1. Towards a law of artificial intelligence

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I. INTRODUCTION

Not only is artificial intelligence a rapidly advancing technology, but the capabilities of artificial intelligence which allow it to learn from experience and to perform autonomously from humans, make artificial intelligence the most disruptive and transformative technology of the early twenty-first century. An important observation to make is that artificial intelligence is already ubiquitous in society, it can be found in consumer appliances, the Internet of Things, Air Traffic Control Systems, the national power grid, healthcare systems, and all aspects of the “intelligent” highway transportation system from autonomous vehicles to the road itself. In fact, we are becoming more and more dependent on systems operating with artificial intelligence for the maintenance and functioning of our physical and digital infrastructure. However, as technology advances, so too must the law advance to account for changes in the capabilities of technology. This is particularly the case with artificial intelligence, whose abilities to learn and operate autonomously from humans is raising a host of challenges to established areas of law.

As noted, the “artificial intelligence revolution” is widespread throughout society; for example, just in the home, artificial intelligence controls many of today’s consumer products ranging from kitchen appliances to thermostats adjusting the temperature in a room.¹ And in commerce, artificial intelligence controls the actions of digital assistants and electronic agents which buy and sell billions of dollars’ worth of products. In human-computer interaction, algorithms which support natural language processing allow humans and computers to speak to each other in a common language raising the specter of free speech doctrine. Additionally, the world is being networked at an astonishing rate, and in a networked world, the Internet is dependent on artificial intelligence to function. For example, consider the use of artificial intelligence for the following: to select content based on user-preferences, show targeted advertisements, predict and manipulate behavioral traits amongst users, create and design high quality content, help determine what a person sees in Facebook feed, and what ads a person sees in their Gmail.² For each of these examples the use of artificial intelligence is allowing increasingly smart machines to engage in creative and sometimes unpredictable behavior; this aspect of what artificial

¹ “Wiresoft Brings Artificial Intelligence to Security Appliances” (discussing the use of AI for security monitoring and maintenance), available at: <https://www.infotech.com/research/wiresoft-brings-artificial-intelligence-to-security-appliances>; in fact, the Nest thermometer “learns” the temperatures a person likes and to save energy turns itself down when nobody is home, Nest store products, available at: <https://store.nest.com/product/thermostat/>.

² Stephen F. Deangelis, “Artificial Intelligence: How Algorithms Make Systems Smart”, available at: <https://www.wired.com/insights/2014/09/artificial-intelligence-algorithms-2/>.

intelligence affords a system offers significant challenges to established areas of law that historically have relied on identifying a human in the decision-making loop.

Discussing the importance of artificial intelligence for the future development of information technology, Tony Tether, former director of the US Defense Advanced Research Projects Agency (DARPA) stated: “machine learning is the next Internet.”³ Further, commenting on the relevance of artificial intelligence for society, Microsoft U.K.’s Chief Envisioning Officer Dave Coplin claimed that “artificial intelligence is the most important technology that anybody on the planet is working on today.”⁴ Within government, the Office of the U.S. Presidency under then President Obama took note of advances in artificial intelligence and through the White House Office of Science and Technology Policy offered workshops in order to generate public dialogue and to identify challenges and opportunities related to this emerging technology.⁵ But perhaps the conclusions of the business and economics research arm of McKinsey Global Institute, a technology think tank, that artificial intelligence is not only contributing to the transformation of society but that compared to the Industrial Revolution, the artificial intelligence revolution is “happening ten times faster and at 300 times the scale, or roughly 3,000 times the impact”,⁶ thoroughly states the case for artificial intelligence as the key transformative technology emerging in the early twenty-first century.

I will return to issues of law surrounding the definition of artificial intelligence later in this chapter, but as a starting point, a standard definition of intelligence is “. . . the ability to learn or understand things or to deal with new or difficult situations.”⁷ With this in mind, generally, the goal of research in artificial intelligence is to create computers, software, and machines that are capable of intelligent and, in some cases, unpredictable and creative behavior. Discussing the concept of intelligence for robotics, a particularly important application using artificial intelligence, law professor F. Patrick Hubbard described intelligence as “the rate at which the machine can receive, evaluate, use, and transmit information, and the extent to which it can learn from experience and use the output of learning to determine future responses.”⁸ Hubbard’s definition of intelligence is also similar to law and robotics expert professor Ryan Calo’s characterization of a robot which produces “emerging behavior” and can “sense, process, and act.”⁹ I should note that each of these aspects of robotics identified by Calo and Hubbard are made possible by the capabilities of artificial intelligence. Additionally, even though advances in sensor and other technologies are leading to “smart machines”, it is still techniques of artificial

³ See, Maria-Florina Balcan, *Foundations of Machine Learning and Data Science* (Lecture) (2015), available at: <http://www.cs.cmu.edu/~ninamf/courses/806/lect09-09-slides.pdf>.

⁴ Dave Choplin, “AI Will Change Everything”, available at: <http://www.winbeta.org/news/microsoft-exec-london-conference-ai-will-change-everything>.

⁵ White House Office of Science and Technology Policy, available at: <http://cdn.ccianet.org/wp-content/uploads/2016/07/CCIA-White-House-OSTP-AI-Comments-Final.pdf>.

⁶ Richard Dobbs, James Manyika, and Jonathan Woetzel, “The Four Global Forces Breaking all the Trends”, 2015, available at: <http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-four-global-forces-breaking-all-the-trends>.

⁷ Definition of “Intelligence”, Merriam-Webster dictionary, available at: www.merriam.com.

⁸ F. Patrick Hubbard, “*Sophisticated Robots*”: *Balancing Liability, Regulation, and Innovation*, 66 Fla. L. Rev. 1803 (2015), available at: <http://scholarship.law.ufl.edu/flr/vol66/iss5/1>.

⁹ Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 Cal. L. Rev. 3, 513–63 (2015).

intelligence and mainly the use of algorithms that analyze and interpret the data collected by sensors. These capabilities allow machines to perform autonomously from humans and this, with other attributes of artificial intelligence, is beginning to offer significant challenges to established areas of law.

I propose that the basic ingredient of artificial intelligence is algorithms which can be described as a procedure for solving a problem in a finite number of steps, or as stated by Microsoft's Tarleton Gillespie, algorithms are "encoded procedures of transforming input data into a determined output, based on specified calculations."¹⁰ But not all algorithms can be considered an example of artificial intelligence, especially those which program a robot to move in predetermined motions (i.e., repetitively) and with little or no decision-making involved. But algorithms which model complex human performance, human thought processes, and that can learn from experience, are considered by most to be an example of artificial intelligence; and when systems with these capabilities operate autonomously from humans, several established areas of law are challenged. For instance, for purposes of assigning liability under tort law, not all algorithms can be traced back to a human programmer, especially algorithms associated with techniques identified as deep learning. This is important because the more artificially intelligent systems are controlled by algorithms that were not written by humans, the more likely they will display behaviors that were not just unforeseen by humans, but were wholly unforeseeable. For the law, this is significant because foreseeability is a key ingredient in negligence.

II. ARTIFICIAL INTELLIGENCE AS A TRANSFORMATIVE TECHNOLOGY RAISING ISSUES OF LIABILITY

The use of artificial intelligence to create the range of behaviors shown by emerging smart technologies is core to the discussion of artificial intelligence as a transformative and disruptive technology. Consider machine learning algorithms which solve problems in ways that are novel to human operators. This scenario alone raises several questions of interest to different areas of law. For example, under intellectual property law, who owns the copyright to original works of authorship created by algorithms and who should receive the patent monopoly for inventions independently created by an algorithm that itself was derived from machine learning techniques? Further, if a system is controlled by artificial intelligence and performs tasks in ways that are novel and unpredictable to humans, if there is harm to a human or damage to property who should courts hold liable—the artificial intelligence directing the actions of the machine that caused the damage but lacks personhood status, or the human that lacks knowledge of how the machine performed or even that the machine was attempting to solve a particular problem? And while the issue of assigning liability for injuries resulting from human interaction with increasingly smart machines is of keen interest to legal scholars and to courts, in such situations the likely causative factor other than human error is the software and algorithms controlling

¹⁰ Tarleton Gillespie, *The Relevance of Algorithms*, In Media Technologies (Tarleton Gillespie, Pablo J. Boczkowski, and Kirsten A. Foot, eds. MIT Press 2014).

the machine's actions, that is, the artificial intelligence embedded within the machine's sensors, microprocessors, and computer vision system.

It is the case that machines that lack the ability to think beyond a few simple rules directing their actions, are so devoid of intelligence, that no one would assign them responsibility for their actions. A case on point is *Comptroller of the Treasury v. Family Entertainment Centers*.¹¹ In *Comptroller*, a Maryland special appeals court considered whether life-sized animatronic puppets that danced and sang at a Chuckie Cheese triggered a state tax on an establishment which serves food "where there is furnished a performance." The court held that "[A] pre-programmed robot can perform menial tasks because a pre-programmed robot has no 'skill'. . . It cannot 'perform' a piece of music."¹² However, while a robot may not be able to perform a piece of music under the Copyright Act, in other contexts artificial intelligence has arguably composed original works of music raising the issue of whether the artificial intelligence is the actual composer of the work. But what does make smart machines interesting and challenging from a legal perspective? As argued repeatedly in this Chapter, the answer is robots that have capabilities provided by artificial intelligence which allows them to sense the environment, initiate actions, and solve problems using solutions that were originally unknown to the human operator.¹³ By the way, these are basically the same set of attributes that make humans "interesting" for different areas of law; therefore, it seems to me, the more human-like artificial intelligence becomes, the more the law is challenged.

As a basic point, the use of artificial intelligence begs the question of who is liable if the artificial intelligence controlling smart technology learns and solves problems in ways completely unknown to the human in the system. In this case should the focus in assigning liability be the person(s) that created the smart machines or the person(s) that produced the software and algorithms which control the machine's behavior and determine its actions? If artificially intelligent systems write their own algorithms and solve problems with solutions unknown to human operators, would it be fair to hold humans liable for any harm the system caused? With an autonomous system sharing control with humans, the future may be one in which significant issues of law and policy are brought forth by the use of artificial intelligence, thus a body of law will need to be available to guide courts in deciding disputes resulting from such systems, and particularly in deciding how to allocate liability between human and artificially intelligent machines when the system design allows joint control.

Given the requirements of the task, many current robots operate efficiently with a set of instructions provided by a programmer, and when robots do not deviate from these instructions, the law is well equipped to handle disputes involving such systems. A case on point is *Jones v. W + M Automation, Inc.*, in which a worker who had entered a prohibited area behind a safety fence was struck in the head by the gripper arms of a robot.¹⁴ The court focused on whether the robot's gantry loading system was defective when the defendant sold it—while this is an interesting case involving a robot, it is a classic products

¹¹ *Comptroller of the Treasury v. Family Entertainment Centers*. 519 A.2d 1337, 1338 (Md. 1987).

¹² *Id.* at 1339.

¹³ Calo, *supra* note 9.

¹⁴ *Jones v. W + M Automation, Inc.* 818 N.Y.S.2d 396 (App. Div. 2006), appeal denied, 862 N.E.2d 790 (N.Y. 2007).

liability case and litigated as such. But as smart machines such as robots become even smarter, more independent of human supervision, and rely more and more on artificial intelligence for their performance, if there is harm to a human or damage to property, attributing liability to a manufacturer or seller or any human in the chain of distribution will challenge current doctrine in tort, contract, and agency law. In fact, determining liability for the actions of an artificially intelligent entity performing autonomously from humans is an area ripe for legal scholarship and legislative action and we see the beginnings of this effort now by the FAA with drones, and state governments with autonomous vehicles.¹⁵ However, drones, autonomous vehicles, and robots, are in many ways different technologies, although they have in common algorithms and other forms of artificial intelligence to control and direct their behavior.¹⁶

In cases where the harm is alleged to have been caused by artificial intelligence the court is often asked to unravel novel technology and apply ill-fitting case law to make determinations of liability. For example, common-law tort and malpractice claims often center on the very human concepts of fault, negligence, knowledge, intent, and reasonableness.¹⁷ So what happens when human judgement, or scienter, is replaced by artificial intelligence, how will courts assign liability for system failures? In a case decided in 1984, *United States v. Athlone Indus, Inc.* the court stated that “robots cannot be sued”, and discussed instead how the manufacturer of a defective robotic pitching machine is liable for civil penalties for the machine’s defects.¹⁸ However, it should be noted that robots and artificial intelligence have become far more sophisticated and autonomous since *Athlone* and as such courts will continue to struggle with the question of assessing liability going forward as the use of artificially intelligent technologies such as autonomous machines gain mainstream acceptance.

¹⁵ See John Frank Weaver, *We Need to Pass Legislation on Artificial Intelligence Early and Often*, Future Tense, The Citizen’s Guide to the Future (2014), available at: http://www.slate.com/blogs/future_tense/2014/09/12/we_need_to_pass_artificial_intelligence_laws_early_and_often.html; Alina Selyukh, *FAA Expects 600,000 Commercial Drones In The Air Within A Year*, The Two-Way, available at: <http://www.npr.org/sections/thetwo-way/2016/08/29/491818988/faa-expects-600-000-commercial-drones-in-the-air-within-a-year>; for a list of state initiatives in the regulation of autonomous vehicles see Gabriel Weiner and Bryant Walker Smith, *Automated Driving: Legislative and Regulatory Action*, available at: cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action.

¹⁶ See e.g., Nevada State Law, NSR 482A.025 defines “Automated Technology” as: “. . . technology which is installed on a motor vehicle and which has the capability to drive the motor vehicle without the active control or monitoring of a human operator. The term does not include an active safety system or a system for driver assistance, including, without limitation, a system to provide electronic blind spot detection, crash avoidance, emergency braking, parking assistance, adaptive cruise control, lane keeping assistance, lane departure warning, or traffic jam and queuing assistance, unless any such system, alone or in combination with any other system, enables the vehicle on which the system is installed to be driven without the active control or monitoring of a human operator.” Further, under Nevada state law, NRS 482A.030 an “Autonomous vehicle” means a motor vehicle that is equipped with autonomous technology.

