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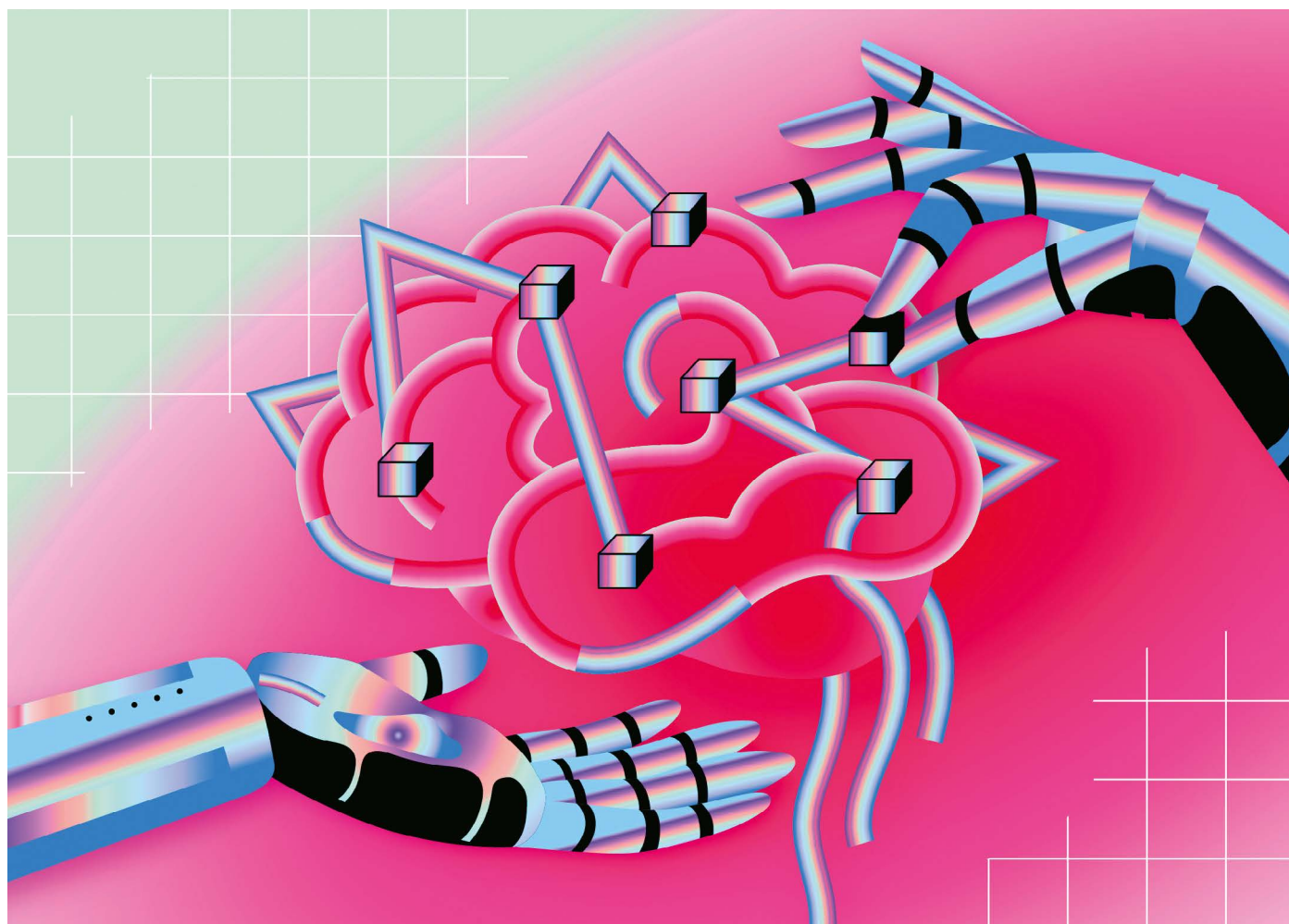


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Artificial intelligence is breaking patent law

Alexandra George & Toby Walsh

The patent system assumes that inventors are human. Inventions devised by machines require their own intellectual property law and an international treaty.

In 2020, a machine-learning algorithm helped researchers to develop a potent antibiotic that works against many pathogens (see *Nature* <https://doi.org/ggm2p4>; 2020). Artificial intelligence (AI) is also being used to aid vaccine development, drug design, materials discovery, space technology and ship design. Within a few years, numerous inventions could involve AI. This is creating one of the biggest threats patent systems have faced.

Patent law is based on the assumption that inventors are human; it currently struggles

to deal with an inventor that is a machine. Courts around the world are wrestling with this problem now as patent applications naming an AI system as the inventor have been lodged in more than 100 countries¹. Several groups are conducting public consultations on AI and intellectual property (IP) law, including in the United States, United Kingdom and Europe.

