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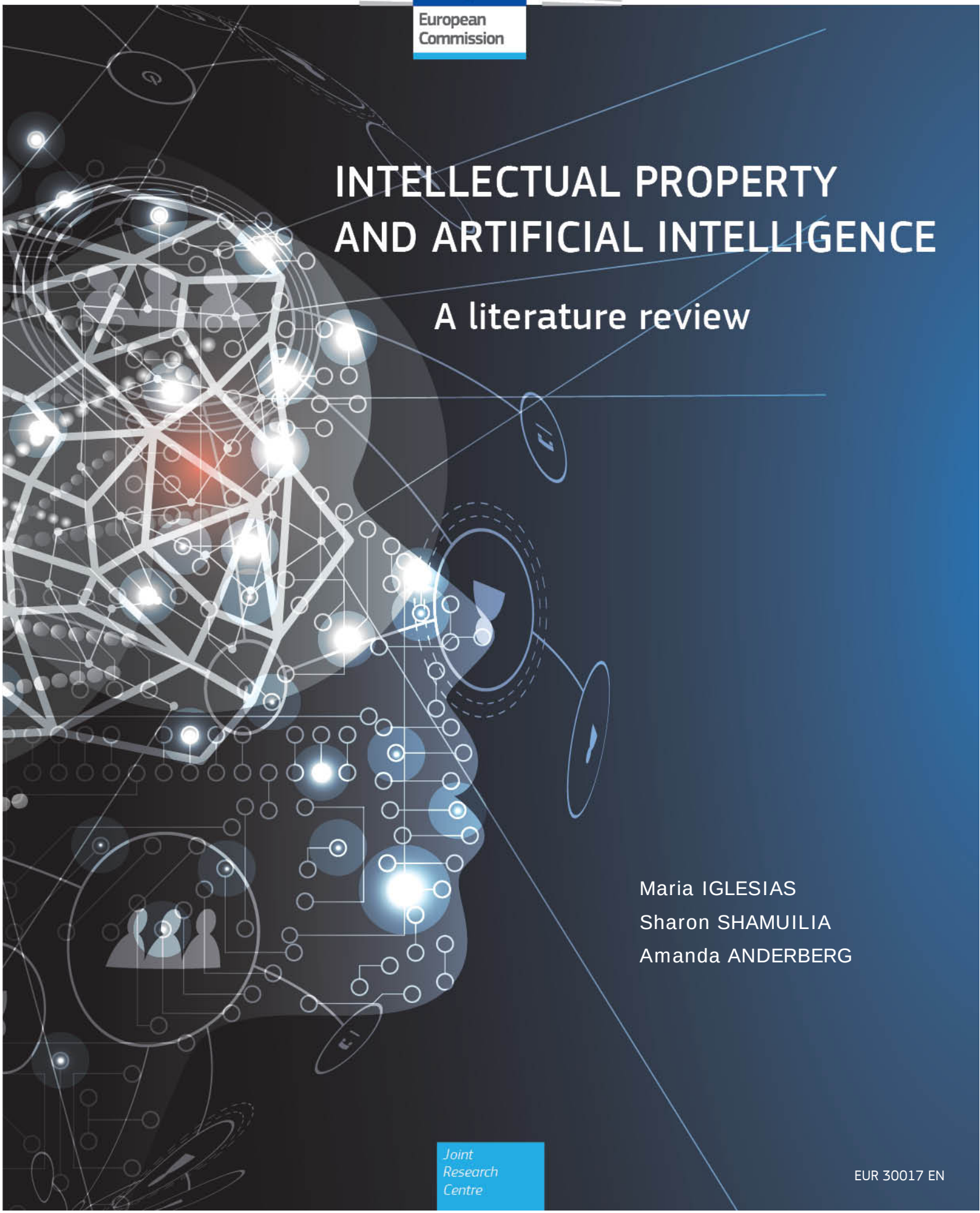

INTELLECTUAL PROPERTY AND ARTIFICIAL INTELLIGENCE

A literature review

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Abstract

Artificial intelligence has entered into the sphere of creativity and ingenuity. Recent headlines refer to paintings produced by machines, music performed or composed by algorithms or drugs discovered by computer programs. This paper discusses the possible implications of the development and adoption of this new technology in the intellectual property framework and presents the opinions expressed by practitioners and legal scholars in recent publications. The literature review, although not intended to be exhaustive, reveals a series of questions that call for further reflection. These concern the protection of artificial intelligence by intellectual property, the use of data to feed algorithms, the protection of the results generated by intelligent machines as well as the relationship between ethical requirements of transparency and explainability and the interests of rights holders.

This report is based on a background paper to the JRC report "Artificial Intelligence: A European perspective" (2018).

1 Introduction

Artificial intelligence[1] (AI) is expected to gain a central role in our daily lives in the not–too-distant future. However, the increasing complexity and autonomous decision-making capacity of AI-powered systems and their potential use across a variety of sectors also pose significant legal and regulatory challenges[2]. This paper concentrates on the impact of AI on the intellectual property (IP) framework, and focuses in particular on (i) the protection of AI as well as of the outputs generated by intelligent systems, and (ii) on potential tensions between IP protection and "Trustworthy AI"[3]. Intelligent machines are now being used for generating news, producing music, writing scripts and for drug development[4]. The AI strategies that have been adopted have not thoroughly addressed whether the current legal framework for IP is suitable for AI, and in particular how it could handle the outputs produced by intelligent systems[5]. However, some recent policy developments have shown an increasing interest in the topic.

Back in 2017, the European Parliament called on the European Commission to support a horizontal and technologically neutral approach to IP that could be applied to the various sectors in which robotics could be employed[6]. In its explanatory statement, the European Parliament's JURI Committee said there was a need 'to come forward with a balanced approach to intellectual property rights when applied to hardware and software standards and codes that protect innovation and at the same time foster innovation'. The committee also demanded 'the elaboration of criteria for "own intellectual creation" for copyrightable works produced by computers or robots'[7]. Finally, the European Parliament resolution also emphasised the relevance of setting up mechanisms to ensure interoperability, and the importance of giving access to source code, input data and construction details 'to investigate accidents and damage caused by smart robots'. The Commission, in the communication on *Artificial Intelligence for Europe*[8], stresses the need to reflect on this issue to foster innovation and legal certainty in a balanced way. As a follow-up to this communication, the Commission published a call for a study to assess whether the current IPR framework is fit-for-purpose for AI-generated works/inventions[9]. Analysis of this question is being considered at the national level. In France, for example, the *Conseil supérieur de la propriété littéraire et artistique* has announced a mission to deal with the legal and economic challenges of AI in the sectors of cultural creation[10]. In the UK, one of the priorities for 2019-2020 for the national IP office is to better understand the impact of AI on the global IP framework[11]. The United States Patent and Trademark Office (USPTO) has recently published a Request for Comments on Patenting Artificial Intelligence Inventions[12].

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1 As highlighted by Craglia et al. 2018, AI is a generic term that refers to any machine or algorithm that is capable of observing its environment, learns, and based on the knowledge and experience gained, takes intelligent action or proposes decisions. There are many different technologies that fall under this broad AI definition. At the moment Machine Learning is the most widely used.

2 For an overview of the main legal challenges raised by widespread use of AI see, among others, Craglia 2018, Chapter 7.

3 On April 8 2019 the High Level Expert Group on AI published the "Ethics guidelines for Trustworthy AI" (Guidelines). Key therein is the notion of "Trustworthy AI", which is defined as AI that is lawful, ethical and robust. The Guidelines take a "human centric approach" to AI where fundamental human rights are identified as the foundation of Trustworthy AI. On the basis of fundamental rights, the Guidelines identify ethical principles governing AI which translate into seven requirements for Trustworthy AI, like e.g. transparency and accountability.

4 For examples see Curzon (2019).

5 A summary of AI strategies in the EU is presented in Craglia 2018. See also the recent report published by the US Library of the Congress: Regulation of Artificial Intelligence in Selected Jurisdictions.

6 European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)).

7 However, the Committee on Industry, Research and Energy 'cautions against the introduction of new intellectual property rights in the field of robotics and artificial intelligence that could hamper innovation and the exchange of expertise', *idem*.

8 EC 2018 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Artificial Intelligence for Europe* COM(2018) 237 final Brussels, 25.4.2018.

9 More info available on https://ec.europa.eu/digital-single-market/en/news/trends-and-developments-artificial-intelligence-challenges-intellectual-property-rights.

10 See http://www.culture.gouv.fr/Thematiques/Propriete-litteraire-et-artistique/Conseil-superieur-de-la-propriete-litteraire-et-artistique/Travaux/Missions/Mission-du-CSPLA-sur-l-intelligence-artificielle.
In a previous report prepared by the French parliament, (C. De Ganay and D. Gillot, 2017), the issue of IP rights on AI-generated assets was briefly addressed: the rapporteurs concluded that if IP rights were to be granted to AI-generated works in no case should those rights be owned by the AI system.