¹⁷ “Artificial Intelligence Litigation: Can the Law Keep Pace with the Rise of the Machines?” Quinn Emanuel Trial Lawyers, Quinn Emanuel Urquhart & Sullivan LLP, December 1, 2016, available at: <http://www.jdsupra.com/legalnews/artificial-intelligence-litigation-can-83824/>.

¹⁸ *United States v. Athlone Indus, Inc.* 746 F.2d 977 (3d Cir. 1984).

Not all machines driven by algorithms and analytical techniques raise issues which challenge established law. For instance, based on the actions of a machine whose task may require limited computational resources and repetition of motion, if a person is injured or property is damaged, the current body of law in tort is not particularly challenged, such disputes are successfully litigated under theories of negligence, products liability, or often resolved on technical issues of civil procedure. *Behurst v. Crown Cork & Seal USA, Inc.*,¹⁹ revolved around an intentional tort action when a plaintiff was fatally injured after being trapped in the danger zone surrounding a robot. The court denied summary judgment to the employer (but granted summary judgment to the manufacturer) finding among others, that the employer's alleged refusal to reprogram the machine was an appropriate jury question in light of the tort claim. The robot in *Behurst* was designed to "unthinkingly" move metal from one die to another, but if roboticists design machines which exhibit creativity, have the ability to learn and engage in non-repetitive behavior, under current legal doctrine it may be difficult to assign liability to any human in the system.²⁰

An example of the above point is illustrated in the following case. A decision in a consolidated class action in the District Court for the Eastern District of Missouri, found that the use of a computer program to simulate human interaction with a bot could give rise to liability for fraud. The claims in *In re Ashley Madison Customer Data Sec. Breach Litig.*²¹ related to a data breach on the "Ashley online dating site" that resulted in mass dissemination of user information. The allegations were that defendants were engaging in deceptive and fraudulent conduct by creating fake computer "hosts" or "bots" which were programmed to generate and send messages to male members under the guise they were "real woman", inducing members to make purchases on the website. It was estimated that 80 percent of initial purchases on the website were conducted by users communicating with a bot. I should note that the bot was controlled by algorithms, the backbone of artificial intelligence.

A. Early Thoughts on a Law of Artificial Intelligence

Except for Isaac Asimov's three laws of robotics discussed in his 1942 short story "Runaround", it is only recently that there has been an interest in developing a body of law that applies to increasingly smart technologies which are improving under the direction of artificial intelligence.²² In fact, several decades after Asimov's laws of robotics, when expert systems began to emulate the decision-making abilities of human experts, the issue of liability for artificially intelligent systems began to be discussed within the

¹⁹ *Behurst v Crown Cork & Seal USA, Inc.*, 2007 U.S. Dist. ELXIS 24922 (D.Ore.Mar.30, 2007). 203 P.3d 207, 346 Or. 29, 2009.

²⁰ Karnow, *supra* note 59.

²¹ *In re Ashley Madison Customer Data Sec. Breach Litig.*, 148 F. Supp. 3d 1378, 1380 (JPML 2015).

²² However, close examination of Asimov's Three Law of Robots indicates that they apply equally if not more so to artificial intelligence. "A robot may not injure a human being or, through inaction, allow a human being to come to harm. A robot must obey orders given it by human beings except where such orders would conflict with the First Law. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law."

legal community.²³ But perhaps the paper published in 1992 by Lawrence Solum on whether an artificial intelligence could be considered a “legal person” was key to generating interest in the field.²⁴ The same year the launch of the *Journal of Artificial Intelligence and Law* revealed an interest among legal scholars and computer scientists to discuss how legal reasoning could be modeled and codified.²⁵ Still, to date, there hasn’t been enough attention among legal scholars or legislators to develop a broad-based body of law to account for advances in artificial intelligence. I propose that the time to do so is now, and that the chapters in this book represent the beginning discussion on an emerging legal doctrine which will form the framework for a law of artificial intelligence.

As developments in artificial intelligence continue, based on the flexibility of its techniques, artificial intelligence is becoming a core technology in many industries ranging from ecommerce, robotics, factory automation, medical diagnosis, virtual worlds, and numerous consumer applications. The flexibility of artificial intelligence is also allowing its techniques to deviate from predetermined rules, and to be used for purposes other than its original intentions and design; this is leading to a diffusion of the technology into society far beyond that of other emerging technologies. According to computer scientist and artificial intelligence expert Michele Zhou three characteristics of artificial intelligence have contributed to its recent spread throughout society, these include: recognition intelligence in which pattern recognition algorithms are used to detect edges and lines in scenes; cognitive intelligence in which algorithms are used to make inferences from the analysis of scene data; and ambitiously, the creation of virtual humans.²⁶ The first two characteristics when combined with deep learning techniques allow a level of autonomy among systems that is beginning to challenge established legal doctrine in many areas of law. But this is to be expected given that much legal doctrine which is applied to systems operating with artificial intelligence were enacted in an age of “low-tech” and non-autonomous machines, that is, before techniques in artificial intelligence were beginning to be used for a wide range of applications. Therefore, given the growing number of applications which use artificial intelligence, when regulating the next transformative technology legislators would be prudent to enact a set of rules which cut across diverse technologies that rely on the same underlying principles of artificial intelligence to act upon the world and to challenge different areas of law. More specifically, a body of law regulating artificial intelligence given its potential to harm humans, engage in commercial activities as an independent agent, and violate criminal law statutes, needs to be developed.

²³ See Marguerite E. Gestner, *Liability Issues with Artificial Intelligence Software*, Vol. 33 (1), SANTA CLARA L. REV., 239–69 (1993) (discussing who is liable when artificial intelligence is involved in a system failure); Michael C. Cemignani, *Product Liability and Software*, 8 RUTGERS J. COMPUTERS, TECH. and L. 173 (1981); G. Steven Turhill, *Legal Liabilities and Expert Systems*, AI Expert, (Mar. 1991) 44, 48.

²⁴ Lawrence B. Solum, *Legal Personhood for Artificial Intelligences*, 70 N.C. L. Rev. 1231 (1992) (the central question of whether personhood rights should be awarded to artificial intelligence is discussed).

²⁵ See e.g., T. J. M. Bench-Capon and F. P. Coenen, *Isomorphism and Legal Knowledge Based Systems*, Artificial Intelligence and Law, Vol. 1, 65–86, (1992)

²⁶ See generally, Om Malik, *The Hype—and Hope—of Artificial Intelligence*, The New Yorker (2016), at: <http://www.newyorker.com/business/currency/the-hype-and-hope-of-artificial-intelligence>.

B. How Soon Does the Future Get Here?

Many assume rightly that it is difficult to make predictions about the future direction of technology and when major advances may occur. However, what if information technology has been following an exponential rate of growth for some time such that one can accurately predict where computing power will fall on the curve, even a few decades away? Still, who would have predicted just a few decades ago that computers equipped with neural net algorithms could learn, solve problems, and exhibit creativity in music and art? Further, who would have predicted that computers with artificial intelligence would beat Jeopardy champion Ken Jennings; and that Ken would exclaim that he welcomed his new computer overlord?²⁷ Similarly, world chess champion Garry Kasparov in losing to IBM's Big Blue computer commented that he saw deep intelligence in the machines moves.²⁸ And who would have predicted that in 2016 Google's DeepMind learning algorithm AlphaGo would defeat one of the world's premier players of the ancient strategy game of Go in what was then considered to be one of the hardest challenges for artificial intelligence yet?²⁹ But soon after, an artificially intelligent computer designed by computer scientists beat experts in the game of poker which required the ability to bluff and to predict whether the opponent was bluffing based on incomplete knowledge of the advisory's hand.³⁰ Of course, while impressive examples of skilled behavior, these are examples of artificial intelligence performing in a narrow domain of expertise; at this time more human-like artificial intelligence remains elusive.

Outside of game shows, commentators have observed that machines driven by artificial intelligence are beginning to displace people from jobs in various industries and at an accelerating pace. Driverless cars, automated factories, and automated laboratories are based to a large extent on techniques of artificial intelligence capable of thinking, writing, creating, or even diagnosing disease. So, how far along are we towards developing artificial intelligence that will have the capability to fully engage our legal system as entities stressing the law or deserving of rights? This is a question which has generated much discussion among scholars producing a range of opinions. According to Yale's Jack M. Balkin "we are still a long way from treating robots and AI agents as self-conscious rights-bearing or responsibility-bearing entities."³¹ For this reason Professor Balkin argues that

²⁷ Watson wins 'Jeopardy!' finale; Ken Jennings welcomes 'our new computer overlords', 2011, available at: <http://latimesblogs.latimes.com/showtracker/2011/02/watson-jeopardy-finale-man-vs-machine-showdown.html>; John Markoff, *Computer Wins Jeopardy: Trivial, It's Not*, N.Y. Times, Feb. 16, 2011 at A1; In 2016 an AI platform predicted the Kentucky Derby first-, second-, third, and fourth-place order at 540- odds.

²⁸ Jennifer Latson, 2015, *Did Deep Blue Beat Kasparov Because of a System Glitch?* Time; available at: <http://time.com/3705316/deep-blue-kasparov/>; Glynn Washington, *Kasparov v. Deep Blue*, North Carolina Public Radio, 2014 available at: <http://www.npr.org/2014/08/08/338850323/kasparov-vs-deep-blue>.

²⁹ John Riberio, 2016, *Google's AlphaGo defeated in fourth Go game by South Korean player*, PC World, available at: <http://www.pcworld.com/article/3043603/analytics/googles-alphago-defeated-in-fourth-go-game-by-south-korean-player.html>.

³⁰ Katie Callahan, *AI Beats Poker Pros in 'Brains vs. AI' Event*, available at <https://www.pokernews.com/news/2017/01/poker-ai-beats-the-pros-26990.htm>.

³¹ Jack Balkin, *The Path of Robotics Law*, 6 CAL. L. REV. CIRCUIT, 45 (2015).

one of the central issues for a law of robotics is “to allocate rights and duties among human beings when robots and AI entities create benefits or cause harms.”³² I believe we should extend this observation to other technologies equipped with artificial intelligence, but eventually the focus of the discussion will need to be on allocating rights between humans and artificially intelligent systems that have reached human levels of intelligence and that argue for many of the rights afforded natural people under laws, statutes, and constitutions. Additionally, discussing how soon we might expect artificially intelligent robots (which I view more as an application of artificial intelligence), Neil Richards and William Smart, commenting in *How Should the Law Think about Robots?* concluded that while “robots have not yet reached the levels of complexity the public associates with science fiction . . . they are surprisingly close.”³³ In a similar observation, Patrick Hubbard noted that “. . . in the next decade or so, a new class of ‘sophisticated robots’ will emerge by nature of their increased autonomy and intelligence.”³⁴

Since several artificially intelligent systems are already equal to humans in performance in a surprising range of tasks and are becoming superior to humans in a growing list of skills that were once considered beyond the scope of artificial intelligence, artificial intelligence does seem to be headed in the direction of human levels of intelligence. But, of course, there is a raging debate among artificial intelligence researchers, philosophers, and scientists as to when, or if, artificial intelligence will equal humans in general intelligence. We will not solve that debate through legal scholarship, nor will we make a major contribution to another controversial issue within the artificial intelligence community—that of machine sentience which if achieved by artificial intelligence would lead a rigorous debate on the granting of personhood status and constitutional rights for artificially intelligent entities.³⁵ However, if artificial intelligence were capable of creative and inventive activity, then the question becomes—why shouldn’t intellectual property and other rights be accorded to the artificially intelligent entity? These questions raise issues that go to the very foundations of constitutional rights and intellectual property law, including the economic incentive to encourage certain activities, and the “moral rights” associated with according credit to authors.

I should note that autonomy and intelligence are both characteristics of what artificial intelligence affords a system, and by Patrick Hubbard’s estimation, robots that are more autonomous than current versions are just around the corner.³⁶ Law and robotics expert Ryan Calo seems to go even further in speculating about the use of artificial intelligence when he states: “But the processing capabilities of robots translate to the tantalizing

³² *Id.* at 46.

³³ Neil Richards and William Smart, *How Should the Law Think About Robots?* (May 10, 2013), SSRN: <http://ssrn.com/abstract=2263363> or <http://dx.doi.org/10.2139/ssrn.2263363>.

³⁴ Hubbard, *supra* note 8; autonomy is a complicated concept that incorporates multiple meanings. It is a term that invokes self-rule, self-determination, and self-sovereignty.

³⁵ Junichi Takeno, *Creation of a Conscious Robot: Mirror Image Cognition and Self-Awareness*, Pan Standard Publishing (2012); John Brockman, *What to Think About Machines That Think: Today’s Leading Thinkers on the Age of Machine Intelligence*, Harpers Perennial (2015); M. E. Tson, *From Dust To Descartes: An Evolutionary and Mechanical Explanation of Consciousness*, Amazon Digital Services, Inc. (2009).

³⁶ Hubbard, *supra* note 8.

prospect of original action.”³⁷ But to some extent, I also agree with Professor Calo’s view that developing human-like artificial intelligence that comes close to mimicking human levels of general intelligence remains elusive, and unpredictable as to whether it will happen, or when. For artificial intelligence to progress towards human levels of intelligence, improvements in algorithms and more robust software will have to be made. Can we expect such improvements to occur within the next few decades? If yes, artificial intelligence as a subject within law and as a technology to be regulated by government agencies and by industry standards seems appropriate.

