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Does Technology Require New Law?

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DOES TECHNOLOGY REQUIRE NEW LAW?

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Technological change affects the law in at least three ways: (1) by altering the cost of violating and enforcing existing legal rules; (2) by altering the underlying facts that justify legal rules; and (3) by changing the underlying facts implicitly assumed by the law, making existing legal concepts and categories obsolete, even meaningless. The legal system can choose to ignore such changes. Alternatively, it may selectively alter its rules legislatively or via judicial interpretation. In this essay I first discuss, as an interesting historical example, past technological changes relevant to copyright law and the law's response. I then go on to describe the technological changes that are now occurring or can be expected to occur over the next few decades, the issues they raise for the legal system, and some possible responses. I conclude with a brief discussion of the degree to which such changes can be addressed under current legal rules and the degree to which new rules may be required.

I. COPYRIGHT: THE TECHNOLOGIES

Prior to the copyright act of 1891, works by British authors were unprotected in the United States. Despite the lack of protection, British authors sometimes made more money from sales in the United States than from sales in Britain. The reason appears to have been that the printing technology of the time, hand set lead type, provided a substantial first-mover advantage.[1] The authorized publisher, having paid his fixed costs from sales during the period after the book had come out

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1. "In fact, lead time was important enough that many English writers earned more from the sale of advance proofs to American publishers (despite lack of copyright protection in America) than from the copyright royalties on their English sales." Stephen Breyer, *The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies, and Computer Programs*, 84 HARV. L. REV. 281, 300 (1970).

but before a pirate copy could be set and printed, could, if necessary, issue a lower priced "fighting edition" designed to prevent the pirate from recovering his fixed cost, making piracy unprofitable. This approach to rewarding writers became ineffectual once technological changes made it possible for a pirate to use photographic methods to free-ride on the typesetting effort of the original publisher, bringing out an unauthorized edition at a lower production cost immediately after the authorized edition appeared.

Over the past few decades, improved means of copying—xerography, cassette tapes, VCR's, floppy disks, CDR's—have made it easier to violate copyright law by copying protected intellectual property (IP). Computer networks make it possible to disseminate pirated IP in digital form anonymously, impeding enforcement of copyright law. On the other hand, Internet search engines make it possible to search for a single text string in over a billion locations in a few seconds at negligible cost, easing the detection of some forms of copyright violation. Thus technological change has altered the cost both of violating and of enforcing the law. In some cases—individual pirating of cassette tapes and computer software and off-the-air recording of television programs are obvious examples—technological advances have made pre-existing law unenforceable. We have moved, in the space of a little over a century, from technologies that made it possible to protect writings even without copyright law to technologies that make it impractical to protect programs even with copyright law.[2]

Finally, consider the issue of whether computer programs are "writings," and hence legally protectable by copyright. The problem arose because computer programs were a new sort of intellectual property, one that did not clearly fit any of the

2. More precisely, it is now impractical to use copyright law to protect computer programs directly against copying by individual users. It can still be used to prevent large-scale commercial piracy, although that may cease to be practical if further progress produces the sort of strong privacy that makes practical large-scale commercial activity online by anonymous actors. *See* David Friedman, *A World of Strong Privacy: Promises and Perils of Encryption*, 13 SOC. PHIL. & POL'Y 212 (1996), *available at* http://www.daviddfriedman.com/Academic/Strong_Privacy/Strong_Privacy.html. In addition, the expansion of copyright implemented in the Digital Millennium Copyright Act may make it easier for owners of intellectual property to protect it by non-legal mechanisms, such as impeding the spread of devices for subverting technological protection. *See* 17 U.S.C. §§ 1201-1204 (Supp. 2000).

relevant legal categories. Some courts argued that they were writings.[3] Others argued that at least some programs, such as machine language programs burned into the ROM of a computer, were not writings, because they were not intended to be read by human beings.[4] They were functional parts of a machine—in John Hersey's memorable phrase, "elaborate cams."[5] Courts taking the latter position even found a precedent—a case ruling that player piano rolls, the functional equivalent of computer programs under an earlier technology, were not writings.[6]

II. COPYRIGHT: THE LEGAL RESPONSE

When technological change affects legal rules, the legal system can respond by trying to deal with the new technology under existing rules, by creating new rules, or by modifying old ones to fit the new technology. Again, copyright law provides examples.