11 Intellectual Property Office Corporate Plan 2019 to 2020, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/797332/Corporate-Plan-2019-2020.pdf.

12 Request for Comments on Patenting Artificial Intelligence Inventions, document available for consultation on: https://www.federalregister.gov/documents/2019/08/27/2019-18443/request-for-comments-on-patenting-artificial-intelligence-inventions.

The discussion on IP and AI is also attracting attention at international fora. The World Intellectual Property Organization (WIPO) has been particularly active in exploring both: (i) the use of information and communication technology and AI by IP offices[13]; and (ii) the relevance of AI for IP policies[14]. The European Patent Office (EPO) has published new guidelines on the patentability of AI and machine learning and a series of studies on economic and legal issues in AI. Last but not least, the IP5, the five largest IP offices in the world[15], have identified AI as a strategic priority for the near future[16], and recently agreed to launch a task force on AI and emerging technologies[17].

This paper looks at the links between IP law and AI. It presents a literature review of the discussion on IP law and AI. It focuses in particular on:

- the IP protection of AI;
- the use of data for training AI;
- the protection for creations and inventions generated by AI;
- the interplay between explainability and IP.

The issue of ownership and access to data, although of paramount importance for AI development, is not discussed here, since it has implications that go beyond the IP framework.

[13] See Meeting of Intellectual Property Offices (IPOS) on ICT strategies and Artificial Intelligence (AI) for IP administration, Geneva, May 23 to 25, 2018, http://www.wipo.int/meetings/en/details.jsp?meeting_id=46586. During the meeting, initiatives were presented in areas such as: automatic patent classification; automatic recommendation of class for goods and services of trademark applications; patent prior art search and analytics trademark; image search trademark examination; helpdesk services and assisting tools for applicants; general administrative tasks to manage IP files; prosecution and formality checks; machine translation; linguistic tools and terminologies; and data analysis for economic research.
Although the use of AI in IP administration is not without challenges, estimates of cost savings are promising. AI also offers clear opportunities for IP lawyers and applicants to reduce costs. The impact of the use of AI on the IP landscape (its impact on: registration costs, the number of applications, the diversity of applicants, the use of AI to draft applications, etc.) deserves to be further explored.

[14] Together with the UK IP Office, the WIPO recently organised the international conference AI: Decoding IP, https://orcula.com/ipo/. See also forthcoming WIPO Conversation on Intellectual Property (IP) and Artificial Intelligence (AI), provisional programme on https://www.wipo.int/meetings/en/details.jsp?meeting_id=51767.
Spain has asked the WIPO Standing Committee on the Law of Patents to conduct a study on patents and IP, Standing Committee on the Law of Patents, Twenty-Eighth Session, July 9-12 2018, SCP/28/7, Proposal by the Delegation of Spain, available on http://www.wipo.int/meetings/en/details.jsp?meeting_id=46439.

[15] The European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO) and the United States Patent and Trademark Office (USPTO).

[16] IP5, Heads of the World's Five Largest Intellectual Property Offices Meet in New Orleans, 14 June 2018 Press Release, available on http://www.fiveipoffices.org/news/20180615/Pressrelease.pdf.

[17] IP5 agree to launch AI and emerging tech task force, http://www.ippromagazine.com/ippromagazinenews/article.php?article_id=6795.

2 The IP protection of AI

AI relies heavily on software and data. While software as such is not patentable, it may be protected by copyright and trade secrets (or even by patent law in the case of computer-implemented inventions (CIIs)) if certain requirements are met. There is an ongoing debate about the adequacy of the current IP system to cope with AI technologies[18] as well as about the implications of AI for existing standards of patentability. The following paragraphs review the key requirements for protection of AI by patent and copyright law.

Patent protection for AI

A recent EPO study notes that AI has been one of the fastest growing Fourth Industrial Revolution[19] (4IR) fields since 2011, with an average annual growth rate of 43% and 83 patent applications in 2016 (EPO, 2017). However, the increased pace of patent applications is confronted with a number of legal uncertainties. A sample of patent-protection issues for AI that consistently appear across jurisdictions and societies are provided in this section.

(i) Eligible subject matter

For several years now, the courts have struggled with the issue of whether to grant patents in new fields of invention, particularly computer software (Kohlhepp, 2008). The eligibility of software, including AI software, to receive patent protection is an intricate issue. Generally, computer programs "as such" are excluded from patentability at the EPO (Article 52(2)(c) and (3) of the European Patent Convention (EPC)), but the exclusion does not apply to computer programs having a technical character (cf. producing a 'further technical effect' when run on a computer (as described in the Guidelines for Examination (GL) under section G – II 3.3.6)).

In 2018, the EPO included a new sub-section (G – II 3.3.1) on patentability of AI and machine learning (ML) in its GL that has been updated in 2019. The new section indicates that 'AI and machine learning are based on computational models and algorithms …, which are considered to be *per se* of an abstract mathematical nature, irrespective of whether they can be 'trained' based on training data'. It further mentions that the guidance provided for mathematical methods (GL G-II 3.3) can be used for such computational models and algorithms. As in the case of computer programs, mathematical methods are excluded from patentability under Article 52(2)(a) EPC when claimed "as such"' (Article 52(3) EPC)'. The GL further clarify that 'the exclusion applies if a claim is directed to a purely abstract mathematical method and the claim does not require any technical means.' In its 2019 update, the GL draw special attention to the clarity of terms used in claims related to mathematical methods as they are of the opinion that 'this is of particular importance where such terms are used in significantly different ways in the application itself and/or in relevant prior art documents, as this may be an indicator that the terms have no well-recognised meaning and may leave the reader in doubt as to the meaning of the technical features to which they refer, which may lead to findings of lack of technical character of the claims'.

The GL further mention that 'if a claim is directed either to a method involving the use of technical means (e.g. a computer) or to a device, its subject-matter has a technical character as a whole and is thus not excluded from patentability.' When

[18] When discussing the patentability of AI, Firth-Butterfield and Chae (2018a), in the World Economic Forum's (WEF) white paper *Artificial Intelligence Collides with Patent Law,* highlight the need to assess the objectives of patent law, including the promotion of innovation and dissemination. The white paper also stresses the role patent law plays in incentivising new inventions. As such, it is important to judge whether granting patents on AI inventions promote or stifle innovation, and whether AI may be more efficiently protected in an alternative manner, such as through copyright or trade secrets law. The white paper stresses the need to consider AI-specific factors rather than broad, software-specific factors when assessing whether incentivising AI through patents has a distinct economic, social and ethical impact on possible legal developments. Firth-Butterfield and Chae further suggest the following: *Lowering the subject-matter patentability standard for AI inventions relating to areas deemed more socially beneficial, such as healthcare, the environment, criminal justice and education, might be one way to help balance promoting innovation with mitigating ethical concerns* (Firth-Butterfield and Chae, *2018a).*

[19] The Fourth Industrial Revolution is a term firstly used by Klaus Schwab, founder and Executive Chairman of the World Economic Forum, to designate the transformation being brought to our society by recent technological innovation in certain fields –notably AI but also robotics, he Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing are bringing to our society. According to the author *The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Now a Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres.* In 'The Fourth Industrial Revolution, What It Means and How to Respond', *Foreign affairs,* December 12, 2015, https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution.

examining whether the claimed subject-matter has a technical character as a whole, the EPO recalls that certain expressions such as 'support vector machine', 'reasoning engine' or 'neural network' must be looked at carefully, because they usually refer to abstract models devoid of technical character. However in its 2019 update, it is clarified that these terms 'may, depending on the context, merely refer to abstract models or algorithms and thus not, on their own; necessarily imply the use of a technical means. This has to be taking into account when examining whether the claimed subject matter has a technical character as a whole[20].

According to the examination guidelines for mathematical methods 'once it is established that the claimed subject-matter as a whole is an invention, it is then examined in respect of the other requirements of patentability, in particular novelty and inventive step. For the assessment of inventive step, all features which contribute to the technical character of the invention must be taken into account. When the claimed invention is based on a mathematical method, it is assessed whether the mathematical method contributes to the technical character of the invention. A mathematical method may contribute to the technical character of an invention, i.e. contribute to producing a technical effect that serves a technical purpose, by: i) its application to a field of technology, and/or ii) being adapted to a specific technical implementation (***T 2330/13***).' The specific criteria for assessing these two situations are explained further in the GL.

The EPO guidelines give following favourable examples of patentable subject matter of AI and ML applications 'the use of a neural network in a heart-monitoring apparatus for the purpose of identifying irregular heartbeats makes a technical contribution. The classification of digital images, videos, audio or speech signals based on low-level features (e.g. edges or pixel attributes for images) are further typical technical applications of classification algorithms'. On the other hand, the guidelines state that the following applications would likely not be patentable 'Classifying text documents solely in respect of their textual content is however not regarded to be per se a technical purpose but a linguistic one (***T 1358/09***). Classifying abstract data records or even 'telecommunication network data records' without any indication of a technical use being made of the resulting classification is also not per se a technical purpose, even if the classification algorithm may be considered to have valuable mathematical properties such as robustness (***T 1784/06***)'.

