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DATA-CENTRIC TECHNOLOGIES: PATENT AND COPYRIGHT DOCTRINAL DISRUPTIONS

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I. INTRODUCTION

Research, development, and investment in data-centric technologies[1] has skyrocketed in recent years.[2] Market adoption and customer use of data-centric technologies have followed a similar trend.[3] Data-centric technologies are proliferating at a faster pace than previous innovations.[4] While data-centric applications have spread, intellectual property law regimes have been slow to react.[5] Critical questions about intellectual property protection have been understudied and the scope, standards, and relationships between actors involved with data-centric technologies is

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1. *Data-centric technologies* is the term used throughout this Article to refer to both 3D printing and artificial intelligence. *See* discussion *infra* Parts II–V. While data-centric technologies utilize and are controlled by software, data-centric technologies are more closely linked to the physical world than software. Tabrez Y. Ebrahim, *3D Printing: Digital Infringement & Digital Regulation*, 14 NW. J. TECH. & INTELL. PROP. 37, 66 (2016) [hereinafter Ebrahim, *Digital Infringement & Digital Regulation*]. This Article is focused on the digital foundations that drive industrial applications in the physical world. *See* discussion *infra* Parts II–V. Data-centric technologies are defined as technology capabilities that create information content that directly controls, modifies, or responds to the physical world. Tabrez Y. Ebrahim, *Trademarks & Brands in 3D Printing*, 17 WAKE FOREST J. BUS. & INTELL. PROP. L. 1, 7 (2016) [hereinafter Ebrahim, *Trademarks & Brands*]. Data-centric technologies' information content resides in the digital world, yet its impact is in the physical world of industrial applications. *Id.* at 7, 15.

2. *See* Navin Shenoy, *Innovating for the* Data-Centric *Era*, INTEL: NEWSROOM (Aug. 8, 2018), http://newsroom.intel.com/editorials/data-centric-innovation-summit/; Neil Tyler, *The Future Is Datacentric, According to Intel*, NEW ELECTRONICS (Mar. 13, 2018), http://www.newelectronics.co.uk/electronics-interviews/the-future-is-datacentric-according-to-intel/170703/.

3. Shenoy, *supra* note 2.

4. *See* Tyler, *supra* note 2.

5. *See* MICHAEL WEINBERG, IT WILL BE AWESOME IF THEY DON'T SCREW IT UP: 3D PRINTING, INTELLECTUAL PROPERTY, AND THE FIGHT OVER THE NEXT GREAT DISRUPTIVE TECHNOLOGY 12 (2010), http://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf.

unclear.[6] A number of doctrinal disruptions have arisen with 3D printing and artificial intelligence, particularly with patent law and copyright law.[7]

While trade secrecy has been an alternative intellectual property protection mechanism proposed for the data-centric world, trade secrecy has some downsides.[8] Trade secrecy of data-centric technologies reduces incentives for creators and inventors, requires corporations to spend resources on policies and reasonable steps to maintain trade secrecy, and produces socially harmful results with innovations that do not enter the public domain.[9] Unlike trade secret law, patent law and copyright law are based on the notion that inventorship and authorship will be rewarded by governmental incentives.[10] Therefore, data-centric technologies that could attain copyright or patent protection incentivize an author or inventor to recoup costs of research and development.[11]

There remain doctrinal quandaries concerning patentability and copyrightability of two data-centric technologies: 3D printing and artificial intelligence.[12] Data-centric technologies are defined to be information flows more closely connected to the physical world than historical definitions of software and computer code.[13] For example, 3D printing is considered a data-centric technology because its use of Computer Aided Design ("CAD") files provide digital data for eventual printing of physical goods and

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6. *See id.*

7. *See* Lucas S. Osborn, *Trademark Boundaries and 3D Printing*, 50 AKRON L. REV. 865, 868–70 (2017); Andres Guadamuz, *Artificial Intelligence and Copyright*, WIPO MAG., Oct. 2017, at 14, 17.

8. David S. Levine & Ted Sichelman, *Why Do Startups Use Trade Secrets?*, 94 NOTRE DAME L. REV. 751, 758–60 (2019) (suggesting that innovators of data-centric technologies, such as software and business methods, tend to focus away from patents and towards trade secrecy); Brenda M. Simon & Ted Sichelman, *Data-Generating Patents*, 111 NW. U. L. REV. 377, 379 (2017) (contending that inventions that generate data that is distinct from the operation and use of the invention can be maintained as a trade secret).

9. RONALD T. COLEMAN, JR. ET AL., TRADE SECRETS — THE BASIC PRINCIPLES AND ISSUES 4 (2014) http://www.americanbar.org/content/dam/aba/publications/litigation_committees/intellectual/trade-secrets-the-basic-principles-and-issues.authcheckdam.pdf; Simon & Sichelman, *supra* note 8, at 432–33.

10. Michael Risch, *Why Do We Have Trade Secrets?*, 11 MARQ. INTELL. PROP. L. REV. 1, 11 (2007).

11. *See id.*

12. *See* Lucas Osborn, *3D Printing and Intellectual Property*, *in* RESEARCH HANDBOOK ON DIGITAL TRANSFORMATIONS 254, 254 (F. Xavier Olleros & Majlinda Zhegu eds., 2016); Sean Semmler & Zeeve Rose, *Artificial Intelligence: Application Today and Implications Tomorrow*, 16 DUKE L. & TECH. REV. 85, 86 (2018).

13. Marco Conti & Andrea Passarella, *The Internet of People: A Human and Data-Centric Paradigm for the Next Generation Internet*, COMPUTER COMM., Oct. 2018, at 51, 51.

objects.[14] Additionally, for example, artificial intelligence is considered a data-centric technology because its information flows can be mathematically trained from unique data sets for use in physical systems.[15] Unlike historical definitions of software and computer code, such as source code and object code, data-centric technologies directly connect with or control the physical world through the laws of probability theory and information science.[16]

This Article focuses on the patent law and copyright law doctrinal disruptions of data-centric technologies.[17] Part II is descriptive and provides the technological foundations and commonalties of data-centric technologies, 3D printing, and artificial intelligence.[18] It describes the similarities of information representation of the physical world, blurring of the digital and physical divide, ease of transmission, and ability to dramatically improve the physical world through modifications in the digital realm.[19] Part III describes the doctrinal foundations of inventorship in patent law and authorship in copyright law as a few of a growing number of doctrinal concerns, and introduces the ramifications posed by 3D printing and artificial intelligence technologies.[20] Part IV.A describes litigation that has resulted from the unclear doctrinal boundaries of copyright and patent protection of data-centric technologies.[21] It identifies recent litigation and summarizes the doctrinal issues underlying the disputes.[22] Part IV.B provides a conceptual foundation and normative justifications for a new spectrum-based view on legal standards.[23] It formulates a two-by-two matrix as a conceptual framework of data-centric technologies encompassing axes of human to non-human and physical to digital.[24] It proposes that standards relevant to patent

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14. Timothy R. Holbrook & Lucas S. Osborn, *Digital Patent Infringement in an Era of 3D Printing*, 48 U.C. DAVIS L. REV. 1319, 1321 (2015); *see also* Osborn, *supra* note 12, at 257–58.

15. *See* Semmler & Rose, *supra* note 12, at 86–87 (defining artificial intelligence as "the process of simulating human intelligence through machine processes," specifying that machine learning, as a subset of artificial intelligence, learns from user-fed data to respond to new data); Phillipe Aghion et al., *Artificial Intelligence and Economic Growth* 2 (Nat'l Bureau of Econ. Research, Working Paper No. 23928, 2017) (defining artificial intelligence as "the capability of a machine to imitate intelligent human behavior or an agent's ability to achieve goals in a wide range of environments.").

16. Stan Schneider, *The Data-Centric Future*, EMBEDDED SYSTEMS EUROPE, Nov.–Dec. 2006, at 30, 30; *see also* Semmler & Rose, *supra* note 12, at 87.

17. *See* discussion *infra* Part II.

18. *See* discussion *infra* Part II.

19. *See* discussion *infra* Part II.

20. *See* discussion *infra* Part III.

21. *See* discussion *infra* Part IV.A.

22. *See* discussion *infra* Part IV.A.

23. *See* discussion *infra* Part IV.B.

24. *See* discussion *infra* Part IV.B.1.

law and copyright law have not been static, but instead have been and continue to be dynamic.[25] It suggests that the doctrinal origins of patent law and copyright law were grounded in the human/physical conceptualization, but data-centric technologies have now introduced human-digital, non-human/physical, and non-human/digital considerations.[26] The conceptualization matrix will be reformulated with time progression to become dominated with non-human/digital considerations and inconsequential human/physical considerations.[27] This analysis suggests that authorship and inventorship should not be evaluated within the human and physical realms, but should also consider non-human and digital realms, which would have prevented the recent litigation identified in Part IV.A.[28] The implication for innovation is that unclear doctrinal boundaries will lessen incentives for copyright and patent protection in a data-centric world and increase trade secrecy considerations.[29] Part V concludes that data-centric technologies' doctrinal disruptions necessitate reevaluation of copyright and patent doctrines.[30]

II. FOUNDATIONS OF DATA-CENTRIC TECHNOLOGIES

The concept of data-centric technologies refers to technologies that transmit, represent, modify, and/or control physical objects through digital operation or use.[31] For instance, 3D printing technology can scan, modify, and transmit a physical object for eventual production of the object at a 3D printer located elsewhere.[32] Additionally, artificial intelligence technology can generate statistical information about physical objects and interpret, modify, and transmit that statistical information for control of physical objects.[33] Specifically, these technologies operate mostly in the digital world yet their beneficial use is in the physical world.[34] While information content

25. *See* discussion *infra* Part IV.B.1.

26. *See* discussion *infra* Part IV.B.2.

27. *See* discussion *infra* Part IV.B.3.

28. *See* W. Keith Robinson & Joshua T. Smith, *Emerging Technologies Challenging Current Legal Paradigms*, 19 MINN. J.L., SCI. & TECH. 355, 357, 372 (2018); discussion *infra* Part IV.A.

29. Levine & Sichelman, *supra* note 8, at 758–60.

30. *See* discussion *infra* Part V.

31. *See* Tan Wee Kwang, *The Future of Production: IoT, AI, Robotics, Wearables and 3D Printing*, ENTERPRISE INNOVATION: EGOV (Apr. 26, 2017), http://www.enterpriseinnovation.net/article/future-production-iot-ai-robotics-wearables-and-3d-printing-51643031.

32. Stefan Bechtold, *3D Printing and the Intellectual Property System* 3 (World Intellectual Prop. Org., Working Paper No. 28, 2015).

33. *See* Semmler & Rose, *supra* note 12, at 86–87.

