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Alice in the Land of Artificial Intelligence: Some Practical Ways to Help Survive "Abstract Idea" Challenges Under Section 101

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I. INTRODUCTION

The next technological revolution centers around artificial intelligence (AI), which many believe is leading to the Fourth Industrial Revolution, comparing its historical impact to steam engine and electricity.[1] Numerous breakthroughs in artificial intelligence in recent years have been made possible by the progression of Moore's Law, cheap computer power and availability of big data.[2]

The term "artificial intelligence" was first coined in 1955 by computer scientist John McCarthy, known as "Father of AI", and is defined as "the science and engineering of making intelligent machines, especially intelligent computer programs."[3] A more recent definition of AI technologies and systems was given by the U.S. National Institute of Standards and Technology (NIST) as a technology or system that "comprise of software and/or hardware that can learn to solve complex problems, make predictions or undertake tasks that require human-like sensing

1. *See, e.g.*, RESPONSIBLE AI: A GLOBAL POLICY FRAMEWORK, (ITECHLAW International Technology Law Association, 1st ed. 2017); World Economic Forum, "What is the Fourth Industrial Revolution" (19 January 2016), https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution.

2. *See, e.g.*, *Technology At Work v4.0*, Citi GPS: Global Perspectives & Solutions (June 2019), https://ir.citi.com/%2Bsi3%2BYKA2e3WrSalzmOchzHQqPUAersOy9%2BRj9AQRfQk%2Bhsikx7zf5aSLAsAXNWO26TTlD49IYM%3D

3. *See* John McCarthy, *What is AI? / Basic Questions*, Professor John McCarthy – Father of AI, (last visited Mar. 17, 2021), http://jmc.stanford.edu/artificial-intelligence/what-is-ai/index.html

(such as vision, speech, and touch), perception, cognition, planning, learning, communication, or physical action."[4]

Around the world, governments and private sectors are investing billions of dollars each year into the research and development of AI technologies and systems.[5] "Globally, we estimate tech giants spent $20 billion to $30 billion on AI in 2016, with 90 percent of this spent on R&D and deployment, and 10 percent on AI acquisitions."[6] China is making huge AI investment as part of what Beijing calls "Made in China 2025" – a master plan to reposition China as an industrial superpower of the future.[7] "China is said to have accounted for more than half of all global AI investment over the last five years and in just the next three years alone Beijing expects a tenfold increase in the size of the industry."[8]

Given this level of investments into the AI research and development, it should not be surprising that AI-related patent applications have mushroomed in the same time period. According to a report published in October 2020 by the United States Patent and Trademark Office (USPTO), the number of AI patent applications received annually by the USPTO grew from 30,000 in 2002 to more than 60,000, more than doubled, in 2018.[9] The report cited many

4. NIST (2019), 7-8. In a leading textbook, Russell and Norvig (2016) define AI broadly as the development of machines capable of undertaking human activities in four areas: thinking humanly, acting humanly, thinking rationally, and acting rationally.

5. *See, e.g.*, McKinsey Global Institute, *Artificial Intelligence, The Next Digital Frontier?* (Discussion paper) (June 2017) https://www.mckinsey.com/~/media/McKinsey/Industries/Advanced%20Electronics/Our%20Insights/How%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/MGI-Artificial-Intelligence-Discussion-paper.ashx.

6. *Id.*

7. *See* Jarrod Fankhauser, *Made in China 2025: Xi Jinping's plan to turn China into the AI world leader*. ABC News (posted Oct. 5, 2018), https://www.abc.net.au/news/2018-10-06/china-plans-to-become-ai-world-leader/10332614.

8. *Id.*

9. New benchmark USPTO study finds artificial intelligence in U.S. patents rose by more than 100% since 2002. https://www.uspto.gov/about-us/news-updates/new-benchmark-uspto-study-finds-artificial-intelligence-us-patents-rose-more.

findings with statistics suggesting an exponential advancement in the field of AI technology and applications in the recent decades.[10] According to the study,

- "Patents containing AI appeared in about 9% of all technology subclasses used by the USPTO in 1976 and spread to more than 42% by 2018."
- "The percentage of inventor-patentees who are active in AI started at 1% in 1976 and increased to 25% by 2018. Growth in the percentage of organizations patenting in AI has been similar."
- "AI diffusion is occurring widely across the United States. For example, inventor-patentees in Oregon are using AI in fitness training and equipment, and in North Dakota, AI is used in agriculture."

Ironically, there has been little confidence among stakeholders and practicing patent attorneys in obtaining patent protection for the heavily-invested and life-changing AI inventions, as protecting software inventions (or computer implemented inventions) in general has become increasingly difficult since the U.S. Supreme Court's 2014 decision in *Alice Corp. v. CLS Bank International*[11].[12]

The patent statute 35 U.S.C. §101 defines four categories of patentable subject matters: process, machine, manufacture, or composition of matter. The Supreme Court has long determined three judicial exceptions as patent ineligible, including laws of nature, natural phenomena, and abstract ideas. In two watershed decisions only two years apart, *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*[13] and *Alice Corp. v. CLS Bank International*,[14] the Supreme Court confirmed these subject matter exceptions and set forth a two-step analysis framework that applies to all three exceptions. The two-step analysis framework consists of 1)

10. *Inventing AI: Tracing the diffusion of artificial intelligence with U.S. patents.* https://www.uspto.gov/sites/default/files/documents/OCE-DH-AI.pdf.
11. 134 S. Ct. 2347 (2014).
12. *See, e.g.,* RESPONSIBLE AI: A GLOBAL POLICY FRAMEWORK, (ITECHLAW International Technology Law Association, 1st ed. 2017).
13. 132 S. Ct. 1289 (2012) (holding that patent claims directed to certain medical diagnostic methods were not patent eligible under 35 U.S.C. §101).
14. 134 S. Ct. 2347 (2014).

