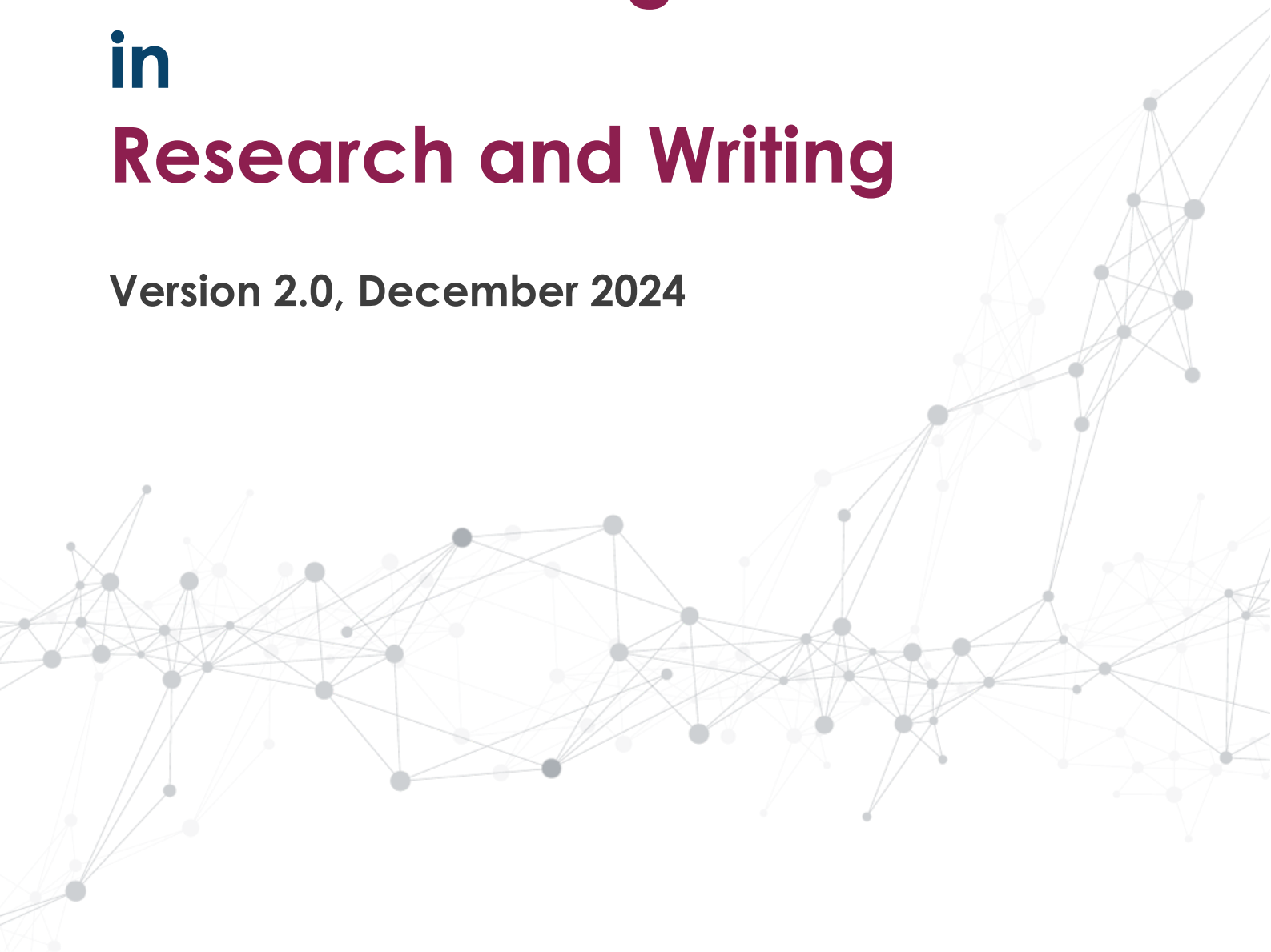


Engaging with Artificial Intelligence in Research and Writing

Version 2.0, December 2024



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What is Artificial Intelligence?

