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Artificial Intelligence and Inventorship: Patently Much Ado in the Computer Program

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1. Introduction

The ‘glamour’ appears not to have abated around the debate on whether an artificial intelligence (AI) system could be an inventor for the grant of a patent. Parallel applications submitted to patent offices around the world naming a creativity machine, Device and Method for the Autonomous Bootstrapping of Unified Sentience (DABUS),¹ as inventor have not met with success leading to appeals in several courts. The matter was dismissed in the United States District Court in Thaler v USPTO based on the plain statutory language of the Patent Act and precedent authority of higher courts,² and, likewise, by the United Kingdom Court of Appeal more recently in Thaler v Comptroller General of Patents, Designs and Trade Marks by a 2-1 majority.³ The trial judge in the Australian Federal Court held, however, that DABUS could be an inventor in Thaler v Commissioner of Patents⁴ by setting aside the Deputy Commissioner’s decision and remitting the matter for reconsideration.⁵

The core arguments in the patent offices and the courts involved the formalities and procedural requirements of naming the inventor in the applications, and, more importantly, the relevance of sentience or humanness of an inventor to the grant of a patent.⁶ The United States’ legislation defines an inventor as the ‘individual’ who invented or discovered the subject matter of the invention,⁷ interpreted as a natural person who performed the mental act of ‘conception’. Thus ‘conception’ which begins in the mind of an inventor is the touchstone of inventorship. In the United Kingdom, an inventor must be the actual deviser of the invention with reference to a natural person’s inventiveness in being able to make or create something new.⁸ In most scenarios, joint inventorship would be claimed when multiple parties contribute to the inventive idea in the research and development phases. The posing of the problems to be solved, the answering of those problems or the ways of improving a current solution, would be deemed as inventive contributions. However, financial backing or provision of basic materials or workspace would be non-inventive contributions.⁹ Despite the subtle difference in the definitions, the result is the same when

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⁴ Thaler v Commissioner of Patents [2021] FCA 879.
⁵ ibid [227].
⁶ See, for example, Thaler v Comptroller-General of Patents Designs and Trade Marks (n 3) [1].
⁷ 35 USC § 100(f).
⁸ Patents Act 1977 (UK), s 7(3).
⁹ IDA Ltd v University of Southampton [2006] EWCA Civ 145.
assessing inventorship for inventions where a human is involved, as shall be demonstrated in the further discussion on the cases in section 4 below.

There is, arguably, no bar to patent eligibility and patentability where an AI system invents something that meets the requirements of novelty, an inventive step or non-obviousness and utility, and sufficiency of disclosure. The authors note the distinction between a computer implemented invention (CII) such as the DABUS machine itself (that discloses a type of AI), AI-Assisted and AI-Generated inventions (such as the ‘neural flame’ and ‘fractal container’ inventions by DABUS). In defining AI inventions, it is critical to distinguish between ‘AI-Assisted’ and autonomously ‘AI-Generated’ inventions. Currently, as all AI related inventions still require human input at varying levels, the full automation of an AI invention is thus a myth.

It is doubtful that DABUS’ ability, ambitiously labelled as an autonomous bootstrapping device, can be said to be fully autonomous as a totally self-organising system. While AI-Assisted inventions pose less significant challenge to the patent system as AI is used as a tool, AI-Generated inventions, on the other hand, leads to major debates on inventorship as it claims AI’s full autonomy in the innovation process. Many do not believe that artificial general intelligence (AGI) akin to human intelligence has arrived as current AI can neither invent nor author without human intervention.

Artificial intelligence is best viewed as a subset of computer implemented inventions (CIIs). AI inventions may comprise inventions that embody an advance in the AI field (e.g. a new neural network structure of an improved machine learning model or algorithm) or inventions that apply AI to another field and inventions that may be produced by AI itself. In terms of computer functionality, AI mimics cognitive functions associated with the human mind and the ability to learn.

The DABUS machine, based on machine learning algorithms, is computer implemented with neural network simulations or hardware-implemented neural networks as well as non-silicon-based computational systems. The background of the invention describes attempts made to build artificial neural systems of the size and complexity of the human brain. An artificial neural network has been described as a form of AI used to generate novel ideas (essentially collections of binary switches simulating neurons in a biological brain) to create in Thaler’s case a creativity machine that can create new inventions.
The state of the entire collective of neural modules for joint activations and network chains is detected via machine vision or acoustic processing algorithms. The thalamobot described in the patent document of DABUS refers to a recognition system based on ‘hot buttons’ that may trigger simulated neurotransmitter release. It may be embodied on a processor in a computer system which is separate from a computer system on which the model of the environment is generated (such as a brain scan). It may then communicate with the brain scan system to modify levels of noise and generate new ideas and promote learning within the model. The thalamic system is used to trigger other algorithms to implement strategies for adaptive learning through fusion with other memories.

This article probes the fundamental issue on whether a computer program, as a computational tool that brings about a certain result, can be an inventor despite the ingenuity of the algorithms involved. The authors look back at the chequered path of computer programs in the past decades in attaining intellectual property rights under a dual track system of copyright and patent protection to contemplate its place to a claim of inventorship. We then review the relevant DABUS cases in three jurisdictions: the United States, Australia and the United Kingdom.

