires lots of concrete evidence which is generally a complex and time-consuming manual task. It often takes at least a year, if not longer. My research aims to speed up this process and aid malware analysts as organisations receive vast quantities of malware on a daily basis.

Being a Turing Enrichment student
I have thoroughly enjoyed getting involved with the Alan Turing Institute both virtually and in-person. On top of furthering my PhD during my placement, I have been able to take time out to learn and expand my knowledge on various different data science techniques and methodologies such as Bayesian Methods and learning about the Ethics of AI as well as understanding Baskerville and how to accelerate my research using GPUs. Additionally, I undertook the Research Software Engineering Training Session to improve my coding style and ability which was super helpful for my PhD research and will continue to benefit me in my career. This has all been alongside such a vibrant and varied community of researchers and being able to learn about the many different impacts of the Enrichment scheme and learn about other interesting research. This has also enabled me to build a network for future collaborations long past the enrichment scheme ends. Finally, I would just like to thank the support from the Turing to ensure the wellbeing and mental wellness of all Enrichment students throughout the pandemic which definitely helped maintain a sense of normality amongst the chaos. I would highly recommend getting involved with the Turing.
Joel Dyer, University of Oxford

Project title
Likelihood-free inference for time-series simulation models

Supervisors
Professor J. Doyne Farmer

Main outcomes of my research
Computer simulation models are used across scientific disciplines, from plasma physics to epidemiology. The (probabilistic) behaviour of such models is often determined by a fixed set of input parameters, and it is sometimes unclear what parameter values result in simulation outputs that match the behaviour of the real system that the model represents. My research entails developing automatic methods for tuning the parameters of simulation models in order to achieve this alignment between simulated and observed data, with a focus on dynamic, stochastic simulation models that appear in the social sciences.

Impact of my work
My research has resulted in competitive procedures for performing parameter inference for complex, dynamic, stochastic simulation models. Some of these have already been published in top machine learning conferences and workshops, while others are under review or due to be submitted soon. This work has furthermore guided thinking and shaped decision-making in industrial and commercial settings too, as a result of my interactions with industry partners over the course of my research degree. In this way, my research has and continues to have the potential for impact in the social sciences, economics, and public policy, by enabling the use of simulation models as a way to explore counterfactuals, conduct “what-if” scenario analyses, and gain a richer understanding of the complex dynamics that emerge from the interactions between many autonomous, decision-making entities.

Being a Turing Enrichment student
The Enrichment scheme has been great for providing me with increased exposure to academics in my research area. I’ve been invited to give talks on my research at a number of different seminars, workshops, and research groups since joining the scheme, and this is certainly at least in part thanks to the scheme itself. This exposure has furthermore helped to facilitate new friendships and lay the groundwork for future collaborations across the different Enrichment centres, and I hope to develop these further beyond the scheme.

Josh Nevin, University of Cambridge

Project title
Explainable machine learning for optical fibre communication systems

Supervisors
Seb Savory

Main outcomes of my research
During my placement I have delivered two machine learning-driven methods which achieve increased capacity, i.e. an increased rate of information transmission, of optical fibre core networks, addressing the demand for increased capacity generated by new internet technologies such as 5G. The first method, presented at AAAI, utilises probabilistic machine learning for network characterisation, improving the accuracy of network models and reducing required margins. In turn, this increases network capacity. The second method leverages prior knowledge-informed reinforcement learning to achieve optimal online network control, increasing the total number of services supported by the network compared to state-of-the-art techniques.

Being a Turing Enrichment student
At the Turing I have been exposed to a highly talented group of researchers from a diverse range of academic backgrounds. This has benefitted my project significantly, as informal knowledge sharing with other Enrichment students has helped me solve issues I have faced in my own research and introduced me to new areas of machine learning I would otherwise likely not be aware of. For example, before starting at the Turing I had almost no expertise in reinforcement learning. Due to the accessibility of other Enrichment students working in this area, I was able to obtain a working knowledge of this area much more quickly by asking for tips and resources, leading to a new research project. Additionally, I have benefitted from organised sessions such as the student-led Lunch and Learn, which have introduced me to entirely new areas of research and techniques that are highly applicable in my own domain.
Kate Highnam, Imperial College London

**Project title**
Real-Time Self-Adaptation for Black-Box Intrusion Detection Systems

**Supervisors**
Nicholas R. Jennings, Sergio Maffeis

**Main outcomes of my research**
Kate Highnam is a postgraduate researcher in the intersection of machine learning and cyber security at Imperial College London. Her PhD explores using adversarial drift detection and its impact on model degradation in intrusion detection systems. Based on her professional experience prior to Imperial, Kate aims to enhance the robustness of black-box machine learning models in non-stationary production environments.

**Impact of my work**
Kate aims to improve the awareness and accessibility of cyber security problems to other machine learning experts. She previously published the BETH dataset for unsupervised anomaly detection, open sourcing millions of cybersecurity events containing real adversaries attacking cloud servers. This provides a new dataset with limited noise and other real-world characteristics that may prevent non-security experts from applying their models. Her work on self-adaptive systems will showcase the need for autonomous solutions to non-stationary environments, and can be extended past security applications.

**Being a Turing Enrichment student**
Being a Turing Enrichment student has connected me with the other experts in my field and expanded my awareness of the numerous areas on which data science is already applied. Through the Defence and Security Programme, I met bright, talented researchers applying state-of-the-art reinforcement learning techniques for autonomous cyber defence and learned about the ethical considerations of AI in defence systems. The other Enrichment and other Ph.D. students at the Alan Turing Institute tackle almost everything: hate speech detection, climate change, seal populations from space, urban acoustics, fiber optics optimisation, topological data analysis, electric vehicles and battery development, protein folding, genome predictions, astrophysics image analysis, and so much more! I am immensely grateful for the opportunity to meet these incredible individuals.

Katharina Zuhlsdorff, University of Cambridge

**Project title**
Investigating reinforcement learning in depression and substance use disorder: using computational, translational and imaging approaches

**Supervisors**
Professor Jeff Dalley and Professor Zoe Kourtzi

**Main outcomes of my research**
My research focuses on investigating cognitive flexibility across a variety of psychiatric conditions. Specifically, I employ reinforcement learning models to extract latent variables that help understand an individual's behaviour on probabilistic tasks. I then aim to identify differences between healthy control participants and patients with mental health conditions, such as depression. I also link these computational parameters to their neural substrates using neuroimaging.

**Impact of my work**
Thus far, I have presented my research at a number of conferences and am preparing papers for publication. I have been able to identify behavioural and neural markers that may help us predict psychiatric disorders. The long-term aim is for these markers to be translated into the clinic, with the potential of early diagnosis of neuropsychiatric disorders.

**Being a Turing Enrichment student**
As a result of the Turing Enrichment scheme, I have been able to apply my skillset to large-scale datasets including dementia patients. I had the opportunity to develop new models for predicting subtypes of dementia, and test these on real-life data from the clinic. Specifically, we have been using data from our collaborators at Cambridge University Hospitals and from other centres in the country. This scheme gave me the opportunity to expand my network in the area I work in, as well as learn new skills through the various training opportunities offered by the Turing.
Khalid Alharthi, University of Warwick

Project title
AI-Driven Failure Prediction in HPC Systems (e.g., Supercomputer clusters and Data centers)

Supervisors
Professor Arshad Jhumka

Main outcomes of my research
Khalid Ayed Alharthi is a Ph.D. candidate in the department of computer science at the University of Warwick. He is a member of the Artificial Intelligence (AI) group, supervised by Professor Arshad Jhumka and a research student visitor at Argonne National Laboratory, operated by the University of Chicago, USA. His research interests lie at the intersection of artificial intelligence (deep learning & machine learning), Natural Language Processing, fault tolerance, and resilience of HPC systems (e.g., supercomputer clusters, datacenters). Khalid Alharthi is focusing on his doctoral study in the area of “Artificial Intelligence-Driven Failure Prediction in HPC Systems”.

Impact of my work
I have published two top-tier conference papers (IEEE/IFIP DSN 2021 and ACM ICS 2022). The titles of these papers are “Sentiment Analysis-based Error Detection for Large-Scale System” and “Clairvoyant: A Log-Based Transformer-Decoder for Failure Prediction in Large-Scale Systems.” Furthermore, I has submitted a third paper to a top-tier conference as well.

