

# AI@Cam

Building Cambridge's AI capabilities



UNIVERSITY OF  
CAMBRIDGE



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# Summary

AI is an area of rapidly advancing research, an accelerator of innovation across research disciplines and industry sectors, and a technology that is intertwined with diverse social interests. The challenge for those driving the next wave of progress in AI is to generate meaningful benefits for individuals, communities, and society, while addressing concerns about continuing and emergent digital divides. Inspired by the University's public purpose, this document introduces AI@Cam, the University of Cambridge's strategic approach to addressing this challenge.

Research institutions are engines for, and stewards of, AI innovation. Cambridge University is already home to world-leading researchers across disciplines from astronomy to zoology, to a student community that is enthusiastic about the potential of AI, and to an innovation ecosystem that has a track-record of bringing cutting-edge technologies to market. In the context of AI, the University of Cambridge aspires to:

- be a global leader in AI research, driving further progress in the development of AI technologies, their application to major scientific and social challenges, and their alignment with the priorities of citizens and society;
- lead the field in AI education and make AI accessible to all in society; and
- become an innovation hub that connects research, business, civil society, and policy leaders and supports the deployment of AI technologies for wider social and economic benefit.

Leveraging the world-leading research currently pursued across the University, Cambridge can drive a new wave of AI innovation through collaborations that bring together AI expertise with deep domain understanding, and that centre societal interests or concerns in AI development. This vision for AI at Cambridge is of AI-enabled innovations that benefit science, citizens and society. It is inherently interdisciplinary, based on an understanding that tackling the challenges facing science and society today requires both expertise in AI technologies and insights from across the natural, physical, environmental, and social sciences and humanities, alongside engagement with diverse stakeholder groups. It also recognises that the future success of AI technologies relies on widening access to its benefits.

AI@Cam's approach to delivering this vision will be to capitalise on the University's outstanding academic track record, while acknowledging that new approaches and capabilities are needed to deliver impactful AI research, education and deployment. AI@Cam will form a flagship mission that orchestrates activities across the University's schools and external partners. AI@Cam will:

- facilitate productive engagement across disciplines and between the University and external partners, nurturing a dynamic interdisciplinary research community;
- build partnerships and collaborations that connect AI researchers, practitioners and affected communities, putting societal interests and ethics at the core of AI deployment;
- create spaces for innovative projects to spin-up and respond rapidly to areas of need, translating Cambridge's tradition of local innovation to wider national benefits;
- enhance teaching and learning, embedding AI skills across the University, putting AI tools into the hands of those that need them, and widening access to AI knowledge and skills; and
- connect expertise and insights from the University's AI community to national priorities, helping deploy AI in the service of national policy goals.

AI is a technical field that is deployed at scale; its pervasive nature gives it a broad impact across science, society and the economy, but today's digital divides dictate who benefits from AI technology. Bridging these divides is a complex, long-term problem. Solution development requires expertise from policy, business, philanthropy, research disciplines, and from individuals and their communities. By developing mechanisms that allow intercommunication between real world deployment and the latest academic developments AI@Cam will enable the University to play a key role in both the innovation and stewardship required to shape our digital futures.



# Foreword

The University of Cambridge has a rich legacy of breakthrough discoveries that have paved the way for many present technologies. With a history of innovations by Charles Babbage, Alan Turing and Maurice Wilkes, Cambridge could be considered the birthplace of modern computing. Today, Cambridge's mathematical and engineering excellence underpins AI technologies that are being applied to some of the world's major challenges, ranging from the climate crisis to precision medicine.

AI research is rapidly expanding across all six Schools of the collegiate University, encompassing all disciplines. Data-driven discovery is changing the way we conduct much of our research, bringing an unprecedented acceleration to progress within and across disciplines. There is an increasing interest from students for data-intensive courses, alongside an actively expanding curriculum to meet the demand. Through its deeply interdisciplinary nature, AI stimulates a high level of collaboration both across the University and with partners outside the sector.

To maintain its current leading role in AI research excellence and enhance these interdisciplinary research efforts across Cambridge, it is time for the University to act in a joined up and collective way. We need mechanisms that bring together our world-leading research talent with real-world needs, inspire even greater collaboration across disciplines and widen access to AI knowledge and tools. We not only need to create an environment in which AI researchers and students can flourish but also a gateway through which those outside our institution can work with us to deliver beneficial AI technologies and AI-enabled outcomes with national and international impact.

AI@Cam is a challenge-led flagship initiative with both inward ambition and outward facing vision. It aims to connect the University's AI capabilities, facilitating productive engagement across the University and putting Cambridge at the centre of a global discussion about the safe and ethical deployment of AI technologies. The AI@Cam review led by Neil Lawrence and Jessica Montgomery provides the framework for our AI mission.

We hope this review will stimulate conversations across the University and beyond, and will encourage you to engage with the initiative so that it can further progress to best support you and the wider Cambridge community. It is an initiative that we want to build for our people, but – most importantly – with our people.



**Anne Ferguson-Smith**  
**FRS FMedSci**

Pro Vice-Chancellor for Research and  
Arthur Balfour Professor of Genetics,  
University of Cambridge

## How can AI from Cambridge University serve science and society?

“ The human race is now generating quite extraordinary amounts of data related to medical science and health. The potential for us to use this to improve lives is enormous. Given the scale and complexity of the data, there is absolutely no question that we need artificial intelligence to understand how we can use this tsunami of information to benefit individual patients and whole populations. I believe Cambridge is ideally placed to seize this opportunity.

**Patrick Maxwell FMedSci**

Head of the School of Clinical Medicine and Regius Professor of Physic, University of Cambridge

“ Through its various centres of excellence, the School of Arts and Humanities has developed an interdisciplinary community that is responding to and shaping technological transformations and the challenges they pose to our cultures, societies, environment and world. We are delighted to participate in the University-wide AI initiative, because with its proven ability to bring multiple perspectives to bear, Cambridge is uniquely placed to analyse and critique, generate and influence new opportunities, today and far into the future.

**Chris Young**

Head of the School of Arts and Humanities, and Professor of Modern and Medieval German Studies, University of Cambridge

“ A long-standing question in biology is how changes in gene expression affect the health of cells, tissues and organs. With cutting edge genome sequencing technologies such as single cell and spatial genomics, projects such as the international Human Cell Atlas initiative generate vast amounts of data that we can use to understand patterns of gene expression, differences between cells, and how these relate to different diseases. We need effective AI tools to interrogate this data, and biologists who are trained to use those tools to advance our science.

AI has already driven rapid progress in areas such as protein folding, showing researchers the potential of AI for scientific discovery. Cambridge's world-leading life sciences research can drive a new wave of innovation through interdisciplinary collaborations that combine AI, genomics and bioinformatics expertise to decipher the biological foundations of health and immunity.

**Sarah Teichmann FMedSci FRS**

Head of Cellular Genetics, Wellcome Sanger Institute, and Director of Research, Cavendish Laboratory, University of Cambridge

“ **Digital twins are a promising set of technologies to help manage more effectively industrial and business processes, as well as systems in the natural and built environment. Developing these complex simulations and coupling them to the reality they represent requires systematic combination of data and physics-based models, using techniques from mathematical sciences, statistical science, machine learning, and AI. Deploying them also demands expertise from all sectors of engineering, science, business and national government agencies.**

**Further progress in the development, deployment and successful use of digital twins will require infrastructures that support high-quality interdisciplinary collaborations and that connect academic expertise with the needs of industry and government. Through AI@Cam, Cambridge can play an important role in building these collaborations, capitalising on its strong local innovation system and working with national partners like the Alan Turing Institute to share the benefits of its expertise across the UK.**

**Mark Girolami**

Sir Kirby Laing Professor of Civil Engineering, University of Cambridge, and Chief Scientist, The Alan Turing Institute

“ **Research and teaching in the School of Biological Sciences is diverse, spanning animal, human, plant and microbial science from the atomic, molecular and cellular levels through to tissues, organs, whole organisms, populations, ecosystems, biodiversity, and human behaviour. Our work contributes to animal and human health, agriculture and environmental management, and industry sectors including pharmaceuticals and biotechnology, as well as clinical practice, public services, and social policy. Through interdisciplinary collaborations that integrate AI across our work, we have the opportunity to accelerate the pace of scientific discovery across these domains and deliver innovations that benefit science, the environment, and the public. AI@Cam can help us harness this opportunity, by providing an infrastructure for AI collaborations that support us in our mission to deliver education, learning and research at the highest international levels of excellence in an inclusive and collaborative environment.**

**Anna Philpott**

Head of the School of Biological Sciences, and Professor of Cancer and Developmental Biology, University of Cambridge



# 01

## Introduction

Exponential growth in data availability and a new family of approaches for extracting insights from data have contributed to a revolution in the tools that can be deployed today for data analysis. The emergence of these advanced automated data analysis methods – here collectively referred to as artificial intelligence (AI) technologies – has driven a new stage of the information revolution that extends across digital and non-digital domains.

Heralded as a new general-purpose technology, the excitement surrounding AI technologies stems from their widespread applicability; their promise lies in their potential to generate new products or services, facilitate new processes, or catalyse new inventions across industry sectors and spheres of life.<sup>1</sup> This pervasiveness gives AI huge potential to benefit science and society. While estimates vary, they suggest AI could add £630 billion of value to the UK economy by 2035.<sup>2</sup> Attempting to harness the value of these technologies, governments across the world are investing in AI research and development. The UK Government, for example, estimates the value of its AI Sector Deal policy package to be close to £1 billion,<sup>3</sup> an investment that sits alongside a wider commitment to increase public investment in R&D to £20 billion per annum by 2024–25.<sup>4</sup>

AI systems in deployment are already delivering benefits to firms, sectors and citizens, and aspirations for their use continue to grow. In research, there is increasing excitement about the potential of AI to accelerate discovery, as high-profile AI-enabled advances signal the scientific progress that can be unlocked through the application of AI and a growing range

- <sup>1</sup> Crafts, Nicholas (2021) Artificial Intelligence as a general-purpose technology: an historical perspective. *Oxford Review of Economic Policy*, 37 (3). pp. 521–536. ISSN 0266-903X, <https://doi.org/10.1093/oxrep/grab012>; Brynjolfsson, E., Rock, D. and Syverson, C. (2018) Unpacking the AI Productivity Paradox, *MIT Sloan Management Review*, available at: [https://sloanreview.mit.edu/article/unpacking-the-ai-productivity-paradox/?utm\\_source=twitter&utm\\_medium=social&utm\\_campaign=sm-direct](https://sloanreview.mit.edu/article/unpacking-the-ai-productivity-paradox/?utm_source=twitter&utm_medium=social&utm_campaign=sm-direct) (accessed 17 March 2022)
- <sup>2</sup> Clark, A., Hollowood, E., Harper, I. and Mostrous, A. (2022) AI in the UK, available at: [www.tortoisemedia.com/2019/12/04/ai-in-the-uk](http://www.tortoisemedia.com/2019/12/04/ai-in-the-uk) (accessed 17 March 2022)
- <sup>3</sup> For further information see: UK Government (2021) National AI Strategy, available at: [www.gov.uk/government/publications/national-ai-strategy](http://www.gov.uk/government/publications/national-ai-strategy) (accessed 22 March 2022)
- <sup>4</sup> For further detail, see: [www.gov.uk/government/news/government-announces-plans-for-largest-ever-rd-budget](http://www.gov.uk/government/news/government-announces-plans-for-largest-ever-rd-budget) (accessed 22 March 2022)

of disciplines identify opportunities for innovative data use.<sup>5</sup> Flagship projects such as AlphaFold, for example, are demonstrating the potential of AI to unlock breakthroughs in long-standing scientific challenges such as protein folding, by combining data-driven insights with existing scientific knowledge of the physics of how proteins fold.<sup>6</sup> In industry, AI offers opportunities for streamlining business processes, implementing new services, and increasing productivity at both firm and national-levels.<sup>7</sup> The manufacturing sector, for example, could generate almost £200 billion in value in the UK by 2027 through the use of AI and associated digital technologies to support real-time management of physical assets, such as wind turbines or trains, through AI-enabled process monitoring and automation, and through savings arising from reduced workplace injuries.<sup>8</sup> In government, AI could play a role in improving the effectiveness and efficiency of public service delivery.<sup>9</sup> For example, the UK Government has sought to deploy AI to improve MOT testing (Department for Transport), to compare the performance of prison services (Ministry of Justice) and to help developing countries more accurately estimate their population density (Foreign, Commonwealth and Development Office).<sup>10</sup> In many cases these new forms of value stem from the ability of AI systems to increase the speed of decision-making through automating data analysis at scale.