If courts and governments decide that AI-made inventions cannot be patented, the implications could be huge. Funders and businesses would be less incentivized to pursue

useful research using AI inventors when a return on their investment could be limited. Society could miss out on the development of worthwhile and life-saving inventions.

Rather than forcing old patent laws to accommodate new technology, we propose that national governments design bespoke IP law – AI-IP – that protects AI-generated inventions. Nations should also create an international treaty to ensure that these laws follow standardized principles, and that any disputes can be resolved efficiently. Researchers need to inform both steps.

Who, not what

Machines that are able to invent were not a consideration for drafters of the world's first patent legislation, the Venetian Patent Statute of 1474. Nor were they contemplated in the 1883 Paris Convention for the Protection of Industrial Property, which established the foundations of the international patent system. Even by 1994, AI-generated inventions were still almost unheard of when the World Trade Organization finalized its Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). The 1883 and 1994 treaties mandate international patent standards today.

The TRIPS agreement protects “any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application” (see go.nature.com/3n4khc2). In its wording, ‘inventions’, ‘new’, ‘inventive step’ and ‘capable of industrial application’ are terms of art, each with a legal definition. In essence, an object is not patentable if any of these requirements is not met (see ‘What is patentable?’).

New technologies have challenged the system before. High-profile cases have tested whether genetic sequences, human-made living organisms and other objects could be patented. The central legal question in these cases was whether they were inventions at all. For example, after a years-long court battle between the US Association for Molecular Pathology (among others) and molecular-diagnostics firm Myriad Genetics in Salt Lake City, Utah, the US Supreme Court concluded in 2013 that isolated human gene sequences were unpatentable because genetic information is a product of nature rather than a human invention².

Inventions generated by AI challenge the patent system in a new way because the issue is about ‘who’ did the inventing, rather than ‘what’ was invented. The first and most pressing question that patent registration offices

What is patentable?

Generally, an invention must meet each of the following requirements before it can be patented.

- **An invention** made by one or more inventors. This includes products, processes or methods in almost all fields of technology.

- **Novel.** The invention does not already exist.

- **Inventive step or non-obvious.** The invention would not be obvious to a ‘person skilled in the art’ who has ‘common general knowledge’ in that field.

- **Capable of industrial application or utility.** The invention can be made or used in industry, does as is claimed and/or has economic significance.

All 164 World Trade Organization members must comply with these principles, standardized by the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

have faced with such inventions has been whether the inventor has to be human³. If not, one fear is that AIs might soon be so prolific that their inventions could overwhelm the patent system with applications.

Another challenge is even more fundamental. An ‘inventive step’ occurs when an invention is deemed ‘non-obvious’ to a ‘person skilled in the art’. This notional person has the average level of skill and general knowledge of an ordinary expert in the relevant technical field. If a patent examiner concludes that the invention would not have been obvious to this hypothetical person, the invention is a step closer to being patented.

“It would be better for governments to create legislation explicitly tailored to AI inventiveness.”

But if AIs become more knowledgeable and skilled than all people in a field, it is unclear how a human patent examiner could assess whether an AI’s invention was obvious. An AI system built to review all information published about an area of technology before it invents would possess a much larger body of knowledge than any human could. Assessed against all knowledge, almost everything would seem obvious⁴. If everyone has access to such AI tools in future, then the ‘inventive step’ criterion of patentability would be close to impossible to achieve, and almost nothing would be patentable. A complete rethink would be required.

Test case

These issues have been brought into focus by an AI system called DABUS (Device for the Autonomous Bootstrapping of Unified Sentience), created by Stephen Thaler, president and chief executive of US-based AI firm Imagination Engines. Thaler claims that DABUS invented a new type of food container and a flashing light for attracting attention in emergencies.

The inventions are not remarkable. The fallout from them is. In 2018, Thaler’s international legal team, led by academic Ryan Abbott at the University of Surrey in Guildford, UK, started submitting applications to patent offices around the world, naming DABUS as the inventor. These cases are thought to be the first to test whether an AI system can be recognized as an inventor under existing laws. Patent offices and courts have had to rule on this question, and have started to flag gaps in the law⁵.

Patent registration offices have so far rejected the applications in the United Kingdom, United States, Europe (in both the European Patent Office and Germany), South Korea, Taiwan, New Zealand and Australia. Challenges to these decisions have for the most part failed, with courts concluding that inventors are presumed to be human (see, for example, go.nature.com/3fjwd9n). In Germany, a court accepted that the inventions could potentially be patented if Thaler was named as the inventor who prompted DABUS to create the inventions – a compromise that acknowledged the AI system’s input. But at this point, the tide of judicial opinion is running almost entirely against recognizing AI systems as inventors for patent purposes.

In the absence of clear laws setting out how to assess AI-generated inventions, patent registries and judges currently have to interpret and apply existing law as best they

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can. This is far from ideal. It would be better for governments to create legislation explicitly tailored to AI inventiveness. We propose three steps to achieving this goal.