Courts that followed the precedent of *White-Smith* by holding that machine language programs were not writings applied existing rules by asking whether the new entity fit the description of the relevant legal category. The answer was obviously "no;" a machine language program burned into a computer chip is not a writing in any ordinary sense of the word.

Courts that came down on the opposite side of the controversy, and the Congress that ultimately settled the matter by revising the copyright code to explicitly cover

3. Strictly speaking, they were "literary works," the term used in the copyright statutes that corresponds to the Constitution's "writings." *See, e.g.*, Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1249 (3d Cir. 1983) (arguing that a computer program is a literary work).

4. Data Cash Sys., Inc. v. JS&A Group, Inc., 480 F. Supp. 1063 (N.D. Ill. 1979) (finding the object phase of a computer program not a qualifying copy under either the Copyright Act of 1909 or common law because it is not intelligible to a human reader). *But see* Tandy Corp. v. Personal Micro Computers, Inc., 524 F. Supp. 171 (N.D. Cal. 1981) (holding that software embedded in a ROM was copyrightable).

5. The analogy to a "cam" was made by Copyright Commissioner (and author) John Hersey in his dissenting opinion in THE FINAL REPORT OF THE NATIONAL COMMISSION ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS (1979), *available at* http://home.nyu.edu/~gmp216/documents/contu/contu-finalreport.txt. Judge Flaum in *Data Cash Systems* described a machine language program on a ROM as "a mechanical tool or a machine part." 480 F. Supp. at 1065.

6. White-Smith Music Pub. Co. v. Apollo Co., 209 U.S. 1 (1908).

software,[7] can be seen as fitting new technology into old law in a different way. They concluded that the purposes of the copyright act could best be served if programs were defined as writings—whether or not programs were writings in any ordinary sense of the word.[8] In effect, they replaced "writings" in the relevant legislation and case law with "writings or computer programs," generating a new set of legal rules for software by piggybacking on an existing set of legal rules for writings.

What about creating entirely new rules to fit new technology? One recent example is the Digital Millennium Copyright Act of 1998.[9] Part of its justification was that easy copying and communication, via computers and the Internet, had made copyright protection for intellectual property in digital form difficult, perhaps impossible. A promising alternative was technological protection, using encryption to build a virtual barbed wire fence around intellectual property whose legal protection was impractical.[10]

Virtual barbed wire might be vulnerable to digital wire clippers. Creating programs to bypass technological protection requires technical skills that few users of the protected material possess, but the Internet makes it possible for those few to produce the tools and then make them readily available to everyone else. Congress responded to that problem with new legislation designed to make the creation and distribution of such tools more difficult. Earlier examples of new legal rules to deal with new technologies for creating or copying intellectual

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7. Pub. L. No. 96-517, 94 Stat. 3028 (1980).

8. This argument for the copyrightability of software is defended in DAVID FRIEDMAN, LAW'S ORDER: AN ECONOMIC ACCOUNT 137-38 (2000).

9. 17 U.S.C. §§ 1201-1204 (Supp. 2000).