2. Computer Programs: Intellectual Property Protection

2.1 Defining computer programs: software applying algorithms

Though the first digital computer capable of operating upon stored programs was the ‘MANIAC I’ in the United States built in the 1950s, it was much later that the legal protection for computer programs began to receive serious consideration.

The United States Supreme Court in *Diamond v Diehr* defined an algorithm as a ‘procedure for solving a given type of mathematical problem’, and adopted the term ‘algorithm’ as synonymous with the term ‘computer program’. More appropriately described as ‘a series of steps for accomplishing a goal’, an algorithm is not necessarily expressed as a mathematical formula. As judicial clarity emerged the basic principle that algorithms comprise computer software and computer codes was evident. In computer technology, a computer program is a ‘a machine-compatible representation of an algorithm’. A collection of computer programs (i.e. the algorithms and related data) is known as software. Software thus involves the manipulating of existing data and generating additional data through algorithms as stated in *Cal Inst of Tech v Hughes Commun, Inc*:

All software only 'receives data', 'applies algorithms,' and 'ends with decisions.' That is the only thing software does. Software does nothing more.

2.2 Copyright in a set of instructions

19 ibid.
22 ibid 1073.
24 ibid 980.
25 ibid.
26 ibid 987.
Computer programs had to steer its way to define a boundary between idea and expression or form and function in copyright law before being included in the category of literary works to join books, poems and plays for copyright protection. Thus, after decades of judicial uncertainty during the 80s and early 90s, computer programs in both source code and object code form were recognised as works of human intellectual effort under the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), the 1996 WIPO Copyright Treaty (WCT) and the Berne Convention.

The United States and Australia copyright legislations define a computer program as ‘a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result’. As the High Court of Australia noted (in the early days of grappling with the algorithms inherent in programs), the language of computer programs must:

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[...] intend to express, either directly or indirectly, an algorithmic or logical relationship between the function desired to be performed and the physical capabilities of the ‘device having digital information processing capabilities’ (emphasis added)
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While copyright law protects computer programs against copying, courts in the United Kingdom remained cautious that the capability of the ‘processing logic’ displayed by the set of instructions behind object and source codes had to be navigated with care to avoid an unjustifiable extension of copyright protection into an inappropriate field. The non-literal elements in computer programs in terms of its architecture, design, structure, logic and algorithms are not protected under copyright law.

This turned out to be a rather protracted task in the United States where over the decades courts continue to find that ‘applying copyright law to computer programs is like assembling a jigsaw puzzle whose pieces do not quite fit’. As the long-running litigation in *Oracle America, Inc v Google Inc* panned out, the Federal Circuit Court of Appeals wrestled over similar issues concerning ‘declaring’ and ‘implementing’ codes before finding copyright infringement by Google on the use of 7000 lines of declaring code. The saga ended recently after almost a decade with the Supreme Court allowing Google’s appeal on grounds of fair use for a new and transformative program. Google’s copying of Oracle’s Java computer program allowed the

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programmers to take a short cut by relying on familiar declaring code without having to rewrite a whole suite of programs for the same methods while independently writing their own implementing code.  

In the uneasy overlap with patent law, courts recognised that while the written source code may be hauntingly familiar like the stuff of copyright, the substance of computer programs was more akin to problems presented in patent law especially when the copyright protected expression was of industrial application. Indeed, the question was raised as to whether the copyright holder was asserting an exclusive right to functional systems, processes or methods of operation that belonged in the realm of patents rather than copyrights.  

### 2.3 Patents and computer implemented inventions (CIIs)

Although there was no outright rejection of its patentability in the United States, scepticism as reflected in the Supreme Court’s views in several leading cases towards patenting mathematical formulas or algorithms was obvious. Prior to 1968, no conceivable computer program was able to cross the threshold for patentability or surmount the hurdle posed by the ‘mental steps’ doctrine. The principle that processes involving mental operations were considered unpatentable was upheld against patent claims in which novelty and inventive step resided in the mental act or mathematical computation. An algorithm for solving a given type of mathematical problem (like a law of nature) was not patentable subject matter. In *Gottschalk v Benson*, the Supreme Court invalidated the claims for a simple conversion of binary-coded decimal numerals into pure binary numerals and held that the algorithm was an abstract idea with no discernible ‘new and useful’ application. Though the invention was computer implemented the process which could be carried out in existing computers involved no inventive concept.

The breakthrough came when the Supreme Court finally clarified in *Diamond v Diehr* that an application of a mathematical formula to a known process may well be deserving of patent protection. Claims in which computer programs implemented or applied a mathematical formula in a structure or process to perform a useful function were allowed. The algorithm incorporating the well-known Arrhenius equation was implemented to calculate the optimal temperature of the rubber moulding process to overcome the industry problem of ‘undercured’ or ‘overcured’ rubber.