34. *See* Holbrook & Osborn, *supra* note 14, at 1321–22.

technologies have generated data about physical objects,[35] data-centric technologies are not limited to simply monitoring and estimating performance of physical objects.[36] Instead, data-centric technologies offer unique capabilities of controlling and transmitting a massive amount of information about the physical objects.[37] When data-centric technologies are utilized, information concerning physical objects and their control and creation can be transmitted across national borders.[38]

Some common traits of data-centric technologies are that they depend on digital foundations,[39] blur the digital and physical divide,[40] and dramatically improve physical goods in some way.[41] Both 3D printing and artificial intelligence have underlying information content that is governed by the law of mathematics and probability; yet, their resulting output is applicable in the physical world of goods, objects, products, and systems.[42] Data-centric technologies' information content produces information

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35. *See* K. J. Bathe et al., *Some Recent Advances for Practical Finite Element Analysis*, 47 COMPUTERS & STRUCTURES 511, 511, 513–14 (1993) (illustrating finite element procedures using iterative methods for analysis and structures with the use of computers); Sergey P. Zotkin et al., *About Development and Verification of Software for Finite Element Analysis of Beam Systems*, 111 PROCEDIA ENGINEERING 902, 902–03 (2015) (describing structural analysis using the finite element method).

36. *See* Betchold, *supra* note 32, at 3–5; Semmler & Rose, *supra* note 12, at 86–87.

37. *See* Kwang, *supra* note 31.

38. Graeme B. Dinwoodie, *Developing a Private International Intellectual Property Law: The Demise of Territoriality?*, 51 WM. & MARY L. REV. 711, 713 (2009).

39. *See* Holbrook & Osborn, *supra* note 14, at 1321–22. Data-centric technologies are digital in nature, but unlike pure software, which refers to data instructions and executable code consisting of machine language instructions, data-centric technologies refer to embodying and directly influencing the physical domain through software. *Id.*

40. *Id.* at 1321. 3D printing's use of CAD files blurs the divide between digital representation of physical objects as blueprint instruction files. *Id.*; Lucas Osborn, *Regulating Three-Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 555 (2014) [hereinafter Osborn, *Regulating Three-Dimensional Printing*]; Lucas Osborn, *Of PhDs, Pirates, and the Public: Three-Dimensional Printing Technology and the Arts*, 1 TEX. A&M L. REV. 811, 812 (2014) [hereinafter Osborn, *Of PhDs, Pirates, and the Public*]. Artificial intelligence blurs the divide between statistical methods that learn from data sets to make predictions of future input data in a physical system or a manufacturing process. *See* Semmler & Rose, *supra* note 12, at 86–87.

41. *See* Holbrook & Osborn, *supra* note 14, at 1321. 3D printing improves development time through the use of prototyping to develop test products, which can quickly be modified for production. Kwang, *supra* note 31. Artificial intelligence improves product design, yield, and efficiency of physical goods and systems, such as manufacturing systems and autonomous vehicle systems. *See id.*

42. Ebrahim, *Trademarks & Brands*, *supra* note 1, at 7–9; Semmler & Rose, *supra* note 12, at 86–87.

goods.[43] The digital foundations of data-centric technologies have enabled cross-border transmission or control of information goods without being hindered by slow-to-respond copyright and patent laws.[44] However, unclear scope of protection, legal standards, and legal relationships between actors of copyright and patent protection of data-centric technologies have created doctrinal disruptions that necessitate greater discussion.[45]

A. *3D Printing*

3D printing is a technology that enables creation, replication, modification, and transmission of three-dimensional objects via instructions from a digital file—a CAD file.[46] The process of 3D printing starts with the creation of a digital representation in a CAD file of a physical object for eventual 3D printing.[47] CAD files serve as templates and blueprint instructions of the physical object that is 3D printed.[48] The creation of a CAD file is either from scanning an existing three-dimensional object or from creating a digital representation of a physical object in a computer program.[49] The CAD file, which is the brain of the 3D printing operation, is utilized to print the physical object by slicing the digital object into electronic 2D layers that are sent to the 3D printer *layer-by-layer* to produce the object *layer-by-layer*.[50] In effect, 3D printing technology enables users to turn digital blueprints and digital models into physical objects with the press of a button.[51] 3D printing challenges intellectual property laws through its digital approach to production and its customization.[52] The information content of physical objects is embedded in CAD files, which can be

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43. *See* Jacqueline Lipton, *Information Property: Rights and Responsibilities*, 56 FLA. L. REV. 135, 140–41 (2004) (describing that information goods, while unlike tangible goods, still may entail the use of the bundle of rights analogy in balancing relevant competing interests); Osborn, *Regulating Three-Dimensional Printing*, *supra* note 40, at 572.

44. *See* Dinwoodie, *supra* note 38, at 713; Lipton, *supra* note 43, at 164.

45. *See* Holbrook & Osborn, *supra* note 14, at 1325–27.

46. Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 41; *see also* Timothy R. Holbrook, *Extraterritoriality and Digital Patent Infringement*, *in* RESEARCH HANDBOOK ON INTELLECTUAL PROPERTY AND DIGITAL TECHNOLOGIES (T. Aplin, ed. forthcoming 2019) (manuscript at 2) (on file with author).

47. Holbrook & Osborn, *supra* note 14, at 1329.

48. Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 41.

49. Osborn, *Of PhDs, Pirates, and the Public*, *supra* note 40, at 814.

50. *Id.* at 812, 814.

51. Weinberg, *supra* note 5, at 2.

52. *See* Michael Henry, *How 3D Printing Challenges Existing Intellectual Property Law*, HENRY PATENT LAW FIRM (Aug. 13, 2018), http://www.henrypatentfirm.com/blog/3d-printing-challenges-patent-law.

modified, replicated, and shared digitally as information content and digital data, away from control from centralized actors in a democratized fashion.[53]

B. *Artificial Intelligence*

There is no single definition of *artificial intelligence*,[54] which is a term that was first introduced in 1956 at an academic research conference.[55] The connotation of artificial intelligence has changed over time and with rapid technological development.[56] The lack of a precise or commonly

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53. John Hornick, *3D Printing and IP Rights: The Elephant in the Room*, 55 SANTA CLARA L. REV. 801, 804–05 (2015) (defining *away from control* to mean making objects without anyone knowing or without being able to control it).

54. KAY FIRTH-BUTTERFIELD & YOON CHAE, ARTIFICIAL INTELLIGENCE COLLIDES WITH PATENT LAW 5 (2018), http://www3.weforum.org/docs/WEF_48540_WP_End_of_Innovation_Protecting_Patent_Law.pdf (defining artificial intelligence as "a computerized system exhibiting behavior commonly thought of as requiring intelligence" or "a system capable of rationally solving complex problems or taking appropriate action to achieve its goals in real-world circumstances"); Aghion et al., *supra* note 15, at 2 (defining artificial intelligence as "the capability of a machine to imitate intelligent human behavior" or "an agent's ability to achieve goals in a wide range of environments"); Semmler & Rose, *supra* note 12, at 86 (defining artificial intelligence as "the process of simulating human intelligence through machine processes"); W. Nicholson Price II, *Artificial Intelligence in Health Care: Applications and Legal Issues*, SCITECH. LAW., Fall 2017, at 10, 10 (defining artificial intelligence as relying on "[s]uch algorithms . . . best described as *black-box*"); Chris Smith, *Introduction*, *in* THE HISTORY OF ARTIFICIAL INTELLIGENCE 4, 4 (2006) (defining artificial intelligence as "a system which amplified people's own knowledge and understanding"); Roger Parloff, *Why Deep Learning is Suddenly Changing Your Life*, FORTUNE, (Sept. 28, 2016, 5:00 PM), http://www.fortune.com/ai-artificial-intelligence-deep-machine-learning/ (defining modern *artificial intelligence* as "a vast range of technologies—like traditional and rules-based systems—that enable computers and robots to solve problems in ways that at least superficially resemble thinking").

55. NILS J. NILSSON, THE QUEST FOR ARTIFICIAL INTELLIGENCE: A HISTORY OF IDEAS AND ACHIEVEMENTS 77 (2009) (ebook). The term *artificial intelligence* came from a proposal titled "Summer Research Project on Artificial Intelligence" that was submitted to the Rockefeller Foundation in August 1955. *Id.* The proposal specified:

> We propose that a [two] month, [ten] man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College . . . . The 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 that a machine can be made to simulate it . . . . For the present purpose the artificial intelligence problem is taken to be that of making a machine behave in ways that would be called intelligent if a human were so behaving.

Id.

56. Joost N. Kok et al., *Artificial Intelligence: Definitions, Trends, Techniques, and Cases*, *in* ARTIFICIAL INTELLIGENCE 1, 1–2 (2009). The following definitions of artificial intelligence are based on The New International Webster's Comprehensive Dictionary of the English Language, EncyclopedicEdition:

accepted definition has made artificial intelligence seem like a *black-box*.[57] The breadth of each word, *artificial* and *intelligence*, conflates the definitional problem of the nebulous and interdisciplinary phrase *artificial intelligence*.[58] Artificial intelligence has been broadly defined as a program running on a computer system that is able to learn and adapt itself in a dynamic environment.[59] This Article utilizes machine learning, a sub-field of artificial intelligence that applies algorithms to parse data and learns from it to make a prediction about the physical world, when referring to artificial intelligence.[60] Artificial intelligence technology, specifically machine learning,[61] utilizes algorithms to change its output based on experiences, and such learning can either be supervised learning or unsupervised learning.[62]

> An area of study in the field of computer science. Artificial intelligence is concerned with the development of computers able to engage in human-like thought processes such as learning, reasoning, and self-correction.
>
> The concept that machines can be improved to assume some capabilities normally thought to be like human intelligence such as learning, adapting, self-correction, etc.
>
> The extension of human intelligence through the use of computers, as in times past physical power was extended through the use of mechanical tools.
>
> In a restricted sense, the study of techniques to use computers more effectively by improved programming techniques.

Id. at 2.

57. *See* Price II, *supra* note 54, at 10.

58. Kok et al., *supra* note 56, at 1–2.

59. Nicolas Miailhe & Cyrus Hodes, *The Third Age of Artificial Intelligence*, 17 FIELD ACTIONS SCI. REPS. (Special Issue) 6, 6 (2017).

60. *Id.* at 7; Harry Surden, *Machine Learning and Law*, 89 WASH. L. REV. 87, 89 (2014); *see also* MARIETTE AWAD & RAHUL KHANNA, EFFICIENT LEARNING MACHINES: THEORIES, CONCEPTS, AND APPLICATIONS FOR ENGINEERS AND SYSTEM DESIGNERS 1 (2015) (describing machine learning as being able to predict future events or scenarios unknown to computers; quoting Arthur Samuel as describing machine learning to be the "field of study that gives computers the ability to learn without being explicitly programmed;" quoting Tom Mitchell as describing machine learning in the context of "[a] computer program is said to learn from experience *E* with respect to some class of tasks *T* and performance measure *P*, if its performance at tasks in *T*, as measured by *P*, improves with experience *E*").

