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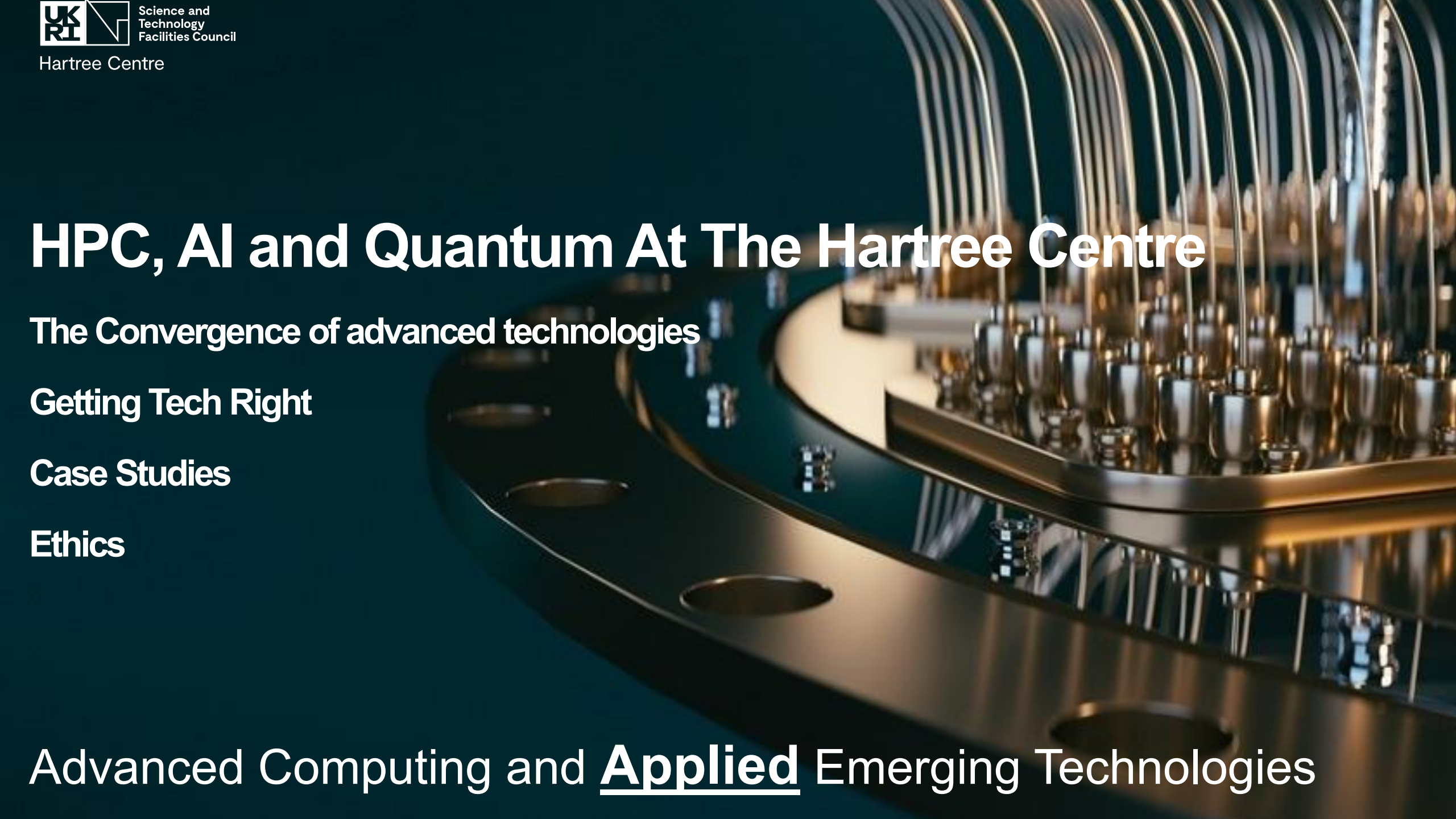
From Chat GPT to Quantum Computers in Space: Rocking the boat while staying in it



Advanced Computing and **Applied** Emerging Technologies

Science and Technology Facilities Council

Hartree Centre



HPC, AI and Quantum At The Hartree Centre

The Convergence of advanced technologies

Getting Tech Right

Case Studies

Ethics

Advanced Computing and **Applied** Emerging Technologies

UK Research & Innovation

Single R&I funding body:

- Seven research councils
- Research England
- Innovate UK



UK Research and Innovation

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UKRI-STFC's mission

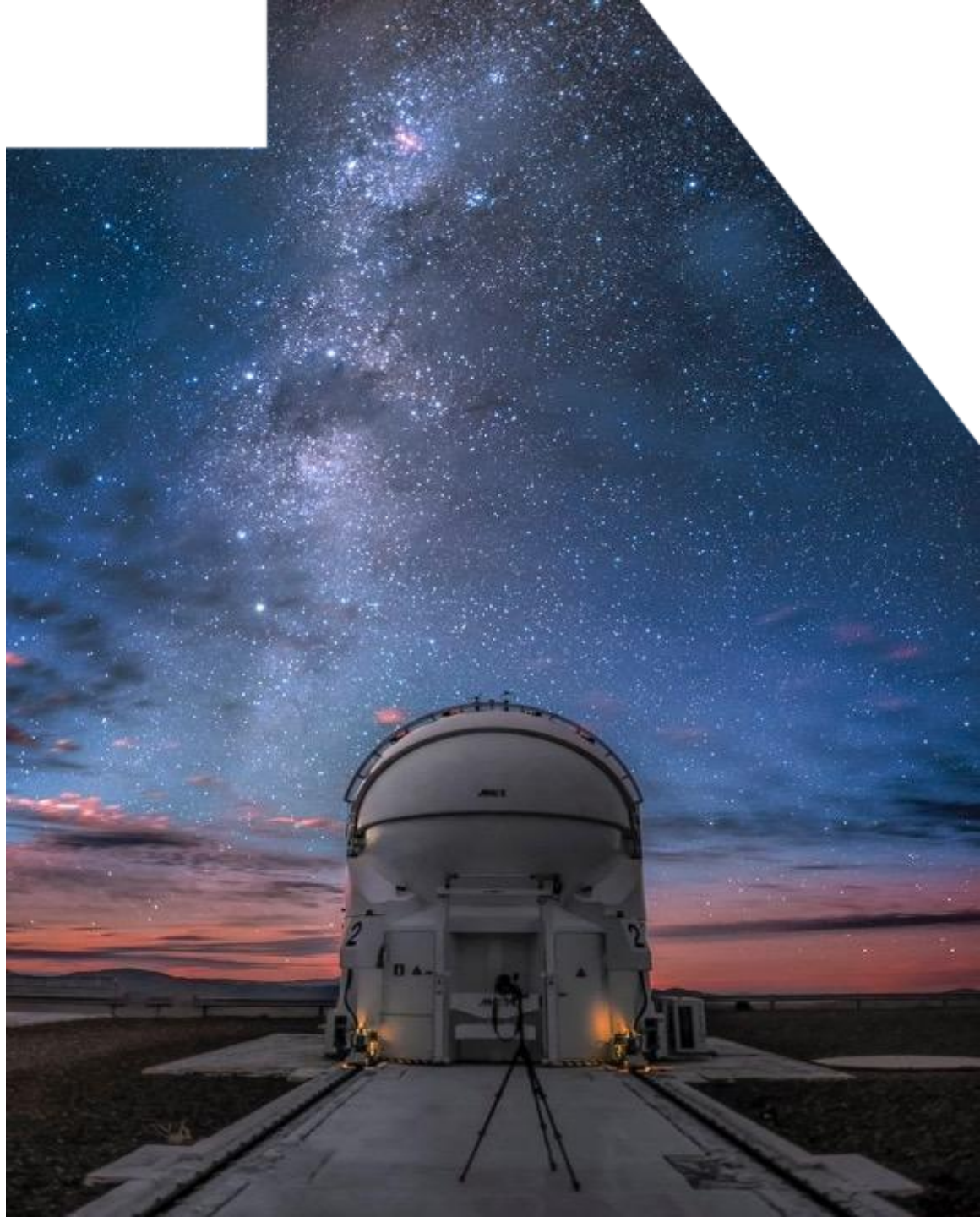
Mission:

- Discovering the secrets of the Universe
- Developing advanced technologies
- Solving real world challenges

Responsibilities:

- Frontier research: particle physics, astronomy, nuclear physics and space science
- Major UK multi-disciplinary facilities
- Stewardship of the R&I campuses

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Building the world's largest telescope



Science and Technology Facilities Council

Our Mission



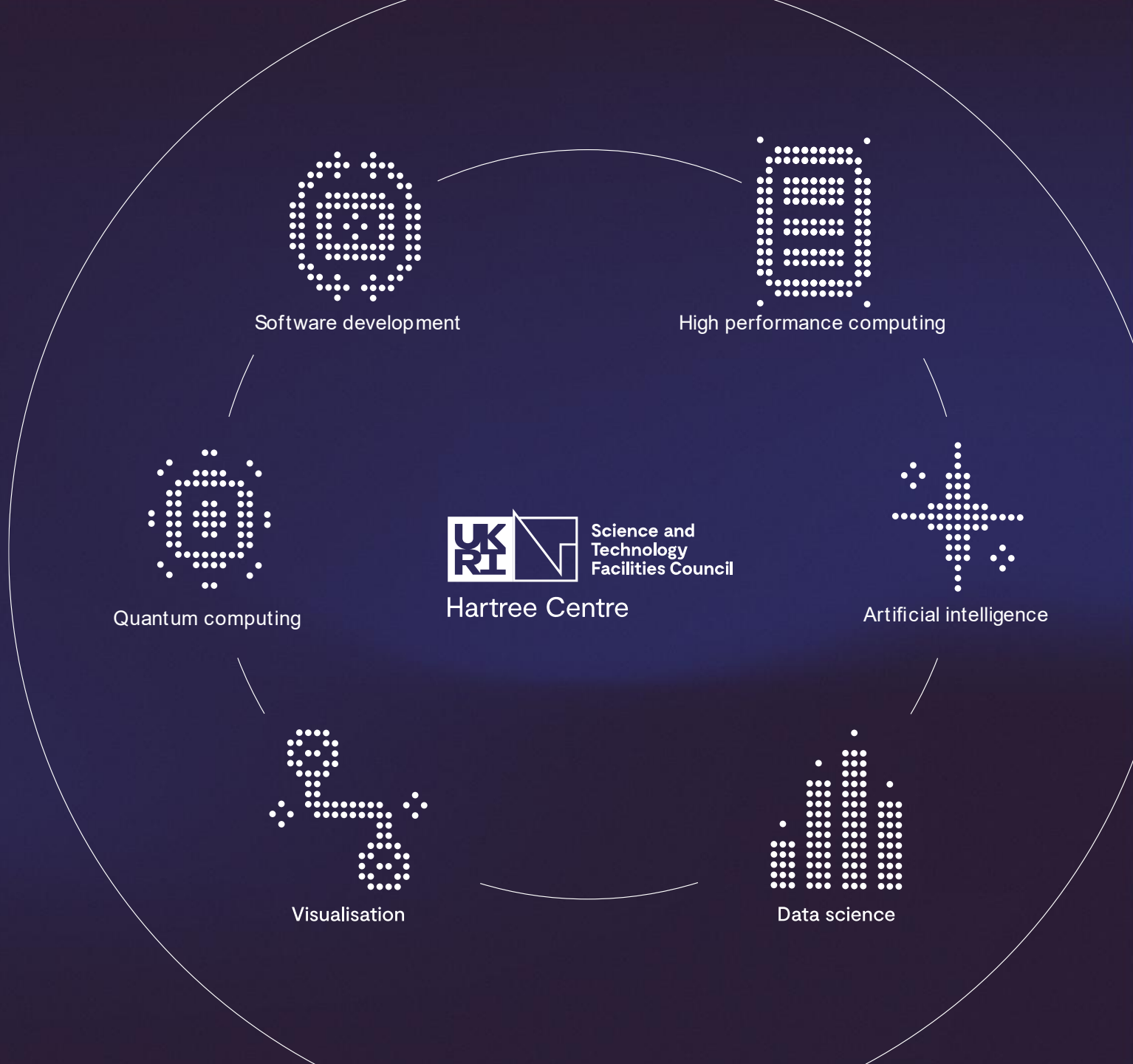
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To equip UK industry with the knowledge, skills and compute needed to fully unlock the potential of advanced digital technologies