The 2019 GL update states that, for mathematical methods, 'merely specifying the technical nature of data may not be sufficient on its own to define an invention (even if the resulting method would not be considered a purely abstract mathematical method as such, it may still fall under the excluded category of methods for performing mental acts as such if no use of technical means is implied)'. However, in relation to AI they do state 'where a classification method serves a technical purpose, the steps of generating the training set and training the classifier may also contribute to the technical character of the invention if they support achieving that technical purpose.' Jones (2018) suggests this may enable the possibility of 'obtaining European patent protection for a method of training an AI or machine learning algorithm, or to a method of generating training data for this purpose, if it is possible to credibly (or plausibly) link the method to a reliable and repeatable technical effect'. With this, 'plausibility' seems to be introduced, which is an aspect of patent law that is usually encountered in the pharmaceutical and life science field[21].

(ii) Sufficiency of disclosure

Article 83 of the EPC requires that a European patent application shall disclose the invention in a manner sufficiently clear and complete for it to be carried out by 'a person skilled in the art'. In exchange for this disclosure, a limited exclusive right is provided which is the core of the patent system. During the EPO's conference on patenting AI[22], it was mentioned that there needs to be sufficient disclosure of AI innovations to avoid decisions being taken by 'black boxes', and that patent offices therefore had an important role to play. In a report of the IP5 expert round table on AI it is further mentioned that the extent of the disclosure depends on what is claimed and that the 'IP5 offices have strict disclosure requirements, whereby an overly strict application might discourage companies from pursuing patent

[20] 'Guidelines for Examination, G-II 3.3.1, Artificial intelligence and machine learning', European Patent Office (EPO), 2019 update

[21] Note that according to Rogitz (2019) the Japan Patent Office (in their recently added ten new case examples pertinent to artificial intelligence-related technology to Annex A of the Examination Handbook for Patent and Utility Model (January 2019)) come to suggest that novel input data and output data may be sufficient to establish an inventive step when seeking patent protection in Japan.

[22] European Patent Office (EPO), EPO hosts first conference on patenting artificial intelligence, (30 May 2018), available at: https://www.epo.org/news-issues/news/2018/20180530.html.

protection and resort to use trade secret protection instead'[23].

Although, nothing is said specifically on how to address clarity and sufficiency of disclosure (Article 83 of EPC) for AI inventions in the recent updates of the EPO Guidelines for Examination (GL), GL F-III, 1(4), on sufficiency of disclosure, stipulates that '...for the requirements of Article 83 and of Rule 42(1)(c) and Rule 42(1)(e) of the EPC to be fully satisfied, it is necessary that the invention is described not only in terms of its structure but also in terms of its function, unless the functions of the various parts are immediately apparent. Indeed, in some technical fields (e.g. computers), a clear description of function may be much more appropriate than an over-detailed description of structure'.

Because AI inventions usually fall into the category of CIIs[22], it could be assumed that minimum requirements for sufficiency of disclosure are at the same level as for computer-implemented inventions in general. However, as indicated in the AIPLA/AIPPI/FICPI AI colloquium primer (AI Colloquium primer, 2019) 'Additional problems may arise if an invention relying on AI technology is claimed but it is not explained in detail how the AI technology is brought to a working example. This often involves specific training or other adjustments. For example, if an AI technology is implemented in the form of a neural network, it may be necessary to describe in detail the network topology and how the weights are set. This was the case in ***T 0521/95***, wherein the Board concluded that the application did not give specific information required to set up the network. However, in that case the network topology was considered to be new and based on recent physiological research, and to not be known to a person skilled in the art'.

According to WIPO's background document on patents and emerging technologies[24], another issue might arise from the fact that 'deep learning technologies are non-deterministic: they involve some randomized initialization. Therefore, even the same training data and the same neural network architecture might lead to slightly different performance of machine learning'. It further compares the similarity of this non-deterministic character to that of biological materials, and mentions that 'consideration might be given to the so-called reproducibility or plausibility of the claimed inventions based on the disclosure in a patent application'. Likewise Read (2019) recalls that 'AI and ML are not CIIs generally, particularly where the computer learns, the behaviour and hence a description of the computer is dynamic until training is terminated and is likely to be unpredictable'. He compares the challenges and requirements on sufficiency for AI and ML inventions to that of the technical fields of chemistry and biology, and is of the opinion that many elements (like e.g. plausibility, use of a depository, etc.), may be readily transposed to inventions based on AI and ML.

Finally, the Japan Patent Office has recently issued ten new case examples pertinent to artificial intelligence-related technology to Annex A of its Examination Handbook for Patent and Utility Model (January 2019), which contains amongst others several concrete examples regarding the application of the disclosure requirements to AI-related inventions[25]. Rogitz (2019) gives an overview of the main takeaways for the description requirements and indicates that, when filing AI patent applications in Japan, one should disclose a "certain relation, such as a correlation" that an AI-related invention might make, and that for certain AI inventions disclosure of test results or validation of the AI model are required 'unless an estimation result by AI can be a substitution for an evaluation on a product that has actually been made'.

Copyright protection for AI software

As computer programmes, AI systems may be granted copyright protection available for original software. However, copyright protection only extends to the original expression of the computer programme and not to the ideas and principles underlying it[26]. Thus 'to the extent that logic, algorithms and programming languages comprise ideas and principles, those ideas and principles are

[23] Report from the IP5 expert round table on artificial intelligence, October 31st 2018, available at: https://www.fiveipoffices.org/wcm/connect/fiveipoffices/5e2c753c-54ff-4c38-861c-9c7b896b2d44/IP5+roundtable+on+AI_report_22052019.pdf?MOD=AJPERES&CVID=

[24] Standing Committee on the Law of Patents, Thirtieth Session Geneva, June 24 to 27, 2019, 'BACKGROUND DOCUMENT ON PATENTS AND EMERGING TECHNOLOGIES', available at: https://www.wipo.int/edocs/mdocs/scp/en/scp_30/scp_30_5.pdf.

[25] See the JPO guidelines, available at: https://www.jpo.go.jp/e/system/laws/rule/guideline/patent/ai_jirei_e.html

[26] According to Article 1(2) of the Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs (Codified version) (hereinafter Software Directive), protection 'shall apply to the expression in any form of a computer program. Ideas and principles which underlie any element of a computer program, including those which underlie its interfaces, are not protected by copyright under this Directive.'

not protected'[27]. Therefore, only the expression is to be protected by copyright. This means that the code of the algorithm, if original, can be protected while the pure concept behind the algorithm cannot.

IP protection for data used in AI

AI systems are highly dependent on data to train intelligent algorithms. These data may be protected by third-party rights, and AI developers may therefore need to acquire permission to access and use those data (see next section). To further complicate matters, processing, cleaning and annotation activities are often carried out on the original datasets by AI developers to ensure data adequacy, and these activities may trigger new rights. Data annotations may indeed be a valuable resource for future users of the same or a different AI system.

Curated data libraries may or may not deserve IP protection on their own. There is no legal or statutory title providing for ownership of data. At most, under certain circumstances data could become protected by the database's *sui generis* right. This specific protection is triggered when a substantial investment has been made in obtaining, verifying or presenting the contents of a database. If annotated data takes the form of a database[28], and the making of this database has entailed substantial investment (either in financial or human resources, for example) the annotated dataset could be subject to the *sui generis right*. The *sui generis* right does not enter into play when an investment is made in the creation of data. However, in the specific case of annotated datasets it might well be considered that the investment is not made in the creation but in the verification of the data. Where the collection of annotated data does not reach the investment threshold, AI developers will probably rely on trade secrets[29] to protect their investments. Or rather, they will rely on contracts to regulate access, use and reuse of the compilation of processed and annotated datasets or the trained models.

In cases where the processed and annotated dataset incorporates individual works (e.g. pictures deserving copyright protection) or a protected subject-matter (substantial part of a database deserving *sui generis* protection), it will depend on the specific case whether the annotated dataset (or even the trained system) is considered as a *derivative* work/subject-matter (on this see also Margoni 2018). In cases where individual works or subject-matter are not per se reproduced (i.e. where only information about those is included), one could in principle conclude that the final results should not be considered as a derivative.

27 Recital 11, Software Directive.

28 Legally defined as 'a collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means', Article 1 of the Database Directive. However, J. Buyers notes that 'it is improbable that such [training] datasets would reach the level of organisation equivalent to a classically ordered database', Buyers 2018.

29 Directive (EU) 2016/943 of the European Parliament and of the Council of 8 June 2016 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure, OJ L 157.

3 Copyright and the use of data for training AI

Data digitisation and data availability have been one of the key drivers of the most recent developments in AI. Most promising AI techniques, such as machine learning or deep learning, are highly dependent on large amounts of data. Millions of images, texts, videos, sounds, and raw data are required to feed and train AI systems.