As these technologies are integrated in decision-making systems, recent years have demonstrated that the risks and benefits associated with AI are unevenly distributed across society. New uses of data bring the potential to deepen existing social fissures or expose individuals, communities and society to new vulnerabilities.<sup>11</sup> If not carefully deployed and designed with

- 5 The Royal Society and Alan Turing Institute (2019) The AI revolution in scientific research, available at: <https://royalsociety.org/-/media/policy/projects/ai-and-society/AI-revolution-in-science.pdf> (accessed 17 March 2022)
- 6 Callaway, E. (2020) 'It will change everything': DeepMind's AI makes gigantic leap in solving protein structures; Nature, 588, 203–204 (2020), <https://doi.org/10.1038/d41586-020-03348-4>; DeepMind (2021) Putting the power of AlphaFold into the world's hands, available at: <https://deepmind.com/blog/article/putting-the-power-of-alphafold-into-the-worlds-hands> (accessed 17 March 2022)
- 7 McKinsey Global Institute (2018) Notes from the AI Frontier: Insights from hundreds of use cases, available at: [www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning](http://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning) (accessed 17 March 2022)
- 8 Department for Business, Energy and Industrial Strategy (2017) Made Smarter Review, available at: [www.gov.uk/government/publications/made-smarter-review](http://www.gov.uk/government/publications/made-smarter-review) (accessed 22 March 2022)
- 9 Misuraca, G. and Van Noordt, C. (2020) AI Watch - Artificial Intelligence in public services, EUR 30255 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-19540-5; World Economic Forum (2021) 7 ways AI could restore trust in public services, available at: [www.weforum.org/agenda/2021/01/ai-trust-public-services](http://www.weforum.org/agenda/2021/01/ai-trust-public-services) (accessed 17 March 2022)
- 10 UK Government (2019) A guide to using artificial intelligence in the public sector, available at: [www.gov.uk/government/collections/a-guide-to-using-artificial-intelligence-in-the-public-sector#examples-of-artificial-intelligence-use](http://www.gov.uk/government/collections/a-guide-to-using-artificial-intelligence-in-the-public-sector#examples-of-artificial-intelligence-use) (accessed 22 March 2022)
- 11 Acemoglu, D. (2021) Harms of AI, National Bureau of Economic Research Working Paper 29247, available at: [www.nber.org/papers/w29247](http://www.nber.org/papers/w29247) (accessed 17 March 2022)

diverse user communities and contexts in mind, AI technologies can cause harm to those individuals they should serve.<sup>12</sup> Because benefit accrues with individual firms or organisations that already have access to pre-existing pools of well-curated data and individuals with AI skills, the technology could reinforce a dynamic in which a long-tail of organisations fail to benefit from innovation-enabled productivity increases, exacerbating sectoral and geographic productivity divides.<sup>13</sup> These social and economic fault lines are not new, and not unique to AI, but mitigating them in the context of AI development remains vital, to ensure that benefit from AI-enabled advances is evenly distributed.

Despite the last decade's rapid progress in AI technology development, industry and society remain in the foothills of the wider changes that AI technologies could bring in personal, professional, and political spheres. AI's pervasiveness presents a challenge for those invested in aligning technological progress with societal interests, demanding a full pipeline of interventions across the activities and stakeholder groups involved in AI development. AI technologies must be safe and effective in deployment, requiring innovation in both technology and regulation.<sup>14</sup> For sectors and organisations to make use of AI they need to increase their technological absorptive capacity<sup>15</sup> and build new pathways from innovation to deployment.<sup>16</sup> Those pathways often require capability-building in management and leadership to understand how to deploy AI as part of (often complex) data-enabled decision-making systems.<sup>17</sup> New interventions are needed to align technical developments with societal interests and manage risks associated with AI deployment.<sup>18</sup> Research, policy and practice all play a role.

<sup>12</sup> Partnership on AI (2020) When AI Systems Fail: Introducing the AI Incident Database, [www.partnershiponai.org/aiincidentdatabase](http://www.partnershiponai.org/aiincidentdatabase) (accessed 17 March 2022)

<sup>13</sup> The Economist (2017) The world's most valuable resource is no longer oil, but data, [www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data](http://www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data) (accessed 17 March 2022)

<sup>14</sup> Rudner, T. and Toner, H. (2021) Key concepts in AI safety: an overview. Center for Security and Emerging Technology Issue Brief, available at: <https://cset.georgetown.edu/publication/key-concepts-in-ai-safety-an-overview/>; ELISE (2021) Creating a European AI Powerhouse: A Strategic Research Agenda from the European Learning and Intelligent Systems consortium, available at: [www.elise-ai.eu/work/agenda-and-programs](http://www.elise-ai.eu/work/agenda-and-programs) (accessed 17 March 2022)

<sup>15</sup> Their ability to absorb information, practices and technologies, and deploy these in service of organisational objectives

<sup>16</sup> Discussed in the context of innovation generally in Haldane, A. (2018) The UK's Productivity Problem: Hub No Spokes, Academy of Social Sciences Annual Lecture, available at: [www.bankofengland.co.uk/-/media/boe/files/speech/2018/the-uks-productivity-problem-hub-no-spokes-speech-by-andy-haldane](http://www.bankofengland.co.uk/-/media/boe/files/speech/2018/the-uks-productivity-problem-hub-no-spokes-speech-by-andy-haldane) (accessed 17 March 2022)

<sup>17</sup> Some of the issues encountered by such managers and leaders are explored in Lawrence, N.D. (2021) Post-Digital Transformation: Intellectual Debt, available at: <http://inverseprobability.com/talks/notes/post-digital-transformation-intellectual-debt.html> (accessed 17 March 2022)

<sup>18</sup> UK AI Council (2021) AI Roadmap, available at: [www.gov.uk/government/publications/ai-roadmap](http://www.gov.uk/government/publications/ai-roadmap) (accessed 17 March 2022)

In this context, research institutions are significant as both engines for AI innovation – developing novel AI methods and using AI as an enabler of innovation – and as stewards of these innovations. The University's role in stewarding the next generation of AI technologies and their application involves shaping AI development to deliver benefits for all in society and address existing inequalities. This requires action to overcome the digital divides that exist in personal and professional domains. Such divides are geographical and generational. They are being exploited commercially and geopolitically. They disenfranchise and disproportionately affect the vulnerable. These divides also exist across the academic disciplines that should be engaged in developing AI solutions. Resolving them is a complex, long-term problem.

The challenge for the next wave of AI development is to create meaningful, real-world benefits for individuals, communities, and society, while addressing concerns about these continuing and emergent digital divides. In the context of Cambridge University's mission,<sup>19</sup> a related challenge is to support progress in the use of AI to tackle real-world problems that deliver benefits for society, while acknowledging and supporting the freedom of thought and expression of individual academics.

This paper introduces AI@Cam as the forum for achieving this balance by convening the University's expertise around societal challenges in a fiercely interdisciplinary manner. It starts by exploring the contribution required from research institutions to delivering national AI priorities. It then considers the role Cambridge University aspires to play in relation to these priorities, and finally introduces the AI@Cam approach to building the University's AI capabilities.

<sup>19</sup> For a description of the University's mission and core values, see: [www.cam.ac.uk/about-the-university/how-the-university-and-colleges-work/the-universitys-mission-and-core-values](https://www.cam.ac.uk/about-the-university/how-the-university-and-colleges-work/the-universitys-mission-and-core-values) (accessed 17 March 2022)

# 02

## Connecting the University to the UK's national AI ambitions

With AI having been identified as a strategically important technology area, a cluster of national policy initiatives are being implemented by the UK Government with the intention of ensuring continued progress in AI development, while distributing the technology dividend across society. These policies aim to position the UK as a global AI leader through support for AI-related R&D, interventions to increase the absorptive capacity of industry sectors, and frameworks that share the benefits of R&D activities across the UK's regions. Interventions targeted at AI development and deployment also contribute to a wider policy agenda for the UK's research and innovation system. Together, these agendas seek to accelerate the development of AI technologies while taking action to prevent the deepening of digital divides. In the process, they point to a critical role for universities and research institutes as engines for a new wave of AI innovation.

The UK's National AI Strategy<sup>20</sup> consolidates the UK's policy agenda for AI technologies. The Strategy sets out Government's ambitions "that the UK: (1) Experiences a significant growth in both the number and type of discoveries that happen in the UK, and [the discoveries that] are commercialised and exploited here; (2) Benefits from the highest amount of economic and productivity growth due to AI; and (3) Establishes the most trusted and pro-innovation system for AI governance in the world." Its route to achieving these ambitions is to:

- invest in the long-term needs of the AI ecosystem, by increasing access to data, compute, and finance for AI start-ups, and by training a wider pool of people to use AI;
- support AI diffusion across the economy, by increasing uptake of AI by new businesses and sectors; and
- review regulatory structures around AI and data, with the intention of developing a pro-innovation governance regime.

<sup>20</sup> For further information see: UK Government (2021) National AI Strategy, available at: [www.gov.uk/government/publications/national-ai-strategy](https://www.gov.uk/government/publications/national-ai-strategy) (accessed 17 March 2022)

AI research – including AI-enabled research – is central to this approach, as both a foundation for scientific discovery and an engine for wider innovation and growth. While the UK benefits from a strong research base, and a history of leadership in computer science and AI, international competition in AI research continues to grow stronger. A recent global comparison of AI capabilities concluded that the UK was amongst the top 5 countries for AI research. UK-based researchers published over 1,100 papers in top journals over the last two years, and the strength of talent currently based in the UK is a major contributor to its strength in international rankings. However, that analysis noted that the ability to translate this research strength into leadership in innovation – measured, for example, by new patents and business activity – and the relative lack of infrastructure to support high-quality research remain weaknesses of the UK system.<sup>21</sup>

The UK's AI Strategy highlights that without action to significantly expand the UK's skills base in AI, and to embed inclusivity in AI research, the UK is likely to fall behind international competitors and its AI innovations are likely to exacerbate inequality. Research consistently shows that demand for data science and AI skills from industry outpaces supply; one analysis suggests a near 13-fold increase in job adverts for data scientists from 2013 to 2018.<sup>22</sup> Inequalities in access and inclusion continue to hold the field back from its full potential; when considering gender inequality, for example, a recent study found that – despite achieving higher performance once in class – “girls are now outnumbered six to one by boys across computer science classes”,<sup>23</sup> meanwhile only an average of 15% of UK AI research papers include authors who are women.<sup>24</sup> Further inequalities persist across different axes of diversity including (but not limited to) race and ethnicity, socio-economic background, and disability.

By creating a home for excellent research, supporting wider adoption of AI technologies through access to education and technology translation, and contributing to the ethical stewardship of AI development, universities can play an important role in delivering the UK's national priorities and aspirations for AI. Figure 1 sets out the role Cambridge University could play in helping deliver these aspirations.

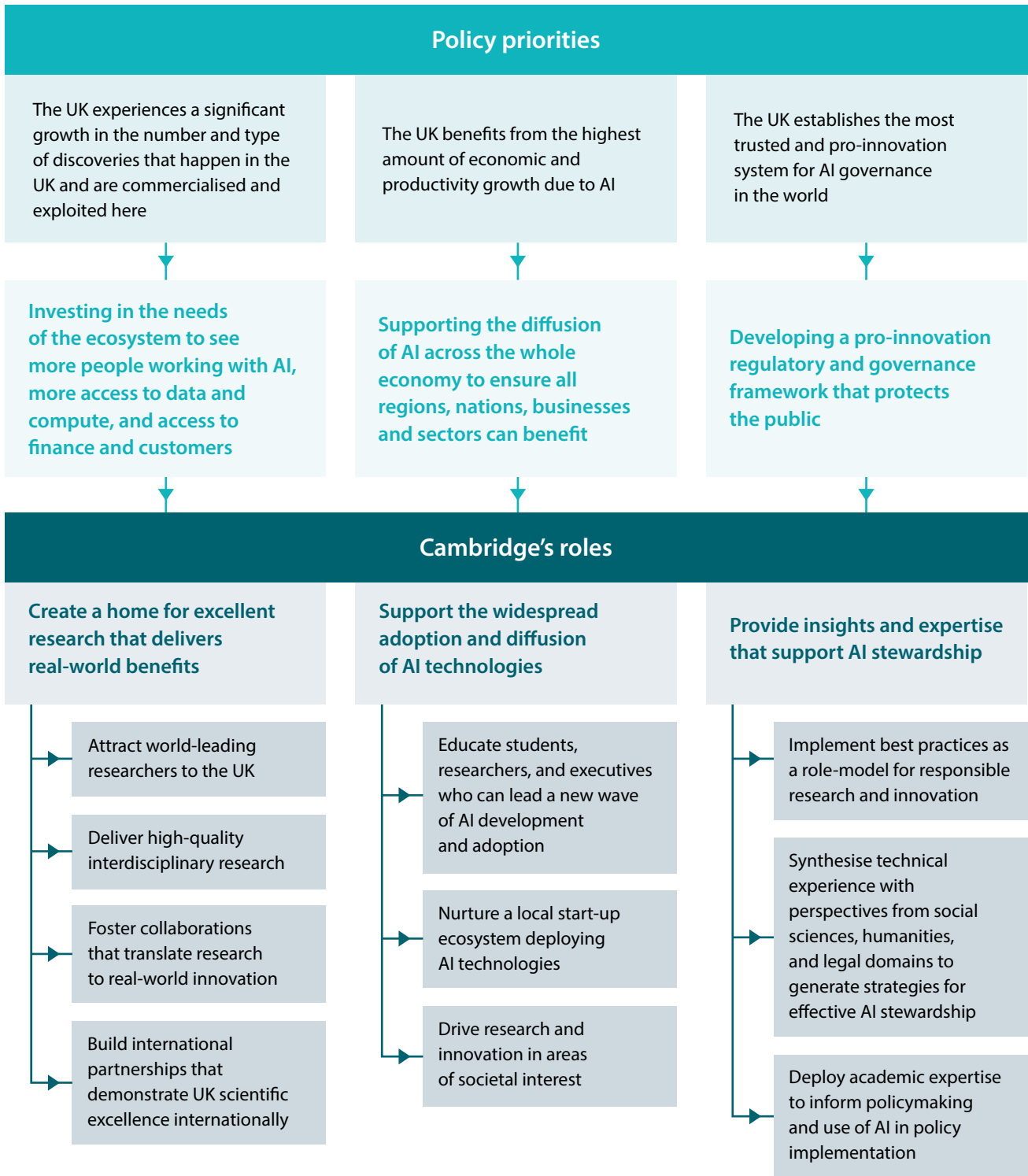
<sup>21</sup> The study cited above is Clark, A., Hollowood, E., Harper, I. and Mostrous, A. (2022) AI in the UK, available at: [www.tortoisemedia.com/2019/12/04/ai-in-the-uk](http://www.tortoisemedia.com/2019/12/04/ai-in-the-uk) (accessed 17 March 2022) Similar findings in relation to the UK's relative strengths and weaknesses can also be seen in Stanford University AI Index (2022) Global AI Vibrancy Tool, available at: <https://aiindex.stanford.edu/vibrancy> (accessed 22 March 2022)

