AI & Intellectual Property: Towards an Articulated Public Domain

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Abstract

This article seeks to clarify the relation between AI and IP in the information society. It aims to critically examine our intellectual property framework at the dawn of the Fourth Industrial Revolution. In that context, it contends that human authorship & inventorship remains the normative organ point of intellectual property law. Additionally, it argues that extending copyrights hinders innovation, cultural diversity, and even fundamental freedoms. Adding extra layers to the existing rainbow of IP rights is not a good solution to balance the societal impact of technological progress. Legislative gaps can be remedied by contracts and generous application of fair use and the three-step-test. Finally, parts of the Roman multi-layered property paradigm can be relevant for AI. Building upon this framework, section VIII of the article includes a proposal for a new public domain model for AI Crea-

tions and Inventions that crossed the autonomy threshold: Res Publicae ex Machina (Public Property from the Machine).

The introduction of the legal concept of Public Property from the Machine is a Pareto improvement; many actors benefit from it while nobody—at least no legal person—will suffer from it.

For illustrative purposes, the article includes a human-machine collaboration example. The examined AI Assisted Creation (a sound recording of a musical work, which can be streamed online) does not qualify as Public Property from the Machine. The article also describes a pure AI Invention that does qualify as Public Property from the Machine and thus could be awarded with official PD mark status: a flu vaccine autonomously brewed by an AI called SAM.

This article describes the current legal framework regarding authorship and ownership of AI Creations, legal personhood, patents on AI Inventions, types of IP rights on the various components of the AI system itself (including Digital Twin technology), clearance of training data and data ownership. It examines whether the rationales and justifications of IP are applicable to AI from the perspective of the function of copyright. Besides that, the article presents ideas and policy suggestions on how the law ought to be understood or designed with regard to AI input and output. Laws that would facilitate an innovation optimum.

The main goal of this research is to contribute to the body of doctrinal knowledge by offering a relatively compact AI & IP overview analysis and in doing so, to provide some food for thought to interdisciplinary thinkers and policy makers in the IP, tech, privacy and freedom of information field. Because AI and the internet are without borders, the article makes these recommendations through the eyes of a global acquis of intellectual property, as being a set of universal principles that form the normative backbone of the IP system.

I. Introduction

This article examines whether the rationales and justifications of IP are applicable to AI from the perspective of the function of copyright. It describes the current legal framework regarding authorship and ownership of AI Creations, legal personhood, patents on AI Inventions, types of IP rights on the various components of the AI system itself, clearance of training data and data ownership. Besides that, it attempts to present ideas and feasible policy suggestions on how the law ought to be understood or designed with regard to AI input and output. Laws that would facilitate an innovation optimum.

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acquis of intellectual property, as being a set of universal principles that form the normative backbone of the IP system.[2]

II. AI and the Function of Copyright Law

This section describes the current state of the art of AI. On top of that, it explains copyrights' principles and rationales as being part of the overarching normative concept of information law.

A. Artificial Intelligence

Artificial intelligence (AI) is usually described as either an entity, a system or a science.[3] AI can be just another word for an intelligent machine, a non-human system that possesses cognitive functions and skills such as learning and reasoning, a smart computer that can think and plan strategically, or a science that can assist humanity to find answers to the big questions/themes we face, such as climate change, dwindling natural resources, income inequality and how we should shape the future.[4]

AI, smart robotics, big data and blockchain are ground-breaking technological innovations that will fundamentally and definitively change society. These disruptive technologies bring us to the dawn of a new age in human history, or the Fourth Industrial Revolution.

We distinguish 3 types of artificial intelligence: Weak AI or Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI). These types of AI are able to reinforce each other. The evolution of AI does not happen at a linear, Darwinian pace. The combined use of innovative, powerful computer chips, 3D integrated circuits, machine learning algorithms, cloud computing, blockchain and big data has strong synergetic effects. Because of this synergy, developmental progress is made at an exponential rate.

The creations and inventions made by AI, either 'independently' or in collaboration with their human creators, are potentially subject to intellectual property law.

B. Copyright

This article considers copyright (an intellectual property right), as part of the

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2 Graeme Dinwoodie & Rochelle Dreyfuss, *An International Acquis: Integrating Regimes and Restoring Balance*, *in* INTERNATIONAL INTELLECTUAL PROPERTY: A HANDBOOK OF CONTEMPORARY RESEARCH 121 (Daniel J. Gervais ed., 2015).

3 David Faggella, *What is Artificial Intelligence? An Informed Definition*, EMERJ (Dec. 21, 2018), https://emerj.com/ai-glossary-terms/what-is-artificial-intelligence-an-informed-definition/ ("Artificial intelligence is an entity (or collective set of cooperative entities), able to receive inputs from the environment, interpret and learn from such inputs, and exhibit related and flexible behaviors and actions that help the entity achieve a particular goal or objective over a period of time"); Bryan Casey & Mark Lemley, *You Might Be a Robot*, 105 CORNELL L. REV. 287 (noting the current lack of a clear legal definition of robots and AI).

4 STEPHEN HAWKING, BRIEF ANSWERS TO THE BIG QUESTIONS (2018).

overarching normative concept of information law.[5] As such, intellectual property law should contribute to a legal framework that best serves the information society, while respecting fundamental rights and freedoms.[6]

The main objective of a copyright (as with other IP rights) is to incentivize and maximize creativity, cultural diversity, technological progress and freedom of expression.[7] As such, an important goal of copyright is to stimulate creation and dissemination of diverse cultural expression by enabling successive generations of authors to draw freely on the work findings of their successors.

Copyright consists of a set of international principles, including rationales and justifications, and a set of norms, (laid down in) Treaties, EU Directives, national laws and case law.[8] The main IP Treaties are the Berne Convention, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the WIPO Copyright Treaty (WTC), to which almost all countries of the world are members. This multilevel framework means that, at a national level in both USA and EU, there is an obligation to comply with international treaties.[9]

The universal principles underneath copyright are human authorship, subject matter such as literary, artistic and scientific works, original expression, a minimum of creative choices and ownership by a legal subject.[10] Human authorship is linked to human communication and freedom of expression.[11] A copyright grants the author the exclusive right of compensation for the publication and reproduction of his work, and a right of prohibition. Simply put: the right to exclusively benefit from the exploitation of his creation and the right to say no.[12] Without limitations of such exclusive rights, innovation would stagnate.

General rationales and justifications for the existence of these exclusive and economic rights are the promotion of science and useful arts and the authors right to

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5 *See* JOÃO PEDRO QUINTAIS, COPYRIGHT IN THE AGE OF ONLINE ACCESS: ALTERNATIVE COMPENSATION SYSTEMS IN EU COPYRIGHT LAW, 11, 12 (2017).

6 INSTITUTE FOR INFORMATION LAW, INFORMATION LAW: EXPANDING HORIZONS, IViR RESEARCH PROGRAM (2012). *See* Jack Balkin, *Digital Speech and Democratic Culture: A Theory of Freedom of Expression for the Information Society*, 79 N.Y.U. L. REV. 1 (2004). *See also* Burkhard Schafer, *Editorial: The Future of IP Law in an Age of Artificial Intelligence*, 13 SCRIPTed 284 (2016).

7 Martin Senftleben & Lotte Anemaet, *Het verleidelijke gezang van een Griekse Sirene—Auteursrecht in het licht van Bourdieu's sociologische analyse van het literaire en artistieke veld*, 39 AMI 1, 1–8 (2015).

8 PAUL GOLDSTEIN & BERNT HUGENHOLTZ, INTERNATIONAL COPYRIGHT: PRINCIPLES, LAW, AND PRACTICE 4–5 (Oxford Univ. Press 3d ed. 2013).

9 Quintais, *supra* note 5, at 15.

10 Goldstein & Hugenholtz, *supra* note 8, at 4–5.

11 Carys J. Craig & Ian R. Kerr, *The Death of the AI Author*, OSGOODE LEGAL STUDIES RESEARCH PAPER (Mar. 25, 2019). (making an ontological inquiry into the plausibility of AI-authorship that transcends copyright law). *See also* Daniel Gervais, *Can Machines be Authors?*, KLUWER COPYRIGHT BLOG (May 21, 2019), http://copyrightblog.kluweriplaw.com/2019/05/21/can-machines-be-authors/.

12 P. Bernt Hugenholtz & Martin Kretschmer, *Reconstructing Rights: Project Synthesis and Recommendations*, COPYRIGHT RECONSTRUCTED: RETHINKING COPYRIGHT'S ECONOMIC RIGHTS IN A TIME OF HIGHLY DYNAMIC TECHNOLOGICAL AND ECONOMIC CHANGE 4 (P. Bernt Hugenholtz ed., 2018).

remuneration. Civil law countries emphasize the authors' natural rights, including moral rights; in common law countries, copyright's utilitarian principles are traditionally more dominant.[13] Copyright rationales and justifications should inform appropriately structured policy choices.[14]

The exclusive character of copyrights is not absolute. Authors' monopoly on their creation is limited by an array of exceptions and limitations, either by law or by contract.[15] The control rights holders can exercise over their works is limited by copyright duration and legal norms such as freedom of speech, equity, unfair competition law, and anti-trust law. Furthermore, the American fair use principle, which allows more permissible use than that of most civil law countries, is recognized as a limitation of copyright in the USA.[16]

Copyright can also be limited (or circumvented) by contract and by licensing frameworks such as creative commons CC0,[17] open source, copyleft, and the GNU General Public License (GPL).[18] These frameworks effectively "restore a commons . . . through voluntary acts that produce a simulated public domain."[19] Additionally, freedom of contract still prevails as a norm in both common and civil law systems.[20]

The exceptions and limitations to copyright are restricted by the Berne Convention three-step-test.[21] On an international copyright level, this test constitutes a flexible balancing tool that offers national policy makers possibilities for the creation of an appropriate system of copyright exceptions and limitations at the national level.[22] On a case by case level, the three step test can be used to determine whether limiting exclusive rights to commercial exploitation is proportional, reasonable and fair, in the light of user interests, public interest, or other cultural, social or economic interests.[23] In essence, the three-step-test is a wohltemperiertes tuning mechanism which can be used by legislators and courts to reach a more balanced, practical and normatively desirable outcome.

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13 Goldstein & Hugenholtz, *supra* note 78, at 6.

14 DANIEL GERVAIS, (RE)STRUCTURING COPYRIGHT: A COMPREHENSIVE PATH TO INTERNATIONAL COPYRIGHT REFORM 2 (Edward Elgar Publishing, 2017).

15 *Limitations on A Copyright Owner's Rights*, COPYRIGHT ALLIANCE, https://copyrightalliance.org/education/copyright-law-explained/exceptions-and-limitations-to-a-copyright-owners-rights/ (last visited Sept., 7, 2020) (listing exceptions as including fair dealing, parody, citation, education, accessible copies, and government works).

16 Lawrence Lessig, *Re-crafting A Public Domain*, 18 YALE J.L. & HUMAN. 56, 72 (2006).

17 *See id*. at 75–78.

18 Open source robotics hardware accelerates research and innovation. *See* Mirjana Stankovic, Ravi Gupta, Bertrand Andre Rossert, Gordon Myers and Marco Nicoli, *White Paper: Exploring Legal, Ethical and Policy Implications of Artificial Intelligence*, LJD (Draft, Oct. 2017, at 1, 18.

19 Lessig, *supra* note 16, at 83.

20 Goldstein & Hugenholtz, *supra* note 8, at 5.

21 Hugenholtz & Kretschmer, *supra* note 12, at 4.

22 Christophe Geiger, Daniel Gervais & Martin Senftleben, *Understanding the "Three-Step-Test", in* INTERNATIONAL INTELLECTUAL PROPERTY: A HANDBOOK OF CONTEMPORARY RESEARCH 167, 189 (Daniel J. Gervais ed., 2015).

23 *Id*.

Ideas cannot be subject to copyright: they can and should not be monopolized or privatized.[24] Ideas are public domain. Only the expression of ideas can be protected.[25] This is known as the idea/expression dichotomy. In many cases, the interests of copyright owners must be balanced against competing public interests such as freedom and equality rights.

III. Authorship and Ownership of AI Creations

This section explores the question whether AI creations, i.e. computer–generated creations and machine–learning output, can and ought to be copyrighted.

The law as it stands does not recognize nonhuman copyright. Authorship is "fundamentally connected with humanness."[26] Is it dogmatically and doctrinally correct to assume that there can be no copyright on pure AI Creations since AI is not human, and since, moreover, there is no originality and creativity linked to human personality present in AI Creations? Do pure AI Creations even exist today?

A. EU and United States

To answer this question, we need to distinguish between purely AI Created Works and AI Assisted Works.[27] In the case of the former, there can be no copyright because of, inter alia, the absence of a human author's own intellectual creation as an extension of his personality.[28] In the case of the latter, copyrights may arise in favor of the person who made creative choices stemming from his or her artistic imagination, e.g., the artificial agent's owner or the user of the creative robot. Besides that, the requirement of originality for the emergence of copyright, linked to generative code instead of a human author, is problematic.[29] Works solely made by code are not protected. They are "free as the air to common use."[30] This is how the law currently stands, both in the EU and the United States.

Moreover, purely AI Created Works require an active agent capable of produc-

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[24] Pamela Samuelson, *Challenges in Mapping the Public Domain*, THE FUTURE OF THE PUBLIC DOMAIN: IDENTIFYING THE COMMONS IN INFORMATION LAW 7–25 (Lucie Guibault & Bernt Hugenholtz eds., 2006).

[25] Goldstein & Hugenholtz, *supra* note 8, at 5.

[26] Craig & Kerr, *supra* note 11.

[27] In case of purely AI Created Works (or AI Made Creations) no human is involved, i.e. these works have crossed the autonomy threshold. There is debate as to whether such works exist anno 2019. In case of AI Assisted Works (or AI Assisted Creations) there is a minimum of human intervention present. *See* THE NEXT REMBRANDT, https://www.nextrembrandt.com/ (last visited Sept. 9, 2020) (providing a video describing an example of an AI Assisted Work).

[28] Shlomit Yanisky-Ravid and Luis Antonio Velez-Hernandez, *Copyrightability of Artworks Produced by*

Creative Robots and Originality: The Formality-Objective Model, 19 MINN. J.L. SCI. & TECH. 1, 8 (2018).

[29] *Id.* at 2, 12.

[30] Yochai Benkler, FREE AS THE AIR TO COMMON USE: FIRST AMENDMENT CONSTRAINTS ON ENCLOSURE OF THE PUBLIC DOMAIN, 74 N.Y.U. L. REV. 354 (1999).

See also Int'l News Serv. v. Associated Press, 248 U.S. 215, 250 (1918) (Brandeis, J., dissenting).

ing works. Autonomous creative agents do not yet exist.[31] They are merely "faithful agents."[32] Aesthetically attractive machine productions may appear to be creative, but they are not.[33] So doctrinally, there can be no question of AI authorship. In that sense, the AI author has not been born yet. There are no AI Authored Works. As technology progresses, and autonomous creative agents that are granted legal status produce truly original works, this may change. Awarding copyright to AI Authors is another story, since authorship is connected to humans.

