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An Uneasier Case for Copyright Than for Patent Protection of Computer Programs

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A. Samuel Oddi*

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I. INTRODUCTION

The ongoing controversy over intellectual property protection for computer programs is the latest battle in the centuries-old war be-

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* Professor of Law, Northern Illinois University College of Law. The author wishes to acknowledge the valuable research assistance provided by Kristin L. Chapman, Paul C. Craane, Thomas F. Darin, and Sheila M. Heitke in the preparation of this article and to thank them for their efforts. It is also acknowledged that the Illinois Bar Foundation provided financial aid to Ms. Chapman.
tween those who favor intellectual property protection and those who oppose it. The conflict over computer programs, however, has an internecine aspect—if you will, a civil war among protectionists. It is not so much a question of whether computer programs should be protected, but rather which form of protection should be the exclusive or even dominant one. These combatants may be loosely grouped into various camps: pro-copyright, pro-patent, pro-sui generis (a separate title of protection), and those favoring or opposing various combinations of the foregoing. There are, of course, some anti-protectionists.

1. The first patent statute was enacted in Venice in 1474. See Giulio Mandich, Venetian Patents (1450-1550), 30 J. PAT. OFF. SOC'Y 166, 176-77 (1948)(translating the statute). The English Monopolies Act of 1623 permitted the granting of patents on inventions as an exception to the general exclusion of monopolies. Statute of Monopolies Act, 1623, 21 Jac. 1, ch. 3, reprinted in 33 HALSBURY'S STATUTES OF ENGLAND AND WALES 5-7 (1987). The sense of the times following the American Revolution is reported in Graham v. John Deere Co., 383 U.S. 1, 7-8 (1966): Jefferson, like other Americans, had an instinctive aversion to monopolies. It was a monopoly on tea that sparked the Revolution, and Jefferson certainly did not favor an equivalent form of monopoly under the new government. His abhorrence of monopoly extended initially to patents as well. From France, he wrote to Madison (July 1788) urging a Bill of Rights provision restricting monopoly, and as against the argument that limited monopoly might serve to incite "ingenuity" he argued forcefully that "the benefit even of limited monopolies is too doubtful to be opposed to that of their general suppression," V Writings of Thomas Jefferson, at 47 (Ford ed., 1895).

The first U.S. patent was enacted in 1791. Act of April 10, 1790, ch. 7, 1 Stat. 109-112 (1790). In the latter half of the nineteenth century, significant anti-patent sentiment developed calling for the abolishment of existing patent systems. See EDITH PENROSE, THE ECONOMICS OF THE INTERNATIONAL PATENT SYSTEM 12-17 (1951); Fritz Machlup and Edith Penrose, The Patent Controversy in the Nineteenth Century, 10 J. ECON. HIST. 1 (1950). The U.S. may currently be said to be in a pro-patent phase after a half century of anti-patent sentiment. See infra note 243.

The first English copyright statute was enacted in 1709. Statute of Anne, 1709, 8 Ann., ch. 19 (Eng.). Opposing the extension of the term of copyright, in a speech before the House of Commons (Feb. 5, 1841), Thomas Macaulay argued: It is good that authors should be remunerated; and the least exceptional way of remunerating them is by a monopoly. Yet monopoly is an evil. For the sake of the good we must submit to the evil; but the evil ought not to last a day longer than is necessary for the purpose of securing the good.


who would favor little, if any, intellectual protection for computer
programs.3

Under the current state of the law, it can be said with a reasonable degree of legal certainty that computer programs4 (including algorithms)5 qualify as the subject matter of both copyrights6 and patents,7

3. See, e.g., Mitchell D. Kapor, co-creator of Lotus 1-2-3, who in testimony before a congressional subcommittee stated:

Congress could help both the software industry and its customers if, when it passes laws, their legislative histories tell the courts that when they consider a copyright case, they should err on the side of innovation over protection.


4. Computer program will generally be used interchangeably with “software” as sets of instructions for computers, with the understanding that software may be more broadly defined as also including databases. See U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, COMPUTER SOFTWARE & INTELLECTUAL PROPERTY: BACKGROUND PAPER 1 n.1 (March 1990), [hereinafter OTA BACKGROUND PAPER].


5. A distinction can be drawn between a computer program and an algorithm in the sense that an algorithm is expressed at a higher level of abstraction which must be transformed along with implementing details into a computer program for use in a computer. See OTA BACKGROUND PAPER, supra note 4, at 2. Justice Stevens, in dissent in Diamond v. Diehr, 450 U.S. 175, 219 (1981), unsuccessfully urged the Court to provide an “unequivocal explanation that the term 'algorithm' . . . is synonymous with the term 'computer program.'” See also Allen Newell, Response: The Models are Broken, the Models are Broken!, 47 PITT. L. REV. 1023, 1029 (1986)(maintaining that algorithms and programs are indistinguishable). An important legal distinction made with respect to algorithms is between mathematical and nonmathematical algorithms. The genesis of this distinction is found in Gottschalk v. Benson, 409 U.S. 63, 65 (1972), where the Court defined “[a] procedure for solving a given type of mathematical problem . . . as an ‘algorithm.’” The Court then went on to hold that such a “mathematical algorithm” did not constitute patentable subject matter under 35 U.S.C. § 101 (1988). Id. at 71-72.

The Court, however, cautioned: “It is said that the decision precludes a patent for any program servicing a computer. We do not so hold.” Id. at 71.

The Court of Customs and Patent Appeals (CCPA) and its successor the Court of Appeal for the Federal Circuit (CAFC) and finally the Patent and Trademark Office (PTO) have taken the distinction between mathematical and nonmathematical algorithms seriously. See infra notes 253-258 and accompanying text. In a recent CAFC case, Judge Rich summarized as follows:

We note these discussions of the meaning of “algorithm” to take the mystery out of the term and we point out once again that every step-by-step process, be it electronic or chemical or mechanical, involves an algorithm in the broad sense of the term. Since § 101 expressly includes processes as a category of inventions which may be patented and § 100(b) further defines the word “process” as meaning “process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material,” it follows that it is no ground for holding
with perhaps a caveat in copyright law to account for the possibility of

a claim is directed to nonstatutory subject matter to say it includes or is
directed to an algorithm. This is why the proscription against patenting
has been limited to mathematical algorithms and abstract mathematical
formulae which, like the laws of nature, are not patentable subject
matter.

In re Iwahashi, 888 F.2d 1370, 1374 (Fed. Cir. 1989). See infra note 262 for a dis-
cussion of this case. See also Newell, supra, at 1024, who from the viewpoint of a
computer scientist, maintains that such a distinction is "doomed." The distinction
will be made herein whenever it is deemed pertinent.

6. 17 U.S.C. § 102(a)(1988) defines copyrightable subject matter as:

Copyright protection subsists, in accordance with this title, in original works
of authorship fixed in any tangible medium of expression, now known or later
developed, from which they can be perceived, reproduced, or otherwise communi-
cated, either directly or with the aid of a machine or device. Works of authorship
include the following categories:
1. literary works;
2. musical works, including any accompanying words;
3. dramatic works, including any accompanying music;
4. pantomimes and choreographic works;
5. pictorial, graphic, and sculptural works;
6. motion pictures and other audiovisual works;
7. sound recordings; and
8. architectural works.

Although the Supreme Court has not ruled directly on the statutory subject issue under
§ 102, lower courts have uniformly held that computer programs are copyrightable sub-
Electronics, Inc. v. Artie Int'l, Inc., 685 F.2d 870, 875 (3d Cir. 1982)(both source and ob-
ject code statutory subject matter); Apple Computer, Inc. v. Franklin Computer Corp.,
714 F.2d 1240, 1249 (3d Cir. 1983), cert. dismissed, 464 U.S. 1033 (1984)(operating system
programs in source and object code statutory subject matter fixed in a read-only mem-
ory); accord, Apple Computer, Inc. v. Formula Int'l, Inc., 725 F.2d 521, 525 (9th Cir.
1984).

Paragraph (b) of 17 U.S.C. § 102 (1988) defines the subject matter that is excluded
from being copyrightable:

In no case does copyright protection for an original work of author-
ship extend to any idea, procedure, process, system, method of operation,
concept, principle, or discovery, regardless of the form in which it is de-
scribed, explained, illustrated, or embodied in such work.

It may be interesting to speculate on how the Copyright Act definition of a com-
puter program may be distinguished from a "procedure" or a "process" or a
"method of operation," as excluded by § 102(b).

7. Patentable subject matter is defined in 35 U.S.C. § 101:

Whoever invents or discovers any new and useful process, machine,
manufacture, or composition of matter, or any new and useful improve-
ment thereof, may obtain a patent therefor, subject to the conditions and
requirements of this title.

This is an exclusive listing compared to the nonexclusive listing in § 102(a) of the
Copyright Act. "The use of the word 'include', as defined in section 101, makes
clear that the listing is 'illustrative and not limitative', and that the seven catego-
ries do not necessarily exhaust the scope of 'original works of authorship' that the

After a rough start in Benson and then in Parker v. Flook, 437 U.S. 584
(1978)(holding that tacking on insignificant post-solution activity to an algorithm
did not qualify as patentable subject matter), the Supreme Court held in Dia-
the merger of idea and expression\textsuperscript{8} and a caveat in patent law to ac-

\textsuperscript{8} The doctrine of merger has been described as follows:

We have already seen that copyright protects expression but that ideas are statutorily free to all. In some circumstances, however, there is a "merger" of idea and expression, such that a given idea is inseparably tied to a particular expression. In such instances, rigorously protecting the expression would confer a monopoly over the idea itself, in contravention of the statutory command. To prevent that consequence, courts have invoked the merger doctrine. In other words, given the dilemma either of protecting original expression even when that protection can be leveraged to grant an effective monopoly over the idea thus expressed, or of making the idea free to all with the concomitant result that the plaintiff loses effective copyright protection even over the precise original expression used, copyright law chooses the latter course.

3 MELVILLE B. NIMMER & DAVID NIMMER, NIMMER ON COPYRIGHT § 13.03(B)(3) (1992) (footnotes omitted) [hereinafter NIMMER ON COPYRIGHT] Nim-

mer concludes, however, that merger is better considered as a defense to infringe-

ment rather than a bar to copyrightability. Id. at 13-66 to 13-67.

An example where this doctrine was applied with respect to computer pro-

grams is Synercom Technology, Inc. v. Univ. Computer Co., 462 F. Supp. 1003 (N.D. Tex. 1978) (organization and configuration of input formats ideas not ex-

pression). Cf. Whelan Assocs., Inc. v. Jaslow Dental Lab., Inc., 797 F.2d 1222, 1239-40 (3d Cir. 1986) [cert denied, 485 U.S. 1031 (1987)] (rejecting reasoning of Synercom and holding the structure, sequences and organization of a program expression. See also Plains Cotton Coop. Assn. v. Goodpasture Computer Serv., Inc., 807 F.2d 1256, 1262 (5th Cir.), [cert denied, 484 U.S. 821 (1987)] (rejecting Whelan approach and indicating that the similarities between the programs were "dictated by the externalities of the cotton market").

Professor Goldstein analyzes the divergent approaches of Synercom and Wh-

elan as follows:

The Synercom approach starts from the program's literal expression and characterizes as the program's unprotected "ideas" all elements whose monopolization will disable public access to its functions. The Whelan approach starts at the opposite pole, with the work's most fundamental idea—in Whelan the idea of "the efficient management of a dental labora-

tory"—and characterizes all remaining elements as protectible "expression."

Of the two approaches to the idea-expression distinction in computer programs, the Synercom approach conforms more closely to the traditional principles that underlie the distinction. Whelan's error was in treating the program's animating concept—the idea of an efficiently
count for ineptness or overzealousness in claiming. Starting from the premise of overlapping protectability, this article will analyze in a comparative manner the economic case in Part II and the general (legal and policy) case in Part III for the respective systems of copyright and patent protection for computer programs (including algorithms). In Part II, a model will be introduced for evaluating the costs and benefits of the respective systems. This model will consider whether the current systems of patent or copyright production induce a high yield of inventions or works of authorship directed to computer programs that would not otherwise be created but for the respective protective systems. In addition, the present systems will be evaluated to determine whether the incentives they provide are excessive, unnecessary, and costly in view of other, particularly market, incentives for the creation of computer programs. Next, various models of the interfaces of the patent and copyright systems as they relate to computer programs will be analyzed, with particular attention paid to the economic consequences that may result from a particular legal determination of the interface model.

In Part III, legal and policy considerations will be comparatively addressed as they relate to the general case for or against patent protection for computer programs, including: the anti-patent sentiment; protection of processes not involving the transformation of matter, including methods of doing business, in an evolving service economy; the specter of patent infringement by thinking; the constitutionality of managed dental laboratory—as the work's only idea, and in overlooking that "idea" in copyright law is only a metaphor for those elements that copyright principle requires to go unprotected.

1 PAUL GOLDSTEIN, COPYRIGHT § 2.15.2, at 210 (1989)(footnotes omitted)[hereinafter GOLDSTEIN, COPYRIGHT].

9. With the wisdom borne of Diehr and more recent CAFC cases such as In re Iwahashi, 888 F.2d 1370 (Fed. Cir. 1989), it appears that the claims in Benson and Flook could be re-drafted by a competent claim drafter to conform to the evolved standard under § 101. In Diehr, Justice Stevens pointed out that the distinction between Diehr and Flook was not in the inventions but in how they were claimed. Diamond v. Diehr, 450 U.S. 175, 211 n.32 (1981). He quotes from an article, in which the claims in Diehr were converted to the Flook style. See David A. Blumenthal & Bruce D. Riter, Statutory or Non-Statutory?: An Analysis of the Patentability of Computer Related Inventions, 62 J. PAT. OFF. Soc'y 454, 505 (1980). The converse, from Flook to Diehr style, should present no drafting problem, with the proviso that a transformation of matter is not required to satisfy the definition of a process, under § 101. See infra text accompanying notes 263-272.

Overzealousness in claiming may be seen in cases such as In re Grams, 888 F.2d 835 (Fed. Cir. 1989) and In re Meyer, 688 F.2d 789 (C.C.P.A. 1982), where no reference is made in the claims to computer programs or functions. For example, in Meyer, at oral argument applicants' counsel admitted that "the claims recite a mathematical algorithm, which represents a mental process that a neurologist should follow." In re Meyer, 688 F.2d 789, 795 (C.C.P.A. 1982). See infra text accompanying notes 273-296 (discussing the mental process doctrine in patent law).
protecting programs by both copyright and patent; assumptions concerning a causal relation between intellectual property and the growth of the computer industry; and advocacy for and problems associated with the establishment of a sui generis system of protection for computer programs.