61. Surden, *supra* note 60, at 88–89 (defining machine learning techniques as algorithms that have the ability to improve in performance over time on some task, by detecting patterns in data in order to automate complex tasks and make predictions).

62. INFO. COMM'RS OFFICE, BIG DATA, ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DATA PROTECTION 7 (2017), http://www.ico.org.uk/media/for-organisations/documents/2013559/big-data-ai-ml-and-data-protection.pdf (defining machine learning generally as being "the set of techniques and tools that allow computers to 'think' by creating mathematical algorithms based on accumulated data" specifying that supervised learning involves algorithms based on labelled datasets, such that the algorithms are trained how to map form input to output with the provision of correct values assigned to them, and where the initial training phase creates models of the world on which predictions can be made in a subsequent prediction phrase; and specifying that unsupervised learning involves algorithms that are not trained, but are left to find regularities in input data without what to look for).

Machine learning has gained prominence in a variety of applications since its computational techniques and tools can automatically design models from large amounts of observed data without relying on rule-based programming.[63] The ability to train existing data sets allows for the production of *data-generating patents*, or inventions that result from generating valuable data by design or use.[64]

C. *Digitization Commonalities: Digital Control and Digital Transmission*

3D printing and artificial intelligence are different technologies yet they share common traits of digitization and the sheer volume of data creation.[65] These data-centric technologies have been enabled by increased computing power that allow for easier data modification, storage, and transmission.[66] For example, advancements in graphics processing units have allowed for quicker and easier digital slicing of 3D printing CAD files comprising complex objects.[67] As another example, advancements in hardware resources and new computer architectures for high performance computing allow for analysis of massive data sets based on specified workflows.[68]

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63. ALEX SMOLA & S. V. N. VISHWANATHAN, INTRODUCTION TO MACHINE LEARNING 3–7 (2008) (describing a variety of machine learning applications, where there exists a nontrivial dependence between some observations for which a simple set of deterministic rules is not known, such as: (1) *web page ranking*, which is a process of submitting a query to a search engine to find webpages relevant to the query and returning them in an order of relevance; (2) *collaborative filtering*, where Internet bookstores utilize users' past purchase and viewing decisions information to predict future viewing and purchase habits of similar users; (3) *speech recognition*, where an audio sequence is annotated with text or where handwriting is annotated with a sequence of strokes; and (4) *classification*, where spam filtering programs can identify whether an email contains relevant information or not, such as a frequent traveler email, based on the type of user); *see also* GIANLUCA BONTEMPI, HANDBOOK: STATISTICAL FOUNDATIONS OF MACHINE LEARNING 9 (2017) http://di.ulb.ac.be/map/gbonte/mod_stoch/syl.pdf.

64. *See* Simon & Sichelman, *supra* note 8, at 378–79.

65. *See* DAVID REINSEL ET AL., THE DIGITALIZATION OF THE WORLD: FROM EDGE TO CORE 2–3 (2018), http://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf.

66. Zulfiqar A. Memon et al., *CPU-GPU Processing*, INT'L J. COMPUTER SCI. & NETWORK SECURITY, Sept. 2017, at 188, 188.

67. Xipeng Zhang et al., *A GPU-based Parallel Slicer for 3D Printing*, *in* 13TH IEEE INT'L CONF. AUTOMATION SCI. & ENGINEERING, 55–56 (2017); Tony Kontzer, *How GPUs Can Kick 3D Printing Industry into High Gear*, NVIDIA: NVIDIA BLOG (June 6, 2017), http://blogs.nvidia.com/blog/2017/06/06/3d-printing/; *NVIDIA GVDB Voxels*, NVIDIA, http://developer.nvidia.com/gvdb (last visited Mar. 24, 2019).

68. Mauro Garofalo, GPU Computing for Machine Learning Algorithms, 60 (2011) (unpublished thesis, Universita' degli Studi di Napoli Federico II),

These data-centric technologies enable information-based product development from digital transmission and digital control.[69] In both technologies of 3D printing and artificial intelligence, control over the physical good, object, product, or system is not entirely by an originator-human, who was the creator or inventor.[70] Instead, data-centric technologies enable for non-human, digital control.[71] In the case of 3D printing, democratization of manufacturing leads to making goods and parting away from control by bypassing the traditional supply chain.[72] The ability to easily modify, share, and transmit 3D printing CAD files has created new interactions between creators, distributors, and end-users of physical objects and products.[73] In the case of artificial intelligence—specifically machine learning—computer programs make predictions and take action based on a training set drawn from hypotheses.[74] In both cases, digital control is not directed by the creator-inventor human, but instead by someone or something else—another person or entity in 3D printing, and a learning algorithm in artificial intelligence.[75] The issue of digital control of data-centric technologies creates new patent law and copyright law doctrinal quandaries concerning the scope of protection.[76]

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http://dame.dsf.unina.it/documents/TESI_GAROFALO_FINALE.pdf; Tulasi Bomatpulli et al., *High Performance Computing and Big Data Analytics — Paradigms and Challenges*, 116 INTL. J. COMPUTER APPLICATIONS 28, 28 (Apr. 2015).

69. *See* Memon et al., *supra* note 66, at 188; Ulf Koester, *Product Development: The Digital Thread in Industry 4.0*, ORACLE (June 7, 2018), http://blogs.oracle.com/today/product-development-the-digital-thread-in-industry-40.

70. *See* REINSEL ET AL., *supra* note 65, at 2–3.

71. *See* Azita Martin, *The Difference Between Knowledge-Centric and Data-Centric Approaches*, MAANA (Sept. 9, 2016), http://www.maana.io/2016/09/knowledge-power-not-data/.

72. *See* Hornick, *supra* note 53, at 804–05 (suggesting that *away from control* with 3D printing includes, "3D printing at home from blueprints obtained [from] peer-to-peer [networks], . . . scanning and [3D] printing anything, . . . buying 3D printed products on the black market," obtaining other's CAD files from the Internet; therefore, with self-manufacturing, traditional supply chains will be disturbed, such that traditional manufacturers will be forced to sell blueprint CAD files and retail outlets will face challenges in selling products).

73. *See* REINSEL ET AL., *supra* note 65, at 2–3; Kontzer, *supra* note 67.

74. KE-LIN DU & M. N. S. SWAMY, NEURAL NETWORKS AND STATISTICAL LEARNING 39, 39 (2014).

75. *See* Osborn, *Regulating Three-Dimensional Printing*, *supra* note 40, at 559; Semmler & Rose, *supra* note 12, at 86–87.

76. *See* discussion *infra* Part III.

The result of digital control not residing in the creator-inventor is digital transmission.[77] Data-centric technologies allow for the transmission of information content concerning physical goods, objects, products, or systems.[78] In the case of 3D printing, CAD files, which represent the physical object that can be printed with *de minimis* effort, can be transmitted from computer-to-computer or from one CAD file-sharing website to another.[79] In the case of artificial intelligence—specifically predictive analytics—which allows for the prediction of future outcomes and trends based on large scale datasets, artificial intelligence can find and transmit potentially valuable information about the physical world.[80] Artificial intelligence "can increase the efficiency of industrial operations," monitor damage to equipment, and enable repairing actions.[81] The valuable information from predictive analytics can take a variety of forms, which can affect the value of a commercial good, object product, or system.[82] In both cases, digital transmission disrupts traditional supply chains and traditional relationships between commercial actors—between the manufacturer and distributor in 3D printing and between the manufacturer and marketer in artificial intelligence.[83] The issue of digital transmission of data-centric technologies creates new patent law and copyright law doctrinal quandaries which require evaluating statutes.[84]

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77. *See* Kholid Rafsanjani, *Data Transmission — Digital Data Transmission*, CCM (Feb. 6, 2018, 5:42 AM), http://www.ccm.net/contents/703-data-transmission-digital-data-transmission.

78. *See* Holbrook & Osborn, *supra* note 14, at 1321–22, 1332.

79. *See id.* at 1319, 1332.

80. ERIC SIEGEL, PREDICTIVE ANALYTICS: THE POWER TO PREDICT WHO WILL CLICK, BUY, LIE, OR DIE 15–16 (2016).

81. IAN WALDEN & THEODORA A. CHRISTOU, LEGAL AND REGULATORY IMPLICATIONS OF DISRUPTIVE TECHNOLOGIES IN EMERGING MARKET ECONOMIES 5 (June 2018), http://www.researchgate.net/publication/327013729_Legal_and_Regulatory_Implications_of_Disruptive_Technologies_in_emerging_market_economics.

82. *See* Thomas H. Davenport, *A Predictive Analytics Primer*, HARV. BUS. REV. (Sept. 2, 2014), http://www.hbr.org/2014/09/a-predictive-analytics-primer (providing as examples customer lifetime value, next best offer, most likely to buy next, forecasts, and determination of best ads as examples of forms of predictive analytics).

83. *See id.*; Osborn, *Regulating Three-Dimensional Printing*, *supra* note 40, at 562; WALDEN & CHRISTOU, *supra* note 81, at 5.

84. *See* Osborn, *Regulating Three-Dimensional Printing*, *supra* note 40, at 586, 589.