Most researchers agree that for artificial intelligence to more fully develop it is necessary for artificial intelligence to have access to greater computational resources. Gordon E. Moore observed as far back as 1965 that computer power was doubling approximately every two years. Over 50 years later, China’s Sunway Taihulight supercomputer operates at around 100 quadrillion cps; and exaflop computing (i.e., 10^{18}) is just beyond the horizon. In comparison, the raw processing power of the human brain while not known is based on approximately 85–100 billion neurons with 100 trillion synapses, with the cell’s dendrites and cell body both performing computations and functioning as an analog digital computer.³⁸ An interesting aspect of Moore’s law for innovation in general is that advances in artificial intelligence seem to be operating under a feedback process which creates accelerated returns.³⁹ So interestingly, while human information processing and cognitive abilities are fixed by biology, in contrast, the capabilities of artificial intelligence are not and are quickly improving. With additional computational resources, improvements in software, and the further development of neuromorphic chips,⁴⁰ I expect the autonomy and intelligence of artificially intelligent machines to correspondingly increase which will continue to significantly challenge established areas of law that historically has looked to humans as responsible parties in legal disputes.

In terms of postulating when artificial intelligence may reach human levels of intelligence, some argue that those who propose that artificial intelligence is improving in leaps-and-bounds, are “cheating” because they select a skill once thought solely within the domain of human expertise, then create an artificially intelligent entity that can do the same task equal to or better than a human expert.⁴¹ Rather than “cheating”, this is an example of the incessant progress being made in the advancement of artificial intelligence for skills once thought unapproachable for artificial intelligence. And if this is cheating, then there is an epidemic of cheating occurring within the artificial intelligence community as artificial intelligence is rapidly advancing in all aspects of society. But to

³⁷ Calo, *supra* note 9, at 532.

³⁸ Jason J. Moore et al., *Dynamics of Cortical Dendritic Membrane Potential and Spikes in Freely Behaving Rats*, Science, March 2017, DOI: 10.1126/Science.aaj1497.

³⁹ See generally Ray Kurzweil, *The Singularity is Near: When Humans Transcend Biology*, Penguin Books (2006).

⁴⁰ Robert H. Hof, Neuromorphic Chips, available at: <https://www.technologyreview.com/s/526506/neuromorphic-chips/>; IBMs DARPA funded SyNAPSE program to design neuromorphic brain inspired chips with 5.4 billion transistors each with 1 million neurons and 256 million synapses.

⁴¹ Jo Best, *IBM Watson: The Inside Story of How the Jeopardy-Winning Supercomputer Was Born, and What It Wants to Do Next*, TechRepublic, available at: <http://www.techrepublic.com/article/ibm-watson-the-inside-story-of-how-the-jeopardy-winning-supercomputer-was-born-and-what-it-wants-to-do-next/>.

some, once a milestone is reached by artificial intelligence, the bar is moved and the skill achieved is no longer considered indicative of intelligence. This sentiment led artificial intelligence pioneer John McCarthy to claim “as soon as it works, no one calls it artificial intelligence anymore.”⁴² Similarly, author Kevin Kelly observed: “What you can do now would be artificial intelligence fifty years ago. What we can do fifty years from now will not be artificial intelligence.”⁴³

Perhaps it is worth noting here author and futurist Ray Kurzweil’s predictions for the future given his seminal writings about the future of information technology and artificial intelligence.⁴⁴ Kurzweil lists 2029 as the date in which an artificial intelligence will pass a valid Turing test and therefore be considered to have achieved human levels of intelligence. Additionally, he lists the date 2045 for the “Singularity” which he claims is when we will multiply our effective intelligence a billionfold by merging with the artificial intelligence we have created. Kurzweil’s timetable for the singularity is consistent with other predictions of noted futurists—for example, those of Softbank CEO Masayoshi Son, who predicts that the dawn of super-intelligent machines will happen by 2047.

III. CONSIDERING THE BODY

Artificial intelligence, embedded in different bodies, controls numerous types of technologies that exert a presence in the world including industrial robots, automated machinery, home service robots, electronic agents that engage in real-world commerce, and virtual avatars.⁴⁵ However, as we transition into a digital economy and as we spend time in virtual reality, in many cases there is no physical body requirement for the intelligent entities we design and interact with, our alter ego may even exist as an artificially intelligent avatar.⁴⁶ Yet the same techniques of artificial intelligence that are creating intelligent machines that are beginning to offer challenges to established law, may also lead to disputes when virtual avatars are used as stand-in actors, as our digital assistants, or as tools for cyberhacking.⁴⁷

Professor Ryan Calo convincingly argues that robots pose interesting questions for law because they have a physical body (the element of “embodiment”) which allows them to act directly upon the world; but reemphasizing a point, artificial intelligence “occupies” not only the physical body of a machine such as a robot but other “kinds of bodies.” This

⁴² John McCarthy, ‘What is Artificial Intelligence? Basic Questions’, available at: <http://www-formal.stanford.edu/jmc/whatisai/model.html> (accessed May 20, 2016).

⁴³ Kevin Kelly, *The Inevitable: Understanding the 12 Technological Forces that Will Shape our Future*, Viking Press, 2016.

⁴⁴ Kurzweil, *supra* note 39.

⁴⁵ Lazaros Iliadis and Ilias Maglogiannis (eds), ‘Artificial Intelligence Applications and Innovations: 12th IFIP WG 12.5 International Conference and Workshops’, AIAI 2016, Thessaloniki, Greece, Springer Press, 2016.

⁴⁶ Woodrow Barfield, *Intellectual Property Rights in Virtual Environments: Considering the Rights of Owners, Programmers and Virtual Avatars*, 39 AKRON L. Rev., 649 (2006).

⁴⁷ See generally James J. Beard, Clones, Bones and Twilight Zones: Protecting the Digital Persona of the Quick, the Dead and the Imaginary, 16 BERKELEY TECH. L. J., 1165, (2001); *Cybersecurity and Artificial Intelligence: A Dangerous Mix*, Posted in General Security on February 24, 2015, available at: <http://resources.infosecinstitute.com/cybersecurity-artificial-intelligence-dangerous-mix/>.

leads to a greater range of applications for artificial intelligence (compared to technology such as robotics) which in turn leads to additional challenges to established areas of law. There are two observations which lead to this conclusion: first, as software, the code and algorithms of artificial intelligence can be copied and “implanted” within the “body” of many different kinds of machines and at zero cost per copy; and second, artificial intelligence can “exist” either embedded within the physical body of a machine, within the cloud, or as a virtual entity operating within cyberspace, this latter aspect of artificial intelligence results in a host of legal issues not directly relevant to machines which occupy physical space and predominantly manipulate physical objects.

As a broad generalization, we can think of machines as an analog technology and subject to the laws which apply to activities occurring in physical space and artificial intelligence as a digital technology which can control not only the actions of analog machines but of digital entities; this distinction is worth noting. Since the same software and algorithms that contribute to make machines “smart” similarly works to make objects within cyberspace smart; this suggests that a law of artificial intelligence will implicate more technologies than the law relating to machines and will reach not “just” the physical world but activities occurring in cyberspace. For example, in cyberspace, the question of whether an electronic agent that operates autonomously from humans can serve as a contracting party, whether products liability law applies to algorithms and software, and whether in the U.S. the Fourteenth Amendment is implicated by the use of algorithms engaging in alleged discriminatory practices are just a few issues of concern for a law of artificial intelligence.⁴⁸

Discussing the importance of embodiment for robotics, Professor Calo argues that a robot’s ability to sense, navigate, and act upon the world “generally requires a physical presence, and that physical presence opens up a universe of new possibilities.”⁴⁹ In other words, intelligence combined with a robotic body creates an entity with the ability to challenge legal doctrine. This observation follows historical developments in the law. For example, under common-law traditions, the law generally requires a body—and robotics provides a body. For instance, many tort actions are the result of a harm inflicted on a body, and with the exception of the legal personhood fiction established for corporations, historically, contracts are negotiated between people.⁵⁰ Additionally, discrimination law is built around the concept that people (not inanimate objects) are the subject of discrimination, and so too are hate crimes directed at natural people; numerous other examples could be given.⁵¹ However, artificial intelligence doesn’t need a physical body to “exist”, and even in the physical world, there are exceptions to the requirement for a body. For example, conviction for murder in the absence of a body is possible, but historically cases of this type have been hard to prove, forcing the prosecution to rely on other kinds of evidence, usually

⁴⁸ See Lori A. Weber, *Bad Bytes: The Application of Strict Products Liability to Computer Software*, 66 ST. JOHN’S L. REV. 66, Iss. 2, 469–85 (1992).

⁴⁹ Calo, *supra* note 9, at 532.

⁵⁰ The term “person” means an individual, corporation, business trust, estate, trust, partnership, limited liability company, association, joint venture, governmental agency, public corporation, or any other legal or commercial entity. Chapter 15 of the U.S. code on electronic signatures in global and national commerce.

⁵¹ Francis X. Shen, *Mind, Body, and the Criminal Law*, 97 MINN. L. REV., 2036 (2013).

circumstantial.⁵² The fact that artificial intelligence doesn't need to occupy a physical body raises a host of unique legal issues given that legal schemes have predominately evolved to account for the activities of avatars that occur in the physical world.

Regardless of the element of embodiment, the very structure of artificial intelligence as software and algorithms raises significant issues for artificial intelligence that are independent of those associated with smart machines that exert a physical presence in the world. For example, under tort law, the provider or distributor of software is liable for harm caused by software errors.⁵³ A fatal accident resulting from the use of an autonomous vehicle also illustrates the above point.⁵⁴ A Tesla Motors Model S driving in Autopilot mode was on a divided highway with Autopilot engaged when a tractor trailer drove across the highway perpendicular to the Model S.⁵⁵ Neither Autopilot nor the driver noticed the white side of the tractor trailer against the backdrop of a brightly lit sky, so the brake was not applied and the driver of the autonomous vehicle was killed.⁵⁶ Given that the error was one of machine vision, I view this as a case dealing with artificial intelligence whose algorithms failed to discriminate objects in the foreground from background. For the concept of embodiment, a point to make is when a machine damages property or harms a human, the physical features of the machine may not be the most direct cause of the accident, or to use the terminology of tort law, the proximate cause of the injury, instead the accident may be caused by the software and algorithms controlling the system.⁵⁷ For example, in *Payne v. ABB Flexible Automation, Inc.*, a robot crushed a worker in its cell resulting in an action in tort. While this is considered a "classic" robot case resulting in a fatality,⁵⁸ the court heard arguments on whether the robot's software was a causative factor in the accident, holding, *inter alia*, that the plaintiff failed to provide evidence that a programming error was a proximate cause of the worker's injuries. So, in *Payne* the issue of liability would have turned on the robot's software had it malfunctioned, this reinforces a central point made throughout this Chapter, that the software and algorithms directing a machine's behavior are challenging current legal doctrine more so than any other feature of the machine's design. Upon closer examination of industrial accidents, I believe many cases that involve robots and automated machinery in general, actually turn

⁵² See Gowri Ramachandran, *Assault and Battery on Property*, 44 LOY. L.A. L. Rev., 253–76 (2010). The United States case of *People v. Scott* held that "circumstantial evidence, when sufficient to exclude every other reasonable hypothesis, may prove the death of a missing person, the existence of a homicide and the guilt of the accused." Assault and battery is normally predicated on an act committed on the person, or in some cases, an extension to the body.

⁵³ Meiring De Villiers, *Virus Ex Machina Res Ipsa Loquitur*, STAN. TECH. L. Rev. 1 (2003).

⁵⁴ Danny Yadron and Dan Tynan, 2016, *Tesla Driver Dies in First Fatal Crash While Using Autopilot Mode*, The Guardian, available at: <https://www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk>.

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ Donald R. Ballman, *Commentary: Software Tort: Evaluating Software Harm by Duty of Function and Form*, 1996 / 1997, 3 CONN. INS. L.J. 417; Bob Gomulkiewicz, *Software Law and Its Applications* (Aspen Casebook) Wolters Kluwer Law & Business (January 7, 2014).

⁵⁸ *Payne v. ABB Flexible Automation, Inc.*, 1997 U.S. App. LEXIS 13571 (8th Cir. Jun. 9, 1997) (per curiam unpublished opinion). 116 F.3d 480, No. 96-2248, 1997 WL 311586, *1-*2 (8th Cir. 1997) (per curiam) (unpublished table decision) (affirming summary judgment in favor of defendant on claim of design defect).

on the machine's programming including the algorithms directing its behavior. Thus, I conclude that the regulation of machines that are becoming smart should revolve around the behavior afforded the machine by its software and particularly the algorithms and analytical techniques of artificial intelligence controlling the machine's behavior.

IV. MACHINES WITH AUTONOMY

Many technologies involving smart machines are becoming autonomous and independently determining the solutions they use to solve problems and achieve goals in ways that are often not predictable beforehand by humans.⁵⁹ It is the unpredictable solutions to problems and in some cases the self-programming aspect of deep learning techniques, which take humans out of the feedback loops of a system and therefore raise interesting questions for the law to consider. For example, according to Jack M. Balkin, "the problem of emergence is the problem of who we will hold responsible for what code does."⁶⁰ I agree, the problem of holding code responsible for the actions it produces, is synonymously the problem which results from the use of artificial intelligence that has the ability to learn and change its behavior in unpredictable ways as it interacts with the world.

Judge Curtis Karrow of the California Superior Court, discussing characteristics of machine learning, observed that the challenge to legal doctrine brought forth by machines with true autonomy involves self-learning in which the program does not simply apply a human-made heuristic, as with the Roomba, but generates its own heuristics.⁶¹ This aspect of machine performance, which is dependent on software and algorithms to generate its own solutions, allows systems to solve problems in ways *a priori* unknown to humans. The more autonomous the system, that is, the more the human is removed from the decision-making loops of the system, the more difficult for courts to assign liability to humans when there is a system failure.⁶² Regardless, the technological trend is clear, based on emerging techniques of artificial intelligence, robots and other "smart technologies" that will become smarter and even more autonomous in the near future.⁶³ But more

⁵⁹ See generally, Curtis Karrow, *The Application of Traditional Tort Theory to Embodied Machine Intelligence*, The Robotics and Law Conference, Center for Internet and Society, Stanford Law School, 2013; to perform unpredictably, models may optimize rules by mimicking the Darwinian Law of survival of the fittest. A set of rules is chosen from those that work the best. The weakest are discarded. In addition, two successful rules can be combined (the equivalent to genetic cross-overs) to produce offspring rules. The offspring can replace the parents, or they will be discarded if less successful than the parents. Mutation is also accomplished by randomly changing elements. Mutation and cross-over occur with low probability, as in nature, available at: <http://www.nasdaq.com/investing/glossary/a/genetic-algorithms>.