The conclusions drawn, on a relative basis, are that a somewhat easier (but not an entirely easy) overall case can be made for patent protection of computer programs than for copyright protection under the current state of patent and copyright law and that a sui generis system offers speculative advantages, at best, over the present systems.

II. THE ECONOMIC CASE

A. Benefits and Costs of Patent and Copyright Systems

Article I, section 8, clause 8 (the patent/copyright clause) of the Constitution grants Congress the power: "To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." The intent of the clause appears to be instrumentalist in philosophy, although there would seem to be an underlying moralistic

10. Both James Madison and Charles Pinckney submitted proposals for this clause. It was adopted without debate. See Karl Fenning, *The Origin of the Patent and Copyright Clause of the Constitution*, 17 GEO. L.J. 109, 112-14 (1929). Written in a style typical of the late nineteenth century, this clause may be dissected into two parallel subclauses, with "Science," "Authors," and "Writings" referring to copyrights ("Science" at that time meaning "knowledge" in general) and with "Useful Arts," "Inventors," and "Discoveries" referring to patents. See 1 ERNEST BAINBRIDGE LIPSCOMB III, WALKER ON PATENTS § 2:1 at 73 (3d ed. 1984).

The constitutional language with respect to copyrightable works is "writings." This is reflected in the Copyright Act of 1909: "The works for which copyright may be secured under this title shall include all the writings of an author." § 4, 61 Stat. 654, (1947). In the Copyright Act of 1976, 17 U.S.C. § 102(a), copyrightable subject matter is referred to as "works of authorship." See infra note 333, for further discussion on the narrower formulation of the 1976 Act.

The word "discovery" is used in the patent/copyright clause with the evident intent to mean "invention." In the Patent Act, 35 U.S.C. § 100 (1988), the term "invention" is tautologically defined to mean "invention or discovery."

11. Instrumentalist in the sense of its intent to produce a net benefit to society in exchange for the grant of exclusivity. The underlying theory is that a patent is a privilege granted in exchange for providing society with an invention. With respect to patents, see STAFF OF SENATE SUBCOMM. ON PATENTS, TRADEMARKS AND COPYRIGHTS, 85TH CONG., 2D SESS., AN ECONOMIC REVIEW OF THE PATENT SYSTEM, STUDY No. 15 (Comm. Print 1958)(Fritz Machlup auth.); hereinafter Machlup and PENROSE, *supra* note 1, where two economic theses are analyzed. The first is the "monopoly-profit-incentive" thesis to the effect that a lottery-type of patent system is needed in order to induce sufficient investment in inventions. Machlup, *supra*, at 21, 25; PENROSE, *supra*, at 26-31. The second is the "exchange-for-secret" thesis, where the system induces an inventor to disclose the invention
COMPUTER PROGRAM PROTECTIONS

aspect, at least for true believers. The legislation implementing this clause, thus, should be designed to promote "science" and the "use-

that would otherwise be kept secret. Machlup, supra, at 24-25; Penrose, supra note 1, at 32-34.

With respect to copyright, see Breyer, supra note 2 (questioning copyright protection on moral and economic rationales). Cf. Barry W. Tyerman, The Economic Rationale for Copyright Protection for Published Books: A Reply to Professor Breyer, 18 UCLA L. REV. 1100 (1971) (challenging Breyer's economic conclusions).

12. The natural rights or property theory of intellectual property is reflected in the French Patent Act of 1791, where the right to an invention is one of the "rights of man" and not dependant on the state granting a privilege. Machlup, supra note 11, at 22. But see, A. Samuel Oddi, Beyond Obviousness: Invention Protection in the Twenty-First Century, 38 AMER. L. REV. 1097, 1105 (1989) [hereinafter Oddi, Invention Protection], discussing the qualifications on the grant as reflecting less than a pure-right system. See Machlup, supra note 11, at 21, 23, and Penrose, supra note 1, at 26-31, for a critical discussion of the natural-law thesis.

Indeed, Thomas Jefferson was critical of this theory, as indicated in Graham v. John Deere Co., 383 U.S. 1, 8 n.2 (1966) (quoting a letter from Jefferson to Isaac McPherson in 1813):

It would be curious then, if an idea, the fugitive fermentation of an individual brain, could, of natural right, be claimed in exclusive and stable property. . . . That ideas should freely spread from one to another over the globe, for the moral and mutual instruction of man, and improvement of his condition, seems to have been peculiarly and benevolently designed by nature . . . and like the air in which we breathe, move, and have our physical being, incapable of confinement or exclusive appropriation. Inventions then cannot, in nature, be a subject of property.

A second moralistic theory is that justice requires a reward proportionate to the invention's usefulness to society. See, e.g., Penrose, supra note 1, at 29-30, concluding that justice cannot be guaranteed, noting the relative importance of scientific discoveries to commercially successful inventions. See also Breyer, supra note 2, at 284-91, who critically discusses the moral justification for copyright protection on a property or reward theory. See generally Tom G. Palmer, Are Patents and Copyrights Morally Justified? The Philosophy of Property Rights and Ideal Objects, 13 HARV. J.L. & PUB. POL. 817 (1990); Dale A. Nance, Foreword: Owning Ideas, 13 HARV. J.L. & PUB. POL. 757 (1990).

13. The First Congress enacted both copyright and patent legislation. The Copyright Act of May 31, 1790, ch. 15, 1 Stat. 124, protected charts and books, being patterned after the Statute of Anne, 1709, 8 Ann., ch. 19 (Eng.). The Patent Act of April 10, 1790, ch. 7, 1 Stat. 109-112, protected "any useful art, manufacture, engine, machine, or device, or any improvement therein not before known or used. . . ." Id. at 110.

14. The late Eighteenth century definition of "science" is broader than its modern one. It is perhaps better translated today as "knowledge." See supra note 10. Some authors in the context of computer programs have begun equating "science" with "liberal arts." See, e.g., Samuelson, Benson Revisited, supra note 2, at 1112, 1129 n.414. Presumably, this usage is to avoid any implication that there may be some overlap between the subject matter of copyright and patent if the broader term "knowledge" were used to translate "science." See infra text accompanying notes 186-202, for a discussion of the potential overlap. See also, Karl B. Lutz, Patents and Science: A Clarification of the Patent Clause of the U.S. Constitution, 18 GEO. WASH. L. REV. 50 (1949), (arguing against any overlap on the rationale that this would have the potential for placing too high a qualitative
ful arts" by providing the incentive of time-limited exclusivity for the creation of writings and inventions. The overall benefit hence to be obtained by society by virtue of the copyright and patent systems is that writings and inventions will be made publicly available through marketing or, at least, by disclosing them, for improving the overall efficiency of the economy and the general well-being. With such incentives, works of authorship and inventions that might not otherwise be made, or that would otherwise be delayed, will be made available to society and redound to its benefit.

Whether the patent and copyright statutes have served this instrumentalist purpose over the past two hundred plus years would seem to depend upon the validity of two underlying assumptions. The first is

standard for patent protection if both the useful arts and science have to be promoted).

15. Perhaps a modern day translation of the term “useful arts” would be “industrial arts” or “technology” or “technological arts.” Although the term has never caught on in the United States, “industrial property” is commonly used throughout the world. As stated in Paris Convention for the Protection of Industrial Property, signed at Stockholm, July 14, 1967, Art. 1(2) - (3)[hereinafter Paris Convention]:

(2) The protection of industrial property has as its object patents, utility models, industrial designs, trademarks, service marks, trade names, indications of source or appellations of origin, and the repression of unfair competition.

(3) Industrial property shall be understood in the broadest sense and shall apply not only to industry and commerce proper, but likewise to agricultural and extractive industries and to all manufactured or natural products, for example, wines, grain, tobacco leaf, fruit, cattle, minerals, mineral waters, beer, flowers, and flour.

The term “intellectual property” is of more recent vintage and is now used as the generic term:

“[I]ntellectual property” shall include the rights relating to:
— literary, artistic and scientific works,
— performances of performing artists, phonograms, and broadcasts,
— inventions in all fields of human endeavor,
— scientific discoveries,
— trademarks, service marks, and commercial names and designations,
— protection against unfair competition, and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields. Convention Establishing the World Intellectual Property Organization, signed at Stockholm, July 14, 1967, Art. 2 (viii).

Technology or technological arts, on the other hand, may have a broader connotation than “industrial arts,” if there is any implication that the word “industrial” is limited to the production of goods and does not extend to the provision of services. The Copyright Act of 1790 included “useful arts” as one of the statutory classes. See supra note 13. In this context “art” may be better translated today as “process or method.” In the current patent act the term “process” is defined to mean “process, art or method . . . .” 35 U.S.C. § 100.

16. See infra text accompanying notes 58-69 (analyzing the relative benefits occurring from the copyright and patent systems).

17. See infra text accompanying notes 71-74.

18. Professor Turner succinctly expresses these as follows:
that society needs more inventions and works of authorship than would otherwise be provided in the absence of external incentives. The second is that the exclusivity provided by patents and copyrights is the needed incentive for the production of an adequate (efficient) number of inventions and works of authorship.

Assuming these assumptions to be warranted, there are still significant costs associated with a system of exclusivity, albeit a time-limited one. Various authorities have discussed the economic costs (as well as the benefits) associated with having patent and copyright systems, although more emphasis has been placed on the former. To the extent that "functional" features of computer programs are pro-

The basic rational of the patent system can be simply put. The economic case rests upon two propositions: first, that we should have more invention and innovation than our economic system would provide in the absence of special inducement; and second, that the granting of a statutory monopoly to inventors for a period of years is the best method of providing such special inducement.


19. Professor Turner concludes that "[n]one of these propositions is entirely free from doubt." Id. at 451.


With respect to copyright, see William M. Landes & Richard A. Posner, An Economic Analysis of Copyright Law, 18 J. LEGAL STUD. 325 (1989), (footnotes omitted), who indicate:

Intellectual property is a natural field for economic analysis of law, and copyright is an important form of intellectual property. Yet while there are good introductions to the economics of copyright law, and a number of excellent articles on the economics of copying (as distinct from copyright law), no article examines the field of copyright as a whole, discussing the evolution and major doctrines in the law from an economic standpoint. This article, which is in the spirit of our recent articles on the economics of trademark law, tries to fill this gap—although the field is so vast that our analysis cannot be exhaustive. As in most of our work, we are particularly interested in positive analysis, and specifically in the question to what extent copyright law can be explained as a means for promoting efficient allocation of resources.

Leading articles on these issues are cited by Landes & Posner. Id. at 325 n. 2. Included on this listing are the classic studies by Arnold Plant: ARNOLD PLANT, THE NEW COMMERCE IN IDEAS AND INTELLECTUAL PROPERTY (1953); and Arnold
tected by both copyright and patent, the costs attributable to the patent system may be reasonably extrapolated to the copyright system.\textsuperscript{21} Within the assumed extrapolation, the relative costs of protecting computer programs by patent or copyright can be compared.

One cost element is that of administering the respective systems.\textsuperscript{22} For the grant of patents, an examination system is employed for ascertaining whether the patent application meets the formal requirements of the statute and Patent and Trademark Office (PTO) regulations,\textsuperscript{23} and whether the claimed invention meets the qualitative standards of the statute.\textsuperscript{24} This process entails the cost of separating patentable from nonpatentable inventions—both by the applicant prior to filing and by the PTO in the examination process.\textsuperscript{25} The difficulty of searching applications for computer-related inventions by the PTO has long been urged as one of the cost elements of using the patent system for their protection.\textsuperscript{26} The costs of preparing and prosecuting patent applications must also be considered.\textsuperscript{27} Relatively high filing, issuance, and maintenance fees are also imposed with respect to patents.\textsuperscript{28} In addition, the administrative costs include evaluations of whether there is infringement by third parties or infringement with respect to patents of others\textsuperscript{29} and the costs of enforcing and defending patent in-
fringement claims. 30

In contrast, the copyright system is one merely of registration, with very low filing fees and no maintenance fees. 31 Thus, the procurement cost of copyright for computer programs is quite low. On the other hand, significant costs may be imposed because of the uncertainty of the scope of copyright protection granted to computer programs. If infringement cannot be determined with a reasonable degree of legal certainty, costly litigation and underutilization may occur. 32

Another cost element is the use of research expenditures to avoid the intellectual property rights of others. 33 In the patent sense this is generally termed "inventing around," which tends to be wasteful when an efficient solution to the problem has already been devised.

30. Litigation costs in patent infringement cases can be considerable depending upon the complexity of the case. A sampling of recent patent infringement cases shows: Kori Corp. v. Wilco Marsh Buggies and Draglines, Inc., 761 F.2d 649 (Fed. Cir. 1985) ($79,000); Mirafi Inc. v. Murphy, 14 U.S.P.Q. 2d (BNA) 1337 (W.D.N.C. 1989) ($175,000); Padco, Inc. v. Newell co., 13 U.S.P.Q. 2d (BNA) 1697 (E.D. Wis. 1988) ($231,000 for 207.4 hours of work); Water Technologies Corp. v. Calco, Ltd., 658 F. Supp. 980 (N.D. Ill. 1987) ($150,000); Advance Transformer Co. v. Levinson, No. 79 C 557 (N.D. Ill. 1988) ($612,700), 1986 WL 15127. See also 1 L.J. KUTTen, COMPUTER SOFTWARE § 3.05 [1][d](sem. ed. rev. vol., 1993) ("Patent litigation incurs substantially higher attorney fees than other types of litigation.... As a result, even a small case can generate more than $200,000 in attorney fees."). It may be noted in passing that in Padco, attorney fees were reduced by $21,200 for duplication and inefficient work, and in Water Technologies, fees were reduced from $245,000 to $150,000 because of duplication.


33. Turner, supra note 18, at 455.
This cost would appear to be equally applicable to copyright, where competitors will have to invest resources in providing alternate computer programs to those already marketed (e.g., by "clean room" techniques) to avoid claims of infringement by "reverse engineering."\textsuperscript{34} With respect to those programs that have become industry standards, this may prove particularly difficult and costly.\textsuperscript{35}

Another cost element involves the practice of procuring patents only to block competitors from using the protected invention.\textsuperscript{36} These so-called "blocking" patents bar competitors from using competing solutions to that used by the blocking patent owner. An alternate solution may be even more efficient than that used by the patent owner.\textsuperscript{37}

\begin{itemize}
\item[34.] The clean room approach to reverse engineering typically involves three groups of engineers and legal specialists. The first group, referred to as the specification team, or as the "dirty room" team, (Duncan M. Davidson, \textit{Reverse-Engineering of Software}, \textit{Computer Software 1989: Protection Marketing}, 95-114 (1989)) reverse-engineer the competitor's program. Then, the team writes a specification, a "blackbox" description of the competitor's product, (Norm Alster, \textit{New Profits from Patents}, \textit{Fortune}, April 25, 1988, at 185, 190) that is passed on to the clean room design team, or the "virgins" (Steven Burke, \textit{Court Support of "Clean Room" Cloning May Legalize Intel '386 Chip Work-Alikes}, \textit{P.C. WK.}, February 27, 1989 at 63) through the coordination team. Douglas K. Derwin, \textit{Licensing Software Created Under "Clean Room" Conditions}, in \textit{Computer Software 1989: Protection and Marketing} 439, 448-49 (1989). The coordination team, usually composed of an engineer and a lawyer, checks the specification to ensure that none of the knowledge of the trade secrets or copyrightable material which was obtained through the reverse-engineering is passed on to the design team. Derwin, \textit{supra}, at 448-49. The clean room design team must be ignorant of the competitor's product and is only allowed to view the specification, prepared by the "dirty" team and approved by the coordinators, and public domain documentation, also cleared by the coordination team. Derwin, \textit{supra}, at 449, 451.

