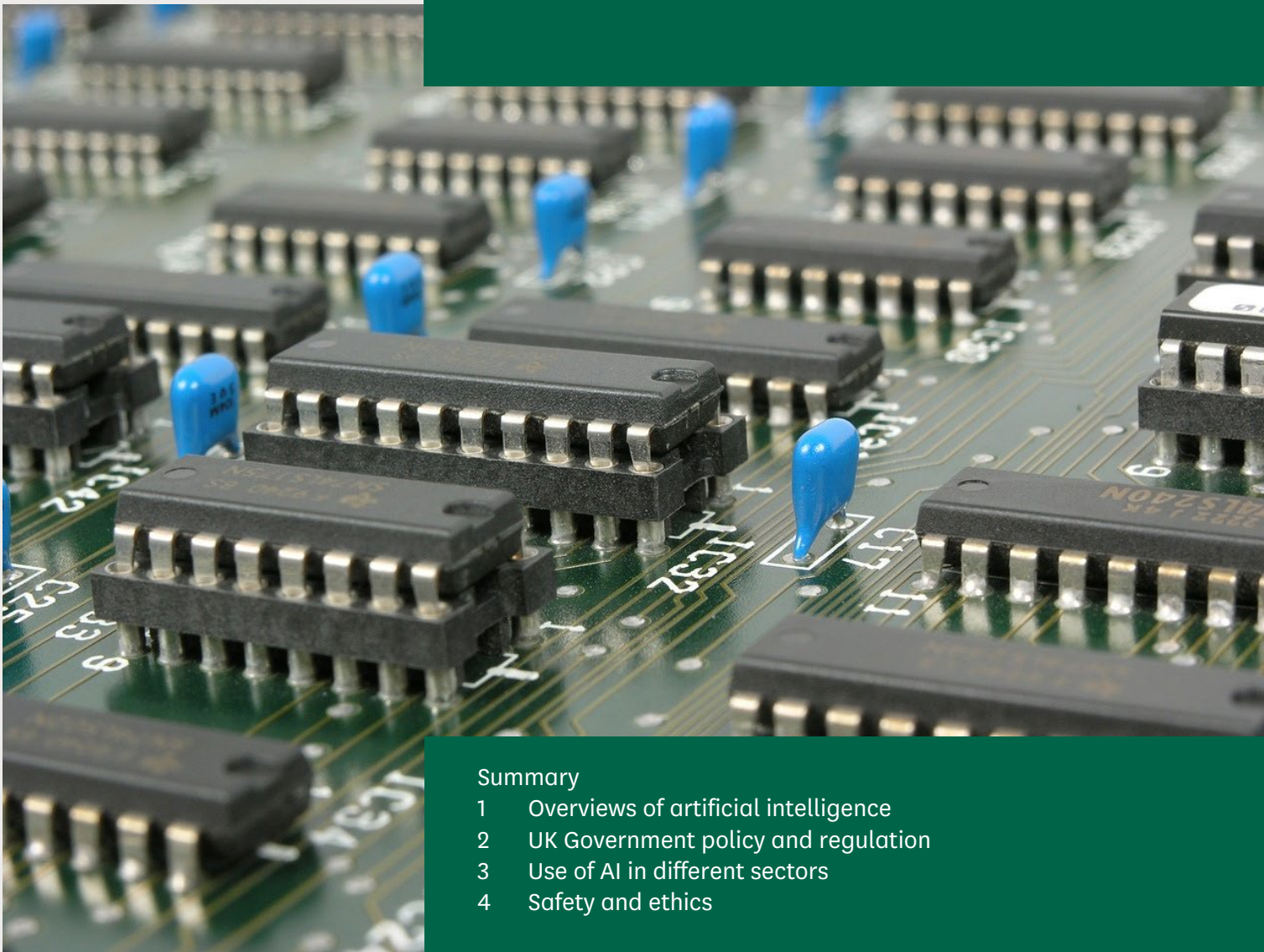


Research Briefing

17 April 2024

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# Artificial intelligence: A reading list



## Summary

- 1 Overviews of artificial intelligence
- 2 UK Government policy and regulation
- 3 Use of AI in different sectors
- 4 Safety and ethics

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## Summary

### What is artificial intelligence (AI)?

Artificial intelligence (AI) can take many different forms and there is no single, universally agreed definition. The term is frequently used as a shorthand to refer to technologies that perform the types of cognitive functions typically associated with humans, including reasoning, learning and solving problems.

To perform these types of functions, AI systems generally rely on vast amounts of data. This data may be 'structured' or 'unstructured'. Structured data is typically stored in a fixed format and can be more easily analysed and processed, such as financial transactions that have a date, time and amount. Unstructured data includes images, videos and text files; it is not organised according to a predefined structure, it is generally unformatted and is much harder to analyse.