⁶⁰ Balkin, *supra* note 31, at 52.

⁶¹ Karrow, *supra* note 59.

⁶² *Id.*

⁶³ One of the most consequential pieces of news for artificial intelligence from the U.S. in early 2017 was the California Department of Motor Vehicles and made available on the DMV's website. It details the efforts of Google (or more precisely its Waymo subsidiary) to make autonomous driving a reality. According to the report, in 2016 Google's self-driving cars clocked 635,868 miles (1,023,330km), and required human intervention 124 times. That is one intervention about every 5,000 miles (8,047km) of autonomous driving. But even more impres-

autonomous machines are seen as a positive development by some, prompting Professor F. Patrick Hubbard to conclude that “severe limits on autonomy drastically reduces the usefulness of robots.”⁶⁴

The use of autonomous systems directed by artificial intelligence can lead to significant challenges to current legal doctrine especially when the human operator is required to share control of the system. I view early developments in automation as a precursor for emerging applications of artificial intelligence and as an example of how established law will more and more be challenged by techniques of artificial intelligence. In fact, common law claims involving automated technology can be analyzed to provide a framework for the developing jurisprudence with regard to artificial intelligence technology. Consider an early wrongful death case involving the joint control of an airplane by human and machine. In *Brouse v. United States*,⁶⁵ the court held that a pilot had the duty to be vigilant to prevent air-to-air collisions even if the plane was flying under “robot control.” Here the use of “automation” (albeit a rudimentary form of automation) did not absolve the pilot from liability, instead the court attributed error to the pilot rather than to the design of the auto-pilot feature of the plane. In *Brouse*, the court indicated that people have the responsibility to monitor automated systems or risk being held accountable if they do not.⁶⁶ However, as artificial intelligence becomes more autonomous, it will become more difficult for humans to monitor systems controlled by artificial intelligence, on this point attorney Andrew Selbst comments that algorithms must reveal their basis for decision-making.

A more recent case of a human-machine combination involving a complex task revolved around the use of a robotic surgeon. In *Mracek v. Bryn Mawr Hosp.*,⁶⁷ after a da Vinci robot malfunctioned, the human surgeons completed the procedure laparoscopically, and after suffering post-surgery injuries the patient sued the robot manufacturer stating claims of strict products liability, strict malfunction liability, negligence, and breach of warranty.⁶⁸ The Third Circuit affirmed the lower court’s decision of summary judgment stating that the plaintiff failed to introduce evidence that the robot was responsible for his injury or that a rational finder of fact could find in his favor.⁶⁹ In future disputes, the failure to use a robotic surgeon may be a factor considered by juries in

sive is the progress in just a single year: human interventions fell from 0.8 times per thousand miles to 0.2, which translates into a 400% improvement. With such progress, Google’s cars will easily surpass my own driving ability later this year, available at: <http://www.bbc.com/future/story/20170309-the-last-things-that-will-make-us-uniquely-human>.

⁶⁴ Hubbard, *supra* note 8 (addresses the issue of whether the current liability and regulatory systems provide a fair, efficient method for balancing the concern for physical safety against the need to incentivize the innovation that is necessary to develop these robots.); *see also* F. Patrick Hubbard, *Do Androids Dream?: Personhood and Intelligent Artifacts*, 83 TEMP. L. REV. 405 (2011).

⁶⁵ *Brouse v. United States*, 83 F.Supp. 373 (N.D. Ohio 1949) (holding that operator of a plane “under robot control” was negligent in failing to “keep a proper and constant lookout” for other planes).

⁶⁶ *Id.*

⁶⁷ *Mracek v. Bryn Mawr Hosp.*, 2010 U.S. App. LEXIS 2015 (3d Cir. Jan. 28, 2010) (unpublished opinion).

⁶⁸ *Id.*

⁶⁹ *Id.*

determining liability, and whether humans have a duty of care to avoid an accident, even after delegating some of the operation to a robot or more generally to a system operating with artificial intelligence. On this point, a statute regulating autonomous automobiles operating in the District of Columbia, requires a human driver to be “prepared to take control of the autonomous vehicle at any moment.”⁷⁰ As artificial intelligence controls more and more of the systems that represent the infrastructure of society a broadly-based body law regulating artificial intelligence will be necessary.

Discussing law in an age of advanced technologies, Judge Karnow describes one type of smart technology, “autonomous robots”, as “software that teaches itself by running experiments, or making other sorts of real or virtual attempts for a solution, correcting for error and approximating a result which it then implements.”⁷¹ These aspects of an autonomous system have the potential to solve problems using solutions unknown to a human in the decision-making loop, thus raising the question of whether the autonomous machine or human is in control and therefore responsible for any harm that may come to property or people. Consider, *Bookout v. Toyota Motor Corp.*,⁷² a case which involved a wrongful death action following a fatality from a sudden acceleration of a Toyota Camry, here the court looked to the role of software as a possible system defect, discussing among others whether the software controlling the system could be considered a causative factor in the accident. During the trial, experts for the plaintiff testified that Toyota’s electronic throttle source code was defective, and that a single bit flip could cause the driver to lose control of engine speed. After a jury verdict in favor of the plaintiff, the case was settled.⁷³ Gary Merchant and Rachel Lindor, writing about autonomous vehicles and the issue of assigning liability, argue that with a malfunction, it would usually be a programming error or system failure that caused the accident, which would then implicate several potentially liable parties.⁷⁴ Additionally, the potential of system failures that may result from errors related to algorithms can also lead to product recall alerts issued by the government, or voluntary product recall by manufacturers. A recent example illustrates the latter point—Toyota decided to recall Priuses based on a software error that allegedly caused their gas-electric hybrid systems to shut down.⁷⁵

⁷⁰ See District of Columbia B19-0931, Autonomous Vehicle Act of 2012.

⁷¹ Karnow, *supra* note 59.

⁷² *Bookout v. Toyota Motor Corp.*, County District Court Bookout v. Toyota Motor Corp., CJ-2008-7969, District Court, Oklahoma County, Oklahoma (Oklahoma City); Margaret Cronin Fisk, *Toyota Settles Oklahoma Acceleration Case After Verdict*, 2013, available at: <http://www.bloomberglaw.com/news/articles/2013-10-25/toyota-settles-oklahoma-acceleration-case-after-jury-verdict>.

⁷³ Gary E. Merchant and Rachel A. Lindor, *The Coming Collision Between Autonomous Vehicles and the Liability System*, 52 SANTA CLARA L. REV. No. 4., 1321–40, 1326. (2012).

⁷⁴ Merchant and Lindor, *Id.*; Sven A. Beiker, *Legal Aspects of Autonomous Driving*, 52 SANTA CLARA L. REV. 1145 (2010).

⁷⁵ Hiroko Tabuchi and Jaclyn Trup, *Toyota Recalls Newest Priuses Over Software*, NY Times (Feb. 12, 2014), available at: http://www.nytimes.com/2014/02/13/business/international/toyota-issues-another-recall-for-hybrids-this-time-over-software-glitch.html?_r=0.

V. INTENT, MENS REA, AND THE PROBLEM WITH DEFINITIONS

Consider an example with robots in which algorithms provide a robot's grippers the force profile for a particular task. By this brief description, we can foresee that the algorithms could direct the robot to exert too much force (the *actus reus*) and damage property or injure a human. If the algorithm had the capacity to independently learn various force profiles to use for different objects and materials, can we look directly at the robot's software and algorithms to determine its mental "state of mind" at the time when a particular gripping act occurred? That is, in a civil or criminal dispute, could the lines of code determining the amount of force applied to an object, provide circumstantial evidence of the mental frame-of-mind or *mens rea* of the artificial intelligence controlling a machine?⁷⁶ Under current legal doctrine, if the code was written by a programmer, with no new software or algorithms contributed by the artificial intelligence, courts would look to the programmer or the programmer's employer as the responsible party. But considering the fact that recent techniques of artificial intelligence can learn from experience and change their code, the ability to look directly at an entity's code as a source of evidence in legal disputes would be a new development in the law and would arguably implicate the self-incrimination clause of the Fifth Amendment, privacy law, the First Amendment's free speech prong, and procedurally the Federal Rules of Evidence.⁷⁷

For this discussion, consider a specific law: under the Model Penal Code simple assault is the most common crime against the person and is expressed as: "a person is guilty of [simple] assault if he attempts to cause or purposively, knowingly or recklessly caused bodily injury to another."⁷⁸ Can an artificial intelligence be thought to have purposively, knowingly or recklessly caused bodily injury to another?⁷⁹ Will an examination of the software or algorithms associated with artificial intelligence allow intent to be determined? For a criminal action which involves a human defendant, in determining *mens rea* we currently do not have the technology to record the individual firing pattern of a person's neurons to directly discern their intent (at the level of neurons) at the time a crime was planned or committed; intent is often deduced by circumstantial evidence. However, not unlike accessing code, according to neuroscientists in the near future we may be able to directly record neuronal activity and thus reproduce components of a person's thought processes.⁸⁰ On that point, Duke University law professor Nita Farahany argues that the neuroscience revolution poses profound challenges for constitutional law and specifically current self-incrimination doctrine, which she argues exposes a deep conceptual confusion

⁷⁶ Ryan Calo, *When A Robot Kills is it Murder or Products Liability?* Slate, available at: http://www.slate.com/articles/technology/future_tense/2016/04/a_robotics_law_expert_on_paolo_baciga_lupi_s_mika_model.html.

⁷⁷ See, e.g., John Frank Weaver, *We Need to Pass Regulation on Artificial Intelligence, Early and Often*, SLATE, Sept. 12, 2014, http://www.slate.com/blogs/future_tense/2014/09/we_need_to_pass_artificial_intelligence_laws_early_and_often.html.

⁷⁸ MODEL PENAL CODE § 211.1(1) (1981).

⁷⁹ See, e.g. *Schad v. Arizona*, 501 U.S. 624 (1991).

⁸⁰ Nita A. Farahany, *Incriminating Thoughts*, 64 Stanford Law Review 351–408 (2012).

at the heart of the doctrine.⁸¹ If artificial intelligence is granted the fiction of legal person status, the same confusion will occur when artificial intelligence is compelled to testify against itself.

In a seminal case involving the Fifth Amendment's self-incrimination doctrine, *Schmerber v. California*, the Court held that under the self-incrimination clause, no person shall be compelled to "prove a charge [from] his own mouth", but a person may be compelled to provide real or physical evidence, and a brain scan could be considered by the court as physical evidence.⁸² By analogy, would the court consider software and algorithms to be physical evidence of thought processes and will artificial intelligence be compelled to provide such evidence? That is, will a future artificial intelligence that operates autonomously from humans be compelled to prove a charge against itself in the form of a software download? Surely, this topic is relevant for a law of artificial intelligence especially if the legal fiction of personhood is granted to the artificially intelligent entity.

Interestingly, there is some precedence that future courts deciding disputes involving artificial intelligence will look for intent from the lines of code. For example, a Minnesota appeals court allowed encrypted software to be introduced as evidence of the defendant's intent⁸³ to possess pornographic images of minors in violation of a Minnesota Statute.⁸⁴ An undercover investigation discovered that the encryption software was used to change the extensions of files, allegedly to hide the true nature of the file.⁸⁵ Similarly, artificial intelligence could encrypt its communications to hide the content of its messages. For example, researchers from Google's brain division have demonstrated that neural networks can create their own encryption standard, and communicate between each other.⁸⁶ The learning algorithms do not require prescribing a particular set of cryptographic algorithms, nor indicating ways of applying these algorithms: it is based only on a secrecy specification represented by training objectives.⁸⁷

Additionally, current legislation in the area of encryption could apply to artificial intelligence. For example, the Health Insurance Portability and Accountability Act (HIPAA) requires certain healthcare providers to implement technical safeguards to guard against unauthorized access to electronic protected health information that is being transmitted over an electronic communications network, including encryption of data where appropriate. And further, under the Gramm-Leach-Bliley Financial Services Modernization

⁸¹ *Id.*

⁸² *Schmerber v. California*, 384 U.S. 757 (1966) (a landmark United States Supreme Court case in which the Court clarified the application of the Fourth Amendment's protection against warrantless searches and the Fifth Amendment privilege against self-incrimination for searches that intrude into the human body).

⁸³ See *State of Minnesota v. Ari David Levine Ct of Appeals* (2005), available at: <http://caselaw.findlaw.com/mn-court-of-appeals/1360182.html>.

⁸⁴ Minn. Stat. § 617.247, subd. 4(a) (2008).

⁸⁵ Appellant was charged with one count of disseminating pornographic work in violation of Minn. Stat. § 617.247, subd. 3(a) (2008) and one count of possession of pornographic work on a computer or other electronic device in violation of Minn. Stat. § 617.247, subd. 4(a). The district court found the appellant guilty of possession of child pornography.

⁸⁶ Roi Perez, 2016, *Artificial intelligence creates its own encryption*, available at: <https://www.scmagazineuk.com/artificial-intelligence-creates-its-own-encryption/article/570120/>.

⁸⁷ *Id.*

Act of 1999, financial institutions must follow the Safeguards Rule, which requires that they develop an information security plan to ensure the security and confidentiality of customer information. In addition, the Federal Trade Commission (FTC) recommends that institutions consider encrypting information that is transmitted. And the IT Control Objectives of Sarbanes-Oxley state that when appropriate, public companies should determine if encryption techniques are to be used to support the confidentiality of financial information sent from one system to another. The above rules aimed among others at the capabilities of software and algorithms, seem relevant for a law of artificial intelligence.