whether an invention is directed to one of the aforementioned judicial exceptions to subject matter eligible for patenting[15], and if so, 2) whether the invention's additional element or combination of elements amount to "significantly more" to "transform the nature of the claim" into a patent-eligible application.[16] Although the *Alice/Mayo* framework is applicable for all judicial exceptions, with respect to software and AI related inventions, the relevant exception is whether the invention is directed to an "abstract idea".[17] The Supreme Court has expressly declined to define the term, "[i]n any event, we need not labor to delimit the precise contours of the 'abstract ideas' category in this case."[18]

The *Alice* Court determined that a method of facilitating business transaction that was merely implemented by a computer was an "abstract idea" that was patent ineligible.[19] Since *Alice*, the courts have invalidated large categories of computer implemented inventions, beyond simply business methods, under this "abstract idea" exception of §101 patent eligible subject matter.[20] Because AI technologies and systems necessarily involve the use of mathematical formulas and software algorithms, the impact of *Alice* is also felt in the AI world, especially when the lower Courts take a broad view in interpreting "abstract idea" and treat features fundamental to AI technologies such as data collection, data analysis and result display all under the umbrella of "abstract idea".[21]

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15. 132 S. Ct. at 1296-1297.
16. 132 S. Ct. at 1294, 1298.
17. *See, e.g.*, Manny Schecter, *Congress Needs to Act So Alice Doesn't Live Here (in the Patent System) Anymore*. (13 February 2017), online: *IP* Watchdog, https://www.ipwatchdog.com/2017/02/13/congress-needs-to-act-so-alice-doesnt-live-here-in-the-patent-system anymore/id=78241.
18. Justice Thomas, Alice Corp v. CLS Bank Int'l, 134 S. Ct. 2347 (2014).
19. 134 S. Ct. at 2352.
20. *See., e.g.,* RESPONSIBLE AI: A GLOBAL POLICY FRAMEWORK, (ITECHLAW International Technology Law Association, 1st ed. 2017).
21. Iancu, Andrei. 2019. "The Current State of Innovation within the U.S. Legal System." Speech, New York City, March 22, 2019. *Journal of the Patent and Trademark Office Society* 101, no. 1 (2019): 11-18.

There have been many criticisms that the judicially-created *Alice* (or *Alice/Mayo*) test is unworkable due to the absence of a clear definition of the term "abstract idea", and creates significant inconsistencies in decisions due to lack of certainty and predictability. Former Under Secretary of Commerce and Director of the U.S. Patent and Trademark Office, David Kappos, has described post-*Alice* §101 jurisprudence as "out of control".[22] There have been calls for legislative actions and reforms from Congress to restore consistency and predictability while reducing the risk of foreclosing patent protection for breakthrough innovation.[23]

Notwithstanding the widespread uncertainty in the post-*Alice* §101 jurisprudence, *Alice* is the current law. To increase the chance of avoiding defeat by *Alice*, the key is in surviving the "abstract idea" challenge at *Alice/Mayo* step one, instead of trying to save it under step two after a finding that the claim is directed to an abstract idea. The purpose of this paper is to (1) highlight the Supreme Court's distinction between basic principles and tools that are ineligible for patent protection because they are building blocks of science and technology, and practical applications of such principles and tools that should remain patent eligible; (2) propose ways to improve the chances of surviving *Alice/Mayo* test at step one by clearly stating a technical problem and describing a specific solution while avoiding broad claims construction, based on the considerations laid out by the Supreme Court and Federal Circuit; and (3) distinguish AI from "mental process" by emphasizing AI's evolving nature based on continued learning and its complexity and efficiency that are far beyond what a human mind can accomplish in any reasonable or practical manner.

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22. *See* Susan Decker, *When a Tech Patent is Neither*, BloombergBusinessWeek, August 17, 2016, http://www.bloomberg.com/news/articles/2016-08-17/why-hundreds-of-software-patents-are-being-thrown-out.

23. *See, e.g.*, Manny Schecter, *Congress Needs to Act So Alice Doesn't Live Here (in the Patent System) Anymore.* (13 February 2017), online: *IP* Watchdog, https://www.ipwatchdog.com/2017/02/13/congress-needs-to-act-so-alice-doesnt-live-here-in-the-patent-system-anymore/id=78241.

II. DESPITE LACK OF CLEAR DEFINITION, JURISPRUDENCE UNDER "ABSTRACT IDEA" CONTINUES TO EMPHASIZE THE DISTINCTION BETWEEN BASIC PRINCIPLES AND PRACTICAL APPLICATIONS OF SUCH PRINCIPLES

A. Pre-emption as the Underlying Concern of §101 Exceptions, including "Abstract Idea", Separates Basic Principles from Practical Applications

Long before *Mayo* and *Alice*, the Supreme Court had repeatedly emphasized the distinction between two types of subject matters with the underlying concern of patent monopoly preempting productive and creative use of fundamental principles and tools. *See*, *e.g.*, *O'Reilly v. Morse*[24] (finding Morse's eighth claim unpatentable because it was so broadly drafted and construed that it would virtually cover all then-existing and any future long-distance communication technologies using electromagnetic current.) *See also*, *Gottschalk v. Benson*[25], a case involving a mathematical formula without "substantial practical application," where the Court stated:

> It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting BCD [binary coded decimal] numerals to pure binary numerals were patented in this case. The mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment below is affirmed, the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself.[26]

Both *Mayo* and *Alice* reemphasized this preemption concern and tried to draw the line between patents that claim the building blocks of human ingenuity and those that integrate the

24. 56 U.S. 62 (1854).
25. 409 U.S. 63 (1972).
26. *Id.* at 71-72.

building blocks into something significantly more, thereby transforming them into a patent-eligible invention.[27]

Therefore, it is clear that although the exact contour of "abstract idea" has not been defined, on the wide spectrum, from principles as basic and fundamental as electricity per se to its concrete and tangible applications as Thomas Edison's patent No. 223,898 on a practical incandescent light bulb used for the domestic use of electric light, the closer a claim is directed to the practical application end, the more likely it will survive *Alice*. On the other hand, the more a claim looks and sounds like a fundamental principle, the more likely it will be treated as one of the judicial exceptions such as "abstract idea" under *Alice*. Using three important cases with sweeping impact on software and AI inventions, including the famous *Mayo* and *Alice* Supreme Court dual decisions and a Federal Circuit 2016 decision in *Electric Power Group, LLC v. Alstom S.A*,[28] the next subsection provides a more in-depth discussion on how the Courts found these disputed claims as patent-ineligible basic principles.