Being a Turing Enrichment student
I collaborated with professor Simon McIntosh-Smith to publish a paper during my Turing Enrichment period. Also, my research network is interested and knew different students from different universities.

Kimberly Ton Mai, University College London

Project title
Representation learning for anomaly detection

Supervisors
Lewis Griffin, Toby Davies

Main outcomes of my research
Anomaly detection is the task of identifying instances that deviate from usual behaviour. Because it can be hard to anticipate the types of anomalies that may arise, anomaly detection models are often trained to learn the distribution of benign samples. The unusualness of a test sample is then measured by comparing its properties with this distribution. Therefore, it is integral that the learnt distribution is illustrative of the population distribution for anomaly detection to work. My research looks at developing anomaly detection models in different domains (such as images, text and audio) and building tools to measure the quality of these models.

Impact of my work
As technology progresses, there is a risk that the methods used by adversaries to bypass systems become harder to detect. Building detection models that are not reliant on previously seen anomalies should be more robust to the characteristics of evolving threats. Applications that benefit from anomaly detection models include detecting firearms in X-ray baggage images, fake news detection, and identifying spoofs.

Being a Turing Enrichment student
Being part of the Turing community has been one of the highlights of my PhD, and I have benefited in many ways.

One of my goals of the Enrichment placement was to apply my research to a new domain. I have achieved this through a collaboration I developed through the Turing network. With the support of Dr Emmanouil Benetos, I have expanded my research to anomalous machinery detection, and this study has resulted in a paper.

I have also been able to access high-performance computing resources through the Turing. This has enabled me to conduct experiments I would not usually be able to do and has accelerated the pace of my projects significantly.

Finally, I have had the privilege of learning from brilliant researchers whose expertise lies in different disciplines.
Lele Liu, Queen Mary University of London

Project title
Automatic music audio-to-score transcription with deep neural networks

Supervisors
Emmanouil Benetos, Veronica Morfi, Simon Dixon

Main outcomes of my research
My research interest falls on the intersection between AI and music. My current research is on automatic music transcription (AMT). Considered as the music parallel to speech recognition, AMT transcribes a music recording into some form of music notation, such as western staff notation. AMT can be used for various applications such as music education, digital music archive, music search, and music production. Nowadays, AMT is still a challenging task when it comes to getting notation-level transcription and transcribing recordings from multiple instruments.

Impact of my work
We have currently developed a baseline model for joint transcribing pitch and symbolic music notation from music recordings. We also developed a system that works on quantizing MIDI (a digital music format) performance recordings into musical scores, which can be used for complete AMT by combining it with a pitch recognition system.

A mature AMT system can be useful in various scenarios. For example, by dictating music scores, people can easily transcribe music improvisations/compositions. Converting music recordings into notation format can help to build and create links for larger and more complete music archives, as well as make it easier to search for certain music pieces (search by melody). Other possible applications include music education and automatic music creation.

Being a Turing Enrichment student
Since the pandemic, I’ve seen a significant drop in my productivity. But the Enrichment scheme saved me a lot by exposing me to various activities. I really appreciated the training, collaboration, and social opportunities. The collaboration call was great, I got to know projects from various disciplines and backgrounds and people from bio-science, cyber security, theoretical deep learning, NLP, economics, etc. From that point I started to think about my research directions after my graduation. The Turing helped me to not limit my research interests to my PhD topic but opened my eyes to a broader research world. I also found people to study together here, it strongly boosted my productivity!

Now I feel more confident in building collaborations and am now having several collaboration projects on the way both within and outside of the Turing. I get more active in exchanging ideas and discussing with researchers from different topics and find it easier to think of possible collaboration points during conversations.

Luca Marinelli, Queen Mary University of London

Project title
Gender-coded sound: A multimodal analysis of gender encoding strategies in music for advertising

Supervisors
Dr Charalampos Saitis

Main outcomes of my research
Recent studies in computational social sciences have shown that, when the training data reflect human biases, machine learning models are able to acquire, reproduce and eventually reveal these biases. Taking into account that music is found in more than 90% of television adverts, and by interpreting it as an inherently multimodal discourse, this study aims at implementing deep learning models for a critical analysis of gendered markers in two large corpora of television adverts, with the purpose of deconstructing the dominant discourse on gender in music and advertising, and to inform further investigations on a commercial and contemporary musical semiotics of gender.

Impact of my work
By means of approaches from music information retrieval and multimodal discourse analysis, the proposed study aims at uncovering and visualising underlying patterns of intersubjectivity emerging from the influence of gender-based segmentation strategies on the selection and composition of music for advertising. Standing in the context of artificial intelligence, computational social sciences, computational musicology and critical discourse analysis, this study can benefit not only scholars but also advertisers, broadcasters, policy makers and the music industry at large.

Being a Turing Enrichment student
I advanced my research without having to worry too much about the bills and rent in London. This alone is an incredibly good reason to join the Enrichment scheme. Regarding skills, thanks to the RSE python course, my understanding of software engineering has improved considerably.

“I advanced my research without having to worry too much about the bills and rent in London. This alone is an incredibly good reason to join the Enrichment scheme.”
Marc Girona-Mata, University of Cambridge

Project title
Towards an improved hydrometeorological understanding of the Water Towers of Asia

Supervisors
Dr Andrew Orr, Professor Richard Turner, Dr Scott Hosking and Dr Hamish Pritchard

Main outcomes of my research
The Hindu-Kush-Himalaya mountain ranges of High Mountain Asia (HMA) supply water to more than 1.4 billion people. However, HMA’s hydrometeorological and hydrological regimes are hugely complex and poorly understood due to a number of factors (e.g., strongly nonlinear spatio-temporal precipitation patterns and an extremely data-constrained environment). This hinders the region’s sustainable development, thereby threatening the livelihoods of a quarter of the world’s population. My research aims to address these critical issues by leveraging and developing probabilistic machine learning to improve the quality of high resolution climate models in the region.

Impact of my work
So far, I have developed a detailed model of daily precipitation that is able to make probabilistic predictions for ungauged (unobserved) locations across High Mountain Asia (HMA). I use observation-based datasets from multiple meteorological stations, which are then leveraged by a probabilistic machine learning model to further improve (that is, bias correct and downscale) a state-of-the-art high-resolution multi-decadal regional climate simulation that covers the entire HMA region.

Being a Turing Enrichment student
The research problem I am tackling is extremely challenging and unique. The Water Towers of Asia are one of the most complex and least understood hydro-climatic environments on the planet, yet they are a critical asset to sustain the livelihoods of a quarter of the planet’s population. The use of probabilistic machine learning to study such complex and remote environments has barely been explored.

Being a Turing Enrichment student at the Alan Turing Institute has allowed me to broaden my horizons, gain exposure to new methodologies, and has inspired me to develop creative solutions, which have resulted in a step-change improvement in my work. I have learned more about probabilistic machine learning and active-learning methods (for optimal decision-making) in spatio-temporal problems; and, crucially, how these can be deployed to tackle complex real-world problems.

The training opportunities available at the Alan Turing Institute have also been an invaluable resource. I have been able to join seminars, presentations from colleagues, and interest groups about different topics (e.g., data-centric engineering, environmental data science, data-constrained environments), and have expanded my software engineering skills to ensure my research is scalable, interpretable, reproducible and fair.

Impact of my work
The training opportunities available at the Alan Turing Institute have been an invaluable resource. I have been able to join seminars, presentations from colleagues, and interest groups about different topics (e.g., data-centric engineering, environmental data science, data-constrained environments), and have expanded my software engineering skills to ensure my research is scalable, interpretable, reproducible and fair.

Martin Ferianc, University College London

Project title
Real-time Uncertainty Estimation in Practical Applications

Supervisors
Miguel Rodrigues

Main outcomes of my research
Neural Networks have gained attention in real-world tasks, such as image comprehension or anomaly detection. However, standard neural nets are unable to capture their uncertainty, which is crucial for understanding what the network does not know. Understanding neural networks frames their trustworthiness, which is important primarily in safety-critical applications e.g. autonomous driving or healthcare. Comparatively, Bayesian neural networks or ensembles of neural networks offer a mathematical grounding to reason about their uncertainty, though they come with a prohibitive computational cost. My research attempts to decrease this cost.