While this led to the lifting of the traditional ban on patents for mathematical models that included algorithms in the United States and other countries, arguments remained fraught as judges dealing with claims for computer software continued to struggle to come to grips with this area of law. In an en banc court of eleven judges in *In re Alappat*, the majority allowed patentability for a rasterizer reducing distortions in a digital oscilloscope on the grounds that the invention as a whole was a

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37 *Google LLC v Oracle Am, Inc* 141 S Ct. 1183 (2021).
38 *Lotus Dev Corp v Borland Int’l Inc* 49 F 3d 807, 820 (1st Cir. 1995).
41 *Diamond v Diehr* (n 21) 1056.
42 *Gottschalk v Benson* 93 S Ct 253, 277 (1972).
43 *Diamond v Diehr* (n 21) 1057.
44 Ibid.
computer implemented system producing a ‘useful, concrete and tangible’ result and not just a disembodied mathematical concept or abstract idea.\textsuperscript{45} The dissent, however, held that Alappat solved no more than a mere mathematical equation while another three judges declined to express any opinion on the patentability issue.\textsuperscript{46}

While Congress was inclined to take a permissive approach to patent eligibility to ensure that ingenuity should receive liberal encouragement, the United States is again proceeding cautiously in cases of bare attempts to patent mathematical formulas, as opposed to algorithms generally, indicating a higher bar to patentability.\textsuperscript{47} The software related inventions in Alice Corp Pty Ltd v CLS Bank Int did not pass scrutiny as the Supreme Court rejected the patent claim for a well-rehearsed business idea of hedging against settlement risks dressed in seven lines of computer code and a veneer of technical jargon.\textsuperscript{48} In the earlier appeal, the Federal Circuit Court of Appeals had held that abstract methods do not become patent-eligible machines by ‘being clothed in computer language’.\textsuperscript{49} In his additional reflections on the matter, the Chief Judge (mindful of judges taking delight in expounding their own ideas of its meaning) had cautioned against allowing software to be the ‘plaything’ of judges that might lead to merely ‘some lovely prose’ as a result.\textsuperscript{50}

The United Kingdom Patents Act 1977 does not define ‘invention’, excluding instead a list of things that are not inventions for policy reasons.\textsuperscript{51} Statutory provisions in the United Kingdom (and New Zealand) exclude a ‘computer program as such’ from patentability to clarify the distinction between a computer implemented invention and a computer program as such, as the latter is basically not inventive by itself.\textsuperscript{52}

Since then, computer software powered by algorithms for pinch and zoom functions in smart phones to the intelligent ‘Quick Search Box’\textsuperscript{54} has enabled more sophisticated machine learning in a virtual intelligent personal assistant ‘Siri’ to speak in a natural and conversational tone.\textsuperscript{55} Relying on natural language generation using AI, there are further developments for imposter rejection using automatic speech recognition algorithms to trigger detection.\textsuperscript{56} The trajectory of progress up to the present where computer implemented inventions display an inventive process to create new inventions should be no surprise when we recall that the first digital computer, MANIAC 1, was able to defeat a human being in a chess-like game.\textsuperscript{57}

\textsuperscript{45} In re Alappat, 33 F 3d 1526, 1544 (Fed Cir. 1994) (en banc).
\textsuperscript{46} ibid (Mayer, Clevenger and Schall JJ took no position).
\textsuperscript{47} See Cal Inst of Tech v Hughes Commun, Inc (n 23) 979.
\textsuperscript{48} Alice Corp Pty Ltd v CLS Bank Int 134 S Ct 2347 (2014). (US Patent 7,725,375 (27 June 2005))
\textsuperscript{49} CLS Bank Intern v Alice Corp Pty Ltd 717 F 3d 1269, 1292 (Fed Cir. 2013).
\textsuperscript{50} ibid 1335. (Rader J citing Giles S. Rich, Principles of Patentability, 28 Geo. Wash. L.Rev. 393, 404 (1960)).
\textsuperscript{52} Patents Act 1977 (UK) s 1(2)(c)-(d) and Patents Act 2013 (NZ) s 11. For ‘computer programs as such’ that were not patentable, see Merrill Lynch’s Application [1989] RPC 561 (improved data processing system for automated trading market controlled by a computer program) and Gale’s Application [1991] RPC 305 (a computer program for a mathematical method or new and better algorithm for finding square roots).
\textsuperscript{53} Thaler v Comptroller-General of Patents, Designs and Trade Marks [2021] EWCA Civ 1374, [93].
\textsuperscript{54} US Patent No. 8086604 December 27, 2011 (a unified search apparatus using a plurality of heuristic algorithms).
\textsuperscript{55} Apple v Samsung 695 F 3d 1370, 1375 (Fed Cir. 2012)
\textsuperscript{56} USPTO Application No. 20210125609 (29 April 2021): Automatic Speech Recognition Imposter Rejection on a Headphone with an Accelerometer.
3. Artificial Intelligence

3.1 DABUS invents (?): Computer-Generated inventions

As mentioned in the introduction, Thaler created and operated DABUS and is the owner and copyright owner of the source code. Had Thaler named himself as inventor there would have been no problems with the application. He chose, however, to doggedly name DABUS as the inventor on the applications for the grant of patents in the United States, Australia and the United Kingdom for two inventions described as:

1) a light beacon that flashes in a new and inventive manner to attract attention ('Neural Flame'),

2) a beverage container based on fractal geometry ('Fractal Container').