An introduction to Artificial Intelligence (AI)

Artificial Intelligence (AI) is an umbrella term for technology capable of performing tasks intelligently. Various definitions have been proposed by pioneers, experts, researchers, companies, organisations, the media and so forth. Some of these definitions include:

“The science of making machines do things that would require intelligence if done by men.”
(Minsky, 1968, p. v)

“The study of man-made computational devices and systems which can be made to act in a manner which we would be inclined to call intelligent.” ([Berkeley, 1997](#))

“It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.”
([McCarthy, 2007, p. 2](#))

“The use of computer programs that have some of the qualities of the human mind, such as the ability to understand language, recognize pictures, and learn from experience.” ([Cambridge University Press, 2017](#))

“AI, shorthand for artificial intelligence, defines technologies emerging today that can understand, learn, and then act based on that information.” ([PWC, 2017, p. 2](#))

“AI generally refers to the ability of machines to exhibit human-like intelligence—for example, solving a problem without the use of hand-coded software containing detailed instructions.”
([Bughin et al., 2017, p. 7](#))

“A system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation.” ([Kaplan & Haenlein, 2019, p. 17](#))

“AI is the ability of a machine to display human-like capabilities such as reasoning, learning, planning and creativity.” ([European Parliament, 2021](#))

“The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.” ([Encyclopedia Britannica, 2023](#))

Simply put, AI can be understood as the brain for computers, robots and other smart technologies. Just as students learn to get better grades in examinations, AI can learn to get better at various tasks. At first, it might not be very good at a specific task, again like a child first learning something new. But as AI keeps learning from data and experience, over time its performance gets better and better.

AI's definition of AI

GPT-4o was used to generate a description of artificial intelligence.

The following prompt was input into GPT-4o: "Could you tell me what artificial intelligence is?"

The output obtained was:

"Artificial Intelligence (AI) is a branch of computer science focused on creating systems and machines capable of performing tasks that typically require human intelligence. These tasks include, but are not limited to, learning, reasoning, problem-solving, understanding natural language, recognizing patterns, and making decisions.

Key Features of AI:

1. **Learning:** AI systems can learn from data (e.g., machine learning) and improve their performance over time without being explicitly programmed for every scenario.
2. **Reasoning:** AI can apply logical rules to data, solve complex problems, and infer conclusions.
3. **Perception:** AI systems can interpret data from the world, such as visual images (computer vision), sounds (speech recognition), or other sensory inputs.
4. **Natural Language Processing (NLP):** AI can understand and generate human language, enabling communication with users in their native tongue.
5. **Decision-Making:** AI can analyze data to make decisions, often in real-time, in fields like healthcare, finance, or autonomous driving.

Types of Artificial Intelligence:

1. **Narrow AI (Weak AI):**
 - Designed for specific tasks.
 - Examples: Voice assistants (e.g., Alexa, Siri), recommendation systems, and spam filters.
2. **General AI (Strong AI):**
 - Hypothetical AI capable of performing any intellectual task a human can do.
 - Not yet realized but remains a goal in AI research.
3. **Superintelligent AI:**
 - A future concept where AI surpasses human intelligence across all fields.
 - Raises questions about ethics and control.

Techniques and Technologies in AI:

1. **Machine Learning (ML):**
 - AI systems learn patterns from data.
 - Types of ML: Supervised, Unsupervised, and Reinforcement Learning.
2. **Deep Learning:**
 - A subset of ML using neural networks inspired by the human brain.
 - Excels in tasks like image and speech recognition.
3. **Expert Systems:**
 - AI designed to mimic decision-making processes of human experts.
4. **Robotics:**
 - AI-powered machines capable of performing physical tasks.

5. Natural Language Processing (NLP):

- Enables AI to understand, interpret, and generate human language.

Applications of AI:

- **Healthcare:** Diagnosing diseases, drug discovery, and personalized treatments.
- **Finance:** Fraud detection, algorithmic trading, and credit scoring.
- **Transportation:** Autonomous vehicles and route optimization.
- **Education:** Personalized learning and grading systems.
- **Entertainment:** Content recommendations and video game design.

Ethical Considerations:

- **Bias:** AI can perpetuate existing biases if trained on biased data.
- **Privacy:** Use of personal data raises concerns about security and consent.
- **Job Displacement:** Automation could lead to significant changes in the job market.
- **Control:** Ensuring AI operates safely and aligns with human values.