Impact of my work
To facilitate the real-world deployment of uncertainty estimation capable neural networks, my research so far has investigated software-hardware optimisations targeting Bayesian neural nets or ensembles. The real-world deployment of these machine learning models can increase the trustworthiness of the neural networks as viewed by practitioners who can make better-informed decisions based on the uncertainty of the underlying model. In a broader view, this is the most important in the context of regulated applications such as autonomous driving or healthcare where an accurate, certain and trustworthy model is needed to help the user to make informed decisions. Deploying such networks could mean that neural nets will finally get from the trial stage to an actual regulatory application.

Being a Turing Enrichment student
During the Enrichment program, I wanted to challenge myself to think about how to improve as an independent researcher and thus I have decided to explore a new research direction - knowledge distillation. I have learnt how to quickly orient myself in related work, individually discover a meaningful challenge to solve and a methodology to target it and implement a solution. The process resulted in success: a paper accepted to the ICML 2022 Workshop on Distribution-Free Uncertainty Quantification.

In parallel, I was able to reconnect with Ondrej Bohdal, a fellow enrichment student. Together, we have proposed a project which involves mutual research interests. In this ongoing collaboration, I have learned how to drive a research idea in tandem with a colleague and how to communicate, share outcomes and iterate through different ideas. Overall, the new research direction and collaboration have helped to improve my research, career outlook, confidence, and the way I think about my work.
Matthew Nixon, University of Cambridge

**Project title**
Investigating the Characteristics of Exoplanetary Atmospheres and Interiors

**Supervisors**
Professor Nikku Madhusudhan

**Main outcomes of my research**
My research focuses on characterising the atmospheres and interiors of extrasolar planets (exoplanets). This involves using spectroscopic data from facilities such as the Hubble Space Telescope to infer properties of planets including chemical composition and temperature structure. This research lies at the intersection of astrophysics and data science, using a range of statistical and machine learning techniques. Ultimately this work will pave the way to searches for extraterrestrial life in our galaxy, one of the holy grails of exoplanet science.

**Impact of my work**
My work to date has focused on improving the scope and computational efficiency of atmospheric characterisation techniques. I have developed new tools using machine learning algorithms to analyse atmospheric spectra of exoplanets, enabling this analysis to be carried out much more rapidly than has previously been achieved. Furthermore, I have improved upon existing modelling techniques to allow for the relaxation of certain simplifying assumptions which are commonly made when analysing the atmospheres of exoplanets.

**Being a Turing Enrichment student**
Being a Turing Enrichment student has enabled me to learn new methodologies which have subsequently been applicable to my research. While much of my work at the Turing has been targeted outside the domain of astrophysics (for example working with Professor Simon Dixon on music informatics), the skills I have developed in this time, e.g. applying ML algorithms to musical data, are highly transferable to my own field. Furthermore, I have been able to engage in discussions with Turing Fellows who are experts in other areas of astronomy and statistics, such as Dr Kaisey Mandel. This opportunity to broaden my horizons has provided important insight into my own work and greatly improved the content of my PhD thesis. I hope to maintain the connections I have made during my enrichment placement as I move on to postdoctoral research - I feel that these links to academics outside my own subfield will continue to be of benefit and have highlighted the importance of continuing to discuss my work with experts in other areas of science who may be able to bring a unique perspective.

Melike Dila Karatas, University of Exeter

**Project title**
Optimisation and network visualisation of high-dimensional search: developing data analytics for computational biology models

**Supervisors**
Professor Jonathan Fieldsend, Professor Ozgur Akman

**Main outcomes of my research**
"No Free Lunch Theorem" states that a general-purpose optimisation strategy for all optimisation problems do not exist. The focus of is therefore on finding the most suitable optimisation algorithm for solving a specific problem.

My research goal is to explain how machine learning techniques and optimisation algorithms operate on various problems, with a specific application on circadian clock models, through features extracted from problem topologies seen by different algorithms. For this, I am utilising the state of the art optimisation algorithms from mainly Evolutionary Computation, Deep Learning and Graph Theory domains.

**Impact of my work**
My research produced a graph construction algorithm for search space representation of continuous optimisation problems seen by population-based algorithms. This method has been specifically applied on circadian clock models from the computational biology domain, facilitating their understanding. This analysis is critical to provide useful information to, for example, biologists in order to have an understanding of biological systems, farmers to crop harvests to extend crop availability and secure them against colossal losses due to weather, or economists who are interested in the effects of climate change on the economy.

**Being a Turing Enrichment student**
Turing Enrichment Scheme has been really helpful for me in so many ways from the facilities it provided for my research to networks I made with people sharing similar areas of interest with me. It was really useful, especially to have so many meetings with Oliver Strickson from the RSE group, on the application of the software which was developed at the Turing previously, on my research. It was a great chance to meet with new people in the coffee queue, for example, with Jon Rowe, where after talking about my research he invited me to a workshop related to my research at the Turing. This has further developed my network in application domain of my research. Other activities such as lunch and learn meetings, career development workshops, external supervision meetings made it possible to experience this placement to the fullest.
Michael Schneider, University of Cambridge

Project title
Measuring Ongoing Chromosomal Instability using single-cell DNA sequencing data

Supervisors
Florian Markowetz

Main outcomes of my research
The broader topics of my PhD are computational oncology, with a focus on the development of statistical models for genome analysis.

In my PhD I am developing statistical methods for processing and analyzing single cell DNA-sequencing data to study ongoing chromosomal instability. Chromosomal instability is a major characteristic of many cancer types. We would like to develop tools to measure ongoing chromosomal instability. This would allow us to better understand how treatments affect cancer evolution and improve the selection of cancer treatment.

Impact of my work
In terms of outcomes, our work will help to better understand the processes driving cancer evolution. It does so by providing better tools to measure genomic damage in cancer and assigning the damage to different biological processes. The idea is that this is a helpful tool for choosing the right treatment in response to certain biological processes activated or deactivated in cancer.

Ultimately, this will help improve patient care, by providing better guidance to clinicians and potentially help discover new biological processes that can be targeted by cancer drugs.

Being a Turing Enrichment student
The Turing Enrichment scheme has provided me with access to state of the art machine learning researchers and helped me to improve my overall competency in machine learning methodology. I was able to talk about and discuss my research with other Enrichment students and learn from them. I would like to particularly point out some of the seminars organized by other Enrichment students such as the one about the Jax software package. I have taken part in events organized through the Omics Interest group (Omnics to All), and listened to many interesting speakers. Lastly, the Turing offices in London are a great place to work and study, and I enjoyed my time there.

Nick Homer, University of Edinburgh

Project title
Image Processing and Machine Learning Techniques Applied to Earth Observation Data of the Cryosphere

Supervisors
Rob Bingham, Noel Gourmelen, Sohan Seth, Hamish Pritchard, Frazer Christie

Main outcomes of my research
I use remote sensing data to research how the cryosphere (ice and snow) is changing in response to climate change, mainly in the polar regions of Antarctica and the Arctic. To do this, I use machine learning techniques with large satellite-derived and climate modelling datasets. One example is the use of deep neural networks for computer vision problems like identifying changes in the area of glaciers and ice sheets from satellite imagery.

Impact of my work
This research is having a real-world impact on quantifying the contribution of ice melt to global sea-level rise, both at the present time, and in narrowing uncertainty in future sea-level rise predictions. Narrowing the uncertainty in future sea-level rise predictions is key to developing mitigation and adaptation strategies for communities around the world, particularly in those coastal communities and island nations which are most at risk. With the Intergovernmental Panel on Climate Change’s recent agreement on developing a ‘loss and damage’ fund, global economic forecasts will be even more impacted by sea-level rise quantification.

Being a Turing Enrichment student
Being a Turing Enrichment student had given me the opportunity to explore new methods and to engage with researchers who are working on similar methodological problems, but in different scientific domains. For one example, joining the Scivision community has given me an insight into different computer vision datasets and models available, as well as linking me with a network of other researchers who are working on computer vision problems. Working on the Environmental Data Science Book project with Alejandro Coca-Castro has given me real-world experience of online project collaboration using state-of-the-art (mainly open source) data science collaboration tools such as GitHub for issue reporting and fixing, HackMD for tracking meeting notes, Jupyter Books for publishing materials, Zenodo for creating citable datasets, and many more. This has been extremely valuable in building my online collaboration skills which are so important in today’s hybrid working world.