B. UK: CGW Regime

Contrary to the approach of the EU and USA, the UK implemented a computer-generated works (CGW) regime, which means—in short—that the AI's programmer gets copyright on the machine's output.[34] In other words, the UK stretches human authorship towards algorithmic authorship. The CGW regime qualifies machine-generated outputs as 'works' under copyright law. No moral rights are assigned (a causal link between human creativity and the output is absent) and the protection term is limited to 50 years.

Japan is planning a similar strategy, but with a commercial impact threshold: only AI Generated Works that have a significant economic impact will be granted protection.[35] The legal subject (person or business) that programmed the algorithm responsible for the creation of the work will be the owner of this intellectual property right.

C. Arguments Against Copyright Protection

Doctrinally, the UK's CGW framework is incompatible with the European acquis and it has a potentially negative market impact (winner takes all, not a balancing effect).[36] There is just no evidence that supports the belief that exclusive IP

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[31] James Vincent, *How Three French Students Used Borrowed Code to Put the First AI Portrait in Christie's*, The Verge (Oct. 23, 2018), https://www.theverge.com/2018/10/23/18013190/ai-art-portrait-auction-christies-belamy-obvious-robbie-barrat-gans.

[32] Jane C. Ginsburg & Luke Ali Budiardjo, *Authors and Machines*, 34 BERKELEY TECH. L.J. 343, 392 (2019).COLUM. PUBL. L. RES. Tech. L.J., https://ssrn.com/abstract=3233885.

[33] *Id.*; Daniel J. Gervais, *The Machine As Author*, 105 IOWA L. REV. 2053, 2068, 2093-2094, 2106 (2020)(concluding that the machine itself is not the source of creativity.).

[34] Paul Lambert, *Computer Generated Works and Copyright: Selfies, Traps, Robots, AI and Machine* Learning' *Learning* 2–3 (July 8, 2017) (unpublished manuscript, Open Science Framework), osf.io/m93dr.

[35] Intellectual Property Strategy Headquarters, "Intellectual Property Strategic Program 2016" (May 2016), http://www.kantei.go.jp/jp/singi/titeki2/kettei/chizaikeikaku20160509_e.pdf accessed May 19, 2019.

[36] Begoña González Otero & Joao Pedro Quintais, *Before the Singularity: Copyright and the Challenges of Artificial Intelligence*, Kluwer Copyright Blog (Sep. 25, 2018), http://copyrightblog.kluweriplaw.com/2018/09/25/singularity-copyright-challenges-artificial-intelligence. *See also* Burkhard Schafer, *supra* note 6; Jerome H. Reichman & Ruth L. Okediji, *When Copyright Law and Science Collide: Empowering Digitally Integrated Research Methods on a Global Scale*, 96. MINN. L. REV. 1362 24–26 (2012). (asserting that stretching IP rights also poses a threat to basic scientific research, and thus innovation). The European acquis or acquis communautaire is the accumulated legislation, legal acts, and jurisprudence which together constitute

rights on computer generated works are needed as an incentive to create, produce and invent. Additionally, the absence of both legal subjectivity and legal/corporate personhood is problematic, as we will see in section IV below. For AI Creations, this results in a no-ownership and public domain scenario. Dogmatically, CGW do not belong in copyright.[37] These works should not be monopolized.

William Fisher canvassed 4 normative sources of intellectual property, which can be used to justify granting copyright protection from an economic, cultural and philosophical perspective.[38] These normative sources (Welfare, Fairness, Culture and Social Planning Theory) do not apply easily to Machine Made Creations. Neither as a rationale for protection for the benefit of the AI Machine itself, nor the benefit of the AI Machine's programmer or the AI Machine's owner.[39]

Can protection of AI generated subject matter (literary, artistic and scientific makings) that would qualify for copyright if created -at least in part- by a human author, be justified by the need for investment protection?

First of all, the scope of economic rights, including remuneration rights (the right of a copyright holder to receive payment when his works are used), should reflect the justifications of copyright protection.[40] This rule of thumb aims to avoid IP overprotection, avoid barricades for communicative use of creative works, avoid roadblocks for technological advancement and avoid market failure.[41]

Second, the need for economic incentives through copyright depends per sector. Innovation economics has made clear that -following the utilitarian approach- certain sectors need to be more incentivised through IP legislation, than others. According to Burk and Lemley, optimal IP rules should be derived from evidence and

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the body of European Union law.

37 Jane Ginsburg, *People Not Machines: Authorship and What It Means in the Berne Convention*, IIC - International Review of Intellectual Property and Competition Law 132, https://link.springer.com/article/10.1007/s40319-018-0670-x. *See also* James Grimmelmann, *There's No Such Thing as a Computer-Authored Work—And It's a Good Thing, Too*, 39 COLUM. J. L. & ARTS 403 (2016); Ana Ramalho, *Will Robots Rule the (Artistic) World? A Proposed Model for the Legal Status of Creations by Artificial Intelligence Systems*, 21 JOURNAL OF INTERNET LAW 1, 12–25 (2017); Andres Guadamuz, *Do Androids Dream of Electric Copyright? Comparative Analysis of Originality in Artificial Intelligence Generated Works*, (June 5, 2017) Intellectual Property Quarterly, 2017 (2); Annemarie Bridy, *The Evolution of Authorship: Work Made by Code*, 39 COLUM. J.L & ARTS 395 (2016).

38 William Fisher, *Theories of Intellectual Property*, *in* NEW ESSAYS IN THE LEGAL AND POLITICAL THEORY OF PROPERTY (1–8 (Stephen R. Munzer (2001). *See also* William Fisher, *Theories of IP 2019.01.15*, http://ccb.ff6.mwp.accessdomain.com/Maps/IPTheories.html (last visited May 12, 2019); The Berkman Klein Center for Internet & Society, *CopyrightX: Lecture 1.1, The Foundations of Copyright Law: Introduction*, YOUTUBE (Jan. 20, 2016) https://www.youtube.com/watch?v=CqkonSY__ic (last visited May 12, 2019).

39 *Id*. *See also* Justin Hughes, *The Philosophy of Intellectual Property*, 77 GEO. L. J. 287, 339–42 (1988).

40 Hugenholtz & Kretschmer, *supra* note 12, at 3–4.

41 Frederic Scherer, *The Innovation Lottery*, *in* EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY - INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY (3, 20–21 (Rochelle Cooper Dreyfuss, Diane Leenheer Zimmerman & Harry First eds., 2001).

not from faith.[42] The authors argue that exclusive rights are performing different roles in different economic sectors.[43] This entails that IP policy makers should differentiate more explicitly between economic sectors.[44]

For example, there appears to be less need for governmental intervention to stimulate optimal innovation levels in the media and entertainment sector, than in the pharmaceutical industry. With this taxonomy—or classification—in mind, governments can choose from at least six strategies on how to respond to the risks of overprotection and underproduction in a certain sector.[45] These strategies are (1) governmental research, (2) grants, (3) prizes, (4) intellectual property laws, (5) legal reinforcement of self-help practices and (6) compelling actors to innovate in socially beneficial ways.[46]

Moreover, IP can be vested in the machine itself (instead of the output) which could then be licensed or sold/commodified. Investments can also be protected by other legal instruments such as antitrust law, unfair competition law and trademark law.[47]

Third, an AI at the current state of the art does not need incentives to create, nor recognition or reward for its endeavours. It simply does not need exclusive rights.

D. Arguments Pro Copyright Protection

Some commentators fear a lack of protection would limit AI machine developers and owners' willingness to invest in innovation[48], or that valuable innovation could move to a different jurisdiction.[49] Others would not reject authorship in non-human entities, such as animals, companies or machines, per se, or the possibility of non-human authorship in general.[50] Arguments in favour of granting copyright status to AI-generated creations focus in particular on the need to incentivise AI programmers, owners and users.[51]

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42 DAN BURK & MARK LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT 38 (2009). *See also* Mark Lemley, *Faith-Based Intellectual Property*, 62 UCLA L. REV. 1328, 1345–46 (2015). https://www.researchgate.net/publication/282955515_Faith-Based_Intellectual_Property

43 Burk & Lemley, *supra* note 42, at 38.

44 *Id.*

45 William Fisher, *Regulating Innovation*, 82 U. CHI. L.R. ONLINE, 251, 253–256 (2015). *See also* GERVAIS, *supra* note 14, at 5; and Brewster Kneen, *Redefining 'Property': Private Property, the Commons, and the Public Domain*, Seedling at 3 (Jan. 2004).

46 *Fisher*, *supra* note 45, at 255–256; *See also* WILLIAM W. FISHER, PROMISES TO KEEP: TECHNOLOGY, LAW, AND THE FUTURE OF ENTERTAINMENT 199–201 (2004).

47 Otero & Quintais, *supra* note 36.

48 *Id*.

49 Benjamin Sobel, *Artificial Intelligence's Fair Use Crisis*, 41 COLUM. J. L. & ARTS 45, 81 (2017).

50 Annemarie Bridy, *The Evolution of Authorship: Work Made by Code*, 39 COLUM. J.L. & ARTS 395 (2016); Annemarie Bridy, *Coding Creativity: Copyright and the Artificially Intelligent Author*, STAN. TECH. L. REV. 5, 18–20 (2012).

51 Kalin Hristov, *Artificial Intelligence and the Copyright Dilemma*, 57 IDEA: THE FRANKLIN PIERCE CENTER I.P. L.R., 431, 438 (2017); Russ Pearlman, *Recognizing Artificial Intelligence (AI) as Authors and Inventors Under U.S. Intellectual Property Law*, 24 RICH. J. L. & TECH. 1 (2018); Robert

Counterintuitively, extending copyright—and its paradigms of control and exclusivity[52]—could ultimately cause less available AI Generated Works for commercial and educational use, which is counterproductive to AI development in general. According to Gervais, the idea that value created by machines must be protected by copyright law is a normative error.[53] Besides that, creating incentives for machine productions could result in less human generated creations.[54]

E. Degree of Human Intervention

Determining who or what created a work is a question of attributing responsibility.[55] Allocation of copyrights in AI Generated Creations can only take place in cases of justified human authorial claims. According to Deltorn, this requires a case by case analysis of the amount of human intervention related to original contribution and creative choices in a particular creation.[56]

Sufficient human intervention would result in an AI Assisted Creation (i.e., a human-machine collaboration). To determine copyrightability, Gervais recently proposed the originality causation test.[57] This test follows creative choices and traces them back to either human programmers, owners, users, or machines themselves.[58]

In case of pure AI Creations, no humans would be involved. Only autonomous agents—that crossed the autonomy threshold[59]—would contribute to the creative process. No sufficient (i.e., de minimis) degree of human responsibility for the creation, neither upstream as programmer nor downstream as a user, would be present.[60] No mental conception or physical execution would be present to justify authorship.[61] No human involvement or intervention means no authorship. No authorship leads to public domain.[62]

Denicola, *Ex Machina: Copyright Protection for Computer-Generated Works*, 69 RUTGERS L. R. 251, 273 (2016); Celine Dee, *Examining Copyright Protection of AI Generated Art*, 1 DELPHI - INTERDISCIPLINARY REVIEW OF EMERGING TECHNOLOGIES 31, 33–36 (2018). *See also* Mark Perry & Thomas Margoni, *From Music Tracks to Google Maps: Who Owns Computer Generated Works?*, 26 Comput. L. & Sec. Rev. 621 (2010) (recommending a public domain scenario for Canada).

52 Carys J. Craig, *The Canadian Public Domain: What, Where, and to What End?*, 7 CAN. J.L. & TECH. 221, 224 (2010).

53 Gervais, *supra* note 14.

54 *Id*.

55 *Id*.

56 Jean-Marc Deltorn & Franck Macrez, *Authorship in the Age of Machine Learning and Artificial Intelligence*, *in* THE OXFORD HANDBOOK OF MUSIC LAW AND POLICY (Sean M. O'Cannon ed., Oxford University Press 2019) (2018).

57 Gervais, *supra* note 33, at 53.

58 *Id*.

59 *Id*. at 51.

60 Ginsburg & Budiardjo, *supra* note 32, at 343–44.

61 *See id* at 392 (describing that "the individual contributions of designer and user may be insufficient to justify a claim of sole authorship").

62 *See id.* at 454 n.370 (arguing that the absence of copyright protection can be compensated by pursuing a 'disseminator's right' and that authorless works result in a public domain scenario).

IV. Legal Personhood and Legal Agenthood

Copyrights can only be owned by legal subjects i.e. persons or companies. An AI machine itself cannot own copyright on its AI Made Creations because an AI system has no legal personality and does not possess legal subjectivity. AI systems qualify as legal object. This applies to both physical goods such as smart robots (hardware) and intangible goods such as deep learning algorithms (software).

Machines equipped with AI therefore do not carry legal rights, obligations and capacities. They cannot independently participate in legal transactions. They have no constitutional rights. They cannot perform unilateral or multilateral legal acts. As we have seen, this has consequences for whether or not intellectual property rights arise: whether AI Made Creations would fall into the propertized domain or the public domain. The absence of legal subjectivity also has consequences for insurance and liability for damage: an AI system cannot be held responsible, liable or appear in court.

This section describes the absence of legal status for machines and explores possibilities for the construction of such a status.

A. AI is a Legal Object

Both natural persons and corporations are legal subjects. Corporations have legal personhood vested in them (corporate personhood). AI is not a legal entity but a legal object. A legal object cannot create copyrightable works, invent patentable technical applications, or own intellectual property. It cannot sign license deals or employment contracts. It cannot accept responsibility. Only legal subjects can. Therefore, AI cannot own IP rights to its AI Made Creations. This path would lead us -if the AI developer or owner cannot claim IP rights- to the public domain.

With AI becoming smarter at an exponential pace, it is conceivable that at a certain point in time there will be a social, moral, or political need for the granting of a certain legal status to autonomous, sentient AI's. Acknowledgement by law, directive, or treaty of machines as carriers of rights and duties could—in theory—help resolving liability, insurance, and employment related issues. I briefly discuss some existing doctrines from which inspiration can be drawn in the construction of sui iuris or sui generis legal subjectivity.[63]

B. Roman Property Paradigm

Traditionally, human beings and property are viewed as legal entities on the two opposite sides of a continuum.[64] Animals and embryos are somewhere in between. Embryos occupy a temporal category in this continuum, until the point of brain birth of the unborn child. An infant does not have legal capacities because the law does not attach any consequence to his or her psychological intention. "[T]he

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[63] *Id.*

[64] Robbie Robinson, *The Legal Nature of the Embryo: Legal Subject or Legal Object*, 21 POTCHEFSTROOM ELEC. L.J. 1, 25 (2018).

bio-ethical nature of the parent-child relationship simply means that as product of a biological process the embryos are included in their parents' legal subjectivity."[65] We see a similar responsibility driven concept, developed by Romans, for quality liability for animals. In some jurisdictions, animals share qualities of both legal object and legal subject.[66]

The Roman property paradigm distinguished various dimensions of private and public property, exclusive and non-exclusive rights, including the concepts of res mancipi, res universitatis, res publicae, res communis omnia and res divini iuris.[67] Res mancipi is property that can be transferred only by formal ceremony of mancipation.[68] Res universitatis refers to things owned by a public or private group in its corporate capacity.[69] Res publicae (public domain) refers to things open to the public by operation of law.[70] Contrastingly, res communes omnia (the commons) refers to things incapable by their nature of being exclusively owned—thus common to all—such as oceans, light or birds in the air.[71] Res divini iuris refers to things that cannot be owned publicly or privately because of their divine status.[72] Analogous to children from Roman parents, and to animals and slaves on Italian territory, smart robots would likely fall into the res mancipe category.[73]

C. Dependent and Independent Personhood

Chopra & White argue that, although autonomous artificial agents are programmed and humans are not, there is no a priori reason to exclude smart robots from sui iuris legal personhood.[74] It is argued that in some circumstances (to pragmatically solve practical legal issues), artificial agents could be treated as legal subjects and that this attribution of rights, obligations, and responsibilities is not an all-or-nothing matter.[75] To this end, Chopra & White distinguish between dependent and independent legal personhood.[76]

Dependent legal persons (such as an animal or an unborn child) can only act

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65 *Id.* at 26.