B. Claims Involving Basic Principles and Tools without Substantial Practical Application Have Been Found to be Ineligible Subject Matter

The Supreme Court's decision in *Mayo*[29] led to its *Alice* decision two years after, and the dual have had sweeping impact on the §101 eligible subject matter analysis across the board including medical diagnostic methods, business methods, software programs, and AI.[30] The

27. Mayo Collab. Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1293-1294 (2012). *See also*, *Alice*, 134 S. Ct. at 2354 (expressing the same idea that certain types of fundamental discoveries should not be granted monopoly through patents, because such discoveries represent basic tools or building blocks of science and technology and their future use by others should not be pre-empted).

28. 830 F.3d 1350 (Fed. Cir. 2016).

29. *Mayo,* 132 S. Ct. 1289 (2012).

30. 2019 Revised Patent Subject Matter Eligibility Guidance, A Notice by the Patent and Trademark Office (Jan. 7, 2019).

claims in *Mayo* involved a method utilizing newly discovered precise correlations between metabolite levels in a patient's blood and the likelihood that a particular dosage of a thiopurine drug could cause harm or prove ineffective for calibrating the proper dosage of a drug for treating autoimmune diseases.[31] The Supreme Court found that the claims were directed to unpatentable natural correlations as "laws of nature," and that the claimed series of steps "simply tell doctors to gather data from which they may draw an inference in light of the correlations."[32] Importantly, even though the claims in *Mayo* applied a basic principle in a practical process, the Supreme Court did not think that simply applying the law was enough to transform an unpatentable law of nature into a patent-eligible application of such law:

> [i]f a law of nature is not patentable, then neither is a process reciting a law of nature, unless that process has additional features that provide practical assurance that the process is more than a drafting effort designed to monopolize the law of nature itself. A patent, for example, could not simply recite a law of nature and then add the instruction "apply the law."[33]

The Supreme Court's above reasoning, along with its 2014 decision in *Alice*, made clear that simply adding the limitation of "applying" basic principles, or its equivalent, such laws of nature, natural phenomena and abstract ideas would not be enough to cross the line from patent-ineligible subject matter to patent-eligible practical applications.

Alice is particularly relevant to the analysis for software and AI related inventions, because it involved a method using a software program on a computer to facilitate certain business transactions.[34] The *Alice* Court held that claims drawn to a method using a computer system as a third-party intermediary to mitigate settlement risk in financial transactions recited an abstract

31. *Mayo*, 132 S. Ct. at 1295, 1296, 1298.
32. *Id.* at 1298.
33. *Id.* at 1297.
34. *Alice*, 134 S. Ct. 2347 (2014).

idea and therefore is not patent-eligible under 35 U.S.C. §101.[35] Following *Mayo*'s two-step framework, the Court found at the step-one analysis that the claims were directed to the concept of intermediated settlement, which was a fundamental economic practice long prevalent in our system of commerce.[36] At the second step of the *Mayo* framework, the *Alice* Court concluded that mere requirement for "generic computer implementation" was not enough to transform the abstract idea of intermediated settlement into a patent-eligible invention. Specifically, the Court determined that the "generic computer" components performed merely "well-understood, routine, conventional" computer functions previously known to the industry, and that "[v]iewed as a whole, petitioner's method claims simply recites the concept of intermediated settlement as performed by a generic computer."[37]

If *Alice* is thought to have dramatically influenced the §101 eligible subject matter analysis for software inventions in general, then perhaps the Federal Circuit's 2016 decision in *Electric Power Group, LLC v. Alstom S.A.* is even more relevant to AI-related inventions in particular because of the claims' recitation of real-time data collection, processing and display using computer systems.[38] Three of Electric Power Group's patents claimed systems and methods for performing real-time performance monitoring of an electric power grid by collecting data from multiple data sources, analyzing the data, and displaying the results. The Federal Circuit agreed with the district court's finding that the asserted patent claims were a collection of abstract ideas without adding any inventive concept in the claims' limitations by stating:

> Though lengthy and numerous, the claims do not go beyond requiring the collection, analysis, and display of available information in a particular field, stating those functions in general terms, without limiting them to technical means

35. *Id.* at 2352.
36. *Id.* at 2356.
37. *Id.* at 2359.
38. 830 F.3d 1350 (Fed. Cir. 2016).

> for performing the functions that are arguably an advance over conventional computer and network technology. The claims, defining a desirable information-based result and not limited to inventive means of achieving the result, fails under §101.[39]

The Circuit in *Electric Power Group* apparently took a very broad interpretation of "abstract idea" under the *Alice/Mayo* framework, and it made sweeping statements:

> [W]e have treated collecting information, including when limited to particular content (which does not change its character as information, as within the realm of abstract ideas. … In a similar vein, we have treated analyzing information by steps people go through in their minds, or by mathematical algorithms, without more, as essentially mental processes within abstract-idea category. … And we have recognized that merely presenting the results of abstract processes of collecting and analyzing information, without more (such as identifying a particular tool for presentation), is abstract as an ancillary part of such collection and analysis.[40]

Data collection and analysis are quintessential to software and AI technologies and systems. Treating them as "abstract ideas" at *Alice/Mayo* step one, even though the Supreme Court has not made such declaration in any of its precedents, makes obtaining patent protection even more unpredictable and difficult for these types of inventions despite the enormous stakeholder investments and the apparent usefulness of such inventions.

