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Foreword

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As I write this, I am in the Galapagos islands. We are anchored off Isabela, the largest of the islands, and most of the ship's small company are off looking at the lava flows, finches, tortoises, iguanas, and the rest of the evidence Darwin used, on his return to England, to assemble the theory of evolution. From his perspective, over time species expand, mutate, and shrivel. When the conditions are right, new species emerge, and old ones may go extinct.

The law works like this too. The doctrine of ancient lights is by and large gone the way of the dodo bird and the great auk. Administrative law has erupted since the second World War,¹ as have developments in law affecting condominiums and the basic rules of pretrial discovery (rules which now occupy the lions' share of litigators' time). Feudal property law—such as tenure by knight service and serjeanty—disappeared a very long time ago. Areas such as torts are quite old, mutating here and there but, like the domestic cat of three thousand years ago, some parts survive with very little variation. The scope of federal Constitutional rights has expanded and contracted; one of them—the personal right to bear arms—was announced just nine years ago,² and the extension of some First Amendment rights to corporations is only three years old.³ Due process has had its ups⁴ and downs.⁵

The law changes as its constraints change. Arriving and departing technologies herald some of these changes, but technological innovation is neither necessary nor sufficient for the sea changes of the law. In the United States we have seen the rise of specialties in insurance law and class action litigation, and over the last decades we have

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¹ See e.g., Richard A. Posner, *The Rise and Fall of Administrative Law* 72 *Chicago-Kent Law Review* 953, 954 (1997) (noting pre-war New Deal activity culminating in the 1946 enactment of the Administrative Procedure Act), available at <http://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1723&context=journal_articles>.

² *District of Columbia v. Heller*, 554 U.S. 570 (2008).

³ *Burwell v. Hobby Lobby*, 573 U.S. ___, 134 S.Ct. 2751 (2014) (closely held company may litigate first amendment freedom of religion rights); *Citizens United v. Fed. Election Comm'n*, 558 U.S. 310 (2010).

⁴ Although the phrase 'due process' does not appear in the decision, see *Hamdan v. Rumsfeld*, 548 U.S. 557 (2006) (adjudication of Guantanamo Bay inmates' status). See e.g., *In re Winship*, 397 U.S. 358 (1970) (due process for juveniles).

⁵ *Lochner v. New York*, 198 U.S. 45 (1905) *abrogated by* *W. Coast Hotel Co. v. Parrish*, 300 U.S. 379 (1937).

witnessed new law special to arbitration. None of these is tied to changes in technology. Even the rise of environmental law practices, while deeply concerned with technology because it may be both the cause and cure of environmental failure, was not directly sparked by technological development. Family law, becoming an identifiable area of law in the twentieth century, developed as a function of more general societal forces, including those which finally challenged the express legal discrimination endured by women.⁶

What then might be the link between changes in the law and in technology? At least in the United States, the answer is probably the impact of economic power and interest. In his classic text,⁷ the dean of American legal history Morton Horwitz traces the development of common law and later statutory law as a function of the relationships among economic forces. During the period of his analysis, economic forces were unleashed by technology and other changes such as housing density, railroads, and generally the rise of the mercantile classes. Profound shifts in real property and contract law resulted.

Cases swell the docket as economic stakes justify the work. Class actions allow plaintiffs' counsel to collect substantial sums, and along with developments in technologies allowing notice to thousands of class members, enable an increase in class actions over the last two generations. In California, attorney's fees availability is one of the reasons for an enormous increase in anti-SLAPP motions,⁸ and the perceived economic efficiencies in arbitration, together with a receptive U.S. Supreme Court, has vastly increased the number of arbitration petitions filed. As the number of cases increases and the area of law becomes increasingly litigated, so does the area of law ramify, distinctions are made, case to case. Issues accordingly proliferate until—lo!—a specialty area is born. So now we have special courses and books devoted to anti-SLAPP, to environmental law, insurance law, arbitration, and so on. Some firms have video game groups, internet law groups, or more often computer law groups.

It is not technology that changes the law. Law changes when technology creates powerful economic stakes.

Modern AI has been developing for well over a generation now, with cybernetics peaking in the 1970s. But that period was a winter of discontent. In 1973 Professor Sir James Lighthill said, "In no part of the field have discoveries made so far produced the major impact that was promised." Connectionism and neural networks were developed in earnest in the 1980s and 1990s, with back propagation used to train networks coming in

⁶ See generally, e.g., Martha Minow, *'Forming Underneath Everything That Grows: Toward A History of Family Law* 1985 Wis. L. Rev. 819, 831 (1985); Lynn D. Wardle, *Autonomy, Protection, and Incremental Development in Family Law A Review of Family Law in America by Sanford N. Katz* 39 Fam. L.Q. 805, 812 (2005).

