

# Patentability and Ownership of AI-Generated Technical Solutions

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## I. Introduction

In August 1956, a selected group of scientists, such as John McCarthy, Marvin Minsky, Claude Shannon, Allen Newell and Herbert Simon, gathered at the Dartmouth Sum-

mer Conference, on which the concept of Artificial Intelligence (AI) was first used.<sup>1</sup> McCarthy proposed at the conference that the AI study is “to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described

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that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves".<sup>2</sup> With decades of development, China has kept abreast of the United States, the birthplace of AI, and become the major region for AI research and education.<sup>3</sup> People's attention to AI is no longer limited to the technical field, various legal departments, including the intellectual property department, have embarked on the AI study, and related disputes have emerged in trials. For instance, in *Beijing Film Law Firm v. Beijing Baidu Netcom Science and Technology Co., Ltd.* (a dispute over copyright infringement)<sup>4</sup>, the Beijing Internet Court made beneficial exploration on whether the analytical report automatically generated by database software constitutes a work.

In the field of patents, there are enormous patent applications<sup>5</sup> relating to AI, as well as lawsuits relating to AI, such as an administrative dispute<sup>6</sup> over the invalidation of an invention patent titled "a chatbot system". Since "AI is to simulate, expand and extend human intelligence by means of digital computers or machines controlled by digital computers, perceive the environment and acquire knowledge and use knowledge to obtain optimal theories, methods, technologies and application systems"<sup>7</sup>, there would not be many controversies under the traditional patent law framework as to whether AI *per se*, as "optimal theories, methods, technologies and application systems", is eligible for patent protection and for the ownership of such patent. The Guidelines for Patent Examination even made revisions specifically by adding, into Part II, Chapter Nine, the Section 6 titled "Provisions relating to examination of patent applications for invention containing algorithmic features or business rules and method features" so as to clarify the criteria for examining patent application relating to AI, Internet Plus, big data, block chain, and the like.<sup>8</sup> Due to the wide application of such technologies as genetic programming and neural network, patents have been granted for AI-generated technical solutions in practice<sup>9</sup>. Of course, there are also cases in which AI-generated technical solutions are rejected for patent protection.<sup>10</sup> Thus, whether AI-generated technical solutions are patent-eligible and the ownership of such a patent are new issues<sup>11</sup> that challenge the patent law system formed in the context of industrial society. For the above reasons, this article is not about patent issues related to AI itself, but rather is in an attempt to conduct a pre-

liminary study on whether AI-generated technical solutions are eligible for patent protection, in other words, the patentability of AI-generated technical solutions, and the ownership of the resulting patent.

## II. Patentability of AI-generated technical solutions

The first issue in the context of patent law is whether AI-generated technical solutions are patent eligible. Eligibility for patent protection is a crucial issue under the patent law because it provides the courts with opportunities to reflect on a series of issues facing particular patents, so as to promote or delay the realization of the legal objective in the name of whether the technical solution is eligible for patent protection after balancing the interests between various parties.<sup>12</sup>

In China, discussions on patent-eligible subject matters often center on whether they are technical solutions or abstract rules and methods for mental activities, but not on whether a technical solution generated by "a machine" such as AI other than a natural person qualifies for patent protection. The Guidelines for Patent Examination stipulate that "Invention in the Patent Law refers to any new technical solution concerning a product, a process or improvement thereof. This is a general definition of the subject matters for which patent protection may be sought, rather than a specific examination criterion for the determination of novelty or inventive step."<sup>13</sup> "A technical solution is an aggregation of technical means applying the laws of nature to solving a technical problem. Usually, technical means are embodied as technical features."<sup>14</sup> Because rules and methods for mental activities "do not use technical means or apply the laws of nature, nor do they solve any technical problem or produce any technical effect, they do not constitute technical solutions". Thus, "rules and methods for mental activities not only fail to comply with Article 2.2 of the Patent Law, but also fall into the circumstances as provided in Article 25.1(2) of the Patent Law. Therefore, rules and methods instructing people on how to perform this kind of activities cannot be granted patent rights."<sup>15</sup> However, "if a claim in its whole contents contains not only matter of rule or method for mental activities but also technical features, then the claim, viewed as a whole, is not a rule or method for mental activities, and shall not be excluded from patentability under Article 25 of the Patent Law."<sup>16</sup> At the meantime, latest

researches have noticed the issues regarding patentability of AI-generated technical solutions. There is a view that since the China's Patent Law focuses on the substantive contributions that inventions make, rather than the subjective process for achieving the inventions, neither the process of inventing nor the definition of technical solution requires the presence of "mental acts". Accordingly, if AI-generated technical solutions satisfy patentability requirements, they are eligible for patent protection.<sup>17</sup>