Both types of data can be used to 'train' AI so that it can recognise patterns and correlations. This is achieved by the AI system applying rules (algorithms), based on the training dataset, to interpret new data and perform a specific task. In some instances, the AI is supervised and trained with data sets labelled by humans, as explained in this [example from IBM](#):

A data scientist training an image recognition model to recognize dogs and cats must label sample images as “dog” or “cat”, as well as key features—like size, shape or fur—that inform those primary labels. The model can then, during training, use these labels to infer the visual characteristics typical of “dog” and “cat.”

This is useful for AI systems designed to look for specific things, such as spam emails.

In other instances, the system is unsupervised and the data is left unlabelled. Under these conditions, the system autonomously identifies patterns in the data. This is useful where the AI is designed to find something that is not known in advance, such as online shopping recommendations.

### Machine learning and deep learning

The process of an AI system developing and improving over time, without all its instructions being explicitly programmed, is called 'machine learning'.

'Deep learning' is a type of machine learning where the design of algorithms is informed by the structure and function of the human brain and the way it transmits information. Deep learning can be seen in numerous applications,

such as voice and image recognition, as well as in ‘foundation models’, of which ‘large language models (LLMs)’ like ChatGPT, are one example.

LLMs refers to those models that are typically (though not always) trained on very large, unlabelled data sets. They can be adapted to do many tasks, despite not having been trained explicitly to do those tasks. In other words, the model can take information it has learnt about in one situation and apply it to another, different situation.

## Different types of AI

Distinctions have also been drawn between ‘narrow’ and ‘general’ AI. Narrow AI is designed to perform a specific task, such as speech recognition, using information from specific data sets. It cannot adapt to perform another task. These are often tools that aim to assist, rather than replace, the work of humans.

Artificial general intelligence (AGI) is an AI system that can reason, analyse and achieve a level of understanding that is on a par with humans; something that has yet to be achieved.

Generative AI has more sophisticated capabilities than narrow AI but has not reached the level of AGI. [Generative AI relies on deep learning models](#) that can use unstructured data to “‘learn’ to generate statistically probable outputs when prompted”, generating new content, such as images.

‘[Frontier AI](#)’, or the term ‘frontier model’, is also being increasingly used to describe AI systems that are “‘cutting edge” foundation models, though the [Ada Lovelace Institute](#), a data and AI research organisation, states that ‘frontier’ is a contested term and that “there is no agreed way of measuring whether a model is ‘frontier’ or not”.

## UK Government policy and regulation

The UK does not have any AI-specific regulation or legislation covering the technology. Instead, AI is regulated in the context in which it is used, through existing legal frameworks, such as financial services legislation.

Some regulators, however, have oversight of the development, implementation and use of AI more broadly. For example, the Information Commissioner’s Office (the UK’s independent body established to uphold information rights) has guidance on its website covering [AI and data protection](#) and [explaining decisions made with AI](#).

The government has started developing a more comprehensive regulatory framework for AI. This has included publishing strategy documents and a white paper on AI.

The [UK's National AI Strategy](#) was published by the government in 2021. It is a 10-year plan to make the UK a “global AI superpower” by focusing on the following aims:

1. Invest and plan for the long-term needs of the AI ecosystem to continue our leadership as a science and AI superpower;
2. Support the transition to an AI-enabled economy, capturing the benefits of innovation in the UK, and ensuring AI benefits all sectors and regions;
3. Ensure the UK gets the national and international governance of AI technologies right to encourage innovation, investment, and protect the public and our fundamental values.

As part of its aim to “ensure the UK gets the national and international governance of AI technologies right” the government ran a [public consultation on regulating AI in 2022](#). A white paper – [A pro-innovation approach to AI regulation](#) – followed in March 2023.

In the paper, the government proposed that AI would continue to be overseen by existing regulators covering specific sectors, such as Ofcom (the UK’s communications regulator), Ofgem (the energy regulator in Great Britain), and the Financial Conduct Authority (the UK’s conduct regulator for financial services). This context-based approach to regulation was favoured by the government, rather than creating a single regulatory function, and uniform rules, to govern AI.

The government proposed that AI regulation would be informed by five, cross-sector principles which regulators will “interpret and apply within their remits in order to drive safe, responsible AI innovation”. The principles are:

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

While the government decided against creating a single regulatory function to govern AI, it proposed that existing regulators would be aided by “central support functions”, established by the government, such as horizon scanning for emerging risks and trends, and monitoring the overall regulatory framework. The government also proposed that the five principles will not, at least initially, be subject to new regulation, but instead will be implemented by existing regulators.