D. *Information Property Commonalities*

Data-centric technologies comprise information flows and information ownership.[85] Intellectual property protection has existed for "information products [such as] computer software and Internet business [models]."[86] However, data-centric technologies, which share digital characteristics of other information products, are different because their information content has direct applicability in the physical world.[87] For example, 3D printing CAD files are digital blueprint representations of physical objects that can be produced with the simple click of a button.[88] As another example, artificial intelligence—specifically machine learning—contains algorithms that provide valuable predictive information about the physical world.[89]

The mixing of digital and physical with data-centric technologies challenges how we think about intellectual property protection.[90] Moreover, such digital-physical mixed objects force reevaluation of whether intellectual property protection even applies.[91] Data-centric technologies may contain information property[92] that is not necessarily protected by a specific intellectual property right or may thrive even without intellectual property protection akin to the theory of the *IP negative space*.[93] Some aspects of data-centric technologies fit comfortably well within traditional intellectual property protection, such as printer equipment and ink with 3D printing and computer readable media and methods with artificial intelligence.[94] However, intellectual property law encounters quandaries with the digital-physical mixed aspects, where the absence of or lack of clarity in information property protection causes doctrinal disruptions.[95] This makes protecting data-centric technologies more difficult for intellectual property owners.[96]

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85. *See* Conti & Passarella, *supra* note 13, at 51–52.
86. Lipton, *supra* note 43, at 143.
87. *See* Ebrahim, *Trademark & Brands*, *supra* note 1, at 7.
88. *Id.*
89. INFO. COMM'RS OFFICE, *supra* note 62, at 9; Davenport, *supra* note 82.
90. *See* Robinson & Smith, *supra* note 28, at 356.
91. *See id.* at 356–57.
92. *See* Lipton, *supra* note 43, at 140 (suggesting that information property refers to private rights in information containing some degree of control over the relevant information).
93. Elizabeth L. Rosenblatt, *A Theory of IP's Negative Space*, 34 COLUM. J.L. & ARTS 317, 319 (2011) (defining *IP negative space* as "a series of nooks, crannies, and . . . oceans . . . where creation and innovation thrive in the absence of intellectual property protection").
94. *See* Robinson & Smith, *supra* note 28, at 364–65.
95. *See id.* at 357, 364.
96. *See id.*

III. DOCTRINAL QUANDARIES

Data-centric technology is a type of emerging, disruptive technology for which the law has struggled to keep pace with its development and adoption.[97] One reason is that data-centric technologies have challenged the precise meanings of intellectual property doctrines, which did not envision such technological advancements.[98] Another reason is that data-centric technologies challenge the scope of intellectual property doctrines, which may overlap or possibly have voids in coverage.[99] Additionally, data-centric technologies create new interactions among actors that challenge the scope of protection intended for each actor in a marketplace.[100] In sum, intellectual property laws—particularly patent law and copyright law—are either ill-defined or ill-suited for data-centric technologies, which have outpaced intellectual property law's response and adaptation.[101]

There are numerous motivations for clarifying doctrinal patent law and copyright law quandaries with data-centric technologies, or for any emerging technology.[102] First, intellectual property law can enable innovation and normatively steer technological development.[103] Second, decisions about the scope of intellectual property coverage shapes society, social futures, and sources of power.[104] Third, intellectual property law can affect the diffusion of new technologies, the demand takeoff, and the creation of complementary infrastructure.[105] These reasons motivate identification, herein in Part III, of the doctrinal quandaries in each of patent law and copyright law based on the foundations of 3D printing and artificial intelligence identified in Part II.[106]

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97. *Id.* at 356; WALDEN & CHRISTOU, *supra* note 81, at 3.

98. *See* Robinson & Smith, *supra* note 28, at 356.

99. Daniel Harris Brean, *Patenting Physibles: A Fresh Perspective for Claiming 3D-Printable Products*, 55 SANTA CLARA L. REV. 837, 841 (2015); *see also* Rosenblatt, *supra* note 93, at 319.

100. *See* WALDEN & CHRISTOU, *supra* note 81, at 4; Lucie Gaget, *Artificial Intelligence and 3D Printing: Meet the Future of Manufacturing*, SCULPTEO: BLOG (Oct. 24, 2018), http://www.sculpteo.com/blog/2018/10/24/artificial-intelligence-and-3D-printing-meet-the-future-of-manufacturing.

101. Robinson & Smith, *supra* note 28, at 356.

102. *Id.*; Rosenblatt, *supra* note 93, at 318.

103. *See* WALDEN & CHRISTOU, *supra* note 81, at 3.

104. Stephen Hilgartner, *Intellectual Property and the Politics of Emerging Technology: Inventors, Citizens, and Powers to Shape the Future*, 84 CHI. KENT L. REV. 197, 198–99 (2009).

105. *See* Shenoy, *supra* note 2; Tyler, *supra* note 2.

106. *See* discussion *infra* Parts II, III.

A. *3D Printing*

3D printing is an emerging technology that challenges how we think about tangible and digital objects.[107] Intellectual property law scholars have identified numerous doctrinal challenges with 3D printing CAD files under patent law and copyright law, as well as trademark law.[108] The uncertainty among the scope of protection afforded by intellectual property laws for 3D printing CAD files has necessitated reevaluating the relationships between actors in a traditional manufacturing value chain, since a producer can also be a consumer.[109] Some scholars have developed proposals for reforming intellectual property laws and proposed new regulations in response to the emergence of 3D printing.[110]

1. Patent Law Disruptions

3D printing technology disrupts the patent system due to digitization and decentralized production.[111] The heart of the doctrinal patent law disruption created by 3D printing is "the CAD file, [which is] the digital representation of a physical object [and] . . . a crucial component of the 3D printing process."[112] The digital-physical blur of 3D printing CAD files presents challenges with patentable subject matter,[113] digital patent

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107. Lucas S. Osborn, *Doctrinal Quandaries with 3D Printing and Intellectual Property*, A.B.A. SEC. LITIG. INTELL. PROP. LITIG., Summer 2016, at 18, 18.

108. Osborn, *supra* note 7, at 868–69; *see also* Digital Millennium Copyright Act, Pub. L. No. 105-304, § 102, 112 Stat. 2860, 2861 (1998) (codified as amended at 17 U.S.C. §§ 101–1401 (2012)).

109. *See* Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 48.

110. Brean, *supra* note 99, at 838, 842 (proposing the creation of new *Beauregard*-like patent claim format to protect CAD files per se); Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 67–70 (proposing the creation of a Digital Millennium Copyright & Patent Act ("DMCPA") and reformation of the repair-and-reconstruction doctrine); Digital Millennium Copyright Act § 103, 112 Stat. at 2863.

111. Geertrui Van Overwalle & Reinout Leys, *3D Printing and Patent Law: A Disruptive Technology Disrupting Patent Law?*, 48 INT'L REV. INTELL. PROP. & COMPETITION L. 504, 506 (2017).

112. *Id.* at 512.

113. *Id.* at 511–12 (suggesting that CAD files may face considerable patentable subject matter challenges similar to traditional software application claims, and instead proposing copyright as an alternative means of protection or suggesting focusing on the physical aspect of CAD file if considering patent protection); Tabrez Y. Ebrahim, *3D Bioprinting Patentable Subject Matter Boundaries*, 41 SEATTLE U.L. REV. 1, 44 (2017) (suggesting that post-processing and integration of 3D bioprinted materials may challenge patentable subject matter doctrine when they are indistinguishable from natural tissues and organs); Phoebe H. Li, *3D Bioprinting Technologies: Patents, Innovation, and Access*, 6 L.

infringement,[114] and the International Trade Commission's ("ITC") jurisdiction over importation of a patented article entering the United States,[115] as well as civil procedure challenges.[116]

First, 3D printing disrupts patentability because a CAD file, which is essentially a mix of software instructions and program code that digitally represents a three-dimensional object, may be too abstract to satisfy 35 U.S.C. § 101 or too challenging to claim in traditional patent claim format.[117] One patent law scholar has proposed using *Beauregard* patent claims for 3D printing CAD files, but has also acknowledged limitations.[118] Additionally, there has been debate on whether 3D printing of nature-based substances, in 3D bioprinting, would qualify as patentable subject matter.[119] This debate has centered on whether 3D bioprinting technology has advanced to the point of creating tissues and organs that are exact replicas of nature and on the unsettled law of genetic replication.[120]

Second, 3D printing disrupts patent infringement doctrine because it challenges the reach of the infringement statute.[121] A doctrinal assessment of 3D printing patent infringement focuses on what constitutes infringement related to digital CAD files and whether laypeople qualify as indirect infringers.[122]

INNOVATION & TECH. 282, 288 (2014) (suggesting that certain cloning and human embryo related inventions produced by 3D bioprinting may not be patentable because they violate the morality exception in European patent law); Timo Minssen & Marc Mimler, *Patenting Bioprinting-Technologies in the US and Europe: The Fifth Element in the Third Dimension*, *in* 3D PRINTING, INTELLECTUAL PROPERTY AND INNOVATION: INSIGHTS FROM LAW AND TECHNOLOGY 13 (Rosa M. Ballardini et al. eds., 2017) (suggesting that perfect replication of human organs via 3D bioprinting could blur the distinction between patentable and unpatentable subject matter).

114. Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 49; *see also* Holbrook & Osborn, *supra* note 14, at 1323–24.

115. *See* Sapna Kumar, *Regulating Digital Trade*, 67 FLA. L. REV. 1909, 1917–20 (2015).

116. Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 49; *see also* Holbrook & Osborn, *supra* note 14, at 1332–33.

117. *See* 35 U.S.C. § 101 (2012); Brean, *supra* note 99, at 852; Van Overwalle & Leys, *supra* note 111, at 512.

118. *See* Brean, *supra* note 99, at 842–845.

119. *See* Ebrahim, *supra* note 113, at 3.

120. *Id.* at 10; *In re* Roselin Inst., 750 F.3d 1333, 1339 (Fed. Cir. 2014) (holding that patent claims directed to the famed Dolly the Sheep were not patent eligible since a cloned animal would be an exact genetic replica).

121. *See* 35 U.S.C. § 271(b) (2012).

122. *See id.;* Holbrook & Osborn, *supra* note 14, at 1327.

A statutory interpretation of 35 U.S.C. § 271(a) concerning direct infringement[123] and applied to 3D printing raises a number of questions, such as: (i) is the CAD file itself considered an *object*, if someone uses a 3D printer to print a patented object when the object is made without authorization or without a license from the patent owner?; (ii) is the *making* of a CAD file considered to be the making of a patented item under the statute?; and (iii) is an *offer to sell* considered a true offer, since the sale of a CAD file involves potentially selling many items—due to the CAD file's potential ability to make many items?[124]

A statutory interpretation of 35 U.S.C. § 271(b) concerning indirect infringement could be interpreted to find anyone who posts a CAD file on a file-sharing networking to be an indirect infringer.[125] Thus, 3D printing intermediaries, 3D printing service companies, and anyone posting or transferring CAD files on websites or peer-to-peer networks could be accused of indirect patent infringement.[126] However, since direct infringement is a necessary element of indirect infringement and it may be difficult to ascertain the occurrence of the 3D printing infringing step, then indirect patent infringement may not be clear cut.[127] Additionally, since indirect infringement requires active inducement and it may be difficult to find anyone who provided printing instructions, then indirect patent infringement may be an even more challenging determination.[128]

A statutory interpretation of 35 U.S.C. § 271(c) concerning contributory infringement[129] and applied to 3D printing also raises doctrinal interpretation questions, such as: Is a CAD file considered a component of a

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123. 35 U.S.C. § 271(a) (specifying that "whoever without authority makes, uses, offers to sell, or sells any patented invention . . . infringes the patent.").

124. *See* Holbrook & Osborn, *supra* note 14, at 1327–28, 1332–36.

125. *See* 35 U.S.C. § 271(b) (stating "[w]hoever actively induces [the] infringement of a patent shall be liable as an infringer"); Ebrahim, *Trademark & Brands*, *supra* note 1, at 50–51.

126. *See* Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 51–52; Holbrook & Osbourne, *supra* note 14, at 1332, 1334.

127. *See* 35 U.S.C. § 271(c); Aro Mfg. Co. v. Convertible Top Replacement Co., 365 U.S. 336, 341 (1961); Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 49.