Different from China, scholars in the US often think over whether AI-generated technical solutions are patentable under the Copyright and Patent Clause in the US Constitution. Therefore, it is unavoidable to touch upon issues other than technical solutions. For instance, Clifford contended that only "humans" can become authors or inventors<sup>18</sup>, whereas Miller thought that no precedent, statute or policy precludes a construction of authors (including inventors) to computers.<sup>19</sup> The United States Court of Appeals for the Federal Circuit (the CAFC) holds the same view as Clifford, stating that inventors must be natural persons and the fact that "an invention shall embody the mental part of humans" becomes an import index for testing whether a technical solution is patentable<sup>20</sup>. However, the U.S. Supreme Court indicated in *Goldstein v. California* that according to Intellectual Property Clause in the U.S. Constitution, the terms, such as "writings" of "authors", have not been construed in their narrow literal sense but, rather, with the reach necessary to reflect the broad scope of constitutional principles.<sup>21</sup> In *Diamond v. Chakrabarty*, the U.S. Supreme Court further stated that the subject-matter provisions of the patent law have been cast in broad terms to fulfill the constitutional and statutory goal of promoting "the Progress of Science and useful Arts".<sup>22</sup>

In regard to the patentability of AI-generated technical solutions, it seems that the issue is whether the AI-generated technology belongs to a subject matter that is eligible for patent protection. But in practice, the research actually focuses not on whether the technology is definite and permanent,<sup>23</sup> but on whether the technical solution can be accepted by the existing patent law system. Among others, the most immediate practical issue is the determination of inventors.

### III. Inventors of AI-generated technical solutions

Judging from Article 17 of the Patent Law that "the inventor or designer has the right to be named as such in the patent document", it is a right, rather than an obligation, to indicate the inventor in a patent application. However, Rule 16.3 of the Implementing Regulations of the Patent Law expressly requires that "the description of a patent application for invention or utility model shall clearly state" "the name of an inventor or designer". Thus, the determination of the inventor is a requisite for a patent application for invention or utility model, and likewise, the determination of the designer is also a requisite for a patent application for design.

#### 1. An inventor recorded in the patent document is merely a nominal inventor

Article 13 of the Implementing Regulations of the Patent Law stipulates that inventor or designer means any person who makes creative contributions to the substantive features of an invention-creation; whereas the Guidelines for Patent Examination explicitly state that "[h]owever, the examiner does not examine whether or not the inventor whose name is filled in the request meets the requirements of the above provisions in the procedures of examination of the Patent Office."<sup>24</sup> Except in cases such as disputes over ownership of a right to apply for a patent, ownership of a patent, rewards and remunerations for the inventor/designer of a service invention/design, a right of inventorship of an invention-creation or a right of authorship of a designer, and a right of invention<sup>25</sup>, the determination of an inventor is not critical in patent-related cases. It is highly likely that the inventors in the application form is not authentic. In the U.S., patents have been granted for many technical solutions exclusively completed by AI. In the absence of explicitly stipulated legal provisions concerning the patentability of AI-generated technologies, these patentees choose not to disclose AI's part in the innovation to the United States Patent and Trademark Office.<sup>26</sup> In these situations, the inventors recorded in such patent documents are surely unauthentic.

Furthermore, even when an inventor has been recorded in the patent documents, it is only a *prima facie* presumption, which can be overruled with further evidence. For instance, in *Advanced Evacuation Systems (Israel) Ltd. (AES) v. Beijing Xinhua Antong Technologies Development Co., Ltd. (Xinhua)* (a dispute over patent ownership), Xinhua was recorded as the patentee and its employees were recorded as inventors of the disputed invention patent No. 201410284125.1 with the title of "Escape System for High-