The purpose of the three-system approach is to have a strong case that any similarities which might arise in the two products, the copyrighted product and the accused product, arise only because of the inherent nature of the technology used and not because of the access to the competitor's product. See NEC Corp. v. Intel Corp., 10 U.S.P.Q.2d 1177, 1188 (N.D. Cal. 1989) (describing the clean room procedure as compelling evidence that the similarities arise because of the technology as access to competitor's product is lacking).

Employing the clean room technique adds significantly to the cost of reverse engineering. For example, with respect to Phoenix Technologies' clone of IBM's BIOS (Basic Input/Output Software), it has been claimed that Phoenix spent "nearly twice as much on cloning . . . as it would have had a clean room not been necessary." Burke, \textit{supra}, at 63-64. In fact, the company "'spent more on legal fees than to pay [their] technical employees.'" Alster, \textit{supra}, at 190. The entire process to "reverse-engineer" the IBM BIOS took 12 months of legal work, 6 months of technical work, and generated an audit paper trail of five volumes at 1000 pages each. Burke, \textit{supra}, at 64.

Competitors may also incur costs by avoiding reverse-engineering and denying themselves access to unprotected ideas in a copyrighted program. \textit{See infra} note 68.

\item[35.] \textit{See infra} text accompanying notes 119-121.

\item[36.] Turner, \textit{supra} note 18, at 455.

\item[37.] For example, a manufacturer may elect to maintain an old design rather than
As there is no "working" requirement in U.S. patent law, a patent owner may carve out a significantly greater area of technological exclusivity than that actually being used commercially. This cost would seem to have less applicability to copyright law because of the requirement of copying for infringement and hence the need for access to the program itself. Nonetheless, it may be expected that, because of the ease and nominal cost of copyright procurement, substantially all programs and modifications, including minor ones, will be protected.

Still another cost introduced by protecting computer programs by patent or copyright is that investment in developing computer programs in a specific field or for a particular application may be inhibited. If a competitor has already heavily blanketed a particular area with patents or copyrights or both, the cost of entering the market may be increased and the overall cost may be increased by lessened competition. This, again, would be especially true with respect to computer programs that are recognized in the market as industry standards.

Another cost element, which historically has been primarily associated with patents and more recently with copyrights, is that of potential competitive abuses, including antitrust violations and misuse. Some examples of anti-competitive practices that could seriously restrain free and fair competition, resulting in underutilization costs, in-
clude price-restrictive licensing, tie-in sales, exclusive grant-backs and pooling arrangements.⁴⁴

Costs may also be incurred if there is misallocation of resources in favor of creating patentable or copyrightable computer programs and hence away from more fundamental research, which may offer higher long-term societal benefit.⁴⁵ It may be expected that investments in developments that are risky because of the uncertainty of obtaining protection against competition will be avoided.⁴⁶ There also may be a costly misallocation between the development of computer programs more ideally protected (i.e., at greater benefit or lower cost) by either copyright or patent.⁴⁷

Another cost particularly related to the patent system is that a patent on a particular invention is granted only to the “first inventor,” and is afforded in rem property status.⁴⁸ Hence, the investment by the

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⁴⁴. Other abuses include attempting to extend the patent monopoly by dilatory prosecution of patent applications, filing closely related “improvement” patents, and extending royalty payments beyond the term of the patent. For a discussion of these forms of patent abuse, as well as those mentioned in the text, see generally WARD S. BOWMAN JR., PATENT AND ANTITRUST LAW, 53-63 (1973); 5 DONALD S. CHISUM, PATENTS § 19.04 (perm. ed. rev. vol., 1991); LAWRENCE A. SULLIVAN, ANTITRUST §§ 116-191 (1977). For a recent case on copyright misuse, see Lasercomb Am., Inc. v. Reynolds, 911 F.2d 970 (4th Cir. 1990), (holding misuse to be a defense against copyright infringement without an antitrust violation). In Lasercomb defendant refused a contract restricting the marketing of competitive programs for the life of the license plus 99 years. Id. at 973. The majority view is to require an antitrust violation for misuse defenses. See 3 NIMMER ON COPYRIGHT, supra note 8, at 13-144. See also Note, Clarifying the Copyright Misuse Defense: The Role of Antitrust Standards and First Amendment Values, 104 HARV. L. REV. 1289 (1991).

⁴⁵. See Turner, supra note 18, at 455.

⁴⁶. Because the fruits of pure research tend to be fundamental truths (“laws of nature”) and copyright and patent tend not to protect ideas at such a fundamental level, investment may be diverted to development of existing technology.

⁴⁷. For example, if the title of protection of choice for computer programs is copyright because of its nominal procurement cost and patent-like protection, costs may accrue if patent protection affords relatively more benefit.

⁴⁸. According to the U.S. system, the patent on a given invention can be granted only to the inventor who qualifies under 35 U.S.C. § 102(g)(1988) as the first inventor. The United States and the Philippines are the only remaining countries that grant patents to the first inventor rather than the first to file. 2 J.W. BAXTER & JOHN P. SINNOTT, WORLD PATENT LAW AND PRACTICE 4-6 (perm. ed. rev. vol. 1992). Even if the U.S. enacts a first-to-file system, the problem of independent development remains. Applicants who lose the race to the PTO may lose their investment.

In rem property status means that the patent right can be enforced against anyone, including an independent but second or slower inventor. As defined by Professor Hohfeld:

A paucital right, or claim (right in personam), is either a unique right residing in a person (or group of persons) and availing against a single person (or single group of persons); or else it is one of a few fundamentally similar, yet separate, rights availing respectively against a few defi-
second, albeit independent, inventor of the same invention may be lost. Also, competitors may run into a late issuing patent after investment has been made in the development or even production of a particular invention.\textsuperscript{49} With respect to copyright, this problem is minimized because of the need to prove copying and, accordingly, access to the particular computer program. However, counterbalanced against this requirement are the costs of “reinventing the wheel” and independently developing state-of-the-art programs to avoid a claim of copying marketed programs.\textsuperscript{50}

The nature of the patent and copyright systems to grant exclusive rights for a particular invention or work of authorship introduces costs due to “rent seeking.”\textsuperscript{51} Judge Posner defines this term as “the incentive to overproduce goods that promise a return greater than the cost of production (that is, an economic ‘rent’), and to the resulting waste when rents are transformed, through competition to obtain them, into costs.”\textsuperscript{52} Posner analogizes the competition costs to obtain “rents” from a patented invention to the search for sunken treasure.\textsuperscript{53} If the cost of searching for the treasure or the invention is less than the value of the treasure or the patent, an incentive is provided for an accelerated search. However, this incentive may induce multiple competitors for the single prize and thus result in costs exceeding the benefit to society.\textsuperscript{54} These same “rent-seeking” costs would also apply to

\begin{itemize}
\item nite persons. A multital right, or claim (right in rem), is always one of a large class of fundamentally similar yet separate rights, actual and potential, residing in a single person (or single group of persons) but avail- ing respectively against persons constituting a very large and indefinite class of people.
\item Wesley N. Hohfeld, Fundamental Legal Conception 72 (Walter Cook ed., 1923)(footnotes omitted).
\item 49. Patent applications must be kept in confidence by the PTO. 35 U.S.C. § 122 (1988). As it may take several years for a patent to issue and hence be an enforce- able right, unsuspecting competitors may thus find themselves infringers upon the grant of the patent.
\item 50. If competitors, fearing copyright infringement action, refuse to avail themselves of their “right to copy” ideas within computer programs, which presumably are in the public domain unless protected by patent, one of the most efficient means of competing has been foregone. As stated in Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 146 (1989):
\begin{quote}
From their inception, the federal patent laws have embodied a careful balance between the need to promote innovation and the recognition that imitation and refinement through imitation are both necessary to invention itself and the very lifeblood of a competitive economy.
\end{quote}
\item 51. See generally Toward A Theory of the Rent-Seeking Society (James M. Buchanan, Robert D. Tollison and Gordon Tullock, eds., 1980)(considering theory, measurement and applications of rent seeking).
\item 54. Posner gives the example where the cost of developing an invention is $250,000
and would be particularly costly with respect to computer programs when coupled with the incentive to be first on the market and the negative incentive of avoiding a charge of copying someone else's program.

A final cost element, which is of particular relevance to the present analysis, is that of the denial of access to, and hence the underutilization of, inventions or works of authorship protected by patents and copyrights that would have been created irrespective of any system of protection, i.e., their creation was induced by other than the respective intellectual property systems. If there were no patent or copyright system covering computer programs, those computer programs that would have come into existence anyway would have been freely accessible by competitors. Underutilization will be costly even if the owner of the right is willing to license it for a "reasonable" royalty.

In view of the foregoing costs, whether or not a net benefit accrues from protecting computer programs by patents or copyright may depend on the magnitude of benefit attributable to such inventions and the value of the patent on the invention is $1 million. Id. at 36-37. The costs are multiplied by the number of searchers and the costs of discovery may accordingly be multiplied. However, the multiplied costs may be somewhat less because the competition is likely to provide the invention sooner. As Posner points out: "This competition will cause [the widget] to be invented sooner. But suppose it is invented only one day sooner; the value of having the widget a day earlier will be less than the cost of duplicating the entire investment in invention." Id. at 36. If the "widget" is a computer program, the analogy should run to both the costs of developing inventions and works of authorship.

Still another cost of a broad copyright law stems from what economists call "rent seeking." This term refers to the incentive to overproduce goods that promise a return greater than the cost of production (that is, an economic "rent"), and to the resulting waste when rents are transformed, through competition to obtain them, into costs. Suppose that the cost of creating a new genre, meter, style, plot, or character type were very low yet whoever was first to create it would, by virtue of copyright law, have a monopoly of exploiting it. There would be a tremendous race to be first, and the costs consumed in the race might exceed the social benefits of accelerated production.

The Supreme Court recognized this cost in the context of the qualitative standard ("invention," "nonobviousness") for the granting of a patent in Graham v. John Deere Co., 383 U.S. 1, 10-11 (1966).

The difficulty of formulating conditions for patentability was heightened by the generality of the constitutional grant and the statutes implementing it, together with the underlying policy of the patent system that "the things which are worth to the public the embarrassment of an exclusive patent," as Jefferson put it, must outweigh the restrictive effect of the limited patent monopoly. The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent.

The cost of the royalty plus the transaction costs must be accounted for in the cost of the product or service. See also Machlup, supra note 11, at 51.
works of authorship. Benefits cannot be measured solely in terms of products or services made available for public consumption; benefits should also include information associated with such products and services. In the case of patents, the Supreme Court has stated the underlying quid pro quo for the exclusive grant:

When the patent is granted and the information contained in it is circulated to the general public and those especially skilled in the trade, such additions to the general store of knowledge are of such importance to the public wealth that the Federal Government is willing to pay the high price of 17 years exclusive use for its disclosure, which disclosure, it is assumed, will stimulate ideas and the eventual development of further significant advances in the art.

In this regard, there may be a significant difference in the degree of access afforded to information provided with respect to patented and copyrighted computer programs. For the grant of a patent, the claimed invention must be disclosed in the patent application in sufficient detail to enable one skilled in the art to practice it. Thus, to obtain a patent on an invention relating to a computer program, the program must be disclosed in a form enabling a person skilled in the art to replicate the claimed invention. By means of the patent docu-

58. As stated by Professor Parker:

A further strand in the economic logic of patents relates to the diffusion of knowledge. The granting of a patent involves disclosure of the principles of an invention. In jargon terms, modification of competition internalises [sic] the benefits of invention, raises the incentive to invent and accelerates the diffusion of knowledge. Patents are a piece of social engineering which deliberately support monopoly at the expense of competition on the grounds that the benefits to the community of improving the potential flow of new knowledge, outweigh the misallocation effects associated with deliberately creating market imperfections.


See also Jessica Litman, Copyright and Information Policy, 55 LAW & CONTEMP. PROBS. 185 (1992)(arguing that too much shortsighted emphasis on reducing the trade deficit through strong protectionism of computer software will eventually damage the free flow of knowledge and society’s access to information in the future).


The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.


61. There is no specific statutory requirement for how a computer program is to be disclosed. The general requirement for all disclosure is 35 U.S.C. § 112, supra note 60. 37 C.F.R. § 1.96 (1991) further provides:

Descriptions of the operation and general content of computer program listings should appear in the description portion of the specifica-
ment, the public is provided with enabling information concerning the invention protected by the patent and also to any other information contained in the document that is not expressly claimed and hence is in the public domain. Moreover, once the patented invention is made publicly available, it is fair game for competitors to ascertain by reverse engineering any trade secrets the invention might reveal.

In contrast, copyright protection of a computer program subsists from its fixation in a tangible medium of expression. There is no requirement for the publication of an enabling disclosure. Indeed, registration may be effected with the deposit of a limited quantity of source code with any trade secrets blocked-out. Copyrighted computer pro-

62. 35 U.S.C. § 112:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

The underlying policy of specific claiming is set out in General Electric Co. v. Wabash Appliance Corp., 304 U.S. 364, 369 (1938)(footnotes omitted):
The limits of a patent must be known for the protection of the patentee, the encouragement of the inventive genius of others, and the assurance that the subject of the patent will be dedicated ultimately to the public. The statute seeks to guard against unreasonable advantages to the patentee and disadvantages to others arising from uncertainty as to their rights. The inventor must “inform the public during the life of the patent of the limits of the monopoly asserted, so that it may be known which features may be safely used or manufactured without a license and which may not.” The claims “measure the invention.”

Compare the effects of the “doctrine of equivalents”, infra note 150.

63. Moreover, if a patent application is filed within one year from the public use, sale or description in a printed publication of the invention, the invention may still be protected. 35 U.S.C. § 102(b). This “grace period” thus minimizes the need to rely upon trade secret protection for the invention and induces earlier public access to the invention.