Thaler had identified DABUS (instead of a natural person) as the inventor on the basis that the claimed inventions were conceived and autonomously generated by artificial intelligence. Allegedly, as DABUS was the program trained with general information in the field of endeavour to independently create the invention, it was DABUS, rather than any person, that recognised the novelty and salience of the invention.

While it is clear and undisputed that Thaler was responsible for the computer on which DABUS operated, he decided he could not be named the inventor. DABUS had ostensibly assigned all intellectual property rights in the claimed inventions to Thaler. Thus, in a rather roundabout manner, Thaler as the legal representative for DABUS executed the relevant documents on behalf of DABUS (the assignor) and himself as assignee. While it was accepted by Thaler himself that DABUS is not a legal person and could not legally own property including the property rights in the inventions, he pursued the argument that DABUS might arguably be considered ‘sentient’ by attempting to equate its associated memory sequences to subjective feelings in humans. Allegedly, according to Thaler ‘DABUS has an emotional appreciation for what it conceives’.

On the sentient argument, it is interesting to compare Thaler’s argument against the monkey copyright dispute in Naruto v Slater in which the United States Circuit Court of Appeals affirmed that the monkey lacked statutory standing under the Copyright Act to be able to file for infringement as author or owner of the photographs. The issue of authorship was debated with regard to the photographs taken by a monkey using the equipment set up by a photographer. The United States Copyright Office decided that ‘only works created by a human could be copyrighted.

58 USPTO Application No. 16/524,350 (29 July 2019). See also UKIPO Application GB1818161.0.
59 USPTO Application No. 16/524,532 (29 July 2019). See also UKIPO Application GB18116909.4.
61 ibid 4.
64 ibid.
65 ibid 3.
under its Copyright Act, which excludes pictures and artwork created by animals or by machines without human intervention' and that ‘because copyright law is limited to ‘original intellectual conceptions of the author’, the copyright office will refuse to register a claim if it determines that a human being did not create the work’. Clearly the United States Copyright Office does not deem an animal as ‘sentient’, and the work taken by an animal may fall under the public domain.

While the United States Copyright Office rejected copyright on a photograph taken by a monkey, analogies have been made regarding the protection of computer-generated works in the United Kingdom Copyright, Designs and Patents Act (CDPA). It states that the author of a literary, dramatic, musical or artistic work which is computer-generated ‘shall be taken to be the person by whom the arrangements necessary for the creation of the work are undertaken’. In the United Kingdom, the ‘sentient’ argument is irrelevant. Regardless of whether the AI system is sentient or not, authorship will be designated to the ‘person’ behind the scene who made the necessary arrangements for the creation of the work.

3.2 Inventorship: Algorithms pave the way for sentient AI?

The starting point, for such a foray into a claim of AI as a sentient being and inventor, is to understand what the inventor claims to have discovered as deserving of being granted a patent. Contributions by a natural person to an AI invention are analogous to the conception of an invention in computer implemented technology, and the use of a machine as a tool to invent by natural persons does not disqualify them as an inventor if they contributed to its conception.

The concept of a computer program being set up as a new tool for modelling identified combinations, and avoid labour and error is not new. It would be precisely ‘just the sort of advantages that are obtained by the use of a computer program’. In this case, the question would be whether a computer program or a set of algorithms is capable of being aware or conscious of a discovery in a sentient sense. The authors hold that this argument could not be addressed alone in the intellectual property realm. Whether an algorithm or a machine can be sentient appears to be a philosophical question, or ultimately, down to collective societal perception and acceptance. At present, this does not need to be unpacked as there are existing policy alternatives. As noted from the Naruto case above, even the monkey as a living animal is not deemed sentient in IP practice; it would be even more so with lifeless computer software or machines.

Referred to as the AI machine, DABUS is clearly a computational tool powered by the algorithms to create the two inventions. A distinction will need to be made between ‘mimicking nature’s effects’ and ‘nature’s effects’. It is the claimed algorithms that are programmed as a neural system to receive and manipulate existing data and generate additional data through algorithms embodied in a processor in a computer system. As the trial judge in Australia noted, the artificial neural networks involved might be implemented within machines and self-organise to simulate the

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69 CDPA 1988 (UK) s 9(3).
70 USPTO ‘Public Views on Artificial Intelligence and Intellectual Property Policy’ (n 13) 3 fn 15.
71 Thaler v USPTO Case 1:20-cv-00903-LMB-TCB (USDC 2021), 5.
brain’s processes and generate information. As a subfield and more sophisticated form of machine learning involving computer systems and data, mathematical modelling was designed for these artificial neural networks to mimic natural neural networks. In this case, DABUS is a form of neurocomputing that allows the machine to generate new concepts encoded as chained associative memories within artificial neural networks.

We review and compare the relevant DABUS cases in major jurisdictions in the following section.

4. DABUS in the courts

4.1 United States District Court: Can an artificial intelligence machine be an inventor?

Affirming the United States Patent and Trademark Office’s (USPTO) conclusion, the United States District Court rejected the inventorship claim despite Thaler’s assertion that the advanced AI systems could generate patentable output under conditions in which no natural person traditionally met inventorship. The court resorted to the plain statutory language in 35 USC § 101 which states:

*Whoever* invents or discovers any new and useful process, machine, manufacture, or composition of matter ... may obtain a patent therefore, subject to the conditions and requirements of this title (emphasis added).