In this section, we explore the use of data in AI models through the lens of copyright law. The issue of access to data is not a copyright issue and, although very much relevant for AI, it is beyond the scope of this paper. Here, the term 'data' is used in a broad sense, including informational items that could be protected by copyright (such as images, videos or text) and items that are not necessarily copyright protected, such as pure raw data. However, the latter may deserve protection through the *sui generis* right granted to database makers[30]. In principle, when data are protected by copyright or the *sui generis* right, any temporary or permanent reproduction of these data or the extraction and reuse of a substantial part of the data contained in a protected database would need the authorisation of the rightholder, unless an exception applies. Often, the use of data to feed AI algorithms will require accessing and processing, and therefore very likely reproducing, materials that might be protected by copyright or by the database maker's *sui generis* right. In many cases, AI developers may collect data from commercial and structured publications and databases. In many other cases, data collection may also involve the scraping of publicly available websites that, despite being freely accessible, may be equally protected by copyright or the *sui generis* right.

In this context, copyright exceptions, and in particular exceptions allowing text and data mining (hereinafter TDM), become relevant[31]. TDM has been defined as 'any automated analytical technique aimed at analysing text and data in digital form in order to generate information which includes but is not limited to patterns, trends and correlations'[32] — a definition that would come to describe many routine operations in the development of AI.

With the advent of the data economy, there has been a polarised discussion around the legal regime for TDM and the most appropriate shape of TDM exceptions[33]. Some scholars have argued that TDM should not be considered as relevant to copyright law since it is not an exploitation of the work[34]. However, the more widely accepted opinion is that often TDM may involve some copying that is covered by the exclusive rights[35], and that TDM therefore requires the permission of the copyright holders unless an exception applies.

To overcome the legal uncertainty about TDM, in 2016 the Commission tabled a legislative proposal for a new Directive on copyright and related rights in the Digital Single Market[36] that provided for a mandatory copyright exception allowing TDM by research organisations with legal access to the works or databases concerned for scientific research[37]. The new exception concern both copyright and database sui generis rights[38]. Some commentators expressed concern about the impact of this exception on European competitiveness, in particular by excluding commercial undertakings, start-ups and unaffiliated researchers[39]. These commentators worried that the exception would

30 It has been assumed that machine generated data are not protected by the database maker's *sui generis* right. This is indeed one of the conclusions reached in the recent Evaluation of the Database Directive, in line with some representatives of the doctrine. This view is mainly supported by the restrictive interpretation given by the CJEU in its landmark cases on the sui generis right. All in all, the Commission recognises the need to monitor the possible application of database law in the context of the data economy.

31 Another exception relevant for TDM is the exception provided in Article 5(1) of the Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society (hereinafter Infosoc Directive) on temporary reproductions. However, when analysing the application of this article to machine learning and natural language processing, Margoni comes to the conclusion that although temporary copies created in the preparation of annotated datasets and trained models are likely to be covered by the exception, there are certain acts, notably the permanent copies that may be stored at the end of the process, that naturally fall beyond its scope (Margoni 2018).

32 Article 2 of the Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC (hereinafter CDSM Directive).

33 See among others Triaille, 2014; Guibault, 2016; Geiger et al, 2018a and b; and all the other authors cited in this section.

34 ECS, 2017; Hilty and Richter, 2017; Senftleben 2018.

35 In this line Guibault, 2016; Geiger et al, 2018a and b; Rosati, 2018; Triaille, 2014.

36 Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC (hereinafter CDSM Directive).

37 Article 3 of the Proposal for a Directive of the European Parliament and of the Council on copyright in the Digital Single Market, COM/2016/0593 final, EC 2016.

38 Íd.

39 It goes without saying that these TDM techniques, like many AI-powered systems, may be applied in very different for-profit and not-for-profit contexts, across sectors (from research organisations to start-ups), and by

prevent activities that could be considered lawful under other regimes, notably in the US under fair use, but also in Canada, Israel or Japan (Geiger et al., 2018b; Samuelson, 2018). Thus, a number of authors recommended introducing more flexibility into European copyright law, either through a more generous provision[40] or through an open norm[41].

The provision evolved in its passage through the Council and Parliament. AI had been gaining prominence in the policy debate, and its potential to improve innovation was being recognised. Against this background, it was finally agreed to expand the scope of the exception so that it would also apply to cultural heritage institutions[42]. It was also agreed to include a second exception or limitation[43] that would allow TDM by other entities (such as private companies) for commercial and non-commercial purposes, provided rightholders have not reserved this right by appropriate means[44]. For content made publicly available on line, it should only be considered appropriate to reserve those rights by the use of machine readable means, including metadata and the terms and conditions of a website or a service[45]. This would allow web mining, provided the remaining conditions of the exception are met. The Directive, as finally adopted, clarifies that other uses should not be affected by the reservation of rights for the purposes of TDM[46].

different actors (from big companies to journalists or citizens).

40 Professors from the CEIPI suggested expanding the scope of TDM exceptions to all those enjoying lawful access or at least to certain categories of beneficiaries such as journalists, even if this is done against a fair remuneration when the use is commercial (Geiger at al., 2018a). The Max Planck Institute (MPI) proposed a general exception authorising TDM by those having access to the work or subject matter coupled with an obligation upon the rightholders 'to provide research organisations with datasets that enable them to carry out text and data mining only' whether or not in exchange for a reasonable payment (Hilty and Richter, 2017). Also Senftleben defended an open exception for TDM, except for those cases implying an exploitation of the commercial value of source data. In his view, this would greatly support start-ups active in big data (Senftleben, 2017).

41 As argued by Geiger et al., an open norm would not only accommodate TDM uses but also allow to cope with the pace of technological developments. See also Schönberger, who explores alternative ways to allow this use of data, such as through the recourse to implicit consent, or a new reading of the private use exception. Schafer et al. had previously advocated for a machine-learning exception that would allow robots to use (and then copy) protected works or subject matter they legally have access to in the same way that humans do (i.e. in their own memory) (Schafer et al. 2015).

42 Article 3 of Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society (hereinafter CDSM Directive).

43 In such cases, Member States may provide for compensation.

44 Article 4 of the CDSM Directive.

45 Recital 18 of the CDSM Directive.

46 Recital 18 CDSM Directive.

4 IP protection for assets generated by AI

As has been widely reported in the media, AI is being used to generate news[47], compose music[48], create artworks (some of which have actually been sold in auctions[49]), and produce scripts[50]. It has even been used to come up with technical inventions that, if made by humans, could be patentable[51]. Recent achievements in AI techniques have allowed machines to reach a level of autonomy that could make the human contribution trivial to the creative or inventive process. We may be entering into an era where machines will not only assist humans in the creative process but create or invent all by themselves. The application of the IP legal framework to the works or inventions generated by AI is a complex question, in particular for: (a) copyright and other *sui generis* or neighbouring rights; and (b) patent law.

The following table includes a set of examples of currently existing AI systems that are challenging the notions of IP law.

Name	Category of possible IP protection if generated by a natural person	Description
Next Rembrandt[36]	Copyright	The Next Rembrandt is a computer-generated 3-D–printed painting developed by a facial-recognition-based AI algorithm that uses scanned data from known paintings by the Dutch painter. An AI-generated portrait consists of 148 million pixels, and is based on 168,263 fragments from Rembrandt's works stored in a purpose-built database. Source: https://www.nextrembrandt.com/ & https://thenextrembrandt.pr.co/130454-the-next-rembrandt
Text-generating programmes	Copyright	There are several text-generating programmes in use. One example is the programme of Stanford PhD student Andrej Karpathy, that teaches a neural network how to read text and compose sentences in a specific style, for example Wikipedia articles and lines of dialogue that resemble the language of Shakespeare. Source: Andrej Karapathy's blog http://karpathy.github.io/2015/05/21/rnn-effectiveness/

[47] According to the Wikipedia entry on automated journalism 'StatSheet, an online platform covering college basketball, runs entirely on an automated program.[4] The Associated Press began using automation to cover 10,000 minor baseball leagues games annually, using a program from Automated Insights and statistics from MLB Advanced Media. Outside of sports, the Associated Press also uses automation to produce stories on corporate earnings. In 2006, Thomson Reuters announced their switch to automation to generate financial news stories on its online news platform. More famously, an algorithm called Quakebot published a story about a 2014 California earthquake on The Los Angeles Times website within three minutes after the shaking had stopped.' 'Automated journalism', *Wikipedia*, https://en.m.wikipedia.org/wiki/Automated_journalism.

[48] 'More Artists Are Writing Songs in the Key of AI', *Wired*, 5.17.18, https://www.wired.com/story/music-written-by-artificial-intelligence/.