10. Intertrust Technologies refers to such a container as a "digibox," *see* Mark Hall, *Digital Rights Firm Intertrust Set For IPO*, COMPUTERWORLD (Sept. 27, 1999), *at* http://www.computerworld.com/cwi/story/0,1199,NAV47-74_STO37107,00.html, whereas IBM refers to it as a "cryptolope," *see* IBM, *IBM Cryptolope Technology—Executive Summary*, *at* http://www-3.ibm.com/software/security/cryptolope/about.html (last visited Dec. 29, 2001). *Compare* Julie Cohen, *Copyright and the Jurisprudence of Self-Help*, 13 BERKELEY TECH L.J. 1089 (1998), *available at* http://www.law.berkeley.edu/journals/btlj/articles/13_3/Cohen/html/reader.html, *with* David Friedman, *In Defense of Private Orderings: Comments on Julie Cohen's "Copyright and the Jurisprudence of Self-Help,"* 13 BERKELEY TECH. L.J. 1151 (1998), *available at* http://www.law.berkeley.edu/journals/btlj/articles/13_3/Friedman/html/reader.html

property include the Plant Variety Protection Act,[11] the Mask Works Act,[12] and the Audio Home Recording Act.[13]

I began this essay by listing the different ways technology affects the law. As we have just seen, the history of copyright law over the past century provides examples of all of them. Legal problems associated with such effects are likely to become increasingly common as rapid technological development continues over the next few decades. In the next Part I describe three such developments and the legal problems they raise in some detail, and briefly sketch several more. Two of the three, human reproductive technology and cryonic suspension, have already begun to raise new legal issues. The third, artificial intelligence, may eventually prove the most difficult to reconcile with our legal system.

III. LEGAL ISSUES OF THE TWENTY-FIRST CENTURY

A. Human Reproductive Technology

Throughout almost all of human history, the fact that a child was born from the body of a particular woman was conclusive proof that she was the child's mother. Paternity, on the other hand, was in most cases impossible to establish;[14] it was a wise child that knew his father. Until very recently, these facts were reflected in the law by rules providing that the woman who bore a child was his legal mother and her husband the child's legal father, even if there was some evidence to suggest that he was not the biological father.[15]

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11. Pub. L. No. 91-577, 84 Stat. 1542 (1970) (codified as amended in scattered sections of 7 U.S.C.) (protecting sexually reproducing plants). Protection for asexually reproducing plants is provided by 35 U.S.C. § 161 (1994).

12. 17 U.S.C. §§ 901-914 (1994).

13. 17 U.S.C. §§ 1001-1010 (1994). The Audio Home Recording Act of 1992 permits home recording and the sale of suitable equipment and compensates music creators and copyright owners out of a royalty pool funded by a tax on digital hardware and blank recording media. *See id.*

14. The exception would be the case where it was only possible for one man to have had sexual access to the mother, a situation that some traditional cultures attempted to assure, at least for high status women, with varying levels of success. For an entertaining eighteenth century account of the practical difficulties, see Matthew Prior, *An English Padlock, in* A COLLECTION OF ENGLISH POEMS 1660-1800, at 213-14 (Ronald S. Crane ed., 1932).

15. "The parent and child relationship may be established as follows: (a) Between a child and the natural mother, it may be established by proof of her having given birth to the child. . . ." Cal. Fam. Code § 7610(a) (West 2001).

These facts are no longer true. Reproduction using a host mother implanted with an egg fertilized in vitro means that a child can be born from an unrelated woman. Genetic testing permits biological paternity to be established with a high degree of confidence. Legal rules at the state level have begun to change, by court decisions and by legislation, to reflect these new facts.[16]

Further technological progress is likely to raise additional legal issues. Consider the parentage of a child produced by cloning.[17] As judged by the clone's nuclear DNA, the child's parents are the parents of the donor whose cell was used to produce the clone. As determined by the clone's mitochondrial DNA, the mother is the woman who donated the egg into which the donated cell's nucleus was implanted. Judged by the traditional rule for motherhood, the mother is the woman in whose uterus the fertilized ovum was incubated. Determined