In summary, AI is a transformative technology with the potential to impact nearly every aspect of human life, from routine tasks to solving complex global challenges." (OpenAI, 2024, November 27)

It is clear that GPT-4o generated a more comprehensive and well-rounded definition and description of artificial intelligence than the content generated by GPT-4 as included in the previous version of this guide that was published in August 2023 (Li, 2023, p. 4).

Key dates and names



Figure 1. A Brief History of Artificial Intelligence (AI); developed from Li (2023, p. 5)

Types of Artificial Intelligence

AI can be broken down into three capability types:

1. narrow AI, also known as artificial narrow intelligence (ANI) or weak AI;
2. artificial general AI (AGI), also known as strong AI; and
3. artificial superintelligence (ASI).

ANI refers to tools developed to carry out very specific tasks (e.g., voice recognition, image classification) but which lack the ability to adapt to new contexts (Nancholas, 2023); some common examples of this type of AI include streaming suggestions and virtual assistants (e.g., Siri, Alexa). AGI is intended to exhibit the adaptability and learning capabilities of a human so that multifunctional tasks can be performed; common examples include ChatGPT, but a comprehensive realisation of AGI is an ongoing challenge in the field of AI research at the moment. ASI is a hypothetical area of AI which aims to surpass human intelligence with superior cognitive capabilities (Nancholas, 2023); it has been portrayed in science fiction as well as films and TV series as threatening characters, including the Noah's Ark artificial intelligence system in *Case Closed: The Phantom of Baker Street* (2002). The dominant concern around ASI is the lack of human ethics and a potential contrast to the common morals and values shared by human beings in today's modern society. Although it is speculation at this stage, there is no doubt that the landscape of many industries and sectors will be significantly changed by ASI once the visions for it are realised. There is therefore an urgent need to rethink which skills and competences students will need to prepare them for a more AI-driven society and workplace in the future, but it is clear that the education sector is not yet ready for this potential change. The discussion remains largely superficial, focusing on academic integrity and plagiarism rather than on reconsidering what should be assessed (i.e., should the focus still be on 'facts' rather than higher level cognitive and metacognitive skills?), how this should be assessed, and how AI tools can be used effectively in education. AI will not replace humans, but those humans who know how to make the most effective use of AI tools will have the greatest advantage.

Applications

Given the dynamic nature of machine learning, AI-based tools are constantly evolving and developing, leading to rapid changes in this field. Therefore, the following discussion is contextually limited to the time at which this report was written. Since the release of our previous guidelines, there has been a notable shift in attitudes within the education sector regarding the use of AI. Initially, institutions were inclined to impose strict bans on AI in assessments and coursework, mainly because of the concerns around academic integrity. However, over time, this perspective has evolved into a more tolerant and nuanced approach. Researchers, practitioners and policymakers are now exploring ways to integrate AI ethically and responsibly, emphasising the importance of transparency and requiring students to appropriately acknowledge their use of AI tools. For example, [OpenAI Platform](#) offers prompt examples which could be searched by categories such as 'Generate', 'Code', 'Natural language', etc. [Google](#) also offers generative AI (GenAI) prompt samples which could be searched by use case such as 'Answer Question', 'Code', 'Extract', etc. In addition, Stanford University released the [GenAI Prompt Guide](#) aimed at helping people to use effective prompts for both text- and image-based GenAI tools.

Examples of AI use

Table 1 below briefly lists some potential applications of GenAI tools for students and staff (developed from University of Cambridge, n.d.).

Table 1. Some Potential Applications of AI Tools

Role	Description	Example of Implementation
Students		
Study/research support	Helping research a topic by providing an overview of new concepts and offering guidance to solve problems collaboratively.	Using some text generation tools (e.g., ChatGPT, Bard, etc.) in a similar way to using search engines; fact-checking is needed.
Creative inspiration	Transforming information into alternative formats to present ideas differently.	Rephrasing personal lecture notes or presenting them in a different or simplified format.
Task management	Assisting with planning and offering strategies to handle complicated tasks effectively.	Generating an organised to-do list for managing a research project.
Idea generation	Helping generate new concepts and overcome creative constraints.	Brainstorming innovative ideas.
Learning facilitation	Simplifying complex ideas and generating reflective prompts to enhance understanding.	Breaking down complicated concepts into simpler concepts and encouraging critical thinking with thought-provoking questions.
Self-assessment	Enabling self-evaluation through structured questions or discussion topics to track progress.	Generating quizzes or discussion prompts to review and reflect on a specific topic or concept.
Staff		
Assessment design	Creating evaluations that focus on advanced cognitive skills, such as critical thinking and idea synthesis.	Designing essay prompts that require students to analyse multiple perspectives and propose original solutions.
Question update/revision	Regularly updating assessment questions to limit training of model answers.	Rotating assessment items and/or essay questions each term or including case-specific scenarios that demand unique responses.