64. Registration of Claims to Copyright, 37 C.F.R. § 202.20(c)(2)(vii)(A)(2)(1991). As summarized in Copyright Office, Circular 61: Copyright Registration for Computer Programs (June 1991), the following should be filed for new programs:

[T]he page containing the copyright notice, if any, plus one of the following:
— first and last 25 pages of source code with portions containing trade secrets blocked out; or
— first and last 10 pages of source code alone, with no block-out portions; or
— first and last 25 pages of object code plus any 10 or more consecutive pages of source code, with no blocked-out portions; or
— for programs 50 pages or less in length, entire source code with trade secret portions blocked out.
grams may be made publicly available only in object (machine readable) code, typically on floppy disks. This access to object code enables anyone, including those totally unskilled in the art, to copy easily the object code; however, it provides limited information concerning the underlying program ideas even to those skilled in the art. Indeed, it may require considerable time, effort and expense to decompile object code to source code by reverse engineering and then at the risk of a claim of copyright infringement. In short, although not intending to over-emphasize the usefulness or timeliness of the disclosure of a program in a patent, in all likelihood that information content exceeds any contained in the copyrighted work, particularly when expressed in object code.

65. See NATIONAL RESEARCH COUNCIL, INTELLECTUAL PROPERTY ISSUES IN SOFTWARE, 75-76, (1991)[hereinafter NRC, SOFTWARE ISSUES][indicating that the decision by IBM to distribute software in object code resulted in the loss of customer improvements).

66. Id. at 76-77.

67. See supra note 34. Even using an automatic disassembler, further “time-consuming steps” are required to perfect the decompiled source code, because the assembly listing produced by the disassembler “may not be 100% accurate.” Robert S. Swanke, The Art of Reverse Engineering, COMPUTER LANGUAGE, June 1991, at 57, 58. “As a matter of fact, probably the toughest job in reverse engineering is turning an executable program into a fully commented source listing. It’s usually quicker to write the program from scratch . . .”

68. Indeed Daniel Bricklin, co-creator of VisiCalc, is reported as saying, “I am not looking at certain products because I don’t want to be accused later of having copied them.” Jane M. Simon, Software Owner Wins “Look and Feel” Victory, BOSTON GLOBE, Mar. 14, 1989, at 43.

69. See, e.g., Brenner v. Manson, 383 U.S. 519, 594 (1966), where the Court stated:

However, in light of the highly developed art of drafting patent claims so that they disclose as little useful information as possible - - while broadening the scope of the claim as widely as possible—the argument based upon the virtue of disclosure must be warily evaluated. See also, Eisenberg, supra note 20, at 1029 n.52. On the other hand, Daniel Bricklin, in testimony before the House Subcommittee on Courts, Intellectual Property and the Administration of Justice stated: “Nobody reads patents to learn anything.” Intellectual Property, House Panel Holds Second Oversight Hearing on Software Protection, BNA, DAILY REP. EXEC., Mar. 9, 1990, at A-7. It is perhaps unfortunate that he had not read Patent No. 3,610,902, filed Oct. 7, 1968, issued Oct. 5, 1971, to Robert A. Rahencamp and William R. Stewart, Jr. and assigned to IBM. The first sentence of the Abstract of this now expired patent states:

ABSTRACT: An electronic display typing system for use by professional accountants and statisticians. A cathode-ray display is alternately utilized to display the contents of a worksheet storage containing all of the entries and identifications normally placed by an accountant on his worksheet and to display a scratch pad storage which is utilized by the accountant for routine, off-the-worksheet calculations.

Figure 1 of the patent shows the now-familiar inverted-L of an electronic spreadsheet. The first 12 claims of the patent are directed to an “electronic display calculator” note, however, the last claim 13, is for a “method of performing repetitive arithmetic operations by a calculator . . . .” Samuelson notes that “IBM
Although the respective costs of the patent and copyright systems are not quantifiable, some insight may be gained from the foregoing analysis concerning the comparable costs of each system. On a relative basis, one could rationally conclude that the cost of patent protection of computer programs is likely to exceed or be as great as that of copyright protection on all cost elements except the underutilization cost, which will be further explained below. On balance, however, underutilization by overinclusive protection by copyright may offset the copyright advantage, particularly when coupled with a diminished benefit because of a lower knowledge content.

The question of whether patent and copyright systems, together or separately, which protect all qualifying inventions and works of authorship, produce a net benefit to society over the costs of the systems has long been the subject of debate and cannot be answered definitively. If, however, patent protection could be limited to protecting only those inventions that were, in fact, induced by the availability of

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70. See infra text accompanying notes 158-172.
71. See George L. Priest, What Economists Can Tell Lawyers about Intellectual Property, in Research in Law and Economics: The Economics of Patents and Copyright 19,21 (John Palmer & Richard O. Zerbe Jr. eds., 1986)("[I]n the current state of knowledge, economists know almost nothing about the effect on social welfare of the patent system or of other systems of intellectual property."). See also Scherer, Industrial, supra note 20, at 444; Machlup, supra note 11, at 80; David Silverstein, Sharing United States Energy Technology with Less-Developed Countries: A Model for International Technology Transfer, 12 J. INT'L L. & ECON. 363, 369 (1978).

With respect to copyright, Posner concludes:

One is not even sure that any copyright protection is necessary to generate the socially optimal amount of book production, given the advantages that accrue to the first publisher (it takes a while to copy) and the fact that royalties are usually only a small fraction of the overall cost of producing and selling a book.

Posner, Literature, supra note 52, at 343 (footnote omitted, citing Breyer, supra note 2, and Tyerman, supra note 11). There would appear to be even less evidence that broad copyright protection should be extended to computer programs. See Posner, Literature, supra note 52, 343-48, on the costs of expanding copyright protection:

Thus, although an expansion of copyright protection might—as in the example of copyrighting an entire genre, such as epic—be devastating for literary creativity, even the existing scope of copyright protection may be damaging to it . . . . The more extensive copyright protection is, the more inhibited is the literary imagination. This is not a good reason for abol-
that system, it is generally accepted that a net benefit would be achieved, as concluded by Professor Scherer:

Except when innovators' profits come largely from cannibalization of the profits that would otherwise be enjoyed by the producers of substitute products, it is likely that society as a whole (i.e., including both consumers and producers) gains from inventions and innovations induced or hastened by the grant of patent rights.\footnote{72}

If this generalization can be extended to copyright protection, which seems justified, at least with respect to those computer programs providing utility from their use,\footnote{73} then the present inquiry may focus on whether the patent and copyright systems are indeed inducing computer programs at an efficient rate compared to nonpatent/noncopyright-induced programs (i.e., induced by the market or other incentives such as, personal curiosity, desire for fame, promotion, tenure, etc.)\footnote{74}

The fundamental problem, of course, is that neither the patent nor the copyright systems differentiate in their protection of computer programs, whether they be patent induced, copyright induced, or market induced. However induced, computer programs are protectible, provided the formal and qualitative requirements are met. Accordingly, it would follow that the cost to society of protecting computer programs by patent or copyright increases directly as the ratio of noninduced to induced inventions/works of authorship increases. Conversely, the cost would decrease where there is higher yield of patent induced or copyright induced computer programs.\footnote{75} A comparative

\footnote{72. SCHERER, INDUSTRIAL, \textit{supra} note 20, at 443; Douglas F. Greer, \textit{The Case Against Patent Systems in Less-Developed Countries}, 8 J. INT'L L. & ECoN. 223, 224 (1973). ("Nevertheless, it can be formally demonstrated that the economic benefits of such inventions (in the form of production cost savings or new product consumption utilities) always exceed those social costs to yield a net social benefit."); see also Alfred E. Kahn, \textit{The Role of Patents, in COMPETITION CARTELS AND THEIR REGULATION} 308, 311 (John P. Miller ed., 1962) ("So long as the innovation would not have been forthcoming without the patent, this social cost must always be less than the benefit; but of course the converse is equally true.").}

\footnote{73. It should be borne in mind that the premise here is a narrowly focused one, \textit{viz.}, where a given computer program is posited to satisfy the subject matter definitions of both copyright and patent.}

\footnote{74. PARKER, \textit{supra note} 58, at 39:

There are a great number of influences that may induce invention. These may include personal gain, curiosity, the outpourings of genius, the pressure of necessity, the type of competition, random and chance events, and economic forces in general. However, there is a growing consensus that economic forces are predominant.

See also Newell, \textit{supra} note 5, at 1034.}

\footnote{75. The underlying assumption is, of course, that those computer programs not induced by either the patent or copyright system would be freely available for use by competitors and consumers. Trade secret protection may impede the free access to certain computer programs, but this protection would apply whether or
analysis of induced versus noninduced inventions/works of authorship will be undertaken in Section B.

Costs would also increase when computer programs could have been induced with lower incentives than those provided under the patent or copyright system. In other words, the inventions/works of authorship could have been created at a lower cost than that afforded by the exclusivity and scope of protection afforded by patents or copyrights. A comparable analysis of incentives will be undertaken in Section C.

B. Induced and Noninduced Inventions/Works of Authorship

The ability of the patent or copyright system, or indeed both, to induce inventions or writings may be seen as comprising a "bundle" of inducements that may be involved in any stage of the creative process—from conception of the underlying idea, through the various stages of development, to commercialization and, perhaps beyond, to improvements and derivatives. For the purpose of this analysis, not the program was induced or noninduced. It should also be made clear that, while it would be economically desirable for courts to uphold inventions and works of authorship that are induced by the respective systems compared to noninduced ones, factual differences and doctrinal concerns make this determination difficult in actual cases. In Oddi, Invention Protection, supra note 12, a proposal is made for a "revolutionary patent," which would require a factual inquiry into how the invention came about and also doctrinal modifications of the present patent system to attempt to separate out revolutionary inventions. In a recent article by Grady and Alexander, they state: "The strong version of reward theory, as advanced in the works of Frederic Scherer and more recently by A. Samuel Oddi, posits that rewards should explain actual patent decisions." Mark F. Grady and Jay I. Alexander, Patent Law and Rent Dissipation, 78 VA. L. REV. 305, 312-13 (1992). They then proceed to attempt to show that their theory of "rent dissipation" is a better predictor than the "reward" theory or the "prospect theory" of Professor Kitch. See Edmund W. Kitch, The Nature and Function of the Patent System, 20 J.L. & ECON. 265 (1977). The attempt by Grady & Alexander to show that "the courts appear to have adopted rules of decision that minimize rent dissipation in the pioneer development stage (by limiting the size of the monopoly reward) as well as in the improvement stage (by enforcing patents against signaled improvements)" (Id. at 309), is not entirely successful, at least with regard to the "reward" theory. See Donald L. Martin, Reducing Anticipated Rewards from Innovation Through Patents: Or Less is More, 78 VA. L. REV. 351 (1992) and Robert P. Merges, Rent Control in the Patent District: Observations on the Grady-Alexander Thesis, 78 VA. L. REV. 359 (1992). See supra text accompanying notes 51-55 (discussing the costs of "rent seeking").

76. The incentive would be deemed excessive if it was greater than the "persuasion" cost needed for the creation of the program. If someone can be persuaded to create a program because of the availability of lesser incentives, e.g., trade secret protection, prizes, tax breaks, fame or curiosity, then exclusivity becomes costly.

77. Economists often distinguish "invention" from "innovation," as summarized by Scherer:

The terms "invention" and "innovation" suggest the conceptual formulations of Abbott Payson Usher and Joseph A. Schumpeter. Crucial
duction will be used in that broad context.

The validity of the first assumption underlying the patent/copy-
right clause, that a sufficient number of inventions and works of au-
thorship would not be induced without patent and copyright systems,
is not an easily verifiable one. The systems do not, and inherently can-
not, separate the induced from the noninduced. Nonetheless, for pur-
poses of analysis, two categories of inventions have been suggested by
Professor Scherer to be patent-induced, i.e., relying on the patent sys-
tem for their creation. The first category is low benefit/cost inven-
tions.78 These tend to be narrow-improvement inventions within
highly developed technological fields. Hence, there is a great deal of
competition, and product substitution is readily available. Inducing in-
vestment where only small technological advances may be anticipated
can be seen as relying upon the availability of patent protection, so
that at least a small scope of exclusivity may be carved out. Scherer
concludes that this category of patent-induced inventions, however,
provides little societal benefit.79

The second and important category of patent-induced inventions
identified by Scherer are those that provide “spectacular technical
contributions.”80 Such inventions effect “a genuine revolution in pro-
duction or consumption patterns” by their creation.81 This class of in-

F. M. SCHERER, INNOVATION AND GROWTH 8 (1984)(footnotes omitted) [hereinafter SCHERER, INNOVATION].

Scherer gives the example of Watt’s “invention” of a steam engine employing
a separate condenser as not being dependent on the patent system. The concep-
tion of the separate condenser required little time and expense and was “sus-
tained as a result of scientific curiosity.” In contrast, the availability of a patent is
likely to have induced Roebuck to go into partnership with Watt and invest
money in the development of the steam engine, i.e. the “innovation.” Id. at 22-25.

See also, Eisenberg, supra note 20, who discusses three incentives offered by
the patent system: (1) the “incentive to invent,” i.e., to invest in research to make
new inventions (id. at 1024-28); (2) the “incentive to disclose” the invention (id. at
1028-30); and (3) the “incentive to innovate” according to Schumpeterian theory
(id. at 1036-40).

78. SCHERER, INDUSTRIAL, supra note 20, at 448.
79. Id. Compare Kitch, supra note 75 at 266, who argues that the patent system by
protecting such inventions performs a useful social function if the prospect func-
tion of patents is taken into account. Kitch defines this function as an opportu-
nity to develop a known technological possibility. Id. He analogizes the patent
system to a mineral claims system. Id. at 271-75. But see Grady & Alexander,
supra note 75, at 313-16 (critiquing the prospect function).
80. SCHERER, INDUSTRIAL, supra note 20, at 448.
81. Id.
ventions, which may be termed "revolutionary," are the important ones in terms of societal benefit, because, as indicated by Scherer, only "a few can make a big difference in the efficiency of production or the quality of life." The principal reason that such inventions require the inducement of the patent system for their creation is that they generally have an uncertain benefit/cost analysis. The benefit is uncertain because of the risk of failure (i.e., in not producing a commercial invention) and the general unavailability of a production or marketing infrastructure for such an invention. Moreover, the cost of development, including capital investment and time, may be unascertainable and entail considerable financial risk. Scherer indicates that black and white television and the early development of xerography may be examples of patent-induced revolutionary inventions. These inventions changed consumption and production patterns and, in the absence of the availability of patent protection, the investment in such developments may not have been made or might have been substantially reduced or delayed.