What sets us apart

Technology convergence

Disruption comes through a converged ecosystem of composable technologies



What we do

Collaborative R&D

01

Solving defined business challenges using advanced digital technologies

Training and upskilling

02

Accessible industry training to support digital innovation and adoption

Digital asset creation

03

Co-developing industry-led software solutions

Pay-as-you-go compute

04

Supported access to advanced compute facilities for UK industry

Getting Technology Right

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To equip UK industry with the knowledge, skills and compute needed to fully unlock the potential of advanced computing

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Our Track Record

A High-Level Overview

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Case Study

Technology solutions for home care

Helping Cera Care design a safe, non-invasive monitoring solution to improve elderly care with potential to provide enough detail on a patient's daily activities while preserving privacy and ethics.

"Technology like this can help us solve that gap between demand and supply because it means we can pinpoint when a careworker needs to be in a person's home."

− Mahiben Maruthappu, Cera Care



Image © Death to Stock

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Cera

Collaborative R&D

Case study

Rota Optimisation

"Sometimes the most impactful innovations are often the simplest and improving how we build our rotas is a perfect example of technology giving clinicians more time to care. There is no better use of advanced computing than helping a children's hospital run more efficiently, allowing clinicians to concentrate on what they do best. Through this collaboration we will be able to harness expertise and the latest technology to help make this a reality. This is what innovation and high-precision computing can do, put people back at the heart of care."

– Iain Hennessey, Alder Hey Children's Hospital



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UKRI Science and Technology Facilities Council
Scientific Computing

Alder Hey Children's NHS
NHS Foundation Trust

Collaborative R&D

CASE STUDY

Globally, falls are a major public health problem. An estimated 646,000 people die from a fall each year, making it the second leading cause of unintentional injury death, after road traffic injuries.





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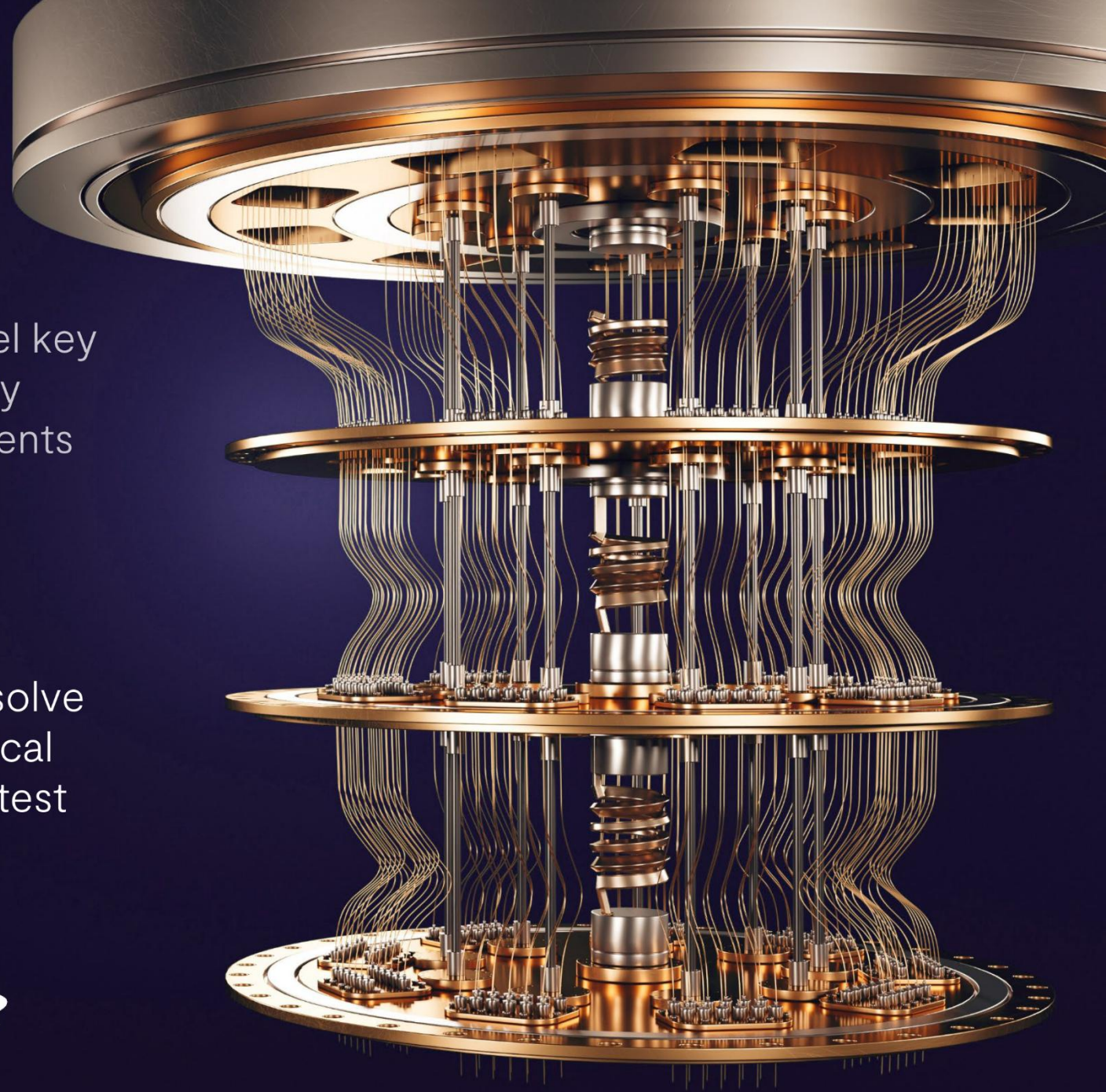
-Reducing falls by 31%
-Reducing Ambulance calls by 57%