AI tutors

Some AI tools, although not originally designed for tutoring purposes, have demonstrated strong tutoring capabilities in specific subjects and topics (e.g., coding, writing). For instance, Google's Gemini 2.0 realtime AI (released on 11 December 2024) could facilitate the tutoring experience simply by the user sharing the screen and talking to their screen. There are also AI tools designed specifically for tutoring contexts, such as Khan Academy's *Tutor Me*, which provides support in mathematics, science and the humanities; Google's *Socratic*, which provides support (especially with visual explanations) in science, mathematics, literature studies and more powered by Google AI; and Wolfram | Alpha, which can compute expert-level answers to help the user understand a concept or topic in mathematics, science and technology, society and culture, and everyday life. These tools are particularly promising in out-of-school contexts, where students are often engaged in self-directed learning and where a professional teacher may not be present to support learning. These tools also challenge current pedagogical approaches as they could facilitate individualised learning, which many teachers find difficult to achieve in classroom contexts. However, AI tools cannot and should not replace teachers, but should play a complementary role in a human-centred approach.

AI detection software

Detection of AI-generated content is possible, but its "results vary widely and are currently unproven in their effectiveness. Some reports also indicate the production of false positives leading to unnecessary investigations and further actions" (University of Cambridge, n.d.). Currently, the University of Cambridge does not offer a standard detection package, and it does not recommend relying on AI detection software of any kind.

Examples of prompts

Here is a list of potential prompts tailored for primary and secondary school teachers:

Subject-based:

- Explain [insert the topic here] in a way a [insert the age of students or year group of students here] student would understand.
- Create a step-by-step explanation of how to solve this [insert the question or the topic of question here] for [insert the year group of students here] students.
- Generate three real-life examples to explain [insert the topic here] to [insert the year group of students here] students.
- Design a [insert the subject here] puzzle involving [insert the specific topic here] for [insert the year group of students here] students.
- Provide hints (not answers) for solving this [insert the question here].

Skills-based:

- Write a discussion question that encourages [insert the year group of students here] students to think about [insert the topic here].
- Create a debate prompt about [insert the topic here] for [insert the year group of students here] students.
- Suggest a real-world problem for [insert the year group of students here] students to brainstorm solutions to [insert the topic here] collaboratively.
- Provide a scenario that challenges students to consider multiple perspectives for [insert the topic here].

The Safe Use of AI Tools

General use

The following flowchart is for general informational purposes only; it does not, and is not intended to, constitute legal advice. One thing that needs to be emphasised is that the user of AI tools is responsible for content, including input (content provided by the user) and output (content generated and returned by AI tools based on the input). The user is responsible for ensuring that the content does not violate any applicable law or the Terms of Use of a specific AI tool. It is important to note that AI tools developed for a specific company or project (i.e., uploaded data are not externally accessible) are not included in the discussion here.