<sup>22</sup> Royal Society (2019) Dynamics of data science, available at: <https://royalsociety.org/-/media/policy/projects/dynamics-of-data-science/dynamics-of-data-science-skills-report.pdf> (accessed 17 March 2022)

<sup>23</sup> BCS (2022) Six boys to one girl in many parts of computing education, new report shows, available at: [www.bcs.org/articles-opinion-and-research/six-boys-to-one-girl-in-many-parts-of-computing-education-new-report-shows](http://www.bcs.org/articles-opinion-and-research/six-boys-to-one-girl-in-many-parts-of-computing-education-new-report-shows) (accessed 17 March 2022)

<sup>24</sup> Benaich, N. and Hogarth, I. (2022) State of AI report, available at: [www.stateof.ai](http://www.stateof.ai) (accessed 17 March 2022)

**Figure 1** Connections between AI policy and Cambridge capabilities



These AI policy interventions contribute to a wider agenda for the UK's innovation system, an agenda that seeks to promote inclusive innovation and growth across the UK.

Recognising the role that innovation plays in enhancing economic productivity and societal wellbeing, the UK's Innovation Strategy<sup>25</sup> seeks to translate the UK's world-leading science base into innovation-led growth, positioning the UK as a global hub for innovation. The Strategy's four pillars – supporting innovation in business; attracting global talent; connecting research institutions to local needs; and increasing capability in key technologies – set out a role for universities as research hubs, as contributors to local innovation ecosystems, and as drivers of AI development and deployment.

Underpinning this vision for UK innovation is excellence in interdisciplinary research, which is integrated with local needs and opportunities and that delivers benefits for people across all of the UK, including communities previously left behind or negatively affected by technological advances. Cambridge has a long track record of interdisciplinary excellence closely integrated with its local innovation cluster, and could extend this success in business engagement and knowledge transfer to the AI domain.<sup>26</sup>

Driving a new wave of ethical AI innovation will require a redoubling of efforts to support collaborations across disciplines, with a focus on the needs and challenges that stem from real-world issues, particularly in left-behind communities. Recent University efforts to encourage such cross-cutting collaborations point to how challenge-driven programmes can position the University to contribute to wider policy agendas (Box 1).

### Box 1

#### **Cambridge Zero: connecting University expertise to national priorities**

Launched in 2019, Cambridge Zero is the University of Cambridge's strategic effort to deploy its research expertise to help tackle climate change. Building on the University's world-leading research on climate sciences and technologies, and leveraging growing efforts among

<sup>25</sup> Department for Business, Energy and Industrial Strategy (2021) UK Innovation Strategy: leading the future by creating it, available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1009577/uk-innovation-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009577/uk-innovation-strategy.pdf) (accessed 17 March 2022)

<sup>26</sup> For a discussion of Cambridge University's role in this cluster see: [www.eastofengland.admin.cam.ac.uk/cambridge-cluster](http://www.eastofengland.admin.cam.ac.uk/cambridge-cluster) and <https://cambridgephenomenon.com/phenomenon> (accessed 17 March 2022)



departments and schools to foster interdisciplinary cooperation on climate change, Cambridge Zero provides a coordination mechanism that seeks to enhance the University's research, education, and engagement capabilities in the climate domain.

Working across departmental silos and providing a focal point for climate activities, Cambridge Zero aimed to create the conditions for improved interdisciplinary collaboration. Examples of such collaboration include:

- engagement with policymakers through the Cambridge Institute for Sustainability Leadership (CISL) and Centre for Science and Policy (CSaP);
- collaborations with the Institute of Astronomy on use of thermal infrared telescopes to monitor energy output of buildings;
- a new partnership with the Cambridge Conservation Initiative (CCI) on climate change biodiversity and nature-based solutions;

By streamlining communications between across the University and fostering new collaborations with external partners, Cambridge Zero has raised the profile of Cambridge University in discussions at regional, national and international levels. At the COP26 in Glasgow, Cambridge Zero played a central role in engagements between the academic and international policy communities; its seminars and festival events attract hundreds of participants; its educational programmes have expanded the pool of researchers in Cambridge working on climate challenges; and it has delivered research insights to inform UK Government climate policy.<sup>27</sup> In the process, Cambridge Zero has demonstrated that the University can play a leading role in delivering research and education for public benefit by marshalling resources behind a flagship initiative.

While the connections between the University and its local innovation system provide a strong starting point for building such collaborations, further work remains to translate the benefits of these successful local approaches to benefits for struggling communities in the region and for other areas of the UK. To step into a national leadership role for a renewed wave of AI innovation, Cambridge must leverage its local experience to deliver benefits for science and society at a national level, sharing its expertise and supporting other areas to grow their innovation clusters in line with their local needs.

<sup>27</sup> These include 'Net Zero Public Dialogue Report' commissioned by UK Department for Business, Energy & Industrial Strategy (BEIS) and the Department for Environment, Food & Rural Affairs (Defra), and 'Climate aware and resilient national security: Challenges for the 21st Century' commissioned by the Government Communications Headquarters (GCHQ)

The recently published Levelling Up White Paper<sup>28</sup> provides a further lens through which to consider Cambridge's role in the UK's innovation ecosystem. Targeted at addressing the geographic inequalities that drive differences in living standards, health, and wellbeing between regions of the UK, the Paper sets out an approach to boosting productivity across the UK that has research, innovation, and education at its core. It suggests three points of interaction between the development of AI technologies and efforts to redistribute growth and opportunities across the UK:

- the Paper reiterates the aims of the Innovation Strategy to more effectively leverage the strengths of the UK's research base to drive increases in productivity and growth, pointing to the role of local innovation accelerators in enhancing such translation;
- commitments to change the distribution of R&D spending across the UK, in combination with the prioritisation of AI in the Innovation Strategy and the National AI Strategy, suggest an imperative to drive AI adoption in innovation clusters outside the Greater South East; and
- missions targeted at individual and community wellbeing – for example, improving healthcare outcomes, reducing crime, increasing education standards, and improving transport links – could benefit from AI-enabled approaches to supporting public services.

As an institution that benefits from existing infrastructures, talent pools, and resources – forms of capital that the framework identifies as enablers of innovation – the challenge for Cambridge University is to develop innovation strategies that extend this privilege beyond those in the Greater South East that are already engaged in AI innovation.

In the context of AI development, one approach to addressing this challenge is to deploy Cambridge's AI research expertise to help deliver public services that meet citizen and community needs, through collaboration with local and national governments, or organisations engaged in policy delivery. Such collaborations would create connections that can translate AI capabilities into practical solutions to societal needs. Understanding what solutions might be useful requires careful engagement between researchers and policymakers, and the ability to address a full-pipeline of AI development challenges, from co-design of research questions, through data management, to deployment.

<sup>28</sup> UK Government (2022) Levelling Up the United Kingdom, available at: [www.gov.uk/government/publications/levelling-up-the-united-kingdom](https://www.gov.uk/government/publications/levelling-up-the-united-kingdom) (accessed 17 March 2022)

Box 2 describes how some of these challenges arise in the context of policy implementation in a major UK city. It highlights that addressing any large-scale policy challenge with AI relies on the ability to bring together research expertise in data science and AI, with access to large datasets, access to compute resources, and insights into the needs of different policy customers, in a way that creates value for different stakeholders. This example raises several questions for a research institution such as Cambridge, including:

- whether the University has the interfaces that would allow it to understand the needs of policy or public service delivery partners;
- whether it is able to provide useful expertise in these contexts;
- how partnerships with universities can equip policymakers to deliver AI-enabled solutions to policy challenges in an ongoing way; and
- what type of partnerships are necessary to make progress in an environment where technical expertise, policy expertise, and access to relevant data might be split across universities, governments, and private sector partners.

## Box 2

### **A perspective from Birmingham City Council on data, AI, and connections with policy delivery**

In 2019 Birmingham City Council declared a climate emergency. Responding to rising global temperatures and emerging impacts of these global changes at a local level, the Council committed to achieving net zero carbon emissions by 2030, two decades earlier than the UK's national target. This target has brought increased focus to attempts to decarbonise activities across the city, with particular attention to reducing emissions from the sectors that contribute the highest proportions of the city's emissions (housing and transport) and to decarbonising the Council's own activities.

A starting point for this work is understanding what levers the Council has available to drive action on carbon reduction in the housing sector. These levers might include invoking statutory duties (for example, relating to planning policy or land use), investing in areas where the Council has direct responsibility (for example, in retrofitting its social housing stock), or leading in areas where the Council has indirect influence.

When considering how to use these levers, data is important, both for policy development and investment decisions. Ideally, policymakers would have access to robust data assets that combine multiple data types, enabling interrogation of the location of physical assets, the social conditions in different localities, and the environmental factors that could influence the feasibility of different policy interventions. However, in many of the policy areas of interest there are few open data sources that reliably describe local conditions. To make progress, officials often use reports prepared for previous policy initiatives or other commissioned work. While such data is useful, it was often not collected for the purposes for which it is now required or provided in formats that facilitate the analysis required.

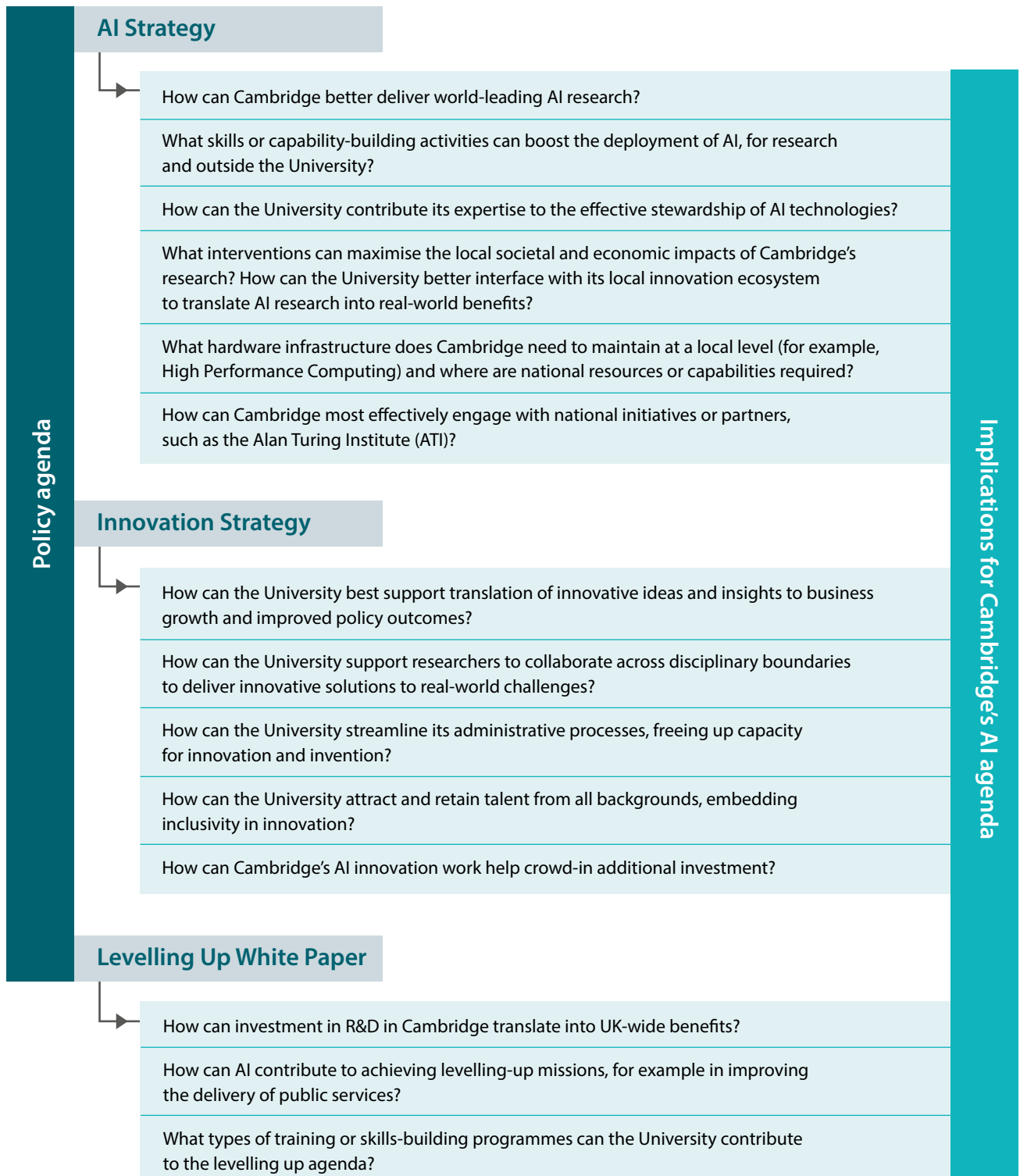
External collaborations have helped the Council fill some of these gaps. Work with Department for Business, Energy and Industrial Strategy-funded Heat Network Delivery Unit has analysed local energy systems and opportunities to develop district heating systems. A project with Birmingham University has created a collaboration space focusing on economic inclusivity in a historically deprived part of the city, opening the University's activities to a wider community of users.