A. The Problem with Definitions

Recent techniques in machine learning involve techniques that enable computers to learn from experience, to learn by example, or to learn by principles of reinforcement. These are significant advances in machine learning that have occurred since the early days of artificial intelligence. However, legislators have not kept pace with advances in artificial intelligence, and courts have been inconsistent in deciding cases dealing with systems that display a degree of intelligence. To illustrate the latter point, compare two cases decided 20 years apart. A year after the first conference on artificial intelligence was held at Dartmouth College, a case decided in 1957 commented briefly on future capabilities of artificial intelligence. In *Arnold v. Reuther*, the dispute involved a driver who hit a pedestrian that had darted out in front of his car. The court held that the defendant driver did not have the “last clear chance” to avoid the accident, stating “A human being, no matter how efficient, is not a mechanical robot and does not possess the ability of a radar machine to discover danger before it becomes manifest.”⁸⁸ This raises the question—how would the court have decided the case if a “mechanical robot” had been used?

Twenty years after *Arnold* was decided, in *Pompeii Estates, Inc. v. Consolidated Edison Co. of N. Y., Inc.*,⁸⁹ a plaintiff brought a negligence claim against the defendant who used a computer to mail past due notices. The court stated that “Computers can only issue mandatory instructions—they are not programmed to exercise discretion” and thus could not act as a shield to relieve Consolidated Edison of its obligation to exercise reasonable care when terminating service. So, in *Arnold*, the court recognized that a machine could possess superior abilities to those of a human, while in *Pompeii Estates*, the computer system was deemed to lack the ability to exercise reasonable care. But more recent machines can engage in far more intelligent and autonomous behavior than both examples just given, which among others, will challenge the reasonable care scheme under tort law and create significant challenges to several other areas of established law. Thus, under tort law courts may have to raise the standard of care for machines with reaction times and sensors that are far superior to those of humans and that are controlled by artificial intelligence.⁹⁰

⁸⁸ *Arnold v. Reuther*, 92 Sp.2d 593 (La.Ct.App. 1957); Michael Negnevitsky, *Artificial Intelligence: a Guide to Intelligent Systems*, Addison Wesley, 2005.

⁸⁹ *Pompeii Estates, Inc. v. Consolidated Edison Co. of N. Y., Inc.*, 397 N.Y.S.,2d 577, 580 (N.Y. Cir. Ct. 1977).

⁹⁰ See generally, David C. Vladeck, *Machines Without Principals: Liability Rules and Artificial Intelligence*, 89 Wash. L. Rev. 117–50, 127, (2014).

For a future which will consist of artificially intelligent entities performing a range of tasks throughout society, one observation to note is that legislators tasked with regulating robotics, artificial intelligence, and other smart technologies will have difficulty defining with specificity the terms of art in each field. For example, within the research community there are numerous and often conflicting definitions used in the literature for the terms “robot”, “autonomous technology”,⁹¹ and “artificial intelligence”; thus, determining the subject matter and scope of regulation for emerging smart technologies will be a challenge for legislators and courts. As an example, New Jersey legislators have defined artificial intelligence as “. . . the use of computers and related equipment to operate a machine to duplicate or mimic the behavior of human beings.”⁹² Interestingly, there is no mention of algorithms or software, or any technique of artificial intelligence in the definition. Instead under the New Jersey definition, artificial intelligence is described in the context of “computers and related equipment”; however, neither standing alone are a form of artificial intelligence; this limited view of artificial intelligence will surely impact the usefulness of the definition for any dispute involving systems directed by artificial intelligence.

Further, compare the previously mentioned District of Columbia statute on autonomous vehicles in which the driver must be prepared to take control of the car,⁹³ to a California statute in which “autonomous technology” is defined as “technology that has the capability to drive a vehicle without the active physical control or monitoring by a human operator.”⁹⁴ Whether artificial intelligence should be allowed to drive automobiles without the possibility of human manual control is a major policy decision with challenging legal consequences. But legal scholars have also been inconsistent when using the terms artificial intelligence in their writings. For example, discussing the use of terminology, Judge Curtis Karnow stated that the term “robot is used indiscriminately to refer to a wide range of machines which exhibit, or are said to exhibit, some semblance of intelligence”.⁹⁵

A review of standard definitions indicates just how intertwined the terms used to describe smart technologies such as robotics and artificial intelligence are, although I argue they are different technologies (one primarily analog, the other primarily digital). Some definitions of artificial intelligence actually include robotics in the root of the definition itself, to wit, artificial intelligence is: “the collective attributes of a computer, robot, or other mechanical device programmed to perform functions analogous to learning and decision making.”⁹⁶ Further, a common definition of robotics states: “Robotics is one branch of artificial intelligence.”⁹⁷ Conversely, artificial intelligence pioneer Marvin

⁹¹ See *supra* note 16 for discussion of the terms “automated technology” and “autonomous vehicle”.

⁹² Definition of artificial intelligence, NJ Senate No 343, available at: http://www.njleg.state.nj.us/2016/Bills/A1000/851_I1.PDF.

⁹³ District of Columbia, *supra* note 70.

⁹⁴ California Statute SB 1298, defining autonomous technology.

⁹⁵ Karnow, *supra* n 59.

⁹⁶ *Definition of Artificial Intelligence*, The Free Dictionary, available at: <http://www.thefreedictionary.com/artificial+intelligence>.

⁹⁷ Vangie Beal, *Robotics*, webopedia, available at: <http://www.webopedia.com/TERM/R/robotics.html>.

Minsky indicated that “Artificial Intelligence is getting robots to do smart things.”⁹⁸ Still, others argue that a characteristic of emerging robotic behavior is autonomy, which is defined as “the state of existing or acting separately from others.”⁹⁹ To further complicate matters, artificial intelligence pioneer John McCarthy stated that there is no solid definition of artificial intelligence that doesn’t relate to human intelligence, and we still struggle to define human intelligence.¹⁰⁰ A point to make is that even though the technologies of smart machines (such as robots) and artificial intelligence are different, the terms are often used interchangeably in legal scholarship, which will add to the difficulty of determining how to regulate artificial intelligence.

Considering that artificial intelligence controls the performance of increasingly smart robots, autonomous machines, and more recently, intelligent virtual avatars,¹⁰¹ perhaps it would be useful for legal scholars and legislators to think of artificial intelligence as a superordinate category in comparison to robotics and other smart technologies that rely on algorithms and machine learning techniques to detect patterns in data, learn from experience, and to interact with the world. Such an approach should lead to legislators enacting laws regulating artificial intelligence that would reach a wide range of applications that rely on the same set of algorithmic techniques for their performance.

VI. HOW ARTIFICIAL INTELLIGENCE CHALLENGES ESTABLISHED LAW

The next section of the Chapter presents an overview of the increasing role of artificial intelligence in society as well as its challenges to established legal doctrine and policy. The main idea explored here is that artificial intelligence is a disruptive technology that is transforming many industries, and raising fundamental and challenging issues for the law to consider.¹⁰²

A. Agency Law

In artificial intelligence, among computer scientists, the term “agent” has a special meaning: an intelligent agent is an autonomous entity which observes the world through sensors and acts upon an environment using actuators and the agent directs its activity

⁹⁸ Marvin Minsky, TELEPRESENCE, OMNI magazine, June 1980, available at: <http://web.media.mit.edu/~minsky/papers/Telepresence.html>.

⁹⁹ Definition of “autonomy”, Merriam-Webster online dictionary, available at: <http://www.merriam-webster.com/dictionary/autonomy>.

¹⁰⁰ John McCarthy, *What is Artificial Intelligence?* John McCarthy’s Home Page, 2–3 (Nov. 12, 2007), available at: <http://www.formal.standard.edu/jme/whatisai.pdf> [<https://perma.cc/U3RT-Q7JK>].

¹⁰¹ See Hsinchun Chen and Yulei Zhang, *AI, Virtual Worlds, and Massively Multiplayer Online Games*, IEEE Intelligent Systems, 2011, available at: <https://ai.arizona.edu/sites/ai/files/MIS510/ai-virtual-worlds.pdf>.

¹⁰² See, e.g., John Frank Weaver, *We Need to Pass Regulation on Artificial Intelligence, Early and Often*, SLATE, Sept. 12, 2014, available at: http://www.slate.com/blogs/future_tense/2014/09/we_need_to_pass_artificial_intelligence_laws_early_and_often.html.

towards achieving goals in a rational manner. Intelligent agents may also learn or use knowledge to achieve their goals. It is not uncommon for an artificially intelligent agent to serve in an agency relationship with humans. The term “agent” also has a special meaning in legal doctrine. Under legal doctrine, the law of agency deals with a set of contractual, quasi-contractual and non-contractual fiduciary relationships that involve a person, called the agent, that is authorized to act on behalf of another, called the principal, to create legal relations with a third party. Succinctly, it may be referred to as the relationship between a principal and an agent whereby the principal, expressly or implicitly, authorizes the agent to work under his or her control and on his or her behalf. For a law of artificial intelligence, there are several issues which arise when the agent is a digital entity, such as an algorithm or analytic procedure.

Transactions by smart machines which legally bind a third party prompted David Vladeck from the Georgetown Law Center to state “. . . concepts of agency may be frayed, if not obliterated, by autonomous thinking machines, even those that are not truly ‘sentient’.” However, under statutory and common-law agency since an artificial intelligence lacks legal person status it cannot serve as a principal or agent.¹⁰³ Therefore, given the increasing autonomy of artificial intelligence, future courts will likely be tasked with deciding disputes involving artificial intelligence performing the duties of an agent but under current law lacking the legal capacity to serve as an agent. Consider the example of software that enters into transactions guided by algorithms.¹⁰⁴ Professor Deborah DeMott of Duke University indicates that from the “standpoint of common-law agency, a computer program is not capable of acting as a principal or agent because it is not a person that may itself hold legal rights and be subject to obligations.”¹⁰⁵ So too does the current generation of artificial intelligence lack legal person status and therefore the capacity to hold rights and be subject to legal obligations.¹⁰⁶ This observation raises the question—what is the “legal status” of artificial intelligence in the form of software and algorithms performing activities much as a human agent would?

Addressing this question, Professor Deborah DeMott commented that under the common-law of agency, an electronic agent is considered the “instrumentality” of the person who uses it.¹⁰⁷ Additionally, legislation concerning electronic agents is consistent with common-law agency; as under statutory agency law software is viewed as a tool.¹⁰⁸ For example, the official commentary to the Uniform Electronic Transactions Act (UETA) explicitly characterizes an “electronic agent” as a machine that is the tool of

¹⁰³ Vladeck, *supra* note 90.

¹⁰⁴ Deborah DeMott, *Defining Agency and Its Scope*, available at: http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=6101&context=faculty_scholarship; see also *Comparative Contract Law: A Tale of Two Legal Systems* (Martin Hogg and Larry A. DiMatteo eds., Oxford Univ. Press 2015).

¹⁰⁵ *Id.*

¹⁰⁶ And commenting on the legal status of artificial intelligence Professor Vladeck stated “. . . these machines, notwithstanding their sophistication, have no attribute of legal personhood.”

¹⁰⁷ DeMott, *supra* note 104.

¹⁰⁸ For example, Title 15 of the U.S. Code on Commerce and Trade, defines an “electronic agent” as “a computer program or an electronic or other automated means used independently to initiate an action or respond to electronic records or performances in whole or in part without review or action by an individual at the time of the action or response.”

the person who uses it, despite its ability to initiate or respond—within the limits of its programming—without further intervention by a person.¹⁰⁹ However, anticipating future advances in technology, the commentary does indicate that based on continuing “. . . developments in artificial intelligence, a computer may be able to learn through experience, modify the instructions of their own programs, and even devise new instructions.”¹¹⁰ The commentary goes on to say that “If such developments occur, courts may construe the definition of an electronic agent accordingly in order to recognize such capabilities.”¹¹¹ Thus, the UETA anticipates developments in artificial intelligence and acknowledges that the law will need to respond accordingly.

So, under current statutory and common-law of agency, an artificial intelligence consisting of software and algorithms, is viewed as an instrument, or tool, that is used by an agent who has legal capacity to enter into an agency relationship. But as artificial intelligence improves and makes decisions on its own, this analysis will prove inadequate. In fact, commenting on the future of autonomous machines Professor David Vladeck concluded “They will not be tools used by humans, they will be machines deployed by humans that will act independently of human instruction based on information the machine itself acquires and analyzes. . . .”¹¹² So if an artificial intelligence engages in behavior that was unforeseen, a byproduct of its ability to “think” and plan its own course of actions, who then is liable for its actions? Unless the law is willing to grant entities controlled by artificial intelligence with legal person status, such entities are beyond the law.

Under current tort law and particularly products liability and negligence, the failure of artificial intelligence to follow the instructions provided by a principal could in theory be attributed to a manufacturing, design, or programing error; compatible with Professor DeMott’s comments above, this analysis flows from the view of software as the “instrumentality” (or tool) of the person using it and with this analysis no liability is attributed to the artificial intelligence. However, the realization that the increasing autonomy and capabilities of artificial intelligence are beginning to stress different areas of law has prompted legal scholars to consider the issue of personhood for artificially intelligent systems. For example, Judge Curtis Karnow has indicated that a new legal fiction, “electronic personalities”, may usefully address conflicting interests to established law which are brought forth by the use of artificial intelligence.¹¹³ And in an early paper, Lawrence Solum explored whether an artificial intelligence could become a legal person under different legal doctrine and particularly whether an artificial intelligence could have legal capacity to serve as a trustee.¹¹⁴

If artificial intelligence is granted legal person rights, the rich body of case law developed for common-law agency could offer guidelines on how an artificial intelligence functioning as an agent would be viewed by courts. For instance, in *Taylor v. Roseville*

¹⁰⁹ Uniform Electronics Transactions Act (UETA), available at: http://www.uniformlaws.org/shared/docs/electronic%20transactions/ueta_final_99.pdf.

¹¹⁰ *Id.*

¹¹¹ UETA Official Commentary.

¹¹² Vladeck, *supra* note 90.