[49] Among others the well-known 'Next Rembrandt' project https://www.nextrembrandt.com/; on the selling of AI artworks see: ' Why One Collector Bought a Work of Art Made by Artificial Intelligence—and Is Open to Acquiring More', *Artnet news*, 3.4.18, https://news.artnet.com/art-world/art-made-by-artificial-intelligence-1258745 or 'Google's 'Inceptionism' Art Sells Big at San Francisco Auction', *artnet news*, 3.2.16 https://news.artnet.com/market/google-inceptionism-art-sells-big-439352. An AI artwork was sold at Christie's for $432 500 as reported here https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx.

[50] 'IBM Watson creates the first AI-made film trailer — and it's incredibly creepy', *Wired,* 2.9.16 http://www.wired.co.uk/article/ibm-watson-ai-film-trailer;. See also, Sunspring, the first film entirely written by AI according to http://www.thereforefilms.com/sunspring.html.

[51] 'How artificial intelligence is changing drug discovery', Spotlight, *Nature* 557, S55-S57 (2018), doi: 10.1038/d41586-018-05267-x.

Aiva	Copyright	Aiva is capable of composing soundtracks for films, video games, commercials and any type of entertainment content. Its AI is taught by reading through a large collection of music partitions, written by the greatest composers (such as Mozart, Beethoven, and Bach) to create a mathematical model representation. This mathematic model is then used (by Aiva) to write and compose new music. Recently, Aiva became the first virtual artist to have her creations registered with an author's rights society (cf. Société des auteurs, compositeurs et éditeurs de musique in France). Source: https://www.aiva.ai/about & https://aibusiness.com/aiva-is-the-first-ai-to-officially-be-recognised-as-a-composer/
DABUS, a type of "Creativity machine"	Patent	DABUS is a patented AI system created by Stephen Thaler, which is a particular type of *connectionist AI*. Such systems contain two neural networks: (i) one neural network, comprising a series of smaller neural networks, that generates novel ideas in response to self-perturbations of connection weights between neurons and component neural nets therein, and (ii) a second that monitors the first network and identifies those ideas that are sufficiently novel compared to the machine's pre-existing knowledge base. DABUS can bootstrap itself from a blank slate, both learning and creating as it goes. Two inventions generated by DABUS, cf. fractal container and neural flame, are described and filed as patent applications that are currently pending. Source: http://artificialinventor.com/patent-applications/ & http://imagination-engines.com/iei_dabus.php & WEF online article by Firth-Butterfield et al (2018b)
John Koza's "Invention machine"	Patent	John Koza is the initiator of genetic programming, a revolutionary approach to AI, solving technical problems with virtually no human guidance and without following a preordained routine. For example, his Invention machine, using 1000 networked computers, has automated the creative process and designed antennae, circuits, and lenses. Moreover, his Invention machine has even earned a US patent for developing a system to make factories more efficient, one of the first IP protections ever granted to a non-human designer. However, the involvement of AI technologies was not disclosed to the US Patent & Trademark Office and only humans were listed as inventors. Source: See Carnet et al (2016) & WEF online article by Firth-Butterfield et al (2018b)

(a) Copyright

AI-generated works in copyright legislation

In the copyright realm, certain countries, such as the UK, South Africa, Hong Kong, India, Ireland, and New Zealand, have set up laws that can provide protection for computer-generated works. This protection would be granted to the person who set up the arrangements necessary for the creation of the work.

In the UK, computer-generated works are defined as works 'generated by computer in circumstances such that there is no human author of the work'. Note that UK provisions leave room for ownership to be allocated either to the programmer or to the user. To our knowledge, case-law on computer-generated works is scarce[52]. These works benefit from a shorter term of protection (50 years compared to the 70 years for other copyright-protected works)[53]. The configuration of the right somewhat resembles a neighbouring right (Bently, 2018).

In those countries where no specific regime exists, it is questionable whether AI-generated works benefit from copyright protection. Can AI-created works be considered original? To whom should ownership be allocated?

[52] The only relevant case being Nova Production Ltd. V. Mazooma Games, [2007] EWCA Civ 219, [2007] Bus LR 1032.

[53] According to S. 12.7 UK copyright, 'if the work is computer-generated the above provisions [...] copyright expires at the end of the period of 50 years from the end of the calendar year in which the work was made'.

Most copyright legislation across EU Member States is very much dependent on human-centred concepts, for: (i) the beneficiary of protection (i.e. the author); (ii) the conditions for protection (e.g. originality); and (iii) the rights granted (economic, but also moral rights). This human-centred focus is also present in the *acquis communautaire,* although arguably to lesser extent due to the lack of regulation on moral rights.

Both the Software Directive and the Database Directive define authorship on the basis of the natural person(s) or group(s) of natural persons who created the work[54]. This anthropocentric approach also applies for the definition of originality. Although the concept of originality is not clearly defined in European law, several directives link originality to natural persons or human attributes. The Resale Directive arguably points to persons ('artists')[55] and the Copyright Term Directive points to human attributes ('personality')[56]. In addition, both the Software and Database Directives (as a well as the Term Directive in relation to photographs) refer to the 'author's own intellectual creation' as the *sole* criterion to consider when assessing originality[57]. This subjective dimension has arguably been harmonised by the Court of Justice of the European Union to all copyright-protected works in a series of landmark decisions. In these decisions, the Court refers to the 'authors' intellectual creation', 'the free creative choices', 'the authors' personality', or 'the author's personal touch'[58] as requirements for the emergence of a copyright-protected work.

The outcome is similar under US law. The US Copyright Act protects original works of authorship and, to qualify as a work of authorship, a work must be created by a human being. The general guide to the policies and procedures of the US Copyright Office is also clear in this regard: 'the Office will not register works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author'[59]. China has taken a similar position: a recent decision by the court of Beijing has refused copyright protection to a report generated by an AI system on similar grounds (Chen 2019).

In recent articles and public presentations, European scholars have debated the possible protection of AI-generated works under current European and national legislation in the context of this humanist approach to copyright law. Most authors conclude that, under present law, AI-generated works might not be eligible for copyright protection. This is because works created *solely* by machines cannot be considered original in the sense of copyright law since they will be lacking of the human attributes required by case law.

Are changes in the legal framework necessary?

Assuming that AI-generated works do not fall under the protection granted by current copyright legislation, it should be assessed whether there really is a need to protect them. Any answer to this question would require a careful examination of the rationale for protection. Is there a market failure? Is there a need to create incentives? Any answer would also require an assessment of the possible effects that protection might have on the market for creative works and on innovation. If it is concluded that such a right should be created, consideration should be given to how this right should be defined and implemented. To our knowledge, no economic research has been published in this field. The subject has nevertheless been addressed by legal scholars.
Legal experts have opposing views on this subject. Guadamuz (2017) has argued that a UK-like system would easily address this problem, and said that refusing to grant copyright protection to AI-generated works could have a 'serious commercial

54 Although company authorship is provided for if this is designated as the author by national law. See Article 2 of Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs (Codified version), OJ L 111 (also referred here as Software Directive) and Article 4 of Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal OJ L 77, (the Database Directive).

55 Article 2 of Directive 2001/84/EC of the European Parliament and of the Council of 27 September 2001 on the resale right for the benefit of the author of an original work of art, OJ L 272 (the Resale Directive).

56 Recital 16 of Directive 2006/116/EC of the European Parliament and of the Council of 12 December 2006 on the term of protection of copyright and certain related rights (codified version) OJ L 372 (the Copyright Term Directive).

57 See Article 3 of the Database Directive, Article 1(3) of the Software Directive, and Article 6 of the Copyright Term Directive on photographs.
Infopaq: C-5/08 Judgment of the Court (Fourth Chamber) of 16 July 2009; BSA: C-393/09, Judgment of the Court (Third Chamber) of 22 December 2010; Panier: C-145/10, Judgment of the Court (Third Chamber) of 1 December 2011; Dataco: Case 604/10, Judgment of the Court, (Third Chamber) of 1 March 2012. In the legal assessment of the Panier case, Advocate General Trstenjak affirms '...only human creations are therefore protected, which can also include those for which the person employs a technical aid, such as a camera'.

59 The Compendium of U.S. Copyright Office Practices: Chapter 300, S. 313.2 https://www.copyright.gov/comp3/chap300/ch300-copyrightable-authorship.pdf.

effect' particularly in the area of databases. He said that the UK system has clear advantages:

> *It would bring certainty to an uncertain legal area; it has already been implemented internationally in various countries; it is ambiguous enough to deflect the user/programmer dichotomy question and have it analysed on a case-by-case basis; and it has been in existence for a relatively long time without much incident.*

Yet, UK provisions have not been exempted from criticism by other scholars who do not consider them to be fully appropriate for dealing with all kinds of computer-generated works (Bently et al. 2018, Dickenson et al. 2017; Lambert 2017; Lauber-Rönsberg and Hetmank 2019). The first criticism raised by these scholars is that these provisions put too much emphasis on the distinction between assisted and non-assisted creations. The second criticism they raise is that these UK provisions leave a considerable margin of uncertainty about the person who made the arrangements for the creation, especially for highly sophisticated systems. Their third criticism is that the UK provisions do not address the issue of originality. Their fourth criticism is that the UK provisions do not solve the problem of creations jointly generated by computers and humans. Their final criticism is that it is questionable whether the UK provisions are compliant with the EU *acquis*.