66 Ton Hartlief, *Van knappe koppen en hun uitvindingen*, Nederlands Juristenblad (May 1, 2018), https://www.njb.nl/blogs/van-knappe-koppen-en-hun-uitvindingen/.

67 Fiona Macmillan, *Arts Festivals: Property, Heritage or More?*, LAW AND CREATIVITY IN THE AGE OF THE ENTERTAINMENT FRANCHISE (K. Bowrey & M. Handler eds., 2013). *See also* FIONA MACMILLAN, MANY ANALOGIES, SOME METAPHORS, LITTLE IMAGINATION: THE PUBLIC DOMAIN IN INTELLECTUAL SPACE 6–8 (2010).

68 *Res mancipi*, BLACK'S LAW DICTIONARY (11th ed. 2019).

69 *See* Macmillan, *Arts Festivals: Property, Heritage or More?*, *supra* note 67, at 14-16; *See also* Kneen, *supra* note 45, at 4-5.

70 *Id.*

71 *Id.*

72 *Id.*

73 *See* WILLIAM SMITH, A DICTIONARY OF GREEK AND ROMAN ANTIQUITIES 590 (London, Taylor and Walton 1842).

74 LAURENCE WHITE & SAMIR CHOPRA, A LEGAL THEORY FOR AUTONOMOUS ARTIFICIAL AGENTS 172 (2011).

75 *Id.* at 171.

76 *Id.* at 189.

through the agency of another legal person in exercising its legal rights.[77] An AI becomes a candidate for dependent personhood the moment it engages in legal acts and interacts with society's networks of social and economic relations, such as with self-driving cars.[78]

Fully independent legal persons are not bound by such constraints.[79] Independent legal personhood could, in theory, be awarded to an AI the moment it becomes sentient and has moral agency.[80] This includes according independent legal subjectivity of hypothetical savant machines with sufficient cognitive abilities that are not designed by humans but by autonomous machines, such as with spontaneous intelligence.[81]

White recently made a slightly different distinction: between an existential construct and a relational construct of human personhood.[82] A relational construct in which personhood is a dynamic, provisional state of value defined by society, could be relevant for AI.[83] This postulate could play an important role in innovating and augmenting personhood, and constructing legal status of artificial agents.

D. Legal Agenthood

According to Pagallo, policy makers should discard any hypothesis of granting AI robots full legal personhood in the foreseeable future.[84] The state of the art in AI, the level of consciousness and legal autonomy of autonomous agents do not justify awarding legal personhood. Instead, policy makers should experiment with establishing new forms of legal agenthood in cases of complex distributed responsibility, accountability and liability for the activities of AI robots in contracts and business

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77 *Id.* at 179.

78 Samir Chopra & Laurence White, Artificial Agents: Philosophical and Legal Perspectives 87 (2007).

79 Chopra & White, *supra* note 74.

80 Chopra & White, *supra* note 78, at 32–33. *See also* Jeanne Gaakeer & Mireille Hildebrandt, Human Law and Computer Law: Comparative Perspectives 60–61 (2013)("Moral agency is the ability to discern right from wrong and to be held accountable for one's own actions and moral judgements.").

81 Woodrow Barfield & Ugo Pagallo, Research Handbook on the Law of Artificial Intelligence 370 (2018); *see also* Jiahong Chen and Paul Burgess, *The Boundaries of Legal Personhood: How Spontaneous Intelligence Can Problematise Differences Between Humans, Artificial Intelligence, Companies and* '*Animals*, 27 Artificial Intelligence and Law 73 (2019).

82 Laurence White, *Personhood: An Essential Characteristic of the Human Species*, 80 The Linacre Q. 74 (2013).

83 *Id. See also* Samir Chopra & Laurence White, *Artificial Agents - Personhood in Law and Philosophy* (2004) 635–639.

84 Ugo Pagallo, *Vital, Sophia, and Co.—The Quest for the Legal Personhood of Robots*, Information, Sep. 18, at 1. See also Robotics Open Letter EU, *OPEN LETTER TO THE EUROPEAN COMMISSION ARTIFICIAL INTELLIGENCE AND ROBOTICS*, http://www.robotics-openletter.eu/ (last visited June 12, 2019). The Open Letter responds to the 2017 Resolution of the EU Parliament on "electronic personhood" of smart robots and states that "From an ethical and legal perspective, creating a legal personality for a robot is inappropriate whatever the legal status model.".

law.[85] The notion of legal agenthood refers to the legal status as accountable agents establishing rights and obligations in civil law.[86] Legal agency of smart machines could be considered as a source of responsibility for other agents in the system.[87] The introduction of legal agenthood for AI should prevent risks of robotic liability shield and of autonomous agents as unaccountable rights violators.[88]

Granting legal agenthood to AI systems would technically not be enough for it to own IP rights–this requires legal subjectivity.

E. Science Fiction

The moment that artificial intelligence becomes aware of itself and may pursue its own goals is what we call the Singularity. The question is whether Robo Sapiens will be interested in universal human rights and intellectual property after the Singularity.

Hollywood's relentless flow of dystopian sci-fi movies (Metropolis, Bladerunner, 2001 A Space Odyssey) predicts strange and complex societal changes, in which AI often plays the leading part. Deus ex Machina is coming to either elevate humanity or eradicate us all. Robot overlords, genetically enhanced post-humans[89], cerebral computers and half-organic, half-mechanical Machinenmenschen[90] will walk the earth. When the Singularity comes it will open a Pandora's Box of urgent existential challenges, such as the Superintelligence Control Problem[91] and the Dominant Species Problem.[92] Who will be granted legal status may well be Robo Sapiens decision, not ours.[93]

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85 Ugo Pagallo, *Vital, Sophia, and Co.—The Quest for the Legal Personhood of Robots*, Information, Sep. 18, at 7. Pagallo warns not to confuse legal personhood with legal agenthood and argues that debates on legal personhood for AI should not be politicized.

86 Ugo Pagallo, *Apples, oranges, robots: four misunderstandings in today's debate on the legal status of AI systems*, Phil. Trans. R. Soc. A., Nov. 18, at 5.

87 Sandra Passinhas, *Robotics and Law: A Survey*, Joint Proceedings of the Workshop on Social Interaction and Multimodal Expression for Socially Intelligent Robots and the Workshop on the Barriers of Social Robotics take-up by Society co-located with the 26th IEEE International Symposium on Robot and Human Interactive Communication (2018).

88 Pagallo, *supra* note 86, at 5.

89 JOS DE MUL, CYBERSPACE ODYSSEY: TOWARDS A VIRTUAL ONTOLOGY AND ANTHROPOLOGY 257–258 (2010).

90 The *Maschinenmensch* (German for "robot" or literally "machine-person") is a film character in Fritz Lang's masterpiece 'Metropolis,' (Wikipedia) https://en.wikipedia.org/wiki/Maschinenmensch (accessed 12 May 2019). As a side note, Amara's law states that we tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.

91 James Grimmelmann, *Copyright for Literate Robots*, 101 IOWA L. REV. 657 (2016). The Superintelligence Control Problem refers to the existential risk that a superintelligent agent refuses to permit its programmers to modify it after launch and decides to follow its own agenda which might be harmful to humankind.

92 Patrick Hubbard, *"Do Androids Dream?": Personhood and Intelligent Artifacts*, 83 TEMP. L. REV. 405, 449–50 (2010) (Discussing the Dominant Species Problem where AI could replace humans as the dominant species on earth).

93 B.J. Koops, M. Hildebrandt & D.O. Jaquet-Chiffelle, *Bridging the Accountability Gap: Rights for New Entities in the Information Society?*, 11 MINN. J.L. SCI. & TECH. 497, 561 (2010).

V. Patents on AI Inventions

Leonardo Da Vinci's robot, in the appearance of a mechanical knight, was a humanoid automaton designed around the year 1495.[94] The world's first statutory patents were granted in Venice in 1474,[95] but Leonardo's Robot was—reportedly—never patented. This section addresses the question whether AI Inventions can and ought be patented.

A. Objectives

Patent law aims to stimulate technological innovation by providing a limited monopoly to inventors such that they can get compensation for their investment. It seeks to provide society within depth information on how inventions need to be practiced such that people can use and build upon them efficiently once the 20-year patent term is over. The patent system intends to incentivize the detailed disclosure of innovative ideas and optimize the allocation of R&D capacity by granting exclusive rights to the inventor. It intends to encourage inventors to disclose, produce and market their invention with the expectation of return on investment. At the same time, it aims at inventors improve upon and design around earlier patents.

As copyrights, patents can be (cross-)licensed, sold or waived. Patent protection and enforcement are regulated—inter alia—by international treaties and national laws.[96] As with copyrights, patents are territorial rights.

B. Rationales and Justifications

Traditionally, only novel, useful, inventive and non-obvious inventions can be patented. Section 101 of the US Patent Act states that subject matter eligible for patent granting consists of "any new and useful process, machine, manufacture, or composition of matter.'[97] Article 52 of the European Patent Convention states that 'European patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application.'[98]

Examples of non-patentable subject matter are ideas, principles, scientific theories, mathematic methods, aesthetic design, prior inventions that are already state of the art, copyrightable works, algorithms as such and software (being math).[99] However, software processes for security technology such as data encryption might sur-

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94 *See* https://en.wikipedia.org/wiki/Leonardo%27s_robot (last accessed 12 May 2019).

95 Craig Nard & Andrew Morriss, *Constitutionalizing Patents: From Venice to Philadelphia*, 2 Rev. L. & Econ. 223, 234 (2006).

96 *See generally, e.g.*, World Intellectual Property Organization (WIPO), Trade-Related Aspects of Intellectual Property Rights (TRIPS, EOP), European Patent Office (EPO), Patent Act, 35 U.S.C. §§ 1–390 (2012).

97 35 U.S.C. § 101 (2012).

98 52 Eur. Pat. Convention (1973).

99 As copyright, the domain of patent law has seen a gradual expansion. *See* Samuelson, *supra* note 24 AT 3–4.

vive the utility patent eligibility threshold.[100]

An invention should be non-obvious to a person having ordinary skill in the art (PHOSITA) i.e. somebody with average professional knowledge in the subject area of a particular invention. The first applicant, not the first inventor, gets the patent, provided formal and material requirements are met. Patent owners are granted exclusive rights to prevent others from making, selling using or importing the patented invention. Patent law requires a (human) inventor. Only legal subjects can own patents. For AI Inventions, this results in a no-ownership and public domain scenario.[101]

Patent rationales and justifications do not apply well to inventive machines. Inventive machines need not stand on the shoulders of giants. Natural rights, moral and economic incentive rationales are irrelevant in case of AI Inventions.[102] This is due to the absence of human beings in the 'automated' inventing process, which would -in theory- make it easier and less costly to invent as a company. The more costly the inventing process, the better defendable the patent grant to recover investment. This applies to both utility patents and design patents.

C. Industry Specific Patent Reforms

Commentators agree on the need for a reform and provide various approaches and solutions to address the reality of autonomous machine inventors. One avenue that scholars are pursuing is removing the human as a prerequisite or relevant factor for appropriation. This could result in official computer inventorship, including sui generis legal personhood[103] and preventing inventions from falling into the public domain.[104] Other scholars advocate pragmatic methods that amount to raising patent threshold, such as redefining definitions of the inventive step, non-obviousness, prior art, non-analogous art and harmonizing guidelines about who or what should be the person or entity ordinary skilled in the art.[105]

Since patent's exclusive rights perform different roles in different industries,

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[100] In the USA, the software patent eligibility threshold is known as the *Alice* Test (named after landmark decision *Alice Corp. v. CLS Bank International*).

[101] Erica Fraser, *Computers as Inventors—Legal and Policy Implications of Artificial Intelligence on Patent Law*, 13:3 SCRIPT-ED 305, 329 (2013).

[102] For a typology of rationales, *see* Birgitte Andersen, *The Rationales for Intellectual Property Rights: The Twenty-First Century Controversies*, DRUID Summer Conference 2003 on CREATING, SHARING AND TRANSFERRING KNOWLEDGE: The role of Geography, Institutions and Organizations (2003).

[103] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57:4 B. C. L. REV. 1079, 1114 (2016).

[104] *See also* Pearlman, *supra* note 51, at 35–36.

[105] Ana Ramalho, 'Patentability of AI-generated inventions: Is a reform of the patent system needed?', (2018) 26; Peter Blok, *The inventor's new tool: Artificial Intelligence—how does it fit the European patent system?*, 39 Eur. Intellectual Prop. Rev. 69, 70–71 (2017); Abbott, *supra* note 103, at 1103–04; *See also* Sonil Singhania & Sana Singh, *Redefine intellectual property with artificial intelligence*, Singhania & Partners (2018) https://singhania.in/wp-content/uploads/2018/09/A76-REDEFINE-INTELLECTUAL-PROPERTY-WITH-ARTIFICIAL-INTELLIGENCE.pdf.

patent policy makers should differentiate more explicitly between economic sectors and consider industry specific reforms.[106] Per sector, such as Health, Agrifood, Mobility, Finance and Energy, policy makers should implement a regime that strikes a balance between underprotection and overprotection.[107]

D. Sharing and Open Source

On the other side of the spectrum, Yanisky and Liu argue that traditional patent law has become outdated, inapplicable, and irrelevant with respect to AI Inventions.[108] In their view, promoting innovation and public disclosure can be better achieved with other tools than granting patents. Such tools include electronic and cyber controls over inventions created by AI systems, license agreements, and first-mover market advantages such as technology leadership.[109] Additionally, the authors argue in favor of making AI systems and inventions open source. Voluntary sharing of knowledge and open-source data can strive toward the fundamental IP goals i.e. promoting welfare and sharing of information. I see this as a step forward compared with the one-way street protection of the interests of the inventor or designer of that knowledge and information. Such sharing could also prevent patent trolling (by patent assertion entities and NPEs) and unwanted licensing behavior.[110]

Another option to consider is a shorter protection duration of 3 to 10 years for AI Inventions (which is better suited to the exponential pace of innovation) in combination with compulsory licenses against payment set by law or arbitration, or a super short duration similar to unregistered designs. Contrary to further expansion of patent scope and subject matter, this would result in a more limited monopoly including dissemination of knowledge. This solution could also be applied to AI-Assisted Inventions and software patents.[111]

E. Abolishing Patent Protection for AI Inventions

IP on AI Inventions can be a roadblock for rapid technological progress and is therefore not beneficial for society. In general, the expansion of patentable subject matter to emerging technical fields hampers the diffusion of technology and is detrimental to follow on innovation, employment, and economic growth.[112] Expansion diminishes the freedom to operate. Patents on AI Inventions such as new medicine and personalized drugs are regarded as contrary to the public interest.[113] The same

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[106] Burk & Lemley, *supra* note 42.