¹¹³ Curtis E.A. Karnow, *The Encrypted Self: Fleshing Out the Rights of Electronic Personalities*, 13 J. MARSHALL J. COMPUTER & INFO. L., 1 (1994).

¹¹⁴ Solum, *supra* note 24.

Toyota, Inc.,¹¹⁵ a California appeals court held that an employer could be liable for injuries caused by an employee while using a company car to run an errand. While there was no express permission to use the vehicle for this purpose, the jury found “ostensible authority”, that is, the authority that the principal, either intentionally or by lack of ordinary care, caused or allowed a third party to believe the agent possessed. This analysis is consistent with common-law agency, in which legal consequences stem from one person’s conduct attributed to another and with the imputation of the agent’s knowledge to the principal.

As with human agents, for artificial intelligence, much of the courts’ considerations on questions of agency will be based on specific fact patterns. For example, in *Commercial Bank v. Hearn*,¹¹⁶ a Mississippi court held that an employer is not liable on the theory of *respondeat superior* for a car accident caused by an employee who was engaged in charitable activities during work time as the activities were not a central part of the work duties. Under the Restatement (Third) of Agency,¹¹⁷ “An employee acts within the scope of employment when performing work assigned by the employer or engaging in a course of conduct subject to the employer’s control.”¹¹⁸ “An employee’s act is not within the scope of employment when it occurs within an independent course of conduct not intended by the employee to serve any purpose to the employer.”¹¹⁹ While it is difficult to envision artificial intelligence at this time deciding on its own to deviate from a task assigned to it by a principal, its algorithms could have considerable leeway to determine how to select a route or perform a task and therefore engage in activities unforeseen by the principal.

B. Antitrust Law

As another example of artificial intelligence challenging established law, consider that only a few “hi-tech” companies with strong commercial interests in artificial intelligence through their acquisitions, mergers, and active research laboratories are dominating the field of artificial intelligence.¹²⁰ This harbors worries about collusion and other monopolistic behavior, and raises the question of whether current antitrust law will be effective regulating the artificial intelligence industry.¹²¹ But more specifically, the functions of algorithms themselves could lead to contract violations. In fact, the role of algorithms in the context of antitrust law has already garnered interest from legal scholars such as Professors Maurice Stucke and Ariel Ezrachi (see their Chapter 24 in this book) who have observed that algorithms could result not only in collusion but in discriminatory pricing. From these observations, antitrust law is a rich example of an established body of law in

¹¹⁵ *Taylor v. Roseville Toyota, Inc.*, 138 Cal. App. 4th 994 (Ct. App., Calif., 2006).

¹¹⁶ *Commercial Bank v. Hearn*, 923 So.2d 202 (Sup. Ct., Miss., 2006).

¹¹⁷ Restatement (Third) of Agency, §7.07 (2006).

¹¹⁸ *Id.*

¹¹⁹ *Id.* (describing that a principal is subject to vicarious liability for an agent’s actions only when the agent is acting within the scope of employment).

¹²⁰ Such companies include Alphabet, Apple, Facebook, Microsoft, Amazon, and Alibaba.

¹²¹ Ezrachi, Ariel and Stucke, Maurice E., *Artificial Intelligence & Collusion: When Computers Inhibit Competition* (April 8, 2015). Oxford Legal Studies Research Paper No. 18/2015; University of Tennessee Legal Studies Research Paper No. 267, available at SSRN: <http://ssrn.com/abstract=2591874> or <http://dx.doi.org/10.2139/ssrn.2591874>.

the U.S. codified in the Sherman Antitrust Act and other federal and state statutes, that will be challenged by the use of algorithms and other techniques of artificial intelligence.

C. First Amendment Law

Another challenge to established law emanating from the use of artificial intelligence occurs when software and algorithms are used to produce speech spoken by machines and virtual entities such as avatars.¹²² Given how widespread speech technology is embedded within commercial products such as digital assistants, First Amendment doctrine for speech produced by algorithms is more and more becoming a topic of importance for a law of artificial intelligence. Under First Amendment speech doctrine, algorithms are a relatively unexplored area of jurisprudence but will become more important as artificial intelligence imbues more technology with the ability to understand, react to, and produce speech. For example, consider a machine programmed to produce, interpret, and understand speech. There are at least four aspects of artificial intelligence which create this level of performance: (1) speech recognition algorithms to detect speech; (2) natural language algorithms to understand what is spoken; (3) algorithms which control “execution”, that is, the ability to fulfill a spoken request; and (4) algorithms which allow the entity the ability to talk back to the speaker.

Law professors Toni M. Massaro and Helen Norton (see their Chapter 12 in this book) argue that computers equipped with speech producing algorithms are pushing First Amendment theory and doctrine in profound and novel ways.¹²³ In their words, “They are becoming increasingly self-directed and corporal in ways that may one day make it difficult to call the communication *ours* versus *theirs*.”¹²⁴ They indicate that this, in turn, “. . .invites questions about whether the First Amendment ever will (or ever should) cover AI speech or speakers even absent a locatable and accountable human creator.”¹²⁵ However, there is precedence that non-human entities may receive First Amendment protection for speech. In *Citizen United v. Federal Election Commission*, a case dealing with the regulation of campaign spending by organizations, the Court in a 5-4 decision held that freedom of speech doctrine prohibited the government from restricting independent political expression by a non-profit corporation.¹²⁶ The principles articulated by the Supreme Court in *Citizen United* have also been extended to for-profit corporations, labor unions and other associations.¹²⁷ Additionally, the Court has made some headway into the question of whether the output of an algorithm should be protected speech: in *Sorell v. IMS Health Inc.*, the Court concluded that the “creation and dissemination of information are speech for First Amendment

¹²² Stuart M. Benjamin, *Algorithms and Speech*, 161 U. PA. L. Rev. 1445–93 (2013).

¹²³ Massaro, Toni M. and Norton, Helen L., *Siri-ously? Free Speech Rights and Artificial Intelligence* (October 4, 2016). 110 Northwestern University Law Review 1169 (2016); Arizona Legal Studies Discussion Paper No. 15-29, available at SSRN: <https://ssrn.com/abstract=2643043>.

¹²⁴ *Id.* at 1169.

¹²⁵ *Id.*

¹²⁶ *Citizens United v. Federal Election Commission*, 558 U.S. 310 (2008).

¹²⁷ *Id.*

purposes.”¹²⁸ Additionally, under Chapter 15 of the U.S. code on electronic signatures in global and national commerce the term “information” means data, text, images, sounds, codes, computer programs, software, databases, or the like.

According to Professor Stuart Benjamin, Supreme Court jurisprudence provides for “very broad First Amendment coverage of speech, and the Court has reinforced that breadth in recent cases.”¹²⁹ Benjamin concludes that under the Court’s jurisprudence “the First Amendment (and the heightened scrutiny it entails) should apply to many algorithm-based decisions, specifically those entailing substantive communications.”¹³⁰

D. Commerce

Another area of importance for a law of artificial intelligence relates to the emerging digital economy of the twenty-first century.¹³¹ Given how widespread artificial intelligence is being used in business enterprises and for consumer applications, an important question is whether current legal doctrine is sufficient to account for systems engaging in transactions on behalf of humans and corporations in ways that are *a priori* unknown or predictable by humans.¹³² For example, a 2016 Stanford Business School White Paper on “Technological Disruption and Innovation in Last-Mile Delivery” emphasized how algorithms are being used to collect orders, monitor deliveries and supplies, determine optimum routes, and forecast demand for products.¹³³ And in the digital economy, artificial intelligence does even more: serving as shopping agents, recommender services, data mining of customer buying patterns, customer service help, auctions, negotiations, contracts, brokering, reputation services, promotions, advertising, procurement, and creating product catalogs.¹³⁴ From this list of applications, artificial intelligence is very likely to be involved in fundamental issues of commerce in terms of negotiating contracts, determining distribution routes, and so on, so just based on commercial transactions which occur yearly in the billions, artificial intelligence is challenging established law.¹³⁵

¹²⁸ *Sorell v. IMS Health Inc.*, 131 S.Ct. 2653, (2011) (the Court held that a Vermont statute that restricted the sale, disclosure, and use of records that revealed the prescribing practices of individual doctors violated the First Amendment.); 15 U.S.C. 96 – ELECTRONIC SIGNATURES IN GLOBAL AND NATIONAL COMMERCE.

¹²⁹ Benjamin, *supra* note 122, at 1445.

¹³⁰ *Id.* at 1447.

¹³¹ Hau L. Lee, Yiwen Chin, Barchi Gillai, and Sonali Rammohan, *Technological Disruption and Innovation in Last-Mile Delivery*, White Paper, Stanford Business School, 2016.

¹³² Calo, *supra* note 9.

¹³³ Lee et al., *supra* note 131.

¹³⁴ Papers from the AAAI Workshop, Tim Finin and Benjamin Grosz, Coauthors, available at: <https://www.aaai.org/Press/Reports/Workshops/ws-99-01.php>.

¹³⁵ Erik Brynjolfsson and Andrew McAfee, *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy* (Digital Frontier Press, 2012) (discussing how the digital revolution is accelerating and that digital technologies are rapidly encroaching on skills that used to belong to humans alone. This phenomenon is both broad and deep, and has profound economic implications. Many of these implications are positive; digital innovation increases productivity, reduces prices (sometimes to zero), and grows the overall economic pie.)

The role of algorithms and other techniques of artificial intelligence in contract law is another emerging subject for a law of artificial intelligence.¹³⁶ For example, in a case dealing with a software bot involving an internet advertising breach of contract claim, the court was asked to resolve a dispute over the meaning of “impressions”, a key term in internet advertising. In *Go2Net Inc. v. C L Host Inc.*,¹³⁷ the court determined that the parties’ contract permitted visits by search engines and other “artificial intelligence” agents in the advertiser’s count of impressions.¹³⁸ Here visits to the website by artificial intelligence were placed on an equal footing with human visits to the same website.

In a world of interconnected devices with artificially intelligent agents contracting on behalf of consumers, common-law agency principles, ecommerce statutes, common-law contract law, and Article 2 of the Uniform Commercial Code (UCC) are implicated by the use of artificial intelligence.¹³⁹ In fact, within the field of commerce there are numerous challenges to established legal doctrine based on the use of software and algorithms to conduct commercial transactions. For example, under the UCC a current topic of interest in contract law is whether algorithms and other techniques of artificial intelligence should be considered goods or a service. This is an important distinction as goods and services receive different treatment by the legal system, including different protections.

Whether an algorithm is considered as goods under the UCC has not been adequately addressed by courts or legislators, but courts normally consider software to be “goods”, which the UCC defines as “all things . . . which are movable at the time of identification to the contract for sale . . .”¹⁴⁰ However, algorithms often perform services such as searching the Internet to find the cheapest flight or shortest distance to reach a destination. As such, many commercial software vendors argue that their software is a service, and utilize licensing schemes to maintain control over their product. Complications may arise when product liability claims are directed to failures in software, as computer code has not generally been considered a “product” but instead thought of as a “service”, with cases seeking compensation caused by alleged defective software more often preceding as breach of warranty cases rather than product liability cases.¹⁴¹

Even though there is no dispute within the legal community that the purchase and sale of machines such as robots are “goods” under commercial law,¹⁴² in contrast, software and algorithms used for commercial transactions are something of a conundrum and present a challenge to established legal doctrine. Recalling that artificial intelligence is expressed in the form of code and algorithms, products liability involving computer software and the conditions under which software is covered by the UCC are issues which will be implicated by the use, sale, and licensing of artificial intelligence, and will

¹³⁶ A software bot, also referred to as a robot bot, or just bot, is a software routine or algorithm which typically runs automated tasks, thus is repetitive.

¹³⁷ *Go2Net Inc. v. C L Host Inc.*, 115 Wash. App. 73 (2003).

¹³⁸ *Id.*

¹³⁹ Uniform Commercial Code (UCC) § 2-105.

¹⁴⁰ *Id.*

¹⁴¹ See e.g., *Motorola Mobility, Inc. v. Myriad France SAS*, 850 F. Supp. 2d 878 (N.D. Ill. 2012) (case alleging defective software more often proceeding as breach of warranty).

¹⁴² Hubbard, *supra* note 8, at 1813.

challenge established legal doctrine as artificial intelligence improves and makes decisions independent of humans.¹⁴³

E. Discriminatory Practices by Algorithms

As another example of how artificial intelligence is beginning to challenge established legal doctrine consider the use of algorithms in areas given constitutional protection by federal statutes. For example, consider a machine-learning algorithm that is used by a company for employee hiring decisions.¹⁴⁴ Claire Miller notes that algorithms can reinforce human prejudices, and target unsuspecting populations.¹⁴⁵ On this point, the Federal Trade Commission commented that unscrupulous advertisers can use algorithms to target people living in low income neighborhoods with high-interest loans.¹⁴⁶

Generally, employment discrimination laws seek to prevent discrimination based on race, sex, religion, national origin, physical disability, and age by employers, all factors an artificially intelligent system using algorithms may consider when evaluating potential employees.¹⁴⁷ The wide body of statutory law enacted to prevent discriminatory practices could be triggered by the use of algorithms and thus would be relevant to a law of artificial intelligence. That the use of algorithms may result in discriminatory practices in situations protected by federal statutes will surely be an important issue for courts and legislators to consider as artificial intelligence proliferates into society.

When considering discriminatory practices, an area of interest for a law of artificial intelligence is employment law. As a basic question, if an algorithm discriminates against applicants based on race, gender, or age will the employer be liable under Title VII of the Civil Rights Act of 1964,¹⁴⁸ which prohibits employment discrimination based on race, color, religion, sex, or national origin; or be liable under the Equal Pay Act of 1963¹⁴⁹ which protects men and women who perform substantially equal work in the

¹⁴³ Lori A. Weber, *Bad Bytes: The Application of Strict Products Liability to Computer Software*, 66 ST. JOHN'S L.REV. No. 2, 1992, 469–85.