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Furthermore, "except as provided in § 7541, the child of a wife cohabiting with her husband, who is not impotent or sterile, is conclusively presumed to be a child of the marriage." Cal. Fam. Code § 7540 (West 2001). The California rule goes back to at least 1919: "'The issue of a wife cohabiting with her husband, who is not impotent, is indisputably presumed to be legitimate.'" Brian C. v. Ginger K., 92 Cal. Rptr. 2d 294, 298 n.2 (2000) (quoting Estate of McNamara, 181 Cal. 82, 91 (1919) (citation omitted)). The rule goes back in the common law at least to Lord Mansfield's Rule: "[I]t is a rule, founded in decency, morality and policy, that [the father or mother] shall not be permitted to say after marriage, that . . . [his or her] offspring is spurious." Goodright v. Moss, 98 Eng. Rep. 1257, 1258 (1777).

16. "Notwithstanding § 7540, if the court finds that the conclusions of all the experts, as disclosed by the evidence based on blood tests performed pursuant to Chapter 2 (commencing with § 7550), are that the husband is not the father of the child, the question of paternity of the husband shall be resolved accordingly." Cal. Fam. Code § 7541(a) (West 2001). In addition:

> [A]lthough the [Uniform Parentage] Act recognizes both genetic consanguinity and giving birth as means of establishing a mother and child relationship, when the two means do not coincide in one woman, she who intended to procreate the child—that is, she who intended to bring about the birth of a child that she intended to raise as her own—is the natural mother under California law.

Johnson v. Calvert, 851 P.2d 776, 782 (Cal. 1993) (describing a surrogacy case in which the host mother, who did not provide the egg, attempted unsuccessfully to assert parental rights).

In the case of *In re Marriage of Moschetta*, 30 Cal. Rptr. 2d 893 (Cal. Ct. App. 1994), the surrogate conceived by artificial insemination in order to provide a child for the sperm donor and his infertile wife. The court affirmed the lower court's judgment establishing the natural father and surrogate mother as the parents. *Id.* The court noted that "[g]enetic parenthood established by blood tests trumps a presumption based on the cohabitation of a married couple." *Id.* at 1225.

17. I am assuming replacement of the nucleus of a fertilized egg with a nucleus taken from a cell of an adult. A different and easier form of cloning—splitting an embryo at the stage where it is only a few cells to produce a set of identical offspring—raises fewer new legal issues.

by the plausible criterion of genetic relatedness, the parent is the cell donor, who is almost twice as closely related to the clone as an ordinary parent to its children, although not quite as closely as one of a pair of identical twins to the other.[18]

This is not the end of the story. Techniques currently exist, and have been applied to mice if not to humans, that produce a chimera (also known as a mosaic)—an individual who is, genetically speaking, two people, with half his cells coming from one fertilized ovum and half from another. Another technique, so far only theoretical, could be used to produce a child with four grandparents and no parents. Either might be used by a homosexual couple to produce a child genetically linked to both members of the couple.[19] Other future possibilities include transplanting sections of chromosomes from one cell to another or creating new genes and implanting them in the cell that will become a child.

There are a variety of ways in which current law could be modified to take account of such developments. Probably the simplest would be to retain existing legal rules for children produced using the traditional method while defining the parent(s) of any child produced by non-traditional means as the person or persons who intended to take parental responsibility when the events that produced that child took place.[20] That rule would provide at least as much certainty as current law does while resolving parenthood issues raised by a considerable range of reproductive technologies. This approach would also do as well as present law, perhaps even slightly better, at matching children with the adults most likely to care for them.

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18. This assumes that the cell donor is not also the egg donor. If she is, then the clone shares both her mitochondrial and nuclear DNA, as would her identical twin sister.

19. LEE SILVER, REMAKING EDEN: HOW GENETIC ENGINEERING AND CLONING WILL TRANSFORM THE AMERICAN FAMILY 199-222 (1998) (describing these technologies and their implications).