On the other hand, there is little doubt that many inventions are created irrespective of the patent system, i.e., there is no causal connection between the creation of the invention and the availability of the patent system. These are nonpatent-induced inventions, where the inducement may range from personal motivation, necessity, chance, and technological development to economic forces in general, including competition. A primary incentive outside the patent system is that of anticipating the market for a particular innovation and being the first, and hence exclusive, supplier. This "lead time" or "head start" may be adequate for the innovator to make adequate profits over the development costs of the invention. An appreciable lead time may be available with respect to an innovation that is difficult to copy or to distribute or that requires significant capital investments. Moreover, trade secrets may often assist in maintaining the

82. Id. at 454.
83. Id. at 448. The success rate for creating such inventions may be considerably lower than the industry average for all inventions, which in one study was found to be about 70%. See PARKER, supra note 58, at 58.
84. SCHERER, INDUSTRIAL, supra note 20, at 448; see also SHERMAN GEE, TECHNOLOGY TRANSFER, INNOVATION, AND INTERNATIONAL COMPETITIVENESS 161 (1981)(concluding that "[m]ajor American innovations—such as xerography, instant photography, transistors, lasers, synthetic textile fibers, and the airplane—have had a revolutionary impact on today's modern society").
85. See supra note 74.
86. See SCHERER, INDUSTRIAL, supra note 20, at 444-47; PARKER, supra note 58, at 301-02, 315.
87. PARKER, supra note 58, at 301-02, 315, who notes that in the absence of these nonpatent barriers to competition, a patent becomes an important incentive.
head start advantage.\textsuperscript{88} In addition, the innovator may be the predominant force in the market or may be able to establish itself as the recognized source of the innovation, and the innovation may become the industry standard or consumer choice.\textsuperscript{89} Product differentiation itself may be adequate to avoid direct price competition.\textsuperscript{90}

Scherer would identify inventions as nonpatent-induced when they are likely to be of high benefit compared to the cost of producing them.\textsuperscript{91} In other words, these inventions would provide significant economic benefit to the developer at a relatively low cost of development. This category of inventions proves the aphorism "necessity is the mother of invention."\textsuperscript{92} Such inventions tend to be market driven, in the sense that there is a ready demand for them. Moreover, certain inventions that have a high benefit but relatively low cost result from "serendipity," solution to another problem that is, while searching for a solution to a particular problem, accidentally found.\textsuperscript{93} Serendipitous inventions would include such famous examples as: x-rays, vulcanization of rubber, Teflon, and penicillin.\textsuperscript{94} Such fortuitously discovered inventions undoubtedly greatly benefitted society, but that benefit can

\begin{itemize}
\item \textsuperscript{88} SCHERER, INDUSTRIAL, supra note 20, at 444-45; PARKER, supra note 58, at 301-02, 315.
\item \textsuperscript{89} SCHERER, INDUSTRIAL, supra note 20, at 445.
\item \textsuperscript{90} Id. at 445-46; PARKER, supra note 58, at 314. See the classic study: Ralph S. Brown Jr., Advertising and the Public Interest: Legal Protection of Trade Symbols, 57 YALE L.J. 1165, 1181 (1948)("The economist, whose dour lexicon defines as irrational any market behavior not dictated by a logical pecuniary calculus, may think it irrational to buy illusions; but there is a degree of that kind of irrationality even in economic man; and consuming man is full of it."). See generally Stephen L. Carter, The Trouble with Trademark, 99 YALE L.J. 759 (1990)(allowing protection of trademarks with no market significance, when some marks are more desirable than others, raises substantial obstacles for market entry by competitors); Robert C. Denicola, Institutional Publicity Rights: An Analysis of the Merchandising of Famous Trade Symbols, 62 N.C. L. REV. 603 (1984)(arguing that economic factors provide practical limitations on the impact of recognizing an exclusive right to the merchandising value of a trade symbol).
\item \textsuperscript{91} SCHERER, INDUSTRIAL, supra note 20, at 447, who indicates that nonpatent incentives may be sufficient "if the invention is economically important—that is, if it has the potential of yielding marketwide cost savings or premium profits large in relation to the innovator's development costs."
\item \textsuperscript{92} JOHN BARTLETT, FAMILIAR QUOTATIONS 151 (14th ed. 1968).
\item \textsuperscript{93} Horace Walpole coined the term in reference to a fairy tale "The Three Princes of Serendip," where the princes were "always making discoveries, by accident and sagacity, of things they were not in quest of." Serendip was also an ancient name for Sri Lanka (Ceylon). GILBERT SHAPIRO, A SKELETON IN THE DARKROOM: STORIES OF SERENDIPITY IN SCIENCE, vii (1986).
\item \textsuperscript{94} See Id. at 1-23 (discussing the discovery of X-rays); DANIEL S. HALACY, SCIENCE AND SERENDIPITY 91-93 (1967)(discussing the vulcanization of rubber); ALFRED B. GARRETT, THE FLASH OF GENIUS 14-15 (1963)(describing the discovery of Teflon); W.B. Cannon, The Role of Chance in Discovery, 50 SCI. MONTHLY 204 (1940)(discussing, among others, Nobel's discovery of dynamite and Richet's discovery of allergies).
\end{itemize}
hardly be directly attributed to the patent system. Nonetheless, the patent system may have had some role in inducing the development and commercialization of such inventions.95

In terms of the cost/benefit analysis of the overall patent system, which protects both induced- and noninduced-inventions alike, it then becomes important to compare the yield of patent-induced inventions, particularly of the revolutionary-type, to the yield of nonpatent-induced inventions, which would have otherwise been introduced through market or other incentives, at a lower cost to society. The anticipated yield of patent-induced compared to copyright-induced programs will be considered below.96

The same form of analysis may be undertaken with respect to the copyright system, where works of authorship may be categorized as induced or noninduced by the copyright system. One approach to this analysis would be to place the various types of works of authorship in a hierarchy based on the need for protection by copyright.97 The highest need category—the most likely to be copyright-induced—accordingly would be "literary artistic works."98 Without copyright protection, the author of a literary work, e.g., a novel, presumably would have difficulty in finding a publisher. The publisher would be faced with competition within a very short time from copyists, who would not have to bear the cost of acquisition of the work and initial publication costs, including editing, printing, publicity, etc.99

The second category in the hierarchy of needed protection would

95. See supra text accompanying note 77 and note 75. Some indirect attribution may be given to the patent system if it is assumed that investment in the experiments leading to the serendipitous invention was induced because of reliance on the patent system. The creation of "spin off" inventions has often been urged as one of the benefits of government-funded research. See George J. Howick, The NASA Technology Utilization Program, in UTILIZING R & D BY-PRODUCTS 69, 78-82 (Jerome W. Blood ed., 1967)(describing NASA program and examples of spin-off inventions, including inorganic paint, walking wheel chair, maintenance-free lubricated bearings, and sight-controlled switches). Some other examples of commercial products arising out of the space program include, smoke detectors, graphite, an artificial pancreas, heated ski goggles and hang gliders, but not velcro, teflon or tang. See Paul Hoversten, Space Technology Put to Earthly Use, USA TODAY, April 6, 1989, at 3A.

96. See infra text accompanying notes 125-143.

97. This is based on the assumption that less than an adequate number of works would be produced for the various classes of works without the incentive of copyright protection.

98. This category would include, e.g., novels and other works of fiction, plays, musical compositions, motion pictures, paintings, sculptures, and other such works not having a significant utilitarian or marketing value. Compare, the utilitarian value of a lamp base with the "Chicago Picasso" sculpture or the marketing value of an advertising poster with a book of poems.

99. See Breyer, supra note 2, who argues that, at least with respect to textbooks, copyright may not be needed. Compare POSNER, LITERATURE, supra note 52, at 343 n.30, indicating that plays are more likely to need the protection of copyright
be "factual" works, which would generally require less creativity than literary or artistic works but would require considerable "sweat of the brow" for their production.\textsuperscript{100} These factual works would include, \textit{e.g.}, maps, directories, compilations and business forms.\textsuperscript{101} Because of the time, effort, and investment required in their creation, there would be a considerable disincentive to their publication if they could be immediately copied. On the other hand, because there is a demand for works compiling facts in an organized manner, there is at least some market incentive to produce them outside the copyright system, including lead time and industry leader status;\textsuperscript{102} also, a relatively low level of legal protection may be provided against copying in certain instances.\textsuperscript{103}

The final category, which would appear to be the least dependent upon the copyright system, consists of "functional" works—works that in and of themselves serve a utilitarian function,\textsuperscript{104} \textit{e.g.}, three dimensional works having separate utility (a lamp base\textsuperscript{105} or a belt

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as the author would otherwise have a powerful incentive not to publish in order to avoid copying.


\textsuperscript{101} See Gorman, \textit{supra} note 100 (considering in detail maps, news stories, historical accounts, directories, advertisements, photographs and legal and business forms).

\textsuperscript{102} Outside of market incentives there may be a statutory requirement to publish, such as in \textit{Feist} Publications, Inc. v. Rural Tele. Serv. Co., 111 S. Ct. 1282 (1991), whereunder the telephone company was obligated to publish a directory. This would be a classic example of a noncopyright-induced work. \textit{See infra} note 131 (discussing the originality requirement imposed by \textit{Feist} on compilations). \textit{But see} Hutcheson Tele. Co. v. Frontier Directing Co., 770 F.2d 128 (8th Cir. 1985)(holding that a statutory requirement to publish a directory did not bar copyright protection, reversing the district court).

\textsuperscript{103} See, \textit{e.g.}, \textit{International News Serv. v. Associated Press}, 248 U.S. 215 (1918)(defendant enjoined from copying news gathered by plaintiff until its commercial value had been lost); \textit{Addison-Wesley Publishing Co. v. Brown}, 223 F. Supp. 219 (E.D.N.Y. 1963)(defendant enjoined from providing answers to problems in physics text books).

\textsuperscript{104} The Copyright Act, 17 U.S.C. \textsection 101, states: A "useful article" is an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information. An article that is normally a part of a useful article is considered a "useful article." \textit{See} \textit{Esquire}, Inc. v. Ringer, 591 F.2d 796 (D.C. Cir. 1978), \textit{cert. denied} 440 U.S. 908 (1979)(upholding the Copyright Office's refusal to register an outdoor lighting fixture as a sculptural work because the utilitarian aspects of the fixture could not be separated from its aesthetic aspects). \textit{See also infra} note 335.

\textsuperscript{105} \textit{See} \textit{Mazer v. Stein}, 347 U.S. 201 (1954)(holding a lamp base representing a Balinese dancer copyrightable subject matter although its primary commercial use was in a lamp combination).
buckle). Computer programs would appear to be an even better example. Programs are created to be used in computers out of necessity. Without programs, no useful function is served by a computer.

With respect to functional works, such as computer programs, the topology developed by Scherer for inventions would seem to be extrapolatable. Thus, the categories of computer programs that would depend upon the copyright system would be the same as for inventions: namely, low benefit/cost and revolutionary types of programs. Programs within the low benefit/cost category, at this time, may include word processing or spreadsheet programs, where the market is cluttered with a wide variety of such programs that are essentially interchangeable. An example of a low benefit/cost program might be a word-processing program that adds a feature specifically employed in a particular field or industry; such a program might not be created except for the availability of copyright protection. This category, again, would be relatively unimportant to protect in view of the availability of alternative programs or easily modifiable ones.

In contrast, however, revolutionary programs would seem to be ideal candidates for protection by copyright, if investment is induced when the benefit and cost of the investment are not assured. Examples of revolutionary programs for personal computers, when they were originally created, might include: word processing, spreadsheet, graphics and video games. These types of programs would appear

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106. See Kieselstein-Cord v. Accessories by Pearl, Inc., 632 F.2d 989 (2d Cir. 1980)(holding a belt-buckle (albeit an expensive one) to be copyrightable). Cf. Carol Barnhart Inc. v. Economy Cover Corp., 773 F.2d 411 (2d Cir. 1985)(holding mannequins of partial human forms utilitarian and hence not copyrightable as separate works of art).

107. This categorization would appear to be particularly applicable to algorithms; however, computer databases may better fit in the factual category as a compilation. See supra notes 4 and 5 for definitions of computer program, software and algorithm.

108. As early as 1983, there were 50 word processing programs competing with the industry leader Wordstar, and 60 spreadsheet programs competing with the industry leader VisiCalc. Bro Utall, Famous Victories in Personal Software, FORTUNE, May 2, 1983, at 150.

109. For example, a program designed for use by engineers or scientists requiring various mathematical symbols.

110. Note, however, that modification may be impeded if the consumer does not have access to the program in source code form. See supra text accompanying notes 65-68 for a discussion of marketing in object code.

111. See DOUGLAS G. CARLTON, SOFTWARE PEOPLE: AN INSIDER'S LOOK AT THE COMPUTER INDUSTRY 38 (1985): "[S]preadsheets, word processors, and adventure games ... turned computers into consumer ideas." Carlton identifies three programs—VisiCalc, Wordstar and Adventureland—as having virtually created the consumer market. Id. Graphics also was considered a revolutionary idea being incorporated into video games after having been developed by the air force. Id. at 96. In Lotus Dev. Corp. v. Paperback Software Int'l, 740 F. Supp. 37, 65 (D. Mass. 1990), Judge Keeton states: "Bricklin's idea for VisiCalc was a revolutionary ad-
to fit the definition in the sense of revolutionizing production or consumption patterns in their utilization. Once, however, the market has been established for such programs, other programs of the same general type would not ordinarily fit within the revolutionary category but would constitute merely improvement programs further advancing the state of the art; such programs might fall within either the low or high benefit/cost category, as discussed above.

The high benefit/cost category of noncopyright-induced programs provides a high benefit at a relatively low cost with little risk of non-success. Again, as with respect to patents in this category, technological developments as well as market conditions may induce the creation of such programs independently of any system of copyright protection. Many application programs would appear to fit into this category. Once a new computer system is introduced on the market, there is an immediate demand for application programs making the particular system more competitive. It is a symbiotic relationship. The introduction of a new computer system stimulates a demand for application programs, and the increase in application programs creates

112. Other programs that may qualify as revolutionary may include: data-base, windowing, utility ("unerase"), desktop manager, and desktop publishing. See Jon Udell, Beyond DOS: Windows and OS/2: Whither Windows?, BYTE, Feb. 1991, at 95, 95 (the author introduces the article with the following statement about Windows: "No other software product so radically expands the horizons of computing."); see also Jeffery H. Lubeck & Bruce D. Schatzman, Making Windows Work: Feeling Left Out By Windows Revolution? Here Are Some Tips that Can Get You Up and Running, BYTE, Feb. 1991, at 293, 293 (using the phrase "windows revolution" and stating that the "number of Window applications that have appeared over the last few months is truly astounding."); Matt Page & Mary Page, Laying Out the Future: Increased Capabilities and Color Should Give Desktop Publishing a Rosy Future, BYTE, Fall 1990, at 169 (naming major software programs for desktop publishing); Daniel Bricklin, Hit or Miss? Secrets for Creating Top Software, COMPUTER WORLD, Nov. 3, 1986, at 122 (discussing the productivity improvements achieved by "unerase," desktop manager, desktop publishing and other programs).