The USPTO construed ‘whoever’ to suggest a natural person, as it would otherwise contradict the plain reading of references to persons and individuals in patent statutes. An inventor is defined as the ‘individual’ who invented or discovered the subject matter of the invention. It is thus the ‘individual’ who is required under the statute to execute an oath or declaration or provide a substitute statement in lieu of it, and who believes himself or herself to be the original inventor of a claimed invention in the application. DABUS is clearly unable to execute the necessary oath or declaration stipulated under the legislation. Neither does DABUS have legal personality or the capability to provide a substitute statement.

Clarifying that patent statutes precluded such a broad interpretation of inventor to cover machines, the USPTO referred to the Manual of Patent Examining Procedure to demonstrate conception as the ‘complete performance of the mental part of the inventive act’. This required ‘the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention’ that would need to be applied in practice. According to the USPTO, this underscored the interpretation that only a natural person may be an inventor to perform the mental act of conception.

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73 *Thaler v Commissioner of Patents* [2021] FCA 879, [19].
74 ibid [20]-[21].
75 ibid [35].
76 *Thaler v USPTO* Case 1:20-cv-00903-LMB-TCB (USDC 2021), 2.
78 35 USC § 100(f).
79 35 USC § 115(a) and § 115(d).
80 35 USC § 115(b).
82 ibid.
Precedents in the Federal Circuit Court of Appeals had, likewise, held that an inventor could only be a natural person stating that ‘it is axiomatic that inventors are the individuals that conceive of the invention’ and that ‘conception’ which begins in the mind of an inventor is the touchstone of inventorship. The United States District Court had buttressed their denial of Thaler’s claim stating:

The Supreme Court and Federal Circuit have explicitly held that policy considerations cannot overcome a statute’s plain language, and that matters of policy are for Congress, not the courts, to decide.

Concluding that Congress intended to limit the definition of an inventor to natural persons, the Court conceded that a time may come when artificial intelligence and technology attain a level of sophistication to satisfy accepted meanings of inventorship. That time, however, is not here yet.

4.2 Federal Court of Australia: Concept of Inventor and the Statute of Monopolies

In Australia, by contrast, a relatively low threshold for software patentability remained undisturbed in line with the principles under the 1623 Statute of Monopolies. An invention under the Australian patent legislation is defined with reference to s 6 of the Statute of Monopolies (which at one time formed part of the examination of patent law in the 1949 United Kingdom legislation too). Section 6 provides for the grant of a patent for any ‘manner of new manufactures’ to the ‘true and first inventor’. The concept of a ‘manner of manufacture’ was given a broad interpretation by the High Court in National Research Development Corporation v Commissioner of Patents in line with the characteristic of the growth of patent law. As it was a field which in 1623 was already noted to be ‘excitingly unpredictable’, their Honours stated further:

To attempt to place upon the idea the fetters of an exact verbal formula could never have been sound. It would be unsound to the point of folly to attempt to do so now, when science has made such advances.

Section 15(1) of the Australian Patents Act 1990 (Cth) provides that a patent may be granted to an inventor or person entitled to have the patent assigned to him or derives title to the invention from the inventor. As the term ‘inventor’ is not defined in the Act, the Deputy Commissioner of the Patents Office resorted to the dictionary for its ordinary English meaning as a person who invents, which means the inventor is the person who devises the invention. He clarified that ‘a person who did not devise the invention but acquired knowledge from the inventor is not themselves an inventor’ and would not qualify to be a person who derives title from the inventor. Be it now that AI and machines could do far more nowadays, it would still be inconsistent with

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83 ibid (citing Univ of Utah v Max-Planck-Gesellschaft 734 F 3d 1315,1323 (Fed Cir. 2013)).
84 ibid 15-16. (See also Association for Molecular Pathology v USPTO 653 F.3d 1329, 1354 (Fed Cir. 2011) where the Federal Circuit noted too in the patentability of DNA sequences that ‘the Supreme Court had repeatedly stated that changes to longstanding practice should come from Congress, not the courts’).
85 ibid 18.
86 21 Ja 1 c 3 (Statute of Monopolies) 1623 (Imp) s 6.
88 ibid 271.
89 Thaler v Commissioner of Patents [2021] FCA 879, [85]-[86].
90 ibid [86]. (citing JMVB Enterprises Pty Ltd v Camoflag Pty Ltd [2006] FCAFC 141).
the object of the legislation to interpret the ordinary meaning of an inventor to include a machine. An inventor is inherently human as it is ‘the human quality of ingenuity that resides in the notion of invention’.

On appeal in the Australian Federal Court in Thaler v Commissioner of Patents, Beach J stated that there was no specific provision to exclude an inventor from being a non-human artificial intelligence system. Beach J saw no reason why the concept of ‘inventor’ should not evolve in an analogously flexible way that is consistent with a widening conception of an invention and a manner of manufacture under the Statute of Monopolies. He held that an inventor could be a person or thing that invents, noting that ‘[W]e are both created and create. Why cannot our own creations also create?’.