128. *See* Global-Tech Appliances, Inc. v. SEB S.A., 563 U.S. 754, 760, 766 (2011); Holbrook & Osborn, *supra* note 14, at 1335–36.

129. 35 U.S.C. § 271(c) (specifying that patent owners may have a claim against actors who while not directly infringing, aid and abet the direct infringer, by, for example, supplying an individual component of a patented invention, more specifically, requiring: (i) somebody offering to sell, selling, or importing into the U.S.; (ii) components of a patented device; (iii) knowing the components are adapted for use in infringement of a patent without substantial non-infringing use; and (iv) which result in an act of direct infringement).

patented device or does a digital representation of a physical object suffice to be considered a component?[130] The uncertainty in the scope of contributory patent infringement could be problematic for patent owners who may raise claims in litigation against CAD file creators and CAD file distributors.[131]

The patent infringement disruptions of 3D printing also encounter territoriality issues, since 3D printing CAD files can be transmitted across borders.[132] The digital-physical blur of CAD files arises in doctrinal issues of jurisdiction, such as whether the ITC's breadth of statutory authority of importation of *articles* encompasses the regulation of CAD files.[133] The scope of whether the word *articles* includes electronic transmission of digital data representing articles has not been considered by Congress and has only recently been addressed by the Federal Circuit.[134]

Each of these doctrinal disruptions stems from patent law lacking a meaningful patent protection for the CAD file.[135] Quite simply, patent law struggles with protecting digital representations of patentable physical objects.[136] In doing so, the patent regime is challenged by 3D printing in patentability and infringement.[137]

2. Copyright Law Disruptions

3D printing technology disrupts copyright law since it challenges the notions of copyright requirements and derivative works.[138] First, 3D printing technologies face challenges with copyright protection due to the conceptual separation between creative and functional features and the status of a derivative work.[139] Second, 3D printing technologies are prone to *Napsteriz[ation]*, or similar peer-to-peer infringement issues faced by digital music files.[140] The peer-to-peer reproduction and distribution issues raise

130. *See* Holbrook & Osborn, *supra* note 14, at 1345–48.
131. *See id.* at 1353.
132. *See* Daniel Harris Brean, *Patent Enforcement in Cyberterritories*, 40 CARDOZO L. REV. (forthcoming 2019) (manuscript at i–ii).
133. *See* Kumar, *supra* note 115, at 1911–12.
134. *See id.* at 1912–13.
135. *See* Brean, *supra* note 99, at 840.
136. *See id.*
137. *See id.*
138. *See* MICHAEL WEINBERG, WHAT'S THE DEAL WITH COPYRIGHT AND 3D PRINTING? 4 (2013), http://www.publicknowledge.org/files/What%27s%20the%20Deal%20with%20Copyright_%20Final%20version2.pdf.
139. *See* WEINBERG, *supra* note 5, at 5–6.
140. Brean, *supra* note 99, at 857; *see also* Holbrook & Osborn, *supra* note 14, at 1332–33.

enforcement and civil procedure challenges in copyright law similar to that of patent law.[141]

Copyright protection over CAD files may be problematic in cases where the 3D printed objects are not purely aesthetic.[142] The doctrine of severability in copyright law prevents an object with both artistic and useful features to attain copyright protection.[143] There is no straightforward severability test and, therefore, a fact-finding inquiry into copyright protection creates uncertainty as to the scope of copyright protection.[144]

The possibility of copyright protection in 3D printing is further complicated with the notion of derivative works.[145] This doctrinal issue is based on the doctrinal assessment of CAD files in a digital environment, which complicates whether copyright protects the design of the eventual 3D printed object.[146] While unsettled, one viewpoint considers that a CAD file that is protected by copyright would require permission from the copyright holder to 3D print the object, since the physical object would be a derivative work of the design in the CAD file.[147] This problem is further complicated by whether the change in the 3D printed physical object is so minor and too trivial to be entitled as a derivative work.[148]

B. *Artificial Intelligence*

Artificial intelligence technologies challenge the way we think about patent law and copyright law doctrines.[149] Artificial intelligence applications minimize the separation between human-generated content and machine-

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141. *See* Brean, *supra* note 99, at 857; Kumar, *supra* note 115, at 1912.

142. WEINBERG, *supra* note 138, at 9.

143. *Id.* (stating that if the aesthetic and functional features cannot be separated, then copyright law errs on the side of keeping useful objects available to the entire public and prevents attachment of copyright protection).

144. ANGELA DALY, SOCIO-LEGAL ASPECTS OF THE 3D PRINTING REVOLUTION 26 (2016).

145. 17 U.S.C. § 101 (2012) (defining *derivative work* as "a work based upon one or more preexisting works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgement, condensation, or any other form in which a work may be recast, transformed, or adapted"); WEINBERG, *supra* note 138, at 19.

146. WEINBERG, *supra* note 138, at 14.

147. *See id.* at 19 (describing that copying and/or distributing the object into 3D-printed physical form would require permission from the copyright holder, but this distinction can vary depending on whether the digital object in the CAD file was created by scanning an object or was created digital in the CAD file itself); DALY, *supra* note 144, at 26.

148. *See* 17 U.S.C. § 101; WEINBERG, *supra* note 138, at 19.

149. Robinson & Smith, *supra* note 28, at 356–57; Guadamuz, *supra* note 7, at 17.

generated content.[150] However, much of patent law and copyright law focuses on either purely human control or human-machine interactions but has yet to counter machine generated content.[151] As artificial intelligence applications proliferate, patent law and copyright law will increasingly need to respond to a world in which human, human-machine interactions, and machine generations move closer together.[152]

Some aspects of artificial intelligence technologies fit well within traditional intellectual property law doctrines.[153] For example, inventors have obtained patents on equipment, processes, and chemicals controlled by artificial intelligence technologies.[154] Even some underlying business methods of artificial intelligence technologies have successfully resulted in issued U.S. patent claims.[155] As another example, musicians could conceivably obtain copyright protection on artistic and musical works with the help of artificial intelligence technologies.[156]

However, intellectual property laws encounter difficulties when algorithms can learn and make predictions on data.[157] These techniques are different from the use of computational statistics, mathematical optimization, or finite element analysis as computational research tools, which have been utilized to solve equations concerning the physical world for many years.[158] Recent advances in computing power, algorithms, and sensor technology, and the proliferation of data as a strategic asset, have enabled computers to make data-driven decisions that affect the physical world.[159] For example, machine learning is being utilized for autonomous vehicles,[160] medical imaging interpretation and diagnosis,[161] oil and gas exploration,[162] and

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150. *See* Guadamuz, *supra* note 7, at 17; JJ Charlesworth, *AI Can Produce Pictures, but Can It Create Art for Itself?*, CNN: STYLE (Sept. 10, 2018), http://www.cnn.com/style/article/artificial-intelligence-ai-art/index.html.

151. *See* Bechtold, *supra* note 32, at 19; WEINBERG, *supra* note 138, at 2.

152. *See* Robinson & Smith, *supra* note 28, at 364–65; Neil Ballinger, *The Proliferation of Artificial Intelligence in 2019 Could Lead to a New Talent Gap*, DRUM: NEWS (Jan. 29, 2019, 4:35PM), http://www.thedrum.com/news/2019/01/29/the-proliferation-artificial-intelligence-2019-could-lead-new-talent-gap.

153. *See* Robinson & Smith, *supra* note 28, at 364–65.

154. *See id.* at 365; FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 5, 8.

155. *See* Levine & Sichelman, *supra* note 8, at 754, 758.

156. Guadamuz, *supra* note 7, at 17.

157. FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 6, 8.

158. *See id.* at 5; DU & SWAMY, *supra* note 74, at 39.

159. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 5–6; REINSEL ET AL., *supra* note 65, at 2.

160. LEX FRIDMAN ET AL., MIT AUTONOMOUS VEHICLE TECHNOLOGY STUDY: LARGE-SCALE DEEP LEARNING BASED ANALYSIS OF DRIVER BEHAVIOR AND INTERACTION WITH AUTOMATION 3, http://www.arxiv.org/abs/1711.06976.

161. Maryellen L. Giger, *Machine Learning in Medical Imaging*, 15 J. AM. C. RADIOLOGY 512, 512 (2018).

predictive maintenance of manufacturing systems.[163] The ability to determine anomalies and predict solutions in behavior profiles of physical phenomena makes protection of machine-controlled physical phenomena difficult for intellectual property owners.[164]

1. Patent Law Disruptions

Artificial intelligence technologies infuse the role of a machine in the invention process.[165] The algorithms at the heart of artificial intelligence are arguably playing a role in *conception* and *reduction to practice* of inventions.[166] Some algorithms substitute the human in the inventive process, and other algorithms augment the human in the inventive process.[167] While conceptually, such algorithms do not think in the cognitive sense of humans, the line between what is attributable to a human and what is attributable to a human-machine interaction becomes blurred.[168]

The involvement of artificial intelligence technologies in the invention process raises doctrinal patent law issues concerning inventorship,[169] non-obviousness,[170] and enablement.[171] These doctrines

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162. Hossein Hassani & Emmanuel Sirimal Silva, *Big Data: A Big Opportunity for the Petroleum and Petrochemical Industry*, 42 OPEC ENERGY REV. 74, 74, 78 (2018).

163. Gian Antonio Susto et al., *Machine Learning for Predictive Maintenance: A Multiple Classifier Approach*, 11 IEEE TRANSACTIONS ON INDUS. INFORMATICS 812, 812–13 (2015); SUMEET KAUL ET AL., PREDICTIVE MAINTENANCE AND THE SMART FACTORY: PREDICTIVE MAINTENANCE CONNECTS MACHINES TO RELIABILITY PROFESSIONALS THROUGH THE POWER OF THE SMART FACTORY 3 (2017).

164. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 6.

165. *See* Robinson & Smith, *supra* note 28, at 357.

166. MPEP § 2138.04 (9th ed. Rev 8, Jan. 2018) (quoting Townsend v. Smith, 36 F.2d 292, 295 (C.C.P.A. 1929) (defining *conception* as "the complete performance of the mental part of the inventive act and it is the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention as it is thereafter to be applied in practice . . . ."); *Id.* § 2138.05 (stating that reduction practice, which "may be an actual reduction or a constructive reduction to practice," requires recognition and appreciation of the invention); Mark A. Lemley, *Ready for Patenting*, 96 B.U. L. REV. 1171, 1177 (2016) (emphasis in original) (explaining that "conception of an invention does *not* require that the inventor know that the invention will work for its intended purpose," and that *conception* does not require "reduction to practice [nor] experimentation").

167. Liza Vertinsky, *Thinking Machines and Patent Law*, *in* RESEARCH HANDBOOK ON THE LAW OF ARTIFICIAL INTELLIGENCE 489, 490 (2018).