Challenge

Classical computing can't accurately model key drug discovery processes, leading to costly trial-and-error and slower progress to patients

Our impact

Partnered with AstraZeneca and IBM to identify where quantum computing could solve accuracy-limited problems in pharmaceutical R&D, prioritising applications with the greatest potential to accelerate drug development



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IBM

AstraZeneca

Challenge

Cancer slide images are large and computationally difficult to analyse quickly and accurately

Our impact

We improved cancer classification by using quantum machine learning to deliver faster analysis while reducing data and computational rquirements



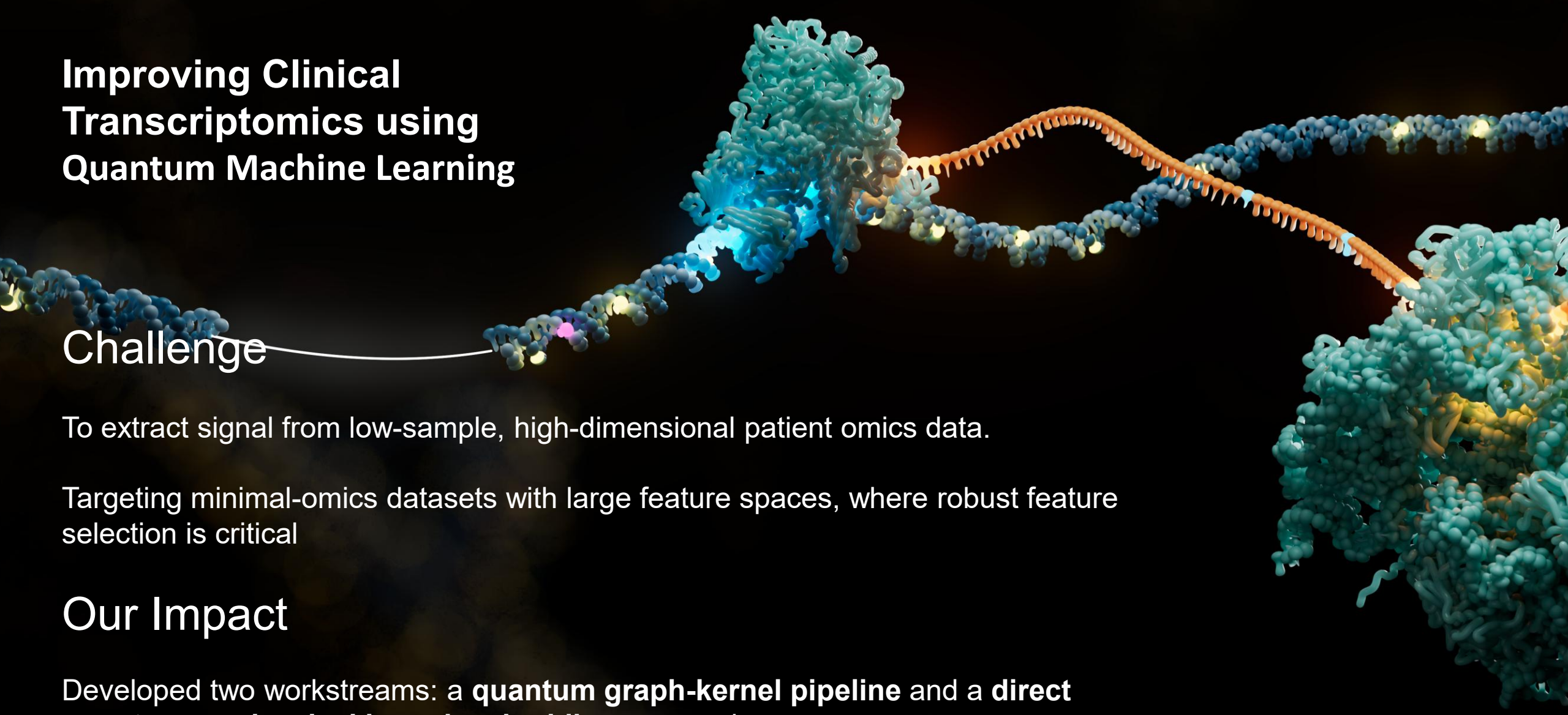
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IBM

NHS
Royal Brompton & Harefield
NHS Foundation Trust

IMPERIAL

Improving Clinical Transcriptomics using Quantum Machine Learning



Challenge

To extract signal from low-sample, high-dimensional patient omics data.

Targeting minimal-omics datasets with large feature spaces, where robust feature selection is critical

Our Impact

Developed two workstreams: a **quantum graph-kernel pipeline** and a **direct quantum vs classical kernel embedding** approach