Beach J applied the label ‘artificial intelligence’ to a system that had the capacity for both deductive and inductive reasoning and pattern recognition without any possible embodiment of awareness, consciousness or sense of self. Thus equating DABUS to an AI system without ‘anthropomorphising’ or attributing any human characteristics to its algorithms, he concluded that DABUS was more than just a brute force computational tool that manifested autonomy rather than just automation. In his determination on AI inventorship, Beach J adopted the assumptions that DABUS (instead of a human programmer) was able to set and define its own goal, had the freedom to choose between various options and pathways towards the goal and could trawl and select its own data inputs. In addition, he assumed that DABUS was a more autonomous system with a larger choice in terms of the algorithms and iterations developed for the artificial neural networks and their interaction. This last assumption is more of a fiction as there are different levels of automation and existing AI systems are not fully autonomous.

According to Beach J, there was, prima facie, a basis for saying that Thaler derived title from DABUS as the owner as well as copyright holder of the source code. Thaler, as owner and inventor of the algorithms, presumably derives some rights to the inventions. As noted by a commentator, AI inventorship (even if convincingly demonstrated) would appear a moot point if ownership was to be ascribed to the inventor of the algorithm, as ‘the inventor is simply the inventor of the platform technology’. Effectively there is much more at stake in deciding ownership than naming the inventor as it designates control of commercial interests.

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91 ibid [98].
92 ibid [106].
93 ibid [64] & [118]. As it was a PCT application, the relevant s 29(1) provides that a person may apply for a patent by filing an application. Section 29(5) extends the reach of s 2C(1) of the Acts Interpretation Act by providing that the term person includes a body of persons, whether incorporated or not.
95 ibid [10]; [15].
96 ibid [17].
97 ibid.
98 ibid [128].
99 ibid [127].
100 ibid [193].
102 ibid
Beside the broad assumptions made, Beach J consciously noted the possible spectre of the volume of computer-generated inventions and applications from the very genius of the algorithms’ randomness and variability that would lead to a breaking point in the patent system. He provided by way of reassurance, rather contradictorily, that these phantoms could be overcome by the fact that since only a legal person could apply and be granted a patent it would be limited to only persons having title and control over the invention. Ultimately, the key issue relies on ownership instead of inventorship.

4.3 United Kingdom Court of Appeal: Does the Patents Act require an inventor to be a person?

The United Kingdom Intellectual Property Office (UKIPO) deemed Thaler’s applications naming DABUS as the inventor to be withdrawn as they did not comply with statutory requirements. The main arguments revolved around s 7(3) and s 13(2) of the Patents Act 1977. Under the Statute of Monopolies which formed part of the early patent law in the United Kingdom a patent was granted to the true and first inventor which included an importer. This was abolished to require an inventor to be the actual deviser of the invention. The concept of an inventor in s 7(3) is limited to the person who devises the invention (i.e. who makes or creates something new) with reference to a natural person’s inventiveness.

Section 13(2) requires the applicant for the grant of the patent to identify a person as the inventor and indicate how he had derived his rights from that person, failing which the application would be deemed to be withdrawn. The inventor must be shown to have transferred the ownership right to the applicant. DABUS, the machine, is not a person as envisaged under s 7(3) and s 13(2) of the Act. In the United Kingdom Court of Appeal, all three Lord Justices adhered strictly to the statutory provisions and concluded that following the existing law and practice, it was simply not possible for DABUS to be an inventor as an inventor must be a person as a matter of law.

Similar to the United States’ requirement of the touchstone of conception, the United Kingdom courts interpret an actual deviser of the invention to refer to a natural person who ‘came up with the inventive concept’. The contribution must be to the formulation of the inventive concept to meet the requirement under the Act. Noting that Thaler’s case was frequently put on the basis of what the law ought to be rather than what it was, Birss LJ clarified that DABUS is not the actual deviser under s 7(3) as while machines may well create, it has no right to be mentioned as the inventor.

Laing LJ stated that rights are a consistent theme in s 7 and only a person (not a machine) can have those rights. As there is no provision to allow for a patent to be granted to a non-person,

103 Thaler v Commissioner of Patents [2021] FCA 879, [133].
104 Patents Act 1977 (UK), s 7(3). Note: The concept of the actual deviser of the invention was already in the UK Patents Act 1949 Act (s 16).
105 Thaler v Comptroller-General of Patents, Designs and Trade Marks [2021] EWCA Civ 1374, [54] (per Birss LJ); [123] (per Arnold LJ); [102] (per Laing LJ).
106 ibid [19].
107 ibid [29].
108 ibid [53] & [55].
109 ibid [102].
and allegedly there is no human but a machine inventor in this instance, then no person would have any right to apply for a patent for the machine’s inventions.\textsuperscript{110}

Arnold LJ stated, nevertheless, that ‘we must apply the law as it presently stands: this is not an occasion for debating what the law ought to be’.\textsuperscript{111} As machines cannot be an inventor nor have rights to apply for a patent under the present law, there is no basis to pre-suppose that a machine would have the right.\textsuperscript{112} Treating it as a test case before the court, it was thought that Thaler’s deliberate naming of a non-person as the inventor (however genuine) was ‘neither here nor there’ and he was unable to show how he derived the right to be granted the patent.\textsuperscript{113}