Rise Buildings". Through trial, the court found that the technical solution of the patent came from AES and thus held that AES was the real patentee.<sup>27</sup> Obviously, under such circumstances, the inventors recorded in the patent document as originally filed shall be overruled as well. In *Zhuang Renping v. Beijing Zhongneng Rishite Electric Co., Ltd. and Dalian Lightning Arrester Co., Ltd.* (a third party) (another dispute over patent ownership), Zhuang was recorded as one of the inventors. When he requested the court to determine him as the patentee of the patent in suit and declare the related patent assignment contract and transaction invalid, the court decided that the patent in suit was a service invention and Zhuang was not the true inventor according to the evidence submitted by the defendant and the third party, thereby dismissing all of Zhuang's claims.<sup>28</sup> The Supreme People's Court of the PRC also confirmed in a case that: "in the patent grant process, the state patent administrative department did not conduct a substantive examination as to the inventor recorded in the application documents, and the record of the inventor on the patent certificate did not have absolute evidence efficacy".<sup>29</sup>

Either in China or abroad, the inventor recorded in the patent document is only formally valid; and in most cases, the recordal of inventors is in fact a unilateral and seemingly true statement made by the patent applicant in the exercise of his right to apply for a patent, and the examination authority only requires that such a statement shall indicate the name of a natural person, rather than a legal person or other organization.

## 2. AI *per se* cannot become the inventor of the AI-generated patents

Although there is a view that AI can be qualified as the patentee of an AI-generated patent or at least as its inventor<sup>30</sup>, in retrospect of the history of law, it was through the struggle with gods and other objects that men have understood as the sole legal subjects<sup>31</sup>. "A subject is a man".<sup>32</sup> Even a fictional legal person or other unincorporated organization is a manifestation of man's free will. If the status of a legal subject is surrendered either in whole or in part, it is like taking away the fundamental root of the modern legal system. Therefore, we must keep a completely sober mind as to AI's potential impact on the system regarding the subject of rights under the patent law.

Judging from the existing patent examination standards and specific practices in various countries, the inventor must be a natural person; otherwise, the patent applica-

tion will be rejected. For instance, the China's Guidelines for Patent Examination clearly stipulate that "the inventor shall be individual, and an entity or organization shall not be filed in the request...The inventor shall use his true name other than his pen name or other informal name", which means only a natural person is qualified as an inventor or a designer. The European Patent Office once rejected two patent applications which listed AI as the sole inventor on the grounds that "an inventor designated in the application has to be a human, not a machine"<sup>33</sup>. Either in theory or in practice, it is quite necessary to set up a bridge between AI-generated technical solutions and natural persons. Due to the existence of the fictional legal person, what first came to my mind is that by legal fiction a specific natural person can be designated as the inventor of a patent concerning an AI-generated technology.

## 3. Institutional barrier for fictional inventors of AI-generated patents

The entire ecological chain of AI contains many entities, such as programmers, software companies, AI users, downstream technical experts, and product engineers<sup>34</sup>. Therefore, as for the fictional inventor of an AI-generated patent, it is only from these candidates that we can select the most suitable "person" as the inventors of AI-generated technologies. But meanwhile, legal fiction should not be arbitrary, but must conform to its inherent logic and existent rules. Then, who should be considered as the fictional inventor of an AI-generated invention? We may take a look at two U.S. cases before answering this question.

In *Oasis Research, LLC v. Carbonite, Inc.*<sup>35</sup>, Carbonite argued that Jack Byrd should have been included as an inventor on a data-handling patent because he first conceived the idea for a remote online backup service. The Eastern District of Texas court reasoned that due to his failure to participate in the actual creation of the invention beyond identifying a goal, Byrd was not an inventor. In other similar cases it is generally held that employing another individual to invent does not make one an inventor: an employer requiring others to create a product to realize a certain function cannot become an inventor; and providing monetary support and instructing others to create new technology are not sufficient to constitute invention.<sup>36</sup> Therefore, even if an AI software or system owner is a natural person, he cannot be an inventor in consideration of his contribution to an invention.

In practice, before generating a particular technical so-

lution with AI, it is often necessary for an operator to set the technical field or parameters for the invention to finalize the selection of technical solution. In this case, can programmers, engineers, and technical experts who specifically operate an AI software or system become inventors of the AI-generated patent? In *Nartron Corp. v. Schukra U.S.A., Inc.*<sup>37</sup>, the CAFC held that a contribution of information in the prior art cannot give rise to inventorship. Apparently, programmers, engineers, and technical experts as mentioned above only provide or specify the information known in the technical fields, to which the patent is related, for the generation of AI technical solutions. Following this standard, the fact that a human operates AI is insufficient to qualify that person as an inventor<sup>38</sup>.