III. POTENTIAL WAYS TO SURIVIVE *ALICE/MAYO* TEST STEP ONE BY CLEARLY STATING A TECHNICAL PROBLEM AND DESCRIBING A SPECIFIC SOLUTION WHILE AVOIDING BROAD CONSTRUCTION

Despite the ambiguity of the "abstract idea" concept and its gloomy impact on subsequent software and AI inventions, the *Alice* Court made clear that "an invention is not rendered

39. *Id.* at 1351.
40. 830 F.3d at 1353-1354.

ineligible for patent simply because it involves an abstract concept," and that the application of an abstract concept to a new and useful end remains eligible for patent protection.[41]

A. Claims Clearly Stating a Technological Problem and Describing a Specific Solution Have Better Chance of Surviving *Alice/Mayo* at Step One

As the Courts found the various claims directing to patent-ineligible basic principles in the above discussed cases, we were also given some guidance on how to overcome the subject matter challenge through specific limitations that describe tangible solutions to some well-defined technological problems. The *Alice* Court contrasted the claim seeking to patent a fundamental economic practice with what it characterized as those seeking to solve "technological problems" that remain to be patent-eligible.[42] The Court clarified their earlier decision in *Diamond v. Diehr*[43] using this distinction.[44] *Diehr* involved a process that implemented a well-known mathematical formula with a computer to monitor and control the curing of synthetic rubber.[45] The Supreme Court held that Diehr's claimed process was patentable subject matter within §101, because it found that Diehr did not seek to patent a mathematical formula per se, but rather the claims were designed to improve the process of curing synthetic rubber and solve specific technological problems of under-curing or over-curing the rubber.[46] The *Alice* Court explained that the claims in *Diehr* "were patent eligible because they improved an existing technological process", and not because they required the use of a computer; even though the claims in *Diehr* used a mathematical equation long used to calculate

41. *Alice*, 134 S. Ct. at 2354.
42. *Id.* at 2358.
43. 450 U.S. 175 (1981), (holding a method using mathematical formula implemented through a computer for controlling the curing of synthetic rubber as patent eligible subject matter).
44. 134 S. Ct. at 2358.
45. *Id.*
46. *Diehr*, 450 U.S. 175 (1981).

the cure time in rubber-molding presses, it was integrated into a process that was designed to solve a technological problem that the conventional rubber curing industry had not been able to solve.[47] In contrast, the Court found that the claims in *Alice* did not "purport to improve the functioning of the computer itself" or "effect an improvement in any other technology or technical field."[48] The flip side of this reasoning suggests that claims purporting to improve the computer functionality or some other tangible technological process will not be treated as "abstract".

Based on the Courts' above reasonings, it is important that the specification and claims clearly state a technological problem in the relevant art that the invention is designed to solve and describe specifically the solution and the mechanism of how exactly it solves the problem. AI technologies and systems rely on algorithms that are mathematical instructions that are used for calculations, data processing and even automated reasoning.[49] Reciting a mathematical formula in the claims does not necessarily make a claim patent-ineligible, as long as the claim is not seeking to patent the mathematical formula itself.[50] It is also worth noting that Diehr's claim involved a physical transformation of material to a different state, as in the curing of the synthetic rubber.[51] Even though the Federal Circuit later rejected a blanket "physical transformation" requirement for finding a claim patent-eligible in *AT&T Corp. v. Excel Communications, Inc.*,[52] the element of such physical transformation can be helpful in surviving

47. *Alice*, 134 S. Ct. at 2358.
48. *Id.* at 2359.
49. *Artificial Intelligence: How Algorithms Make Systems Smart.* WIRED https://www.wired.com/insights/2014/09/artificial-intelligence-algorithms-2/.
50. *Diehr*, 450 U.S. 175 (1981).
51. *Id.*
52. 172 F.3d 1352, 1358-1359 (Fed. Cir. 1999).

Alice/Mayo step-one analysis, because a physical transformation of some particular and tangible article makes the invention less "abstract" by definition.

B. **Improvement to the Functionality of Computers or Networks, including the Internet, Is a Recognized Practical Practice Taking Claims Out of "Abstract Idea"**

As touched on already, one classic form of solving an existing technological problem that the courts have recognized is the improvement to the computer functionality itself, meaning a specific improvement in how computers could carry out one of their basic functions such as data storage and retrieval.[53] The Federal Circuit in *Enfish* concluded that Enfish's patent claims, directed to a self-referential model for a computer database, were patent-eligible, because they focused on "an improvement to computer functionality itself, not on economic or other tasks for which a computer is used in its ordinary capacity."[54] The Circuit found the claims "directed to a specific improvement to the way computers operate, embodied in the self-referential table."[55] Specifically, the Circuit found the claimed self-referential table to "function differently" from conventional database structures and "improve an existing technology" by achieving "increased flexibility, faster search times, and smaller memory requirements."[56] In drawing the conclusion that Enfish's claims are not directed to an abstract idea (*Mayo/Alice* step-one), the Circuit distinguished this invention from situations "where general-purpose computer components are added post-hoc to a fundamental economic practice or mathematical equation. Rather, the claims are directed to a specific implementation of a solution to a problem in the software arts."[57]

53. *See, e.g.,* Enfish, LLC v. Microsoft Corp., 822 F.3d 1327 (Fed. Cir. 2016).
54. *Enfish*, 822 F.3d at 1336.
55. *Id.* at 1336.
56. *Id.* at 1337.
57. *Id.* at 1339.