A third group of commentators has discussed the possible need to incentivise the creation or commercialisation of AI-generated works. Although these commentators are reluctant to grant copyright protection to works generated by AI, they still think that alternative protection should be put in place. Ramalho (2017) argues for a solution based on a public-domain approach combined with a 'disseminator right', very much inspired by the protection granted to publishers of unpublished works under the Copyright Term Directive[60]. In the US, Samuelson, writing in 1985, concluded that ownership of computer-generated works should be allocated to users (Samuelson 1985). Bridy (2016), Yanisky et al. (2017) and Pearlman (2018) have defended the implementation of the work-for-hire doctrine to AI systems. Ginsburg (2018) plays with the idea of granting a *sui generis* or neighbouring right[61]. Sui generis protection is also considered as a potential option to be assessed by De Cock (2018), Lauber-Rönsberg (2019), Saiz (2019). The latter suggests that in case there is evidence for the creation of a new right, inspiration should be taken from industrial property rights that, different from copyright, normally require registration.

However, other authors have argued that there is a lack of empirical evidence supporting the need to create new property rights. Some of these authors favour excluding AI-generated works from any IP protection, so that such works would simply fall into the public domain (Perry & Margoni, 2018; Schönberger, 2018). Other authors with similar views instead suggest relying on contracts or on unfair competition law (Bently, 2018) [62]. While it is difficult to ascertain the precise impact that this public-domain argument would have, it may well have a disadvantageous effect on investment. If developers doubt whether creations generated through AI qualify for copyright protection, what is the incentive to invest in such systems?[63].

Consequences of granting or denying protection

Michaux (2018) draws attention to the difficulties in distinguishing works generated by humans and by machines, if AI-generated works are deprived of copyright protection. Strikingly, this problem would still exist if protection were granted on the basis of a different right. On the other hand, he predicts such protection could lead to a substantial increase in the number of protected works and in the concentration of copyright in a handful of

60 Article 4 of the Copyright Term Directive reads: 'Any person who, after the expiry of copyright protection, for the first time lawfully publishes or lawfully communicates to the public a previously unpublished work, shall benefit from a protection equivalent to the economic rights of the author. The term of protection of such rights shall be 25 years from the time when the work was first lawfully published or lawfully communicated to the public.'

61 Together with copyright, there exists a series of neighbouring or *sui generis* rights generally granted on the recognition of the investment made in the subject matter. This is the case for neighbouring rights granted to audio-visual producers or database makers. Cruquenaire et al. (2017:228) have also evoked the possibility of having certain AI-generated works protected by the *sui generis* rights of the Database Directive in light of the recent jurisprudence of the CJEU concerning the expanded notion of 'database'. Esterbauer, Case C490/14, Judgment of the Court (Second Chamber), 29 October 2015. Photographs which are not original may also be granted protection under national law. This neighbouring protection of photographs which are not original is permitted under Article 6 of Directive 2006/116/EC. It is implemented in some European countries. For instance, in Spain, limited protection of 25 years is granted to non-original pictures (see Article 128 of Spanish copyright law). A more generous term of 50 years is granted to non-original photographs in Germany, a provision that has been invoked to protect satellite images. Protection for non-original photographs obeys a different rationale linked to the commercial or documental value of these assets (Bondía, 2006).

62 Vid also the proposal of L. Szuskin cited in C. De Ganay and D. Gillot, 2017: 146.

63 See Andres Guadamuz 'AI and copyright', *WIPO Magazine*, October 2017, WIPO, https://www.wipo.int/wipo_magazine/en/2017/05/article_0003.html.

companies. Protection could lead to an instrumentalisation of the notion of work, and to excessive monetisation of access to works.

Similar concerns have been expressed by Lauber-Rönsberg (2019), who stresses that integration of AI-generated works in the copyright regime may profoundly disrupt the fundamentals of copyright legislation and the notions upon which the whole system is built. She recognises that the creation of an ad hoc right might better respond to the peculiarities of AI, but also expresses reservations about the requirements for triggering protection and rights allocation. Another obstacle she sees is that the mandatory/voluntary disclosure of the use of AI in a work or related matter might be very difficult to implement.

Perry and Margoni (2010) warn about the constant erosion of the public domain, while Schönberger (2018) predicts the possible destruction of incentives for human creators if machine-generated works are treated the same.

(b) Patents

Patentability of AI-generated inventions

Fast-moving developments in technology have enabled AI to play an important role in innovation processes. AI may have the potential to increasingly marginalise human ingenuity and human input in new inventions (Ramalho, 2018). As in the case of copyright, the patentability of inventions generated by AI raises several questions for patent law. Although some jurisdictions seem to have been dealing with patents for inventions created by machines[64], the subject is open to discussion. Should inventions created by AI be granted patents? If the answer is yes, to whom should inventorship be awarded for such AI-created inventions?

In principle, nothing prevents the granting of patents for AI-generated inventions, provided they are for a patentable subject-matter. According to Article 52(1) of the EPC, European patents can be granted for any inventions that may have an industrial application, are new and involve an inventive step (or in other words an invention shall not be obvious to a 'person skilled in the art' taking into account the 'state of the art', as mentioned in Article 56 EPC). In addition Article 83 stipulates that 'an application shall disclose the invention in a manner for it to be carried out by a "person skilled in the art"'. The 'person skilled in the art' is a key issue for machine-generated inventions[55], however the EPC does not give a definition of a 'person skilled in the art'. This definition has instead been interpreted through case-law and various guidelines. In GL G-VII, 3, under the heading of inventive step[65], a 'person skill in the art' is '...presumed to be a skilled practitioner in the relevant field of technology, who is possessed of average knowledge and ability and is aware of what was common general knowledge in the art at the relevant date. He is also presumed to have had access to everything in the "state of the art", in particular the documents cited in the search report, and to have had at his disposal the means and capacity for routine work and experimentation which are normal for the field of technology in question...'. GL G-VII, 3 also says that '...there may be instances where it is more appropriate to think in terms of a group of persons, e.g. a research or production team, rather than a single person...' Therefore, it has been argued that the possible use of AI as a tool (if its use was common in the field in question) needs to be taken into account when assessing the inventive step[55]. One effect of inventions involving AI and machine learning may thus be an increase in the level of skills and knowledge of the skilled person and thus an increase in the level of inventive step required[66]. This increase is not without problems, as highlighted by one commentator who argues that 'the toughest problem may be how to determine the capabilities of a normal artificial intelligence tool, and more in particular, how examiners, patent attorneys and patent judges can establish whether the average skilled person equipped with that tool could and would create a specific product or process. Determining the reach of artificial intelligence is particularly difficult, because the output of an artificial intelligence application is hard to predict (Blok, 2017)'.

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64 See Colin R. Davies 'An evolutionary step in intellectual property rights — Artificial intelligence and intellectual property', 2011, p. 608, referring to a patent granted in the US for a satellite communications antenna designed by an AI system. A recent article by Coulter, M. (2019) in the Financial Times mentions the patent applications filled by Professor Abbott at the UK, US and European patent offices for two inventions generated by DABUS.

65 Although a description of a person skilled in the art is provided for evaluating inventive step, there is no distinction made between the skilled person assessing inventive step and the skilled person assessing sufficiency of the description in the EPO Guidelines. See also 'COMPARATIVE STUDY REPORT ON TRILATERAL PROJECT 12.6 REQUIREMENTS FOR DISCLOSURE AND CLAIMS' available at: https://www.trilateral.net/wcm/connect/trilateral/9422775b-52e8-41f9-b020-9c71746a7120/Pro.%252012.6%25202007update%2520final.pdf?MOD=AJPERES&CVID=

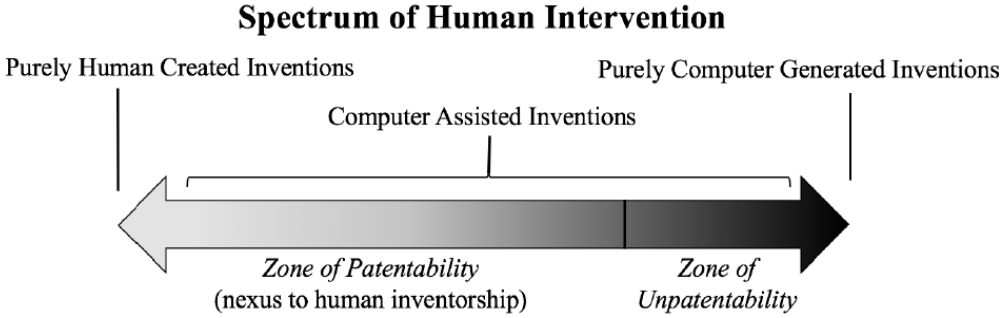
66 Presentation of Dr Argyrios Bailas/Dr Doris Thums of the EPO, given on 5 June 2018, entitled 'Patentability of AI related inventions — The EPO perspective'.

