Computer Science and Intellectual Property

Joshua Beitelspacher

jj_beetle@ou.edu

Computer Science and Intellectual Property

As computer science has become increasing tied to other interests, intellectual property rights from both inside and outside the field have posed unique problems for the advancement of computer science as a scientific discipline. Influences of intellectual property rights from inside the field of computer science have impeded the free exchange of ideas within the field, and influences from outside the field have undermined research in areas where copyright owners have sought to gain strict control over all uses of their works. These intrusions of intellectual property rights into a scientific discipline have shown the potential to slow scientific progress in computer science. To promote the advancement of computer science, intellectual property rights must be handled in a well-balanced manner that takes all interests into account.

Computer science is currently positioned at the intersection of technology into almost every other field. As computers, and computer programs, become more useful for a wider variety of purposes, computer science is being applied to all aspects of society. Industries use computers to automate and optimize manufacturing processes. Scientific researchers in all fields use computer databases to organize information and calculate data. Copyright holders use computer networks to disseminate their holdings. Individuals use computers to communicate with others around the world (Denning 15-16). This unique position of computer science, at a convergence point of many others aspects of society, makes legal questions that were formerly outside the domain of computer science very important to the field. Also, long existing legal questions in computer science are given greater relevance by the extreme importance of the field to society as a whole.

The uniqueness of the computer science discipline has created two unprecedented legal questions. The first is the question of where computer programs fit into existing intellectual property laws. The second is the question of what copyright holders' rights should be in a digital environment. On the surface, these legal questions do not seem fundamentally different from many other intellectual property questions that can arise in the complicated field of copyright and patent law. Also, it is hard to see an immediate reason why these legal questions are important to the scientific discipline of computer science. The importance of these questions can only be understood after examining the implications that their potential answers pose for the uniquely positioned field of computer science.

Looking at even the most fundamental aspects of intellectual property rights can begin to hint at the problem. In the United States Constitution, Congress is given the authority "To promote the Progress of Science and the useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries" (qtd. in Johnson 144). This clause is the basis of intellectual rights in the United States (Johnson 144). From the simple wording, it is easy to see the underlying reason for intellectual property rights, to encourage scientific and cultural growth. In *Digital Copyright*, Jessica Litman sums up how intellectual property rights encourage scientific and cultural progress:

> Copyright was a bargain between the public and the author, whereby the public bribed the author to create new works in return for limited commercial control over the new expression the author brought to her works. The public's payoff was that, beyond the borders of the authors' defined exclusive rights, it was entitled to enjoy, consume, and learn from, and reuse the works. (78)

As described by Litman, copyright is a careful balance between encouraging people to create new works and allowing people to build on previous works. If authors do not have an incentive to create new works, society will suffer. Also, if people cannot build on previous works, progress will be stunted (Litman 78). In the case of computer science, the balance of intellectual property rights can influence the scientific progress of the field.

The effect of intellectual property on scientific fields is still hard to justify, because science and intellectual property are usually thought of as mutually exclusive. This view comes from one of Robert Merton's norms of pure science. "Communism" is Merton's explanation of the scientific ideal of free information exchange (Merton 273). In "communism" all ideas are shared and it is selfish for a scientist to not share his or her studies (274). Private ownership of scientific concepts as intellectual property goes strongly against this scientific norm. Acknowledging this discrepancy, Merton states, "the communism of the scientific ethos is incompatible with the definition of 'private property' in a capitalist economy" (275). The positioning of computer science at the convergence of theoretical science and applied technology makes the norm almost impossible to follow.

The capitalist economy immediately seeks to apply new computer science principles to solve real world problems and has a vested interest in maintaining ownership of the result. Software producers attempt to use intellectual property laws to keep competitors out of the market for as long as possible, in order to make back the high expenses of developing innovative software and maximize profits thereafter (Davis et al. 26). However, software companies are not necessarily stealing innovations from the scientific and academic side of the computer science discipline. Instead, the software companies are creating and marketing their own innovations, and can make a solid argument for stronger intellectual property rights (27-28).