[107] Christopher Buccafusco, Mark Lemley & Jonathan Masur, *Intelligent Design*, 68 DUKE L. J. 75, 77 (2018). Available at SSRN: https://ssrn.com/abstract=3062951

[108] Yanisky-Ravid, Shlomit & Liu, Xiaoqiong, *When Artificial Intelligence Systems Produce Inventions: The 3A Era and an Alternative Model for Patent Law*, 39 CARDOZO L. REV. 2215, 2215 (2018).

[109] *Id*.

[110] *Id*.

[111] It is not unthinkable that the humans who initiate the AI system that is used to produce the AI Assisted Invention, in certain sectors, would need some form of patent protection to be motivated make the necessary investments in time and money.

[112] *OECD Science, Technology and Industry Outlook 2012*, 195 (2012).

[113] Pascale Boulet, Christopher Garrison & Ellen ‘t Hoen, *Drug patents under the spotlight: Sharing*

may apply to scientific disciplines such as biotechnology, analytical chemistry, plant breeding, quantitative genetics, and nutrigenomics, that integrate AI in their research programs.[114] There should be no plant variety rights on innovative crops invented by an AI system that crossed the autonomy threshold.

Moreover, there is no empirical data that supports the idea that incentives or (the expectation of) a return of investment are needed in case of 'pure' AI Inventions. There is also no evidence of a free-riding problem in the sense that non-patented AI Inventions are not embraced by the market because of the fear that successful products might be copied freely by (human or AI) competitors.

The reality of autonomous computer systems supporting and even replacing humans in the invention process forces us to rethink the patent system, possibly even beyond rationales and justifications. Abolishing patent protection for AI Inventions[115]—including a formal public domain or open source status—appears to be the most innovation-friendly option.

VI. Types of IP Rights on the AI Machine Itself

This section explains which IP rights can be vested in the various components of the AI system itself. These IP rights can be owned by legal subjects only. If in the future there would be a need to grant AI systems some form of legal personhood, these systems could own IP rights on other systems. If this ever happens, humans or corporations owning IP rights on AI systems that have legal personhood could be problematic, from a technical/legal point of view because IP rights cannot be vested in legal subjects.

Smart robots equipped with AI can be protected by different types of intellectual and industrial property rights, such as chip rights, design rights, trade secrets, patents, and copyrights. Because each right protects different aspects of a given technology, combination of these rights is the key to effective protection.[116] For example, the datasets used or processed by an AI system can be subject to database rights, at least in the European Union.[117] At the same time, the system's underlying software, the way in which the system is trained, the algorithm, and the neural network each may be protected by a set of different IP rights. Even though the objectives of the patent system and the copyright system differ in part, patents and copyrights could be substitutes for each other in providing incentives for AI development. Thus, maximization of intellectual property protection on AI systems can be realised only by using a mixture of these rights.

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practical knowledge about pharmaceutical patents, Medecins Sans Frontieres (2004).

[114] Tom Fleischman, *Plant breeder taps latest technology to feed the world*, Cornell Chronicle (October 31, 2018).

[115] Yanisky-Ravid, Schlomit & Liu, *supra* note 108.

[116] Jean-Marc Deltorn, *Disentangling deep learning and copyrights*, AMI 2018/5, p. 172 (2018).

[117] *See* Bernt Hugenholtz, *Something Completely Different: Europe's Sui Generis Database Right*, THE INTERNET AND THE EMERGING IMPORTANCE OF NEW FORMS OF INTELLECTUAL PROPERTY (2016), 205–22 (Susy Frankel & Daniel Gervais eds., 2016) (outlining the history and nature of database rights in the EU).

An AI system globally consists of input data, software, and hardware. From a legal point of view, we can distinguish at least 7 relevant components: (1) the computer program including the software source code and algorithms, (2) the training data corpus, (3) the neural network, (4) the machine learning process, (5) the AI applications, (6) the hardware, (7) and the inference model. As explained below, these different components are most effectively protected by different forms of IP.

A. Software Source Code and Algorithms

Software consists of several elements, and each has its own structure, purpose, and legal classification. At the "surface" level of software, we have source code and firmware, both of which can be protected by copyright.[118] As we look under the hood, however, the software's underlying algorithms, functionality, principles, and ideas are not protected by copyright.[119] This is a result of the idea/expression dichotomy, which generally provides that copyright protection "is given only to the expression of the idea—not the idea itself."[120] Thus, only the expression of a computer program is protected. The EU Software Directive prohibit copyright protection on functionality. As in the EU, copyright protection of software functionality is unavailable in the US.[121] In some jurisdictions, fundamental ideas not protected by typical IP rights might have other forms of protection, but this is not consistent around the world.[122]

Should software functionality be eligible for patent protection? Arguments for and against patentability of software and computer implemented inventions often focus on economic implications. On one hand, patent protection of software functionality could offer start-ups and small market entrants some protection against bigger players when new concepts and ideas are developed. On the other hand, those same market entrants could be disproportionally affected by patent trolls, who could weaponize software patents in a harmful manner that hinders innovation and the creation of new jobs.

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[118] *See, e.g.*, TRIPS: Agreement on Trade-Related Aspects of Intellectual Property Rights art. 10, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197 (classifying software as "literary works" that are subject to copyright protection).

[119] Daniel Gervais & Estelle Derclaye, *The scope of computer program protection after SAS: are we closer to answers?*, 34(8) European Intellectual Property Review, 565, 572 (2012).

[120] *See* Mazer v. Stein, 347 U.S. 201, 217 (1954).

[121] Pamela Samuelson, 'Functionality and Expression in Computer Programs: Refining the Tests for Software Copyright Infringement' (January 31, 2017). Berkeley Technology Law Journal, Forthcoming. Available at SSRN: https://ssrn.com/abstract=2909152 and Peter Menell, Rise of the API Copyright Dead?: An Updated Epitaph for Copyright Protection of Network and Functional Features of Computer Software (January 18, 2017). 31 Harvard Journal of Law & Technology 305 (2018), UC Berkeley Public Law Research Paper No. 2893192, Available at SSRN: https://ssrn.com/abstract=2893192.

[122] For example, in the Benelux, an idea can be safeguarded by making an "i-Depot," which generally works like a time-stamp on the idea in case the idea is later incorporated in works that are subject to more traditional forms of IP protection. *See Ideas*, https://www.boip.int/en/entrepreneurs/ideas (last visited Oct. 10, 2020).

B. Training Corpus

A refined or labelled training corpus, that is, the data used to develop an AI system, can be protected by a sui generis database right in countries such as The Netherlands and France, or by a "neighbouring right" in other EU countries such as Germany and the Nordics.[123] The criterion for database protection of training corpora is the systematic modelling and organizing of information. This implies an investment in time, energy, and money. Methodically transforming raw data into high-quality data, including a substantial investment fulfils this criterium for protection. Originality and creativity are not required (sweat of the brow doctrine).

Besides that, raw data can, both in Europe and in the USA, in theory be protected by trade secret legislation.[124] Additionally, in the USA (beyond the scope of IP law), raw data can be protected by cybersecurity law. The unauthorized access of online data could also be a violation of tort law, privacy legislation, and criminal law.

C. Neural Network, Machine Learning Process, AI-Applications, and Hardware

The neural network topology can be protected by a patent, which protects technical inventions for up to 20 years. A generative adversarial network (GAN) that consists of a generative and a discriminative neural network (or algorithm) that contest with each other can be patented.[125] The same applies to the machine learning process and the AI applications: these are patentable (art. 64 lid 2 EPC). New inventions related to Digital Twin technology, which can be used to create self-learning and updating digital simulation models (replica's) of products, systems, production processes, complete lifecycle performance, cities, and even plants, animals, and persons, can be patented as well.

The hardware design, schematics and circuits can also be protected by patent or a computer chip right. Examples of computer chip right subject matter are neuromorphic chips, nano-biological chips, memristors, optical fiber chips and quantum computers.[126]

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[123] Hugenholtz, *supra* note 117, at 210, 211, 218. The method of protection is not completely harmonized in the EU. Further, the training data might need to be cleared before it can be protected by a database right. This level of protection is not provided for in the United States.

[124] Drexl, Josef, *Designing Competitive Markets for Industrial Data - Between Propertisation and Access*, MAX PLANCK INSTITUTE FOR INNOVATION & COMPETITION RESEARCH PAPER NO. 16-13, Oct. 31, 2016; Yonida Koukio, *The (R)evolutionary Impact of AI-Generated Work and Big Data on Intellectual Property Law and Commercialization*, IP Osgood BLOG (Mar. 21, 2018), https://www.iposgoode.ca/2018/03/the-revolutionary-impact-of-ai-generated-work-and-big-data-on-intellectual-property-law-and-commercialization/; Thomas Hoeren, *A New Approach to Data Property*, https://www.itm.nrw/wp-content/uploads/AMI-–-tijdschrift-voor-auteurs-media-en-informatierecht-Nummer-20182-A-New-Approach-to-Data-Property.pdf (AMI 2018 / 2).

[125] *See A Beginner's Guide to Generative Adversarial Networks (GANs),* SKYMIND AI, https://wiki.pathmind.com/generative-adversarial-network-gan (last visited 12 May 2019) (explanation of GANs).

[126] For IP rights on quantum computers, *see*: Mauritz Kop, Regulating Transformative Technology in

D. Inference Model

Inference models can be protected by a trade secret (EU Trade Secret Directive 2018). However, this IP right does not protect against reverse engineering. The resulting legislative gap can be remedied by excluding reverse engineering by contract.[127] A machine learning model uses what it has learned about other objects in the training data to infer, deduct, or predict an outcome.[128] The inference model applies these learned logical relationships to new objects or problems. The inference model cannot be protected by copyright since its purpose is to obtain a technical result. Even if the inference model has been encoded in a database, protection by a database right under copyright regime could be problematic because of the absence of originality and creativity.[129] Sui generis database protection could again be the solution here, in Europe at least. It remains to be seen if inference engines can be protected by patents—if useful at all.

Lawmakers, courts, and patent offices ought to do a continuous re-evaluation of whether the patent system's supporting rationales and justifications remain appropriate,[130] and should proactively update their evidence-based policies and examinations.[131]

In this context, the European Patent Office (EPO) recently amended its guidelines and implemented new sections on AI, mathematical methods, algorithms, and blockchain.[132] Flexibility in addressing the mathematical idea/expression dichotomy as well as allocating competent divisions and interdisciplinary staff at EPO can remove important hurdles for patent protection of the Fourth Industrial Revolution applications.[133]

E. AI-Systems: Shift Towards Trade Secrets

Legal uncertainty about the patentability of AI systems is causing a shift towards trade secrets, in order to protect investments and monetize AI applications. On top of that, prior art cannot be documented in AI Inventions. Because of cloud computing and the AI black box, there is no way to determine whether there is pa-

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The Quantum Age: Intellectual Property, Standardization & Sustainable Innovation, (October 7, 2020). Stanford - Vienna Transatlantic Technology Law Forum, Transatlantic Antitrust and IPR Developments, Stanford University, Issue No. 2/2020, https://law.stanford.edu/publications/regulating-transformative-technology-in-the-quantum-age-intellectual-property-standardization-sustainable-innovation/.

127 Between licensor and licensee, or developer/owner and user.

128 Jason Lohr, *Litigating intellectual property issues: The impact of AI and machine learning*, Hogan Lovells, 2019.

129 Football Dataco Ltd v Yahoo! UK Ltd, (2012) C-604/10 (Eng. & Wales), http://curia.europa.eu/juris/liste.jsf?&num=C-604/10; *See also* Deltorn, *supra* note 116.

130 *See, e.g.*, Fraser, *supra* note 101, at 312.

131 Jean-Marc Deltorn, Andrew Thean, Markus Volkmer, *The examination of computer implemented inventions and artificial intelligence inventions at the European Patent Office*, 4IPCouncil (2019).

132 *Id*. at 1.

133 *Id*. at 6.

tent (or trade secret) infringement.[134] This is simply inconceivable for humans. The shift from patents towards trade secrets results in a disincentive to disclose ideas and information.

Since the definition of a trade secret is so broad in the new EU Trade Secrets Directive, it potentially includes any data, including personal customer/user data and newly created data handled by a European commercial entity.[135] This large scope means that derived and inferred data can be classified under the Trade Secrets Directive, which impedes dissemination of information.[136]

F. Design Rights, Trademark, Tradename and Trade Dress

PCB artwork, layouts, and hardware modelling can be protected by design right in Europe, which is valid for 5 years and can be extended 4 times until the maximum of 25 years has been reached. This industrial IP right protects the visual appearance of a product. In the USA, functional aspects of design can be protected by a design patent, which has a lower threshold than utility patents and a duration of only 15 years.[137] Non-functional creative aspects of design can be protected by copyright.

Product design, software interfaces and website design can also be protected by trade dress in the US and UK. Trade dress aims to protect consumers from using or buying products that imitate the shape, look, feel and packaging of the original.[138] Once granted, trade dress rights last in perpetuity, which hinders competition and innovation.[139]

Finally, the name and logo of an AI machine or product can be registered as a trademark. In order to create a strong AI brand, registration of the trade name and the domain name are also recommended.

All in all, there are sufficient IP instruments to protect the various components of AI systems.[140] There would even be some protection overlaps because of theoretical cumulation of patents, copyrights, trade secrets, and database rights.[141] In light of this, additional layers of rights do not seem advisable.

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[134] *See* Jason Lohr, *Artificial intelligence drives new thinking on patent rights,* LimeGreen IP News (Jul. 15, 2016), http://www.limegreenipnews.com/2016/07/artificial-intelligence-drives-new-thinking-on-patent-rights/. Note that DLT could be of some help to make AI transparent.

[135] Sandra Wachter & Brent Mittelstadt, *A Right to Reasonable Inferences: Re-Thinking Data Protection Law in the Age of Big Data and AI*, 2019 Colum. Bus. L. Rev. 1, 116 (2019).

[136] *Id*. at 119. Wachter warns for tension between business interests protected by the Directive and private interests such as data protection and privacy. As a remedy she proposes a novel right to reasonable inferences i.e. a personal data protection right that protects against unreasonable machine learning inferences.

[137] Buccafusco et al., *supra* note 107, at 101.

[138] *Id.* at 86.

[139] *Id.* at 120.