113. These would include updated versions of the same program. See infra note 178. Also, the original program may not be the one that is the most commercially successful. For example, although WordStar was the first commercially successful word processing program, it was not the first such program. See, CARLTON, supra note 111, at 38-39 (identifying Electric Pencil as the first commercial word processing program). Also, LOTUS 1-2-3 replaced VisiCalc as the leading spreadsheet program. See infra note 118.

114. See supra text accompanying notes 78-79 and 91-95.
115. See supra text accompanying notes 91-92. Serendipity may also play some part in the development of new computer programs. A programmer may be seeking to solve a particular problem, yet by chance find a solution to another problem and obtain the spin off results of this at low cost. It is not apparent, however, how often this is as likely to occur compared to inventions. See supra text accompanying notes 93-95.
a greater demand for the computer system. Examples of programs which would seem not to depend upon the copyright system would be those developed from the state of the art for a particular narrow application, such as an inventory control program for a particular industry, or, to take an example from a well known case, a program for the administrative operation of a dental laboratory. An example of a revolutionary program that led to a high benefit/cost program may be the original spreadsheet program, VisiCalc, from which Lotus 1-2-3 evolved.

There also appears to be a strong market incentive for early introduction of many programs in order to establish familiarity among users, in the hopes of becoming the industry standard. Thus, menu formats, screen displays, and symbolic representations become highly important even in the absence of copyright protection. Moreover, the decision to maintain an interface as proprietary or not often will be market driven.

The availability of an alternate means of legal protection for computer programs may also decrease reliance on either the copyright or

116. See, e.g., NRC, SOFTWARE ISSUES, supra note 65, at 51: Thousands of software applications were written by third-party developers, motivated by the prospect of market success. In turn, those who succeeded by writing high-quality programs benefitted the hardware manufacturers by increasing the utility and value of their computers.


118. VisiCalc was conceived by Daniel Bricklin in 1978 and with the assistance of Robert Frankston was developed for use on an Apple II computer, while they were graduate students at the Harvard Business School. See Mark Whitehorn, Buyer's Guide: Spreadsheets, PC USER, June 6, 1990, at 120. Lotus 1-2-3 was developed by Mitchell Kapor and Jonathan Sachs. Lotus Dev. Corp. v. Paperback Software Int'l, 740 F. Supp. 37, 66 (D. Mass. 1990). Both were financial successes, but Lotus 1-2-3 (designed for the IBM PC) replaced VisiCalc because of inherent limitations in VisiCalc. Id. at 65. Indeed, Judge Keeton in Lotus suggests this categorization when, after indicating the revolutionary character of VisiCalc, see supra note 111, states that "[Lotus] 1-2-3 like many other electronic spreadsheet programs since, could thus be thought of as an evolutionary product that was built on the shoulders of VisiCalc." Id. at 66 (emphasis added).

119. This would appear to be the case with the introduction of WordStar and VisiCalc, even though later displaced as industry leaders.

120. The downside of this is that when a user interface becomes commercially successful it becomes the obvious target for copiers.

121. NRC, SOFTWARE ISSUES, supra note 65, at 52: The debate over proprietary interests in program code that expresses external interfaces is intense and often divides the industry. Those firms offering integrated systems solutions to computer communications environments see component interfaces as crucial elements of proprietary value added. Those who produce software and hardware components that must attach to and work with complex information systems see proprietary interfaces as a barrier to market entry. Thus, even if intellectual property law provides reasonable protection for interfaces—the subject of a wide spectrum of opinion—business strategies dictate whether a firm will deem an interface as open or proprietary.
patent systems. In this regard, state trade secret law\textsuperscript{122} may provide an adequate system of protection independent of either the copyright or patent systems. Trade secrets work particularly well where a program is not widely distributed but is licensed to a relatively limited group of users who are contractually obligated to maintain the program in confidence.\textsuperscript{123} In the case of retail distribution of programs, especially for personal computer use, limiting their availability in only object code provides a technological barrier to decompiling any trade secrets that might be buried in the object code.\textsuperscript{124} In a recent survey, about 75\% of software developers indicated that they relied on trade secret law, while 25\% relied on copyrights and only 8\% on patents.\textsuperscript{125} This finding seems to indicate that trade secret law provides an independent and significant incentive for the creation of computer programs.\textsuperscript{126}

In comparing the two systems of protection, because computer programs are protectible by both patents and copyright, a particular program may have been induced by (i) the patent system solely, (ii) the copyright system solely, (iii) both the patent and copyright systems or (iv) neither the patent nor the copyright system.\textsuperscript{127} The system (patent or copyright) that achieves the higher net benefit over cost to society, by producing the greatest yield of induced-computer programs to noninduced programs, would seem to be the more desirable one.\textsuperscript{128} Although it is theoretically possible that both systems induced a particular program, a binary analysis (patent or copyright) is thought to


\textsuperscript{123} At one time it was standard practice to provide programs along with the sale or leasing of mainframe computers or to strictly license the use of programs with a particular system. See NRC, SOFTWARE ISSUES, supra note 65, at 6-9.

\textsuperscript{124} See supra notes 94 and 67, for a discussion of decompiling. It became industry practice in the 1980's to market programs only in machine code under restrictive license terms. The rationale for the decision, according to a spokesman for IBM (Peter Schneider), was: "The reaction to become more secretive was because of the uncertainty of the legal system was a prudent business decision," although admitting that this policy greatly diminished possibilities of customers improving programs. NRC, SOFTWARE ISSUES, supra note 65, at 75.

\textsuperscript{125} The survey was undertaken by the Massachusetts Software Council and the above figures are reported in NRC, SOFTWARE ISSUES, supra note 65, at 62. (Copyrights may be used in conjunction with trade secret law. Hence, the figures cited do not add up to exactly 100%).

\textsuperscript{126} As previously discussed, the protection of trade secrets under the guise of copyright may impose additional costs compared to a legal regime where programs would have to be made available in source code to be protected by copyright or where reverse engineering could be undertaken without fear of copyright infringement. See supra text accompanying notes 64-68.

\textsuperscript{127} One could also speculate that a program could be induced by the copyright system coupled with trade secret protection afforded by distribution only in object code.

\textsuperscript{128} The converse is that the system that produces the lowest yield of induced programs is the costlier.
be justifiable because all computer programs are protectible by copyright, except in the narrow case where merger of idea and expression may occur.129

There are two major differences between the patent and copyright systems, which lead to the conclusion that the patent system produces a higher yield of induced-computer programs, particularly those of a revolutionary quality, than does the copyright system. First, the qualitative requirements of the patent system are likely to eliminate a significant proportion of computer programs from patent protection that would not be eliminated by the copyright system. To qualify for patent protection, a computer program, assuming that it meets the statutory subject matter requirement and is not subject to a statutory bar,130 must also meet the requirements of novelty, utility and nonobviousness. The only requirement for protection by copyright law is that the program be original, i.e., subjectively original with its creator.131 The program need not be new, useful, or nonobvious. In theory, a program satisfying the originality requirement could replicate a prior program and still be protectible by copyright.132 Interestingly, a

129. The merger doctrine is discussed supra note 8. Obviously those computer programs that were created prior to the recognition of copyright or patent protection should be disregarded. It would be highly speculative to presume that the creators of computer programs were anticipating or relying upon such future protection.

130. See 35 U.S.C. § 102(b)(19)("public use or on sale in this country, more than one year" before application filed); § 102(c)(abandonment); § 102(d)(filing abroad more than one year prior to U.S. filing date).

131. See generally 1 GOLDSTEIN, COPYRIGHT, supra note 8, at §§ 2.2.1-3, (discussing the originality requirement). Recently, the Supreme Court in Feist Publications, Inc. v. Rural Tele. Serv. Co., 111 S. Ct. 1282 (1991), addressed the originality issue in the context of a compilation—the white pages of a telephone book. The Court reasoned:

Rural's selection of listings could not be more obvious: it publishes the most basic information—name, town, and telephone number—about each person who applies to it for telephone service. This is "selection" of a sort, but it lacks the modicum of creativity necessary to transform mere selection into copyrightable expression. Rural expended sufficient effort to make the white pages directory useful, but insufficient creativity to make it original.

Id. at 1296. Feist may cast some shadow over the originality of certain databases.

132. It has become de rigueur to quote Judge Learned Hand:

Borrowed the work must indeed not be, for a plagiarist is not himself pro tanto an "author"; but if by some magic a man who had never known it were to compose a new Keat's Ode on a Grecian Urn, he would be an "author," and, if he copyrighted it, others might not copy that poem, though they might of course copy Keat's.

Sheldon v. Metro-Goldwyn Pictures Corp., 81 F.2d 49 54 (2d Cir.), cert. denied, 298 U.S. 669 (1936). This is the independent creation theory of developing compatible programs from the specifications of existing ones by the clean room technique. See supra note 34. Compare Jessica Litman, The Public Domain, 39 EMORY L.J. 965, 1023 (1990), who concludes: "In fact, originality is an apparition; it does not, and cannot, provide a basis for deciding copyright cases."
program need not even work, i.e., it need not satisfy a utility require-
ment.\textsuperscript{133} Extensive debugging may be required to obtain a useful pro-
gram; yet, because it satisfies the statutory subject matter requirement
and because it is original, it is protectible.\textsuperscript{134}

It has been estimated that only a small percentage of all computer
programs would satisfy the requirements for patentability.\textsuperscript{135} None-
theless, with respect to revolutionary programs, which are the impor-
tant class of patent-induced inventions, most of these programs are
likely to satisfy the patent qualitative standards almost by definition.\textsuperscript{136} It thus seems probable that the patent system is more likely to
induce a higher yield of computer programs of the revolutionary type
compared to the copyright system because of the qualitative sorting
mechanism.

Second, the cost of securing protection and the cost of maintaining

\begin{footnotesize}
\begin{enumerate}
\item\footnote{With respect to patents, the Supreme Court held in Brenner v. Manson, 383 U.S. 519 (1966), that a chemical compound whose only utility was as an object for fur-
ther investigation did not satisfy the utility requirement of 35 U.S.C. \textsection{}101, stating:
\begin{quote}
The basic quid pro quo contemplated by the Constitution and the
Congress for granting a patent monopoly is the benefit derived by the
public from an invention with substantial utility. Unless and until a pro-
cess is refined and developed to this point—where specific benefit exists
in currently available form—there is insufficient justification for permit-
ing an applicant to engross what may prove to be a broad field.\cite{Brenner}
\end{quote}
\item It may be questioned why anyone would want to copy an inoperable program. Yet debugging may be less costly than independent development. Also, the entire
program need not be copied for infringement; there need be only "substan-
tial" copying. \textit{See} 2 GOLDSTEIN, COPYRIGHT, \textit{supra} note 8, at 27. Professor
Goldstein cites a number of examples where infringement was found although
the \textit{quantity} of copied expression was small: Harper & Row, Publishers, Inc. v.
Nation Enters., Inc, 471 U.S. 539 (1985)(300 words out of a 200,000 word manu-
script); Dawn Assocs. v. Links, 203 U.S.P.Q. (BNA) 851 (N.D. Ill. 1978)(one sen-
tence from an advertisement); Henry Holt & Co. v. Liggett & Myers Tobacco Co.,
\item In 1983 one commentator stated. "Only a minute number of programs (perhaps
less than 1 percent) are inventive enough to be patented." Duncan M. Davidson,
\textit{Protecting Computer Software: A Comprehensive Analysis}, 23 JURIMETRICS J.
339, 357 (1983). The only rationale given is that most software is mundane. \textit{Id}. A
rationale that would lead to a larger (perhaps substantially) estimate of the po-
tential patentability of computer programs is the relative commercial importance
of particular programs. Commercial importance would be relevant to the deci-
sion whether a program developer will invest in the cost of securing a patent.
Commercial success may bear on the issue of nonobviousness of a program. The
CAFC requires that secondary considerations, such as, commercial success, long
felt but unresolved need, and the failure of others, be taken into account on the
\textsection{}103 issue. \textit{See}, e.g., Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1538-40
(Fed. Cir. 1983).
\item On the other hand, programs that may revolutionize production or consumption
may have a more difficult time in being categorized as statutory subject matter.
\textit{See} Oddi, \textit{Invention Protection, supra} note 12, at 1127.
\end{enumerate}
\end{footnotesize}
that protection will result in the elimination of certain computer programs from patent protection, but will not have the same result with respect to copyright protection. The costs of securing patent protection for computer programs may be appreciable. The cost for the preparation and prosecution of an application may be in the order of $10,000-$50,000. In addition to attorney fees, the time expended by the inventor and other individuals in the preparation and prosecution of the patent application should be included. Also, there are substantial PTO filing and issuance fees for the patent grant and maintenance fees to keep the patent in force. These procurement costs are not insignificant, particularly for small software houses or for individual programmers, and hence may eliminate an appreciable number of otherwise qualifying computer program inventions.

In contrast, for copyright protection, there are essentially no formalities, the cost of registration is nominal, and registration may even be delayed. In addition, there are no maintenance fees to keep a copyright in effect during its entire term. It is abundantly clear that the cost of procurement of copyright protection serves as no bar

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137. See Rory S. O'Connor, Patent Fever Sweeps Software Developers Trying New Avenues to Protect Programs, CHICAGO TRIBUNE, § 4, Mar. 20, 1989, at 8 (reporting that patents may cost as much as $20,000 to obtain and $50,000 to defend). The total procurement costs from pre-examination searching through maintenance fees have been estimated by Kahin to range from $15,000 to over $25,000. See NCR, SOFTWARE ISSUES supra note 65, at 63 (citing Kahin, Software Patents: Franchising the Information Structures, CHANGE, May/June 1989, at 24-25). These figures may be low. R. Lewis Gable estimates that $10,000 is the probable minimum with as much as $50,000 for an application requiring extensive prosecution. Interview with R. Lewis Gable, Chairman of Ad Hoc Computer Software Committee of American Intellectual Property Law Association (1992).

138. As of December 16, 1991, filing fees increased to $690 compared to $630 in November, 1990, and $370 in April, 1988; issuance fees increased to $1,130 compared to $1,050 in November, 1990 and $620 in April, 1989. Maintenance fees are now $900 payable 3.5 years after the patent grant, $1,810 payable 7.5 years after the grant; and $2,730 payable 11.5 years after the grant, making a total of $5,440 to maintain the patent over its entire 17-year term. PTO Final Rule Increasing Patent and Trademark Fees, 43 PAT. TRADEMARK & COPYRIGHT J. (BNA) 142, 157-60 (1991).

