AI Primer

Briefing Note September 2025

Lib**STEMM** is the party body (AO) for Science,Tech, Engineering, Medicine and Maths – either for those qualified in those fields or with an interest.

2024/5 may have marked the point of peak hype of the new wave of AI technologies and tools launched or publicised, not only by big tech companies, but also by a plethora of start-up "AI" companies, as well as medium-sized companies keen to associate their offering with "AI". With this explosion of activity, AI as a term is becoming less and less useful except as an umbrella.

Understandably, in such a fast changing environment there is much room for confusion. This briefing note provides a status update on some of the key terminology being used, the state of the technology, and the issues at the public policy and political interface – specifically aimed at a Liberal Democrat audience.

AI – by types of application:

Optimisation or pattern spotting –

Systems which optimise for a particular parameter by learning from previous widely collected data over time, or many repeated specimens. Examples include chemical plant optimisation systems, or image processing systems in medical applications – e.g. automated x-ray or MRI scan analysis. Molecular drug screening and protein-folding models may be considered in this category, although they may also use additional functional techniques.

Chemical and laboratory based AI tools can be used to optimise experiments by coupling with automated lab systems, performing many experiments, interpreting the results and optimising based on molecular scale properties. For example, selecting and optimising catalysts.

Generative – Systems which generate content or art based on user inputs.

Not all generative AI are foundation models. Generative AI can be narrowly designed for a specific purpose. There are a range of generative AI techniques. These include generative adversarial networks (GANs), style transfer, generative pre-trained transformers (GPT) and diffusion models. A short description of each generative AI technique is also included in the glossary of ref [2]. Large Language models, which are systems which are trained on text data, generating natural language responses to user prompts.

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Agentic – Models or programs which the user devolves agency to, performing tasks in response to instructions, but requiring multiple steps or access points.

Examples include booking, or reserving travel, ordering from online retailers, sending emails. Notably, such agents require the user to divulge login details, keys or passwords typically used to securely access "privileged" services such as banking or correspondence. Suggestions for action can also be made by scraping data from the systems which agents have access to – e.g. by reading incoming mail. Other examples include casework management, automated form filling to interface with services – e.g. housing and healthcare.

Could and should an agentic AI replace election agents?

Assistive – Generally now considered to mean technologies which augment or supplement a person's capabilities.

Voice assistants such as Alexa and Siri may be considered to fall in this category, although they may also cross into the Agentic category. Technologies which provide accessibility services, such as screen reading, grammar and spelling aids, hearing and sight augmentation or conversion of images to audio description.

Biometric data recognition - uses artificial intelligence to analyse uniquely identifying human characteristics, such as fingerprints, faces, and voices, for identity verification and other purposes. Such models may be linked to existing databases e.g. for criminal justice suspect identification "live facial recognition" which rely on matches to images or derived biometric (pattern) data stored in databases of past images of suspects or the general population. There are also other models which have been developed for animal or plant species and individual identification.

The degree of autonomy which an AI model has can have implications for its definition and regulatory treatment.

Biological – AI which interface with biologically functional molecules. The best-known gene editing tool is CRISPR/Cas9, the discovery of which secured the Nobel Prize in Chemistry 2020 [7]. Artificial intelligence (AI) transforms gene editing tools, offering greater precision, efficiency, and speeding up discovery. For example, the biotechnology company Profluent has developed OpenCRISPR-15, an open-source AI-created gene editor. This CRISPR-like protein does not exist in nature and early work suggests it may show greater specificity in gene editing, although research is ongoing.
AI is used to predict the outcomes of CRISPR edits, and interpreting the vast, complex datasets generated by genome sequencing. This can provide feedback to the models promoting desired functionality or sought-after optimisations. [6]

AI by Functional Scope:

Narrow AI – perform (tasks) in a limited predefined environment, for example predictive text or image recognition, optimisation of a chemical plant.

Foundation model/General purpose

- ‘Foundation’ models are sometimes called ‘general-purpose AI’ or ‘GPAI’ systems. These are capable of a range of general tasks (such as text synthesis, image manipulation and audio generation). Notable examples are OpenAI’s GPT-3 and GPT-4, foundation models that underpin the conversational chat agent ChatGPT [2]. Because foundation models can be built ‘on top of’ to develop different applications for many purposes, this makes them difficult – but important – to regulate.

In 2025, foundation models’ capabilities include but are not limited to the ability to: translate and summarise text; generate reports from a series of notes; draft emails; respond to queries and questions; and create new text, images, audio or visual content based on text or voice prompts.