Much of the research at the cutting edge of the field is occurring in industrial settings rather than under traditional academic computer scientists (Denning 18). However, the setting where most of the advancement is occurring is not surprising because of the nature of the field. According to Davis, Samuelson, Kapor, and Reichman, "progress in software is typically innovative, not inventive" (Davis et al. 23). They suggest that while some scientific fields advance by major inventions, advances in computer science are more often comparatively small innovations (24). These small innovations are coming from the people doing day-to-day activity on commercial computer programs. Peter Denning characterizes the computer science field in this way:

> Computer scientists are the inventors and visionaries, but the field is being driven by the large numbers of pragmatists who are the users of the field and include many powerful business, civic, government, and industry leaders. Computer scientists need to come to grips with the fact that they are no longer in control of the field. They do not call the shots. Their research is not the driving force behind most IT [information technology] innovations. (Denning 18)

Looking at the computer science field from this angle makes intellectual property rights seem far less damaging to the field.

The connection between intellectual property rights and progress in the field is made much clearer from this realization. As leading innovators, the businesses involved have a fundamental desire, and arguably a right, to profit from their innovations. The goal of most businesses is to profit from marketing successful products. To achieve this end, it is often necessary to protect a product from being undersold, and intellectual property rights are one of the best ways for businesses to hold their positions in free markets (Davis et al. 26-27). In this way, intellectual property rights provide a secure position for businesses with established products and encourage new competitors to enter the field, confident that their investments will be worthwhile (27). Intellectual property can be a powerful tool for encouraging industry to take an active role in the scientific growth of computer science.

Merton's scientific norm of "communism" and the idea of intellectual property rights in the sciences are fundamentally opposed but both have their relative merits in the case of computer science. The analogy of intellectual property as a balance between "communism" and complete ownership has much importance to computer science, as does the setting of that balance at a level that encourages as much scientific growth as possible. This is a very divisive issue, where good arguments are possible from both extremes. A central issue to both sides is the idea that existing intellectual property laws fit computer science very poorly (Johnson 143).

None of the three types of intellectual property protections, copyrights, patents, and trade secrecy laws, seem fitting for computer programs, the end result of applied computer science. Copyrights cover the artistic expression present in both the source code and the final program, but not the functionality of the program (Davis et al. 22). Patents cover major innovations, but not the minor improvements that characterize the normal incremental advancement that occurs in the field of computer science. To be covered under a patent, an advancement must be non-obvious to a knowledgeable source, a standard that most incremental advances fail to meet (24). This has meant that computer programs have been hard to cover under existing laws (23). The only remaining option for software producers is to use trade secrecy laws. However, because most software needs to be easy for end users to understand, much of the functionality and inner workings of the software is given away through the user interface as soon as it sold commercially, voiding trade secrecy protection (24).

The question of whether new intellectual property laws have to be created to accurately fit computer science issues, and what those laws should state, is one of the two fundamental legal debates concerning computer science and intellectual property. From what has already been discussed, it has been suggested that the best solution should be a balanced one, in accordance with the intellectual property clause in the Constitution. However, doing this is far from easy and may require a radical change from existing law (Johnson 142).

The most contentious part of the debate has centered on patent protection. In addition to the rule that the advancement must be non-obvious, there are also strong limitations on what can be patented (Johnson 150). For computer science, the most important of these limitations is the inability to patent mental operations. Algorithms in computer programs are complicated processes, but often ones that could be performed either mentally or with paper and pencil. Because of this, a patent on an algorithm could give a company or individual complete control over all executions of a mental process (Samuelson, “Should” 24). In recent years, the problem of mental processes has become less problematic as courts have set limits on what types of algorithms can be patented and in what situations those patents should apply (Johnson 151; Samuelson, “Should” 24-26).

The concern has shifted to the consideration of mathematical algorithms as “building blocks of science and technology” (Johnson 151). In a very extreme example posed by computer scientist Allen Newell, the mathematical concept of addition could itself be patented (Samuelson, “Should” 26). The result of a patent on such a fundamental technique could be devastating to the field (Johnson 151). Every program that needed to use addition would be forced to license it from the patent holder (152). Luckily, this extreme example is unlikely to happen, because patent law strictly prohibits patents on mathematical operations (150). However, all programs are sequences of logical steps performed in specific order to accomplish a certain goal, and drawing a line between an unpatentable series of mathematical operations and a patentable computer program is almost impossible to do (151).

Where this line is set can have great implications for the field. If too much is patented, the price of entry into the field will increase, because software firms will have to do expensive patent searches and pay high licensing fees before new software can be put on the market (Johnson 152). Small firms would be unable to pay the high price of entry into the field, and the significant innovations they produce would be lost (Samuelson, “Should” 27). Yet at the same time, better legal protection may encourage more firms to develop truly innovative products that significantly advance computer science (Litman 80).