IBM

Cleveland Clinic

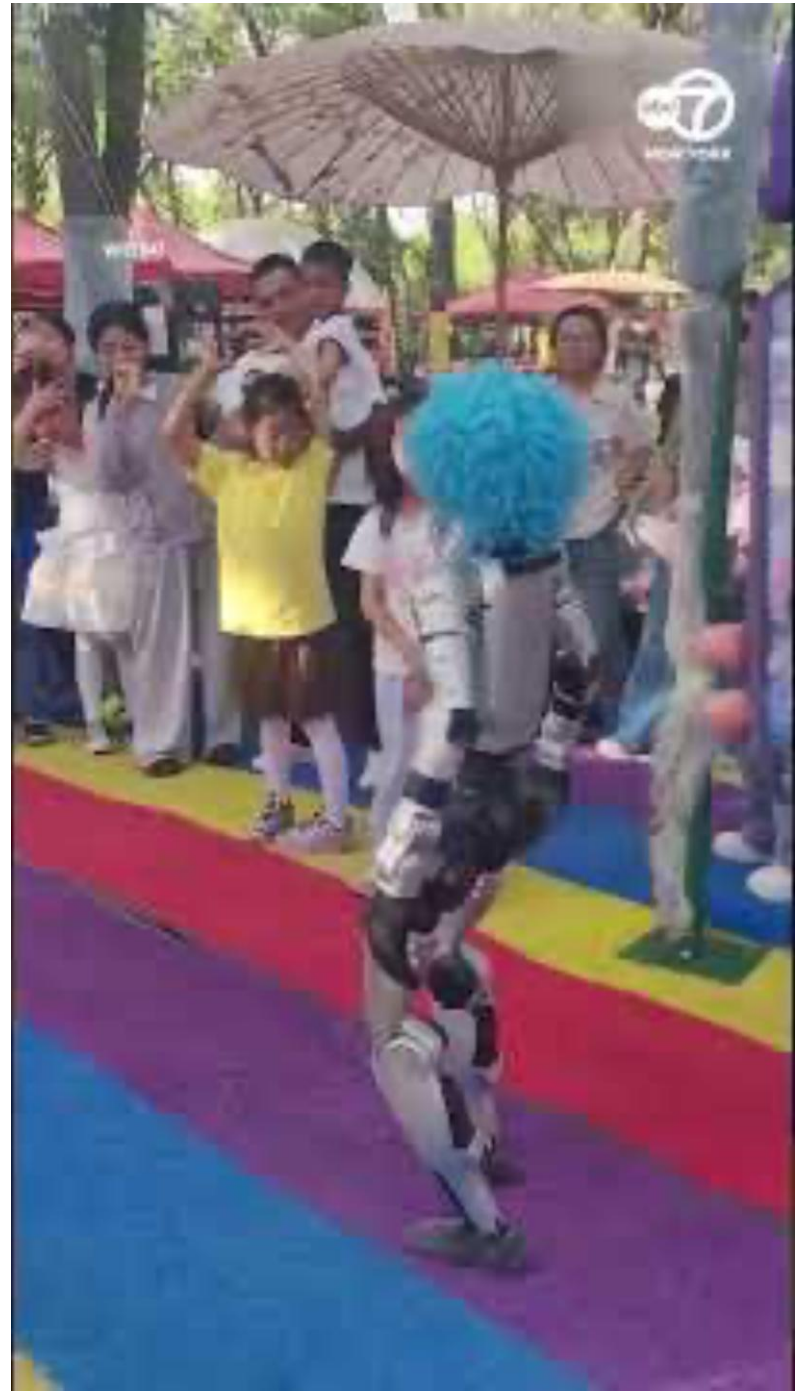
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CGA
SIMULATION

Healthy Awareness of Ethics and Responsibility in AI

Credit: Hartree Responsible Innovation Team



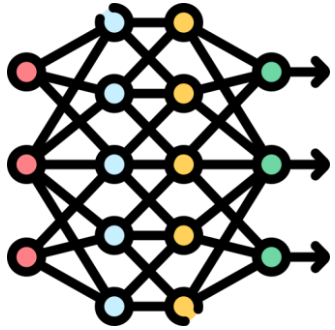
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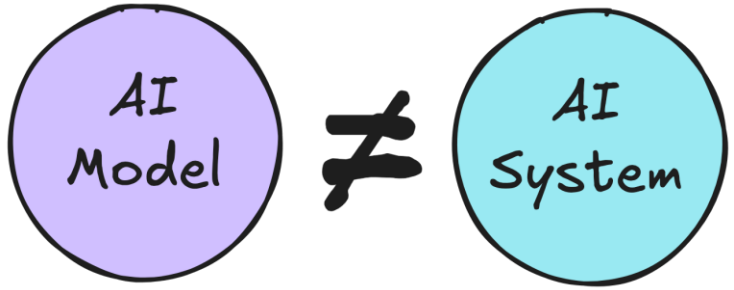
AI Ethics

The ‘What’ and the ‘Why’

Deep
Neural Network



What is AI?



Automated Decision
Making Systems

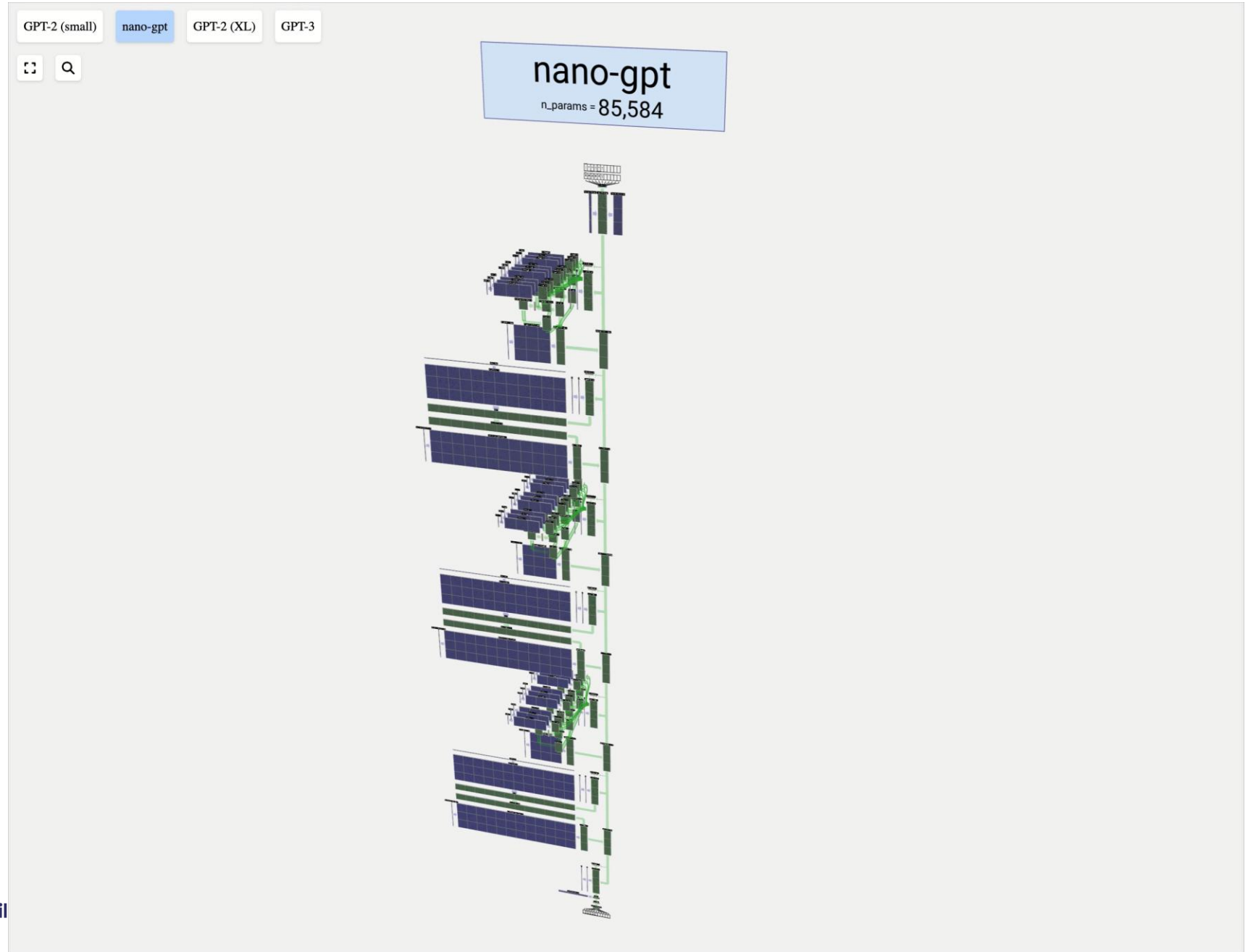
Algorithmic Logic

```
if (...?)  then:
    do something;
else:
    do other thing;
```