20. This is the approach taken by the court in *Calvert*, 81 P.2d at 776, and then followed by the court in *In re Marriage of Buzzanca*, 61 Cal. App. 4th 1411 (1998). As the situations that produce such cases become more common with the increasing use of the technologies, perhaps the law will begin to require that before a medically assisted conception may take place the responsible parties file a conception certificate specifying the intended parents.

B. Cryonic Suspension

One striking feature of the past century has been the extraordinary rate of progress in medical technology. A hundred years ago, all that a doctor could do for most illnesses was predict—tell the patient whether he should plan to be back at work in a few days or start making his will.[21] Today, most serious contagious illnesses can be cured. Diseases such as measles and the flu, once mass killers, are now little more than nuisances, at least in developed countries.

Some killers, however, such as cancer, AIDS, and heart disease, still remain. This raises an interesting possibility:

> You are dying of a currently incurable disease. Being a technological optimist, you expect that the cure will be discovered sometime in the next decade or two. Unfortunately, you can't wait that long.
>
> Or perhaps you can. You make arrangements to have your body frozen immediately after death, before any substantial deterioration has occurred, with precautions to minimize any damage done in the process.[22] In return for a suitable payment, the firm that freezes you guarantees that it will store your body safely and arrange for your revival and cure when medical progress makes it possible.
>
> The cure for what killed you may appear in a decade or so, but it will probably take considerably longer to cure the damage done by dying and being frozen. You are in no hurry. If a cure never appears, all that you have lost is money. Comparing the downside risk with the upside gain, this looks like an attractive gamble, at least if there is any significant chance of winning.

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21. *See generally* LEWIS THOMAS, THE YOUNGEST SCIENCE: NOTES OF A MEDICINE-WATCHER (1983) (describing medical practice at the beginning of the twentieth century and the radical changes that followed the development of sulfa drugs and antibiotics).

22. This is not a trivial problem. Ice crystals produced in the body by freezing can be expected to do very substantial damage, which current techniques attempt to minimize. For a general discussion of the subject of cryonic suspension, see Ralph C. Merkle, *Cryonics, at* http://www.merkle.com/cryo (last visited Dec. 29, 2001). *See also* The Alcor Life Extension Foundation, *What We Do: Cryo Transport and the Alcor Life Extension Foundation, at* http://www.alcor.org/01b.html (last visited Dec. 29, 2001).

This is not a purely imaginary scenario. There are currently at least three companies in the United States[23] in the business of freezing and storing people, and a large number of people have made arrangements to be frozen when and if they die.[24] Of course, no one has been thawed and revived thus far, nor is anyone likely to be anytime soon.

Cryonic suspension raises legal issues by changing an underlying assumption implicit in present legal rules: that someone is either dead or alive, and we can almost always discover, with a high degree of confidence, which. To see some of the problems that may result from this new technology, let us extend our story a little further:

> Under current law, you cannot be frozen until you are legally dead. Since you are legally dead, your wife is a widow and free to remarry; she does. Since you are dead, your heir is free to inherit your fortune; he does.
>
> A decade of increasingly rapid medical progress passes. Just ten years to the day after your suspension, a research team publishes some startling news. A dog has been suspended, kept frozen for a year, and revived, with no major damage. Although it is still too early to start reviving humans, the writing is on the wall. Alcor begins making a list of customers who died of causes now curable, and your name is on the list.
>
> Your wife's new husband and your heir jointly break into Alcor's storage facility one night, steal your body, and cremate it. When questioned, they explain that they have strong religious objections to maintaining the corpse of one dear to them in such an unnatural state.
>
> They are guilty of breaking and entering and of vandalism. They owe tort damages to Alcor for damage to its property. The one thing they cannot be

23. The Alcor Life Extension Foundation, Cryonics Institute, and American Cryonics Society.

24. Reports estimate that 80 to 90 bodies are in suspension and about a thousand individuals have signed up for future suspension. Sidney C. Schaer, *Cryonics in a Deep Freeze: Predictions from the Past That Haven't Come True . . . Yet*, NEWSDAY, Feb. 5, 1999, at A19.