Frontier Model - hard to define, and largely understood to be a subset of foundation models with cutting edge capabilities. Due to transience, it is thought unlikely this term will last.

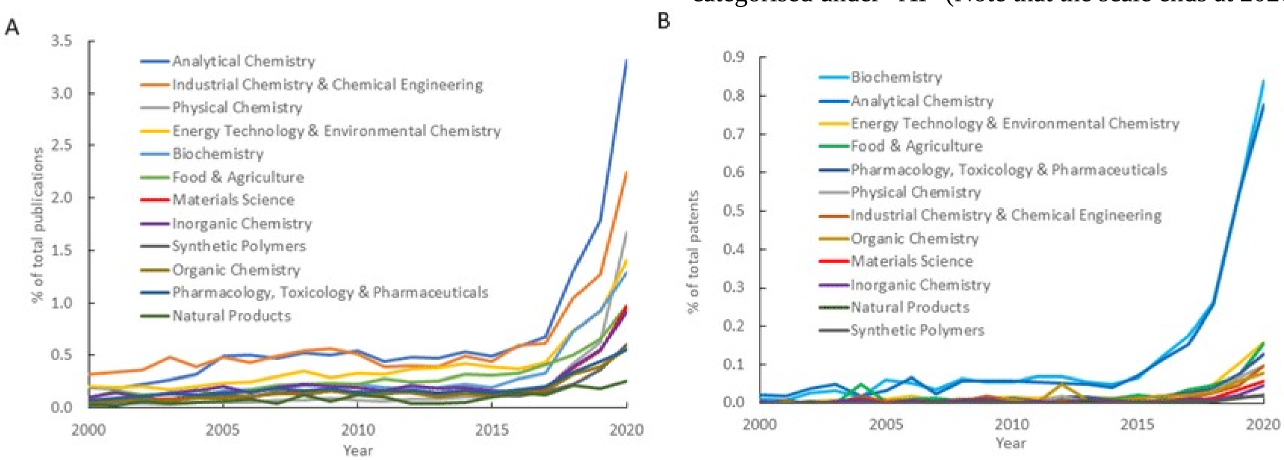
Artificial general intelligence (AGI) / strong AI

– Reference to models which can undertake tasks which hitherto, only humans might be expected to perform. Although there are stated intentions by some big tech companies to build AGI, in 2025, none exist.

Explainable AI. - Across different fields, in particular in life sciences, there is a need for further research into the inner workings of AI models so that humans can understand them, which is known as Explainable AI [6]. Although models may be trained to well understand the complexity, e.g. of biological systems, many AIs are “black boxes” to those in the field, and there is a need to distil the findings into clear insights.

Peak Hype?

Business leaders [4] note that Generative AI is now considered to be in a “Trough of Disillusionment” whilst other AI technologies such as AI Agents and AI-ready-data are reaching peak hype. None of these are particularly objective or scientific measures, but some proxy measurements may be used to justify these assertions:
Image: Published Chemistry Research Papers and patents categorised under “AI” (Note that the scale ends at 2020) [3]



Where is AI seeing ROI in 2025?

According to Google's survey of managers [8], returns on investment have been seen in the following applications:[8]

- Customer service agents (chatbots)
- Retail sites with large database sets – data hungry activities
- Repetitive tasks – widely repeated industry / service contexts
- Guided or co-ordinated coding and programming – speed-up (Whilst half of developers say AI can code better than most people, not all coders use AI or find it useful in their workflow ~ only 78% according to industry survey [9]

How did we get here?

C18 - C19

Automata have been created since ancient times. It was from the mid-18th century to the end of the Victorian age, however, that the building of automata truly flourished. However, these were never intelligent devices, merely mechanical toys, in some cases able to carry out pre-ordained routines.

20th Century

Neural nets - The advent of programmable computers with sufficient flexibility and capability underpinned by early and mid 20th century mathematical foundations, led in the last decade of the century, to neural networks capable of "deep learning", which is a reinforcement programming where the network evolves through feedback and input of "training" data sets.

1990s

Public awareness - **ALDES, the predecessor to LibSTEMM held a very prescient fringe meeting, Spring 1998 with Prof Chris Winter, Head of future systems at BT Labs where AI agents and future internet developments were envisaged.**

- "it looks like you're trying to write a letter"

The late 1990's Microsoft paperclip, was an early generally released and fairly basic form of AI, with internet chat-bots also being examples of the state of the art at this time.