In China, Rule 13 of the Implementing Regulations of the Patent Law only stipulates that “any person who, during the course of accomplishing the invention-creation, is responsible only for organizational work, or who offers facilities for making use of material and technical means, or who takes part in other auxiliary functions, shall not be considered as an inventor or designer”, without specifying whether a human operating AI software or an AI system is qualified as an inventor or designer. However, since related technical solutions are exclusively generated by AI and its operators make no substantive contribution to the invention-creation, it is really infeasible to draw such a conclusion that AI software or platform operators are inventors.

#### 4. Designating inventors by applicants of AI-generated patents

Since there are obstacles in the present legal system to directly determine the inventors of AI-generated patents in advance by means of fiction, is it possible to find another solution? The author opines that the patent document only records a nominal inventor according to the unilateral and not-necessarily-true statement made by the patent applicant (i.e., the patentee of the granted patent) who exercises its right to apply for a patent, the examination authority does not conduct substantive examination on the inventorship, and the inventor’s name can be changed through subsequent remedial procedures. In view of the above facts, it may be better to show respect for the autonomy of will and let the patent applicant designate a nominal inventor, instead of mandatory fiction in advance.

The inventor designated in this manner may not be the person who really makes substantive contributions to the invention-creation. But “the existence of the law is to protect

freedom”<sup>39</sup>. Putting aside empty theoretical disputes and from the perspective of respecting civil rights, like the right to apply for a patent and subsequent patent right, the most realistic and feasible way is to let the one who should own the AI-generated patent to choose a natural person as the inventor according to its will or any agreement. Those granted AI-generated patents are exactly the result of the “tacit understanding” between patentees and patent examination authority.

In this sense, the key issue is how to determine the ownership of an AI-generated patent: who is the owner of such a patent?

## IV. Ownership of AI-generated patents

AI is not a subject in the sense of laws. Since it is not eligible as an inventor of a patent, it is unlikely to be the owner of such a patent.<sup>40</sup>

As stated above, “AI is to simulate, expand and extend human intelligence by means of digital computers or machines controlled by digital computers, perceive the environment and acquire knowledge and use knowledge to obtain optimal theories, methods, technologies and application systems”,<sup>41</sup> the core of which is computer software employed by AI. Although many entities, such as programmers, software companies, AI users, downstream technical experts and product engineers,<sup>42</sup> will be proposed in the discussion about patentees of AI-generated technical solutions, the most possible candidates are actually users of computer software and owners (or copyright owners) of computer software, considering the employment relationship and the fact that sophisticated AI software is often possessed by companies as legal persons.

### 1. Two different opinions

There is a view that owners or licensors of AI software shall possess the patent rights granted for all technologies generated by the AI.<sup>43</sup> A similar view is found in connection with the copyright ownership of AI-generated products. For instance, some scholars contend that if AI software users or programmers make no creative effort for a work, “the court shall grant the work copyright to the copyright owner of the software”<sup>44</sup>.

The opposite view is that the persons who utilize AI software, i.e. the users, shall own the patent rights of AI-generated technical solutions.<sup>45</sup> This view also prevails in the copyright field, as Samuelson once said that the copyright

in software-generated works shall be allocated to the computer software user because the user is one most responsible for the work according to the requirements for copyright grant.<sup>46</sup>

## 2. Enlightenment of Coase Theorem

According to economic theories, competitive markets shall be in pursuit of economic efficiency, i.e., a party cannot be made better off without cutting into the pleasures of the other party, the goal of which is called Pareto efficiency or allocative efficiency. Such efficiency also applies to the patent law.<sup>47</sup> An authoritative theory to realize this efficiency is the famous Coase theorem, that is to say, with clear allocation of property rights and in a regime of zero transaction costs, negotiations between the parties would lead to those arrangements being made which would maximize wealth and this irrespective of the initial assignment of rights.<sup>48</sup> Despite that a regime of zero transaction costs is merely a theoretical hypothesis, it is still possible to achieve the goal of maximizing wealth to the largest extent by means of gradually reducing transaction costs. Of course, I cannot go on without talking about externality.