> guilty of is murder, because the body they burned had been dead for ten years.

As this story suggests, there are serious problems with applying current law to a technology that makes it possible for many people to spend an extended time in a state of "maybe dead." The problem is not entirely novel—there is some similarity to the situation of a patient in a coma or a missing person mistakenly declared dead.[25] But the former usually involves only a brief period of time and the latter a mistake. Cryonic suspension raises the possibility that large numbers of people may be known to be in a state neither dead nor alive—with no bodily function, but a possibility of future revival. It is difficult to see how the law can adequately adapt to such a situation without a substantial innovation, perhaps the creation of a new legal category to apply to such people.

The lack of a suitable category is not merely a problem for dealing with people who might destroy suspended bodies in some hypothetical future.[26] It is a problem today, and one that, arguably, has lethal consequences. If revival is possible at all, it is likely to be a good deal easier for someone frozen ten minutes before he dies than for someone frozen ten minutes after. Freezing someone ten minutes before he dies is, under current law, murder.[27]

C. Artificial Intelligence

Computers do many of the same things that human beings

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25. *See, e.g.*, Martin v. Phillips, 514 So. 2d 338, 339 (Miss. 1987) (involving a man who disappeared in 1969, was declared dead in 1976, reappeared in 1983, and tried to reclaim property that his wife had inherited from him and sold); Cann v. Cann, 632 A.2d 322, 324 (Pa. Super. 1993) (adjudicating a similar issue in the context of marriage law).

26. Even now, the problem is not entirely hypothetical. In 1987, there was an extended legal conflict between Alcor and a local coroner who wished to autopsy the head of Dora Kent, who had, according to Alcor's account, been suspended at a point when she was clinically but not legally dead. Alcor succeeded in preventing the autopsy. *See* Jennifer Warren, *Investigation Closing in Case of Frozen Head*, L.A. TIMES, Nov. 29, 1990, at A3.

27. Thomas Donaldson unsuccessfully petitioned a California court in 1992 for the right to be suspended before legal death, in order that he could be frozen before, rather than after, the growth of a brain tumor seriously damaged his brain. Donaldson v. Lungren, 2 Cal. App. 4th 1614 (1992). *See also* Miles Corwin, *Tumor Victim Loses Bid to Freeze Head Before Death*, L.A. TIMES, Sept. 15, 1990, at A28; Cynthia Gorney, *Cryonics and Suicide: Avoiding 'the Slippery Slope,'* WASH. POST, May 1, 1990, at D6.

do: arithmetic, pattern recognition, logic. This raises the intriguing possibility that, at some time in the future, there may exist programmed computers that are the functional equivalents of humans. More than fifty years ago, Alan Turing proposed a simple intuitive test of personhood: have a human being converse, via teletype, with a computer and another human; if he cannot reliably tell which is which, the computer is a person.[28]

No machine has yet passed a Turing test, and it is unlikely that any will do so in the near future. Current estimates suggest that the processing power of the most advanced computer is still orders of magnitude less than that of the human brain. But this situation is changing. The processing power of computers doubles every year or two;[29] the power of the human brain does not. Raymond Kurzweil, a computer pioneer and entrepreneur, estimates that in about thirty years computers will reach human levels of intelligence.[30]

Creating an intelligent computer is not merely a problem of hardware; without software, the most advanced computer is only an expensive paperweight. This raises an intriguing question: is it possible for humans to design something as intelligent as, or more intelligent than, ourselves?

The short answer is that, although it may not be possible to design such a program, it may still be possible to create it. We ourselves demonstrate this fact. If we are, as most biologists believe, the product of Darwinian evolution, then we are intelligent beings created without the intervention of any being more intelligent than, or even as intelligent as, ourselves. Processes analogous to evolution have been applied to the

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28. A.M. Turing, *Computing Machinery and Intelligence, in* COMPUTERS AND THOUGHT 11 (Edward A. Feigenbaum & Julian Feldman eds., 1963).