As Ramalho reminds us (2018), the inventive step requirement is meant to prevent patent numbers from rising to undesirable levels by excluding obvious inventions. Inventions involving AI may challenge current practices in assessing inventiveness. Yet Ramalho does not call for amendments in the current law. Instead, she proposes the harmonisation of practices across different jurisdictions and calls upon patent offices to develop a common set of guidelines on the patentability of AI-generated assets (Ramalho, 2018). The author suggests broadening the scope of analogous art taking the use of AI into account when assessing who is the person 'skilled in the art'. She even suggests making the disclosure of the inventive process mandatory and taking secondary indicia into consideration, so to consider AI use as an indication of obviousness. All this would result in a more demanding patentability threshold.

Concerns regarding patent numbers rising to undesirable levels (due to AI generated inventions) are also being somewhat met by projects attempting to algorithmically create and publicly publish all possible new prior art so that any of such output would no longer be patentable by others[67]. In addition, the enabling disclosure and industrial applicability (utility) requirements should prevent patenting AI-generated subject matter without any description of how it can be reduced to practice[68]. In the US, Samore maintains that once genetic programming (a branch of AI) enters into widespread use for designing particular devices, designs created with these tools should not be patentable because they should be considered as obvious. The author proposes a test consisting of four factors to assess whether genetic programming is in widespread use. The four factors are:

1) was the invention actually designed by a genetic programme?
2) what was the proportion of persons having ordinary skill in the art in the field with access to genetic programmes?
3) what was the financial cost associated with using a genetic programme for this type of design?
4) how long and how much effort was required to operate the necessary genetic programme?

Finally McLaughlin (2018) proposes a framework that analyses the spectrum of human intervention to distinguish between patentable and unpatentable computer-assisted and computer-generated inventions. According to this framework, when a computer-assisted invention lacks sufficient human intervention to constitute a connection (cf. 'nexus') to human inventorship, the computer assisted invention enters a zone of unpatentability. Although being unpatentable, it remains free to be protected in other areas of law such as trade-secret law. This framework is illustrated in the figure below taken from McLaughlin (2018).



The discussion on inventorship through the lens of legal scholars

For patentable AI-generated inventions, the question of inventorship also arises. Who should be listed as the inventor of the new asset? European patent law does not provide a definition of inventorship, although there is a presumption that it belongs to a 'natural person'. However, this

[67] See the 'All Prior Art'-project by Alexander Reben: https://areben.com/project/all-prior-art/ by
However, the EPO GL indicate in G-IV, section 2 that 'Subject-matter can only be regarded as having been made available to the public, and therefore as comprised in the state of the art pursuant to Art. 54(1), if the information given to the skilled person is sufficient to enable him, at the relevant date (see G-VI, 3) and taking into account the common general knowledge in the field at that time, to practice the technical teaching which is the subject of the disclosure (see T 26/85, T 206/83 and T 491/99)'. It has therefore been argued that for the 'All Prior Art'-prior art this enabling disclosure is missing (see Bernan (2016)).

[68] See also the WIPO's background document on patents and emerging technologies.

presumption has not been seen as a great obstacle by scholars. Blok argues that patent law cannot and should not be interpreted in a way that allows AI systems to have the same position in patent law that human inventors have. Human input is inevitable in the inventive process, whether that is through selecting a specific AI application or creating a specific algorithm to solve a technical problem. Therefore, he argues that AI systems 'are and should be treated as tools of inventors and skilled persons, instead of autonomous inventors' (Blok, 2017). Shemtov takes a similar view. In a report commissioned by the EPO, he concludes that under patent law it is neither possible nor desirable in the current state of the art to designate AI systems as inventors (Shemtov 2019)[69]. The report maintains that, given the current state of the technology, it is highly unlikely that an invention involving AI will not involve a human actor that can be designated as inventor. He says the following:

> *When it comes to a human actor that uses an AI system, whose identity may be inconsequential to the invention process, who simply uses a machine learning technique developed by another, the inventor may be the person who 'tooled' the AI system in a particular way in order to generate the inventive output. Hence, under such circumstances the person that carries out the intelligent or creative conception of the invention may be the one who geared up the AI system towards producing the inventive output, taking decisions in relation to issues such as the choice of the algorithm employed, the selection of parameters and the design and choice of input data, even if the specific output was somewhat unpredictable.*

Davies (2011) takes a contrasting view. In a unique proposal, he favours authorship and ownership being allocated to computers. However, he recognises that the creation of secondary rights may be needed to allow the original programmer to benefit from the exploitation of the programme. Allocation of ownership to the AI system would make it necessary to: (i) grant intelligent machines legal personality; and (ii) implement a series of measures (e.g. deposit or insurance schemes) to ensure that financial claims can be addressed in the event of responsibility proceedings. This approach goes far beyond the IP framework. In 2017, the European Parliament invited the European Commission to consider a specific legal status for robots, which could lead to recognising the legal personality of AI (EP 2017a). So far, this invitation has not been taken on board by the Commission or national legislators, with the exception of a debate started by the Estonian government[70] and has received little support from legal scholars.

Pearlman argues for the recognition of AI inventorship. He argues that this would be possible under a framework that 'introduces an IP rights assignment regime like "work-for-hire" and "employed-to-invent" based on the nexus between the AI and the natural persons programming and/or using it' (Pearlman, 2018). This would entail the AI being named inventor, but the rights being instantly awarded to the creator of the AI, the user of the AI, or to both creator and inventor as a joint invention (Pearlman, 2018). In the view of the author, recognising an AI system as an inventor is necessary to be consistent with the objectives of IP law, including serving the public interest in art and science advancements (Pearlman, 2018).

Similarly, Abbott argues that rethinking the boundaries of patent law is a worthwhile endeavour that could allow the recognition of computers as inventors. This has the possibility to provide 'certainty to businesses, fairness to research, and promote the progress of science' (Abbott, 2016). Abbott calls for the recognition of computers as inventors, yet shies away from assigning patent ownership to computers or AI systems. He maintains that anything a computer system generates should be automatically assigned to the computer's owner, as that would be 'most consistent with current ownership norms surrounding personal property (including both computers and patents)' (Abbott, 2017).

Yanisky-Ravid and Liu point out that we live in a new era of machines that are increasingly autonomous without humans being part of the actual inventive act. They argue that traditional patent law has therefore become 'outdated, inapplicable and irrelevant with respect to inventions created by AI systems' (Yanisky-Ravid & Liu, 2017). Yet in contrast to other scholars, they do not call for a change in the law, but for the complete abolition of patent protection for AI-generated inventions. Rather than relying on traditional IP law, they say that AI-generated inventions could be protected by alternative tools,

[69] The author recalls that designating an AI system as inventor in an application for a European patent would lead to rejection in application of Article 81 and 90 of the EPC and Rule 19 of the EPC.

[70] 'Skype's Homeland Grapples With Dilemma of Robot as Legal Person', Bloomberg, 10.10.2017, https://www.bloomberg.com/news/articles/2017-10-10/skype-s-homeland-grapples-with-dilemma-of-robot-as-legal-person.

including but not limited to 'first-mover advantages, social recognition of AIs, and alternative technologies that prevent infringement of rights' (Yanisky-Ravid & Liu, 2017).

What is the best reason for granting patents to AI-generated inventions?

Scholars discussing the eligibility of patents for AI-generated inventions commonly assess this eligibility with reference to the main objectives of the patent system, including the overall net impact the patent would have on innovation, how the patent would lead to dissemination of information, and whether the patent would create incentives for creating new inventions (Firth-Butterfield and Chae, 2018a).

According to Hetman, granting patent protection to AI-generated inventions/works may create a series of negative outcomes, such as market concentration; restraining market entry of other new ventures; and reducing human incentives to create new inventions. At the same time, it can be said that patents on AI-generated assets may be a requirement for: (i) continued investments in AI; (ii) incentivising the dissemination of AI-generated inventions; and (iii) disclosing the usage of AI in the inventive process. Adjustments to the existing law may be necessary to recalibrate the system. These adjustments might include re-establishing inventorship for companies; reducing the duration of patent protection; and rethinking the requirements for patent specifications to make them more concise and easy to interpret (Lauber-Rönsberg & Hetmank, 2019). Similarly, Blok (2017) considers that a 20-year patent may be excessive if AI systems are widely available.

Others have argued that patenting AI-generated inventions by recognising computers as inventors could incentivise the further development of intelligent computers. Thus, Abbot maintains that granting patents could increase incentives to invent, while it 'is true that a computer does not respond to financial incentives, but the entities who develop inventive machines do' (Abbott, 2017).

Fraser stresses the need for policymakers to recognise the possible challenges and benefits that AI-generated inventions can bring and the need to 'continuously examine these developments and their potential effects to ensure that the fundamental rationale and justifications for the patent system are being fulfilled' (Fraser, 2016).