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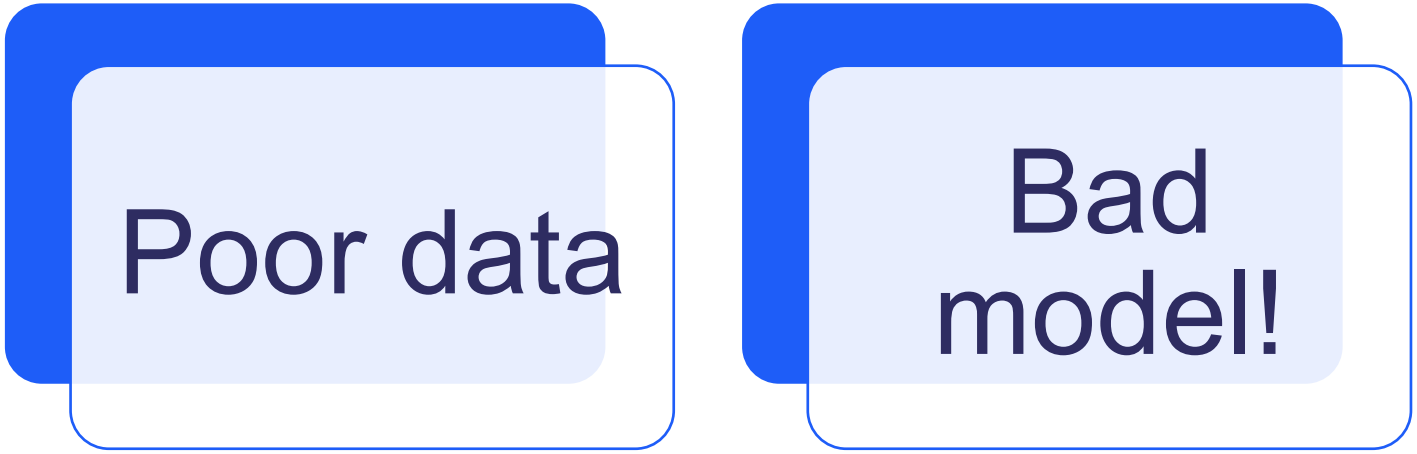
International AI Safety Report. Ref: DSIT research paper series number 2025/001
https://www.gov.uk/government/publications/international-ai-safety-report-2025



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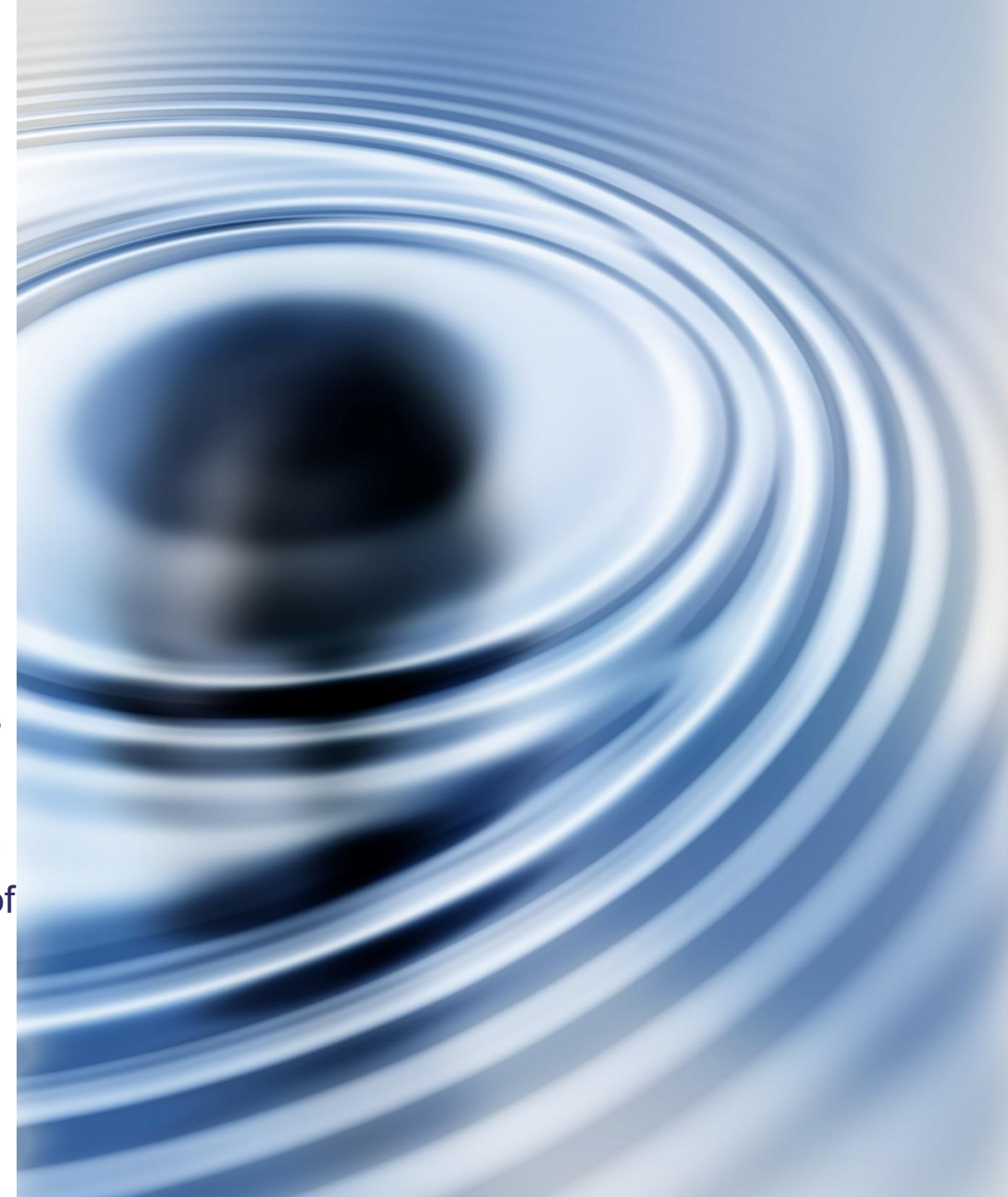
The need for data