There are several proposed solutions to the patent debate. One argument suggests that too much has already been patented and proposes a law making software unpatentable (Johnson 152). Another proposes returning to a very conservative approach when granting patents to software, arguing that patents have a place as long as they do not block access to the fundamental building blocks of computer science (Samuelson, “Should” 27). A third argument asks for a new registration system, designed to take the place of patents, with a much shorter active life (Davis et al. 28). Patents last seventeen years, far too long in the rapidly changing computer science field (Johnson 149). The final argument is to leave the current system alone, because it is doing well enough on its own (152).

The patent issue, and the overall intellectual property issue, should each be solved in the spirit of the copyright clause in the Constitution. An approach that maximizes the scientific progress of computer science should be the ideal goal. However, there is more to consider than just computer science. As mentioned earlier, computer science is at a convergence point of theoretical science and applied technology. The intellectual property balance set within the borders of computer science has the potential to affect other interests. These affected interests should be considered when setting the balance. For example, when other scientific fields require the use of specialized computer programs they have an interest in being able to make free use of computer algorithms with relevance to their subject matter. In this way, the advancement of other scientific disciplines can be linked to computer science.

The potential link between intellectual property rights of computer science and those of other fields is shown even more clearly in the opposite direction. Intellectual property rights of outside fields can have a detrimental impact on the advancement of computer science. The second fundamental legal question comes from one such intrusion of outside intellectual property rights into computer science. The primary question is what copyright holders' rights should be in a digital environment. This question has emerged as computer science has converged into areas where copyright holders seek to gain strict control over the access and use of their content holdings.

Computers and the Internet have had an undeniable effect on the way people listen to and watch copyrighted media content in their homes. This is understandably very troubling to large content holders. The Recording Industry Association of America (RIAA) was very concerned as home Internet users flocked to MP3 music and services like Napster (Litman 158). In the same way, the Motion Picture Association of America (MPAA) has strong objections to pirated movies being traded freely across the Internet (Peterson). The Internet has stepped into the domain of media content holders, and they have an interest in extending existing copyright protections into the digital word (Litman 90-91).

The economy of the United States also has an interest in securing rights for content holders on the Internet. As technology has become linked more and more with the economy, the Internet has been an increasingly important part of the economy. To maintain economic dominance world-wide, the United States Government has an interest in getting content holders to embrace the Internet, and a good way to do this is to ensure them that their holdings will be protected, even in digital form (Litman 90).

The United States took this issue to the world. In December 1996, the United States presented a draft of a new copyright treaty before the World Intellectual Property Organization (WIPO), an agency of the United Nations. While some of the more extreme elements were removed before the treaty was signed, one article that was potentially dangerous to computer science still made it through. This article stated that technological measures that prevent unauthorized use must be protected by law, but was limited in its implementation (Litman 128-31). Next, the Digital Millennium Copyright Act (DMCA) was passed in the United States to put the treaty into effect. However, this legislation went past the WIPO Treaty and offered much stronger protection for technological measures, in other words it had much stronger anticircumvention regulations (Samuelson, “Why” 21).

Industry experts had hinted at a possible threat to science very early, but several United States court cases showed beyond a doubt the effect of the anticircumvention rules on computer science. Three court cases, *Universal City Studios, Inc. v. Reimerdes*, *Felten v. RIAA*, and *United States v. Sklyarov*, have been instrumental in showing the effects. Each one has shown how the DMCA has a potential to slow scientific progress, however the Felten case has presented issues most directly related to the subject of computer science research (Samuelson, “Anticircumvention” 2028; Kelleher).

Princeton University Professor Edward Felten took a challenge put forth by the Secure Digital Music Initiative (SDMI) to attempt to break several copyright management information candidate technologies. These technologies consisted of digital watermarks embedded in secure formats that could not be played if the digital watermark was absent. Felten’s group successfully broke some of the technologies and intended to publish a paper on their results, but SDMI and RIAA claimed that any publication of their results would violate the DMCA. Felten decided to challenge the claim, and brought his position to court with the backing of the Electronic Frontier Foundation (Samuelson, “Anticircumvention” 2028).