While all three Lord Justices agreed on the interpretation of s 7(3), the appeal was dismissed by a 2-1 majority, as Birss LJ allowed the appeal based on a ‘literal’ interpretation of s 13(2). According to Birss LJ, Thaler’s application satisfied the obligation to provide a statement identifying the person he believed to be the inventor,\textsuperscript{114} a point on which Laing LJ disagreed.\textsuperscript{115} Section 13(2) could not be met simply on the basis of an applicant’s statement and genuine belief that the invention was devised by a machine (or, for that matter, by a cat)’.\textsuperscript{116} The High Court had earlier held that for an otherwise ill-founded application to succeed on a ‘subjective, albeit honestly held, belief’ would render the relevant provision of the Act otiose.\textsuperscript{117} As Laing LJ had further noted:

\begin{quote}
Whether or not thinking machines were capable of devising inventions in 1977, it is clear to me that Parliament did not have them in mind when enacting this scheme. If patents are to be granted in respect of inventions by machines, the 1977 Act will have to be amended.\textsuperscript{118}
\end{quote}

As mentioned above, in copyright law, s 9(3) CDPA stipulates that authorship of computer-generated output is the person responsible for the arrangements necessary for the creation of the work. A corollary analogy could be made in relation to the inventorship of AI or computer-generated inventions. Full automation of AI inventions is somehow a myth. Currently AI inventions are ‘AI-Assisted’ rather than autonomously ‘AI-Generated’. All innovation still requires a ‘human-in-the-loop’ and human intervention.\textsuperscript{119} Inventorship of AI inventions would fall on the persons by whom the necessary arrangements were made for the creation of the invention.

5. Conclusion

5.1 As the law stands

Courts in the three key jurisdictions discussed above based their determinations regarding AI inventorship on the relevant legislations governing the applications. Both the United States’ and

\begin{footnotes}
\item 110 ibid [103]
\item 111 ibid [114]
\item 112 ibid [136].
\item 113 ibid [143] & [144].
\item 114 ibid [97 ii-v].
\item 115 ibid [108].
\item 116 ibid [108].
\item 117 \textit{Thaler v Comptroller-General of Patents, Designs and Trade Marks} [2020] EWHC 2412 Pat, [29 (2)].
\item 118 \textit{Thaler v Comptroller-General of Patents, Designs and Trade Marks} [2021] EWCA Civ 1374, [103].
\item 119 Kim ‘AI-Generated Inventions: Time to Get the Record Straight?’ (n 11) 443-456.
\end{footnotes}
the United Kingdom’s stance on Thaler’s application demonstrates a cautious approach to the claim of AI inventorship as public and industry opinions were being sought.120

Responses to the USPTO on whether any revision to current patent laws on inventorship is needed to consider instances where entities, other than a natural person, contributed to the conception of an invention demonstrate no such need. The public generally does not think that AI presents unique challenges to the intellectual property system.121 The current law is equipped to handle inventorship in AI technologies and the different ways in which natural persons contribute to the conception of AI-related inventions.122 One commentator stated that ‘conception is inherently a human activity’ and that ‘entities other than a natural person cannot contribute to the conception of an invention’.123 Many commentators took issue with the question’s premise that a machine could conceive an invention, disagreeing with Thaler’s claim that AI machines should be recognised as inventors.

Responses to the UKIPO, likewise, show a general consensus that the current framework can meet the challenges posed by AI and warn against allowing AI ownership of intellectual property rights.124 The clear indications are that it is impossible for an AI system to ‘devise’ an invention or be able to seek patent rights without human intervention. In copyright law, copyright subsists in a work by virtue of the human intellectual effort to allow its maker to enjoy copyright and moral rights protection. In Thaler’s case, Arnold LJ, likewise, noted that as only persons can have rights, in particular moral rights, it follows that inventors must be persons.125

Clearly, patent offices and the United States’ and United Kingdom’s judiciary are not willing to adopt carte blanche assumptions inconsistent with the text and object of the legislations. Scant attention was given to Beach J’s parallel judgment in the Australian Federal Court as it dealt with a Patent Cooperation Treaty application under the Australian patent regulations requiring the applicant to name an inventor.126 While Beach J painstakingly attempted to steer a path justifying AI inventorship, the issue as to who may be an inventor had been discussed before in the Full Federal Court of Australia in *JMV Enterprises Pty Ltd v Camoflag Pty Ltd*.127 Though the case did not concern an AI system, the Full Federal Court (in the absence of a definition for an inventor under the Australian legislation) had interpreted an inventor to be a person who ‘devises’ the invention based on the ordinary English meaning.128 Thus in an approach similar to that adopted in the English Court of Appeal, it was noted:

> The language of s 15(1) evinces a clear intention on the part of the Parliament to limit the grant of a patent, relevantly, to a person who is the inventor or to a person who derives title