But overall, one of the best outcomes of being an Enrichment student has been to build up a network of like-minded PhD students, who are working on exciting data science problems. This kind of network is invaluable in coming up with new approaches to problems, getting help when stuck with certain software or programming languages, or just in having someone to talk through your data science problems with.
Ondrej Bohdal, University of Edinburgh

**Project title**
Efficient meta-learning methods and their applications

**Supervisors**
Timothy Hospedales

**Main outcomes of my research**
In my research I focus on meta-learning - automatically learning how to improve the learning of neural networks in desired ways. More specifically, I work on developing efficient meta-learning algorithms and using meta-learning to solve various challenging problems. Most recently I have worked on making neural networks more trustworthy by combining meta-learning with a novel meta-objective designed to improve calibration. With our method, we have been able to obtain state-of-the-art calibration of neural networks, a challenging problem in which we try to ensure that the probabilities predicted by a neural network accurately reflect its true performance. In practice this makes confidences of neural networks more reliable, allowing us to trust the neural network models more.

**Being a Turing Enrichment student**
Thanks to the Enrichment scheme I have been able to build very valuable connections with students and researchers working on a wide variety of problems related to machine learning and data science. I have found it especially exciting to learn first-hand from people working on different real-world applications of machine learning methods. In my PhD research I focus on the core parts of machine learning, so it has been very inspiring to see what are all the different real-world problems where machine learning can make an impact.

From my experience, the Enrichment scheme has been perfect for networking and learning about the research of other people, for example by having lunch together or going to various social events. For instance, I have been able to learn more about reinforcement learning, drug discovery and neuroscience, among many others. I really appreciate the diversity of areas in which other Turing students and researchers work, which makes the Enrichment scheme a fantastic learning experience. In particular, it has enabled me to better see how to make a positive impact on society with the machine learning methods that we develop.

“"I really appreciate the diversity of areas in which other Turing students and researchers work, which makes the enrichment scheme a fantastic learning experience.""
Penelope Jones, University of Cambridge

Project title
Forecasting lithium-ion battery performance amid uneven usage

Supervisors
Alpha Lee

Main outcomes of my research
Lithium-ion batteries reduce reliance on fossil fuels: they power electric vehicles and stabilise supply from intermittent renewable energy sources. Easing concerns about the longevity and reliability of lithium-ion batteries demands accurate forecasting of their performance.

Most battery forecasting methods assume batteries will be operated in the same way over their lifecycle. In practice there is huge variability in use, and historical performance data may not be available, which makes forecasting much harder. I have developed a method that combines rapidly attainable and non-invasive electrochemical impedance measurements with probabilistic machine learning to forecast battery performance under different operating conditions, with no knowledge of historical performance.

Being a Turing Enrichment student
The highlight of the Enrichment scheme for me has been having the opportunity to engage in informal conversations with PhD students from a variety of disciplines and geographies, and to understand how data science and machine learning are being applied to solve a broad range of problems.

I participated in the Turing Research Data Science course which has greatly increased my confidence as a data scientist. Additionally, taking part in the AI UK conference was a fantastic experience. I enjoyed learning about the ways in which AI is being applied in government and industry, and in particular in the fight against climate change.

Peter Strong, University of Warwick

Project title
Methodological Advances in Explainable Modelling using Chain Event Graphs

Supervisors
Jim Q. Smith

Main outcomes of my research
My research involves researching and developing ideas around Chain Event Graphs. Chain Event Graphs (CEGs) are a class of probabilistic graphical model which represent complex independence statements. They are a generalisation of Bayesian Networks, so can be applied in a wide variety of domains. More specifically, my research interests involve developing methodology for model selection and Bayesian Model Averaging for explainable modelling. I am also interested in applications, including migration and public health.

Impact of my work
CEGs are beneficial for stakeholders as they provide a comprehensive, explainable representation of the systems and structures present in our society. My research makes progress to improve the capabilities and opportunities of the model: my work on Bayesian Model Averaging means stakeholders can now be more aware of the uncertainty in the validity of independence statements; work to demonstrate how some Agent Based Models can be represented as CEGs to provide additional benefits to stakeholders is also ongoing, providing a Bayesian framework and allowing for compact representation of the implicit independence statements.

Being a Turing Enrichment student
Being a Turing Enrichment student has provided me with opportunities to meet with other researchers from across the country and has helped me recognise the importance of working across a wide variety of disciplines. Through attending networking events and conferences—both online and in-person, at the Alan Turing Institute and at my home university—I have met a wide variety of fascinating individuals which has led to some exciting research opportunities including using probabilistic graphical models for mental health research.

I have also taken advantage of a wide variety of training opportunities during my Enrichment year, which has developed my skill base both technically and more holistically. I took up the opportunity to become a Mental Health First Aider and found the Introduction to Data Science course extremely useful for developing skills in independence, criticality and collaboration.

My time at the Alan Turing Institute has been a highlight of my PhD, providing enriching experiences and supporting me to become a better researcher. I look forward to continuing to collaborate with researchers I have met through my enrichment year and the skills I have learnt will be invaluable throughout my development as a researcher.
Rachael Pirie, Newcastle University

**Project title**  
Shape Similarity for Drug Discovery

**Supervisors**  
Daniel Cole, Stuart Hall, Matthew Forshaw

**Main outcomes of my research**  
My research focuses on developing new software tools to speed up and reduce the cost of drug discovery. My primary project involves applying mathematics developed by my supervisor to create a new, open-source method for approximating the 3D shape of molecules. The method permits rapid comparisons, allowing molecules known to have some drug-like behaviour against a particular protein to be used as templates to screen large databases for other potential drugs. Through my placement I have begun to investigate the use of these descriptors as a feature representation for use in machine learning for drug discovery.

**Being a Turing Enrichment student**  
Having spent much of my PhD working from home, being amongst others who have had a similar experience has been invaluable and reassuring! The opportunity for discussions with researchers from different backgrounds has allowed me to think about my own work from a new perspective and to pursue a small project outside my original PhD looking at the use of image recognition in drug discovery. This has also led to an idea for a future project that I have proposed for an EPSRC Doctoral Prize Fellowship. Coming from a non-computer science discipline, my coding skills have also greatly improved through participation in the courses offered by the RSE team.

Being one of the “Community Champions” has allowed me to have an active role in arranging both social and enriching activities for the student community. This is something I definitely wouldn’t have had the opportunity to do at my home institute and has been a real highlight of my time at the Turing.

“Being one of the “Community Champions” has allowed me to have an active role in arranging both social and enriching activities for the student community.”

Ridda Ali, University of Leeds

**Project title**  
Whole systems approach to obesity: Integrating causal inference methodology

**Supervisors**  
Mark Gilthorpe, Andrew Prestwich, Jiaqi Ge

**Main outcomes of my research**  
My PhD focus is a mix of methodological and applied advances surrounding the understanding of prediction and causal explanation, and their distinct differences in obesity research. My research also illustrates the methodological challenges in analysing composite variables (e.g., BMI and change scores).

**Impact of my work**  
My PhD aims to explore the understanding of key issues in obesity research through the lens of causal inference. To begin, it clarifies the distinction between prediction and causal explanation including the implications of confusing causation and correlation. For example, we found some differences in the coefficients generated by the prediction and causal inference models (even sign reversal), indicating that the potential for misinterpreting causal relationships could be severe.

Later, it illustrates that the analyses of composite weight outcomes are misleading from the perspective of causal inference with potential for sign reversal in estimates derived from the same dataset. We outline robust methods for obtaining causal insights with weight outcomes. Although we used composite weight outcomes to demonstrate this methodological issue, it naturally extends to and has implications for all composite variable outcome analyses where causal interpretation is the primary focus.

**Being a Turing Enrichment student**  
It allowed me to engage, network and collaborate with other Turing fellows from a wide range of disciplines, giving me new perspectives on my work. It also enabled me to improve my skills and knowledge through seminars and courses (e.g., Cofactor course “Writing and publishing a research paper”).

Although I was based in Leeds, I was able to visit the Turing office in London and network in-person. I also found the external supervision session to be extremely beneficial, as it provided me with valuable advice and guidance.
Scott Jeen, University of Cambridge

Project title
Real-World Reinforcement Learning

Supervisors
Jonathan Cullen

Main outcomes of my research
I’m interested in developing autonomous agents that can reason usefully about the physical world. My recent work has looked at RL for energy-system control, specifically controlling buildings such that they interact with the grid optimally, drawing power from the grid when grid carbon intensity is low. This setting, as with most real-world environments, is non-stationary, non-episodic and has strict safety requirements, making for really interesting theoretical challenges.