⁷ Morton J. Horwitz, *The Transformation of American Law 1780-1860* (1977). See generally Morton J. Horwitz, *The Transformation of American Law 1870-1960* (1992).

⁸ Lawsuits brought to chill the exercise of First Amendment rights, such as a suit by a developer (e.g., for libel), to intimidate residents from protesting against a project, may be met with an anti-SLAPP (Strategic Lawsuit Against Public Participation) motion which, if granted, entitles the defendant to recoup attorneys' fees.

1986 and 1987,⁹ right around the time of Minsky's *Society of Mind*.¹⁰ Deep Blue beat Kasparov in 1997, but later that was dismissed as a mere brute force attack. The chess victory did not then lead to a significant impact outside of research labs, although it did provide inspiration for what we might term classic expert systems, i.e. algorithms able to handle a lot of data and spit out inferences. But the data then was generally spoon-fed, i.e. formatted specially for the software, and the rules were hardwired.

But by 2008 Google released a voice recognition app, and at the end of 2012 the Neural Information Processing Systems (NIPS) conference hosted a presentation on a convolutional neural networks that took classification algorithms (important components of AI systems) from 72 to a 85 percent success rate. Now the world started to take notice. Bill Gates, Elon Musk and Steven Hawking (none of them AI researchers) warned of danger from AI systems.

And then the Deep Mind researchers published a landmark article in *Nature* in January 2016, introducing us to AlphaGo which then went on to beat the top human Go player in the world. This was only a few years before considered highly unlikely, in great part because Go is not subject to a brute force attack. But AlphaGo established the practical feasibility of self-teaching networks employing unformatted data to reach human-comparable performance. By self-teaching, I mean the software modifies itself, and its analyses cannot be understood by humans even as it outstrips human performance.¹¹ For the first time, AI was truly contributing not in routine *imitation* of human work, but with results humans could not achieve on their own. To be sure, computer have always been useful in other ways. Simply speeding up tasks—which is what computers, at root, do—makes many tasks possible which otherwise would never get done. But AI development over the last few years has taken on an added dimension. This specific technology, and deep learning neural networks in particular, now attracts vast sums of money.

The economic forces are gathering.

Some of the forecasts may be optimistic, but even so the numbers are very large. Tractica has estimated AI revenues may reach \$59.8 billion worldwide by 2025, up from \$1.4 billion in 2016. IDS forecasts \$47 billion by 2020. CB Insights notes over 200 AI companies acquired since 2012 as of the Fall 2017. As to specifics, China's Albia

⁹ Ian Goodfellow, et al., *Deep Learning* (2016).

¹⁰ Marvin Minsky, *The Society of Mind* (1985).

¹¹ For more on AlphaGo and more generally self-teaching networks which succeed with rules not comprehensible by humans, see my *The Opinion Of Machines*, XIX Columbia Science & Technology Law Review 136 (2017-2018), preprint available at <https://works.bepress.com/curtis_karnow/30/>. As of October 2017, a new version, named 'AlphaGo Zero' was fed only the basic rules of the game (which are exceedingly simple) and without *any* human intervention within 72 hours sufficiently taught itself the intricacies of the game that it beat its former incarnation (which had beat the top humans). Rory Cellen-Jones, "Google DeepMind: AL becomes More Alien," BBC News October 18, 2017, available at <<http://www.bbc.com/news/technology-41668701>>. That is to say, it took 3 days—over which it played 4.9 million games against itself—to achieve what humans took thousands of years to learn. See generally, <<https://deepmind.com/blog/alphago-zero-learning-scratch/>>. The new paper announcing this remarkable work is David Silver et al., *Mastering the game of Go without human knowledge* 550 *Nature* 354 (19 October 2017) <<https://www.nature.com/nature/journal/v550/n7676/full/nature24270.html>>.

announced investment of \$15 billion into AI (but this includes other initiatives on e.g. quantum computing and network security), Salesforce has \$50 million set aside for AI investments, Intel has set aside \$1 billion, and Ford also spent \$1 billion, in its investment in Argo AI in February 2017. Baidu and Google are estimated to have spent \$20 billion to \$30 billion on AI in 2016, most of it for research.¹²