[140] Exhaustion of certain aspects of patent rights and copyrights on sold instantiations or copies may apply. *See also* Shubha Ghosh and Irene Calboli, *Exhausting Intellectual Property Rights: A Comparative Law and Policy Analysis,* (Cambridge University Press 2018), 101.

[141] *See also* Deltorn & Macrez, *supra* note 56.

VII. Clearance of Training Data

Good quality shared data is a sine qua non for successful AI.[142] The use of training corpora for AI systems usually has two relevant IP dimensions. This section covers third party ownership rights on the input data and ownership of the processed output data.

A. Clearance of the Input Data

If the input data (open or closed data) contains works that are protected by copyright, or by database rights (and no text and datamining exception applies), prior permission to use and process the data (for both commercial, non-commercial and scientific objectives) must be obtained from the various owners of those rights.[143] The feeding qualifies as a reproduction of works and requires a license.[144] This type of licensing is called clearance. Clearance can be obtained individually or (in some cases) collectively.

B. European Database Rights on Augmented Data

The second aspect of training data is the emergence of IP rights on this methodically organized collection of snippets of information using a computer. In Europe, these IP rights can be a database right, a sui generis database right, or both, and have a duration of 15 years.[145] Each substantial update of the database results in a new database right. However, to prevent an unending monopoly, old content may be used freely after the initial 15-year term expires.

A database right can be qualified as either a neighbouring right or a true sui generis IP right, but not as a full copyright.[146] Copyright protects the original creative expression of arranging a database. A sui generis database right protects substantial investments made and has characteristics of a property right. In the USA, after the landmark decision Feist, no sui generis database rights exist on labelled datasets.[147]

The rationale of this IP right "of its own kind" is the protection of investments made in the data by EU- based legal persons or corporations. Systematically refin-

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[142] *See also* Data: A Cornerstone for AI—Toward a Common European Data Space, European Commission; and https://ec.europa.eu/knowledge4policy/ai-watch/topic/data-cornerstone-ai-%E2%80%93-toward-common-european-data-space_en (last visited May 12, 2019). The need for training data may change when AI gets stronger.

[143] Mauritz Kop, *Machine Learning & EU Data Sharing Practices*, TTLF Newsletter on Transatlantic Antitrust and IPR Developments Stanford-Vienna Transatlantic Technology Law Forum, Stanford University 2020, Volume 1, https://www-cdn.law.stanford.edu/wp-content/uploads/2015/04/2020-1.pdf.

[144] *See also* Grimmelmann, *supra* note 91. Access to out-of-commerce works held by cultural heritage institutions also requires clearance. In Europe, this license can be obtained from collective rights organisations (art. 8 DSM Directive).

[145] DIRECTIVE 96/9 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 11 MARCH 1996 ON THE LEGAL PROTECTION OF DATABASES, ART. 10.

[146] Hugenholtz, *supra* note 117.

[147] *Id.*

ing and augmenting data, including a substantial investment by the maker, qualifies for a database right. The maker of the database, usually a rich data company, is the owner of these rights.

The same applies to the European maker of a Digital Twin. The output data of the Digital Twin's AI and machine learning process qualifies for a sui generis database right. An AI system (such as a Digital Twin) that generated or provided the output data (i.e. created the database) cannot own the sui generis database rights because an AI system has no legal personhood. Only legal subjects can own the sui generis database rights. If necessary, a (human) database maker should also have clearance from individual owners of input data.

C. Stimulate Innovation: Ex ante Compulsory License or Open Source

Introducing an ex ante compulsory license for competitors of database producers would be in line with exceptions to other IP rights. This applies all the more to single source databases that obtain detailed individual consumer preferences, purchase behaviour, and sales records through a single, integrated system of data collection via internet and television. Limiting the monopoly on datasets will stimulate innovation, facilitate global harmonisation, and make follow-on investments less expensive. This license could provide legal certainty to both users of the database, such as AI-developers, and producers of the database, such as rich data companies.[148] There exists no empirical data that supports the belief that the introduction of a compulsory license would reduce investments made in AI development.

Database rights can also be voluntarily waived by the owner of the database. This has the same legal effect as a CC0 form for copyright or a patent waiver. The result is the database being transferred to public domain. Making the data open source is another option that would have the same effect.

D. TDM Exception

Text and Datamining (TDM) can infringe on copyrights' reproduction right and database rights' extraction right (the latter EU only). This Sword of Damocles leads to legal uncertainty for researchers and hinders research output. Aiming to remove legal roadblocks and facilitate innovation, the DSM Directive introduced a new fair use alike exception for text and datamining.[149] The TDM exception or limitation has been consolidated in Article 3 and 4 of the final text of the DSM Di-

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[148] ANNEMARIE BEUNEN, PROTECTION FOR DATABASES: THE EUROPEAN DATABASE DIRECTIVE AND ITS EFFECTS IN THE NETHERLANDS, FRANCE AND THE UNITED KINGDOM (Wolf Legal Publishers, 2007).

[149] Geiger, Christophe and Frosio, Giancarlo and Bulayenko, Oleksandr, *The Exception for Text and Data Mining (TDM) in the Proposed Directive on Copyright in the Digital Single Market*, LEGAL ASPECTS, (March 2, 2018). Centre for International Intellectual Property Studies (CEIPI) Research Paper No. 2018-02. Similar problems exist in the USA, where health research, science, data, and research results are trapped in silos, preventing accelerated progress and greater reach to patients. See Joe Biden, *Inspiring a New Generation to Defy the Bounds of Innovation: A Moonshot to Cure Cancer*, https://medium.com/cancer-moonshot/inspiring-a-new-generation-to-defy-the-bounds-of-innovation-a-moonshot-to-cure-cancer-fbdf71d01c2e (2016).

rective, and have to be understood as "measures to adapt exceptions and limitations to the digital and cross-border environment."[150] Article 3 and 4 apply to non-profit scientific research only.[151] Archiving one legal copy of the obtained datasets is permitted. The TDM exception is a good start. However, a broadly scoped, mandatory TDM exception covering all types of data including news media would have facilitated accelerated progress more effectively.

E. Data Ownership: No Need for Another Layer of Rights

Data is the new oil—it must first be refined to be useful. For over a decade now, big tech has harvested the data riches. Does labelling and augmenting data justify an absolute data property right, a (neighbouring) data producer right or a sui generis database right for non-creative databases? Are IP incentives needed to share the high-quality data needed for successful AI? Economic analysis has shown that there are no convincing economic arguments for the introduction of a new IP right, especially due to the lack of an incentive problem for the production and analysis of data.[152] Raw non personal machine-generated data are not protected by any intellectual property rights.[153]

According to Hoeren, the discussion about an absolute property right for data is obscure.[154] Information should not be enclosed.[155] Information is free as the air for common use.[156] There is no need for another layer of rights. The world needs an accessible dataverse with freedom to express, operate and develop.[157]

F. Focus on Design of Data Sharing Models

A better strategy to foster data sharing, data collaboration, and access to unbiased analysis of data is to focus on the actual design of data sharing models.[158] Our

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[150] Council Directive 2019/790, art. 3-4, 2019 O.J. (L 130) 92, 113 (EU).

[151] The education exception/*onderwijsexceptie* does not cover text and data mining. *Id.* at 21–23.

[152] Kerber, Wolfgang, *A New (Intellectual) Property Right for Non-Personal Data? An Economic Analysis*, GEWERBLICHER RECHTSSCHUTZ UND URHEBERRECHT, INTERNATIONALER TEIL 989–99 (2016). *See also* Landes, William M., and Richard A. Posner, *An Economic Analysis of Copyright Law*, 18 J. LEGAL STUD. 325, 325-63 (1989).

[153] For an in depth analysis of IP rights for private data see Begoña Gonzalez Otero, *Evaluating the EC Private Data Sharing Principles: Setting a Mantra for Artificial Intelligence Nirvana?*, 1 J. INTELL. PROP. INFO. TECH. E-COMMERCE L. 66, 70 (2019). For non-personal machine generated data, *see* P. B. Hugenholtz, *Data Property: Unwelcome Guest in the House of IP* 3–4 (2017); ANA RAMALHO, DATA PRODUCER'S RIGHT: POWER, PERILS & PITFALLS, BETTER REGULATION FOR COPYRIGHT 51 (2017); JOSEF DREXL ET AL., POSITION STATEMENT OF THE MAX PLANCK INSTITUTE FOR INNOVATION AND COMPETITION OF 26 APRIL 2017 ON THE EUROPEAN COMMISSION'S "PUBLIC CONSULTATION ON BUILDING THE EUROPEAN DATA ECONOMY" 4–5 (2017); For appropriation of data, trade secrets and liability, *see* Hoeren, *supra* note 124, at 12–13; Drexl, *supra* note 124, at 58.

[154] Hoeren, *supra* note 124, at 18–19.

[155] Benkler, *supra* note 30, at 357. Secret information excluded.

[156] Hugenholtz, *supra* note 153, at 6. The economic freedom to conduct a business sets limit to intellectual property rights and is one of the rationales underlying the idea/expression dichotomy.

[157] This calls for a clear-cut interpretation of the definition of trade secrets in the new EU Trade Secrets Directive by the courts.

[158] Mining unbiased data insights provides different perspectives on data, instead of just the biased

energy should be directed to the actual creation of normative governance models which preserve human rights and privacy[159] that work for both developed and underdeveloped countries.[160]

The goal should be to create a global open data sharing community with competing firms.[161] There is a strong need for comprehensive, cross sectoral data reuse policies,[162] such as standards for interoperability. This need is more prominent in cases where databases are produced by public bodies in exercising their public task. An effective legal instrument to achieve this is a compulsory license for parties that wish to use data, combined with fair remuneration to parties that legally harvested, transformed, refined, augmented, or controlled the data. This would be similar to charging a statutory fee.[163] An alternative approach would be to implement a superior right to process public and private data for machine learning purposes, while respecting privacy and other fundamental rights through ethically aligned design of digital systems.[164] A comprehensive open data policy will result in a network effect, which means even more people and businesses will be comfortable sharing data.[165] This network effect, by creating a more comfortable sharing environment, would thus incentivize sharing, access and re-use of data.[166] The benefits of an open data policy, such as promoting transparency and strengthening economic growth, must be weighed against disadvantages, such as misinterpretation and misuse of data, perceived competitive disadvantages, and privacy concerns.[167]

VIII. An Articulated Public Domain for AI Made Creations and

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one. It leads to more valuable discoveries and completer answers. Swathy Rengarajan, *Biased and Unbiased Data and Why They Matter*, IBM BUSINESS ANALYTICS BLOG (June 6, 2017), https://www.ibm.com/blogs/business-analytics/biased-unbiased-data-matter/.

159 Drexl, *supra* note 124, at 258, 277; Otero, *supra* note 153, at 26.

160 Yasodara Córdova, et al., *Can Data Become Part of a Development Strategy?*, BERKMAN KLEIN CENTER FOR INTERNET & SOCIETY (Apr 2, 2019), https://cyber.harvard.edu/story/2019-04/can-data-become-part-development-strategy (originally published on DigitalHKS). https://cyber.harvard.edu/story/2019-04/can-data-become-part-development-strategy accessed 12 May 2019.

161 Otero, *supra* note 153, at 31.

162 John Wilbanks & Stephen H. Friend, *First, Design for Data Sharing*, 34(4) NATURE BIOTECHNOLOGY 377, 377 (2016).

163 *See* Sobel, *supra* note 49, at 91–92; Hoeren, *supra* note 124, at 60; Ramalho, *supra* note 153, at 49.

164 Mauritz Kop, The Right to Process Data for Machine Learning Purposes in the EU (June 22, 2020). Harvard Law School, Harvard Journal of Law & Technology (JOLT) Online Digest 2020, Forthcoming, Available at SSRN: https://ssrn.com/abstract=3653537.

165 *See* MIREILLE VAN EECHOUD, A PUBLISHER'S INTELLECTUAL PROPERTY RIGHT: IMPLICATIONS FOR FREEDOM OF EXPRESSION, AUTHORS AND OPEN CONTENT POLICIES 41 (2017)(discussing open data policy); *See also* LAWRENCE LESSIG, *CODE AND OTHER LAWS OF CYBERSPACE* 112 (2006)(The book's title is also referred to as Code 2.0 2006).

166 Incumbents who benefit the most from status quo will lobby against open data policy. These settled market players from Europe, the United States or Asia should adopt an apollonian attitude in ideology and corporate philosophy. *See* PETER STONE, et al, ARTIFICIAL INTELLIGENCE AND LIFE IN 2030, ONE HUNDRED YEAR STUDY ON ARTIFICIAL INTELLIGENCE: REPORT OF THE 2015 STUDY PANEL, 48–49 (2016).

167 ANNEKE ZUIDERWIJK AND MARIJN JANSSEN, THE NEGATIVE EFFECTS OF OPEN GOVERNMENT DATA - INVESTIGATING THE DARK SIDE OF OPEN DATA 147–148 (2014).

Inventions

The public domain is an important objective of copyright. A vital public domain enables democracy, innovation, cultural diversity, prosperity and a participative society. An underinclusive public domain hinders innovation and free expression.[168] In the same way, too much copyright protection is bad for our economy and democracy (as is too little). A robust public domain is an essential requirement for cultural, social, and economic development, a healthy democratic society, and a sustainable information ecology.[169]

This section proposes a new public domain model for AI Creations and Inventions: Res Publicae ex Machina (Public Property from the Machine). This articulated model builds upon the Roman multi-layered property paradigm. It configures machine-made non-exclusive property as a public domain status and includes an official PD mark.

A. Revitalizing the Public Domain

It is crucial to realize the benefits of openness to innovation and culture.[170] Moreover, considerations of the democratic requirements of fundamental rights, such as freedom of expression and access to information, should augment the economic definitions of the public domain.[171] Revitalizing the public domain also means regenerating the human right to freedom of speech and expression. Both the three-step test with its open-ended exceptions and limitations and the fair use doctrine mirror the importance of the fundamental right to freedom of speech, and ought to be seen as an affirmative aspect of the public domain at large.[172]

Empirical research concludes that companies are innovating with public domain material despite the absence of exclusive rights in the source material.[173] Overgrazing, overuse, and underinvestment do not seem to be a concern. According to empirical study, there is no tragedy of the commons.[174]

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[168] Netanel, Neil Weinstock, *Why Has Copyright Expanded? Analysis and Critique*, NEW DIRECTIONS IN COPYRIGHT LAW, Vol. 6, Fiona Macmillan, ed., Edward Elgar, 2008; UCLA School of Law Research Paper No. 07-34; Yochai Benkler, *Through the Looking Glass: Alice and the Constitutional Foundations of the Public Domain*. 66 LAW AND CONTEMPORARY PROBLEMS 173–224 (Winter 2003), available at: https://scholarship.law.duke.edu/lcp/vol66/iss1/7.

[169] Samuelson, *Challenges in Mapping the Public Domain*, at 22.

[170] JAMES BOYLE, THE PUBLIC DOMAIN: ENCLOSING THE COMMONS OF THE MIND 246 (Orange Grove Books 2008).

[171] Kristofer Erickson, *Defining the Public Domain in Economic Terms—Approaches and Consequences for Policy* (May 9, 2016), Etikk i praksis, Nordic Journal of Applied Ethics 2016, pp. 61–74.