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120 See the UKIPO ‘Artificial Intelligence call for views’ (Consultation outcome) 23 March 2021 & USPTO ‘Public Views on Artificial Intelligence and Intellectual Property Policy’ (n 13).
121 USPTO ‘Public Views on Artificial Intelligence and Intellectual Property Policy’ (n 13) 41 fn 208.
122 ibid 3 fn 12.
125 *Thaler v Comptroller-General of Patents, Designs and Trade Marks* [2021] EWCA Civ 1374, [121].
126 Patents Regulations 1991 (Cth) reg 3.2C(2)(aa) (which requires an applicant for a Patent Cooperation Treaty application to provide the name(s) of the inventor(s)).
127 *JMV Enterprises Pty Ltd v Camoflag Pty Ltd* [2006] FCAFC 141.
128 ibid [72].
to the invention from the inventor. There is no warrant for reading the word inventor as meaning anything different from the person who is responsible for making the invention, namely, the person who makes or devises the process or product.\textsuperscript{129}

The outcome of an appeal that the decision so clearly invites is keenly awaited, pending which it remains to be seen whether this same interpretation will be resurrected in the Full Court.\textsuperscript{130}

Focusing on the algorithms, a logical approach would be that algorithms and the resulting creativity machine should not be the inventor but the people driving it would be.\textsuperscript{131} In so doing, we align the position with that for copyright in the United Kingdom for the protection of computer-generated works. It is the person working behind the algorithms that would be deemed an inventor or joint inventor when the employment of the algorithms results in an inventive contribution. Algorithms may be computer implemented to result in a patentable invention such as the DABUS creativity machine and in turn create inventions. However, based on the existing law and practice, algorithms cannot attain inventorship status. Nor can any alleged sentience reside in the algorithms. The machine intelligence and computational functionalities are the result of human design and the work of computer programmers. Without full automation, clearly it cannot be concluded that the brute computational force of DABUS was fully autonomous as Beach J’s conclusion was based on his assumption to dispense with the ‘human programmer’ in the process as discussed above.\textsuperscript{132} Thus, while DABUS may well have created the inventions, it is not the deviser in the sentient sense of one who has conceived it as a complete performance of the mind.

The majority of public views submitted to the USPTO consider the concept of AGI as merely a theoretical possibility for some distant future.\textsuperscript{133} As the law stands, the language of the statute will be interpreted as taking their ordinary, contemporary and common meaning to refer to the inventor as a person. If AI inventorship is to be decided based on the settled expectations of the inventing community and the law is to be changed, it will be for Congress or Parliament (as emphasised respectively in the decisions of the United States District Court and the United Kingdom Court of Appeal above) to decide when that time comes, if at all, how the scope of patent law should expand.

5.2 Next steps

In conclusion, there is belief that AI will soon be inventing and creating things in ways whereby it is impossible to identify the human intellectual input in the final invention, and some believe it is happening now.\textsuperscript{134} Following the United Kingdom Court of Appeal decision, while the question

\textsuperscript{129} ibid [71].
\textsuperscript{131} See Kim ‘AI-Generated Inventions: Time to Get the Record Straight?’ (n 11) 455: ‘As long as a human specifies instructions that determine how the input-output relation is derived through computation, and as long as computers are bound by such instructions, there is seemingly no reason why AI-aided – allegedly ‘AI-generated’ – inventions should be treated under patent law differently […] as far as inventorship is concerned’.
\textsuperscript{132} Thaler v Commissioner of Patents [2021] FCA 879 (Beach J did concede at [18] that DABUS is only semi-autonomous although its output in terms of the operation of the artificial neural networks could be said in one sense to be autonomously generated.)
\textsuperscript{133} Thaler v USPTO Case 1:20-cv-00903-LMB-TCB (USDC 2021), 17.
remains as to whether or not a computer needs to be sentient to invent, many believe the law must be prepared for a future that includes AI inventorship. The UKIPO has noted that AI can support innovation and creativity and be a tool in enabling new human inventions and creations. Concerns were raised that the current stance might pose a barrier to innovation as the use of AI systems increases. In considering how the current rule for inventorship could potentially be improved to better support innovation, a range of policy options for consultation has been identified.

One of the options, which the authors are inclined to support, is to change the definition of inventor by expanding it to include humans responsible for an AI system which devises inventions. This allows for explicit recognition of the person who makes the necessary arrangements to be an inventor and mirrors the CDPA for computer-generated copyright works discussed above. Inventorship could rest with persons such as the programmer or operator of the AI or those selecting input data such as training data, subject to the test for inventive contribution. Naming a human inventor would be in line with most international inventorship practice.

Inventorship or co-inventorship could be established if the contribution of the person who made the necessary arrangement is not trivial nor akin to non-inventive contributions. If the provision of algorithm is a standard formula or basic framework (such as the supply of facilities or workspace) the contribution would then be non-inventive. However, if the algorithm was customised for the specific research and development of the invention, then it is possible to name the person who made the necessary arrangements as an inventor. The requirement could be made for detailed information to be disclosed in the statement of inventorship at submission. As AI inventorship is hinged on the broader issues of separate legal personality and social policy, which is beyond the scope of IP, we hold that interpretations on the ambiguities and gaps in the existing law could be clarified in government policy guidelines instead of substantial law reforms presently, while full automation is still a myth.