Impact of my work
Existing work in the RL for smart building control has required some prior knowledge, either historical data from sensors, or access to a simulator that accurately characterises the system dynamics. In response, we’ve shown it is possible to bypass this requirement with a new algorithm called PEARL (Probabilistic Emission-Abating Reinforcement Learning) that can reduce emissions from buildings by 31% without pre-training. Such generality means we could feasibly scale PEARL to every building in the world which would prove a cost-effective, useful method for tackling climate change.

Being a Turing Enrichment student
The Enrichment scheme has significantly broadened my network, both with experienced academics and Early Career Researchers. My most valued connection is with Alessandro Abate, Turing Fellow and Professor in Oxford’s Computer Science Department. Alessandro’s group work on RL, control, and verification, with interests in high-impact applications like energy-system control. We worked together on PEARL, where his expertise in stochastic control and system identification proved invaluable, and I hope to work closely with his group moving forward on related topics. I’ve also benefited greatly from the broad knowledge of my enrichment scheme cohort. Our weekly seminars have showcased research across varied domains, including: drug discovery, explainability, topological analysis, meta learning, neuroscience, cybersecurity and climate modelling. I am indebted to my peers for interesting conversations at the Turing, they made my experience incredibly rewarding.

Stanislav Zhydkov, University of Warwick

Project title
Mechanism Design and Strategyproofness on Networks

Supervisors
Paolo Turrini

Main outcomes of my research
My research primarily studies models and systems on networks, in which self-interested agents interact to achieve their goals. I am interested in designing such systems in a way that motivates greedy agents to achieve a socially good outcome. I also consider models in which a malicious attacker attempts to corrupt the system and look at the ways to make the system secure from such attacks.

Impact of my work
Creative incentives for agents to behave in a certain (hopefully beneficial for others) way is cornerstone of policy-making within businesses, public institutions and the economy as a whole. My research can eventually help improve peer-reviews systems used in academia and elsewhere; help governments motivate businesses share skills and innovations in an efficient way; and help tackle the spread of malicious news in various media.

Being a Turing Enrichment student
The Turing provides plenty of opportunities for students to become better data scientists and researchers in general. I found the Introduction to Research Data Science course particularly useful as it teaches you to think about the problem and the data deeply, rather than just apply generic tools with little understanding.

The Enrichment scheme also provides excellent opportunities for collaboration as you are bound to find someone related to your research easily. For example, in our ongoing work with Keiran Suchak in setting up an Agent-Based Modelling network at LIDA, we realised how many researchers in different fields are doing very similar work without realising it and talking to each other. The Turing Enrichment scheme is perfectly tailored to address this problem as it attracts enthusiastic students from different domains.
Syu-Ning (Shunee) Johnn, University of Edinburgh

Project title
Optimising the design of a food supply chain network

Supervisors
Jörg Kalcsics, Sergio García Quiles

Main outcomes of my research
My research combines operational research theory and practice for application areas such as supply chain network design, logistics, scheduling and transportation optimisation. My research interests include applying exact optimisation methods and heuristics to solve combinatorial optimisation problems, especially those with a facility location or vehicle routing aspect. I am also interested in integrating classical optimisation approaches with machine learning techniques.

Being a Turing Enrichment student
Recalling the engagement with the Enrichment scheme, I can only encourage current and future participants to reach out and embrace the fantastic opportunities Turing offers. The generous support from the Turing network has been overwhelmingly exhaustive: assorted workshops and training for young researchers, academic mentoring, REG technical question drop-ins, external supervision, lunch and learn, randomised coffee chat, and so many more during my time as an enrichment student! Amongst all, the project collaboration platform has been particularly beneficial, since it enabled me to propose and advertise my own project as an extension of my PhD work. I was most fortunate to kickstart a multidisciplinary collaboration using this platform, and I want to thank my Turing collaborators, Victor and Julia, as well as the Academic Services team for raising my research to the next level and building one of the highlights of my PhD journey.

The diversity, enthusiasm, openness and compatibility at the Turing have influenced me in so many ways. This unique experience has broadened my research perspective, which would be impossible without Turing’s vibrant and collaborative environment. I find myself exploring an exciting cutting-edge field integrating operation research and machine learning. Throughout the journey I have also unlocked a great deal of transferable skills and become more confident in communicating academically with people outside my research discipline.

Thomas Davies, University of Southampton

Project title
Topological Machine Learning

Supervisors
Ruben Sanchez-Garcia, Long Tran-Thanh

Main outcomes of my research
I am interested in researching methodological Topological Data Analysis (TDA), along with applications of TDA to new domains. Topological Data Analysis uses mathematical tools that can analyse the ‘shape’ of data to enable new ways of performing data analysis. As well as working on developing new tools for practitioners, I am interested in the interface between TDA and machine learning, as well as applying these tools to novel application areas.

Impact of my work
My research has looked at the use of Topological Data Analysis to produce feature vectors for machine learning in the context of anomaly detection in cyber security. Better detection of anomalous behaviour in computer logs enables more secure computer networks, and the ability of Topological Data Analysis to analyse the structure of actions taken within computers makes it well suited to analysing computer logs for cyber security.

Being a Turing Enrichment student
I have met a broad array of researchers working across all sorts of fields. Exposure to researchers from different areas has enabled me to better understand more of machine learning as a research area, which is invaluable coming from a mathematics background. Asking research engineers questions about my implementations of algorithms has given me a better understanding of both how to write usable code, but also when and where to improve performance to make the code more accessible to a broader array of researchers using larger datasets. I have also got involved with the third iteration of the CAGE challenge. This has exposed me to reinforcement learning for cyber security, whilst contributing my research experience working with network structures. I have also collaborated with doctoral and enrichment students at the Alan Turing Institute to submit a poster on causal learning, an area I previously had no experience in. That, alongside the Causal Inference Interest Group, is another example of how the Alan Turing Institute has enabled me to learn about a research topic I previously knew nothing about.
Thomas Statham, University of Bristol

Project title
Evaluating the accuracy and uncertainties of gridded population datasets for supporting evidence-based policy assessments.

Supervisors
Sean Fox, Levi John Wolf

Main outcomes of my research
My research area explores the accuracy and uncertainty of global gridded population datasets, to identify where the inconsistencies are, which is important supporting evidence-based assessments.

Impact of my work
In the context of evidence-based policy assessments, data on global population distributions are a key strategic resource, which are used for the calculation of key urban statistics. After identifying large inconsistencies in the calculation of key urban statistics using different gridded population datasets, the accuracy of areal interpolation methods used by these datasets were directly assessed, in addition to piloting a novel geobootstrap method. The findings showed that this novel method provides more accurate and certain estimates compared to these methods. Following this, a global coefficient variation surface was created, to help identify where our knowledge gap in global population distributions is highest.

Being a Turing Enrichment student
Collaborating with other students from different departments gave me a broader and more rounded understanding of state of the art methods.

“Collaborating with other students from different departments gave me a broader and more rounded understanding of state-of-the-art methods.”

Tiffany Vlaar, University of Edinburgh

Project title
Stochastic Dynamics and Partitioned Algorithms for Model Parameterization in Deep Learning

Supervisors
Benedict Leimkuhler

Main outcomes of my research
My research aims to increase our understanding of the foundations of deep learning. In particular, during my PhD I have studied properties of neural network optimization, and used my findings to obtain enhanced generalization performance and increase the efficiency of neural network training. My work paves the way towards obtaining generalizable and practical neural networks for real-world applications.

Being a Turing Enrichment student
As a Turing Enrichment student I was able to experience the exciting research happening at the Turing Institute and to get involved through interest groups. I had the privileged position of being able to interact with other enrichment students and researchers affiliated with the Alan Turing Institute. The rich variety of backgrounds, skill sets, and research interests of researchers at the Turing Institute offers for a truly interdisciplinary environment. I enjoyed being a part of the Turing research community.