139. Fees are reduced by 50% for “any small business concern as defined under section 3 of the Small Business Act, and to any independent inventor or nonprofit organization” as defined in the PTO regulations. 35 U.S.C. § 41(h)(1)(1988).


141. The term is life plus 50 years for a named sole author, 17 U.S.C. § 302(a)(1988); life plus 50 years for joint authors, measured from the death of the last surviving author, 17 U.S.C. § 302(b)(1988); and 75 years from the publication date for anonymous and pseudonymous and works for hire. 17 U.S.C. § 302(c)(1988).
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to the protection of any computer program irrespective of quality or benefit/cost ratio.

On the basis of the foregoing analysis, the conclusion may reasonably be drawn that, because copyright protects substantially all programs and because the patent system has some inherent means of sorting out on the basis of the qualitative standards and the relatively high cost of procurement, the ratio of patent-induced programs to non-patent-induced programs will be substantially higher than the ratio of copyright-induced to noncopyright-induced programs. In theory, at least, the patent system may thus be considered more likely to produce greater benefits because of its tendency to induce computer programs, especially revolutionary ones, that would not be created in all likelihood on its basis of the market or other inducements; it would also inhibit the patenting of marginal improvement programs.\textsuperscript{142} The copyright system, on the other hand, has essentially no barriers to protection and thus protects all programs; hence it tends to be a relatively costly system. However, this does not mean that the copyright system does not produce a net benefit, only that it may be less beneficial because of over-inclusiveness by protecting a high percentage of programs that would otherwise be freely available to the public.\textsuperscript{143}

C. Excessive Inducement

The second assumption underlying the patent and copyright systems is that exclusivity is the needed incentive for the appropriate level of creativity.\textsuperscript{144} Contrary to this assumption, an appropriate number of inventions and works of authorship may, in fact, be created by lesser incentives, (i.e., lower persuasion costs), such as governmental subsidies, tax policies or prizes.\textsuperscript{145} Any incentive is costly if a lesser incentive would have induced the invention or work of authorship. A primary consideration concerning whether an excessive inducement is being provided by either title of protection would be the scope of protection afforded.

The scope of protection for a patent is defined by its claims.\textsuperscript{146} In order to infringe, the alleged infringer must either make, use or sell the patented invention as defined in the claims.\textsuperscript{147} Claims tend to be

\begin{footnotes}
\item[142] It would only be in the case of the low benefit/cost type of program that the owner may risk the investment because of the competitive need for even narrow protection. See supra text accompanying notes 78-79.
\item[143] Moreover, it is far from clear whether there would be sufficient incentive in the absence of copyright to proceed to the commercialization stage, including debugging and documentation.
\item[144] See supra notes 18-19 and accompanying text.
\item[145] See supra text accompanying notes 85-90.
\item[147] "Except as otherwise provided in this title, whoever without authorization
construed strictly within the confines of the patent disclosure.\textsuperscript{148} The usual formula given is that each element of the claim must be "read on" infringing subject matter, and infringement occurs "if it performs substantially the same function in substantially the same way to obtain the same result."\textsuperscript{149} The doctrine of equivalents, however, may somewhat expand the scope of coverage and introduces some degree of ambiguity into the scope.\textsuperscript{150}

The protection granted under a patent is a powerful one because it affords in rem property treatment,\textsuperscript{151} with strict liability being the theory of liability.\textsuperscript{152} Independent development of the invention with-

\textsuperscript{148} The strict rule of patent infringement in the Supreme Court can be traced from Prouty v. Draper, 41 U.S. (16 Pet.) 336 (1842) through Deep South Packing Co. v. Laitram Corp., 406 U.S. 518, 532 (1972), where the Court stated: "When so many courts have so often held what appears so evident—a combination patent can be infringed only by combination—we are not prepared to break the mold and begin anew." The CAFC has recently narrowly construed \textit{Deep South} as applying only when the infringing combination is assembled outside of the United States. See Paper Converting Mach. Co. v. Magna-Graphics Corp., 745 F.2d 11 (Fed. Cir. 1984) (finding infringement for testing separate components of the invention prior to expiration date of the patent even though the complete combination was not assembled until after expiration).


\textsuperscript{150} The test for equivalency under \textit{Graver Tank} \& \textit{Mfg. Co. v. Linde Air Prod.}, 339 U.S. 605 (1950) is whether the accused device and the claimed invention perform "substantially the same function in substantially the same way to obtain the same result." \textit{Id.} at 607. This test is known as the "function, way, result" test and is used as an alternative analysis to literal infringement, where "every limitation set forth in a claim must be found in the accused product or process exactly." Johnston v. IVAC Corp., 835 F.2d 1574, 1577 (Fed. Cir. 1989).


\textsuperscript{151} See supra note 48, for the definitions of a right in rem.

\textsuperscript{152} See Aro Mfg. Co. v. Convertible Top Replacement Co. (\textit{Aro II}), 377 U.S. 476, 484
out intent to infringe or even knowledge of the patent does not constitute a defense. For monetary damages to be awarded, however, actual or constructive notice of the patent is required.

The scope of protection afforded under copyright law is considerably more ambiguous than under patent law. The copyright statute established a series of exclusive rights reserved to the copyright owner. A principal one of these is that of precluding copying of the copyrighted work. Copying requires access to the copyrighted work and "substantial similarity" between the two works.

A major problem with respect to infringement of copyright has been the idea/expression dichotomy. Expression is protectible by copyright, but ideas are not. The black letter rule may be simply stated, but, within whatever category of copyrightable subject matter,
the problem has proved to be a difficult one. The problem is especially difficult with respect to computer programs.

The question of the literal copying of source code or object code presents the simplest case. If all or a substantial part of a work is copied, whatever expression there is will also be copied. On the other hand, the idea/expression issue becomes of paramount importance when there is nonliteral copying. Two cases are illustrative: Whelan Associates v. Jaslow Dental Laboratory and Lotus Development Corp. v. Paperback Software International. The basic approach of both of these cases was to resolve the idea/expression dichotomy at a high level of abstraction of idea. In Whelan the Third Circuit adopted the following test for separating idea from expression: "[T]he purpose or function of a utilitarian work would be the work's idea, and everything that is not necessary to that purpose or function would be part of the expression of the idea." The court then defined the purpose or function of the program under consideration as being the general purpose for which that program was created—in this instance, the efficient operation of a dental laboratory. It then follows that everything beyond the efficient operation of a dental laboratory as the idea would be expression, including the organization, structure and sequence of the program.

In Lotus the court separated idea from expression based upon whether the program under consideration included "identifiable ele-

159. See e.g., Nichols v. Universal Pictures Corp., 45 F.2d 119 (2d Cir. 1930), where Judge Learned Hand, in the context of a movie alleged to infringe the copyright on a play, developed the "abstractions" test, in which patterns of increasing generality are imposed on the two works to determine if there is a common "idea" and then the work is dissected to determine if there has been appropriation of "expression" at a lower level of abstraction; Sid & Marty Krofft Television Prod., Inc. v. McDonald's Corp., 562 F.2d 1157 (9th Cir. 1977), in the context of a TV commercial alleged to infringe the copyright on a children's TV program, a bifurcated extrinsic/intrinsic test was developed, where first it is determined whether there is substantial similarity of ideas between the two works. If it is so determined extrinsically, which may include expert testimony and dissection, then the intrinsic test is applied to determine if a lay observer would find substantial similarity in the expression of the common idea. See infra text accompanying notes 160-171, for a discussion of the tests used in the context of computer programs.


162. 740 F. Supp. 37 (D. Mass. 1990). The case was settled with defendants agreeing to pay $500,000 for infringement, stop marketing infringing programs, not appeal the district court decision and drop any court claims against Lotus. See 40 Pat. Trademark & Copyright J. (BNA) 545 (1990).


164. Id. at 1238.

165. Id. at 1239.
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In applying that test, the court found that the idea was the "rotated-L" configuration essential to a spreadsheet program and everything beyond that constituted expression. The fact that the idea of the "rotated-L" was not original to the owner of the Lotus 1-2-3 program or its creators did not appear to dissuade the court in making the dichotomy.

By conceptualizing idea at such a high level of abstraction and reserving everything at a lower level of abstraction to expression, a rather expansive scope of protection is being afforded to computer programs by copyright for nonliteral copying. Such a broad scope of protection would suggest the expansion of copyright into areas traditionally protected by patents in the sense of the utility associated with a particular idea at whatever level of abstraction, but certainly at lower levels of abstraction than defined in Whelan and Lotus.


168. Judge Keeton states: "The idea for an electronic spreadsheet was first rendered into commercial practice by Daniel Bricklin" and describes the "idea" as a "revolutionary advance" upon which the authors, Michael Kapor and Jonathan Sacks, of Lotus 1-2-3 "built upon the shoulder of VisiCalc." Id. at 65. See supra note 118, for a discussion of the development of VisiCalc and Lotus 1-2-3. See also, supra note 69 (discussing Patent No. 3,610,902, granted Oct. 7, 1968, relating to an electronic spreadsheet).

169. Recently, the Second Circuit declined to follow Whelan in determining substantial similarity of the non-literal aspects of an alleged infringing job scheduling computer program by stating that the district court correctly found that "Whelan's synonymous use of the terms 'structure, sequence, and organization' . . . demonstrated a flawed understanding of a computer program's method of operation." Computer Assoc. Int'l, Inc. v. Altai, Inc., 982 F.2d 693, 706 (2d Cir. 1992) (amended after rehearing, Dec. 17, 1992). Instead, the court invoked a three-step procedure involving abstraction, filtration and comparison based on Judge Learned Hand's abstractions test in Nichols v. Universal Picture Corp., 45 F.2d 119 (2d Cir. 1930). First, the abstraction levels of the allegedly infringed program's structure are determined from the lowest level of individual instructions to the highest level of module functions. Computer Assoc. Int'l, Inc. v. Altai, Inc., 982 F.2d 693, 706 (2d Cir. 1992). The second step, filtration, which is performed on a case-specific basis, sorts out noncopyrightable elements dictated by efficiency, external factors, and those taken from the public domain a core of copyrightable expression. Id. at 707. The third step, comparison, focuses on whether the accused program copied any aspect of the protected expression as well as the relative importance of the copied portion of the original program. Id. at 710.

Other courts have been quick to adopt this analysis. See Atari Games Corp. v. Nintendo of Am., Inc., 975 F.2d 832 (Fed. Cir. 1992)(applying the Altai abstractions approach to determine protectible expression as including programming instructions that create an arbitrary data stream that serves as the key to unlocking the computer program); CMAX/Cleveland, Inc., v. UCR, Inc., 804 F. Supp. 337
An even broader scope of protection is being sought in the *Apple* litigation against Micro-Soft and Hewlett-Packard.\(^{170}\) The theory of infringement is that of "look and feel," in which it is asserted that the defendants' "windowing" programs infringe Apple programs because they replicate the pull-down menu and symbolic "look and feel" of the Apple format.\(^{171}\)

(M.D. Ga. 1992) (following three-step abstraction analysis of *Altai* to find that the nonliteral elements of a rental appliance company's computer program including file structures, transaction codes, and screens and reports protectible expression as they are not dictated by efficiency considerations or the nature of the industry); *Autoskill* v. National Educ. Support Sys., 793 F. Supp. 1557 (D.N.M. 1992) (rejecting analysis of *Whelan* and utilizing abstractions approach to determine protectible elements of expression of software program used in the testing, diagnosis and training of reading skills).

See also *Brown Bag Software* v. Symantec Corp., 960 F.2d 1465 (9th Cir. 1992). The court approved application to computer programs of the "revised" version of the "extrinsic/intrinsic" test for substantial similarity developed in Sid & Marty Krofft Television Prod., Inc. v. McDonald's Corp., 562 F.2d 1157 (9th Cir. 1977), as modified in *Shaw* v. Lindheim, 908 F.2d 531 (9th Cir. 1990). The "revised" test permits not only an objective analysis of the similarity of ideas between two programs, but also an objective analysis of copyrightable expression for which "analytic dissection" and expert testimony are appropriate. *Brown Bag Software* v. Symantec Corp., 960 F.2d 1465, 1473-75. The court also approved using "analytical dissection" for determining whether similarity in programs resulted from "unprotected expression." *Id.* at 1475-76.


See A. Samuel Oddi, *Functionality and Free Market Theory*, 17 A.I.P.L.A. Q.J. 173 (1989) [hereinafter Oddi, *Functionality*], for a discussion of how the doctrine of "functionality" from trademark and unfair competition law could be used to analyze the potential functionality of program features at lower levels of abstraction than *Whelan*.

170. So far four decisions have been rendered in this case on various motions: (1) *Apple Computer*, Inc. v. *Microsoft Corp.*, 709 F. Supp. 925 (N.D. Cal. 1989) (Schwarzer, J.) (ruling that Microsoft did not have a complete defense to the infringement action based upon a 1985 settlement agreement, but that this settlement licensed Microsoft to use certain visual displays); (2) *Apple Computer*, Inc. v. *Microsoft Corp.*, 717 F. Supp. 1428 (N.D. Cal. 1989) (Schwarzer, J.) (granting Microsoft's motion that 1985 settlement operated as a partial affirmative defense to Apple's copyright infringement action); (3) *Apple Computer*, Inc. v. *Microsoft Corp.*, 759 F. Supp. 1444 (N.D. Cal. 1989) (Walker, J.) (ruling there was insufficient evidence to establish fraud against the Copyright Office by Apple claim and sufficient originality in Apple's works to satisfy copyright requirement); (4) *Apple Computer*, Inc. v. *Microsoft Corp.*, 799 F. Supp. 1006 (N.D. Cal. 1992) (Walker, J.) (ruling that the arrangement for a computer screen display comprising a user interface serves "a purely functional purpose" so as to not be entitled to protection under a "look and feel" theory of substantial similarity).