[A further consultation accompanied the publication of the white paper](#). The [government's response](#) was published in February 2024 and confirmed that it remained committed to its cross-sector principles and “context-specific” approach to regulation. It said that it would seek to build on this in the future, only legislating when it was “confident that it is the right thing to do”.

In February 2024 the government also published guidance for regulators, [Implementing the UK's AI Regulatory Principles](#) (PDF). The guidance sets out the “considerations that regulators may wish to have when developing tools and guidance to implement the UK's approach to AI regulation”.

## Use of AI in different sectors

AI is currently being used across many different industries, from finance to healthcare. In 2022, [the UK Government reported](#) that “around 15% of all businesses (432,000 companies) had adopted at least one AI technology”. The [management consultancy firm McKinsey](#) identified the following examples of AI that can be applied across a range of industries:

- Predictive maintenance

[...] Rather than waiting until a piece of equipment breaks down, companies can use predictive maintenance to project when maintenance will be needed, thereby preventing downtime and reducing operating costs. Machine learning and deep learning have the capacity to analyze large amounts of multifaceted data, which can increase the precision of predictive maintenance. For example, AI practitioners can layer in data from new inputs, like audio and image data, which can add nuance to a neural network's analysis.

- Logistics optimization

Using AI to [optimize logistics](#) can reduce costs through real-time forecasts and behavioural coaching. For example, AI can optimize routing of delivery traffic, improving fuel efficiency and reducing delivery times.

- Customer service

[AI techniques in call centers](#) can enable a more seamless experience for customers and more efficient processing. The technology goes beyond understanding a caller's words: deep-learning analysis of audio can assess a customer's tone. If a caller is getting upset, the system can reroute to a human operator or manager.

[The business magazine Forbes](#), for example, highlighted the use of AI by the retailer Marks and Spencer which had deployed “autonomous event capture” to help identify unsafe behaviours in its warehouses. Since adopting the technology, it reported an 80% reduction of warehouse accidents.

AI is also used in the public sector. [The NHS AI Lab](#), for example, is focused on developing and deploying AI systems in health and care. In 2023, the [government provided funding of £21 million](#) to roll out AI imaging and decision



support tools to help analyse chest X-rays, support stroke diagnosis and manage conditions at home.

[The Food Standards Agency](#) uses an AI tool to help local authorities prioritise inspections by predicting which establishments “might be at a higher risk of non-compliance with food hygiene regulations”. The government also announced in January 2023 that it would be [using AI to help “find and prevent more fraud across the public sector”](#).

## Safety and ethics

The UK Government interprets AI safety to mean the [prevention and mitigation of harms \(whether accidental or deliberate\) from AI](#). Harms may arise from the ethical challenges that complex AI can present. These include the ‘black box problem’, where the inputs to and outputs from an AI system are known but humans cannot decipher – and the AI cannot explain – the process it went through to reach a particular conclusion, decision, or output. The AI’s decision-making process, in other words, is not transparent nor accountable to humans.

Such decisions may also be susceptible to biases, such as ‘embedded bias’. Embedded biases arise from relying on training data that reflects social and historical inequalities. These inequalities are then perpetuated in the outputs from the system. As IBM explains, “using [flawed training data can result in algorithms that repeatedly produce errors](#), unfair outcomes, or even amplify the bias inherent in the flawed data”. In addition, there are concerns about the privacy and security implications of AI, including the use of sensitive data to train AI systems, as well as the ability of those systems to infer personal information.

The Ada Lovelace Institute, an independent data and AI research organisation, [groups AI risks and harms into four areas](#):

- accidental harms from AI systems failing, or acting in unanticipated ways, such as self-driving car crashes, or discrimination when sifting job applications.
- misuse harms from AI systems being used in malicious ways, such as bad actors generating misinformation using ‘generative’ AI applications such as ChatGPT and Midjourney.
- supply chain harms from the processes and inputs used to develop AI, such as poor labour practices, environmental impacts, and the inappropriate use of personal data or protected intellectual property.
- structural harms from AI systems altering social, political, and economic systems, such as the creation of unequal power dynamics (for example through market concentration or inequitable access to AI systems), or the aggregate effect of misinformation on democratic institutions.

As well as misuse risks, the UK Government (and others) has considered “[loss of control risks](#)” in which human oversight and control over a highly advanced, autonomous AI system is lost, leaving it free to take harmful actions. There is an ongoing, contentious debate about such ‘existential risks’ and their likelihood. The Ada Lovelace Institute has emphasised that we [should not lose sight of the harms](#) that can arise from existing (rather than futuristic) AI systems:

risks from AI do not simply grow in proportion with the technical capabilities of a given system, but depend intimately on the contexts in which those systems are deployed. Existing systems with capabilities far behind the ‘frontier’ can produce unexpected harms when deployed in new contexts, particularly without prior testing or consultation with users and other affected parties.