[172] David Lange, *Reimagining the Public Domain*, 66 LAW AND CONTEMPORARY PROBLEMS, Winter 2003, at 463-484, https://scholarship.law.duke.edu/lcp/vol66/iss1/13; Erickson, *supra* note 171, at 67; Goldstein & Hugenholtz, *supra* note 8, at 406.

[173] *See* Erickson, *supra* note 171, at 67–68.

[174] Garret Hardin, The Tragedy of the Commons, (Science, 1968); *See also* Rose, Carol M., 'The Several Futures of Property: Of Cyberspace and Folk Tales, Emission Trades and Ecosystems' *Minnesota Law Review*. 964 (1998)

The boundary between private, monopolized domain and public, freely accessible domain has increasingly shifted towards enclosure and commodification in recent decades. This shift is caused by the ongoing horizontal expansion of IP brought by new technology. Disruptive innovation is "an innovation that creates a new market and value network and eventually disrupts an existing market and value network, displacing established market-leading firms, products, and alliances."[175] For every new disrupting tech, policy makers tend to invent a new layer of rights.

It is, however, a misunderstanding that more exclusive rights will automatically bring more innovation.[176] The opposite may be true in many cases: intellectual property rights may slow down innovation by putting myriad necessary licenses as roadblocks in the way of subsequent innovation.[177] Patent, copyright, and database thickets result in "a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology."[178]

The IP thickets phenomenon has been extensively evidenced in academic literature.[179] In my own legal practice, I see on a daily basis the negative effect of an impenetrable forest of layers of rights on rapid innovation. This trend hinders smooth market entry and innovative performance of enterprises. It causes legal uncertainty and reluctance to enter into technology areas affected by thickets. Overprotection of information leads to market barriers for tech companies, both big and small.

It is key not to enclose the intangible commons of the mind, nor to monopolize the information commons. Information is a non-rivalrous resource.[180] Each information product or snippet is raw material for future innovation.[181] The most spectacular innovation our society has ever seen is built on an architecture that mixes freedom and control,[182] an innovation architecture that searches for an optimum after a balanced assessment of interests involved. An articulated public domain stimulates productive synergistic interactions.[183] To preserve an optimal level of overall

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[175] Joseph L. Bower, and Clayton M. Christensen, 'Disruptive technologies: catching the wave.' (Harvard Business Review 1995). *See also* Ab Rahman, Airini & Abdul Hamid, Umar Zakir & Chin, Thoo, 'Emerging Technologies with Disruptive Effects: A Review' (PERINTIS eJournal 2017-7) 111–128.

[176] Boyle, *supra* note 170, at 41.

[177] *Id.*

[178] 'Patent thicket' Wikipedia, https://en.wikipedia.org/wiki/Patent_thicket, accessed 12 June 2019.

[179] James Bessen, *Patent Thickets: Strategic Patenting of Complex Technologies* (SSRN Electronic Journal 2004) 10.2139/ssrn.327760. *See also* Iain Cockburn et al., *Patent Thickets, Licensing and Innovative Performance. Industrial and Corporate Change* (2010) 19. 899-925. 10.2139/ssrn.1328844; Bronwyn Hall et al., *A Study of Patent* Thickets (2013) 10.2139/ssrn.2467992.

[180] Lawrence Lessig, *The Architecture of Innovation*, 51 Duke L.J. 1783, 1798 (2002).

[181] James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, LAW AND CONTEMPORARY PROBLEMS, Vol. 66, pp. 33–74 (Winter-Spring 2003).

[182] Lessig, *supra* note 180, at 1799.

[183] Macmillan, *supra* note 67.

societal progress, the erosion of the public domain must be reversed.

B. Res Publicae ex Machina: Public Property from the Machine

What would be the most feasible strategy to realize a vital public domain? When attempting to revitalize, refine, and articulate the public domain, we can draw inspiration from Roman Law. The Romans invented public domain. They had more property options than we do nowadays: their public domain consisted of various forms of non-exclusive property. According to Boyle, there can be many public domains.[184] Technological advancement in our present time allows for a more complex, yet more efficient, regulatory property regime by separating the traditional bundle of property rights into its different components.[185] This differentiation will lead to useful and effective propertization, as to a greater public domain.

Roman categories of non-exclusive property relevant for AI Made Creations are: res communes, res communes omnium, res publicae, res nullius, res divini iuris, res universitatis and res patrimonium. These can be considered as antonyms of exclusive property, i.e., res privatae.[186] Building on the multi-layered property paradigm a new model of AI specific propertization can be imagined. An explicit public domain regime for AI Made Creations in the form of Res Publicae ex Machina: Public Property from the Machine.

This article proposes the following model:

- res publicae as species within the genus public domain.

- res publicae ex machina as species within the genus res publicae.

- res publicae digitalis (ex machina) as species within the genus res publicae ex machina.

+ formal AI public domain (PD) mark by a government institution, territory worldwide.

This model addresses the legal public domain status of both physical and intangible AI Creations and Inventions. The creations and inventions will be enshrined in a permission-free space where creativity and inventiveness can flourish. The introduction of Public Property from the Machine is a Pareto improvement: many actors benefit from it while nobody, at least no legal person, will suffer from it.[187] If this model or legal categorisation[188] is adopted, no clearance ex ante or re-

[184] Boyle, *supra* note 181; *See also* CHARLOTTE WAELDE & HECTOR& MACQUEEN, INTELLECTUAL PROPERTY: THE MANY FACES OF THE PUBLIC DOMAIN (EEP 2007).

[185] Eli M Salzberger, *Economic Analysis of the Public Domain*. THE FUTURE OF THE PUBLIC DOMAIN, Ch. III, pp. 27–59, Kluwer Law International, 2006.

[186] Andreas Rahmatian, *Copyright and Creativity: The Making of Property Rights in Creative Works* (EEP 2011), 105.

[187] Van der Noll, et al., Flexible Copyright. *The Law and Economics of Introducing an Open Norm in the Netherlands*, 10.13140/RG.2.1.1691.6563 (IViR 2012) 63. It might even be a *Pareto superior move* in the sense that everybody involved is better off. See Lessig, *supra* note 165, at 14.

[188] On legal categorisation, conceptualisation and the legal recognition of res through the legal con-

muneration ex post would be necessary. No licenses and no infringement. Derivative works would be allowed without the need for permission or equitable compensation (no Copyleft).

Either Ginsburg's absence of upstream or downstream human involvement model, or Gervais's originality causation test can serve as public domain/copyright threshold criterium.[189] A complementary test can be found in the application of norms of Fishers' 4 theories of IP.[190]

C. Official AI PD Mark

According to Lange, public domain should be configured as a status that is independently and affirmatively recognized in law.[191] The public domain should be a positive space that offers affirmative protection against private appropriation.[192] Formalizing worldwide public domain status for AI Generated Works and Inventions would restore and expand the public domain for the common good.

One practical tool to formalize the legal concept of Res Publicae ex Machina can be an official PD mark issued by a central government institution.[193] Since IP rights are territorial rights, this PD mark should be issued per country, per continent, or even worldwide.[194] Confusion in the industry and uncertainty among the general public about AI & IP rights potentially lead to conflicts.[195] The proposed PD mark will help businesses and research institutions understand their core rights and thereby tackle the uncertainty that discourages AI start-ups and industry's development in general. The simpler the PD mark is, the more effective this permission-free zone will be.[196]

An example of an AI Invention that qualifies as Public Property from the Machine and thus could be awarded with official Public Domain Mark status is a flu vaccine autonomously brewed by an Australian pharmabot called SAM (Smart Algorithms for Medical Discovery).[197]

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cept of real rights, *see* Rahmatian, Andreas, *Intellectual Property and the Concept of Dematerialised Property* (May 31, 2011). MODERN STUDIES IN PROPERTY LAW, Vol. 6, S. Bright, ed., (Hart Publishing, 2011).

189 Jane C. Ginsburg & Luke Ali Budiardjo, *Authors and Machines* (August 5, 2018). COLUM. PUB. L. RES. Columbia Public Law Research PAPER No. 14-597; BERKELEY TECH. L.J.Technology Law Journal, Vol. 34, No. 2, 2019, https://ssrn.com/abstract=3233885; *Gervais*, *supra* note 33.

190 This '4 Theories Test' gives different results for AI Assisted Creations and pure AI Generated Creations. *See generally,* William Fisher, *Theories of Intellectual Property*, *supra* note 38.

191 Lange, *supra* note 172, at 474.

192 RONAN DEAZLEY, RETHINKING COPYRIGHT: HISTORY, THEORY, LANGUAGE 104 (Edward Elgar Publishing 2006).

193 Boyle, *supra* note 170; *see also*, Lessig, *supra* note 180 at 1799.

194 Such as the European patent, issued by the OHIM in Alicante, Spain. *The Office*, EUIPO, https://euipo.europa.eu/ohimportal/en/the-office (last visited Sep. 10, 2020).

195 Yanisky-Ravid, Shlomit & Velez-Hernandez, *supra* note 28.

196 Lessig, *supra* note 16, at 58. This also prevents unequal distribution.

197 Kristin Houser, *First Human Drug Developed Solely by AI Is a Vaccine*, Futurism: The Bite (July 15, 2019), https://futurism.com/the-byte/first-human-drug-ai-flu-vaccine (last visited Jul. 16, 2019). If the vaccine passes clinical trials, this opens the door for more AI developed medicines.

D. AI Assisted Creations

Authorial autonomy is declining in AI Assisted Creations. AI Assisted Works are born from hybrid human-machine collaboration. These joint works are exceedingly far away from the romantic notion of ex nihilo creation.[198] The presence of justified incentives could mean that AI Assisted Works will not meet the threshold criteria for public domain status—they would be granted conventional copyright or patent protection.[199] As mentioned, certain sectors lack clear economic justification for protection via IP rights, with or without AI.[200]

Ginsburg recently identified four IP relevant human-machine relationships.[201] Based on this approach, authorship on AI Assisted Creations can be allocated by ordinary users and AI programmers (the persons who designed the machine, wrote the software or trained the algorithm), or a combination of the two. In case legal actors such as the designer, owner, or user cannot claim authorship, a creation remains authorless and thus within the public domain. This would be the case if neither party can predict, foresee, or control the machine-enabled output[202]—in other words, if no human can claim to be sufficiently involved in the conception and execution of an autonomous entities' creation.

E. Human-Machine Collaboration Example

For illustrative purposes, I produced an AI Assisted song, which can be streamed on Spotify.[203] This cinematic retrowave track was created by a human author using hardware (computer, synths, midi-controllers, soundcard), software, smart algorithmic tools, non-exclusive licensed samples and public domain samples (NASA recordings from Russian astronauts in the international space station). Because of built-in randomness in tailor-made virtual software synthesizers and smart VST effect processors, each rendition (mix or master) of the song is slightly different using the same settings—almost as if the system is "alive."

One can hear a female vocalist singing "Beam Me Up, Take Me To Another Galaxy." Counterintuitively, this quasi recitando, parlando section does not feature a human being but a robot whose voice was made, tuned, and refined (humanized) using voice generative software. Auditory anthropomorphism. She (or rather ''it'') has no recording rights, performance rights, copyrights or neighbouring rights on

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198 See Bechtold, Stefan and Buccafusco, Christopher J. and Sprigman, Christopher Jon, *Innovation Heuristics: Experiments on Sequential Creativity in Intellectual Property*, 91 Indiana Law Journal 1251 (2016); Sobel, *supra* note 49.

199 *See also* Ginsburg, *supra* note 37. Courts could (*inter alia*) use the human involvement model and/or the originality causation test to resolve conflicts about public domains status of AI Assisted Creations.

200 Scherer, *supra* note 41; Fisher, *Regulating Innovation*, *supra* note 45, at 353–54; Burk & Lemley, *supra* note 42.

201 Ginsburg & Budiardjo, *supra* note 32, at 343. The authors also proposed a very interesting conception-and-execution theory of authorship.

202 *Id.* at 354.

203 ULATEK, BEAM ME UP (The Ambient Society 2019).

her performance or lyrics. This is because she is a legal object doctrinally[204] and has made no creative choices. The same applies to the other machines used in the production of the song. There was no need to sign a record deal or a songwriter split sheet with this "faithful agent" before the worldwide digital release of this track.

Furthermore, software user licenses prevent the allocation of copyrights in the master recording or the underlying music composition on behalf of the upstream programmers of the source code of the various software tools involved in the production of the track. This AI Assisted Creation is no Res Publicae ex Machina. The whole spectrum of rights layers vested in this human/machine collaboration that involves originality and making creative choices, is owned by the composer and the producer of the song.

F. Shorter Copyright Duration

For AI Assisted Works, limited copyright regimes could be imagined, with a short protection term of 15 years.[205] Another option for AI Assisted Works worth mentioning is a paying public domain, as supported by Victor Hugo during the development of the Berne Convention.[206] This solution aims to respect the author's moral rights and resembles the practical effect of neighbouring rights and the protection of derivative works. Another solution might draw inspiration from trademark law, database law, and the Statute of Ann: an initial copyright protection term of 10 years that can be optionally renewed until a maximum duration of 50 to 70 years has been reached.[207] A final solution is to create zones of freedom that simulate features of the public domain.[208]

Examples of private initiatives to pull information out of the enclosed domain—and in doing so restore the public domain—are the Creative Commons movement, the Open Source concept, the Data Commons which enables R&D across and within datasets, and the GNU General Public License. These initiatives use contractual tools (licenses) to establish privately constructed commons and to maximize user rights, (usually not completely abandoning property rights)[209] such

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[204] A smart VST (Virtual Studio Technology) instrument (a machine) has no legal personhood. It is a legal object. Lawrence B. Solum, Legal Personhood for Artificial Intelligences, 70 N.C. L. REV. 1231, 1231 (1992).

[205] Jennifer Jenkins, *In Ambiguous Battle: The Promise (And Pathos) Of Public Domain Day, 2014*, 12 DUKE L. & TECH. REV. 1, 23 (2013). *See also* Rufus Pollock, *Forever Minus a Day? Calculating Optimal Copyright Term*, Review of Economic Research on Copyright Issues, Vol. 6, No. 1, 35 (July 19, 2009); William M. Landes & Richard A. Posner, *Indefinitely Renewable Copyright*, U. CHI. L. REV. 471, 475 (2003); Boyle, *supra* note 181.

[206] Lucie Guibault, *Wrapping Information in Contract: How Does it Affect the Public Domain?*, *in* THE FUTURE OF THE PUBLIC DOMAIN 87, 89 (Lucie Guibault & P. B. Hugenholtz eds., Kluwer Law International 2006).

[207] *See generally Statute of Anne*, WIKIPEDIA, https://en.wikipedia.org/wiki/Statute_of_Anne (The UK Copyright Act 1710 prescribed a copyright term of 14 years, with a provision for renewal for a similar term, during which only the author and the printers to whom they chose to license their works could publish the author's creations).

[208] Jenkins, *supra* note 205, at 1.