“The rich variety of backgrounds, skill sets, and research interests of researchers at the Turing Institute offers for a truly interdisciplinary environment.”
Timothy Lam, University of Exeter

Project title
Quantifying Teleconnection pathways leading to Droughts and Fires in Indonesian Borneo

Supervisors
Jennifer Catto, Peter Challenor, Anna Harper, Rosa Barciela, Alberto Arribas

Main outcomes of my research
My project aims to understand the drivers behind the multiple drought- and fire-associated hazards in the peatlands of Central Kalimantan Province, Indonesian Borneo, by quantifying teleconnections, i.e. the sources of predictability for regional weather and climate, which can be represented by causal relationships between climate features in physically separated regions. Exploiting the copious amounts of observed, reanalysis and derived data of the past climate and future projections, causalities between target variables (rainfall, drought and fire indicators in Indonesian Borneo) and climate drivers (mainly sea surface temperatures and wind anomalies across the globe) are determined.

Impact of my work
An enhanced understanding of present and possible future changes of drivers of droughts and fires informs decision making for prevention and control of multihazards and long-term resilience building. It underpins the threat to livelihood security under combined climatic and human-induced stresses and thus shapes policy recommendations for scenario planning. These real-world impacts could be achieved through collaboration with the academia, government agencies and NGOs in Indonesia, under a multi-million pound project funded by the Global Challenges Research Fund (Project Reference: NE/T010401/1; Project website: https://kali-project.com).

Being a Turing Enrichment student
I embarked on the journey towards enhancing reproducibility of Environmental Data Science. It started from a self-introduction on Slack Channel ‘ds4s’ (a.k.a. Data Science for Science) on the first day of placement, where I was given a chance to present a few weeks later at a Show & Tell event for Environmental Data Science Book organised by Alejandro Coca on my user experience of Pangeo. A few opportunities emerged from there such as: (1) Enrichment Student Project Collaboration with Alejandro, which led to publication of an open-source tool useful for working with rainfall datasets (2) Participation at the EGU (European Geoscience Union) General Assembly, where I presented the Pangeo use cases in a first-ever session on Pangeo

Training workshops for students are of excellent quality, particularly the Academic Writing Workshop by Cofactor (led by Anna Sharman and Bruce Johnson) and the Public Engagement Workshop by Jamie Gallagher, I will always remember the takeaways through my lifelong career journey.

Tom Bewley, University of Bristol

Project title
Explainable Interactive Reinforcement Learning

Supervisors
Jonathan Lawry, Arthur Richards

Main outcomes of my research
Explainable artificial intelligence (XAI) aims to open the black box of data-driven learning algorithms, providing human-interpretable summaries of their behaviour. One class of learning algorithm that has received little attention from the XAI community are those that use exploratory data to learn control policies for dynamic environments, such as reinforcement learning (RL). The challenge of explanation in this context is even harder than in the more well-studied supervised learning domain because control problems have inherent dependencies that make localised modelling or explanation difficult. Rather than sidestepping the complexities of the RL explainability context, my research attempts to tackle them head-on, and develop bespoke tools for this domain. This problem is highly multi-faceted, and I believe that it is best tackled by a suite of tools offering multiple perspectives on an agent’s behaviour at various levels of abstraction.

Impact of my work
Explainability will be a vital component of any deployed autonomous system where trust and verifiable performance are important, and is also likely to yield scientific insight into the internal mechanisms of AI models that could be leveraged to inspire further performance improvements. It is the former motivation that primarily interests the industrial partner company for my PhD, and one of the key components of my work has been a long-term collaboration with engineering staff to develop a suite of human-agent interaction tools that enable a person to both guide and monitor the learning of an RL system. In the new year, we plan to conduct an extensive user evaluation of these tools in the context of an aeronautical use case. Outside of this application-focused output, my research has yielded numerous peer-reviewed publications which outline new theoretical proposals and experiments.

Being a Turing Enrichment student
In addition to developing my core research skills by attending Turing courses such as the excellent RSE programme, I have gained a huge amount of insight and social support from being in a vibrant physical space filled with other research students. This informal mixing and sharing of ideas has helped me to further ground my research in the wider AI field, which will benefit me greatly when writing up my thesis over the coming year. It also led directly to me beginning a productive research collaboration with a fellow Turing student, which has led to a paper that is currently in the final stages of peer review at one of the top global AI conferences.
Umang Bhatt, University of Cambridge

**Project title**
Algorithmic Transparency in Machine Learning

**Supervisors**
Adrian Weller

**Main outcomes of my research**
My research explores trustworthy machine learning (ML), wherein algorithmic decision-making systems are endowed with the ability to explain their behavior and adjust to stakeholder preferences. Specifically, I focus on algorithmic transparency and its effects on ML-assisted decision-making. Algorithmic transparency exposes properties of ML models to stakeholders for purposes that include understanding, improving, and contesting model recommendations. Algorithmic transparency modulates a stakeholder’s trust in decision-support systems through tools like explainability and uncertainty estimation. I develop methods grounded in information theory and probabilistic ML, while drawing from advances in cognitive science and psychology.

**Impact of my work**
Motivated by applications in healthcare and defense, I study how to create models that explain their predictions to stakeholders and leverage stakeholder expertise to improve human-machine team performance. My research style includes (a) convening stakeholders to understand model shortcomings, (b) devising principled methods to address stakeholder needs, and (c) running large-scale user studies to study the efficacy of our methods. After I convened multiple participatory design sessions to collate the needs of policy makers, data scientists, and executives with respect to deploying explainability, my work influenced multiple governing bodies and advocacy organizations to develop strategies for algorithmic transparency.

**Being a Turing Enrichment student**
Being a Turing Enrichment Student allowed me to collaborate with many great Turing researchers including Parameswaran Kamalaruban, Matthew Wicker, Giovanni Cherubin, and other members of the Safe and Ethical AI Programme. I appreciated the lively discussions and enjoyed working on multiple publications with the team. I look forward to many fruitful collaborations to come.

William Finnegan, University of Oxford

**Project title**
Education in the climate emergency: Smart grids, digital storytelling and the quest for net-zero schools in the UK

**Supervisors**
Sarah Darby, Tina Fawcett

**Main outcomes of my research**
My research is investigating the social practices of sustainability at secondary schools, and how climate education is preparing young people for a future shaped by climate change and our response to the climate crisis. During my time at the Turing Institute, I’ve been working with schools in London to explore how they use energy and air quality data to engage school stakeholders in climate action.

**Being a Turing Enrichment student**
At Turing I was able to participate in a range of training opportunities and develop data science skills. This was particularly important as my research group is primarily composed of qualitative social scientists, so I wasn’t able to get the same support at my home university. I also have really appreciated being part of the Turing Data Stories group, and helping craft a number of data stories on very different themes, as well as bring a participatory data storytelling process to secondary schools in London involved in my research.

“At Turing I was able to participate in a range of training opportunities and develop data science skills.”
Xinyu Yang, University of Glasgow

Project title
Understanding the evolutionary dynamics of cancer via computational approaches

Supervisors
Ke Yuan

Main outcomes of my research
Cancer is an evolutionary process which accumulates somatic alterations along the genome. Contrasting with the strong inter-tumour heterogeneity in subclonal mutations, robust clustering of gene expression patterns, which leads to molecular subtypes of diseases, are identified in the breast, colon, and pancreatic cancers. My research focuses on quantifying cancer evolution via computational approaches, which allows us to answer several questions: how can individual disease progression end up with similar phenotypic traits? does it suggest certain degrees of convergence of evolution? If so, how can we measure it? How should we guide clinical therapy from the view of evolution?

Impact of my work
Intratumoral heterogeneity (ITH) has recently emerged such a universal feature of tumours. While studies have been focused on linking ITH with the underlying evolutionary dynamics that drive cancer cells, the consequence of the ITH or how it influences or is influenced by other players in the tumour microenvironment is largely unknown. The short-term impact of my work is to bridge the gap between evolutionary analysis and omics profiles and make assessments of the consequences of ITH possible in bulk sequenced tumour samples by proposing a new computational framework. In the long term, I hope that this research can accelerate understanding of how cancer evolves and provide clinical insight and value.

Being a Turing Enrichment student
The Turing Enrichment scheme offered a unique opportunity to support my development and relocate to London. This placement enabled me to engage and network with a wide range of students from different educational and world-leading Turing researchers in the data science community. This is extremely valuable to research as I was able to gain many ideas and useful feedback about my research. Besides, the support no matter from academia or the tools team facilitates a lot of daily work; training opportunities such as events, seminars and workshops at the Turing helped me learn new techniques and knowledge and follow recent advancements in AI and data science. Last but not least, it allowed me to access the Turing’s fancy office in London and computational resources. I’ve always enjoyed joining formal and informal discussion groups and social events, which helps me to fit into life in London quickly. I’ve always felt lucky to enter the Turing community which provides a great atmosphere through various channels of communication.