Listen and learn

First, national governments and multilateral bodies involved in patent policy (such as the World Trade Organization) should undertake a systematic investigation of the issues, evidence and viewpoints. They should consult stakeholders including patent registration offices; professional bodies that represent scientists and engineers; consumer and patient advocacy groups; bodies for business development and commercialization, and professionals in IP law. Previous inquiries of this nature have led to changes in many countries' IP laws in response to the development of the Internet and the digital economy. For example, the Australian government's public consultations on online piracy during 2014–18 resulted in laws that allow courts to block access to websites that infringe copyright.

Several countries have already begun preliminary investigations of this kind relating to AI-generated inventions, as has the European Union (go.nature.com/3j6qgu3) and the World Intellectual Property Organization (go.nature.com/3nc79cr). This is a good start, and one that patent systems in every jurisdiction should emulate.

These inquiries must go back to basics and assess whether protecting AI-generated inventions as IP incentivizes the production of useful inventions for society, as it does for other patentable goods. Programmers of AI systems can already obtain some IP protection through copyright in the computer code and patents over the functionality of the software they write. Some people, for political or pragmatic reasons, might prefer to leave the output of AI-generated inventions in the public domain, free for all to use. Others are calling for IP protection to be extended (see, for example, refs 6–8).

AI-IP law

Tinkering with existing legal protections risks leaving grey areas, so more-comprehensive law reform is preferable. An ideal solution would be for governments to design a bespoke form of IP known as a *sui generis* law. Such custom-built laws are designed to cover types of creative output not addressed by the 'big four' IP doctrines of copyright, industrial designs, trademarks and patents. They already incentivize and protect investment in circuit layouts, new varieties of plants and, in some jurisdictions, databases.

Some critics might object to the mushrooming of topic-specific forms of IP. But a distinct AI-IP doctrine has the advantage that it could be tailored to meet the specific conditions in which AI creativity occurs. For

example, lawmakers might decide that, if AI-IP is easier and faster to develop, it should be protected for a shorter period than the conventional 20-year term of standard patents. This would encourage others to build on inventions as soon as the patent term expires. And whereas patents are typically awarded to the inventor, lawmakers could decide to distribute the rewards from an AI-generated invention differently – perhaps between the AI developer, the person directing the AI and the owner of the data used to train it⁹.

International treaty

Countries where AI-IP is put in place would be likely to attract investment in research and development. On the flip side, royalties attached to the use of an invention could make it less available. The same situation occurs today with drugs and vaccines: patents can attract the investment that allows them to be developed, but people lose out in

“We think that an international treaty is essential for AI-generated inventions.”

countries that are unable to afford the products or unable to pay royalties to manufacture them. For instance, patent restrictions on the manufacture of COVID-19 vaccines are among the reasons why, some 18 months after the vaccines first became available, only around 16% of people in low-income countries have received at least one dose. Meanwhile, some higher-income nations are offering fourth doses (see *Nature* **603**, 764; 2022). In designing AI-IP, a balance must be found to avoid reproducing this sort of inequity.

A country that tends to import inventions might see benefits in not protecting AI-generated ones. It could then provide its population with cheap copies of an expensive new drug that an AI had invented elsewhere, instead of paying royalties. However, it might also miss out on attracting industry-building investment.

Patent treaties address this 'free-rider problem'. The TRIPS agreement was set up partly to make it more difficult for countries to opt out of providing IP protection in the form of patents. International conventions also govern the use of designs, trademarks, copyright and various other areas of IP.

We think that an international treaty is essential for AI-generated inventions, too. It would set out uniform principles to protect AI-generated inventions in multiple jurisdictions. This could be done by negotiating a new treaty or adding those rules into an existing international IP agreement.

Establishing such a treaty would be an

ambitious, long-term plan. Critics could object to nations relinquishing the freedom to make domestic policy about AI-generated inventions, especially when the full potential of AI is still unclear. We feel that the global benefits of an international agreement would make the time and cost of negotiating it worthwhile, because it would avoid uncertainties and disputes down the line.

An AI-IP treaty should also avoid a key limitation of the patent system. Patents are registered separately in each jurisdiction, and enforcement disputes must normally be resolved by the legal system of the country of registration. This can result in patent holders running similar legal cases in many countries – as when the technology firms Apple and Samsung spent 7 years battling more than 50 lawsuits about phone and tablet design and functionality (see go.nature.com/3lfzpej). Cumbersome and expensive, this system means that some people cannot afford to enforce or defend their rights under patent law.

Instead, an AI-IP treaty could include dispute-resolution mechanisms, perhaps adjudicated by a specialist international court. Inspiration can be found in Europe's new Unified Patent Court, which is due to commence in the next year (www.unified-patent-court.org), and various arbitration courts around the world.

Creating bespoke law and an international treaty will not be easy, but not creating them will be worse. AI is changing the way that science is done and inventions are made. We need fit-for-purpose IP law to ensure it serves the public good.

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