[209] Rahmatian, *supra* note 188, at 14.

as access to scholarship and free software.[210]

IX. Ethics

When reflecting upon AI and IP, moral principles should not be absent.[211] Because of the elusiveness and transformative power of artificial intelligence, it is essential to include safeguarding fundamental freedoms and equal rights in discussions about applying and implementing smart robotics and AI systems in our society. This section explains the importance of ethics within the context of AI.

A. French Revolution Values

Humans are responsible for the role that artificial intelligence plays in society. Machines must become our supporters, not our opponents; our allies, not our adversaries. Robots should be like a third hand to humankind.[212] It is key that, if technically possible, the fundamental norms and ethical values from the French Revolution of 1791—Equality, Freedom and Brotherhood—are programmed into the design of autonomous intelligent machines from the first line of code.

B. Trustworthy AI

Europe is taking the lead in the ethical side of AI. The EC is, following the example set by IEEE and MIT, making serious work of accountable and ethical AI by Design.[213] Ethical AI by Design is about integrating ethical thinking in AI engineering practice.[214] It is about understanding and managing the ethical dimensions of AI development and implementation. Europe's efforts are directed to Trustworthy AI. The 2018 EU flagship report on AI identified the need for a clear ethical framework and guidelines on responsible AI design that should be compatible with the EU principles and regulatory frameworks.[215]

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[210] Jenkins, *supra* note 205, at 13–16. One could even take it a step further and argue that AI outputs are cultural heritage and thus belong in the public domain.

[211] For ethical norms in IP research, *see* Robin Feldman, Mark A. Lemley, Jonathan S. Masur & Arti K. Rai, *Open Letter on Ethical Norms in Intellectual Property Scholarship*, 29 Harv. J.L. & Tech. 339 (2016).

[212] For challenges regarding the development of intelligent autonomous machines, *see*: Peter Werkhoven, Leon Kester & Mark Neerincx, *Telling autonomous systems what to do*, Proceedings of the 36th European Conference on Cognitive Ergonomics - ECCE'18 (2018), available at https://dl.acm.org/doi/abs/10.1145/3232078.3232238.

[213] For efforts in the USA, see '*Explainable Artificial Intelligence: Can We Hold Machines Accountable? A Q&A with Professors Surden and Kaminski* (Apr. 29, 2019), https://www.colorado.edu/law/2019/04/29/explainable-artificial-intelligence-can-we-hold-machines-accountable-qa-professors-surden; *see also* Kush R. Varshney, *Introducing AI Fairness 360*, IBM Research Blog, https://www.ibm.com/blogs/research/2018/09/ai-fairness-360/ (September 19, 2018).

[214] *See, e.g.*, Kim Martineau, *Ethical AI by Design*, Slice of MIT (Apr. 26, 2019), https://alum.mit.edu/slice/ethical-ai-design; *see also Ethically Aligned Design in Practice*, IEEE Ethics in Action in Autonomous and Intelligent Systems, https://ethicsinaction.ieee.org/ (last visited June 12, 2019).

[215] European Commission, *Artificial Intelligence - A European Perspective* 61 (Max Craglia ed., 2018), available at https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113826/ai-flagship-report-online.pdf.

Furthermore, an independent High-Level Expert Group on Artificial Intelligence (HLEG) was setup by the European Commission, which drafted European ethics guidelines for AI. Building upon the shared values in the Treaties and the Charter, the HLEG's goal is "to create a culture of 'Trustworthy AI for Europe,' whereby the benefits of AI can be reaped by all in a manner that ensures respect for our foundational values: fundamental rights, democracy and the rule of law."[216]

Trustworthy AI has three components, which have to be met throughout the system's entire life cycle: legal, ethical and robust. The resulting Trustworthy AI assessment list can be used as technical/ethical/legal code of conduct in the same manner as the Dutch AI Impact Assessment.[217]

In the words of the HLEG[218], AI applications should respect seven key requirements to be considered trustworthy:

1. Human agency and oversight

Including fundamental rights, human agency and human oversight

2. Technical robustness and safety

Including resilience to attack and security, fall back plan and general safety, accuracy, reliability and reproducibility

3. Privacy and data governance

Including respect for privacy, quality and integrity of data, and access to data

4. Transparency

Including traceability, explainability and communication

5. Diversity, non-discrimination and fairness

Including the avoidance of unfair bias, accessibility and universal design, and stakeholder participation

6. Societal and environmental wellbeing

Including sustainability and environmental friendliness, social impact, society and democracy

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[216] It is important that the time and energy invested in ethical AI does not slow down rapid technological advancement, innovation and AI implementation, but instead increases business competitiveness. *See* European Commission, *Ethics Guidelines for Trustworthy AI* (2019), available at https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=60419.

[217] *See Artificial Intelligence Impact Assessment*, ARTIFICIAL INTELLIGENCE & LAW, available at https://static1.squarespace.com/static/5b7877457c9327fa97fef427/t/5c368c611ae6cf01ea0fba53/1547078768062/Artificial+Intelligence+Impact+Assessment+-+English.pdf (The AI Impact Assessment offers AI developing companies, data scientists and software programmers a concrete code of conduct with which AI can be safely implemented. The AIIA is carried out by multidisciplinary teams).

[218] European Commission, *supra* note 215 (Note that these guidelines are non-binding and do not create new legal obligations. Instead, they create a moral obligation).

7. Accountability

Including auditability, minimisation and reporting of negative impact, trade-offs and redress.

X. AI & IP Policy: Regulating Disruptive Innovation

Intellectual property law has become the new battleground for ideas on how societies should deal with transformative change caused by disruptive tech.[219] While trying to fill legislative gaps when laws cannot keep up with the pace of innovation, lawyers are becoming the policy makers. In this context, this section presents ten thoughts and policy suggestions on social, inclusive and innovation-friendly AI and data regulation.[220] I start with a short legal policy vision of the direction I feel we should take.

A. AI & IP for Dummies

More or less protection for the owner of IP rights each has both advantages and disadvantages. More protection could stimulate costly and labor-intensive innovation, because that protection is offered as a reward. But the opposite, open access, also has social benefits. The degree of IP protection is therefore based on a consideration of pros and cons, and thus has a legal-political character.

IP law policy aims to implement a regime that strikes a balance between underprotection and overprotection of IP rights—a regime that searches for an innovation optimum. That this is not an easy task as illustrated by IP history, which shows a pendulum swinging between underprotection and overprotection.[221] Right now, we are in a stage of overprotection.[222] In other words, intellectual property rights are getting too stretched. Besides that, IP law is poorly structured.

This is not good because disruptive technologies such as AI, blockchain, and big data require a balanced, innovation-friendly regime. Solutions to resolve negative effects that overprotection has are available. These include, on the one hand, technology-neutral open standards and exceptions or limitations such as the American fair use principle, which allow more breathing room for both consumers and

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[219] Peter W.B. Phillips, *Governing Transformative Technological Innovation: Who's in Charge?* 94–97 (The concise nature of civil law code makes it difficult to draft. This potentially slows down the process of change, which has a negative effect on forces promoting transformative change); *see also* Giandomenico Majone, *The rise of the regulatory state in Europe*, 17 West European Politics 77 (1994); *see also* Feldman, Lemley, Masur & Rai, *supra* note 211.

[220] For a proposal for a regulatory framework for AI & data, see: Mauritz Kop, Shaping the Law of AI: Transatlantic Perspectives, TTLF Working Papers No. 65, Stanford-Vienna Transatlantic Technology Law Forum (2020), https://law.stanford.edu/publications/no-65-shaping-the-law-of-ai-transatlantic-perspectives/. In addition to a set of fundamental, overarching core AI rules, the author suggests a differentiated industry-specific approach regarding incentives and risks.

[221] Michelle Riley and David Haas, *Intellectual Property Thought Leader Interview With Mark Lemley* 7 (2016) https://www.stout.com/es-es/insights/article/intellectual-property-thought-leader-interview-mark-lemley.

[222] This can be illustrated by impenetrable forests of layers of rights, IP thickets and spectrums of rights as discussed earlier in this article.

online platforms; and on the other hand, the introduction of an articulated public domain for AI Creations and Inventions (Res Publicae ex Machina). In general, we need more flexible IP laws and more open access. IP overprotection leads to market barriers for start-ups and SME's and hinders international trade.

When expressing preference for open access, AI & IP policy makers should ask themselves 2 questions:

1. To what extent can the assessment of the magnitude of the advantages and disadvantages of more open access versus more layers of IP rights be substantiated?

This could, inter alia, be substantiated by sector specific empirical research.

2. And how and why do I weigh the pros and cons of this substantiation, and thus arrive at a preference for more open access?

The goal should be at least a Pareto optimum/equilibrium, and preferably a Pareto improvement.

B. 10 AI Related Policy Suggestions

First of all, in order to have a sensible short-to-medium-term policy discussion about IP law in the context of emerging tech, it is important to demystify AI, resist anthropomorphisation and avoid speculation about the distant future. The state of the art is that we do not have Strong or General AI yet. What we have today is weak, pattern-based AI that is reaching task specific performance.[223] It is a suite of tools that can be used for computer deductive reasoning and machine learning.

Second, the unchartered terrain of IP and AI law makes it possible for legislators to harmonize the acquis for AI internationally. For example, this can be done by introducing an official PD mark for AI Creations and Inventions (Res Publicae ex Machina). A harmonized, global acquis prevents forum shopping to countries such as the UK, Australia, and Japan and promotes legal certainty. It is vital that countries stop stretching IP rights at the expense of public domain and fundamental rights such as the right to information that are enshrined in the EU Charter and the USA Constitution.

Third, AI related IP law policy should recognize the social value of disruptive technology and resist protecting settled market players who benefit from the status quo.[224] IP law should not create barriers for new market entrants.

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[223] Human superiority in chess, Go and poker has ended. Lawyers and policy makers should anticipate on AI getting stronger. *Cf.* Noam Brown and Tuomas Sandholm *Superhuman AI for multiplayer poker*,365 Science 885, 885–890 (30 Aug. 2019), https://science.sciencemag.org/content/early/2019/07/10/science.aay2400 accessed 11 July 2019.

[224] Mark Lemley and Mark McKenna, *Unfair Disruption* (Stanford Law and Economics Olin Working Paper No. 532; Notre Dame Legal Studies Paper No. 1926, 2019), https://ssrn.com/abstract=3344605. (Incumbents try to prevent market disruption using doctrines such as unfair competition, utility patent, antitrust and unjust enrichment. These tactics hinder innovation.).

Fourth, AI governance should be human centered.[225] Global governance of AI and data should focus less on data ownership and more on data usage. Balancing privacy against innovation is a challenge. If we regulate data use in accordance with clear values about privacy and fundamental equality rights, the general public will be able to be confident about the flow of this data. People will have a sense of control and more trust in institutions on the web.[226] We need guidelines for a global governance framework and data architecture that integrate universal principles of fairness and sustainability to advance the growth and well-being of all countries and people.[227] The pros of such data usage regulation outweigh the cons of doing nothing. A decentralized cloud based on blockchain principles could mitigate privacy concerns, data uncertainty, and a feeling of control loss. Only in this way privacy and access to information seem to be able to coexist in cyberspace.

Fifth, countries should use instruments such as competition law, anti-trust law, contract law, consumer privacy protection[228], tax law[229], as well as penalties and fines[230] to balance the effects of disruptive innovation and enable fair-trading conditions between digital platforms and users. [231]Because of disproportionately large market power, ubiquitous mega platforms are becoming more important actors in the global arena than nation-states. This conflicts with consumer welfare. Copyright cannot correct skewness[232] (nor make it worse), but competition law can.[233] A help-

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[225] *See* Floridi, Luciano, *Soft Ethics and the Governance of the Digital and the General Data Protection Regulation* (Oct. 15, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3266790. *See also* Stankovic, Gupta, Rossert, Myers and Nicoli (n 18).

[226] Dan Costa, *Lawrence Lessig Is Fired Up About Campaign Corruption, Dangers of AI*, PCMag, Jan. 29, 2018, https://www.pcmag.com/article/358802/lawrence-lessig-is-fired-up-about-campaign-corruption-dange.

[227] Córdova, supra note 160.

[228] Michael Kearns, *Data Intimacy, Machine Learning, and Consumer Privacy*, U.Pa. L., CTIC, (2018). *See also* Jack Balkin, *The Path of Robotics Law*, 6 Calif. L. Rev. Cir. 45 (2015). Yale Law School, Public Law Research Paper No. 536; Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 Calif. L. Rev. 513, 549–63 (2015); Giancarlo Frosio, *Why Keep a Dog and Bark Yourself? From Intermediary Liability to Responsibility* 26(1) Oxford Int. J. of L. and Info. Tech. 1–33 (2018); Robert van den Hoven van Genderen, *Privacy and Data Protection in the Age of Pervasive Technologies in AI and Robotics*, 3 Eur. Data Port. L. Rev. 338 (2017); M.J. Vetzo, J.H. Gerards & R. Nehmelman, *Algoritmes en grondrechten*, (Den Haag: Boom Juridisch) (2018).

[229] The author suggests a data tax.

[230] *See* Fisher, *supra* note 45, at 255 (discussing government strategies to promote innovation including intellectual property law and "legal reinforcement of self-help practices"); *See also id.* at 258 (discussing an approach to alter regulations on pharmaceutical research such that penalties might be employed to encourage firms to act in a socially beneficial way).

[231] Mauritz Kop, Beyond AI & Intellectual Property: Regulating Disruptive Innovation in Europe and the United States—A Comparative Analysis, https://law.stanford.edu/projects/beyond-ai-intellectual-property-regulating-disruptive-innovation-in-europe-and-the-united-states-a-comparative-analysis/.

[232] *See* Scherer, *supra* note 41, at 21–22 (arguing that evidence suggests that patent and copyright enforcement is biased in favor of large corporations whose behaviour conforms less to skewness, in obtaining big rewards from technology development, than does the behaviour of independent innovators).

[233] *See* Drexl *supra* note 124, at 42–45 (arguing that competition law could be used to address the critical balance between allowing data-based firms to maintain their competitive edge and allowing

ful option in bringing back harmony on the markets would be to ensure trading between a dominant digital platform and others on a FRAND basis (Fair, Reasonable, and Non-Discriminatory).[234] Voluntary FRAND licensing is a proven mechanism that is relied on in both commercial contracts and regulation.[235]

Sixth, online behemoth platforms should adopt an "apollonian" attitude in world view, corporate ideology, and philosophy of life and art.[236]

"With the apollonian, derived from the name of Apollo, the Greek god of the arts, one indicates everything that—compared to the "dionysian" world view, doctrine and art—bears the characteristics of the static, balanced intellect and that which strives for size, order and harmony. . . . It is an attitude on which reason, boundary and balance have their stamp."[237]

Seventh, smart, cross-sectoral public-private collaboration i.e. co-operation and synergy based on the triple helix model should be encouraged. This encouragement should promote a focus on areas such as healthcare, energy, education, and the facilitating role of the government. Multidisciplinary cooperation would involve science and education, business, government, and would require social representatives to jointly map the legal and ethical challenges, risks and opportunities of AI in the infosphere. The keywords here are inclusiveness, knowledge infrastructure, an innovation-friendly entrepreneurial environment, and an economy based on joint knowledge and thinking. Best practices and sector-specific governance codes of conduct established through cross-sectoral public-private collaboration are important options for managing the transformative power of AI.