2000-2020

Machine learning – Improved processing, development of algorithms and computing power, in addition to the widespread availability of large data sets (licensed or otherwise) via broadband internet connections. Large language models (LLMs) – beginning with "next word" or phrase completion, and subsequently, with larger and larger training sets marked the next significant development of the technology in the 21st century.

Technology enablers

- Development of tools to optimise and train neural networks – including transformers (which are optimised through iterative data analysis, feedback and comparison). e.g. GPT stands for Generative pre-trained transformer. Optimisation of these tools for the defined task is commonly referred to as "learning".
- Database technologies, including graph databases – allowing ever faster storage and retrieval, assimilating some of the work previously done by computational algorithms in the underlying database structure for efficiency.
- Large data processing hardware – more powerful chips, hard disk drives and solid state storage (memory) allow faster storage and retrieval. In conjunction, software to allow parallel processing has lowered the time to perform larger calculations and data analysis. New and advanced programming languages have been developed, and data centres to house the increasing storage and processing needs.

Problems and Concerns

As AI technologies have been rolled out to wider public use, a variety of concerns have gained traction 2020-2024.

The impact on the creative sector of use of AI technologies, either to generate art or content, to reproduce or assimilate existing art has become clearer. In-depth explanations of the legal background to IP and copyright in the UK and USA are available in the book "Living with the Algorithm"[5], by LibDem peer, Lord Tim Clement-Jones.

Use of AI in misinformation, the ownership and licensing of data, and the rise in size and power of big tech companies, and increasing digitisation also became mainstream concerns.

There has also been evidence of AI vs AI arms-races being set up, sometimes with people caught in between. An example is Job application vs submitting and reviewing. The technologies are frequently not being used in a smart or productive way.

Although not an AI system, the Post office Horizon system IT scandal has also highlighted the need to amend Computer misuse act 1990 to enable legitimate independent testing of computer systems and the presumption that computer evidence is accurate unless proved otherwise. Requiring the ability to test and challenge AI systems, as any new IT system, and performing such testing, is an acute need.

What's new in 2025? Examples:

- Digital Sovereignty – which can refer to both state ownership or geo-location of software and cloud computing hardware.
- AI poisoning tools such as Glaze and Nightshade, developed at the University of Chicago [1].
- A realisation in organisations that there isn't data for everything. This has two facets: Tension between digitising and not... Anti digitisation drive… Is more value added by making data AI-ready? Or gate-keeping data that AI agents, competitors (and big-tech) should be denied access to?
- Compute Power and environmental impact. Realisation and quantification: and big tech's response to commission their own renewable or nuclear power plants.
- Roll-out of live facial recognition systems by the Met. Police.
- Responsible handover framework for genomic data in AI launched. The framework was developed by Sense about Science in collaboration with the Institution of Engineering and Technology and funded by Wellcome. It has undergone months of testing and validation with organisations as varied as the Wellcome Sanger Institute, Biobank, Royal Academy of Engineering, Guy's and St Thomas' Hospital, African Population Health Research Centre in Kenya and MIT. Sense About Science and integrated into Ensembl [10], [11]

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New Jobs

- The tech Industry has developed a need for new skill sets, but what are these?
- Prompt Engineer – the art of writing succinct prompts to rapidly get the desired results from models.
- Data cleaner – making data "AI-ready"
- AI trainer (many AIs trained using cheap labour overseas) - We must think about the ethics of that..
- Reviewer or fixer of AI generated output. (Technical authors or proof readers / stats and data checking).
- AI Ethicists – considering the potential pitfalls and limits of AI models, and data handling, and postulating solutions, limits in use cases or disclaimers.

The Need for "Guardrails"

Some examples of practical technical concerns on the horizon, and indeed which industry and regulators are currently grappling with, in order to limit the harm which can be done by AIs given unfettered access to data and resources:

- AI building chains using AI tools itself to multiply... The threat extends from a massive denial of service attack to something more sinister, if connected to advanced and diverse manufacturing facilities.
- AIs developing their own languages (what looked like gibberish was actually communicating with each other) [12]. Are humans locked out or is this simply extension of comms protocols which can't be "read" as language anyway.
- AIs developing their own code languages which human actors may struggle to interpret.
- Military applications – and the potential need for new treaties to cover (or prohibit) some uses.
- AI-linked biology applications, e.g. use for biological design at RNA or DNA level, and use of DNA for encoding.

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