Externality is the side effect of market subjects' activities; however, the subjects do not assume all the consequences or benefit therefrom.<sup>49</sup> Such a side effect presents a policy issue because a divergence is caused between private and social marginal costs, and enterprises may make a choice according to their private economic benefits without considering the social costs or interests. Under many circumstances, enterprises would make a decision at a non-effective level for the sake of self-interests. Nevertheless, the Coase Theorem minimizes those concerns, for it believes that with clear assignment of property rights, the resources will be effectively allocated in a regime of zero transaction costs and with full information, irrespective of how property rights were initially assigned.<sup>50</sup>

While the Coase Theorem deals with a negative externality, it is likewise applicable to situations involving positive externalities — external benefits created by market activity. Patenting AI-generated technical solutions is properly treated as such because — depending on how the government allocates the right to obtain a patent — it potentially creates benefits for parties outside the initial sale of software (e.g., software programmers, engineers, product designers, downstream users or owners of the software, etc.).<sup>51</sup>

Based on the Coase Theorem, Schuster conducted analysis of external factors of AI: in the presence of positive

externalities, firms underproduce goods for sale because they base manufacturing decisions only on the value inherent in the good (e.g., the value of the inventing AI), rather than considering the net social value created (e.g., the AI patents). This is not an economically efficient situation, as one party's (the public's) situation could be improved, but the producer will cease production of AI software.<sup>52</sup>

Starting from the hypothetical premise of the Coase Theorem, within the bounds of no transaction costs and perfect information, the ownership of AI-generated technical patents is rendered superfluous. It does not matter to whom the patent rights are allocated because the party that most values them will purchase the patent and this value will trickle upstream to the software company. However, as pointed out by Schuster, in an attempt to make the ownership of AI-generated patents mimic an idealized Coasean state, the best way is to eliminate or decrease the number of transaction costs and parties involved in a transaction, thereby maximizing economic benefits and social wealth.<sup>53</sup> Therefore, the corollary is that patent rights shall be allocated to parties who hold these patents in highest value.

## 3. Optimum solution of patent ownership

In the entire ecological chain of AI, except the persons who utilize AI software (AI users), subjects (such as software programmers, downstream technical experts and product designers) cannot independently conduct relevant acts due to employment relationship; and subjects (such as AI software manufacturers) are unable to sensitively find out the field and direction that need further development with the help of AI due to lack of knowledge on market demands. Thus, all of them fail to maximize the value of AI. As a result, they would not put more investment in AI and AI-generated technical solutions in comparison with AI software users.

For the above reasons, the author thinks that AI software users are those who most value the patents. In accordance with the Coase Theorem, AI software users should receive the patent rights granted for AI-generated technical solutions.

In current actual situations, the AI software is usually developed with a sophisticated process, so the subjects that can obtain the software ownership or the right of use through market transactions are usually corporations with abundant capital. It cannot, however, be excluded that with the advance and popularity of technologies, development costs of AI software may go down, and it will be possible for



small and micro enterprises and individuals to own or use AI through purchasing or licensing, and in turn obtain the patent rights of AI-generated technical solutions.

## V. Conclusion

As far as technologies are concerned, the patent law poses no obstacles for patenting AI-generated technical solutions. Theoretically speaking, the problem that AI is not qualified as a legal subject and therefore cannot become an inventor of AI-generated technical solutions can surely be solved with techniques. From the perspective of the exercise of rights, how to record inventors is purely the manifestation of the exercise of patent rights by patent applicants (which are also patentees after the patent grant), and the autonomy of will of a party shall be respected by law. The key issue in patent protection of AI-generated technologies is in fact the ownership of the patent rights. With the help of the Coase Theorem in economics, it is not hard to find that assigning patent rights of AI-generated technical solutions to users who most cherish and value AI software is most effective and can maximize the social wealth. ■

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<sup>1</sup> Nick. *A Brief History of Artificial Intelligence* (2017 edition, pp 1-9). Posts & Telecom Press under China Industry and Information Technology Publishing & Media Group.

<sup>2</sup> J McCarthy, ML Minsky, N Rochester, CE Shannon (2006). A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence. *Journal of Molecular Biology*, 278 (1), 279-289.

<sup>3</sup> WIPO (2019). *WIPO Technology Trends 2019: Artificial Intelligence* (p. 6). Geneva: World Intellectual Property Organization.

<sup>4</sup> See the Civil Judgment No. Jing 0491 Minchu 239/2018 issued on 24 April, 2019.

<sup>5</sup> For instance, the invention patent No. 201180004193.2 and titled "Data Acquisition Method of Large - Scale Network and Network Node"; the invention patent No. 201610606305.6 and titled "System for Collecting and Analyzing Mobile Phone Data"; and the invention patent No. 201610327324.5 and titled "Artificial Neural Network Processor Integrated Circuit and Design Method Thereof".