Felten has received wide support. One of his most credible sources of support has been the Association for Computing Machinery (ACM), a large organization of computing professionals and students. ACM filed a declaration in the case and outlined their reasons for doing so in a recent journal article:

> ACM's various publications have published articles on topics such as watermarks, encryption, authentication, access control systems, tamper resistance, and threat and vulnerability assessment. If any of these articles could be interpreted as dealing with "a technological measure [that] effectively controls access to a work," ACM may find itself at risk. (Simons 24)

The article goes on to note that the DMCA could have "significant implications for encryption research and development" and "could be used to prevent reverse engineering for the purpose of detecting bugs in software, [and] removing viruses" (26). The position of ACM goes right to the heart of the matter in showing the negative consequences that the DMCA can have on scientific research. By limiting legal subject matter, the DMCA can slow, or even stop, scientific progress in the affected subject areas.

Regrettably, rather than seeing the mistakes made in the United States, the European Union "Directive on the Harmonisation of Copyright" was recently passed with language strikingly similar to the DMCA. This was noted in an article in the *Irish Times*, as was the important role that the United States is playing in deciding the extent of copyright protection. The *Irish Times* stated, "this is an issue that will be decided in the US courts and it may determine the future development of the Internet and the Information society" (Kelleher).

The balance of intellectual property rights has been shifted too far in favor of content holders without considering the effects that strict copyright legislation can have on other fields. Although the DMCA might be a reasonable law from a media producer's standpoint, the effects of the law on other interests must be taken into account in order to live up to the Constitution's goal of promoting "the Progress of Science and the useful Arts." Even now, a new piece of legislation, the “Security Systems Standards and Certification Act,” that could be even more damaging to the interests of computer science, has been proposed (Simons and Spafford). The entertainment industry, with powerful groups such as RIAA and MPAA, currently has a lock on producing new copyright bills that inevitably favor their interests above those of all other groups (Litman 63). Scientific groups like ACM must fight to be heard in order to finally set the intellectual property balance at a level that promotes the ideals that the Constitution originally presented.

Setting the intellectual property balance is a very difficult and complicated thing to do, with far reaching implications. The proper balance also depends on what society values, because the rights of one party will always infringe upon the rights of other parties. The two fundamental questions, where computer programs fit in intellectual property law and what copyright holders’ rights should be in a digital environment, both seek to set the balance of intellectual property at a level that promotes the most scientific and cultural growth, relative to society’s values. Sixty-three years ago Robert Merton wrote, “as pure science is eliminated, science becomes subject to the direct control of other institutional agencies and its place in society becomes increasingly uncertain” (Merton 260). In the case of computer science this is undeniably true. However, if intellectual property rights can be balanced at an appropriate level, the effect for computer science might not necessarily be negative. Well-balanced intellectual property rights may actually accomplish their intended purpose and promote progress.

Works Cited

Davis, Randall, Pamela Samuelson, Mitchell Kapor, and Jerome Reichman. "A New View of Intellectual Property and Software." Communications of the ACM 39.3 (March 1996): 21-30.

Denning, Peter J. "Who Are We?" Communications of the ACM 44.2 (Feb. 2001): 15-19.

Johnson, Deborah G. Computer Ethics. 3rd ed. Upper Saddle River, NJ: Prentice Hall, 2001.

Kelleher, Denis. "Confusion over Copyright and Free Speech." The Irish Times [Dublin] 27 Aug. 2001: 8.

Litman, Jessica. Digital Copyright. Amherst, NY: Prometheus Books, 2001.

Merton, Robert K. The Sociology of Science: Theoretical and Empirical Investigations. Chicago: University of Chicago Press, 1973.

Peterson, Kim. "Online Pirates Raid the Movies." San Diego Union-Tribune 7 July 2001: A1.

Samuelson, Pamela. "Anticircumvention Rules: Threat to Science." Science 293 (14 Sept. 2001): 2028-31.

Samuelson, Pamela. "Should Program Algorithms be Patented?" Communications of the ACM 33.8 (Aug. 1990): 23-27.

Samuelson, Pamela. "Why the Anticircumvention Regulations Need Revision." Communications of the ACM 42.9 (Sept. 1999): 17-21.

Simons, Barbara, and Eugene H. Spafford. Letter to Senate Committee on Commerce, Science, and Transportation. 26 Sept. 2001. 7 Dec 2001 <http://www.acm.org/usacm/SSSCA-letter.html>.

Simons, Barbara. "The ACM Declaration in Felten v. RIAA." Communications of the ACM 44.10 (Oct. 2001): 23-26.