The technology is far advanced; it has serious practical uses. Those uses have now been recognized by those with money. Similar interest is being shown in quantum computing. Quantum computing was a peculiar interest of physics and computer scientists—at first, a 1981 fantasy of one of my heroes, Richard Feynman—and until recently confined to the behavior of one qubit (the quantum equivalent of a classic binary bit). But it was demonstrated feasible by 1999,¹³ and now, Microsoft and others are expected to spend significant sums in research and development.¹⁴ Intel produced a 17 qubit chip 10 October 2017.¹⁵ The correlation of economic interest in AI and quantum computing is probably not coincidence.¹⁶

So, the timing of this book could not have been better: conditions are ripe for the law to be impacted by AI. We have deep and rapid technological advances, we have consequent practical applications, and now we have the world's largest companies expressing a serious interest—with a lot of money. It would be naïve to think that the legal system will not be influenced.

This influence will proceed in stages. The law, a conservative animal, always looks back, citing precedent. So in the first stage legal issues will be parsed with the terms and principles of current law. The challenge comes when we must choose which

¹² For some of these figures, see e.g., McKinsey & Co., McKinsey Global Institute, *Artificial Intelligence: The Next Frontier* (June 2017).

¹³ <http://www.nature.com/nature/journal/v402/n6760/full/402390a0.html?foxtrotcallback=true>.

¹⁴ John Markoff, *Microsoft Spends Big to Build a Computer Out of Science Fiction*, The New York Times (20 Nov. 2016) <<https://www.nytimes.com/2016/11/21/technology/microsoft-spends-big-to-build-quantum-computer.html>>. See also <<http://www.fudzilla.com/news/40194-microsoft-spending-a-fortune-on-quantum-computing>>. Intel is putting in about \$50 million. <

<http://www.datacenterdynamics.com/content-tracks/servers-storage/intel-to-spend-50-million-on-quantum-computing-research/94726.fullarticle>>. See also Google's involvement, <<https://www.wsj.com/articles/how-googles-quantum-computer-could-change-the-world-1508158847>>.

¹⁵ <<https://newsroom.intel.com/news/intel-delivers-17-qubit-superconducting-chip-advanced-packaging-quatech/>>.

¹⁶ “For instance, quantum computing is finding a vital application in providing speed-ups for machine learning problems, critical in our ‘big data’ world. Conversely, machine learning already permeates many cutting-edge technologies, and may become instrumental in advanced quantum technologies. Aside from quantum speed-up in data analysis, or classical machine learning optimization used in quantum experiments, quantum enhancements have also been (theoretically) demonstrated for interactive learning tasks, highlighting the potential of quantum-enhanced learning agents.” Vedran Dunjko, et al., *Machine learning & artificial intelligence in the quantum domain*, arXiv preprint arXiv:1709.02779 (September 2017) available at <<https://arxiv.org/pdf/1709.02779.pdf>>. NASA plans on using quantum computing in its AI research. “Quantum Computing at NASA: Current Status” (2017) at 6 <<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20170009213.pdf>>. See also, e.g., Vedran Dunjko, et al., *Quantum-Enhanced Machine Learning* 117 *Physical Review Letters* 130501 (23 September 2016), available at <<https://journals.aps.org/prl/pdf/10.1103/PhysRevLett.117.130501>>.

law to invoke, because there are always choices. We must make analogies, we must ask what is “similar” to the issue now presented.

We have seen this before.

We may not under the Fourth Amendment search a person’s filing cabinet without a warrant; may we search her Google Docs without a warrant? Is online storage “like” a paper storage file? The First Amendment protects speech in public places; are privately owned shopping malls like “public places”? The press has the right under e.g., California law to protect its sources; but are all bloggers covered too—are they “like” reporters or are they “like” the local gossip? One of my earliest computer law cases was a client’s trademark problem: was the unauthorized appearance of a famous trademark in a video game “like” its use in the real world (serious legal issue), or was it “like” an appearance in for example an art work (not so serious)? Are rants in the comment section of a privately owned website “like” speeches given in public park because the section is open to all? Or are they “like” verbal abuse in a privately owned grocery store where presumably the owner can throw the miscreant out? Now that sophisticated drones are in widespread use and significant economic actors such as law enforcement, airlines, airport authorities, and others are affected, new issues will arise. For example, is shooting down a drone over one’s property a federal felony because it’s “like” shooting at aircraft, or is it protected under state law which may allow one to stop a trespasser?¹⁷

Every new claim searches for a home, an analogy that fits it best; and he who wins that fight will likely prevail in the case. Different cases will be decided differently. Different metaphors will be invoked.