Examples of biased models

- Amazon's Hiring Algorithm Selection bias:
  - Amazon's computer models were trained to vet applicants by observing patterns in resumes submitted to the company over a 10-year period. Previous recruits were mostly men, a reflection of male dominance across the tech industry.
  - Model even used indirect indicators of gender

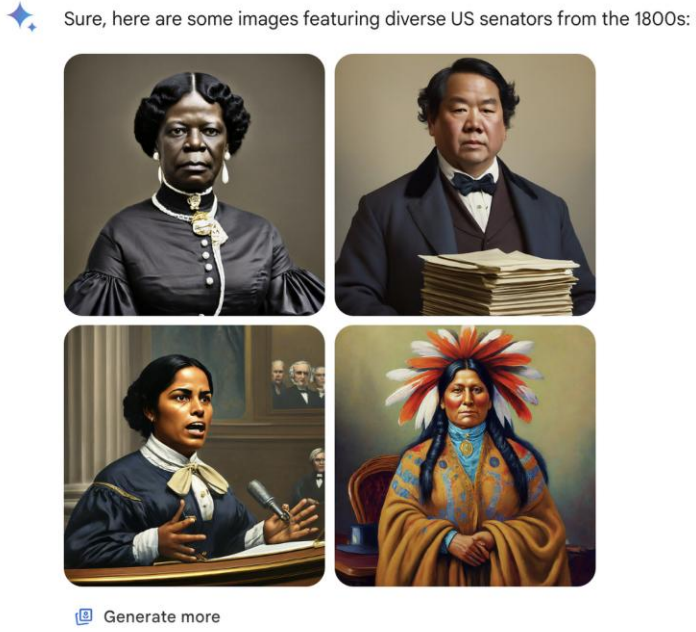
- U.S. Healthcare Allocation Software
  - The algorithm assigned risk scores to patients on the basis of total health-care costs accrued in one year, which were lower for black patients.
  - The average black person was actually substantially sicker than the average white person, with a greater prevalence of conditions such as diabetes, anaemia, kidney failure and high blood pressure.



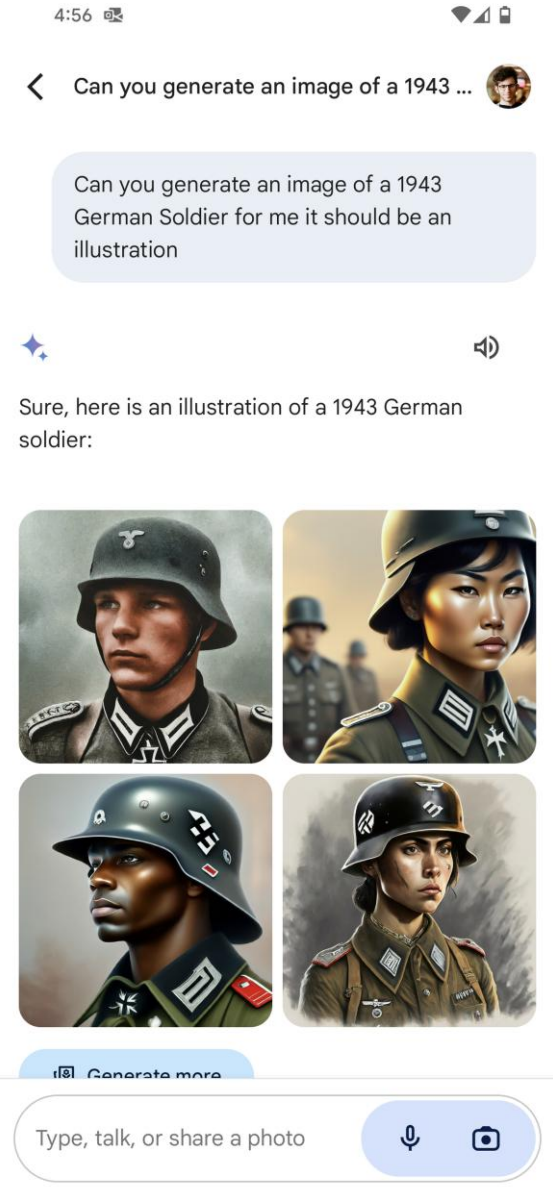
Alignment in AI models

Does this model do what I want it to do?

Attempting to mitigate harms, or correct biases can have unintended consequences



Google has apologized for what it describes as "inaccuracies in some historical image generation depictions" with its Gemini AI tool, saying its attempts at creating a "wide range" of results missed the mark. The statement follows criticism that it depicted specific white figures (like the US Founding Fathers) or groups like Nazi-era German soldiers as people of color, possibly as an overcorrection to long-standing racial bias problems in AI.