In bringing insights from data science to bear on policy challenges, an important function of such collaborations is to support policymakers to explore options for intervention. This requires action to: identify relevant data resources from across organisations and sectors; curate and combine those resources into a form that can be used for policy analysis; and visualise the insights that come from combining different data types to show the issues that policymakers should consider. To align with the policy cycle, these processes need to proceed at pace.

Across these different types of initiative, an important area for action for the Council now is to move from piloting to scaling effective activities. This will in turn require new collaborations across supply chains, new forms of data or physical infrastructure, and initiatives to build skills in different sectors and communities.

Together, these policy developments create a role for research institutions as enablers of AI innovation and as stewards of such innovations. They highlight the importance of world-leading AI research, skills and capability-building programmes, and efforts to translate research advances to real-world innovations in contributing to an AI ecosystem that delivers benefits for the UK economy and society. In so doing, they pose new questions about how the University can build an infrastructure for connecting its AI expertise to wider national priorities (Figure 2).

**Figure 2** Connections between recent policy and current practice



# 03

## Building Cambridge's AI capabilities

### Cambridge's AI aspirations

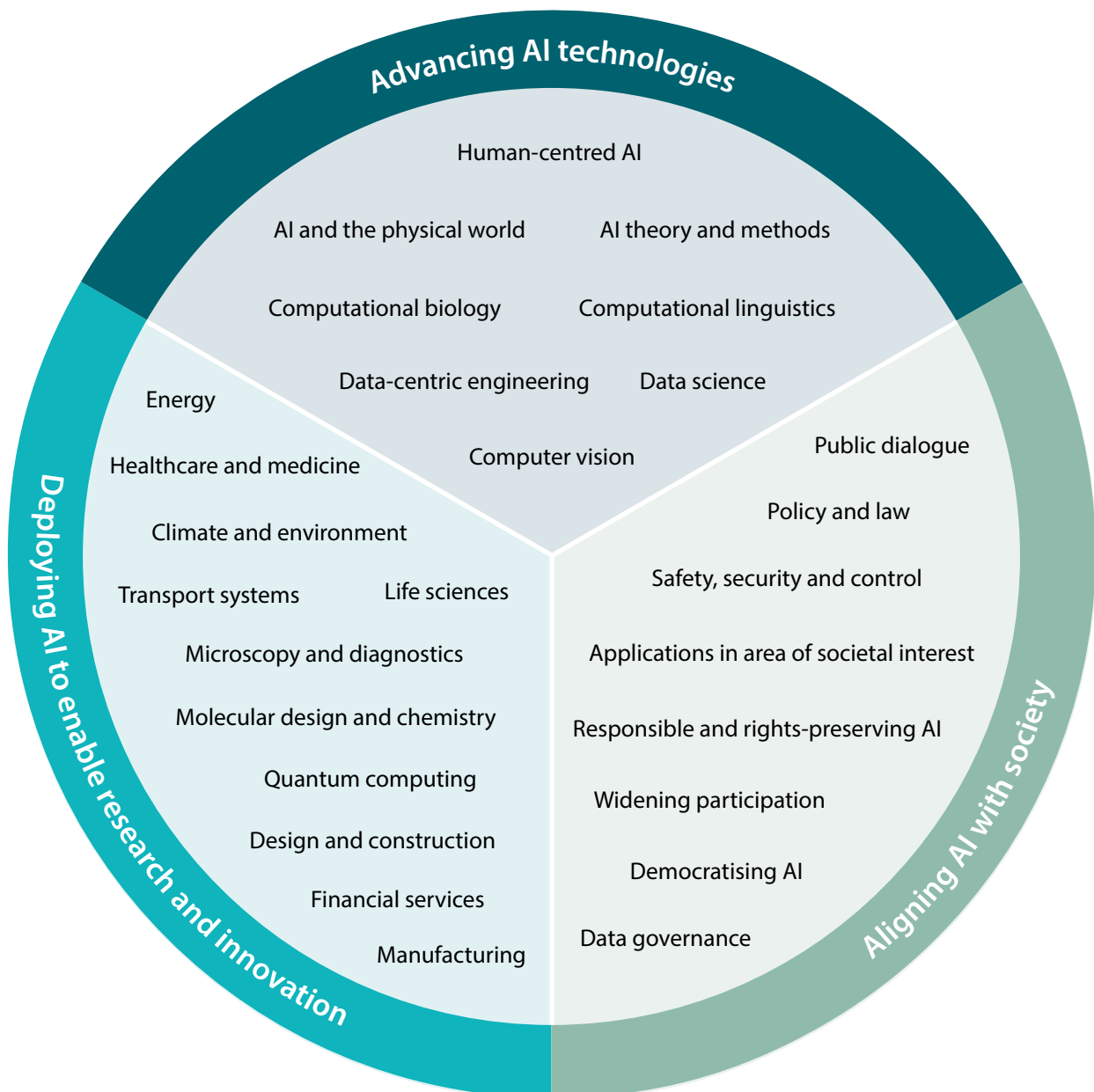
Cambridge University's mission is to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence. As AI technologies become pervasive across spheres of life and work, prompting pressing questions about how the benefits of technological development are distributed across society, the challenge for the University is to identify how to deliver its mission while contributing to the effective stewardship of AI technologies. This challenge engages all elements of the University: its role as a national and international research organisation, as an education provider, and as an institution of public life. It demands new strategies for delivering high-quality research collaborations, fostering an interdisciplinary research culture, and integrating research, policy and practice.

Reflecting the pervasive nature of AI technology itself, AI or AI-enabled research is already distributed across the University (Figure 3). The scope of 'AI' in the University context spans:

- technical research in AI theory and methods, including machine learning, deep learning, and similar data-driven techniques, and associated work in fields such as robustness, explainability, causality, and bias mitigation;
- application-focused research that uses AI to support scientific discovery across the full range of other research domains, which range from medicine to museum artefact curation; and
- social science and humanities-focused research that tracks the impact of AI on society, considers emerging business practices, develops routes to responsible innovation, and brings new perspectives on inequality and equity.

These domains feed into and from each other, with advances in AI technologies contributing to progress in other research domains and insights from those domains in turn shaping how AI theories and methods develop. They are sometimes in tension, or have differences in purpose or direction. This diversity of approaches and perspectives is a strength of the Cambridge AI community.

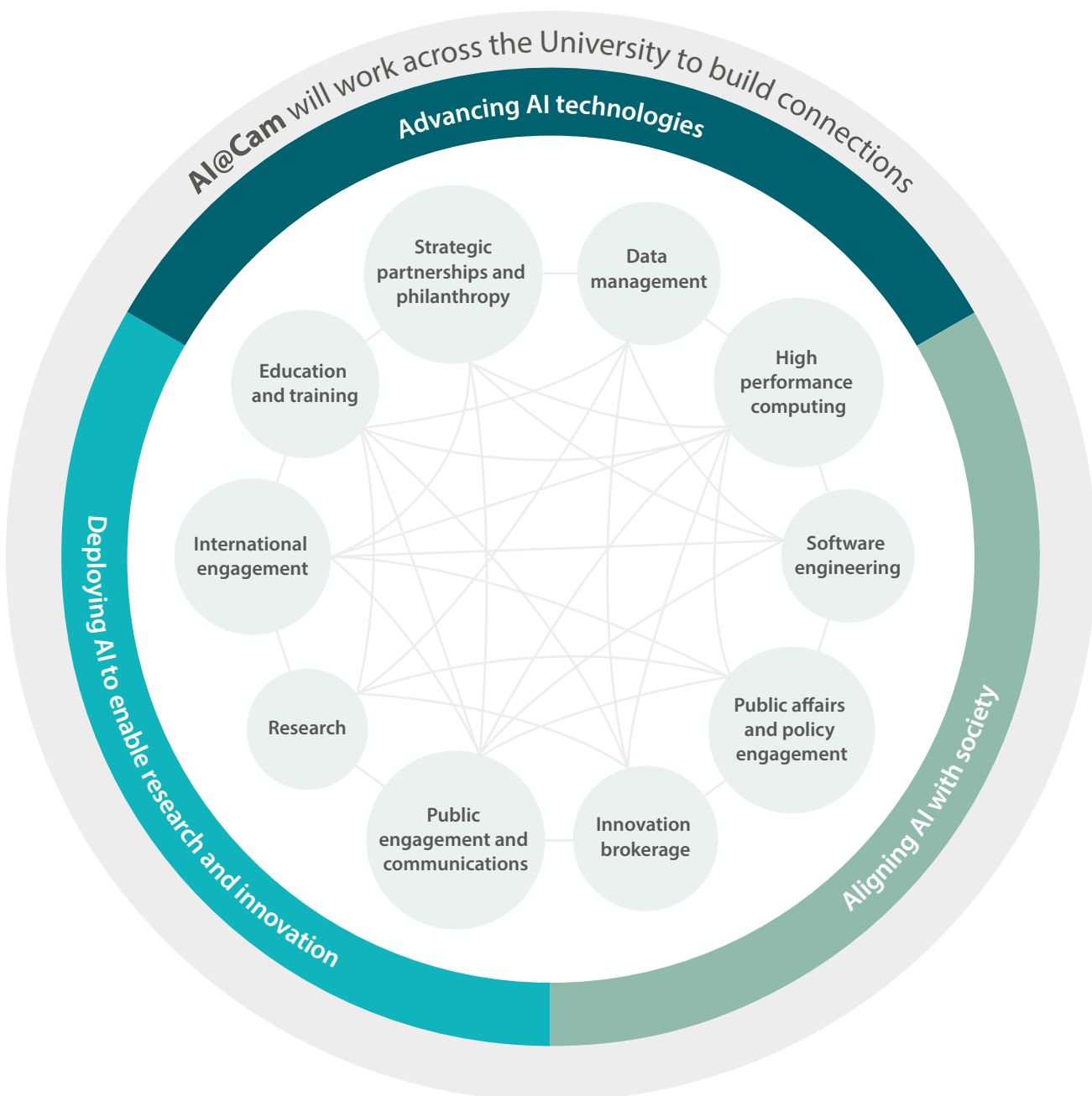
**Figure 3** Understanding the diversity of interests in AI across the University\*



\* This figure shows the range of disciplines engaged in AI research across the University; its scope is illustrative rather than comprehensive. These research themes are explored across the Schools of Arts and Humanities; Biological Sciences; Clinical Medicine; Humanities and Social Sciences; Physical Sciences; and Technology, as well as in University-associated bodies such as the University Information Services.

The research pursued across Cambridge's Schools, Departments, and associated institutions responds to the interests or concerns of different domains. Within those domains the University prides itself on supporting individuals with academic freedom. That freedom has resulted in a variety of research agendas, groups, initiatives and institutions, illustrated in Figure 3. This variety points to the potential resource that the University could deploy in service of its mission and public purpose, but also to the challenge in building connections and collaborations across this complex landscape (Figure 4).

**Figure 4** Mapping the University functions that contribute to AI research and development





The University of Cambridge is an institution with a storied history of innovation, from Bell Burnell and Hewish's observation of the first pulsar<sup>29</sup> to Balasubramanian and Klenerman's development of next generation sequencing.<sup>30</sup> These past innovations were also underpinned by development of technological tools to deliver those new insights, such as the dual electrode voltage clamp developed by Hodgkin and Huxley for measuring action potentials<sup>31</sup> or Wilkes and Wheeler's first use of a digital computer to solve a differential equation.<sup>32</sup>

From this diversity of domains and tradition of innovation emerges shared aspirations for the future of AI research, and for the University's role in promoting that future. Our survey of Cambridge's research community in late 2021 concluded that the University should aspire to:

- be a global leader in AI research, driving progress in technical domains, applying AI to tackle major scientific and social challenges, and aligning the development of AI technologies with societal interests;
- lead the field in AI education, training the next generation of AI leaders and making AI accessible to all in society; and
- become an innovation hub, and a go-to source of advice, that connects research, business, civil society, and policy leaders working to deploy AI for wider social and economic benefit, shaping the development and deployment of AI for the benefit of all in society.

Achieving these aspirations would not only place the University at the vanguard of the next wave of AI technology development, but also position the University to contribute to achieving national ambitions for AI technologies. These goals demand a range of capabilities across both the academic and administrative functions of the University; an agile, responsive institutional environment that can facilitate cooperation across disciplinary, departmental, and organisational boundaries (Figure 4). Figure 5 illustrates the capabilities required, with further detail provided in Annex 1.