With respect to AI in particular, many of the disputed analogies are implied by the articles in this book. Other examples come to mind. Are AIs ‘like’ people agents of action, or are they ‘like’ typewriters and telephones, only conduits? Must humans guard against all actions of an AI, as we would with our small children, or are there some consequences for which humans should not be liable, such as the proverbial first (and unexpected) bite of a dog? Can all legal entities in the chain of distribution be sued for the infractions of an AI, such as we do for defective consumer products like cars and toys—suing for example specialized chip makers,¹⁸ designers, software sellers, neural network trainers, as well as companies actually using the AI—or are AIs more “like” services (where one usually sues only the direct provider) because they are analogous to what a human would do under a services contract, or because, perhaps, the software is in

¹⁷ Jeff Stone, *Shooting Down Drone Costs California Man \$850 Penalty, One Angry Neighbor* International Business Times at 13 (29 June 2015), < <http://www.ibtimes.com/shooting-down-drone-costs-california-man-850-penalty-oneangry-neighbor-1987699>>. This is cited in Scott Carr, et al., *Drone On! Emerging Legal Issues for Commercial Use of Unmanned Aerial Vehicles (UAVs)* ABA Section of Litigation--Environmental, Mass Torts & Products Liability Litigation Committees' Joint CLE (January 2016) available at <https://www.americanbar.org/content/dam/aba/administrative/litigation/materials/2016_joint_cle/1_drone_on_final_of_outline.authcheckdam.pdf>.

¹⁸ Google and Microsoft for example are making specialized chips. Tom Simonite, *The Rise Of AI Is Forcing Google And Microsoft To Become Chipmakers* Wired (25 July 2017) available at <<https://www.wired.com/story/the-rise-of-ai-is-forcing-google-and-microsoft-to-become-chipmakers/>>.

fact provided remotely under a services contract?¹⁹ Indeed, with *embedded* AI (likely to be a widespread use) what *is* the product or service—the software or the larger item? The code or the autonomous car? The drone or its brain? The legal, financial, accounting or other services rooted in code, or the underlying code as such? Are humans responsible for code which unforeseeably modifies itself—when foreseeability is the usual predicate for liability?²⁰

At this stage, the law is developed by many state and federal courts, and in many areas of the law—not just in cases which are ostensibly about computers or their software. It will not be clear except in retrospect what is happening, as the rationale of some opinions is picked up by others, as some trial courts are affirmed or overruled, and as supreme courts, many years later, resolve conflicts among lower appellate courts. This first stage of disparate opinions slowly mutates into a second stage, usually culminating in review by supreme courts. That is the period of consolidation. But with fast moving technologies, and commercialization which is almost as rapid, by the time the battles are resolved the world may have passed on to the next wave.

Concurrently with both these stages, some state legislatures may act. Legislation has now been passed in 21 states regarding autonomous vehicles.²¹ Legislative action is usually a turning point, because legislatures need not track the principles used by the courts; they can just make up the rules. They may do so in response to a mess in the courts, but they may not wait if they think chaos looms, which may have been the motivation for regulating autonomous vehicles and probably drones (where federal regulation is in the works).

But unless there is a reasonable fear of a *specific* widespread injury from AI—and that’s not apparent—the issues will probably be left to courts. Judges usually only listen to the parties in the suit, even though the case may be an important building block in the development of the law. As judges apply the constraints to the evolution of law corresponding to our evolving AIs, commentators, professors, and others with both technological knowledge in mind and the public interest at heart—they must attend. They must write, testify, and (even if indirectly through the briefs of lawyers) be heard. The authors of this book may be those people.

¹⁹ The Uniform Computer Information Transactions Act § 12 (UCITA) takes the position that software is not a product, suggest strict products liability is not appropriate. Pointing the other way are cases holding software is a “good” within the meaning of the Uniform Commercial Code. U.C.C. § 2–101 et seq. E.g., *Executone of Columbus, Inc. v. Inter-Tel, Inc.*, 665 F. Supp. 2d 899 (S.D. Ohio 2009).

²⁰ I take this issue on in my *The Application of Traditional Tort Theory to Embodied Machine Intelligence* Stanford Law School, Center for Internet & Society (April 2013), republished and updated in *Robot Law* (2016).

²¹ <<http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx>>.