AI technologies are often implemented on a network of computers or other smart devices, including the Internet, to improve efficiency. For example, Google's search engine is powered by AI, driven by machine learning and deep learning algorithms that automatically generate a response to each query.[58] It has become clear that a technological problem does not need to only exist in the "physical" world for the invention of a solution to survive an "abstract idea" challenge.[59] DDR's 399 patent involved an e-commerce system and method on the Internet, which addressed the problem of maintaining a website's "stickiness" where visitors to a host website tend to be "lured away" to other sites when clicking on links for third-party merchants' advertisements.[60] The patent was directed to systems for generating a "composite" web page to retain the "look and feel" of the host site in order to retain the host site's traffic.[61] The Court found that DDR's 399 patent did not recite a mathematical algorithm or a fundamental economic or longstanding commercial practice, and instead it addressed a challenge "particular to the Internet."[62] Specifically, the Court found that the claims "specif[ied] how interactions with the Internet are manipulated – to yield desired results – a result that overrides the routine and conventional sequence of events ordinarily triggered by the click of a hyperlink."[63]

C. **Claims Reciting Special-Purpose Physical Things, Such as Innovative Use of Sensors, with Specific Benefits from Their Use, Help to Get Out of "Abstract Idea"**

Another recent example of claims that survived the "abstract idea" challenge under *Alice/Mayo* at step one because of its focus on a particular solution to a specific technological

58. *See, e.g.*, *AI Is Transforming Google Search. The Rest of the Web Is Next.* Wired Business, https://www.wired.com/2016/02/ai-is-changing-the-technology-behind-google-searches/.
59. *See, e.g.,* DDR Holdings, LLC v. Hotels.com, L.P., 773 F.3d 1245 (Fed. Cir. 2014).
60. *DDR Holdings*, 773 F.3d 1245.
61. *Id.* at 1249.
62. *Id.* at 1257.
63. *Id.* at 1258.

problem in the relevant arts, despite the use of mathematical formulas, is *Thales Visionix Inc. v. United States*, 850 F.3d 1343 (Fed. Cir. 2017). The Circuit in *Thales Visionix Inc.* (TVI) disagreed that patent claims concerning an inertial tracking system were directed to an abstract idea under *Mayo/Alice* step one.[64] The Circuit found the challenged claims to recite a "particular" and "unconventional" arrangement of sensors that improved prior art motion-tracking systems by changing the reference frame from the earth to a moving platform containing the object.[65] The Court noted several specific benefits of TVI's invention over the prior art systems, including increased measurement accuracy, independence from hardware on the moving platform, and simpler installation.[66] Again, the use of necessary mathematical formulas in operating the system did not make the invention an abstract idea.[67]

From those sensors used at airports for facial recognition and temperature detection purposes, to those installed around modern vehicles to enable autonomous driving, and to wearable smart medical devices collecting patents' physiological data, the use of sensors for data-collection have become ubiquitous in our daily life as a product of the merging of machine learning and Big Data into affordable technologies and accessible everyday products including the Internet of Things (IoT).[68] The combination of physical things with special purposes employed by the AI algorithms intuitively help to categorize an invention as a tangible and practical application instead of "abstract idea".[69] However, as seen in *Alice* and *Electric Power Group*, the mere implementation or recitation of some physical thing, such as a generic computer or generic

64. *Thales Visionix*, 850 F.3d at 1349.
65. *Id.* at 1349.
66. *Id.* at 1345.
67. *Id.* at 1349.
68. Anastasia Greenberg, *Protecting Virtual Things: Patentability of Artificial Intelligence Technology for the Internet of Things*, 60 IDEA 328 (2020).
69. *Id.*

sensors, is not enough. Along with *Thales Visionix Inc.*, these cases tell us that it is key to also pinpoint the specific benefits associated with, and enabled by, the innovative use of the associated physical things.

The Courts' reasonings in these decisions all suggest that it is vital to clearly state the technological problem and the solution provided by the invention, while pointing out the specific benefits of the invention and explaining the mechanism of how the problem is solved by which operation of which component that result in which specific benefit beyond the prior art. The more concrete the claims can pinpoint to a problem, a solution, and the mechanism linking a certain component with an improvement, the more the claims will lean towards the practical application end of the concrete-to-abstract spectrum and therefore more likely to survive the *Alice* "abstract idea" subject matter challenge. Whether or not the particular application is novel and non-obvious is left for §102 and §103 analyses.

IV. THE "MENTAL STEPS" DOCTRINE UNDER ABSTRACT IDEA DOES NOT APPLY TO AI DUE TO THE ALGORITHMS' COMPLEX AND EVOLVING NATURE AND THE RESULTING EFFICIENCY AND ACCURACY FAR BEYOND HUMAN MENTAL CAPACITY

It is important to note that in the aftermath of *Alice*, many federal court decisions have used the so-called "mental steps" doctrine to invalidate patents under the category of "abstract ideas", despite its lack of statutory basis.[70] The idea is, if method claims can be characterized as able to be performed within the mind of a human being, perhaps with the aid of a pencil and paper

70. *See, e.g.*, Ben Hattenbach & Gavin Snyder, *Rethinking the Mental Steps Doctrine and Other Barriers to Patentability of Artificial Intelligence*, 19 COLUM. Sci. & TECH. L. REV. 313 (2018). http://vww.stlr.org/cite.cgi?volume=19&article=Hattenbach.