Project title
Some Topics on Statistical Transfer Learning

Supervisors
Francois-Xavier Briol

Main outcomes of my research
My research aims at transfer learning in computational statistics and machine learning. The general idea is to make learning algorithms achieve better performance by exploring and exploiting the hidden information shared across different tasks, from Monte Carlo integration to image classifiers. It is often the case when we do not have access to a sufficient amount of data for the task of interest. But we do have the same data available for other related/similar tasks of which data can be obtained at a lower cost. In these cases, transfer learning can help the algorithm learn the target task well by conditioning not only on the limited data of itself but also the abundant data from other related similar tasks.

Impact of my work
My work has been applied to many areas of computational statistics and machine learning where only a little amount of data is available for a target learning task or a collection of them. For instance, when the estimation of several intractable expectations is of interest but only few samples for each task are available, we can make use of transfer learning on estimating these expectations jointly and achieve a better accuracy. These expectations often occur in multi-fidelity modelling for physical modelling, Bayesian inference of random variables and so on. The improved estimators can therefore be beneficial to the cases from algorithms themselves to the associated decision.

Being a Turing Enrichment student
This is a unique experience during my PhD. Being a Turing Enrichment student provides me with extra opportunities of collaborating with researchers working in my field. My research during the Enrichment mainly focused on the transfer learning in the field of Monte Carlo integration. Meanwhile, I also got to know other fellow PhD students working in many other interesting areas as well, e.g., engineering science and urban science. In addition to research itself, I also co-organized the Statistics in Data-Centric Engineering (S-DCE) seminar series and got to know lots of interesting work and a broader community both within and outside The Alan Turing Institute. In all these ways, this experience has made me a better researcher who can think independently and work collaboratively. Finally, I would also like to thank The Alan Turing Institute for the financial support as well for this fruitful year.

Project title
Understanding the evolutionary dynamics of cancer via computational approaches

Supervisors
Francois-Xavier Briol

Main outcomes of my research
Cancer is an evolutionary process which accumulates somatic alterations along the genome. Contrasting with the strong inter-tumour heterogeneity in subclonal mutations, robust clustering of gene expression patterns, which leads to molecular subtypes of diseases, are identified in the breast, colon, and pancreatic cancers. My research focuses on quantifying cancer evolution via computational approaches, which allows us to answer several questions: how can individual disease progression end up with similar phenotypic traits? does it suggest certain degrees of convergence of evolution? If so, how can we measure it? How should we guide clinical therapy from the view of evolution?

Impact of my work
Intratumoral heterogeneity (ITH) has recently emerged such a universal feature of tumours. While studies have been focused on linking ITH with the underlying evolutionary dynamics that drive cancer cells, the consequence of the ITH or how it influences or is influenced by other players in the tumour microenvironment is largely unknown. The short-term impact of my work is to bridge the gap between evolutionary analysis and omics profiles and make assessments of the consequences of ITH possible in bulk sequenced tumour samples by proposing a new computational framework. In the long term, I hope that this research can accelerate understanding of how cancer evolves and provide clinical insight and value.

Being a Turing Enrichment student
The Turing Enrichment scheme offered a unique opportunity to support my development and relocate to London. This placement enabled me to engage and network with a wide range of students from different educational and world-leading Turing researchers in the data science community. This is extremely valuable to research as I was able to gain many ideas and useful feedback about my research. Besides, the support no matter from academia or the tools team facilitates a lot of daily work; training opportunities such as events, seminars and workshops at the Turing helped me learn new techniques and knowledge and follow recent advancements in AI and data science. Last but not least, it allowed me to access the Turing’s fancy office in London and computational resources. I’ve always enjoyed joining formal and informal discussion groups and social events, which helps me to fit into life in London quickly. I’ve always felt lucky to enter the Turing community which provides a great atmosphere through various channels of communication.

Project title
Understanding the evolutionary dynamics of cancer via computational approaches

Supervisors
Francois-Xavier Briol

Main outcomes of my research
Cancer is an evolutionary process which accumulates somatic alterations along the genome. Contrasting with the strong inter-tumour heterogeneity in subclonal mutations, robust clustering of gene expression patterns, which leads to molecular subtypes of diseases, are identified in the breast, colon, and pancreatic cancers. My research focuses on quantifying cancer evolution via computational approaches, which allows us to answer several questions: how can individual disease progression end up with similar phenotypic traits? does it suggest certain degrees of convergence of evolution? If so, how can we measure it? How should we guide clinical therapy from the view of evolution?

Impact of my work
Intratumoral heterogeneity (ITH) has recently emerged such a universal feature of tumours. While studies have been focused on linking ITH with the underlying evolutionary dynamics that drive cancer cells, the consequence of the ITH or how it influences or is influenced by other players in the tumour microenvironment is largely unknown. The short-term impact of my work is to bridge the gap between evolutionary analysis and omics profiles and make assessments of the consequences of ITH possible in bulk sequenced tumour samples by proposing a new computational framework. In the long term, I hope that this research can accelerate understanding of how cancer evolves and provide clinical insight and value.

Being a Turing Enrichment student
The Turing Enrichment scheme offered a unique opportunity to support my development and relocate to London. This placement enabled me to engage and network with a wide range of students from different educational and world-leading Turing researchers in the data science community. This is extremely valuable to research as I was able to gain many ideas and useful feedback about my research. Besides, the support no matter from academia or the tools team facilitates a lot of daily work; training opportunities such as events, seminars and workshops at the Turing helped me learn new techniques and knowledge and follow recent advancements in AI and data science. Last but not least, it allowed me to access the Turing’s fancy office in London and computational resources. I’ve always enjoyed joining formal and informal discussion groups and social events, which helps me to fit into life in London quickly. I’ve always felt lucky to enter the Turing community which provides a great atmosphere through various channels of communication.

Project title
Understanding the evolutionary dynamics of cancer via computational approaches

Supervisors
Francois-Xavier Briol

Main outcomes of my research
Cancer is an evolutionary process which accumulates somatic alterations along the genome. Contrasting with the strong inter-tumour heterogeneity in subclonal mutations, robust clustering of gene expression patterns, which leads to molecular subtypes of diseases, are identified in the breast, colon, and pancreatic cancers. My research focuses on quantifying cancer evolution via computational approaches, which allows us to answer several questions: how can individual disease progression end up with similar phenotypic traits? does it suggest certain degrees of convergence of evolution? If so, how can we measure it? How should we guide clinical therapy from the view of evolution?

Impact of my work
Intratumoral heterogeneity (ITH) has recently emerged such a universal feature of tumours. While studies have been focused on linking ITH with the underlying evolutionary dynamics that drive cancer cells, the consequence of the ITH or how it influences or is influenced by other players in the tumour microenvironment is largely unknown. The short-term impact of my work is to bridge the gap between evolutionary analysis and omics profiles and make assessments of the consequences of ITH possible in bulk sequenced tumour samples by proposing a new computational framework. In the long term, I hope that this research can accelerate understanding of how cancer evolves and provide clinical insight and value.