<sup>29</sup> For a description of Jocelyn Bell Burnell's work, see: [www.cam.ac.uk/stories/journeys-of-discovery-pulsars](http://www.cam.ac.uk/stories/journeys-of-discovery-pulsars) (accessed 17 March 2022)

<sup>30</sup> For a description of this work, see: [www.cam.ac.uk/stories/journeys-of-discovery-rapid-genomesequencing](http://www.cam.ac.uk/stories/journeys-of-discovery-rapid-genomesequencing) (accessed 17 March 2022)

<sup>31</sup> Schwiening, C.J. (2012) A brief historical perspective: Hodgkin and Huxley, *Journal of Physiology*, 590, 11, 2571–2575, <https://doi.org/10.1113/jphysiol.2012.230458>

<sup>32</sup> See page 357 in Fisher, R. A. (1950) Gene Frequencies in a Cline Determined by Selection and Diffusion. *Biometrics*, vol. 6, no. 4, pp. 353–61, Wiley, International Biometric Society, <https://doi.org/10.2307/3001780>

**Figure 5** Range of different areas where there may be bottlenecks to innovation



## Building capability for the future

These aspirations for research, teaching, and translation expose some natural tensions between the University's AI ambitions and its capabilities. Such tensions arise from the nature of the research collaborations that can help drive progress in AI, the institutional and cultural influences that shape those collaborations, and the wider context that influences AI research and practice. They are summarised as challenges in Table 1 and discussed further below, alongside examples of how recent AI initiatives have sought to address some of these tensions.

**Table 1** Challenges in coordinating a new wave of progress in AI technologies across the University

| Challenge   | Question this poses   |
|---|---|
| Bridging between the needs of challenge-driven applications and the focus of academically driven research   | The next wave of progress in AI will be inspired by (or driven by) applications; how well prepared is Cambridge for this type of research?  |
| Supporting the agility required for innovative solutions and the scale required for deployment in practice  | Innovative solutions are often most easily developed at a small-scale, but achieving impact for these ideas requires the ability to scale-up (sometimes rapidly). What approaches to scaling the deployment of AI systems can help translate innovation to practice?                                |
| Resolving expectations of AI capabilities and the deliverability of AI systems in deployment  | Hype surrounding AI progress contributes to a mismatch between expectations about its utility and technical capabilities in the field. What forms of engagement and communications can help overcome barriers to wider understanding of AI's capabilities?  |
| Encompassing the pursuit of academic understanding over the long-term and the need for near-term and real time decision-making in deployment                              | Academic research typically proceeds at a different pace to decision-making in policy and private sector organisations. Connecting University expertise to this wider environment requires action to align these timescales. What interventions can support rapid deployment of academic expertise? |
| Balancing the incentives that drive progress in AI outside academia and the incentives that shape individual academic's career progression                                | Progress requires cooperation and collaboration across sectors and communities, which in turn requires investment of time and energy from academics. How do we align collective needs with individual interests?  |
| Accommodating the intellectual agility needed to follow new lines of investigation and the institutional inertia that influences how to pursue new research opportunities | Effective research and teaching requires effective administration. How can the University manage its administrative functions to support agile, responsive and effective collaborations?  |

| Challenge  | Question this poses  |
|--|--|
| Mediating between locality as a Cambridge strength and national leadership as an area of opportunity | The Cambridge ecosystem is an important strength and enabler of impact for the University. How does this local strength translate into benefits for the wider UK, and communities or organisations that are not benefitting from advances in AI technologies?      |
| Orchestrating the scale of demand for expertise and the scalability of Cambridge's AI resources      | Demand for AI expertise continues to outpace supply. How can the University scale its portfolio of AI teaching and research, and maintain the quality of that portfolio, without overloading its AI research staff?  |
| Moderating between the excitement surrounding AI today and the desire for long-term sustainability   | Hype surrounding AI technologies continues to grow. How can the University leverage the current excitement around AI, without contributing to hype that could be detrimental to AI development – and the relationship between AI and society – in the longer term? |

## Collaborations

Effective collaborations are vital to connect the University's AI expertise to areas of opportunity and need. Those collaborations need to engage organisations using AI, people and communities affected by AI, and policymakers investigating the impact of AI, working flexibly across disciplinary and organisational boundaries. Successful interdisciplinary working is a long-term challenge in research; overcoming barriers to such collaborations will be vital to make progress in the next wave of AI development.

### 1 Bridging between the needs of challenge-driven applications and the focus of academically driven research

Deployment is central to current and emerging research directions in AI. It is prompting progress in AI theories and methods, enabling new efforts to tackle scientific and social challenges, and generating new understandings of the impact of AI on different communities and wider society. In this new wave of AI progress, the horizons of 'applied' and 'blue skies' research blend into each other. They also intersect with the ethical questions that AI raises, particularly in attempts to rapidly deploy digital technologies, and that must be addressed in the development and deployment pipeline.

These different aspects contribute to tensions in projects that necessarily bridge across traditional academic boundaries. Challenge-driven research requires a breadth of expertise, combining insights from multiple

research domains to develop solutions that can be deployed at scale.<sup>33</sup> In the context of AI, challenge-driven research also requires careful consideration of the ethical implications of data and AI, and engagement with affected communities. In many cases, progress comes from operationalisation of existing knowledge or tools, combining pre-existing knowledge across domains to bring significant impacts for a firm, community, or sector. In contrast, academic research culture rewards depth of experience or novelty in a single domain.

Bridging the silos between these approaches – through engagement with diverse stakeholder communities, co-design of research projects, and collaborations across domains and organisations – will help unlock new ideas and frontiers in AI development. In the process, the University needs to negotiate how to scale these challenge-focused programmes in an environment where access to AI research insights and talent is limited, but demands for expertise to support routine application of AI techniques continues to grow. The task for the University is to create a culture that values and rewards challenge-driven interdisciplinary work while capitalising on its tradition of domain-specific research excellence. This raises questions about how to scale the community of researchers able to implement AI technologies safely and effectively in the context of specific domain interests.

## **2 Supporting the agility required for innovative solutions and the scale required for deployment in practice**

Exploring new ideas requires intellectual agility. In highly-innovative organisations, researchers are empowered to pursue novel directions of investigation and radical innovation, facilitated by light-touch and flexible processes that scale successful ideas. In the university context, novelty and curiosity are often prioritised over reliability and scalability, with judgements of success dominated by publication and citation in place of positive societal outcome.

Translating innovative ideas into viable products requires a different approach to research. The solutions need to be scalable, reliable and robust in their operational deployment. This requires market and regulatory understanding alongside larger teams of technical experts (often engineers). These multidisciplinary teams tend to be larger than typical academic teams, they involve interdependencies and require more rigid processes for successful delivery at scale. When the innovation is social rather than technical a further set of scaling techniques is required.<sup>34</sup> The different nature

<sup>33</sup> Brown V. A., Harris J. A., Russell J. Y., eds. (2010) *Tackling Wicked Problems through the Transdisciplinary Imagination*. London: Earthscan, ISBN 978-1-84-407925-4

<sup>34</sup> Nesta (2007) *Innovation in response to social challenges*, available at: [www.nesta.org.uk/report/innovation-in-response-to-social-challenges](http://www.nesta.org.uk/report/innovation-in-response-to-social-challenges) (accessed 17 March 2022)

of the teams that look to innovate radically versus teams that look to deliver that innovation consistently leads to different working methods that bring challenges when collaborating with external partners.

As the discipline of AI evolves, the resources required to progress AI research are also changing, and becoming differentiated across different communities. Some researchers focused on compute-heavy AI methods might feel held back by the concentration of compute and data resources in industry. Others seeking to use AI for more focused scientific projects might, in contrast, be less concerned about compute but have a greater requirement for accessible software environments or guidance on how to use existing High Performance Computing resources. The type of resource required by the AI research community – and over what timescale – has implications for both the University's central infrastructure planning and for the type of partners it might seek in scaling its AI activities. Across all areas there is high demand for a strong research engineering base, which is difficult to accrue and highly susceptible to attrition, due to high demand in industry.

### 3 Resolving expectations of AI capabilities and the deliverability of AI systems in deployment

Across domains, grand promises have been made about the potential of AI to revolutionise research, individual and social wellbeing, and productivity – these promises suggest rapid progress in improving healthcare outcomes, better environmental management, rapid business growth, more effective public administration, and more. Amidst such promises, expectations from user communities about what AI can deliver often lose step with the technical capabilities of AI systems. For example, despite widespread excitement about the potential of AI to drive progress in cancer diagnosis, a recent review by the UK National Screening Committee of the accuracy of AI systems in breast cancer screening found that 94% of such systems are less accurate than the consensus of two or more radiologists, often due to poor methodological quality.<sup>35</sup> Likewise, a review of hundreds of AI tools developed for detection of Covid-19 in chest radiographs and CT scans, and prediction of clinical outcomes, found that none were suitable for clinical use “due to methodological flaws and/or underlying biases”.<sup>36</sup> Deploying AI technologies in many contexts remains a challenge; one that can only be overcome with careful technology design, stakeholder engagement, system testing, and domain expertise.

<sup>35</sup> Study cited in Benaich, N. and Hogarth, I. (2022) State of AI report, available at: [www.stateof.ai](http://www.stateof.ai) (accessed 17 March 2022)

<sup>36</sup> Roberts, M., Driggs, D., Thorpe, M. et al. (2021) Common pitfalls and recommendations for using machine learning to detect and prognosticate for COVID-19 using chest radiographs and CT scans. *Nat Mach Intell* 3, 199–217. <https://doi.org/10.1038/s42256-021-00307-0>

In addition to contributing to practical challenges in the design of research programmes, this hype also presents a barrier to building the well-informed public conversation that is a necessary foundation for wider progress in AI development, and for empowering publics and policymakers to direct the development of these technologies in line with societal interests.<sup>37</sup> In this regard, the University has a responsibility both to bring citizen voices into research programmes and to ensure that its own communications surrounding AI do not convey a misleading impression of research progress and capabilities.

### Cyber Valley: building coalitions across the public, private and philanthropic sectors for impact at local and national levels

Describing itself as “Europe’s largest AI research consortium”, Cyber Valley brings together over 20 research-driven organisations in the Stuttgart-Tübingen region of Germany, with the goal of “building bridges between curiosity-driven basic research and applied research”.<sup>38</sup> Its objectives include advancing AI research, facilitating technology transfer between academia and industry, building capability in the use of AI in industry, and promoting a start-up culture in the Baden-Württemberg region. Its approach is to build on the region’s high-quality AI research, combining this with a strong local manufacturing base, the Stuttgart region long having been a leader in the automotive industry. The automotive industry is the largest industry sector in Germany, and accounts for around 25% of all cars manufactured in Europe. The sector is also an important contributor to national R&D spending, accounting for 35% of total German R&D expenditure in 2018.<sup>39</sup>

Founded in 2016 by the state government of Baden-Württemberg, the Max Planck Society, the Max Planck Institute for Intelligent Systems, the Universities of Stuttgart and Tübingen, and a coalition of seven private sector partners representing industry leaders from the region’s car manufacturing sector (including Amazon, BMW, Daimler, IAV GmbH, Porsche, Bosch, and ZF Friedrichshafen AG), Cyber Valley aligns public, private and philanthropic investment in areas of shared need. Total investments of over 180 million euros are supporting new research groups and academic positions in local universities, new buildings and research facilities, and new

<sup>37</sup> Involve (2019) How to stimulate effective public engagement on the ethics of artificial intelligence, available at: [www.involve.org.uk/sites/default/files/field/attachemnt/How%20to%20stimulate%20effective%20public%20debate%20on%20the%20ethics%20of%20artificial%20intelligence%20.pdf](http://www.involve.org.uk/sites/default/files/field/attachemnt/How%20to%20stimulate%20effective%20public%20debate%20on%20the%20ethics%20of%20artificial%20intelligence%20.pdf) (accessed 17 March 2022)

<sup>38</sup> For further information, see: <https://cyber-valley.de/en> (accessed 17 March 2022)

<sup>39</sup> For further information, see: [www.gtai.de/en/invest/industries/mobility/automotive-industry](http://www.gtai.de/en/invest/industries/mobility/automotive-industry) (accessed 22 March 2022)

graduate training programmes. Today, Cyber Valley hosts more than 20 research institutions and networks working to progress AI research and application. Activities to date have advanced technical research agendas, built networks of expertise across industry, start-up and academic communities, and created new spaces for public dialogue and education.

Coalitions with industry bring both the potential to scale innovative AI methods and the ability to translate local investments in research excellence to increased R&D activity in the region's industrial base, which can be leveraged to national benefits, via increased growth and the creation of high-skilled jobs. In addition to bringing in investment, these coalitions help inform the development of research challenges, provide opportunities for student placements, and promote the region's AI excellence nationally and internationally.

#### **Takeaways for AI@Cam**

A coordinated effort to create strategic collaborations across the university, private and public sectors can drive a step-change in AI research funding that delivers benefits at institutional, regional, and national-levels. Opportunities for such collaborations can be found by building bridges between local industrial strengths, research excellence, and national AI priorities.