168. *See id.* at 490–93; Surden, *supra* note 60, at 89 (suggesting that the idea that computers are *learning* is a metaphor and does not mean that machines are replicating the cognitive abilities of humans in human learning).

169. MPEP § 2137.01.

170. 35 U.S.C. § 103 (2012).

171. *Id.* § 112(a).

assume a human being as the inventor for inventorship, as a standard for comparison of non-obviousness, and as providing some act of ingenuity to be eligible patentable subject matter.[172] The specific meanings of these doctrines have profound implications for ownership and control of the invention, as well as for management of innovation and competition.[173]

First, artificial intelligence technologies seem to challenge patent law's inventorship doctrine, which is based on conception.[174] U.S. patent law defines an inventor as being a human being, as evidenced in the statement: "The threshold question in determining inventorship is who conceived [of] the invention. Unless a person contributes to the conception of the invention, he is not an inventor."[175] Inventorship in U.S. patent law is attributed to conception, which is defined as "the complete performance of the mental part of the inventive act," presumably achieved by a human being.[176] The doctrinal issue is whether artificial intelligence technologies qualify under the inventorship requirement of U.S. patent law.[177] Additionally, the creation and use of artificial intelligence technologies raises the doctrinal issue of whether the human beings that assist artificial intelligence technologies also qualify as inventors.[178] The doctrinal problem with either the artificial intelligence technology or the human assisting the artificial intelligence technology stems from patent law's restrictive definition of *inventor* and imprecise definition of *conception*.[179] Is the term *inventor* in U.S. patent law limited to only a *person*, or does *person* have a more expansive meaning?[180] Is conception in U.S. patent law restricted to a mental act by a human being only?[181] U.S. patent law has not addressed these questions.[182]

Second, artificial intelligence technologies also challenge the non-obviousness doctrine, which is a threshold requirement for patentability in

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172. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 9–10.

173. *See* Vertinsky, *supra* note 167, at 493; Iain M. Cockburn et al., *The Impact of Artificial Intelligence on Innovation* 26 (Nat'l Bureau of Econ. Research Working Paper No. W24449).

174. *See* MPEP § 2138.04; Lemley, *supra* note 166, at 1172.

175. MPEP § 2137.01 (quoting *In re* Hardee, 233 U.S.P.Q. (BNA) 1122, 1123 (Comm'r Pat. & Trademarks 1984)).

176. MPEP § 2138.04.

177. FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 9–10.

178. *Id.* at 10.

179. *See* MPEP §§ 2137.01, 2138.04.

180. *See id.*; Patrick G. Gattari, *Determining Inventorship for US Patent Applications*, INTELL. PROP. & TECH L.J., May 2005, at 16, 16.

181. *See* MPEP § 2138.04; Gattari, *supra* note 180, at 16.

182. *See* MPEP § 2138.04.

U.S. patent law.[183] The finding of obviousness is based on ascertaining the difference between the claimed invention and the prior art based on the "person of ordinary skill in the art," or a PHOSITA, which is also known as POSITA.[184] The POSITA is defined as "a hypothetical person who is presumed to have known the relevant art at the time of the invention,"[185] and is also a "person of ordinary . . . creativity, not an automation."[186] Thus, U.S. patent law's standard for obviousness involves a comparison with a hypothetical person with knowledge of the relevant art or similar technologies.[187] A doctrinal problem arises because inventions generated by artificial intelligence technologies may not be comparable to the capabilities of a POSITA.[188] Artificial intelligence technologies may develop inventions based on learning from data representations—capabilities and computational horsepower that is lacking in human beings.[189] In the rare case of an extraordinary human being who possessed computational-like pattern detection capabilities, they would be unable to develop the invention generated by the artificial intelligence technology that learns from data representations.[190] Another doctrinal problem arises from the phrase *relevant art*, which may be problematic with inventions generated by machine learning techniques that rely on training of unique data sets, since machine learning algorithms are capable of changing their behavior to enhance their performance; hence, the *relevant art* would conceptually change.[191] Since *relevant art* is not static in a machine learning context, then this aspect of the obviousness comparison standard is inapplicable for comparison purposes.[192] Thus, the obviousness doctrine is problematic with inventions generated by artificial intelligence technologies due to limitations with the phrase *person*, unclear implications with the phrase *not an automation*, and dynamic interpretation with the phrase *relevant art*.[193]

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183. 35 U.S.C. § 103 (2012); FIRTH-BUTTERFIELD & CHAE, *supra* note 154, at 10.

184. MPEP § 2141.03.

185. *Id.*

186. KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007).

187. *See id.* at 419–20.

188. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 5.

189. *See* Lance Whitney, *Are Computers Already Smarter Than Humans?*, TIME (Sept. 29, 2017), http://www.time.com/4960778/computers-smarter-than-humans/.

190. *Id.*

191. MPEP § 2141.03 (9th ed. Rev. 8, Jan. 2018); *see also* Surden, *supra* note 60, at 89–90.

192. MPEP § 2141.03; *see also* Surden, *supra* note 60, at 89–90.

193. MPEP § 2141.03; *see also* Apple Inc. v. Samsung Elecs. Co., 839 F.3d 1034, 1076 (Fed. Cir. 2016).

Third, inventions generated by artificial intelligence technologies may not satisfy the enablement requirement of U.S. patent law.[194] Enablement requires that "one skilled in the art must be [able] to make and use . . . that defined by the claim(s) of the particular application or patent."[195] Similar to the issues with the obviousness standard requiring a POSITA, the enablement requirement also faces challenges with the phrase "one skilled in the art."[196] In order for an invention created by a machine learning algorithm to meet enablement, "one skilled in the art"—whether a person or machine learning technique—would need access to the same data set utilized by the machine learning algorithm that created the invention.[197] Since inventions created by machine learning are based on detecting patterns in data and making predictions based on training, one would not be able to make and use the invention without data and without sophistication in knowing the same machine learning technique.[198] The enablement standard is problematic with artificial intelligence technologies due to the inapplicability of the phrase "one skilled in the art."[199]

Each of these doctrinal disruptions stems from patent law lacking meaningful patentability standards and terms applicable to artificial intelligence technologies.[200] Quite simply, patent law struggles with its focus on a human being in its patentability requirements.[201]

2. Copyright Law

The conceptual difficulties with copyright law for artificial intelligence technologies concern the doctrines of authorship,[202] originality,[203] and work made for hire.[204] Copyright law protects original

194. FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 4; *see also* 35 U.S.C. § 112 (2012).

195. MPEP § 2164.

196. *Id.* §§ 2141, 2164.01; Frank A. DeCosta & Aliza George Carrano, *Intellectual Property Protection for Artificial Intelligence*, WESTLAW J. INTELL. PROP., Aug. 30, 2017, at 3.

197. MPEP § 2141; DeCosta & Carrano, *supra* note 196, at 3.

198. DeCosta & Carrano, *supra* note 196, at 3.

199. *Id.*; *see also* 35 U.S.C. § 112(a).

200. FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 4.

201. *Id.* at 8–9.

202. 17 U.S.C. § 102(a) (2012) (stating that "[c]opyright protection subsists, in accordance with this title, in original works of authorship . . . .").

203. H.R. REP NO. 94-1476, at 51 (1976); *see also* 17 U.S.C. § 102(a) (which codifies developments in case law that require some independent creation by the author and modest quantum of creativity); 17 U.S.C. § 102(b) (which codifies developments in case law that copyright protects an author's expression of an idea, but not the idea itself).

works created by authors, and the doctrinal issues concern whether copyright protection can be attained for computer generated works.[205] Similar to artificial intelligence technologies that develop functional patentable inventions embodying utility, artificial intelligence technologies can develop potentially copyrightable works embodying creativity.[206] Thus, similar to—although distinct from—ingenuity and inventorship issues with artificial intelligence patents, creativity and authorship issues arise with copyrightable works from artificial intelligence technologies.[207]

First, copyright law is a form of protection for anyone who creates *original work[s] of authorship*.[208] The problem with works generated by artificial intelligence technologies—or computer-generated works—is that they do not fit "the *standard model* of copyright law, [for] which a person" is the author who creates the work.[209] Artificial intelligence can output what appears to be a *work* created by its underlying technology, "but there [is] no person whose actions resemble those of a traditional *author*."[210] In such a case, the meaning given by copyright law's existing construction of authorship does not qualify works generated by artificial intelligence technologies.[211] The lack of a *spark of human brilliance* and the lack of human creativity showing *some creative spark* would suggest that copyright law would not qualify computer generated works for authorship.[212] In fact, the U.S. Copyright Office has indicated that a work must be created by a human being to qualify as a work of authorship.[213] The unresolved question

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204. 17 U.S.C. § 101; Pamela Samuelson, *Allocating Ownership Rights in Computer-Generated Works*, 47 U. PITT. L. REV. 1185, 1190 (1986).

205. Samuelson, *supra* note 204, at 1185 (defining computer generated work as "software [that] automatically generates output that is not identical to its own text, some of which is potentially copyrightable and some of which is not.").

206. *See id.* at 1197; 17 U.S.C. § 102(a)–(b), FIFTH-BUTTERFIELD & CHAE, *supra* note 54, at 4.

207. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 4; Samuelson, *supra* note 204, at 1192, 1195–97.

208. 17 U.S.C. § 102(b).

209. Bruce E. Boyden, *Emergent Works*, 39 COLUM. J.L. & ARTS 377, 378 (2016).

210. *Id.*

211. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 8.

212. Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991); Margot E. Kaminski, *Authorship, Disrupted: AI Authors in Copyright and First Amendment Law*, 51 U.C. DAVIS L. REV. 589, 592 (2017); *see also* Annemarie Bridy, *The Evolution of Authorship: Work Made by Code*, 39 COLUM. J.L. & ARTS 395, 398 (2016) (providing as reasoning, that how creativity defined as quintessentially human faculty would prohibit computers, or artificial intelligence technology utilized by computers, from being authors).