<sup>6</sup> See the Administrative Judgment No. Gaoxing(zhi)zhongzi 2935/2014 issued on 21 April, 2015.

<sup>7</sup> China Electronics Standardization Institute. *Artificial Intelligence Standardization White Paper* (2018, p. 5). Retrieved from <http://www.cesi.ac.cn/images/editor/20180124/20180124135528742.pdf>. Last visited on 29 December, 2019.

<sup>8</sup> See the CNIPA's Announcement (No. 343). The revised Guidelines for Patent Examination took effect on 1 February, 2020.

<sup>9</sup> U.S. Patent No. 6,847,851 (filed July 12, 2002). See Ryan Abbott (2016). I Think, Therefore I Invent: Creative Computers and the Future of Patent Law, 57 Boston College Law Review 1079, 1086.

<sup>10</sup> Sarah Morgan. EPO rejects 'AI inventor' patent applications, 2019-12-23, Retrieved from <http://www.worldipreview.com/news/epo-rejects-ai-inventor-patent-application-19057>. Last visited on 30 December, 2019.

<sup>11</sup> Ryan Abbott (2016). I Think, Therefore I Invent: Creative Computers and the Future of Patent Law, 57 Boston College Law Review 1079, 1081.

<sup>12</sup> Robert P. Merges & John F. Duffy. *Patent Law and Policy: Cases and Materials* (7th. Ed.). Carolina Academic Press, 2017, Chapter 2, A., page 163.

<sup>13</sup> The Guidelines for Patent Examination 2010 (Revised Edition) (June, 2017 edition, p 119).

<sup>14</sup> See *ibid*.

<sup>15</sup> See supra note 13, p 123.

<sup>16</sup> See supra note 13, p 124.

<sup>17</sup> Liu Youhua and Li Xinfeng (2019). Study on criteria for assessing inventiveness of AI-generated technical solutions. *Intellectual Property*, 11, 40 and 42.

<sup>18</sup> Ralph D. Clifford (1997). Intellectual Property in the Era of the Creative Computer Program: Will the True Creator Please Stand Up? 71 TUL. L. REV. 1675, 1701.

<sup>19</sup> Arthur R. Miller (1993). Copyright Protection for Computer Programs, Databases, and Computer-Generated Works: Is Anything New Since CONTU? 106 HARV. L. REV. 977, 1067.

<sup>20</sup> *University of Utah v. Max-Planck-Gesellschaft Zur Forderung Der Wissenschaften EV.*, 734 F.3d 1315, 1323 (Fed. Cir. 2013).

<sup>21</sup> *Gordstein v. California*, 412 U.S. 546, 561 (1973).

<sup>22</sup> *Diamond v. Chakrabarty*, 447 U.S. 303 (1980).

<sup>23</sup> *Burroughs Wellcome Co. v. Barr Laboratories, Inc.*, 40F.3d 1223, 1229 (Fed. Cir. 1994).

<sup>24</sup> See supra note 13, p15.

<sup>25</sup> See the relevant provisions of the Supreme People's Court's Provisions on the Cause of Action of Civil Cases (No. Fafa 42/2011).

<sup>26</sup> W. Michael Schuster (2018). Artificial Intelligence and Patent Ownership. 75 WASH. & LEE L. REV. 1945, 1948.

<sup>27</sup> See the Civil Judgment No. Jingminzhong 190/2019.

<sup>28</sup> See the Civil Judgment No. Jingminzhong 522/2018 and the Civil Ruling No. Zuigaofaminshen 888/2019.

<sup>29</sup> See the Civil Ruling No. Zuigaofaminshen 4145/2017.

<sup>30</sup> Deng Jianguo and Cheng Zhiting (2019). Challenges of artificial intelligence to patent protection system and its countermeasures. *Journal of Nanchang University*, 4, 15-24.

<sup>31</sup> Ou Jialu. Tracing the concept of civil subjects—In the context of Greek and Roman society. Carried in Xiao Houguo (editor-in-chief). *On the Philosophy of Civil Law (Vol. I)* (2009 edition, pp. 22-58). Law Press•China.