¹⁴⁴ Anupam Chander, *The Racist Algorithm?* 115 MICH.L.REV. 2017, Forthcoming; UC Davis Legal Studies Research Paper No. 498. Available at SSRN: <http://ssrn.com/abstract=2795203>.

¹⁴⁵ Claire Cain Miller, *When Algorithms Discriminate*, 2015, A version of this article appears in print on July 13, 2015, on page B1 of the New York edition with the headline: Algorithms May Echo Human Bias, Studies Find, available at: <http://www.ischool.berkeley.edu/newsandevents/news/presscoverage/2015-07-09-mulligan>.

¹⁴⁶ Nathan Newman, *The Cost of Lost Privacy: Consumer Harm and Rising Inequality in the Age of Google*, 40 W.M.MITCHELL.L.REV. (2014); *Federal Trade Commission, PrivacyCon, Part 3 Slides*, available at: <https://www.ftc.gov/news-events/events-calendar/2016/01/privacycon>; Amicus Curiae Brief of Center for Digital Democracy in Support of Respondent, *Spokeo v. Thomas Robins*, Supreme Court of the United States (discussing how the use of algorithms may discriminate and harm individuals), available at: <https://epic.org/amicus/spokeo/Center-for-Digital-Democracy-Brief.pdf>.

¹⁴⁷ Joel Friedman, *The Law of Employment Discrimination: Cases and Materials* (University Casebook Series) 9th edition, (Foundation Press 2013) (the casebook discusses major aspects of employment discrimination law, including legislative, administrative, and judicial developments); 42 U.S.C. §§ 1981, 1981a, 1983, 1988 – Nineteenth Century Civil Rights Acts.

¹⁴⁸ Title VII of the Civil Rights Act of 1967, 42 U.S.C. Chapter 21 – Civil Rights Act of 1964.

¹⁴⁹ 29 U.S.C. § 206 – Equal Pay Act of 1963.

same establishment from sex-based wage discrimination?¹⁵⁰ Further, in developing a law of artificial intelligence, will an algorithm be found to discriminate under the Age Discrimination in Employment Act of 1967,¹⁵¹ which protects individuals who are 40 years of age or older? Or could an algorithm be found to engage in discriminatory practices under Title I and Title V of the Americans with Disabilities Act of 1990,¹⁵² which prohibits employment discrimination against qualified individuals with disabilities in the private sector, state, and local governments? Additionally, would the use of algorithms in decision-making contexts trigger Sections 501 and 505 of the Rehabilitation Act of 1973,¹⁵³ which prohibits discrimination against qualified individuals with disabilities who work in the federal government; or more generally the Civil Rights Act of 1991,¹⁵⁴ which, among others, provides monetary damages in cases of intentional employment discrimination?¹⁵⁵ From the above list, it is clear that the use of artificial intelligence has the potential to challenge entire bodies of statutory law which relate to constitutional issues of equality; this important topic of law which could be challenged by the use of algorithms would seem to be a proper subject for a law of artificial intelligence and for legislative action.¹⁵⁶

F. Issues of Jurisdiction

The structure and form of artificial intelligence consisting of bits moving through the Internet could undermine certain assumptions that gave rise to the traditional model of jurisdiction which was articulated among others in *American Banana Company v. United Fruit Company*.¹⁵⁷ In *American*, the Court stated: “The character of an act as lawful or unlawful must be determined wholly by the law of the country where the act is done.” But of course, this “territorial-based view” of jurisdiction provides few guidelines for an Internet connected world and even less so for artificial intelligence moving throughout cyberspace.

In the 1980s courts began to face the challenge of applying long-standing principles of personal jurisdiction to a borderless communication medium that enabled individuals to instantaneously interact across state and international boundaries.¹⁵⁸ From *International*

¹⁵⁰ However, in such a situation, it is likely that the terms of an EULA would state the choice of law and jurisdiction for the contracting parties.

¹⁵¹ Age Discrimination in Employment Act of 1967.

¹⁵² Title I and Title V of the Americans with Disabilities Act of 1990, 42 U.S.C. Chapter 126 – Americans with Disabilities Act of 1990.

¹⁵³ Section 501 and 505 of the Rehabilitation Act.

¹⁵⁴ Civil Rights Act of 1991.

¹⁵⁵ Solon Borocas and Andrew D. Selbst, *Big Data's Disparate Impact*, 104 CAL L. REV. 671-29 2016.

¹⁵⁶ Cathy O’Neil, *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (Crown 2016) (discussing that algorithms being used today are opaque, unregulated, and uncontestable, and that they may reinforce discrimination).

¹⁵⁷ *American Banana Company v. United Fruit Company*, 213 U.S. 347, 356 (1909).

¹⁵⁸ See *Goodyear Dunlop Tires Operations, S.A. v. Brown*, 131 S. Ct. 2846, 2854–57 (2011); *Goodyear Dunlop Tires Operations, S.A. v. Brown and Daimler AG v. Bauman* (a company doing business on the Internet may be sued for any reason in the jurisdiction where it is “at home”, typically its place of incorporation. Because general jurisdiction is now quite limited, courts will often

Shoe Co. v. Washington, it was held that specific jurisdiction over a defendant could be established by a court only if he or she had “certain minimum contacts” which give rise to the action in question in the forum such that the exercise of jurisdiction “does not offend traditional notions of fair play and substantial justice.”¹⁵⁹ The question raised by legal scholars was whether geography-based laws of jurisdiction applied to the borderless boundaries of cyberspace. Similarly, would established law, such as *International Shoe*, be applicable if a person was subject to personal jurisdiction in a distant forum based solely on the activities of artificial intelligence working independently of the human? And if so under which fact patterns?

In evaluating the assertion of jurisdiction in cases involving the Internet, courts have applied both traditional tests and in some cases standards customized to the online world. For example, in *Zippo Manufacturing Co. v. Zippo Dot Com, Inc.*, a Federal Court held that “the likelihood that personal jurisdiction can be constitutionally exercised is directly proportionate to the nature and quality of commercial activity that an entity conducts over the Internet.”¹⁶⁰ The “sliding scale” or “Zippo Test” has been generally accepted as the standard in Federal Courts in deciding personal jurisdiction in Internet cases; however the type of activities resulting from the use of artificial intelligence does not fit neatly in the Zippo test, among others because the test is aimed at websites hosting information for human consumption and establishing the location of artificial intelligence at any particular website located in physical space may be difficult. On this point, Professors Susan Brenner and Bert-Jaap Koops stated, “. . . with cybercrime it is difficult to pinpoint ‘where’ the act actually takes place”,¹⁶¹ and such may especially be the case with artificial intelligence. They further indicate that “Publishing a Web site with a content-related offense. . . such as hate speech, may be considered to take place at the computer where the material is uploaded, which constitutes the act of publishing the material. But the act of uploading can cover several countries. . . ;”¹⁶² exacerbating the problem of determining jurisdiction, this is especially true for artificial intelligence.

Based on the *Zippo* test, this last observation that “cyber activities” may cross international boundaries poses problems for determining jurisdiction when digital content in the form of artificial intelligence is involved. Of course, in addition to *Zippo* there are other cases which have explored the issue of Internet jurisdiction, but taken together they have produced a complex web of rules, sensitive to different fact patterns, which are difficult to apply to artificial intelligence. In fact, determining Internet jurisdiction for activities occurring within cyberspace will be exacerbated by artificial intelligence because it can move effortlessly across physical boundaries and as a new development act autonomously from humans in a distant forum. In *Bragg v. Linden Research, Inc.*,¹⁶³ which involved a

look to specific personal jurisdiction to determine whether a company is amenable to suit in a given jurisdiction); TiTi Nguyen, *A Survey of Personal Jurisdiction based on Internet Activity: A Return to Tradition*, 19 Berkeley Tech. L.J. 519 (2004).

¹⁵⁹ *International Shoe Co. v. Washington*, 326 U.S. 310 (1945).

¹⁶⁰ *Zippo Manufacturing Co. v. Zippo Dot Com, Inc.*, 952 F. Supp. 1119 (W.D. Pa. 1997).

¹⁶¹ Susan W. Brenner and Bert-Jaap Koops, *Approaches to Cybercrime Jurisdiction*, 4 J. HIGH TECH. L. J., 15, (2004).

¹⁶² *Id.*

¹⁶³ *Bragg v. Linden Research, Inc.*, 487 F. Supp. 2d 593 (E.D. Penn. 2007).

dispute over virtual property located in the online world of Second Life, the court ruled that the district court had personal jurisdiction over Linden based on representations made by its representatives in national advertisements and based on Bragg's "attendance" at several virtual town meetings hosted by Second Life.¹⁶⁴ On the issue of personal jurisdiction, Judge Robreno's discussion of minimum contacts had some unique twists when he recognized that Rosedale's avatar may have actually interacted with Bragg's avatar within the virtual world. Once inside Second Life, participants could view virtual property, read additional materials about purchasing virtual property, interact with other avatars who owned virtual property, and, ultimately, purchase virtual property themselves. Significantly, participants could even interact with Rosedale's avatar in Second Life during town hall meetings that he held on the topic of virtual property.¹⁶⁵

G. The Use of Artificial Intelligence as Evidence

Another body of law which will be challenged by the use of artificial intelligence relates to the issue of authenticating artificial intelligence when used for evidentiary purposes in court proceedings.¹⁶⁶ In the U.S. under the Federal Rules of Evidence (FRE), for evidentiary purposes, authenticating evidence means that the proponent must produce evidence sufficient to support a finding that the item is what the proponent claims it is.¹⁶⁷ While there is no definition of artificial intelligence in the FRE or Federal Rules of Civil Procedure (FRCP), a discussion of electronically stored information (ESI) may shed light on how courts will view the admissibility of artificial intelligence when proffered as evidence. For comparison purposes, not unlike artificial intelligence, electronically stored information is "information created, manipulated, communicated, stored, and best utilized in digital form, requiring the use of computer hardware and software."¹⁶⁸

Some uses of ESI for evidentiary purposes were clarified by the court in *Lorraine v. Markel American Insurance Co.*¹⁶⁹ in which the plaintiff brought a federal action to enforce an arbitrator's finding and to set aside the limits placed on the award. While the defendant counterclaimed to enforce the arbitrator's award in full, the problem for both sides was that neither supplied the evidentiary foundation needed for the court to rely upon various e-mails and other ESI offered in support of and in opposition to the arbitrator's award. The court's analysis in *Lorraine* discussed several issues that may help future courts determine how artificial intelligence should be proffered in admissible form.¹⁷⁰ This includes whether the artificial intelligence is relevant,¹⁷¹ authentic,¹⁷² hearsay and, if so,

¹⁶⁴ *Id.*

¹⁶⁵ *Id.*

¹⁶⁶ See generally, *Griffin v. State*, 419 MD 343 (2011).

¹⁶⁷ Federal Rules of Evidence, Rule 901. Authenticating or Identifying Evidence.

¹⁶⁸ *Electronically Stored Information: The December 2006 Amendments to the Federal Rules of Civil Procedure*, Kenneth J. Withers, *Northwestern Journal of Technology and Intellectual Property*, Vol.4 (2), 171.

¹⁶⁹ *Lorraine v. Markel American Insurance Co.* 241 F.R.D. 534 (D. Md. May 4, 2007).

¹⁷⁰ *Id.*

¹⁷¹ Federal Rule of Evidence, Rule 401.

¹⁷² Federal Rule of Evidence, Rule 901.

whether it meets an applicable exception under the FRE.¹⁷³ Additionally, courts will need to determine whether artificial intelligence can be considered an original or an acceptable duplicate (or “best evidence”), or whether it meets an exception.¹⁷⁴ And, when proffered as evidence courts will need to consider whether the probative value of the artificial intelligence is outweighed by unfair prejudice.¹⁷⁵ This could be an issue of particular interest to courts given algorithms may use discriminatory practices for decision-making. There are, of course, a multitude of ways to authenticate artificial intelligence for evidentiary purposes, for example, relying on any “self-authenticating” characteristics of the artificial intelligence itself.¹⁷⁶

Additionally, the rules on hearsay will also be relevant for artificial intelligence proffered as evidence, as well as the many exceptions for hearsay.¹⁷⁷ But two broad points should be made. First, lacking legal personhood status much of artificial intelligence may not be considered hearsay because no natural or legal person is making an assertion. For example, when an electronically generated record is entirely the product of the functioning of a computerized system or process, there is no “person” involved in the creation of the record, and therefore no “assertion” being made by a person, in this case the record may not be hearsay under the FRE.¹⁷⁸ But arguing innuendo that the artificial intelligence in question is “hearsay”, there are a multitude of exceptions that might apply. Thus, even if artificial intelligence has cleared the authentication and hearsay hurdles, additional evidentiary rules, such as showing the material is an “original” and is not unfairly prejudicial such that it should be excluded from evidence will apply.

H. Intellectual Property

Another major area of law that will be challenged by the use of artificial intelligence is copyright, trademark, and patent law especially given increasingly intelligent and creative machines and software entities. Patent law will implicate key aspects of artificial intelligence, including algorithms, neural nets, and statistical modeling, these are techniques which are widespread throughout many smart technologies, and would seemingly be of interest to a law of artificial intelligence. For patent law, Professor Lisa Vertinsky (see her chapter 18 in this book) commented that “thinking machines” are “transforming the invention process in ways not easily accommodated with the present U.S. patent system requiring that existing and supporting legal doctrine needs to be re-examined and rules for patentability, patent scope and patent infringement adjusted, to accommodate the new

¹⁷³ Federal Rule of Evidence, Rules 801, 803, 804 and 807.

¹⁷⁴ Federal Rule of Evidence, Rules 1001 through 1008.

¹⁷⁵ Federal Rule of Evidence, Rule 403. Further, Federal Rule of Evidence 901(b)(3) and (b)(4) provide common ways to authenticate ESI. Rule 901(b)(3) permits authentication by “[a]ppearance, contents, substance, internal patterns, or other distinctive characteristics, taken in conjunction with circumstances.” 901(b)(4) allows authentication essentially through “circumstantial evidence”.