Being a Turing Enrichment student
The Turing Enrichment scheme offered a unique opportunity to support my development and relocate to London. This placement enabled me to engage and network with a wide range of students from different educational and world-leading Turing researchers in the data science community. This is extremely valuable to research as I was able to gain many ideas and useful feedback about my research. Besides, the support no matter from academia or the tools team facilitates a lot of daily work; training opportunities such as events, seminars and workshops at the Turing helped me learn new techniques and knowledge and follow recent advancements in AI and data science. Last but not least, it allowed me to access the Turing’s fancy office in London and computational resources. I’ve always enjoyed joining formal and informal discussion groups and social events, which helps me to fit into life in London quickly. I’ve always felt lucky to enter the Turing community which provides a great atmosphere through various channels of communication.
<table>
<thead>
<tr>
<th>Name</th>
<th>University</th>
<th>Enrichment Placement Centre</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam Ó Conghaile</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>6</td>
</tr>
<tr>
<td>Alberto Caron</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>7</td>
</tr>
<tr>
<td>Alexander Lyttle</td>
<td>University of Birmingham</td>
<td>The Alan Turin Institute, London</td>
<td>8</td>
</tr>
<tr>
<td>Andrea Luppi</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>9</td>
</tr>
<tr>
<td>Andreea Avramescu</td>
<td>University of Manchester</td>
<td>The Alan Turin Institute, London</td>
<td>10</td>
</tr>
<tr>
<td>Andrew Mitchell</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>11</td>
</tr>
<tr>
<td>Arnaud Dyevre</td>
<td>London School of Economics</td>
<td>The Alan Turin Institute, London</td>
<td>12</td>
</tr>
<tr>
<td>Benjamin Wallis</td>
<td>University of Leeds</td>
<td>Leeds Institute for Data Analysis (LIDA) at the University of Leeds</td>
<td>13</td>
</tr>
<tr>
<td>Chang Luo</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>14</td>
</tr>
<tr>
<td>Chaoyi Lu</td>
<td>University College Dublin</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Charlie Pilgrim</td>
<td>University of Warwick</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Christopher Parsonson</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>David Massegur</td>
<td>University of Southampton</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>15</td>
</tr>
<tr>
<td>Edward Cunningham</td>
<td>University of Warwick</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Elias Galiounas</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>16</td>
</tr>
<tr>
<td>Emma Vestesson</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>17</td>
</tr>
<tr>
<td>Fabian Gunzinger</td>
<td>University of Warwick</td>
<td>The Alan Turin Institute, London</td>
<td>18</td>
</tr>
<tr>
<td>Gabriel Jones</td>
<td>University of Oxford</td>
<td>The Alan Turin Institute, London</td>
<td>19</td>
</tr>
<tr>
<td>Georgina Mathlin</td>
<td>Queen Mary University of London</td>
<td>The Alan Turin Institute, London</td>
<td>20</td>
</tr>
<tr>
<td>Giuseppe Degan Di Dieco</td>
<td>University of Bristol</td>
<td>The Alan Turin Institute, London</td>
<td>21</td>
</tr>
<tr>
<td>Hannah Nicholls</td>
<td>Queen Mary University of London</td>
<td>The Alan Turin Institute, London</td>
<td>22</td>
</tr>
<tr>
<td>Heather Selley</td>
<td>University of Leeds</td>
<td>Leeds Institute for Data Analysis (LIDA) at the University of Leeds</td>
<td>23</td>
</tr>
<tr>
<td>Hin Ting Frankie Cho</td>
<td>University of Exeter</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>24</td>
</tr>
<tr>
<td>Hope Kent</td>
<td>University of Exeter</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>25</td>
</tr>
<tr>
<td>Ilaria Manco</td>
<td>Queen Mary University of London</td>
<td>The Alan Turin Institute, London</td>
<td>26</td>
</tr>
<tr>
<td>Iman Bilal</td>
<td>University of Warwick</td>
<td>The Alan Turin Institute, London</td>
<td>27</td>
</tr>
<tr>
<td>Isabella Deutsch</td>
<td>University of Edinburgh</td>
<td>Leeds Institute for Data Analysis (LIDA) at the University of Leeds</td>
<td>28</td>
</tr>
<tr>
<td>Jack Doyle</td>
<td>University of Southampton</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>#N/A</td>
</tr>
<tr>
<td>James Fulton</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Janosch Haber</td>
<td>Queen Mary University of London</td>
<td>The Alan Turin Institute, London</td>
<td>29</td>
</tr>
<tr>
<td>Jason Gray</td>
<td>Royal Holloway University Of London</td>
<td>The Alan Turin Institute, London</td>
<td>30</td>
</tr>
<tr>
<td>Jiamu Jiang</td>
<td>University of Nottingham</td>
<td>The Alan Turin Institute, London</td>
<td>31</td>
</tr>
<tr>
<td>Joel Dyer</td>
<td>University of Oxford</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>32</td>
</tr>
<tr>
<td>Josh Nevin</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>33</td>
</tr>
<tr>
<td>Kate Highnam</td>
<td>Imperial College London</td>
<td>The Alan Turin Institute, London</td>
<td>34</td>
</tr>
<tr>
<td>Katharina Zuhlsdorff</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>35</td>
</tr>
<tr>
<td>Khalid Algarth</td>
<td>University of Warwick</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>36</td>
</tr>
<tr>
<td>Kimberly Ton Mai</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>37</td>
</tr>
<tr>
<td>Name</td>
<td>University</td>
<td>Enrichment Placement Centre</td>
<td>Page</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------</td>
<td>------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Laura Fritsch</td>
<td>University of Oxford</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Lele Liu</td>
<td>Queen Mary University of London</td>
<td>The Alan Turin Institute, London</td>
<td>38</td>
</tr>
<tr>
<td>Luca Marinelli</td>
<td>Queen Mary University of London</td>
<td>The Alan Turin Institute, London</td>
<td>39</td>
</tr>
<tr>
<td>Marc Girona-Mata</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>40</td>
</tr>
<tr>
<td>Marios Kalomenopoulos</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Martin Ferianc</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>41</td>
</tr>
<tr>
<td>Matthew Nixon</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>42</td>
</tr>
<tr>
<td>Melike Dila Karatas</td>
<td>University of Exeter</td>
<td>The Alan Turin Institute, London</td>
<td>43</td>
</tr>
<tr>
<td>Michael Schneider</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>44</td>
</tr>
<tr>
<td>Michael Smith</td>
<td>University of Hertfordshire</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Nick Homer</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>45</td>
</tr>
<tr>
<td>Ondrej Bohdal</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>46</td>
</tr>
<tr>
<td>Paul Rottger</td>
<td>University of Oxford</td>
<td>The Alan Turin Institute, London</td>
<td>47</td>
</tr>
<tr>
<td>Paula Martin-Gonzalez</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Penelope Jones</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>48</td>
</tr>
<tr>
<td>Peter Strong</td>
<td>University of Warwick</td>
<td>The Alan Turin Institute, London</td>
<td>49</td>
</tr>
<tr>
<td>Premdeep Gill</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Rachael Pirie</td>
<td>Newcastle University</td>
<td>The Alan Turin Institute, London</td>
<td>50</td>
</tr>
<tr>
<td>Rafiah Patel</td>
<td>City, University of London</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Rebecca Green</td>
<td>King's College London</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Riccardo Barbano</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Ridda Ali</td>
<td>University of Leeds</td>
<td>Leeds Institute for Data Analysis (LIDA) at the University of Leeds</td>
<td>51</td>
</tr>
<tr>
<td>Samuel Bell</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Scott Jeen</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>52</td>
</tr>
<tr>
<td>Seng Ah (Michelle) Lee</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Shishir Rao</td>
<td>University of Oxford</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>Stanislav Zhydkov</td>
<td>University of Warwick</td>
<td>Leeds Institute for Data Analysis (LIDA) at the University of Leeds</td>
<td>53</td>
</tr>
<tr>
<td>Syu-Ning (Shunee) Johnn</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>54</td>
</tr>
<tr>
<td>Thomas Davies</td>
<td>University of Southampton</td>
<td>The Alan Turin Institute, London</td>
<td>55</td>
</tr>
<tr>
<td>Thomas Statham</td>
<td>University of Bristol</td>
<td>the Jean Golding Institute (JGI) at the University of Bristol</td>
<td>56</td>
</tr>
<tr>
<td>Tiffany Vlaar</td>
<td>University of Edinburgh</td>
<td>The Alan Turin Institute, London</td>
<td>57</td>
</tr>
<tr>
<td>Timothy Lam</td>
<td>University of Exeter</td>
<td>The Alan Turin Institute, London</td>
<td>58</td>
</tr>
<tr>
<td>Tom Bewley</td>
<td>University of Bristol</td>
<td>The Alan Turin Institute, London</td>
<td>59</td>
</tr>
<tr>
<td>Umang Bhatt</td>
<td>University of Cambridge</td>
<td>The Alan Turin Institute, London</td>
<td>60</td>
</tr>
<tr>
<td>William Finnegan</td>
<td>University of Oxford</td>
<td>The Alan Turin Institute, London</td>
<td>61</td>
</tr>
<tr>
<td>Woojung Kim</td>
<td>University of Warwick</td>
<td>The Alan Turin Institute, London</td>
<td>#N/A</td>
</tr>
<tr>
<td>XINYU YANG</td>
<td>University of Glasgow</td>
<td>The Alan Turin Institute, London</td>
<td>62</td>
</tr>
<tr>
<td>Zhuo Sun</td>
<td>University College London</td>
<td>The Alan Turin Institute, London</td>
<td>63</td>
</tr>
</tbody>
</table>