(sometimes referred to also as "pencil-paper test"), then it is presumably a patent-ineligible "abstract idea".[71] An article published in 2016 documented that,

> Between the June 2014 Alice decision and March 29, 2016, there have been 175 federal court decisions invalidating patents under Section 101, and 24% of those decisions relied upon the 'mental steps' doctrine. The eighty-two patents thus invalidated were not limited to suspect categories such as 'business methods,' but included electronic design automation, computer and database security, information retrieval, microbiology, user interfaces for interactive television, telecommunications, and digital image management.[72]

The definition of AI given by the U.S. NIST mentioned in the introduction of this article necessarily encompasses "mental processes" that include "learn to solve complex problems, make predictions or undertake tasks that require human-like sensing (such as vision, speech, and touch), perception, cognition, planning, learning, communication, …"[73] Thus, if interpreted broadly enough, the mental steps doctrine can pose particular risk for AI inventions having underlying processes that can be portrayed as consisting of mental steps or their equivalent, especially considering those involving computational layers that loosely represent human neural networks.[74] Once labeled as "mental steps", claims rarely survive *Alice*.[75]

A. The Problem of the Doctrine When Applied to the Collection and Manipulation of Big Data Coupled with AI Machine Learning or Deep Learning

71. *Id.*

72. Robert Sachs, *The Mind as Computer Metaphor: Benson and the Mistaken Application of Mental Steps to Software,* BILSKiBLOG (Apr. 6, 2016), http://www.bilskiblog.com/blog/2016/04/the-mind-as-computer-metaphor-bensonand-the-mistaken-application-of-mental-steps-to-software.html.

73. NIST (2019), 7-8. In a leading textbook, Russell and Norvig (2016) define AI broadly as the development of machines capable of undertaking human activities in four areas: thinking humanly, acting humanly, thinking rationally, and acting rationally.

74. *See, e.g.*, Ben Hattenbach & Gavin Snyder, *Rethinking the Mental Steps Doctrine and Other Barriers to Patentability of Artificial Intelligence*, 19 COLUM. Sci. & TECH. L. REV. 313 (2018). http://vww.stlr.org/cite.cgi?volume=19&article=Hattenbach.

75. *Id.*

Certainly, the collection, processing and manipulation of data or information in general can be thought of as "mental steps", as humans are generally capable of performing these abstract tasks in their mind and sometimes with the help of pencil and paper. This line of reasoning is indeed a reality in today's patent subject matter jurisprudence under "abstract idea" and *Alice*. One notable example is, again, *Electric Power Group, LLC v. Alstom S.A*.[76] The Federal Circuit in *Electric Power Group* interpreted "abstract idea" broadly, and it did so by superficially equating data collection, analysis and result display with mental steps, "[i]n a similar vein, we have treated analyzing information by steps people go through in their minds, or by mathematical algorithms, without more, as essentially mental processes within the abstract-idea category."[77] This pronouncement apparently lumped all algorithms using mathematical formulas, including those underlying AI inventions, into the concept of "mental steps", arbitrarily and dramatically expanding the scope of this common law doctrine well beyond what can be reasonably accomplished within a human brain or even with the aid of pencil and paper. Interestingly, there has never been a parallel of "physical steps" doctrine for processes that a human can perform with his or her physical body only. This problem of sweepingly categorizing automated data collection and analysis as abstract ideas, here through equating them with mental steps, is vividly illustrated by Director Iancu through an analogy to the automated processes at a milling system designed by a steam engine engineer in the late 1700s at the beginning of the First Industrial Revolution,

> I think about this and similar stories as we contemplate some of the thorniest issues that face us today. For example, I suspect nobody ever thought—back then or now—that Evans' automated manufacturing method (and machine) for processing flour would be abstract and, therefore, ineligible to be patented under Section 101 of the Patent Code. I suspect nobody would argue that "collecting,

76. 830 F.3d 1350 (Fed. Cir. 2016).
77. *Id.* at 1355.

> analyzing and manipulating" the grain is an abstract idea! Or that automating this process, which was previously done by hand, is insufficient to render it eligible.[78]

To say the processes of data collection and analysis are the same as mental process is ignoring the very breakthrough nature of modern AI technologies and systems. It is perhaps true that simple calculations using computer codes can be done in a human brain with the help of pencil and paper, but it is no longer possible when we talk about complex machine learning, or even deep learning algorithms in the world of Big Data.[79] Machine learning algorithms go beyond human knowledge as they "learn" from the raw data fed to the system through identifying trends and patterns, which means that for AI systems that employ repeated or continuous learning through dynamic real-time data, it may be impossible to identify the particular algorithm(s) used to process a certain input data set.[80] This is often done through complex calculations and iterations while adjusting the weights of various factors through multiple layers of dynamic network architecture (known as "neural networks" loosely inspired by human biological network of neurons), that humans often have no visibility to and cannot keep up or fully understand even with visibility.[81] Perhaps more importantly, zettabytes of big data now existing in the online world are being analyzed through AI machine learning or deep learning algorithms, returning highly accurate and useful results, within seconds with minimal

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78. Iancu, Andrei. 2019. "The Current State of Innovation within the U.S. Legal System." Speech, New York City, March 22, 2019. *Journal of the Patent and Trademark Office Society* 101, no. 1 (2019): 11-18.

79. *See, e.g.,* RESPONSIBLE AI: A GLOBAL POLICY FRAMEWORK, (ITECHLAW International Technology Law Association, 1st ed. 2017).

80. *Id.*

81. *Id.*

incremental costs.[82] This magnitude of scope, efficiency and accuracy is never possible with human brain(s) and the aid of pencil and paper.

B. The Problem of the Doctrine in the Healthcare and Medical Field Using AI Pattern Recognition for Disease Detection, Diagnosis and Treatment

Besides the collection and manipulation of big data, another type of AI software that can be lumped into the "mental process" with a broad interpretation of the doctrine is its use in early disease detection, diagnosis and treatment in the healthcare medical field.[83] An AI software can accurately predict breast cancer risk by scanning a patient's mammograms and pathology reports, detecting and collecting diagnostic features, and correlating mammogram findings with breast cancer subtypes.[84] This process is mimicking a human mental process of pattern recognition, looking at the patient's charts, visually identifying suspicious features and correlating them with the typical breast cancer features that a clinician or doctor has in their knowledge (i.e., stored in their mind) before predicting each patient's probability of breast cancer diagnosis. It is thus arguably a series of mental steps that a clinician or human doctor can perform in their brain. However, there are significant and tangible benefits of the AI software that are far beyond human capability. In terms of speed and efficiency, in technology from 2016, a human review of 50 charts has taken clinicians 50 to 70 hours, while the software reviewed 500 charts in only a few hours.[85] Another clear advantage is the technology's humanly unachievable

82. *See, e.g.*, *How much data is on the internet? The Big Data Facts Update 2020*. NodeGraph (published Mar. 26, 2020). https://www.nodegraph.se/how-much-data-is-on-the-internet/.