### **DSNE: co-designing challenge-driven research programmes to deliver high-quality interdisciplinary research**

Data Science of the Natural Environment (DSNE) is a collaboration between Lancaster University and the Centre for Ecology and Hydrology that aims to "co-create and deploy a data science of the natural environment".<sup>40</sup> Starting from the observation that the potential of data science tools to help develop strategies for tackling climate change has yet to be fully exploited, DSNE seeks to integrate insights from statistics, computer science, environmental science, and policy development to create data science tools that can be deployed for environmental management. Its goal is to drive both a step-change in data science for the environment and to support better-informed decision-making in relation to environmental challenges.

<sup>40</sup> For further information, see: [www.lancaster.ac.uk/data-science-of-the-natural-environment](http://www.lancaster.ac.uk/data-science-of-the-natural-environment) (accessed 17 March 2022)



Working across research disciplines, and with public and private sector stakeholders, DSNE has codesigned three grand challenges in environmental science: predicting ice sheet melt, modelling and mitigating poor air quality, and managing land use for maximal societal benefits.<sup>41</sup> Its approach is to develop research directions that tackle real-world environmental issues, integrate data science and scientifically-informed approaches to create novel and useable data science tools, and train end-users to be able to use those tools.

#### **Takeaways for AI@Cam**

Producing data science research that delivers meaningful insights – and real-world benefits – requires careful co-design of research programmes across disciplines, which in turn requires time and commitment from different disciplines and stakeholder organisations. The commitment of individual researchers to delivering high-quality interdisciplinary collaborations plays an important role in delivering such research. Creating an environment in which students and researchers are naturally exposed to multiple disciplines and perspectives – and have opportunities to learn how to apply AI in their own domains – can help scale these efforts, by expanding the interdisciplinary AI community and widening opportunities for impact.

## **Culture**

Cambridge University has a long history of producing excellent research. Its traditional academic culture prioritises and rewards research that deepens understandings or produces novel insights in specific domains. While advancing the frontiers of knowledge through new insights or inventions plays an important role in real-world collaborations, such collaborations also require a broader approach to research and often lead to different types of results. The challenge for the University is to create a research culture that values this different type of research, equipping researchers with the skills to operate outside the narrow confines of individual academic disciplines and disrupting 'ivory tower' approaches. If the University is to be successful in embedding AI ethics and equity in its work, that culture must also value and seek to bring in a diversity of perspectives, welcoming input from all backgrounds.

<sup>41</sup> For further information, see: <https://gow.epsrc.ukri.org/NGBOViewGrant.aspx?GrantRef=EP/R01860X/1> (accessed 17 March 2022)

#### **4 Encompassing the pursuit of academic understanding over the long-term and the need for near-term and real time decision-making in deployment**

High-quality interdisciplinary research typically takes time: to establish shared frames of reference across disciplines, clarify research questions, and gather evidence for analysis. While sharing an inherently interdisciplinary dynamic, many of the questions faced by policymakers or business communities demand responses over much shorter timescales.<sup>42</sup> If the University is to play a meaningful role in helping to respond to such questions, it will need mechanisms to build collaborations and deliver results over shorter timeframes. Aligning these timeframes may be possible through priming the research environment for such collaborations, increasing its administrative agility, building a culture that treats interdisciplinarity as an equal partner, and convening stakeholders to rapidly agree research questions and priorities. All these require dynamic interfaces between disciplines across the University and with its external stakeholder communities.

#### **5 Balancing the incentives that drive progress in AI outside academia and the incentives that shape individual academic's career progression**

Achieving our ambitions for AI requires collective action. Whether delivering on national AI priorities, advancing interdisciplinary research, or training a new generation of AI researchers and practitioners, the enablers for progress require cooperation and collaboration across sectors and communities. If successful, this collaboration promises benefits for science and society – more effective AI technologies; more successful deployments to address areas of need; more capacity to build and use trustworthy AI. This collaboration requires commitment, and a willingness from researchers to contribute to wider national or community priorities alongside pursuing their individual research interests.

Aligning these collective and individual interests is key. However, career incentives for individual academics tend to downplay the importance of this integration. Within individual academic fields, communal agreement of the quality of research is sufficient to ensure publication, grant success and career progression. Interdisciplinary work requires pleasing multiple audiences, addressing challenges that fall outside the remit of any of the individual domains.<sup>43</sup> This means that researchers don't have

<sup>42</sup> Sucha, V. and Sienkiewicz, M. (Eds) (2020) Science for Policy Handbook, European Commission, Joint Research Centre, Elsevier, ISBN: 978-0-12-822596-7

<sup>43</sup> Nesta (2020) Creating value across boundaries: Maximising the return from interdisciplinary innovation, Research report, May 2020, available at: [https://media.nesta.org.uk/documents/creating\\_value\\_across\\_boundaries.pdf](https://media.nesta.org.uk/documents/creating_value_across_boundaries.pdf) (accessed 17 March 2022)

a ready-body of peers to validate the work whether it's for publication or in grant submissions. The difficulty of bridging these domains is often underestimated and as a result career progression suffers. Pressures to deliver on short-term research contracts – and the relatively high staff turnover that results from such contracts – exacerbate these dynamics.

## 6 Accommodating the intellectual agility needed to follow new lines of investigation and the institutional inertia that influences how to pursue new research opportunities

A theme that cuts across these tensions is the need to connect researchers and practitioners together across disciplines, organisations, and sectors, bringing multiple perspectives to bear on emerging challenges and responding to those challenges in a timely fashion. Such collaborations require flexibility – those involved must be able to pursue novel lines of investigation – and agility, with research partners able to adapt and respond to needs or issues from different communities. With AI technologies advancing at pace, and in the context of a wider race to capitalise on those developments, there is also a need to respond rapidly to new research or partnership opportunities. This flexibility, agility and pace is not naturally accommodated by many of the University's institutional processes. Aligning Cambridge's research support with its ambitions to expand its AI portfolio will require pragmatic administrative approaches that empower researchers to pursue impactful external collaborations. It requires an institutional environment that supports flexible deployment of resources across departments and organisations, quickly spinning-up new collaborations and facilitating innovative approaches to conducting AI research.

### Computing, Data Science and Society at UC Berkeley: creating new educational pathways

The Division of Computing, Data Science and Society at UC Berkeley brings together data science-focused initiatives from across the UC Berkeley campus to “leverage Berkeley's pre-eminence in research and excellence across disciplines to propel data science discovery, education, and impact”.<sup>44</sup> Launched in 2019, the Division takes an interdisciplinary approach to its work, supporting researchers to collaborate across computing, statistics, the humanities and the social and natural sciences, using data science as “the nexus that links” disciplines.<sup>45</sup>

<sup>44</sup> For further information, see: <https://data.berkeley.edu/about-division> (accessed 17 March 2022)

<sup>45</sup> For further information, see: <https://data.berkeley.edu/news/it's-official-we're-division-computing-data-science-and-society> (accessed 17 March 2022)

One of the Division's aims is to train a generation of "capable and ethical leaders in an increasingly data-rich world"<sup>46</sup> through programmes that are responsive to student needs and that embed data science skills across campus. In pursuit of this aim, the Division's educational activities include a variety of gateways through which students from different backgrounds can access data science skills and opportunities. These include:

- summer schools that introduce school-age students to data science methods and to discussions about the impact of data on society;
- foundational courses for undergraduate students that provide an introduction to core concepts and skills;
- open, accessible material that is available for researchers to adapt to their own teaching and learning activities; and
- modules on ethics in data science and computing that are required for some majors.<sup>47</sup>

In developing this offer, the Division has an explicit aim to create inclusive curricula, seeking "to work with partners and to serve populations that may have been left out of Data Science in the past".<sup>48</sup>

### Takeaways for AI@Cam

Widening participation in AI research and practice is vital, if AI technologies are to deliver positive outcomes across disciplines and sectors. New entry points to the field can build a community that is able to develop and use AI tools in the long-term; those entry points must be designed with the needs of different communities in mind, and delivered in ways that are inclusive and engaging.

## Context

The context for AI development matters. It shapes what type of AI research is pursued, who is engaged in the production of new knowledge, and who benefits from that knowledge. The Cambridge ecosystem provides a host of opportunities for AI research and development; the challenge for the University is to capitalise on its local strengths, but to translate these to wider

<sup>46</sup> For further information, see: <https://data.berkeley.edu/news/it's-official-we're-division-computing-data-science-and-society> (accessed 17 March 2022)

<sup>47</sup> For further information, see: <https://data.berkeley.edu/about/diversity-equity-and-inclusion> (accessed 17 March 2022)

<sup>48</sup> For further information, see: <https://data.berkeley.edu/about/diversity-equity-and-inclusion> (accessed 17 March 2022)

national benefits, while bringing a diversity of perspectives to bear on the development of AI systems. At the same time, it must negotiate pressures arising from the dynamics of the wider AI ecosystem.

## **7 Mediating between locality as a Cambridge strength and national leadership as an area of opportunity**

The Cambridge cluster is internationally-recognised for its strength in fostering novel technology applications and bringing them to new markets. Co-location of world-leading academics, global technology companies, investors, and knowledge exchange practitioners fosters a vibrant environment for technology start-ups and scale-ups. Developments at the West Cambridge site offer further possibilities to connect Cambridge's research expertise with local business opportunities.<sup>49</sup>

Although there is broad awareness of and respect for the University's existing capabilities, interacting effectively with the University often requires personal connections to help navigate the complexity of the AI research landscape (illustrated in Figures 3 and 4). This can make it difficult for those companies outside a direct circle of contacts to benefit from advances the University develops, potentially exacerbating digital divides. To accelerate the translation and adoption of AI at a larger-scale – delivering national benefits and international leadership – the University needs ways of extending access to these local strengths beyond such immediate contacts. It needs to expand its ambitions and field of vision, leveraging its local success to help deliver national AI priorities.

## **8 Orchestrating the scale of demand for expertise and the scalability of Cambridge's AI resources**

With new research directions, applications, and policy developments emerging across disciplines and sectors, the demand for AI expertise is growing at pace. While the University's technical AI community is also expanding, the pace of demand for their expertise is outpacing the growth of supply.

If Cambridge is to scale its portfolio of AI and AI-enabled activities, it will need to find new approaches to collaborating, sharing expertise, and rapidly upskilling in areas of demand. Traditional teaching and learning approaches struggle to rapidly upskill students and staff in AI methods, and the pace of AI developments requires new bridges between AI research and teaching. The University needs new strategies to integrate AI across its education and training programmes, and to widen access to AI expertise.

<sup>49</sup> For further information, see: [www.cam.ac.uk/news/west-cambridge-innovation-district-will-create-new-destination-quarter-and-put-the-science-on-show](https://www.cam.ac.uk/news/west-cambridge-innovation-district-will-create-new-destination-quarter-and-put-the-science-on-show) (accessed 17 March 2022)

## 9 Moderating between the excitement surrounding AI today and the desire for long-term sustainability

Waves of excitement and disillusionment about progress in AI over the past fifty years have influenced both the pace and focus of AI research and the composition of the AI community.<sup>50</sup> Today's excitement about the field offers opportunities to expand AI research activities in areas of current interest. An estimated 77.5 billion USD was invested by venture capital in AI in 2021, with 2.5 billion USD in funding reaching UK-based AI businesses in the same period.<sup>51</sup> Success over the longer-term will depend on the sustainability of new initiatives, and the ability of today's AI researchers to both inspire and deliver meaningful benefits for the wider community.

### Cancer Research UK Cambridge Centre: engaging affected communities in research design

The CRUK Cambridge Centre's mission is "to end death and disease caused by cancer through research, treatment and education".<sup>52</sup> Contributing to its objective to deliver impactful interdisciplinary cancer research, the Centre's approach is to encourage "the open exchange of scientific knowledge and skills across the many disciplines involved in cancer science".

As part of its efforts to develop new diagnostics and treatments, the Centre's Ovarian Cancer Research programme<sup>53</sup> has convened a patient group to help shape its research. This group encourages participation in clinical trials, while also providing a mechanism for patients to frame the research questions that researchers at the Centre investigate and give feedback to those leading trials and research programmes about the experience of patients involved in the Centre's work. Close engagement between researchers and the patients has helped deliver impactful research and develop treatment strategies for patients dealing with ovarian cancer.<sup>54</sup>

50 Horgan, J. (2020) Will artificial intelligence ever live up to its hype? Scientific American, available at: [www.scientificamerican.com/article/will-artificial-intelligence-ever-live-up-to-its-hype](https://www.scientificamerican.com/article/will-artificial-intelligence-ever-live-up-to-its-hype) (accessed 17 March 2022)

51 Mousavizadeh, A., Mehta, B. and Darrah, K. (2022) AI boom time, available at: [www.tortoisemedia.com/2021/12/02/ai-boom-time](https://www.tortoisemedia.com/2021/12/02/ai-boom-time) (accessed 17 March 2022)

52 For further information, see: <https://crukcambridgecentre.org.uk/content/our-vision-and-strategy> (accessed 17 March 2022)

53 For further information, see: <https://crukcambridgecentre.org.uk/research/programmes/ovarian-cancer> (accessed 17 March 2022)

54 For further information, see: [www.cam.ac.uk/stories/ovarian-cancer](https://www.cam.ac.uk/stories/ovarian-cancer) (accessed 17 March 2022)

**Takeaways for AI@Cam**

AI research is more likely to deliver widespread benefits if the communities affected by that research are given a voice in its design and development. Understanding the aspirations, interests and concerns of the public helps deliver more trustworthy AI technologies and more effective research outcomes. Careful public dialogue can also help overcome the barriers to effective communication created by current AI hype. Pockets of best practice in such engagement already exist; to build on this success, these activities need to become standard practice.