29. Gordon Moore, an inventor of the integrated circuit and chairman of Intel, noted in 1965 that the surface area of a transistor in an integrated circuit was being reduced by about 50% every twelve months; he later lengthened the estimate to twenty-four months. Various forms of this observation have circulated under the name of "Moore's Law." Because doubling the number of transistors on a chip both doubles the amount of processing it can do and increases its speed by getting the transistors closer together, the implication is that the doubling time for computing power is less than two years. *See* RAY KURZWEIL, THE AGE OF SPIRITUAL MACHINES: WHEN COMPUTERS EXCEED HUMAN INTELLIGENCE 20-25 (1999).

30. *Id.* Much of this Part of the article is based on Kurzweil's work. Kurzweil is the originator of, among other things, the Kurzweil reading machine for the blind and the Kurzweil synthesizer.

creation of computer programs.[31] One approach to creating an intelligent computer, if we are unable to design one, is to let it create itself.

A second possibility is to pirate our design from the most readily available source: the human brain. As scanning techniques improve, it should become possible to freeze and scan a human brain,[32] layer by layer, giving us a full structural map at the level of the individual neuron. Combine that with the information currently being generated by research on brain function, and we have the possibility of emulating a generic human being in software—creating a program modeled after the structure of the human brain.

A still more intriguing possibility is copying a particular human brain, complete with memory. Given a good enough form of nondestructive scanning and sufficiently powerful hardware, it should be possible to upload a human being, copying the entire structure that makes up a particular person's thoughts, personality, memory, and consciousness to a computer.

It may be that all of this will turn out to be a fantasy. Moore's Law may break down before we are able to build sufficiently powerful computers; further research may demonstrate that human consciousness requires some essential element that cannot be duplicated by machinery, however complex. All we can say is that, thus far, there is no reason to think so. Hence for the purposes of this article I will assume that Kurzweil is correct, that at some point during this century there will exist programmed computers that are the functional equivalents of humans.

Artificial intelligence ("A.I.") undercuts fundamental legal categories. Our law has been built on the assumption that all real persons are human beings with the characteristics of human beings. One of those characteristics is a well-defined identity. A program, however, can be copied. Once there is one human-level A.I. program, as many identical copies can be made as there is hardware available to run them. Which of these is the original? Which is guilty for his crimes and torts,

31. *Id.* at 40-50.

32. Such a technique could first be applied to the brain of someone recently dead, and later, when nondestructive techniques become available, to a living brain.

owns his property? The same problem arises for biological humans if they can be uploaded. After I have been copied into a computer, which version is really me: the one running on carbon or the one(s) running on silicon?

A closely related problem arises when we consider what it means for an A.I. to live or die. Suppose a human saves the A.I. program to mass storage and then turns off the computer. Has he just killed the A.I.? His defense is that he can always turn the computer back on, reload the copy, and have the A.I. back with, from its viewpoint, no time having passed. Does it become murder if he fails to first save the program in its current state, but has a backup of it as of a day earlier? What if he saves it but never plans to reboot? If I upload myself by a process that destroys the original, have I ended my life or extended it?

One possible response to these problems is for the law to close its eyes to the personhood of A.I. programs, interacting with them only through biological persons. In the short run this raises serious moral issues; it permits, for example, chattel slavery. In the long run, if Kurzweil's projections are correct, it becomes unworkable both because increasingly able A.I.'s will be unwilling to put up with it and because the distinction between biological people and A.I. people will become less and less sharp. Humans will be doing some of their thinking in silicon—and must do so if they are not to become obsolete with the further progress of the hardware A.I. runs on. Some programmed computers will in fact be uploaded humans, and in some cases the biological human may no longer exist.