In finding a solution for the protection of AI-generated inventions, scholars have stressed the importance of acknowledging human responsibility for AI, as innovations completely lacking direction and supervision could have negative and unintended consequences. There is therefore always a need for a degree of human responsibility, and future discussions should address how to ensure transparency and accountability (Firth-Butterfield and Chae, 2018a).

5 The interplay between IP and transparency and explainability

The interplay between the implementation of transparency and auditability requirements (critical in the AI regulatory debate[71]) and the preservation of IP rights should also be taken into account[72]. As discussed in the report *Artificial Intelligence: A European Perspective* (Craglia et al. 2018), although transparency and explainability have become key issues in regulating AI, it is not yet clear what this would mean in terms of legal requirements[73].

The need for transparency or explainability is to some extent already present in IP law. As already discussed, Thus in patent law, as inventions seeking patent protection are to be clearly and sufficiently disclosed such that they can be reduced to practice. Under European copyright law, the lawful user of software is entitled to 'observe, study or test the functioning of the program in order to determine the ideas and principles which underlie any element of the program'[74]. However, as highlighted by Noto La Diega (2018), the limited scope of the exception makes it of limited value to algorithm transparency. The author also remains sceptical about the provisions in the Trade Secrets Directive[75] and the experimental-use defences in (UK) patent law.

The tension between explainability and proprietary rights is already present in the provisions of the General Data Protection Regulation (GDPR). It has been argued that the IP rights of the data controller may curtail the data subject's right to access information — in particular the right to access 'meaningful information about the logic involved' in automated decisions (Wachter et al. 2017)[76]. The Data Protection Working Party has also clarified, in relation to Article 15, that 'companies cannot rely on trade secret protection as an excuse to deny access or refuse to provide information, and agreed with a case-by-case approach when balancing both rights'[77]. Malgieri and Comandé (2017) also note that the 'mere disclosure of specific decisions rationales and information about auditing cannot be considered as adversely affecting proprietary assets of data controllers'.

Recent guidelines and studies, while acknowledging this tension, do not detail the mechanisms that could be used to ensure that public and private interests of all the parties involved are sufficiently protected[78]. At the same time, clauses restricting access to source code and proprietary algorithms are being included in trade negotiation agreements

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71 See the recently adopted *Ethics Guidelines for Trustworthy AI* by the European Commission High Level Expert Group on Artificial Intelligence as well as the EC Communication 'Building Trust in Human-Centric Artificial Intelligence', COM(2019) 168 final.
It is worth recalling that non-ethical AI will probably also be excluded under Article 53(a) of the EPC, as it specifies that 'European patents shall not be granted in respect of inventions the commercial exploitation of which would be contrary to "ordre public" or morality; such exploitation shall not be deemed to be so contrary merely because it is prohibited by law or regulation in some or all of the Contracting States'.

72 As sustained by the American scholar Frank Pasquale 'trade secrecy, where it prevails, makes it practically impossible to test whether [engines of reputation, search, and finance's] judgments are valid, honest or fair' (Pasquale 2015: 217).

73 In this sense, the Finnish AI strategy states that 'transparency, accountability and extensively notable societal benefit are held as its general principals. However, it has yet to be specified what these principles mean in practice from the viewpoint of various actors and regulatory systems'.

74 Article 5.3 of the Software Directive.
Article 3(1): ' The acquisition of a trade secret shall be considered lawful when the trade secret is obtained by [...] (b) observation, study, disassembly or testing of a product or object that has been made available to the public or that is lawfully in the possession of the acquirer of the information who is free from any legally valid duty to limit the acquisition of the trade secret'.

76 See also Recital 63 of the GDPR: '*[...] A data subject should have the right of access to personal data which have been collected concerning him or her, and to exercise that right easily and at reasonable intervals, in order to be aware of, and verify, the lawfulness of the processing. Every data subject should therefore have the right to know and obtain communication in particular with regard to [...]the logic involved in any automatic personal data processing and, at least when based on profiling, the consequences of such processing.[...]That right should not adversely affect the rights or freedoms of others, including trade secrets or intellectual property and in particular the copyright protecting the software. However, the result of those considerations should not be a refusal to provide all information to the data subject. [...]*' Emphasis in underline is ours.

77 'Guidelines on Automated individual decision-making and Profiling for the purposes of Regulation 2016/679', 17/EN, WP251rev.01.

78 For a brief overview on how the interplay between transparency and IP is looked at in recent reports (in particular, Ethically Aligned Design (EAD1e), Responsible AI: A Global Policy Framework, and the OECD's AI principles), see Meyer and Fernandez 2019.
The Ethics Guidelines for Trustworthy AI also briefly refer to this issue to clarify that 'auditability entails the enablement of the assessment of algorithms, data and design processes. This does not necessarily imply that information about business models and intellectual property related to the AI system must always be openly available. Evaluation by internal and external auditors, and the availability of such evaluation reports, can contribute to the trustworthiness of the technology. In applications affecting fundamental rights, including safety-critical applications, AI systems should be able to be independently audited.'
A recent study by Castelluccia et al (2019) of the European Parliament on algorithmic decision-making systems (ADS) recommends that '...it should be made clear that reverse engineering for the purpose of analysing, explaining or detecting biases in automatic decision systems (ADS) should be considered lawful and should not be limited by trade secret, or more generally by intellectual property rights laws...

(Koene et al. 2019; Lee-Mkiyama H., 2018). The extent to which these and similar clauses may affect to transparency will depend on the detailed arrangements finally produced (Koene et al. 2019). Beyond this friction, it has been suggested that transparency or explainability can also help elucidate how outputs are generated by AI systems and therefore address questions related to the allocation of intellectual property rights and as well as empower users who are better informed about AI being used in a given system (Sturm et al. 2019). To a certain extent, explainable AI could also contribute to detect infringing uses of IP protected assets and overcome the challenge of determining if a given use is within or outside the scope of exclusive IP rights[79].

In light of the above, it is unquestionable that the IP dimension should be incorporated into the wider debate on: (i) the ethics and legal dimension of AI policies; and (ii) the specific tools and methods to develop trustworthy AI and an appropriate liability and safety framework.

[79] As highlighted by Vesala and Ballardini, 2019, while referring to copyright: "[…] another fundamental challenge specific to NNs is that the workings of neural networks are difficult even to explain and understand. It is therefore hard to determine whether or not reproduction or use takes place within an NN in any particular case".

6 Conclusion

AI strategies have so far paid little attention to the challenges that AI poses to the intellectual-property rights legal framework. However, the increasing importance of AI technologies and the gaps identified by scholars in both the copyright and patent system reveal the need for further investigation of these issues.

On the patentability of AI, the EPO's newly released guidance on patentability criteria for AI is to be welcomed. However, the protection of AI-generated works or inventions seems to be more problematic. In light of the humanistic approach to copyright law, it is questionable whether AI-generated works deserve copyright protection. On laws, although an AI-generated invention may be in principle a patentable subject-matter, the assessment of the inventive step or inventorship attribution also raise policy questions.

Although some copyright scholars clearly advocate for AI-generated works to be placed in the public domain, others have put forward a series of proposals aiming at ensuring a certain level of protection. With notable exceptions, these proposals are still too vague. They do not always sufficiently detail the possible elements underpinning such protection. In particular, this would require laying down: (i) the requirements for the subject-matter to be protected; (ii) the scope and nature of the rights granted (What term? Which acts would require right holders authorisation? Which exceptions or limitations?); and (iii) the allocation of ownership (To the producer, the user or the robot? What about jointly created works?).
There is no doubt that certain AI-generated creations/inventions may share the characteristics of information goods — non-excludable and non-rivalrous in nature —. If there are no enough incentives for the production and commercialisation of those the creation of quasi-monopolistic rights to foster innovation and commercialisation could be justified. However, concerns have been expressed about: (i) the need for incentives, especially in cases where the investment cost is low; and (ii) the consequences of granting such rights on the market, including on innovation and on creations or inventions made by humans (is there any other public interest needing special protection?). Would more property rights encourage or rather deter innovation?

Before favouring one solution or another, further economic and legal research is needed to assess to what extent the creation of new rights is needed at all. Who is/will be producing AI-generated goods? How autonomous are inventive/creative machines? What impact might regulation have on the relevant stakeholders, including artistic and cultural workers? What are the consequences of protection or non-protection? How would disparities in legislation/practices affect European companies? Which legal models should be put in place to address shortcomings, if any? What would be the most efficient allocation of rights?

It goes without saying that the response to these questions may vary depending on the IP rights to be considered. In particular, in relation to copyright, societal and philosophical considerations may also have an influence on how proper rules for a new era of authorship are shaped[80]. However, this dimension is far beyond the purposes of this paper. Last but not least, this paper argues for the incorporation of the IP dimension into the ethical and legal discussion about transparency and accountability to take into account the interests of the rightholders as well as of users and society at large.

[80] For an overview of the evolution of the notion of author and artistic practices along the years, and how laws and rules have reacted to those practices, see S. Dusollier 2018.

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