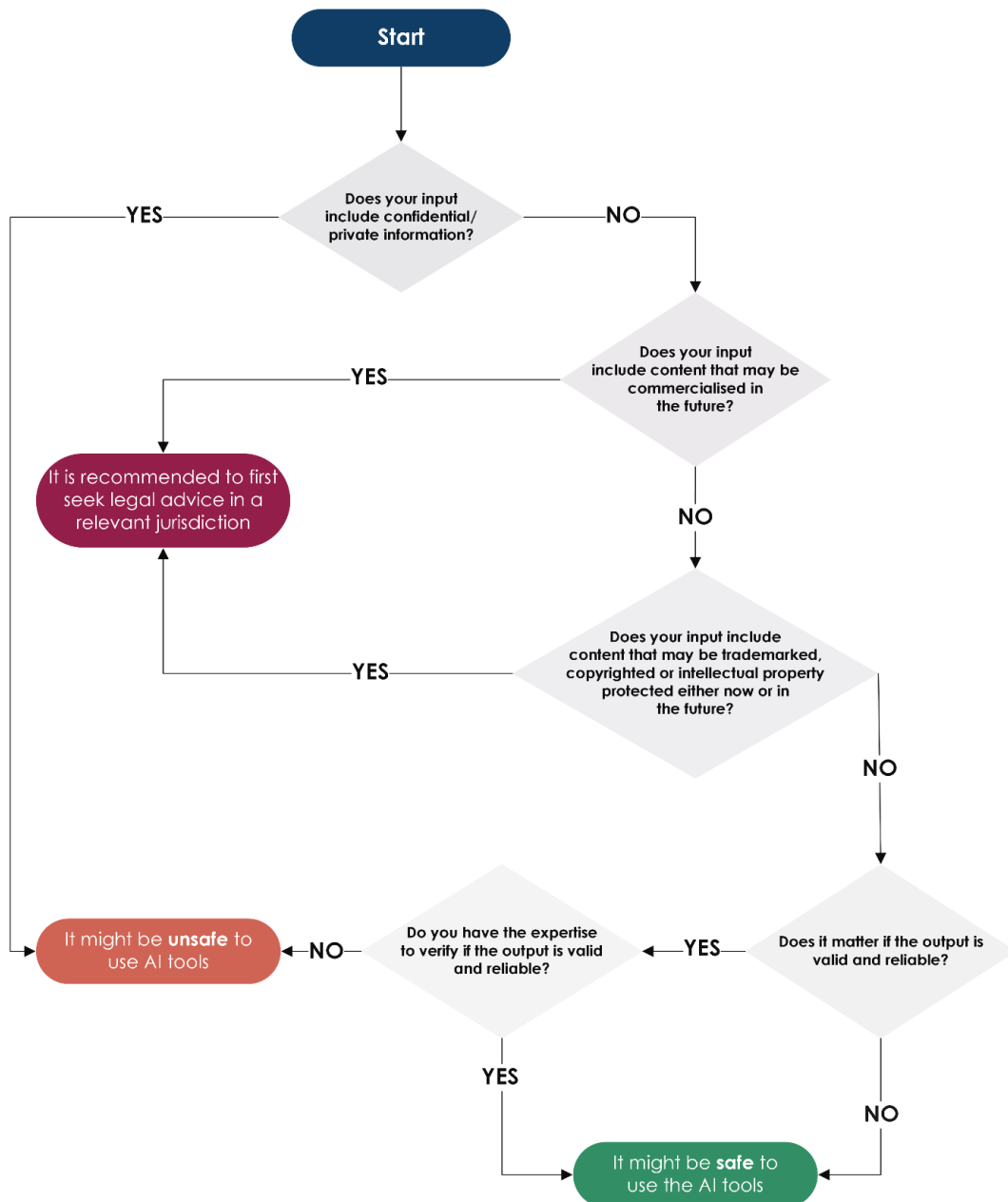


Figure 2. Safe and Unsafe Use of AI Tools

Responsible and Ethical Use of AI

The [OECD AI Principles](#) are the first intergovernmental standard on AI, promoting innovative, trustworthy AI. They have been updated in 2024, and comprise five values-based principles and five recommendations for policy makers.

The five values-based principles are:

- Inclusive growth, sustainable development and well-being
- Human rights and democratic values, including fairness and privacy
- Transparency and explainability
- Robustness, security and safety
- Accountability

The five recommendations for policy makers are:

- Investing in AI research and development
- Fostering an inclusive AI-enabling ecosystem
- Shaping an enabling interoperable governance and policy environment for AI
- Building human capacity and preparing for labour market transformation
- International co-operation for trustworthy AI (OECD, 2024)

On 4 July 2023, the Russell Group (an association consisting of 24 world-class and research-intensive universities including the University of Cambridge, the University of Oxford and UCL) published their [principles on the use of generative AI tools in education](#), emphasising the importance of ethical and responsible use of GenAI in education. In addition, many higher education institutions have developed and updated guidelines to promote the ethical use of AI, including the notable examples of [Stanford University Human-Centered Artificial Intelligence \(HAI\)](#) and [University College London \(UCL\)](#).

