



Human ownership of artificial creativity

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Advances in generative algorithms have enhanced the quality and accessibility of artificial intelligence (AI) as a tool in building synthetic datasets. By generating photorealistic images and videos, these networks can pose a major technological disruption to a broad range of industries from medical imaging to virtual reality. However, as artwork developed by generative algorithms and cognitive robotics enters the arena, the notion of human-driven creativity has been thoroughly tested. When creativity is automated by the programmer, in a style determined by the trainer, using features from information available in public and private datasets, who is the proprietary owner of the rights in AI-generated artworks and designs? This Perspective seeks to provide an answer by systematically exploring the key issues in copyright law that arise at each phase of artificial creativity, from programming to deployment. Ultimately, four guiding actions are established for artists, programmers and end users that utilize AI as a tool such that they may be appropriately awarded the necessary proprietary rights.

Artistic creativity has traditionally been viewed as a product of the human mind. This association is increasingly cast into doubt as artificial intelligence (AI) becomes more pervasive in everyday life and, more recently, the world of art.

As generative algorithms and robots continue to evolve, they will soon be capable of creating more than just art, namely inventions and brands. Researchers have already used machine learning for backend design flow in electronic design automation tools¹. McKinsey predicts that AI will create US\$3.5–5.8 trillion annual value in the global economy² in the coming years. Entrusting the protection of artificially generated works to legal frameworks that predate current generative techniques presents two key problems: (1) in the absence of clear guidance, corporations may be disincentivized in using AI-based tools to develop works where protection is not guaranteed; and (2) end users of generative AI may unknowingly infringe on the rights of other artists, leaving themselves vulnerable to liability.

Ambiguity in law may lead to innovation in AI moving to more permissive jurisdictions. A leading example is the portrait *Edmond de Belamy* (Fig. 1), which looks like a painting from the seventeenth century, but in actuality is the creation of a machine learning algorithm trained on a dataset of 15,000 portraits from the 1300s to the 1900s. The algorithm stemmed from a concept published in 2014 titled ‘Generative adversarial nets’ (GANs)³, which has made the generation of synthesized data, images and audio significantly more accessible (Fig. 2). Multiple contributors built on each other’s code, until it was ultimately used by French-based art collective Obvious to generate the portrait^{4–6}.

On 24 October 2018, the portrait was auctioned at Christie’s in New York and sold for US\$432,500. In this new world where brushstrokes have been replaced by lines of code, who owns the rights to AI-generated creations? And how can programmers and contributors protect their own proprietary interests? While there are legal analyses that seek to answer similar questions, none have yet considered the specific practices that machine learning engineers and data scientists undertake in developing GANs and other generative algorithms^{7,8}. These practices will be essential in assisting courts with determination of proprietary rights.

This Perspective will seek to navigate and apply the present legal frameworks to AI-generated works, in a manner accessible to engineers, programmers and artists. This is achieved by considering the

human tasks that enable the automation of artwork, including programming a neural network, dataset curation, training, and execution or inference⁹. How various tasks in AI-based art generation give rise to proprietary rights will be explored across various jurisdictions. For end users to confidently utilize AI-generated works, a set of four guiding principles, which consider the programmer, trainer, user and the output, will be provided to assist AI artists with being appropriately awarded the necessary proprietary rights.

Fundamentals of copyright

An AI-generated creation must first satisfy some basic requirements to be afforded protection by copyright law. The overarching principles of copyright¹⁰ in common law systems, including the United States, United Kingdom, Canada and Australia, indicate that if the artwork is an original work of authorship fixed in a tangible medium, then it will be afforded protection. Civil law jurisdictions, including most European and Asian nations, generally do not have a fixation requirement¹¹. Additionally, there is some variation in the definition of ‘original’ across jurisdictions. In the United States, a modicum of creativity must be present for originality to subsist in the artwork¹². In the United Kingdom, there used to be a lower threshold requiring the exercise of skill or labour¹³, but in 2009, along with the rest of Europe, they adopted the view that the work must be the author’s own intellectual creation¹⁴. How these thresholds are harmoniously applied in practice is arguably not wholly settled in UK jurisprudence. If a spectrum were to exist between creativity and labour, then Canada¹⁵ and Australia¹⁶ would be placed somewhere in between.

Is it possible for AI to exercise creativity, skill or any other indicator of originality? At this point in time, the capacity for AI to generate abstract or inventive thought is severely limited. Neural networks fundamentally transform a set of discrete, limited-domain input parameters into another set of discrete, limited-domain output parameters, using a set of pre-defined functions. The US Copyright Office relies on long-standing Supreme Court precedent that ‘copyright law only protects ‘the fruits of intellectual labour’ that ‘are founded in the creative powers of the mind’¹⁷. This does not include works generated by a machine¹². Of course, this position may change as AI improves at solving ill-posed problems without human intervention. As Lord Briggs observed in the recent patent case of Warner-Lambert Co Ltd versus Generics, ‘the court