D. Et Multae Caetera

I have described in some detail three areas in which new technology may require new law. There are many others. Consider, for example:

A major constraint on wiretapping at present is its high cost, mostly in law enforcement labor. The progress of speech- to-text software[33] promises to reduce that cost drastically, perhaps by orders of magnitude. It soon will be (if it is not already) practical for law enforcement to tap hundreds of thousand of

33. Commercial examples include Dragon Dictate, from Dragon Systems, Inc., and Naturally Speaking, from IBM Corp.

phones simultaneously, with a computer listening to and recording each call, notifying a human only if the message fits the criteria it has been programmed to check. A law enforcement agency might even argue that such taps do not require warrants, that until a human being listens to the recording the process is more analogous to a pen register than to a wiretap. When a human being wishes to listen to one recording out of a thousand, the fact that the computer reported that this particular recording met its criteria can be offered as evidence justifying a warrant. How will the courts and the law respond?

Surveillance technology is becoming increasingly cheap and, as computer pattern recognition, including facial recognition, improves, increasingly effective as a law enforcement tool. How will the law adapt to a world in which everything that happens in public places (and perhaps much that happens in nominally private places) can be almost instantly known and the information rapidly searched?[34]

The combination of computer networking and encryption makes possible a world of strong privacy where individuals can choose to interact anonymously, maintaining a cyberspace identity linked to a reputation while keeping strictly private the link between their cyberspace and realspace identities.[35] Such a world raises a set of intriguing legal issues. How do you sue for tort damages or enforce a contract when you have no idea what the defendant's name is, what he looks like, or what continent he lives on?[36]

IV. DOES NEW TECHNOLOGY REQUIRE NEW LAW?

I have described technological developments, past, current, and prospective, that have had or will have significant consequences for the law. There remains the question of whether all of them can be dealt with under existing legal rules,

34. *See* DAVID BRIN, THE TRANSPARENT SOCIETY: WILL TECHNOLOGY FORCE US TO CHOOSE BETWEEN PRIVACY AND FREEDOM? (1998) (discussing many of the issues raised by surveillance technology).

35. *See* Friedman, *supra* note 2.

36. *See* David Friedman, *Contracts in Cyberspace, at* http://www.daviddfriedman.com/Academic/contracts_in_%20cyberspace/contracts_in_cyberspace.htm (May 4, 2000).

properly understood, or whether at least some require legal innovation by judges or legislatures.

If legal rules are defined in sufficient breadth, legal innovation is never necessary. Most issues raised by new reproductive technologies, for instance, could be resolved by a single, non-novel, rule: define parentage in whatever way best serves the interests of the child. Indeed, it is arguably possible to resolve all legal issues by a single very broad rule: have whatever legal rules maximize economic efficiency.[37]

Such principles, however, are too broad to apply with predictable results at a reasonable cost. Hence legal systems employ significantly more specific statements of the law, such as the traditional rules for defining parentage, and fall back on general principles like efficiency only when such rules prove insufficient for dealing with hard cases or when changed circumstances require the development of new rules.

If what we mean by "new law" is "new legal rules at the level of generality of the rules now used to decide cases," it is clear that new technologies will at least sometimes require new laws. Legal rules that assume the identity of host mother and gene mother or take it for granted that paternity cannot be reliably determined are no longer useful in a world in which both assumptions are false—and the legal system has begun to alter itself accordingly. Legal rules that assume that a brief examination is sufficient to determine whether someone is alive or dead and that the latter status is irreversible might produce unfortunate results in the context of cryonic suspension. Rules that consider as legal persons only human beings or organizations of human beings and take it for granted that persons have the characteristics associated with human beings and human organizations will be wholly unsuited to a world of advanced artificial intelligence, when and if that world arrives. In these cases and many others, new technology requires new law.

37. *See* FRIEDMAN, *supra* note 8, at 21-24 (discussing whether the rule, originally proposed by Judge Richard Posner under the label of "wealth maximization," is desirable); *see also id.* at 297-308 (discussing whether the rule correctly describes the common law).