¹⁷⁶ *Lorraine*, *supra* note 169, at 553.

¹⁷⁷ Federal Rule of Evidence 801 through 807.

¹⁷⁸ *Id.* at 564–65; *see also State v. Dunn*, 7 S.W.3d 427, 432 (Mo. Ct. App. 2000) (Computer generated telephone records “are not the counterpart of a statement by a human declarant” and “should not be treated as hearsay.”).

paradigm of invention.”¹⁷⁹ As a general observation, mental processes and the processing of human thinking are presumed to be abstract and non-physical and therefore largely ineligible for patent protection.¹⁸⁰ With this observation in mind, will artificial intelligence techniques which emulate human decision-making be considered abstract and not eligible for patent protection?

Currently the patent statutes do not on their face allow for software or algorithms to be listed as an inventor as the patent statute defines “inventor” to mean “the individual who invented or discovered the subject matter of the invention.”¹⁸¹ But inventions by artificially intelligent entities may be done independent of humans, which begs the question of who is the inventor? For example, in the area of product design, attorneys Ben Hattenbach and Joshua Glucoft note that computers with artificial intelligence are already independently designing genuinely useful inventions in a number of fields.¹⁸² Artificial intelligence can also be used to solve design problems often using novel solutions that were originally unknown to the human in the system.¹⁸³ However, certain subject matter is not copyrightable, whether by human or artificial intelligence inventor. For example, in *Blue Spike, LLC v. Google Inc.*, the Court found that because the patent at issue sought to model using on a computer “the highly effective ability of humans to identify and recognize a signal”, the patents simply cover a general-purpose implementation of “an abstract idea long undertaken within the human mind.”¹⁸⁴

From the examples just given, as indicated by Hattenbach and Glucoft, inventions by artificially intelligent systems suggest that it is perhaps “on a collision course with existing patent law” with regard to independently designed useful invention.¹⁸⁵ Under the U.S. Constitution, intellectual property law focuses on creators and inventors—that is, “people” who create and invent. Additionally, the U.S. Constitution refers to securing exclusive rights to “authors and inventors” and the notion of human as inventor is embedded within the patent application process, in that the patent laws are framed in terms of human creation. For example, Section 100 of the Patent Act states “whoever shall invent” and section 102 prohibits patenting of subject matter that the person “did not himself invent.” Further, under the U.S. patent statute, the “term ‘inventor’ means the individual or, if a joint invention, the individuals collaboratively who invented or discovered the subject matter of the invention.”¹⁸⁶

As policy, perhaps the law could be amended to define “author” and “inventor” as “hardware or software capable of human-like intelligence” or a more nuanced definition of an author should be used that references independent thought. However, attorney

¹⁷⁹ Lisa Vertinsky and Todd Rice, *Thinking About Thinking Machines: Implications of Machine Invention for Patent Law*, B.U.J. SCI & TECH., Vol 8:2.

¹⁸⁰ Steven B. Roosa, *The Next Generation of Artificial Intelligence in Light of In re Bilski*, 21 Intellectual Property and Technology Law Journal, 6 (2009).

¹⁸¹ 35 U.S.C. §103.

¹⁸² Robert Plotkin, *The Genie in the Machine* (Stanford University Press 2009).

¹⁸³ *Id.*

¹⁸⁴ *Blue Spike, LLC v. Google Inc.*, No. 14-CV-01650-YGR 2015 WL 5260506 at *5 (N.D. Cal. Sept. 8, 2015), *aff’d*, 2016 WL 5956746 (Fed. Cir. Oct. 14, 2016).

¹⁸⁵ Ben Hattenbach and Joshua Glucoft, *Patents in an Era of Infinite Monkeys and Artificial Intelligence*, 19 STAN. TECH. L. REV, 32, 35, 2015, at 32.

¹⁸⁶ 35 U.S.C. 100(f).

Jeremy A. Cubert asks: “would we be opening Pandora’s Box of conferring ‘additional rights’ to AI capable of independent thought and creativity?”¹⁸⁷ If so, how would creativity and invention be incentivized by expanding the definition of an author to include artificial intelligence? These policy considerations will be pressing as artificial intelligence becomes more creative and autonomous from humans. Consider that in a typical scenario, the employer of a creator or inventor becomes the owner of the intellectual property by virtue of the work for hire doctrine or an employment agreement; perhaps artificial intelligence could be regulated under the work for hire doctrine in which case the employer would own the copyright to the work.¹⁸⁸

Moving from the patent statute, another area of intellectual property law that will be challenged by artificial intelligence, is the question of authorship for works created by algorithms. Under U.S. copyright law, software is considered a “literary work” but under the current copyright statute software is not considered to be an author no matter how creative the work produced by artificial intelligence or how autonomous the work was produced from human input. But legislators have begun to take action in this area. On this point, a draft motion prepared by the European Commission argues that the sophisticated autonomous robots coming online should be granted the status of an “electronic person” with specific rights and obligations such as to claim copyright protection for their work, this implicates employee contracts and nondiscrimination agreements.¹⁸⁹ Considering intellectual property rights, for artificially intelligent entities, issues of civil procedure will also need to be considered. For example, for copyright law, computers do not have standing to file an application or to initiate an infringement claim. But given algorithms are now writing news stories and financial reports independent of human authors how long before artificial intelligence entities are offered legal person rights or dealt with in some other way?

VII. TOWARDS A LAW OF ARTIFICIAL INTELLIGENCE

To begin, as policy for artificial intelligence, the goal of government regulators should be to draft legislation that does not stifle artificial intelligence research, but still protects the public from possible dangers when artificial intelligence approaches and then exceeds human levels of intelligence. For “smart machines” and other emerging technologies which are controlled by artificial intelligence, and which perform tasks that require computationally intensive algorithms and sophisticated analytical techniques, current legal doctrine is becoming challenged as these systems engage in creative and unpredictable behavior.¹⁹⁰ So, how should the law respond to increasingly smart technologies? In the area of regulation, Professor Matthew Scherer writing about artificial intelligence

¹⁸⁷ Jeremy A. Cubert, *Opening Pandora’s Box in an Age of Artificial Intelligence Innovation*, IPWatchdog, 2017, <http://www.ipwatchdog.com/2017/01/07/opening-pandoras-box-artificial-intelligence-innovation/id=76002/>

¹⁸⁸ Louis Miranda, *Artificial Intelligence Algorithms Now Writing the ‘News’ You Read*, 2012. <http://planet.infowars.com/technology/artificial-intelligence-algorithms-now-writing-the-news-you-read>

¹⁸⁹ Karnow, *supra* note 59.

¹⁹⁰ Calo, *supra* note 9.

concluded that to regulate artificial intelligence the regulatory regime must be able to define the term. This is a first step, but also a difficult step as people use terminology such as robotics and artificial intelligence as if they were interchangeable, when in fact, they are not.¹⁹¹ However, I do not propose that a law of artificial intelligence be developed from first principles as there already is a well-established body of constitutional, statutory, and case law that has relevance to emerging smart systems; this book is a testament to that conclusion. In fact, in my view, the statutes and case law which relate to artificial intelligence as discussed throughout this book represent a body of law which will serve as precedence for future disputes involving increasingly smart machines and virtual entities operating under the direction of artificial intelligence. But even with a body of law that represents a starting point for the regulation of artificial intelligence, still, the current law will be stressed by increasingly smart versions of artificial intelligence and thus new legislative action will be needed to provide additional guidance to courts dealing with systems that are learning on their own, performing autonomously, and reacting to the environment in unpredictable ways. For example, in commercial law, as Professor Stacy-Ann Elvy indicates, when artificial intelligence is a contracting party, Article 2 of the UCC will need to be amended to safeguard consumers experiencing the increased levels of information asymmetry and the growing distance between artificially intelligent consumers.¹⁹²

What features of artificial intelligence challenge established areas of law and should therefore be the focus of a law of artificial intelligence? I believe there are several attributes of artificial intelligence to consider. As argued throughout this Chapter, the technology driving the “artificial intelligence revolution” and creating challenges to current legal doctrine are the analytical techniques and algorithms which give machines the capability to go beyond their original programming and to operate autonomously from humans.¹⁹³ Thus, the “techniques” of artificial intelligence, the algorithms and sophisticated analytical techniques, should be the focus of a law of artificial intelligence as opposed to the manifestation of artificial intelligence in a particular physical form. This is because while artificial intelligence controls the actions of machines that project a physical presence in the world, artificial intelligence doesn’t need a body either to “exist” or to act on the physical world. Artificial intelligence also controls digital entities, and this fact alone creates tension in the law beyond those created by increasingly smart machines and implies that a law focusing just on “smart machines” would not adequately cover the full range of technologies controlled by artificial intelligence that are entering society. Additionally, there are other features of artificial intelligence to consider for those who advocate for the regulation of artificial intelligence, such as the ability of artificial intelligence to act autonomously from humans, to engage in creative problem solving, and as noted above to exist either as a physical or digital entity. Other commentators, such as artificial intelligence experts Stuart Russell and Peter Norvig, point to self-improvement, the use of language, and having an internal model of the world as distinguishing factors of artificial intelligence. Each of these general features of artificial intelligence raises specific ques-

¹⁹¹ Matthew U. Scherer, *Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies*, 29 HARV. J. L. Tech. 354, 2016.

¹⁹² *Id.*

¹⁹³ Ethem Alpaydin, *Machine Learning: The New AI* (MIT Press 2016) (explaining important learning algorithms, and presenting example applications).

tions of law. For example, whether a “virtual avatar” that operates autonomously from humans can serve as an agent, whether products liability law applies to algorithms and software, whether algorithms are patentable subject matter, and whether courts can access the internal model of the world developed by artificial intelligence as evidence to be used against the artificial intelligence in a criminal proceeding, these are just a few issues of concern for a law of artificial intelligence.¹⁹⁴

Further, how to assign liability when an artificially intelligent entity harms a human or damages property is, of course, an important issue to discuss for those who advocate that artificial intelligence needs to be regulated. In the area of liability, Professors William Smart, Cindy Grimm, and Woody Hartzog, have rightly observed that complex autonomous systems will present a problem for classic fault-based legal schemes like torts because intelligent systems have the potential to behave in unpredictable ways.¹⁹⁵ They pose the following important question—how can people who build and deploy automated and intelligent systems be said to be at fault when they could not have reasonably anticipated the behavior and thus the risk, of an automated intelligent system?¹⁹⁶ So, how to address this issue? Given the lack of legal person status for artificial intelligence, a strict liability scheme that holds producers liable for harm regardless of fault might be an approach to consider (at least until artificial intelligence is granted the fiction of legal person status).¹⁹⁷ Thus, lacking legal person standing, given that artificial intelligence may cause property damage or harm humans, it is possible that the courts or legislators will be asked to impose strict liability on the creators of programs, for the acts of such programs.

There is a growing movement among governments to regulate artificial intelligence, or at least to acknowledge that increasingly smart systems will pose challenges for law and policy. For example, in the U.S., the White House released a report on the future of artificial intelligence which offers several recommendations for how to regulate this technology, for purposes of this Chapter it is worth noting a few of the recommendations made in the report.¹⁹⁸ First, given that the data used to train artificial intelligence may influence what it learns, and how it responds, federal agencies should prioritize the creation of open training data and open data standards in artificial intelligence. Thus, the government should emphasize the release of datasets that enable the use of artificial intelligence to address a number of issues such as desired social changes. Potential steps in this area could include developing an “Open Data for AI” initiative with the objective of releasing a significant number of government datasets to accelerate artificial intelligence research and to encourage the use of open data standards and best practices across government, academia, and the private sector. Second, government agencies should draw on appropriate technical

¹⁹⁴ See Lori A. Weber, *Bad Bytes: The Application of Strict Products Liability to Computer Software*, 66 ST. JOHN’S L. REV. 66, Iss. 2, 469–85 (1992).

¹⁹⁵ William D. Smart, Cindy M. Grimm, and Woodrow Hartzog, *An Education Theory of Fault for Autonomous Systems* (Yale University Press 2017).

¹⁹⁶ *Id.*

¹⁹⁷ Michael Guihot, Anne Matthew, and Nicolas Suzor, *Nudging Robots: Innovative Solutions to Regulate Artificial Intelligence* (WE Robots 2017).

¹⁹⁸ Artificial Intelligence, Automation, and the Economy, Executive Office of the President, 2016, available at: <https://www.whitehouse.gov/sites/whitehouse.gov/files/images/EMBARGOED%20AI%20Economy%20Report.pdf>.

expertise when setting regulatory policy for artificially intelligent enabled products; given the complexity of artificial intelligence techniques, domain expertise will be critical for informing legislators of the scope and capabilities of artificial intelligence. Additionally, it has been suggested that effective regulation of artificially intelligent products will require collaboration between agency leadership, staff knowledgeable about the existing regulatory framework and regulatory practices generally, and technical experts with knowledge of artificial intelligence. Third, it is recommended that schools and universities should include ethics, and related topics in security, privacy, and safety, as an integral part of curricula on artificial intelligence, machine learning, computer science, and data science.

As I have argued throughout this Chapter, the most important aspect of increasingly smart technologies from the perspective of challenging established law and policy is the algorithms and analytical techniques of artificial intelligence controlling the entity. The idea that legislators need to act in response to advances in smart technology is especially relevant given the increasing autonomy of systems controlled by artificial intelligence. The need for legislative action is also clear when one considers that cases decided almost 50 years ago mirror the current analysis allocating liability for automated technologies; this indicates the need for new approaches for artificially intelligent systems that are beginning to act independently of humans.

So, given that increasingly smart entities are entering society, what is the next step to take? As artificial intelligence accelerates quickly into society, according to law professor John McGinnis this creates a need for a response from governments to react to the potential huge effects of disruptive innovations being spurred by the use of artificial intelligence across a range of applications.¹⁹⁹ So, let the debate about whether artificial intelligence should be considered a disruptive and transformative technology, and should therefore be regulated and the subject of a new field of law begin now while we still have time to chart our future.

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