83. PWC (Jun. 2017). *What doctors? Why AI and robotics will define New Health.* https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health/ai-robotics-new-health.pdf.

84. Sarah Griffiths (Aug. 26, 2016). *This AI software can tell if you're at risk from cancer before symptoms appear.* https://www.wired.co.uk/article/cancer-risk-ai-mammograms.

85. *Id.*

accuracy, leading to real benefits for patients' mental and physical wellbeing. The AI software was able to diagnose cancer risk at early stage, before symptoms appear, with 99% accuracy, while half of manual evaluations yield false results resulting in tremendous emotional stress on these misdiagnosed patients and 20% of invasive and painful biopsies performed unnecessarily.[86] As said by Dr. Stephen Wong, chair of the Department of Systems Medicine and Bioengineering at the Houston Methodist Research Institute in Texas where the AI software was developed, "accurate review of this many charts would be practically impossible without AI."[87] Clearly, the superior efficiency and accuracy enabled by such AI programs go beyond human capacity and the meaning of "mental processes" for the purpose of §101 eligible subject matter determination.

The tangible advantages and meaningful benefits of an AI invention, such as those found in the cancer detection and diagnosis software example, many of which are also quantifiable, should be explicitly stated, explained with specificity, and emphasized in drafting the specification and claims of a patent application to distinguish them from claims that recite actual mental steps utilizing some "laws of nature" like in *Mayo*.[88] *Mayo* also involved the use of correlations in medical decision making (newly discovered correlations between thiopurine metabolite levels versus toxicity and efficacy of thiopurine drugs in deciding a need to decrease or increase the drug dosage.)[89] As mentioned above, the *Mayo* court held that the claimed process was not patent eligible, because the recited relationships (i.e., the correlations) were "laws of nature", and the limitations in the claims were not sufficient to transform an unpatentable law of nature into a patent-eligible application of such a law.[90] After all, simple

86. *Id.*
87. *Id.*
88. *Mayo*, 132 S. Ct. 1289 (2012).
89. *Id.* at 1291.
90. *Id.*

correlation calculations can be performed within a human brain or with the aid of pencil and paper, and so can the step of identifying threshold values of critical parameters, such as blood thiopurine metabolite levels, or graphic patterns suggesting cancer in patient mammograms and pathology charts; the steps of collecting and viewing patient data, comparing them against the pre-defined thresholds or patterns, and then subsequently making a medical judgement either to adjust drug dose or to instruct biopsy. *Mayo* indeed recited mental steps, but AI software that automates pattern recognition and diagnosis processes to humanly impossible levels of speed and accuracy is fundamentally different. Suppose the steps recited in the *Mayo* claims were to be implemented at least partially through the aid of an AI program, with a sensor (or multiple sensors) to collect and monitor data on patient blood thiopurine metabolite levels continuously, compare against the threshold values, and determine the need to release more or less drug into the human body, all in real time. Such technologies could be implemented to treat millions of patients with utmost accuracy, free from human errors, with minimal to no human intervention, and no delay. Their benefits and advantages over human labor and mental capacity would be obvious, taking the claims articulating such benefits in a particular application out of the "mental process" doctrine.

C. The Problem of the Doctrine in Other Rapidly Advancing Technological Fields Using AI for Performing Human-Like Perception Functions but in a Fundamentally Different Manner

AI applications involving the function of pattern recognition go well beyond pattern detection and categorization in healthcare. Object detection and recognition applies to autonomous driving vehicles, facial recognition and voice recognition software used for security, business transaction, and entertainment purposes, automated inspection in the quality assurance

and quality control (QA/QC) processes, etc. Recent breakthrough technological developments in these practical fields have been powered by the advances of AI technologies and systems that perform human-like perceptions and cognitive categorizations.

Despite their clear impact on the individuals and human societies at large, AI inventions that automate human-like perception and categorization functions could potentially be trivialized as "mental processes" under the current section 101 jurisprudence, thereby posing dangerous barriers to obtaining patent protection that incentivizes investments. The utility of these AI algorithms is largely to replace humans in performing these seemingly basic mental tasks, despite the complexity of the algorithm designed to perform them. For example, human drivers can see trees, pedestrians, road signs and other cars, make judgments of whether any of them poses potential collision risk, and determine when there is a need to change the speed and or course of driving. Humans can certainly look at and or listen to someone and determine who they are or whether they are a stranger. Trained technicians or medical staff are able to examine patient information to recognize any problems that need to be addressed. But human cognitive capacity is limited, and individuals make individual mistakes. It is important to recognize, for the purpose of patent eligibility subject matter analysis, that AI technologies performing these human-like tasks in a fundamentally different way can result in life-changing benefits.[91] AI technologies and systems are capable of performing these tasks in real time, continuously, absent of individual human errors, and thus with humanly unachievable magnitude and consistency.

91. *See, e.g.*, Ben Hattenbach & Gavin Snyder, *Rethinking the Mental Steps Doctrine and Other Barriers to Patentability of Artificial Intelligence*. 19 COLUM. Sci. & TECH. L. REV. 313 (2018). http://vww.stlr.org/cite.cgi?volume=19&article=Hattenbach.