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access to data to promote competition and innovation in the data driven economy); *see also* J.H. Reichman & Paul F. Uhlir, *Database Protection at the Crossroads: Recent Development and Their Impact on Science and Technology*, 14 Berkeley Tech. L.J. 793, 829 (1999) (arguing that the movement away from the exclusive property approach to databases, in the Hatch Database Discussion Draft, to an unfair competition approach better served to protect the interests of existing industry players while better avoiding harm to potential public-service innovations in this space).

234 Mathew Heim & Igor Nikolic, *A FRAND Regime for Dominant Digital Platforms* 2 4IP COUNCIL (Jan. 2019), https://www.4ipcouncil.com/application/files/8915/4817/0794/A_FRAND_Regime_for_Dominant_Digital_Platforms_-_v2.pdf; *See* Ginevra Bruzzone & Sara Capozzi, *Collaborative Standardisation and SEP licensing: a EU Policy perspective* in THE INTERPLAY BETWEEN COMPETITION LAW AND INTELLECTUAL PROPERTY: AN INTERNATIONAL PERSPECTIVE ch. 1 (Gabriella Muscolo & Marina Tavassi eds., 2019).

235 *See* Heim *supra* note 234, at 12–14.

236 *See* Friedrich W. Nietzsche, Die Geburt der Tragödie aus dem Geiste der Musik (1872) (inspired by A. Schopenhauer (1788–1860) (English Translation)(defining and using terms "apollonian" and "dyonisian"), http://www.gutenberg.org/ebooks/51356. What would this mean for such platforms in concrete terms? A good start would be paying taxes and respecting consumer privacy.

237 Algemeen Letterkundig Lexicon, DBNL, https://www.dbnl.org/tekst/dela012alge01_01/dela012alge01_01_02017.php, (last visited 12 May 2019).. With regard to the arts, the term 'apollonian' refers to light and comprehensibility, reason, symmetry, beauty and healing. According to Nietzsche, neither the apollonian nor the dyonisian ever prevails, due to each containing the other in an eternal balance. *See also* Nietzsche, *The Birth of Tragedy*, WIKIPEDIA, https://en.wikipedia.org/wiki/The_Birth_of_Tragedy#The_book.

Eighth, synergetic effects with other emerging tech such as blockchain, quantum computing and neuromorphic computing should be encouraged. Encouraging AI + Blockchain pilots is important, since these technologies can reinforce each other. DLT can fix traditional database-centric shortcomings. According to McConaghy, blockchain can transform and boost AI the way big data did before.[238] Blockchain's characteristics (decentralized / shared control, immutable / audit trails, and native assets / exchanges) encourage data sharing, and lead to better and new data models and more trustworthy AI predictions.[239] Additionally, blockchain can be used control the upstream of one's data.[240] It can also be used as a tamper proof IP registration tool.[241]

Ninth, AI certification and standardization (such as ISO, ANSI, IEEE/IEC, compatibility and interoperability of IoT devices) should preferably not be done by private parties with commercial objectives, but by independent public bodies.[242] For instance in healthcare, enforcement should be carried out by a government agency/ public body such as Farmatec in The Netherlands, via a multidisciplinary approach. Thus, healthcare experts, IT experts, ethicists and privacy experts together are coordinated by this central body, instead of by notified bodies who have commercial interests in issuing CE-markings, which is similar to how the FDA (Food and Drug Administration) operates in the United States.

Finally, machine learning can assist humans in making the best laws possible in a democracy, if the system is fed with proper data.[243] The result could be better rules in the form of computable laws, designed and reinforced by a digital government as a platform. Rules as Code (RaC). In case of IP law, there are simply too many variables and stakeholders to deal with. Besides that, IP rationales are not working properly in the internet age and copyright law is currently poorly structured.

Computable law-making is already happening in NSW Australia, where multidisciplinary RaC teams are drafting and publishing rules from legislation, regulation, and policy in a human and machine consumable form.[244] The clear benefits of laws augmented by machine learning are improved policy outcome, consistency of application, less room for misinterpretation, faster deployment, increased legal certainty, and public trust.[245]

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[238] Trent McConaghy, *How Blockchains could transform Artificial Intelligence* (Dec. 21, 2016). https://dataconomy.com/2016/12/blockchains-for-artificial-intelligence/ (accessed 12 May 2019).

[239] *Id.*

[240] *Id.*

[241] *Id.*

[242] *See, E.g.*, ISO/IEC JTC 1/SC 42, *Standardisation in the area of artificial intelligence* https://www.iso.org/committee/6794475.html (accessed 12 July 2019).

[243] Yanisky, Shlomit & Liu, *supra* note 108; Lohr *supra* note 134; *See also* Harry Surden, *Machine Learning and Law*, 89 WASH. L. REV. 87, 102–05 (2014).

[244] *See* Stanford FutureLaw Conference 2019, *Government as a Platform,* https://youtu.be/5EgO7WtMXYA (accessed 12 May 2019).

[245] *See id*. (explaining that reasonableness, fairness, proportionality and tailor-made solutions could be challenging in the early stages of computable laws).

C. HLEG Policy and Investment Recommendations

On 26 June 2019 the HLEG presented its Policy and Investment Recommendations for Trustworthy AI to the European Commission and Member States.[246] The document contains 33 recommendations, including 11 key takeaways, that can guide European AI towards sustainability, growth and competitiveness. The 11 key takeaways are:[247]

1. Empower and protect humans and society

2. Take up a tailored approach to the AI landscape

3. Secure a Single European Market for Trustworthy AI

4. Enable AI ecosystems through Sectoral Multi-Stakeholder Alliances

5. Foster the European data economy

6. Exploit the multi-faceted role of the public sector

7. Strengthen and unite Europe's research capabilities

8. Nurture education to the Fourth Power

9. Adopt a risk-based governance approach to AI and an ensure an appropriate regulatory framework

10. Stimulate an open and lucrative investment environment

11. Embrace a holistic way of working, combing a 10-year vision with a rolling action plan

Embracing self-regulation flanked by risk based, proportional bottom-up governance that does not stifle innovation but instead creates trust, awareness, and legal certainty reflects an important shift in the European AI Policy. In this innovation-friendly approach, best practices and codes of conduct will play prominent roles.

XI. Conclusion

This article considers intellectual property rights as a part of the overarching normative concept of information law. As such, IP law should contribute to a legal framework that best serves the information society while respecting fundamental rights and freedoms.

As the cyberspace environment develops and expands, legal perceptions and rules need to evolve.[248] Copyright must be reconstructed into a framework of well-structured economic rights, under which fair use does not hinder scientific progress

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[246] High-Level Expert Group on Artificial Intelligence, 'POLICY AND INVESTMENT RECOMMENDATIONS FOR TRUSTWORTHY AI' (European Commission, 26 June 2019), https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=60343 (last visited 27 June 2019).

[247] *Id*. at 47–9.

[248] Lawrence Lessig, *The Law of the Horse: What Cyberlaw Might Teach*, 113 HARV. L. REV. 501–49 (1999).

and human creators (authors and inventors) are able to make a living.[249] The system should maximize creativity and diversity, freedom of expression and prosperity.

This article concludes that human authorship remains the normative organ point of intellectual property law and that (for now) smart robots do not have—and ought not have—legal personhood. All the rationales of intellectual property are weak when applied to AI. Moreover, it is argued that AI does not need IP incentives. Extending copyrights slows down innovation, cultural diversity, and even fundamental freedoms; adding extra layers to the existing rainbow of IP rights is not a good solution to balance the societal impact of technological progress. Furthermore, extending copyrights to AI is not useful since there are already enough IP instruments available.[250] Legislative gaps, if any, can be remedied by contracts, technological measures, and generous application of fair use and the three-step test.

Traditionally, human beings and property (such as AI systems and smart robots) are viewed as legal entities on the two opposite sides of a continuum. The article describes the absence of legal status for machines (which are legal objects) and explores possibilities for the construction of such a status in the form of dependent and independent legal personhood as well as legal agenthood.

The reality of autonomous computer systems supporting and even replacing humans in the invention process forces us to rethink the patent system, possibly even beyond rationales and justifications. Abolishing patent protection for AI Inventions,[251] including a formal public domain or open source status, appears to be the most innovation friendly option.

The article explains which IP rights can be vested in the various components of the AI system itself. An AI system globally consists of input data, software, and hardware. From a legal point of view we can distinguish at least seven relevant components: (1) the computer program including the software source code and algorithms, (2) the training data corpus, (3) the neural network, (4) the machine learning process, (5) the AI applications, (6) the hardware, (7) and the inference model.

IP rights on these components can be owned by legal subjects only. The article argues that legal uncertainty about the patentability of AI systems is causing a shift towards trade secrets to protect investments and monetize AI applications. Furthermore, it concludes that there are sufficient IP instruments to protect the various components of AI systems.[252] Even some protection overlaps exist, because of theoretical cumulation of patents, copyrights, trade secrets, and database rights.[253] New layers of rights do not seem to be opportune.

If, in the future, there would be a need to grant AI systems some form of legal

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[249] Gervais, *supra* note 14.

[250] *See also* Deltorn & Macrez, *supra* note 56.

[251] *See* Yanisky, Shlomit & Liu, *supra* note 108, at 8.

[252] Exhaustion of certain aspects of patent rights and copyrights on sold instantiations or copies may apply. *See also* Ghosh & Calboli, *supra* note 141.

[253] *See* Deltorn, *supra* note 55, at 24.

personhood, these systems could own IP rights on other systems. If this ever happens, humans or corporations owning IP rights on AI systems that have legal personhood could be problematic from a technical-legal point of view because IP rights cannot be vested in legal subjects.

Good quality shared data is (still) a sine qua non for successful AI.[254] The use of training corpora for AI systems usually has two relevant IP dimensions. The article discusses (clearance of) third party ownership rights on the input data and ownership of the processed output data. Economic analysis has shown that "there are no convincing economic arguments for the introduction of a new IP right on data or a data producer property right, especially due to the lack of an incentive problem for the production and analysis of data."[255]

Parts of the Roman multi-layered property paradigm can be relevant for AI. Society can benefit from a newly proposed public domain model for AI Creations and Inventions that crossed the autonomy threshold—Res Publicae ex Machina (Public Property from the Machine), which should include an official (government issued) PD mark. The introduction of the legal concept of Public Property from the Machine is a Pareto improvement; many actors benefit from it while nobody (at least no legal person) will suffer from it.

For illustrative purposes, the article includes a human-machine collaboration example. The examined AI Assisted Creation (a sound recording of a musical work) can be streamed online and does not qualify as Public Property from the Machine. The article also describes a pure AI Invention that qualifies as Public Property from the Machine and thus could be awarded with official PD mark status: a flu vaccine autonomously brewed by an AI called SAM.

Lawyers and scholars who specialize in intellectual property law should strive for the highest achievable ethical standards in IP research and practice.[256] When reflecting upon AI and IP, moral principles should not be absent. The article explains the importance of ethics for the development and implementation of AI and discusses Europe's efforts towards Trustworthy AI. Trustworthy AI has three components, which have to be met throughout the system's entire life cycle: legal, ethical, and robust.

IP law policy aims to implement a regime that strikes a balance between underprotection and overprotection of IP rights. A regime that searches for an innovation optimum. More or less protection for the owner of IP rights has both ad-

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[254] *See Data: A Cornerstone for AI—Toward a Common European Data Space*, European Commission, https://ec.europa.eu/knowledge4policy/ai-watch/topic/data-cornerstone-ai-%E2%80%93-toward-common-european-data-space_en (last visited 12 May 2019). The need for training data may change when AI gets stronger.

[255] Wolfgang Kerber, *A New (Intellectual) Property Right for Non-Personal Data? An Economic Analysis, in* Gewerblicher Rechtsschutz und Urheberrecht, Internationaler Teil (GRUR Int), 989-999 (forthcoming Nov. 2016). *See also* William M. Landes and Richard A. Posner, *An Economic Analysis of Copyright Law*, 18 No.2 J. of Legal Stud. 325, 327 (1989).

[256] See Jenkins, *supra* note 205, at 13.

vantages and disadvantages. More protection could stimulate costly and labor-intensive innovation because that protection is offered as a reward. But the opposite, open access, also has social benefits. The degree of IP protection is therefore based on a consideration of pros and cons. The assessment of the magnitude of the advantages and disadvantages of more or less protection should be properly substantiated.

Finally, a small collection of AI related policy suggestions and recommendations include:

1. In order to have a sensible short to medium term policy discussion about IP law in the context of emerging tech, it is important to demystify AI, resist anthropomorphisation, and avoid speculation about the distant future.

2. The unchartered terrain of IP and AI law offers legislators an important chance to harmonize the acquis for AI on an international level. In general, the article contends there should be less focus on enforcement and monopolization and more on access and remuneration.

3. Additionally, AI related IP law policy should recognize the social value of disruptive technology and resist protecting settled market players who benefit from the status quo.[257] IP law should not create barriers for new market entrants.

4. That AI governance should be human centred. Global governance of data and the infosphere should focus less on data ownership and more on data usage.

5. Countries should use instruments such as competition law, anti-trust law, contract law, and tax law as well as technological measures to balance the effects of disruptive innovation and enable fair-trading conditions between digital platforms and users.

6. Online mega platforms should adopt an apollonian attitude in corporate ideology, world view and philosophy of life.

7. Smart cross-sectoral public-private collaboration based on the triple helix model should be encouraged since this co-operative, multidisciplinary approach has strong synergetic effects.

8. Synergetic effects with other emerging tech such as DLT, quantum computing, 3d integrated circuits, memristors and parallel, brain-inspired computing should be maximized. Blockchain can be used as a tamper proof IP registration tool and fix traditional database-centric shortcomings.[258]

A symbiosis between blockchain and AI as a fundament for trusted, secure decentralized shared datasets that preserve privacy is a promising AI pilot accelerator.[259] FIAR datasets are interoperable, increase public trust and deliver the much

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[257] *See* Lemley, *supra* note 224, at 160.

[258] *See* McConaghy, *supra note* 238.

[259] Thomas Hardjono, Alexander Lipton, and Alex "Sandy" Pentland, '*Towards a Design Philosophy for Interoperable Blockchain Systems*, MIT Connection Science, Massachusetts Institute of Tech-

sought after hi-quality training corpora for public and private AI initiatives.

9. AI certification and standardization (such as ISO, ANSI, IEEE/IEC) should preferably not be done by private parties with commercial objectives, but by independent public bodies.

10. Lastly, machine learning can assist humans in designing better rules in the form of computable laws. The EU should learn from less successful legislative attempts including trade secret law discouraging information disseminations, copyright reform infringing on human rights and the sui generis database right leading to trade imbalances. In scenarios where protracted legislative processes hinder rapid innovation, legal sandboxes should be considered. It is argued that computational laws can achieve more consistent, effective, and transparent legislation with the help of machine learning. This human-machine hybrid collaboration would lead to increased legal certainty and public trust.

nology Cambridge, MA (July 7, 2018).