Copyright Ownership and Intellectual Property

The rapid development of AI is posing many challenges to the current copyright field; it has raised concerns about various legal implications, including uncertainty about ownership, copyright, and intellectual property (IP) issues, resulting in confusion and many unanswered questions. According to the World Trade Organization (WTO), "intellectual property rights can be defined as the rights given to people over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creations for a certain period of time." In particular, trade-related aspects of intellectual property rights (TRIPS) is an international agreement among WTO members, and "for the purpose of TRIPS Agreement, 'intellectual property' refers to: ... all categories of intellectual property that are the subject of [Sections 1 through 7 of Part II](#) of the agreement ([Article 1:2](#)). This includes copyright and related rights, trademarks, geographical indications, industrial designs, patents, integrated circuit layout-designs and protection of undisclosed information" (WTO, n.d.).

The interaction between copyright and GenAI presents two key challenges: 1) the potential copyright infringement by the developers of GenAI tools through the use of copyright-protected resources in the algorithm's training process; and 2) whether works created using GenAI tools qualify for copyright protection and, if so, who holds the resulting rights. This section is not intended to answer these questions or to provide legal advice. Instead, its aim is to briefly present some relevant information on these complicated issues.

Recent debates in Europe have focused on the training datasets used for GenAI. In the European Union (EU), through the *Directive 2019/790/EU on copyright in the Digital Single Market* (European Parliament and Council, 2019), the legal definition of data mining was introduced, and it is considered lawful in the EU, with several exceptions and limitations. The UK House of Lords Communications and Digital Committee published their report *Large Language Models and Generative AI* in February 2024, which called on the UK government to support copyright holders while LLM developers exploit the works of rightsholders. According to their report, “text and data mining (TDM) involves accessing and analysing large datasets to identify patterns and trends to train AI. Obtaining permission for this typically involves acquiring a licence or relying on an exception. Non-commercial research is permitted” (p. 66); legal compliance might therefore be involved. It is clear that this concern has been considered from the AI development end; a notable figure in the field, Professor Zoubin Ghahramani of Google DeepMind, stated that “we acknowledge that creators have valid concerns about the use of their content” if the language models were to directly reproduce works, and that developers “try to take measures so that does not happen” (UK House of Lords Communications and Digital Committee, 2023). The ownership of copyright and IP for content generated by GenAI is a complex and evolving issue, with legal interpretations varying across jurisdictions. It is important to emphasise that guidelines, laws and regulations in this field are evolving; therefore, the validity of the information in this section has been verified only as of the publication date of this guideline.

The US Copyright Office (USCO, 2023) issued a statement of policy to clarify registration guidance on works that contain materials generated by AI technology, which became effective on 16 March 2023. According to USCO, AI-generated images are not eligible for copyright protection as the work is “not the product of human authorship” (p. 16192). For example, AI-generated logos do not fall under copyright protection and cannot be trademarked.

UK legislation has a definition for computer-generated works. Under the Copyright, Designs and Patents Act 1988, these works are considered as “generated by computer in circumstances such that there is no human author of the work” (Intellectual Property Office, 2018, section 178). The law suggests that content generated by AI can be protected by copyright. However, as AI cannot be treated as an author or owner under the Copyright, Designs, and Patents Act 1988, it is clear that AI itself cannot own copyright. But this does not mean that the user of AI would automatically own the copyright; decisions should be made on a case-by-case basis.

However, the UK uniquely provides copyright-like protection for computer-generated works under Section 9(3) of the Copyright, Designs, and Patents Act (1988), where the “author” is considered the person who made the necessary arrangements for the creation. AI-generated content is created by analysing a large amount of data and generating outputs based on patterns identified from the datasets; it may need to summarise, rearrange, or extract information from the pre-existing information (e.g., in the training data) to present “new” – although not entirely novel – information. This poses the question of whether AI could be considered as authors if authors could be non-persons by definition.

At this stage, copyright over works developed with GenAI may belong to 1) the creators of the algorithm; 2) the user of the GenAI tool; or 3) no one (European Innovation Council and SMEs Executive Agency, 2024). Given the evolving and complex nature of this field, it is important to seek legal advice from a counsel in a relevant jurisdiction if you have any concerns, questions or uncertainties regarding these issues.

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