In contrast to "mental steps", the history of our patent jurisprudence is not evaluated on a "human physical steps" doctrine barring inventions that replace manual labor by machines and automations under any subject matter exception, simply because they are performing the physical tasks that human can perform by using their body parts. The machines that replace human labor deliver many of the same benefits as AI technologies and systems, including time- and cost-efficiency, consistency and accuracy, scalability, etc. The physical mechanics enabling such machines, just like the algorithms enabling the AI systems, are not uniform, beyond their distinctions from human body autonomy and human neural network processing. Otherwise, there could be no improvements over the first-generation of such machines or algorithms, and there could be no separate patents for robots that can only sort physical objects of different shapes on an industrial assembly line and those that can detect and defuse bombs in a war zone[92] or perform complex surgeries for medical patients. If the concern of "abstract idea", along with the "mental steps" doctrine under its umbrella, is driven by the fear of monopolizing fundamental principles thereby preempting other uses or further innovation, then the key in eligibility is perhaps in how broad versus specific the claims are drafted, instead of whether they resemble some kind of human-like functions regardless of whether such functions are physical or mental.

D. An Example to Illustrate How AI-Related Claims could be Drafted to Avoid Abstract Idea Impression and Distinguish from Mental Processes Analogy

To bring all this together, an example to illustrate how an AI-system-like method claim could be drafted differently to fail or succeed in avoiding the abstract idea categorization will help. When rejecting the claims in *Electric Power Group* as abstract ideas, the Federal Circuit

92. This type of technology may be determined as patent-ineligible for national security reasons instead.

provided some useful directions.[93] The Circuit made clear that claims "defining a desirable information-based result and not limited to inventive means of achieving the result, fails under §101."[94] It pointed out that the claims at issue "do not even require a new source or type of information, or new techniques for analyzing it" without claiming any "new algorithms" or any "arguably inventive set of components or methods, such as measurement devices or techniques, that would generate new data[,]" or "invoke any assertedly inventive programming."[95] Because of the focus on functional results instead of *how* the result is achieved in terms of particular means of achieving (performing) them, the claims were categorized as "mental processes" within the abstract-idea category.[96] Therefore, to avoid such categorization, focusing on the *how* is critical. To this end, the *Electric Power Group* claims should have mimicked the *Thales Visionix* approach to explicit focused on the mechanisms behind how the data from multiple sources are collected and analyzed real time, with an emphasis on the specifics of the innovative positioning of sensors that collect data from strategic locations (*see, e.g., Thales Visionix*, claims reciting "particular" and "unconventional" arrangement of sensors found to be not abstract idea)[97], and any innovative algorithms that perform specific computations to detect abnormal event patterns while filtering out noise and providing a constant stream of overall grid vulnerability indications.

Equally importantly if not more so, Electric Power Group's claims should explicitly specify any tangible and quantifiable benefits of the new system over the prior art systems, such as percentage increase in measurement accuracy, fraction of manual labor and costs requested, the percentage decrease in delay of event detection and summary report and percentage decrease of

93. 830 F.3d 1350.
94. *Id.*
95. *Id.* at 1355.
96. *Id.* at 1354-56.
97. 850 F.3d at 1349.

serious damages and repairs prevented due to real time alert and proactive maintenance. All the above-mentioned benefits are among what is quintessential and characteristic of modern AI algorithms and systems in practical application areas as discussed broadly in this paper.

It is easy for AI claims to appear abstract if they are focused on information-based result with no grounding in "how" or specific comparison to prior methods, which would reasonably invoke the preemption concern to fundamental principles and tools. After all, just like Morse's famous eighth claim back in 1850s was not allowed to block all future long-distance communication technologies using electromagnetic current,[98] Electric Power Group's claims today should not block other innovative methods including other AI systems to collect data from multiple sources, analyze them and return results real time. The same logic applies to most AI systems that perform data collection, analysis, and result display in healthcare screening, medical diagnosis, fraud detection, security event detection, autonomous driving, and more. Therefore, it is key for AI-related claims to avoid broad and information-based result-focused language, and instead specify the tangible mechanisms utilized in a particular system including any physical component, such as innovative use of sensors, innovative algorithm and any quantifiable benefits in terms of efficiency, accuracy and scalability that are not only advantageous over prior art but also beyond human capability.

V. CONCLUSION

The Supreme Court's 2014 *Alice* decision relying on an undefined term "abstract idea" has created much chaos and uncertainty in the U.S. patent system, especially in the world of software

98. O'Reilly v. Morse, 56 U.S. 62 (1854).

inventions. Artificial intelligence inventions, sharing many of the common underlying characteristics with software, unfortunately are not immune.

Before either the Congress reforms the patent statute or the Supreme Court takes upon itself to provide the much-needed clarity to the post-*Alice* Section 101 subject matter analysis, *Alice* is still the current law. Having to continue to live with *Alice* for the time being, patent practitioners need to recognize the preemption concern, and the related distinction between patent-ineligible fundamental principles and their practical applications that remains patent eligible, that the Courts have consistently emphasized across all three judicial exceptions. Recognizing this underlying concern, another objective of this article is to extract and summarize some practical ways to increase the chance of surviving *Alice*, based on the Courts' specific considerations from several key precedents. These strategies include, without being exclusive: clearly stating a technological problem in the arts and explaining the mechanism of how the invention provides a tangible solution; pinpointing the specific improvement(s) to the functionality of a computer or network, such as the Internet; and recitation of special-purpose physical things as an integral part of an AI system, such as special-purpose sensors and smart Internet of Things.

Additionally, as we enter the next technological revolution, largely powered by AI and machine learning, together with robotics, a patent system not recognizing life-changing technologies as beyond mental steps, simply because they have some metaphorical resemblance to human activities, will create unnecessary barriers to incentivizing these advances while going

against the intent of our Constitutional mandate[99] and risking losing out in this highly strategic global competition.[100]

99. U.S. CONST. art. I, § 8, cl. 1, 8 ("The Congress shall have Power … To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries….").

100. *See, e.g.*, Jarrod Fankhauser, *Made in China 2025: Xi Jinping's plan to turn China into the AI world leader*. ABC News (posted Oct. 5, 2018), https://www.abc.net.au/news/2018-10-06/china-plans-to-become-ai-world-leader/10332614.