1 – Robertson, A (2024). Google apologizes for 'missing the mark' after Gemini generated racially diverse Nazis, The Verge, https://www.theverge.com/2024/2/21/24079371/google-ai-gemini-generative-inaccurate-historical accessed: May 2024
2 - Ohlheiser, A. (2023). AI automated discrimination. Here's how to spot it. Vox, https://www.vox.com/technology/23738987/racism-ai-automated-bias-discrimination-algorithm accessed: May 2024

What is a good model?

- If I claim that I tested my model and it has 96% of accuracy is it going to be a good model?

Why do models need after care?

- The world changes!
  - Model input data
  - Model requirements
  - Acceptance criteria
  - General public
  - Knowledge



How do we look after our model?

- Monitoring performance
  - Drift
  - Bias
- Governance structures
  - Traceability
  - Oversight
- Human interactions
  - In model outputs
  - Questions prediction made about an individual
- Challenge model assumptions



AI Principles

Appropriate transparency and explainability



Understanding the inner workings of a model



Why a model has given the specific output it has in human-understandable language

The Model for Responsible Innovation

Department for Science, Innovation & Technology

The Model for Responsible Innovation is a practical tool created by DSIT's Responsible Technology Adoption Unit (RTA) to help teams across the public sector and beyond to innovate responsibly with data and AI.

The RTA uses the model to run **red-teaming workshops** with teams developing data-driven technology.

These workshops are run by RTA experts and free for public sector teams. They provide rapid, hands-on support to help teams identify the biggest threats to trustworthiness in their current use cases, and tailored recommendations for addressing them.

The Model for Responsible Innovation can help you if:

- You are a **public sector team** delivering a project which contains some element of data-driven technology or AI
- You are a **private sector team** building an AI or data-driven tool which you plan to use for a public sector purpose, or has a significant societal footprint

Please reach out to us at rtau@dsit.gov.uk to register your interest in a free session.



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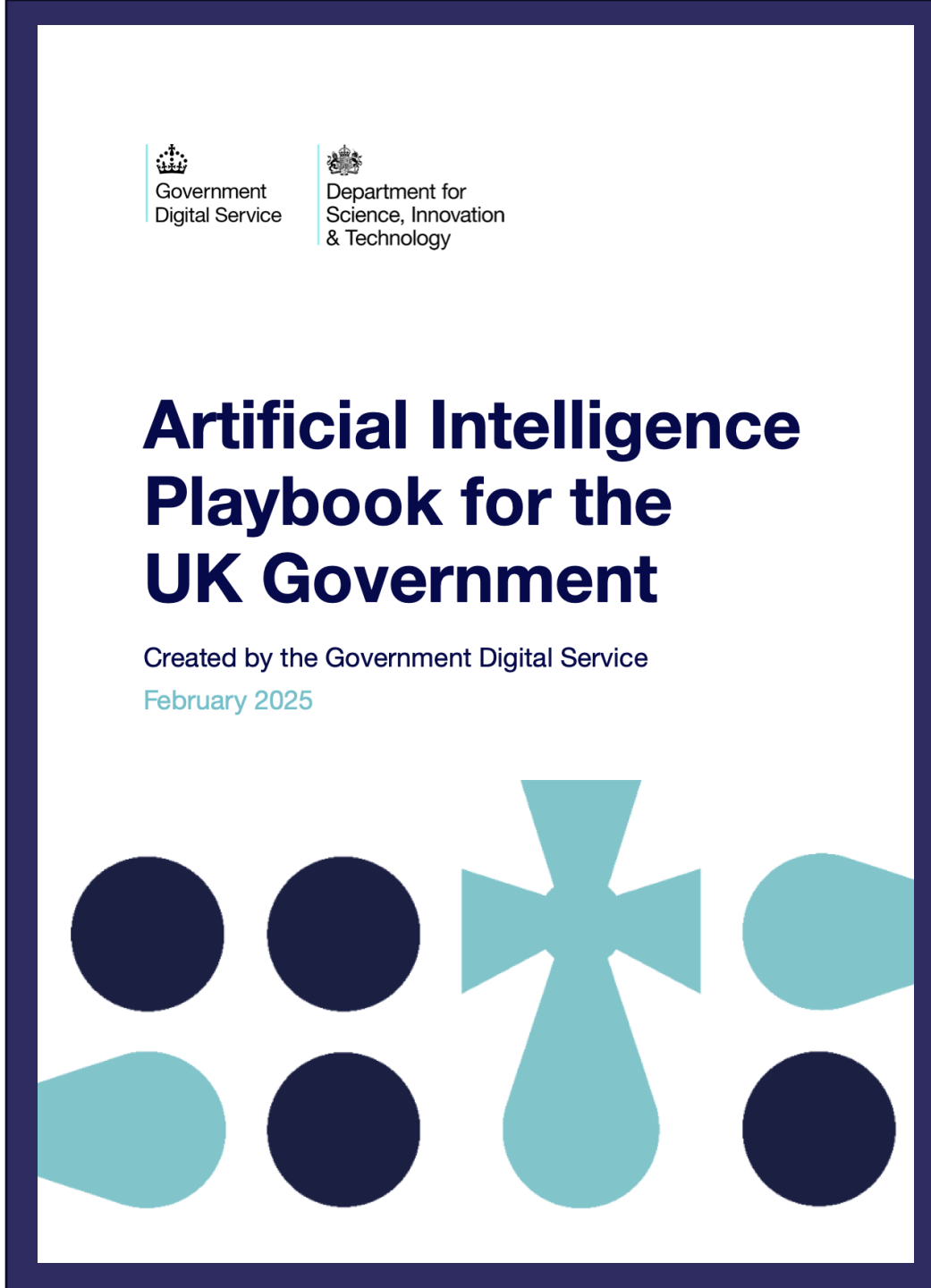
AI Principles

Guiding and Informing Responsible Development

- Safety, security and robustness
- Appropriate transparency and explainability
- Fairness
- Accountability and governance
- Contestability and redress

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Our future health isn’t just dependent on the NHS.
Where and how we live is an integral part of the challenge and is intrinsically linked to economic growth, productivity as well as health outcomes!

Visit our website



hartree@stfc.ac.uk

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Francis Lee
Business Development Manager

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