<sup>32</sup> “The universality of this will which is free for itself is formal universality, i.e. the will’s self-conscious (but otherwise contentless) and simple reference to itself in its individuality; to this extent, the subject is a person.” See Hegel (GE). Fan Yang and Zhang Qitai (translators). *Elements of the Philosophy of Right* (1961 edition, p 44). The Commercial Press.

<sup>33</sup> See supra note 10.

<sup>34</sup> W. Michael Schuster (2018). Artificial Intelligence and Patent Ownership, 75 WASH. & LEE L. REV. 1945, 1977.

<sup>35</sup> No. 4:10-CV-00435, 2015 WL 123642 (E.D. Tex. Jan. 8, 2015).

<sup>36</sup> *Nartron Corp. v. Schukra U.S.A. Inc.*, 558 F.3d 1352, 1359 (Fed. Cir. 2009); *Ethicon, Inc. v. U.S. Surgical Corp.*, 937 F. Supp. 1015, 1035 (D. Conn. 1996); *TS Holdings, Inc. v. Schwab*, No. 09-CV-13632, 2011 WL 13205959, at \*4 (E.D. Mich. Dec. 16, 2011).

<sup>37</sup> *Nartron Corp. v. Schukra U.S.A. Inc.*, 558 F.3d 1352, 1359 (Fed. Cir. 2009).

<sup>38</sup> W. Michael Schuster (2018). Artificial Intelligence and Patent Ownership, 75 WASH. & LEE L. REV. 1945, 1950.

<sup>39</sup> Friederick Carl von Saviny, *System des heutigen Romischen Rechts* I (Berlin, 1840-8), 331-2. James Gordley. Zhang Jiayong (translator). *Foundations of Private Law: Property, Tort, Contract, Unjust Enrichment* (2007 edition, p 21). Law Press•China.

<sup>40</sup> Of course, there is an opposite view. Some scholars agree that it is possible to recognize a computer as a legal person in their studies. See Erica Fraser (2016). Computer as Inventor: Legal and Policy Implications of Artificial Intelligence on Patent Law, 13 SCRIPT-ED 305, 330.

<sup>41</sup> See supra note 7.

<sup>42</sup> See supra note 34.

<sup>43</sup> Ryan Abbott (2016). I Think, Therefore I Invent: Creative Computers and the Future of Patent Law, 57 Boston College Law Review 1079, 1082.

<sup>44</sup> Andrew J. Wu, From Video Games to Artificial Intelligence: Assigning Copyright Ownership to Works Generated by Increasingly Sophisticated Computer Programs, 25 AIPLA Q.J. 131, 138 (1997).

<sup>45</sup> See supra note 26.

<sup>46</sup> Pamela Samuelson (1986). Allocating Ownership Rights in Computer - Generated Works, 47 U. PITT. L. REV. 1185, 1203; Xie Lin and Chen Wei (2019). The solution to the copyright dilemma of AI products under the rule of fictional author. *Journal of Law Application*, 9, 38-47.

<sup>47</sup> *Willingham v. NovaStar Mortg., Inc.*, No. 04 - CV - 2391, 2006 WL6676801, at\*19 (W.D. Tenn. Feb. 7, 2006).

Stephen S. Ellis and Grant M. Hayden (2010). The Cult of Efficiency in Corporation Law, 5 VAL. & BUS. REV. 239, 241.

<sup>48</sup> Jeanne L. Schroeder (1998). The End of the Market: A Psychoanalysis of Law and Economics, 112 HARV. L. REV. 483, 527.

Jeff Sovern (2009). The Coase Theorem and the Power to Increase Transaction costs, 40 MCGEORGE L. REV. 935, 935 n.1.

<sup>49</sup> Wendy E. Wagner (2002). What’s It All About, Cardozo? 80 TEX. L. REV. 1577, 1586.

Thomas A. Donovan (2007). Litigation: An Antidote for Democracy, 54 FED. LAW. 8, 9.

<sup>50</sup> R. H. Coase (1960). The Problem of Social Cost, 3 J.L. & ECON. 1, 15.

<sup>51</sup> Paul E. McGreal (2016). On the Cost Disease and Legal Education, 66 SYRACUSE L. REV. 631, 637.

<sup>52</sup> W. Michael Schuster (2018). Artificial Intelligence and Patent Ownership, 75 WASH. & LEE L. REV. 1945, 1976.

<sup>53</sup> W. Michael Schuster (2018). Artificial Intelligence and Patent Ownership, 75 WASH. & LEE L. REV. 1945, 1979-1980.