213. U.S. COPYRIGHT OFFICE, COMPENDIUM OF U.S. COPYRIGHT OFFICE PRACTICES 313.2 (3d ed. 2014) (stating that "the Office will not register works produced by a

on this doctrinal issue is whether the artificial intelligence technology is an assisting mechanism to a human being, or whether the authorship was not truly fully executed by a human being.[214]

Second, depending on how the invention is developed by the artificial intelligence technology, it may or may not contain the requisite originality.[215] In *Feist Publications, Inc. v. Rural Telephone Service Co.*,[216] the Supreme Court ruled that the Copyright Clause requires originality, which means that "(1) the work must be independently created (2) with a modicum of creativity."[217] However, copyright law has not defined the precise boundaries and scope of creativity.[218] While the lack of clarity concerning creativity has not caused much litigation concerning creativity since *Feist*, copyright law is facing a doctrinal disruption with creations from artificial intelligence technologies.[219] The notions of *independent creation* and *modicum of creativity* are being strained by human-machine interactions or machine-generated works of artificial intelligence technologies.[220]

Third, the work made for hire doctrine of copyright law could either help to complicate or to resolve doctrinal copyright disruptions of artificial intelligence technologies.[221] The work made for hire doctrine, which is found in "Section 201(b) of the Copyright Act, states: 'In the case of a work-made-for-hire, the employer or other person for whom the work was prepared is considered the author for purposes of this title.'"[222] Thus, a person who is an employer and one who has played no role in the creation of the work could be treated as the author and owner of the work.[223] The doctrinal problem stems from "a broad, utilitarian interpretation of [the] *author*[]," and hence, for the work made for hire doctrine.[224] A person who is a *motivating factor in producing* can be considered to qualify as the author for the work made for hire, and in doing so, would treat the employer as the

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machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author.").

214. Samuelson, *supra* note 204, at 1192.

215. *See* 17 U.S.C. § 102(a)–(b) (2012); Edward Lee, *Digital Originality*, 14 VAND. J. ENT. & TECH. L. 919, 920 (2012).

216. 499 U.S. 340 (1991).

217. Lee, *supra* note 215, at 920.

218. *Id.* at 920–21.

219. *Id.*; *see also Feist Publ'ns, Inc.*, 499 U.S. at 345.

220. Lee, *supra* note 215, at 920–21.

221. *See* 17 U.S.C. § 201(b) (2012); Bridy, *supra* note 212, at 400–01.

222. Robert C. Denicola, *Ex Machina: Copyright Protection for Computer-Generated Works*, 69 RUTGERS U. L. REV. 251, 275 (2016) (quoting 17 U.S.C. § 201(b)).

223. *Id.* at 276.

224. *Id.* at 277; *see also* Goldstein v. California, 412 U.S. 546, 561 (1973).

author.[225] The treatment of a work generated by artificial intelligence technology as a work made for hire would provide a solution to the aforementioned doctrinal copyright problems of vesting legal rights in a machine for a computer-generated work.[226] However, the level of human interaction with an artificial intelligence technology would weigh on the assessment of the work made for hire doctrine.[227] For example, a small degree of human interaction with an artificial intelligence technology could prevent attributing authorship to the employer.[228] Thus, similar to the unresolved question of authorship with artificial intelligence technology, the applicability of the work made for hire doctrine depends on whether the authorship was not truly fully executed by a human being.[229]

IV. INITIAL DATA-CENTRIC LITIGATION & A CONCEPTUAL PROPOSAL

The law's struggle "to keep pace with technological developments" has always raised questions about intellectual property protections in emerging areas.[230] Data-centric technologies are not an exception.[231] Some of the aforementioned doctrinal quandaries have created unclear boundaries concerning patent law and copyright law protections, which has resulted in initial litigation.[232]

A. *Doctrinal Problems in Recent Litigation*

There is a mismatch between traditional intellectual property law doctrinal frameworks and new innovation with data-centric technologies, which has resulted in recent litigation.[233] These cases have centered over tensions in the scope of protection.[234]

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225. Denicola, *supra* note 222, at 277 (quoting Picture Music, Inc. v. Bourne, Inc., 457 F.2d 1213, 1216 (2d Cir. 1972).

226. Bridy, *supra* note 212, at 400.

227. *See id.* at 399–400.

228. *See id.*

229. *See id.* at 400.

230. Robinson & Smith, *supra* note 28, at 356.

231. *See id.* at 356–57.

232. *See supra* Section III.B.

233. *See* ClearCorrect Operating, LLC v. Int'l Trade Comm'n, 810 F.3d 1283, 1286–88 (Fed. Cir. 2015); Naruto v. Slater, 888 F.3d 418, 420 (9th Cir. 2018); Purepredictive, Inc. v. H20.AI, Inc., No. 17-cv-03049-WHO, 2017 U.S. Dist. LEXIS 139056, at *1 (N.D. Cal. Aug. 29, 2017).

234. *See ClearCorrect Operating, LLC*, 810 F.3d at 1286–87; *Naruto*, 888 F.3d at 420; *Purepredictive, Inc.*, 2017 U.S. Dist. LEXIS 139056, at *7–21.

1. 3D Printing Patent Law Dispute Over *Articles*

In *ClearCorrect Operating, LLC v. International Trade Commission*,[235] the dispute centered on the interpretation of the term *articles*, which the ITC has the power to regulate under section 337 of the Tariff Act.[236] The doctrinal issue concerned whether the production of digital data sets of infringing digital patient data files was considered to be unfair importation into the United States.[237] In evaluating whether a patent owner could assert whether another entity was importing infringing articles, the ITC interpreted *articles* broadly to include all intangible digital information and asserted jurisdiction over digital information, resulting in an appeal to the U.S. Court of Appeals for the Federal Circuit.[238] After a challenge of the ITC's decision, the Federal Circuit challenged the ITC's decision that its jurisdiction included digital files and held that Congress had never intended the ITC to have authority over the Internet.[239] While the Federal Circuit determined that Congress had directly spoken on this issue concerning *articles*, it also brought to light the imprecise and vague meaning of *articles*—which Congress may still want to clarify further.[240] This case highlighted the mismatch between a definition intended by Congress and the patent law's inability to keep with digitization and digital transmission of 3D

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235. 810 F.3d 1283 (Fed. Cir. 2015).

236. *Id.* at 1286–87; *see also* 19 U.S.C. § 1337 (2012).

237. *ClearCorrect Operating, LLC*, 810 F.3d at 1286–88; Barclay Oudersluys, *Following* ClearCorrect*: A Guideline for Regulating Digital Trade*, 32 BERKELEY TECH. L.J. 653, 659–60 (2017).

238. *ClearCorrect Operating, LLC*, 810 F.3d at 1286; Oudersluys, *supra* note 237, at 659–60; *see also* Kumar, *supra* note 115, at 1912, 1924–25 (summarizing that the litigation involved plastic, invisible braces for repositioning teeth and a series of custom-made aligners for successively straightening a patient's teeth, wherein the sequence of events included: (1) uploading digital scans of patients' teeth to a server in Houston; (2) digital modification by creating digital models of patients' teeth in Pakistan; and (3) retransmission back to Houston for downloading and eventual 3D printing of physical models of the patient's teeth to create aligners; noting that none of the patent claims were directed to a tangible object, but instead were directed to methods of creating dental appliances, digital data sets, and digital treatment plans; stating that the ITC interpreted the term *articles* broadly to include all intangible digital information).

239. *ClearCorrect Operating, LLC*, 810 F.3d at 1294, 1302; *see also* Oudersluys, *supra* note 237, at 661–62.

240. *ClearCorrect Operating, LLC*, 810 F.3d at 1291–92, 94; Oudersluys, *supra* note 237, at 661–62.

printing.[241] It provided motivation for how the law should evolve in light of a proliferating data-centric technology.[242]

2. Artificial Intelligence Patent Law Dispute Over *Predictive Analytics*

In *Purepredictive, Inc. v. H2O.AI, Inc.*,[243] the dispute centered on patent eligibility of *predictive analytics* and whether the mere running of data through a machine goes to the "general abstract concept of predictive analytics rather than a specific application."[244] The case, which is being appealed to the Federal Circuit, centers around whether an artificial intelligence technology—specifically machine learning ensembling in the form of predictive analytics that "could be performed by humans"—qualifies as patentable subject matter or is an abstract idea.[245] This case highlights the mismatch between patent law's origination on human-based considerations in the physical world and emerging artificial intelligence technologies that focus on non-human considerations in a digital world.[246]

3. Artificial Intelligence Copyright Law Dispute Over *Monkey Selfie*

In *Naruto v. Slater*,[247] the dispute centered on whether animals could sue for copyright infringement and on who had rights to a photograph taken by a macaque.[248] The case concerned the doctrinal issue of whether animals had the statutory standing to sue for copyright infringement under the Copyright Act.[249] While the case did not concern data-centric technology, but instead a monkey, the underlying issue of the lack of specificity of

241. *See ClearCorrect Operating, LLC*, 810 F.3d at 1291–92, 1295; Kumar, *supra* note 115, at 1912, 1924–25; Oudersluys, *supra* note 237, at 661.

242. *See ClearCorrect Operating, LLC*, 810 F.3d at 1291–92; Oudersluys, *supra* note 237, at 658, 664.

243. No. 17-cv-03049-WHO, 2017 U.S. Dist. LEXIS 139056, at *2 (N.D. Cal. Aug. 29, 2017).

244. *Id.* at *15.

245. *Id.* at *4, 6, 13–15.

246. *See id.* at *7.

247. 888 F.3d 418 (9th Cir. 2018). This *monkey selfie* litigation is being classified under artificial intelligence for the purposes of this Part IV and for the purposes of this Article, even though it does not fit the prior definition of artificial intelligence technology. Paulina Julia Perkal, *Monkey Business Finally Settled: The* Monkey Selfie *Disputes*, KLUWER COPYRIGHT BLOG (Feb. 5, 2018), http://copyrightblog.kluweriplaw.com/2018/02/05/monkey-business-finally-settled-monkey-selfie-disputes/; *see also Naruto*, 888 F.3d at 431. The reason for introducing this *monkey selfie* case here is to provide an analogy of a non-human consideration, which has similar consideration as artificial intelligence technology with respect to copyright law. Perkal, *supra*; *Naruto*, 888 F.3d at 420.

248. *Naruto*, 888 F.3d at 420.