**AgriFoRwArdS Centre for Doctoral Training: developing coalitions to respond to local industrial opportunities**

Agri-food is the UK's largest manufacturing sector, and an area that could benefit from the deployment of a variety of robotic and data-enabled technologies. Bringing together the Universities of Lincoln, East Anglia and Cambridge, the AgriFoRwArdS CDT is an EPSRC-funded doctoral training centre that "is committed to developing the next generation of experts in the agri-food robotics sector".<sup>55</sup> Real-world applications are central to the CDT's research programmes; research projects are co-designed with industry partners, with the intention of solving the technology challenges facing the sector today, and student projects help build bridges between the Centre's industry and academic partners. This allows the CDT to act as a hub for academic expertise and industry engagement across institutions in the East of England with a focus on the use of digital technology in agriculture.

**Takeaways for AI@Cam**

Successful collaborations with industry partners solve real-world problems and build organisational capability for AI deployment over the long-term. Working flexibly across organisations and embedding researchers and research projects in partner organisations can provide a way of creating that legacy, while delivering AI-enabled solutions that benefit organisations in the near-term.

While many of these issues are not unique to AI, their manifestation in AI research and practice today is becoming acute. If not addressed, they will lead to bottlenecks in progress. AI@Cam is the University's response to this challenge.

<sup>55</sup> For further information, see: <https://agriforwards-cdt.blogs.lincoln.ac.uk/about-us> (accessed 17 March 2022)

# 04

## Introducing AI@Cam

### **A new vision for AI at Cambridge**

AI today is a rapidly-moving research area, an enabler of innovations across different research and application domains, and a technology that has the potential to significantly influence wider society. It is a technical field and one deployed at scale, intertwined with a variety of societal interests. Achieving success in such an environment requires research that can connect AI tools to areas of AI need, and shape their deployment in ways that benefit all in society. Such research requires careful integration of insights from technical domains, subject-matter expertise, and real-world experience.

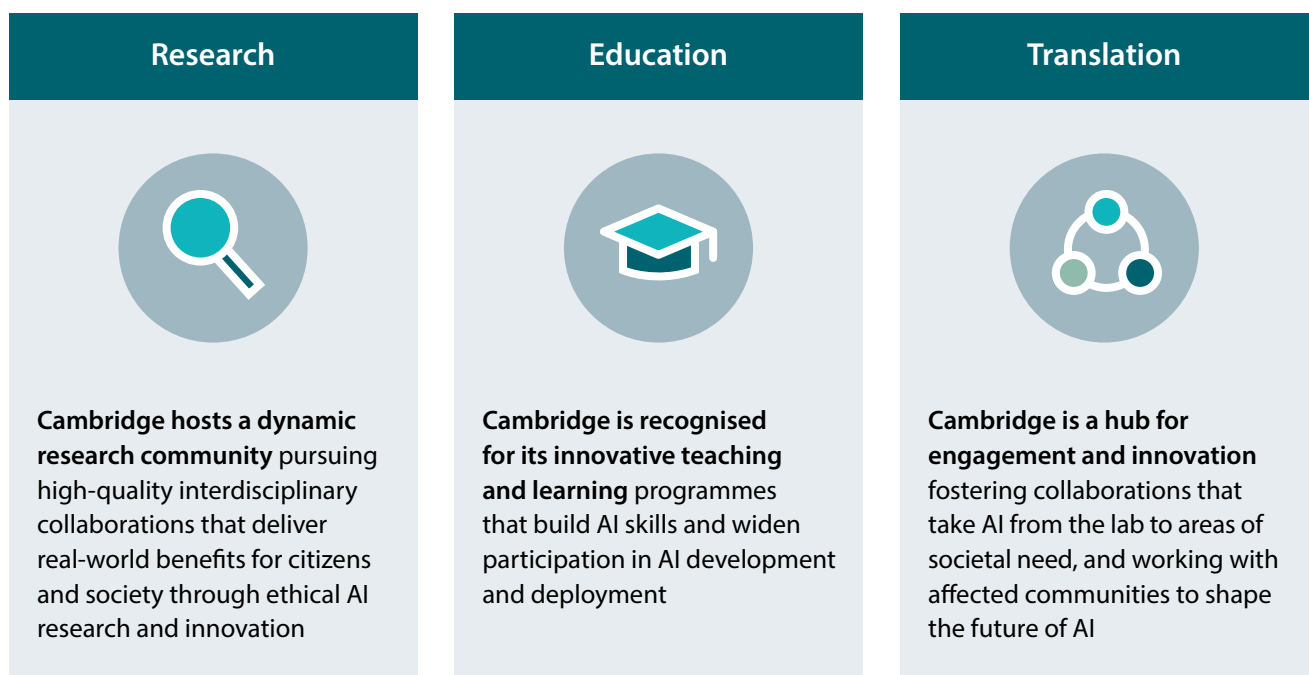
Bridging the digital divides that influence how AI technologies are developing today – and who in society benefits from those developments – is a complex, long-term problem. Identifying and deploying solutions will require expertise from across research disciplines, from policy, business and civil society, and from citizens and affected communities. If it is to help bridge these divides, and play a leading role in the next wave of AI development and deployment, the University must create an environment where signals from the real world propagate to academics, and novel academic ideas find application in the real world.

Cambridge is already home to world-leading academics, to students passionate about advancing the frontiers of science, and to spin-outs and start-ups bringing leading edge technologies to market. The task today is to connect these strengths to the opportunities created by AI, by embedding AI in its broader science and humanities base and by connecting that base to areas of real-world need. The University can lead the next wave of AI development by becoming a place that has incorporated AI across the humanities, social sciences, sciences and engineering. To do so, it needs mechanisms that connect its expertise – across departments and externally – and brings insights from the wider world into its work. The fundamental question it must grapple with is: how can the University bring people together to harness the potential of AI to solve today's pressing social and scientific challenges?



The University's vision for AI at Cambridge is for a research and teaching environment that delivers this integration, fostering excellent research, innovative teaching, and engagement that translates academic AI advances in real-world benefits for citizens and society (Figure 6). AI@Cam is the response to this vision. This new flagship AI mission will drive a step-change in the University's AI capabilities through enhanced interdisciplinary collaboration. It will seek to build the bridges across domains, organisations and communities that can drive progress in AI research and development in line with societal interests.

**Figure 6** Cambridge's AI vision



In its initial form, AI@Cam will stimulate activities that deliver benefits in the short-term, while creating the conditions for the University's AI community to align in areas of societal interest in the longer-term.

Its approach will be to:

- facilitate productive engagement across disciplines and between the University and external partners;
- build partnerships and collaborations that connect AI researchers, practitioners and affected communities;
- create spaces for innovative projects to spin-up and respond rapidly to areas of need;

- enhance teaching and learning, embedding AI skills across the University and putting AI tools into the hands of those that need them; and
- connect expertise and insights from the University's AI community to national priorities.

As it delivers these core functions, AI@Cam will develop a long-term vision for AI at the University, working with University leadership to overcome institutional barriers to effective AI research and teaching.

## AI research that benefits citizens and society: AI@Cam's approach

In seeking to bridge the gap between the University's AI aspirations and current capabilities, AI@Cam will focus on five core functions. Today, these functions are carried out in different ways across the University ecosystem. This reflects the multiple interests and stakeholders involved in AI research and teaching across the University. AI@Cam's approach is not to centralise these functions, but to seek to build from successful experiences, responding to gaps in the current AI research landscape and encouraging interdisciplinary engagement across domains and departments.

### 1 Build interdisciplinary collaborations in areas of social and scientific interest

Tackling today's scientific and societal challenges with AI requires interdisciplinary collaboration that centres societal interests and equity in AI development and that drives ethical data-enabled innovation across disciplines. Across the University, there are signals of growing demand for such collaborations: from students wishing to use AI to accelerate their research, to AI researchers concerned with the societal implications of their work, to social scientists and humanities scholars seeking levers to direct the development of AI towards more equitable outcomes. Universities should be able to connect these interests, developing AI tools that serve science and society, and the strength of Cambridge University's scholarship across domains provides a basis from which to build such interdisciplinary collaborations. The University can further empower researchers to pursue these collaborations by:

- setting an agenda that has equity front-and-centre;
- driving data-driven innovation across disciplines; and
- connecting innovation to societal benefit.

As highlighted in Box 2, successful operationalisation of such collaborations requires partnerships that combine insights into the needs of groups (whether local or national governments, NGOs, businesses, or researchers), with access to data, access to compute, and pathways to implementation. The success of those pathways will depend on the ability to deploy AI into existing systems, taking into account both technical requirements and the expertise or needs of the people working alongside such systems. This may in turn require upskilling or capability-building in organisations responsible for managing AI systems in deployment. Such management might include maintaining the systems themselves, monitoring of their performance, or scrutiny of their outputs to avoid different failure modes.<sup>56</sup>

Creating an environment that embeds these collaborations will be central to the work of AI@Cam. It will create spaces and mechanisms for engaging across disciplines and with stakeholders in the public, private and philanthropic sectors to co-design research agendas that can deliver real-world benefits. Working across research and policy communities, AI@Cam will help propose grand challenges and create a community where the nature of the challenges that arise in real world deployment can be rapidly understood and addressed.

## **2 Bring stakeholders from research, public, private and philanthropic sectors, and affected communities into research design**

Reflecting the pervasive impact of AI, a range of different stakeholders bring important perspectives to bear on the design of AI research programmes. Delivering high-quality AI research requires partnerships and collaborations that connect AI researchers, practitioners and affected communities, ensuring diverse voices are heard in AI design and deployment. Many of these voices are underrepresented in university environments. While individual projects or initiatives across the University have been successful in bringing citizen voices into research, too often opportunities to widen engagement are missed. Reflecting on these successes, AI@Cam will seek routes to bring different perspectives to bear on the development of AI research and practice. AI@Cam will help build partnerships across research and practitioner communities, and to embed public dialogue in research, with the aim of developing AI research that delivers real-world benefits.

For example, when engaging with international partners there are opportunities to bring a broader set of perspectives into Cambridge's AI work. One example of such convening might come from the Sustainable

<sup>56</sup> Such failure modes might include the use of out-of-date data, or the introduction or reinforcement of systemic biases, for example

Development Goals.<sup>57</sup> With ICT penetration in developing economies exceeding availability of basic sanitation<sup>58</sup> the influence of deployed AI is already being felt, for instance in the hands of Ugandan small holder farmers.<sup>59</sup> This widens the base of those affected by AI and necessitates engagement within international networks that can represent those voices.

### 3 Create spaces for innovative projects to spin-up and respond rapidly to areas of need

Cambridge's local innovation ecosystem is recognised across the world as an incubator for high-tech start-ups and scale-ups. This ecosystem combines proximity to world-class academic research with spaces for business-university collaborations, networks that build connections in specific domains, access to talent from the University and local companies (both SMEs and the large technology companies based in Cambridge), and professional support from local knowledge and innovation brokers.<sup>60</sup> While not specific to AI, this innovation system provides an infrastructure for innovation that can be leveraged to support diffusion of AI to businesses, NGOs, and the public sector.

To capitalise on the variety of innovative AI and AI-enabled research happening across Cambridge, the University needs spaces that encourage new collaborations, allowing researchers and external partners to experiment, prototype and pilot AI tools that can connect AI innovation to societal needs. Such spaces should allow for rapid set-up of research and policy projects, providing an infrastructure for collaboration and reducing administrative overheads. They might also provide a forum for identifying and developing the scalable tools that can support AI diffusion across disciplines and sectors. Drawing lessons from makerspaces, policy-labs, and innovation incubators, AI@Cam will seek to create spaces where innovators can initiate and spin-up AI projects that address real-world needs.

- <sup>57</sup> Goals 17.6 through 17.8 focus on equitable sharing of technological dividends. Specifically 17.8 refers to “enhance the use of enabling technology, in particular information and communications technology.” Domain expertise is vital in delivering on these goals. For further information, see: UN (2015) UN Resolution General Assembly 70/1 – Transforming our world: the 2030 Agenda for Sustainable Development, available at: <https://sdgs.un.org/sites/default/files/publications/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> (accessed 17 March 2022)
- <sup>58</sup> World Bank (2018) Atlas of Sustainable Development Goals 2018: World Development Indicators. Washington, DC: World Bank. doi: 10.1596/978-1-4648-1250-7. License: Creative Commons Attribution CC BY 3.0 IGO
- <sup>59</sup> Mutembesa, D. et al. (2018) Crowdsourcing Real-Time Viral Disease and Pest Information: A Case of Nation-Wide Cassava Disease Surveillance in a Developing Country. HCOMP (2018), arXiv:1908.04237 [cs.CY]
- <sup>60</sup> Examples of the latter include Cambridge Enterprise, Cambridge Innovation Capital, Cambridge Angels, and venture capital funders, such as Amadeus Capital Partners

By building links with the local innovation ecosystem and Cambridge's successful mechanisms for business engagement, the University has an opportunity to extend its success, spinning out new companies and initiatives. AI@Cam will work to strengthen links between the University's AI community and this local environment, while also identifying ways that Cambridge's local innovation success can benefit communities and organisations beyond the Greater South-East.