Elsewhere, thousands of AI experts [signed an open letter in March 2023](#), calling for a pause on the development and training of generative AI systems that are more powerful than ChatGPT-4. According to the signatories, a pause would have allowed time for the development and implementation of “a set of shared safety protocols for advanced AI design and development that are rigorously audited and overseen by independent outside experts”. No such pause occurred.

In November 2023, the UK Government hosted the [AI Safety Summit](#); a two-day global event at Bletchley Park, Buckinghamshire. Its aims were to examine the risks of AI, particularly in relation to ‘frontier AI’, and discuss how those risks could be mitigated by the international community. Frontier AI is [defined by the UK Government](#) (PDF) as “highly capable general-purpose AI models that can perform a wide variety of tasks and match or exceed the capabilities present in today’s most advanced models”.

Briefings published by the House of Commons and House of Lords Libraries, and the Parliamentary Office of Science and Technology on AI can all be found at: [Artificial intelligence - House of Commons Library \(parliament.uk\)](#)

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- Google Cloud, [What Is Artificial Intelligence \(AI\)?](#), not dated
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- [Artificial intelligence \(AI\): recent trends and applications](#) / edited by S. Kanimozhi Suguna, M. Dhivya, and Sara Paiva. Publisher: Boca Raton, Florida ; London, England ; New York : CRC Press, 2021

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- IBM, [Understanding the different types of artificial intelligence](#), October 2023

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- McKinsey, [What is ChatGPT, DALL-E, and generative AI?](#), April 2024
- Rishi Bommasani and Percy Liang, [Reflections on Foundation Models](#), Stanford University, October 2021
- Yoon Kim, Jacob Andreas and Dylan Hadfield-Menell, [Large Language Models](#) (PDF) Massachusetts Institute of Technology, Schwarzman College of Computing, November 2023

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## 2 UK Government policy and regulation

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- [AI Roadmap](#), January 2021
- [National AI Strategy](#), September 2021
- [National AI Strategy - AI Action Plan](#), July 2022

#### White papers

- [Establishing a pro-innovation approach to regulating AI](#) (consultation paper), July 2022
- [A pro-innovation approach to AI regulation \(white paper\)](#), March 2023 (updated August 2023)
- [A pro-innovation approach to AI regulation Government response to consultation](#) (PDF), February 2024

#### Risks and safety

- [Holistic AI: Risk Mitigation Roadmaps](#), September 2023
- [Capabilities and risks from frontier AI: discussion paper](#), October 2023
- [Introducing the AI Safety Institute](#), November 2023
- [Emerging processes for frontier AI safety](#), October 2023

#### AI Safety Summit, November 2023

Outputs from the summit, including the [Bletchley Declaration](#), can be found at: [AI Safety Summit 2023 - GOV.UK](#)

#### AI Standards Hub

Establishing an [AI Standards Hub](#), to develop technical AI standards, was one of the actions set out in the National AI Strategy. The hub is led by the Alan Turing Institute and supported by the British Standards Institution and the National Physical Laboratory.

- An explanation of its work on AI standards is available at: [What are standards? - AI Standards Hub](#)
- The AI Standards database can be searched at: [AI Standards Search](#)
- Separately, the Department for Science, Innovation and Technology has published an [Introduction to AI assurance](#), February 2024

## 2.2 Government Office for Science (GO-Science)

- [Rapid Technology Assessment: Artificial Intelligence](#), March 2023
- [Future Risks of Frontier AI](#) (PDF), October 2023

## 2.3 Information Commissioner's Office (ICO)

- [Explaining decisions made with AI](#), October 2022
- [Guidance on AI and data protection](#), March 2023
- [Generative AI: eight questions that developers and users need to ask](#), April 2023

## 2.4 Digital Regulation Cooperation Forum

The Digital Regulation Cooperation Forum (DRCF) brings together the major UK regulators tasked with regulating digital services:

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- the Financial Conduct Authority (FCA),
- the Information Commissioners Office (ICO), and
- the Office of Communications (Ofcom).
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- Paul Shepley, Matthew Gill, [Artificial intelligence: how is the government approaching regulation?](#), Institute for Government, October 2023

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- Culture, Media and Sport Committee, [Connected tech: AI and creative technology](#), Eleventh Report of Session 2022–23, 30 August 2023

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- Ministry of Defence, [The Government Response to the Report by the House of Lords AI in Weapon Systems Committee: 'Proceed with Caution: Artificial Intelligence in Weapon Systems'](#) (PDF) (Session 2023–24 HL Paper 16), CP 1023, February 2024



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