249. *Id.*

copyright law for animals—and arguably other non-humans, such as artificial intelligence technology—is similar.[250] This case highlights the mismatch between copyright law's coverage to certain entities, touching on the similar consideration of authorship with artificial intelligence technology.[251]

B. *Conceptual Data-Centric Matrix to Address Doctrinal Disruptions*

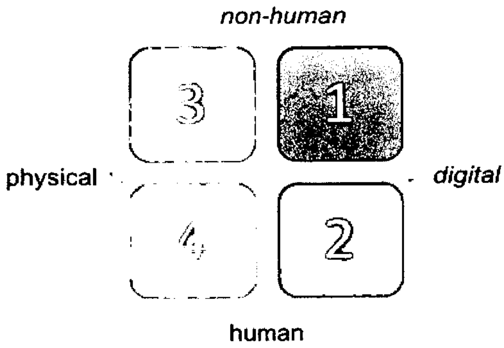
Data-centric doctrinal disruptions of an initial litigation is a result of intellectual property law's traditional assumptions that do not keep pace with emerging technologies.[252] While there may not be "a single model legal framework to govern" emerging technologies, intellectual property law should still evolve and clarify its scope of protection in order to avoid litigation.[253] This Part introduces a broad, over-arching conceptual framework for intellectual property law's treatment of scope of protection in present day, in the past, and in the likely future.[254]

1. Introducing the Conceptual Data-Centric Doctrinal Matrix

The doctrinal disruptions brought by data-centric technologies and the recent litigation concerning data-centric technologies can be conceptualized as levels of interpreting domains of human, non-human, physical, and digital.[255] This Part has conceptualized patent law and copyright law statutes not as a static and narrow interpretation, but instead as a dynamic and broad interpretation.[256] First, key patent law and copyright law terms have varying meanings that are being brought to the forefront due to unimagined, yet now feasible, data-centric technological developments.[257] Second, the scope of protection provided by patent law and copyright law will continue to change as data-centric technology continues to advance at a much faster pace than regulations.[258] These considerations are

250. *Id.* at 425–26.
251. *Id.* at 420.
252. *See* Robinson & Smith, *supra* note 28, at 356.
253. WALDEN & CHRISTOU, *supra* note 81, at 3.
254. *See infra* Part IV.B.3.
255. *Naruto*, 888 F.3d at 420; ClearCorrect Operating, LLC v. Int'l Trade Comm'n, 810 F.3d 1283, 1286–87 (Fed. Cir. 2015); Purepredictive Inc. v. H2O.AI, Inc., No. 17-cv-03049-WHO, 2017 U.S. Dist. LEXIS 139056, at *1 (N.D. Cal. Aug. 29, 2017).
256. Kalin Hristov, *Artificial Intelligence and the Copyright Dilemma*, 57 IDEA: J. FRANKLIN PIERCE CTR. FOR INTELL. PROP. 431, 453 (2017); *see also* discussion *supra* Part IV.B.1
257. Hristov, *supra* note 256, at 437–38, 453.
258. *See* Robinson & Smith, *supra* note 28, at 364–65.

conceptualized in the forthcoming figures, starting with the present-day pictorial representation of scope of coverage not as a dot or circle, but instead as two-by-two matrix encompassing these multiple domains:



This conceptual data-centric doctrinal matrix demonstrates that patent law and copyright law definitions, scope, and standards should be evaluated in multiple domains, such as: (1) non-human in digital domain; (2) human in digital domain; (3) non-human in physical domain; and (4) human in physical domain.[259] This conceptual framework demonstrates that patent law and copyright law is multi-faceted and more complex than what may have been intended in their originations.[260]

2. From the Past to the Current Time

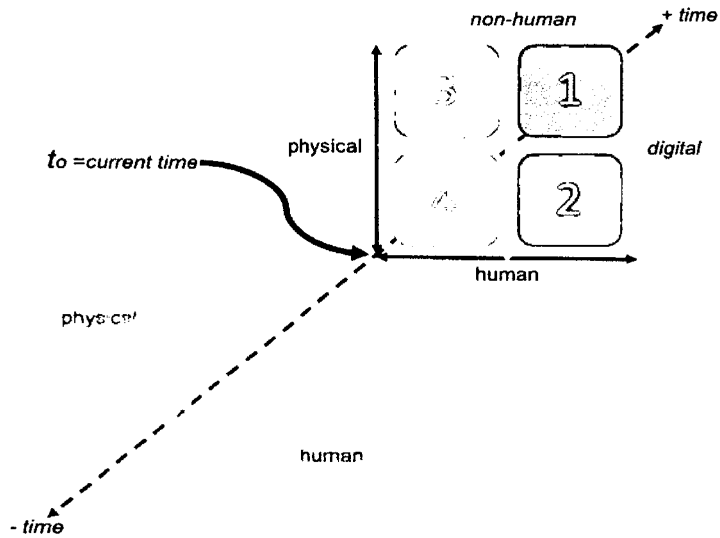
The aforementioned conceptual data-centric doctrinal matrix can better be understood by evaluation from a time standpoint.[261] As shown here, in the past, during the origination of patent law and copyright law statutes, the definitions, scope, and standards were based on only physical and human considerations—shown as region four, prior to the current time and closer to time, below.[262]

259. *See id.* at 372.

260. *See* Kumar, *supra* note 115, at 1911; Robinson & Smith, *supra* note 28, at 364–65.

261. *See* Robinson & Smith, *supra* note 28, at 364–65.

262. *See* 17 U.S.C. §§ 101–102 (2012); 35 U.S.C. § 101 (2012); U.S. COPYRIGHT OFFICE, *supra* note 213, at 313.2 (stating that "To qualify as a work of *authorship* a work must be created by a human . . . . [T]he 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."); Robinson & Smith, *supra* note 28, at 364–65.



Thus, the origination of patent law and copyright law in this conceptual framework is based on the past—without digital and without non-human aspects.[263] However, present-day time has required patent law and copyright law to evaluate data-centric technologies with considerations of digital and non-human interpretations.[264] Thus, at the current time, the definitions, scope, and standards of patent law and copyright law doctrines are not limited to only human in physical domain, but instead, also encompass non-human in digital domain, human in digital domain and non-human in physical domain.[265] The cause of recent litigation of data-centric technologies is that data-centric technologies, in the current time, are being evaluated by the origins of patent law and copyright law from a prior time that based principles only on human and physical principles.[266]

3. From the Current Time to a Future Time

In order to prevent future litigation, patent law and copyright law will need to evolve not only from their past framework to apply to a data-centric current framework, but also anticipate and prepare for a future

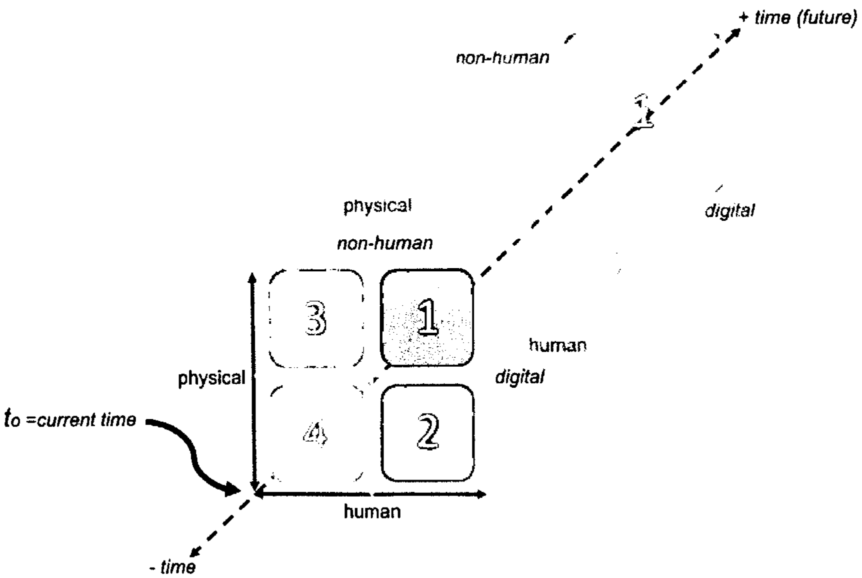
263. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 9; Hristov, *supra* note 256, at 440.

264. Hristov, *supra* note 256, at 433; Robinson & Smith, *supra* note 28, at 356–57.

265. *See* Robinson & Smith, *supra* note 28, at 364–66.

266. *See* Perkal, *supra* note 247.

framework.[267] Conceptually speaking, patent law and copyright law will need to prepare for a future where data-centric technologies will need more clarity and precision of non-human/digital considerations that will be prevalent and dominating—shown in the future matrix closer to +time for region 1, as shown below.[268] The future of data-centric technologies will also need more clarity and precision of human/digital considerations—shown in the future matrix closer to +time for region 2, as shown below—and non-human/physical considerations—shown in the future matrix closer to +time for region 3, as shown below.[269] However, the human/physical considerations will be less relevant in the future of data-centric technologies—shown in the future matrix closer to +time for region 4, as shown below.[270]



Thus, this conceptualization has implications for how patent law and copyright law should evolve in light of rapidly developing and proliferating

267. FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 4; Hristov, *supra* note 256, at 453; Robinson & Smith, *supra* note 28, at 372.

268. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 4; Robinson & Smith, *supra* note 28, at 372.

269. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 14; Robinson & Smith, *supra* note 28, at 372.

270. *See* FIRTH-BUTTERFIELD & CHAE, *supra* note 54, at 14; Robinson & Smith, *supra* note 28, at 365–67.

data-centric technologies.[271] First, patent law and copyright law should not remain static, but should anticipate the need to evolve.[272] Second, patent law and copyright law should focus on non-human and digital considerations.[273] Third, they should also anticipate an increase in unique, future doctrinal disruptions not only in the non-human/digital domain, but also in the human/digital domain and in the non-human/physical domain.[274] These considerations will impact incentives for inventors and creative authors, and in doing so, impact the breadth, pace, and scope of innovation and advancement of data-centric technologies.[275]

V. CONCLUSION

Data-centric technologies such as 3D printing and artificial intelligence are rapidly proliferating and gaining adoption.[276] Digitization of the physical world into digital operation or use has enabled transmission or control of information goods.[277] However, the information content view of the physical world has caused doctrinal disruptions with patent law and copyright law.[278] Imprecise and unclear definition, scope, and standards has challenged doctrines and resulted in initial litigation.[279] Data-centric technology disputes will continue unless patent law and copyright law embrace and better define the non-human and digital worlds, rather than remaining tied to doctrinal concepts only in the human and physical worlds.[280]

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271. Kumar, *supra* note 115, at 1911; *see also* Hristov, *supra* note 256, at 437–38.

272. *See* Hristov, *supra* note 256, at 453; Robinson & Smith, *supra* note 28, at 365.

273. *See* Naruto v. Slater, 888 F.3d 418, 420 (9th Cir. 2018); Guadamuz, *supra* note 7, at 19; Hristov, *supra* note 256, at 453; Robinson & Smith, *supra* note 28, at 365.

274. Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 41; Hristov, *supra* note 256, at 453; Robinson & Smith, *supra* note 28, at 365; Van Overwalle & Leys, *supra* note 111, at 507–08.

275. Hristov, *supra* note 256, at 453; *see also* Guadamuz, *supra* note 7, at 17.

276. Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 41; Robinson & Smith, *supra* note 28, at 358.

277. *See* Lipton, *supra* note 43, at 141, 143.

278. *See id.* at 157, 164; Ebrahim, *Digital Infringement & Digital Regulation*, *supra* note 1, at 42; Hristov, *supra* note 256, at 453; Robinson & Smith, *supra* note 28, at 365, 372.

279. *See* ClearCorrect Operating, LLC v. Int'l Trade Comm'n, 810 F.3d 1283, 1291–92 (Fed. Cir. 2015); Perkal, *supra* note 247.

280. *See* Naruto v. Slater, 888 F.3d 418, 420 (9th Cir. 2018); Hristov, *supra* note 256, at 453; Robinson & Smith, *supra* note 28, at 365, 372.