#### **4 Enhance teaching and learning, deploying innovative training approaches to meet new needs**

Researchers across disciplines, professionals across sectors, and citizens from all backgrounds have a stake in the development of AI technologies, whether by deploying them directly, managing their deployment in an organisation, or contributing to democratic debate about their place in society. The University can play a role in both training a new generation of research leaders, deploying AI to accelerate scientific discovery, and in making the knowledge and skills necessary to use AI technologies accessible to all in society. In the process, it has the opportunity to widen participation in AI, opening the field to people with a diversity of lived experiences, and to put the ethical dimensions of AI at the heart of the University's educational offering.

The University today supports a thriving community of students at undergraduate, postgraduate and executive levels. Computer Science is already Britain's second-fastest growing degree course;<sup>61</sup> demand is increasing for both high-quality technical education in computer science and AI, and for training in the use of AI in specific domains or disciplines. Cambridge has opportunities to integrate AI across its educational offering, from teaching undergraduates in scientific domains how to use AI in their research, to training managers and leaders in the mechanics of deploying AI in their organisations, building understandings of how to successfully use AI in different contexts and the potential failure modes to avoid. Several courses or training programmes are already seeking to capitalise on these opportunities; the question for the University is how best to scale these efforts and connect them to customer need.

<sup>61</sup> Clark, A., Hollowood, E., Harper, I. and Mostrous, A. (2022) AI in the UK, available at: [www.tortoisemedia.com/2019/12/04/ai-in-the-uk](http://www.tortoisemedia.com/2019/12/04/ai-in-the-uk) (accessed 17 March 2022)

To be a leader in AI education, the University must create pathways for diverse audiences to gain access to AI skills and insights, tailored to their needs. This includes:

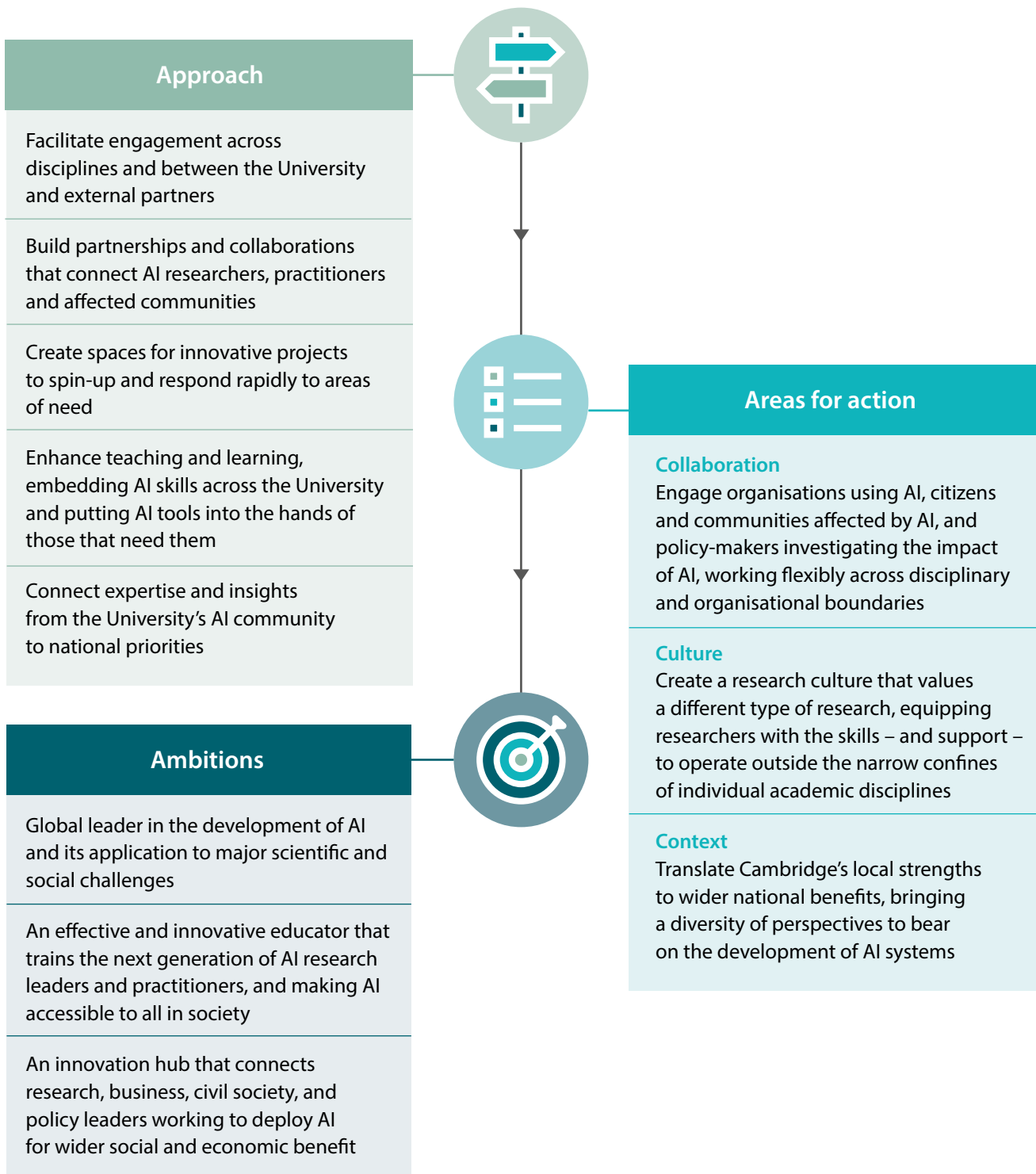
- embedding AI awareness and expertise in using AI for research across the University, for students in all disciplines and researchers in all departments;
- supporting researchers to access the resources and infrastructures necessary to deploy AI in their work, for example through effective software environments;
- expanding the University's continuing education offer, making its AI expertise accessible across sectors and organisations;
- increasing efforts to widen participation in AI, creating accessible entry points to the field and taking action to ensure teaching and learning opportunities are inclusive and accessible.

AI@Cam will support innovation in teaching and learning approaches with the aim of creating these pathways, connecting the University's interdisciplinary strengths with its education provision.

## **5 Connect expertise and insights from the University's AI community to national priorities**

Many open questions remain about how to influence the development and deployment of AI technologies for wider societal benefit. Recent policy announcements have created a space for research institutions to help answer these questions – and to direct AI development along beneficial pathways – and there is an opportunity for the University to lead the debates that follow. Building on the University's previous success in connecting researchers and policymakers, AI@Cam will foster policy engagements, collaborations and innovations that create strategies for AI stewardship and that deploy AI in the service of national policy goals. Recognising this is a national project, and that in many areas of policy concern – such as levelling up or net zero – there is a need for coalition-building across the UK that engages national bodies such as the Alan Turing Institute and other local innovation organisations, to develop appropriate responses, AI@Cam will seek to work with partners to help share the benefits of AI across society.

**Figure 7** Summary visualisation of AI@Cam's roadmap for a new enabling ecosystem



In pursuing these functions, AI@Cam will seek to build capabilities across the University, engaging across its academic and administrative functions with the aim of improving AI research and teaching outcomes (Figure 7). It will create the connections that leverage Cambridge's strengths –

including excellence in specific domains across the sciences and humanities, and vibrant local innovation ecosystems – to drive a step-change in its AI research, education and translation, connecting the bottom-up nature of Cambridge’s AI research to strategic priorities emerging from the wider landscape.

Delivering this vision requires a dynamic research community that is well-connected across disciplines and with the wider environment of public, private, and philanthropic sector stakeholders with an interest in AI. By building an infrastructure for interdisciplinary AI collaborations, AI@Cam aims to strengthen connections between departments and disciplines. The philosophy underpinning this approach is that, over the long-term, domains that ‘fire together, wire together.’<sup>62</sup> AI@Cam will instigate this fusion by supporting collaborations that align with real-world needs, with the ultimate aim of re-orientating the network over the longer-term to be interdisciplinary-by-default and embedding the mission’s approach in routine ways of working.

## Next steps

This document marks the initiation of AI@Cam. It signals the University’s commitment to supporting the next generation of AI research, researchers, and practitioners, and to playing an active role in stewarding the development of AI technologies for wider society. In the coming months, AI@Cam will be working with partners across the University and externally to develop a strategy and roadmap to implementing the vision set out in this document. This process will identify actions that AI@Cam will take forward directly, create connections that help researchers make progress in their individual or group areas of interest, and build consensus behind the principles that will shape AI@Cam’s operations over the longer-term.

Core to those principles will be addressing the challenge of scale. Through targeted interventions in areas where there are opportunities to address bottlenecks in existing systems, connect to national priorities and policy debates, or build partnerships and collaborations, AI@Cam will seek to scale the reach and impact of successful AI activities. Specific principles and strategies will be developed through further community engagement, nuancing the framework set out in this document.

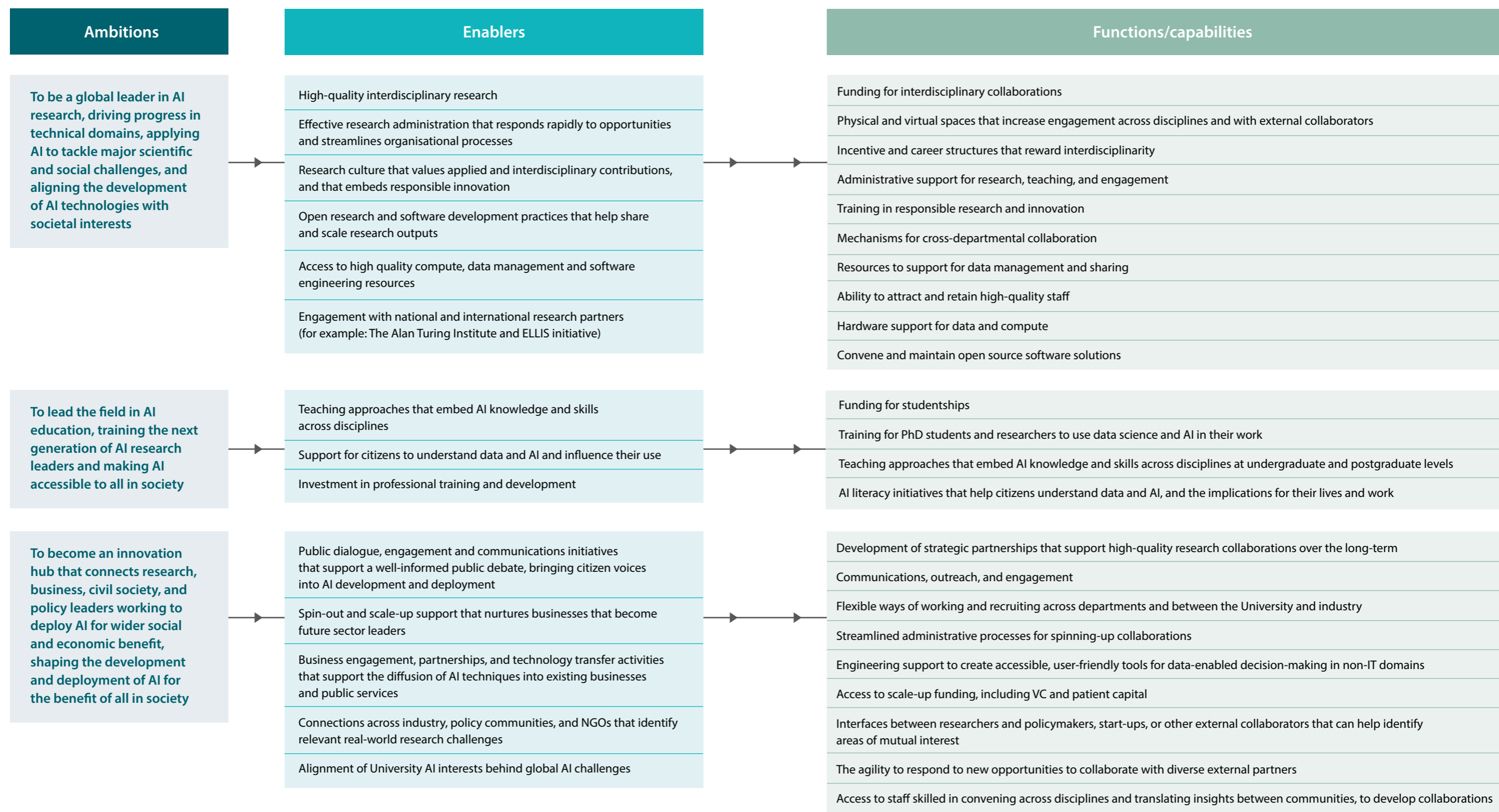
Further information about AI@Cam’s strategy, focus and activities will be published over the coming months, and we look forward to working with the AI community to develop this mission.

<sup>62</sup> In brain plasticity Donald Hebb argued that neurons interconnect through coexpression: neurons that fire together wire together. AI@Cam will foster collaborations that align with the vision we describe



# Annex

What functions or enablers would allow Cambridge to play a leading role in the UK's AI agenda?





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