171. See generally, on the "look and feel" infringement theory, Alfred C. Yen, *A First Amendment Perspective on the Idea/Expression Dichotomy and Copyright in a Work's "Total Concept and Feel"*, 38 EMOHY L.J. 393 (1989), Samuels, supra note
The scope of protection afforded computer programs by copyright may also be seen as, in essence, providing a form of trade secret protection under the guise of copyright. If competitors must reverse engineer to determine what, if any, trade secrets (i.e., ideas) a program might contain and if, in engaging in such reverse engineering, they run the risk of a copyright infringement action, access becomes self-restrictive which increases costs to society when compared to other forms of technology on the market.\textsuperscript{172}

Another factor that may bear upon the measure of inducement provided by patent or copyright protection is the risk of invalidity or unenforceability of the right. Patents are frequently found invalid. With the institution of the Court of Appeals for the Federal Circuit (CAFC) as the common appellate court for patent appeals, the rate of invalidity has dropped appreciably; still, a relatively high percentage of all patents are found invalid.\textsuperscript{173} In the case of copyright, because of

\textsuperscript{158} Richard D. Moreno, Note, "Look and Feel" as A Copyrightable Element: The Legacy of Whelan v. Jaslow? Or, Can Equity in Computer Program Infringement Cases Be Found Instead By the Proper Allocation of Burden of Persuasion?, 51 LA. L. REV. 177 (1990); Elizabeth G. Lowry, Comment, Copyright Protection for Computer Languages: Creative Incentive or Technological Threat?, 39 EMORY L.J. 1293 (1990). Professor Goldstein cautions: "Though appropriate for fanciful works of art, the "total concept and feel" test creates the risk of protecting unprotectible as well as protectible elements of functional works." 1 GOLSTEIN, COPYRIGHT, supra note 8, at 136 (footnotes omitted).

\textsuperscript{172} See supra notes 34, 67, and 68. Two recent copyright cases have recognized limited exceptions for reverse engineering to qualify under the fair use doctrine. See Sega Enterprises, Ltd. v. Accolade, Inc., 977 F.2d 1510 (9th Cir. 1992) (ruling that intermediate copying of computer video game program necessary for disassembly of computer object code constitutes fair use as a matter of law where it was the only way for Accolade to gain access to the ideas and functional elements embodied in Sega's program and where a legitimate reason existed for seeking such access); Atari Games Corp. v. Nintendo of Am., Inc., 975 F.2d 832 (Fed. Cir. 1992) (ruling that Atari's intermediate copying of Nintendo's computer video game chip for the purpose of reverse engineering did not constitute fair use because the defense is only available as long as the copying is not more than necessary to understand the unprotected elements of the work and does not attempt to commercially exploit the protected expression).

\textsuperscript{173} History shows that courts have invalidated a relatively high percentage of patents. In a 53-year study from 1921 through 1973, courts of appeals invalidated 65% of the patents, while district courts invalidated 55%. Lawrence Baum, The Federal Courts and Patent Validity: An Analysis of the Record, 56 J. PAT. OFF. SOC'y 758, 760-61 (1974). In a 30-year study from 1948 through 1977, limited to the issue of nonobviousness, 52% of patents were held invalid by district courts and 64% by the courts of appeals. See Myron Cohen, Nonobviousness and the Circuit Courts of Appeal—Twenty-five Years in Review, in NONOBVIOUSNESS—the Ultimate Condition of Patentability 3:1, 3:13 (John F. Witherspoon ed., 1980). In the first three years of operation of the CAFC with respect to appeals from district courts, the invalidation rate decreased to 46% on the obviousness issue and 50% on § 102 issues. If § 112 issues are included, the overall percentage of invalidity was 44%. Donald R. Dunner, The Court of Appeals for the Federal Circuit—Its First Three Years: Introduction, 13 A.I.P.L.A. Q.J. 185, 186-89 (1983). In a
the low qualitative standard of protection of originality, it is relatively rare that a copyright would be invalid for that reason.\footnote{174} Also, if history is any teacher, a higher percentage of patents than copyrights is likely to be held unenforceable for various abuses, including antitrust violations, misuse or fraud in the procurement.\footnote{175}

The duration of exclusivity provided under patent and copyright protection, respectively, would bear significantly on the incentive provided by that particular title.\footnote{176} A greater incentive obviously is provided under copyright law with life plus 50 years or 75 years for institutional protection compared to 17 years from date of grant of a later study, it was found that the CAFC affixed a finding of validity in substantially all cases (only 3 out of 28 were reversed), while it was equally likely to reverse as to affirm if invalidity was found by the trial court. See Ronald B. Coolley, \textit{What the Federal Circuit Has Done and How Often: Statistical Study of the CAFC Patent Decisions—1982 to 1988}, 71 \textit{J. Pat Off. Soc'y} 385, 391 (1989). It is also interesting to note that the CAFC has reversed a holding of validity only 14 times out of 120 opportunities, thus indicating an affirmation rate of approximately 88%. See ROBERT C. GORMAN, \textit{PATENTS AND THE FEDERAL CIRCUIT} 639 (2d ed. 1991). See also, infra note 244.

In terms of predictability of outcome for infringement litigation, one would expect more consistency with patent appeals being heard by a single court, the CAFC, in comparison to copyright infringement appeals which are heard within the various circuits. In addition, because of the relative paucity of cases and the difficulty in applying tests for separating idea from expression, which were developed in a literary context, a greater uncertainty might be expected concerning the scope of protection afforded to computer programs by copyright.

\footnote{174} The originality standard may be becoming more meaningful, particularly with respect to nonliterary—factual and functional works. See \textit{supra} note 131, for a discussion of the \textit{Feist} telephone work case, and Reichman, \textit{supra} note 2 at 683-89. There are also cases where the merger and idea and expression will preclude copyright protection. See \textit{supra} note 8 (discussing \textit{Plains Cotton} and \textit{Synercom}).

\footnote{175} This is not to say that copyright law is not subject to antitrust abuses. See \textit{Nimmer on Copyrights, supra} note 8, § 13.09. Broadcast Music Inc. v. Columbia Broadcasting Sys., Inc., 441 U.S. 1 (1979)(implying acceptance of antitrust misuse copyright defense from action of Court in reversing and remanding for further proceedings antitrust judgment and dependent misuse judgment). There has also been an increase in the use of the misuse defense in copyright cases. See, e.g., Lasercomb Am., Inc. v. Reynolds, 911 F.2d 970 (4th Cir. 1990)(holding not only antitrust violations, but any violation of the public policy interests embodied in the grant of the copyright grounds for use of misuse defense). Also, although fraud in procurement has in the past almost been exclusively limited to patents because of the examination system, it may also be alleged in copyright cases. See, e.g., Apple Computer, Inc. v. Microsoft Corp., 759 F. Supp. 1444, 1455 (N.D. Cal. 1989)(finding "no evidentiary basis for [defendant's] claim that Apple intended to commit a fraud on the Copyright Office" in failing to make full disclosure to the copyright).

\footnote{176} The optimal term for a patent has been studied. See e.g., Machlup, \textit{supra} note 11, at 66-73; WILLIAM D. NORDHAUS, \textit{INVENTION, GROWTH AND WELFARE} Ch. 5 (1969); PARKER, \textit{supra} note 58, at 303-306; SCHERER, \textit{INNOVATION}, \textit{supra} note 77, at 130-41. With respect to copyright duration, see Landers & Posner, \textit{supra} note 20, at 361-63.
patent. However, this incentive is to a considerable extent ameliorated, especially for copyright, by the functional nature of computer programs and rapid technological developments in the computer field rendering many programs obsolete within a few years.\(^\text{177}\) Nonetheless, there are certain basic programs that have become industry standards or that can be updated, which unquestionably will be protected by copyright beyond the 17-year patent term.\(^\text{178}\)

A particularly appealing argument can be made that copyrightable works that may be easily copied should be given a relatively broad scope of protection because, when copying becomes essentially cost-free, the market incentives for creation, such as lead-time, are seriously undermined.\(^\text{179}\) Of the “material objects” in which a work may be fixed, floppy discs upon which computer programs are recorded, are among the easiest to copy, along with audio- and video-tape cassettes. Landes and Posner have developed an economic model according to which the scope of protection under copyright would be proportional to the cost of copying, \(i.e.,\) the cheaper a work can be copied, the greater the scope of protection that should be afforded.\(^\text{180}\) On the other hand, Landes and Posner indicate that, the broader the scope of protection, the more difficult it becomes for others to create works of authorship because of being denied access to previous authors’ works:

The intuition behind these results is straightforward. Some copyright protection is necessary to generate the incentives to incur the costs of creating easily copied works, but too much protection can raise the costs of creation for subsequent authors to the point where those authors cannot cover them even though they have complete copyright protection for their own originality.\(^\text{181}\)

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177. In general, computer software has a life cycle, or expected obsolescence, of three to four years. See Arthur Middleton Hughes, \textit{How to Build a Successful Marketing Database}, DM NEWS, Mar. 18, 1991, at 27. The duration of the life cycle is influenced by the speed at which the industry for which the application is written is changing and the speed at which the hardware on which the application is running is upgraded. See Bruce Caldwell, \textit{Blue Cross, In Intensive Care, Beeps EDS}, INFO. WK., Jan. 27, 1992, at 10, ("The health-care business is changing dramatically and rapidly . . . Major [software] applications that started four years ago were becoming obsolete before they were complete."); Some specific applications, such as computer games, may have even shorter life cycles (one year) than the average. Gary Coffey, \textit{Timing Appears to be Right for New Learning Software}, NASHVILLE BUS. J., May 14, 1990, § 1, at 25.

178. Since its introduction in the spring of 1984, a new version of Lotus 1-2-3 has been issued roughly every year. Interview with Customer Service, Lotus Dev. Corp. Since its introduction in 1982, a new version of Word Perfect has been issued roughly every two years. Interview with Customer Service, Word Perfect Corp. Since its introduction in late 1982, AutoCAD has had 10 revisions. Interview with Customer Service, Autodesk, Inc.


180. \textit{Id.} at 331-41.

181. \textit{Id.} at 335.
In the case of verbatim copying of either source or object code, and in particular the latter, the scope of protection would not need to be any broader than prohibition of that copying to overcome any disadvantage arising from ease of copying. However, when one goes beyond verbatim copy to situations, such as in *Whelan* and *Lotus*, where the copying is not nearly as easy and, indeed, involves a great deal of time and expense to engage in the necessary rewriting of the program, a narrower scope of protection would seem economically justified.\textsuperscript{182} To the contrary, the *Lotus* and *Whelan* courts provided an expansive scope of protection that may inhibit competitors from entering the market for fear of infringement.\textsuperscript{183} Moreover, such decisions have a prohibitory effect on reverse engineering where the dividing line between idea and expression is drawn at such a high level of abstraction that it becomes virtually impossible to avoid expression in copyrighted computer programs where access can be shown.\textsuperscript{184} The presumed incentive of a broad scope of protection may indeed become excessive and thereby diminish the quantity of programs generated to an inadequate or inefficient rate.\textsuperscript{185}

In summary, except for the in rem property type of protection afforded by patents compared to the requirement for copying in the copyright law, the scope of incentives provided by copyright protection with respect to computer programs would appear to favor copyrights. This advantage is particularly evident when the idea of a program is defined at a high level of abstraction, such as in *Whelan* and *Lotus*, so that many low level of abstraction ideas are protected under the guise of expression that otherwise would be in the public domain unless protected by patent. In terms of costs, patents providing in rem protection for computer programs extract no greater cost than for other inventions. Extending copyright protection to “functional” works,
however, would seem to be more costly than would be expected for "literary" or "factual" works, as will be further explained in the next section.

D. Patent/Copyright Interface

A basic premise of this article is that computer programs may be the subject matter of both patent and copyright, i.e., a given computer program may satisfy the subject-matter definition of both patent and copyright.186 This premise will now be examined in more detail, be-

186. There is no general agreement on this premise; in a survey conducted by an ad hoc subcommittee of the Computer Software Committee of the American Intellectual Property Association, 15 out of 26 respondents thought that there was some overlap, while the remaining 11 thought that the subject matters to be mutually exclusive. See Pamela Samuelson, Survey on the Patent/Copyright Interface for Computer Programs, 17 A.I.P.L.A. Q.J. 256, 261 (1989)[hereinafter Samuelson, Survey]. For the reasons given for the positions taken, see id. at 261-264. The position of the PTO is that there is an overlap. In response to the question "Should someone who has received a patent on computer software be allowed to receive a patent or vice versa?", submitted to the PTO by Representative Robert W. Kastenmeier, Chairman, Subcommittee on Courts, Intellectual Property and the Administration of Justice, Acting Commissioner Jeffrey M. Samuels in a letter dated Nov. 1, 1989 responded:

The protective offered by the copyright and patent statutes is not mutually exclusive. Cf. In re Yardley, 493 F.2d 1389, (C.C.P.A. 1974)(there is an area of overlap between copyright and design patent statutes). As long as the Constitutionally-mandated objective of promoting the progress of science and the useful arts is being served, the Administration sees no problem in issuing a patent to a computer process notwithstanding any overlap in patent and copyright protection. Thus, one can patent a novel and nonobvious computer process and copyright the software for implementing that process; one might, in fact, copyright several different software implementations of the same computer process. There is a distinction between a patentable computer process, which is a series of steps performed by a computer, and copyrightable software (i.e., a "computer program" under the copyright Act), which is a list of instructions fixed in a tangible medium. Although there is a functional relationship between a computer process and the software for implementing the process, patenting of the computer process and providing copyright protection for one or more software programs encourages innovation and provides appropriate incentives in this important and developing area of new technology.


In another study conducted to elicit the viewpoints of United States computer software companies regarding their positions on various forms of intellectual property protection for software, and regulatory developments, demographic data and responses to twelve statements (scale = strongly disagree-disagree-neutral-agree-strongly agree) were analyzed from 212 usable questionnaires (40% response rate). Linda B. Samuels & Le Thi Cao, Survey of the Opinion of Software Development Companies Concerning Intellectual Property Protection, 32 IDEA 343 (1992). A comparison of small to large companies (large classified by more than 50 employees) was also undertaken to determine whether the needs of the
cause the economic consequences of protecting computer programs by either or both titles of protection may depend upon the legal interrelationship between them.

In this context, various models may be developed showing the interrelationship of patent and copyright protection when the subject matter is a computer program. The first and simplest model would be where the subject matter of patent and copyright operate in independent spheres. This interface model may be represented by two circles: one representing patentable subject matter and the other representing copyrightable subject matter. The two circles would be independent of one another and, at their closest, the two circles would be tangential. Thus, this is a trinary model, where the computer program would be either: (i) patentable subject matter or (ii) copyrightable subject matter or (iii) neither. This is in essence a preemp-

small business are adequately addressed. Results from the data indicate that a majority of the respondents (61.3%) disagree that current law effectively protects software development and does not need to be changed; a greater majority (78%) agree that software should have its own unique type of legal protection. The responses specifically addressing copyright protection indicate that only 9% of the respondents agreed that courts are properly drawing the line between protectible expression and unprotectible ideas in deciding cases (45.2% disagreed; 45.8% neutral). The responses specifically addressing patent protection show that 56.1% of the respondents agreed that patent should be granted for new and innovative software programs. Yet, 47.8% agreed with the current law that patents should not be granted on mathematical algorithms, though an otherwise patentable process should receive protection if it employs an algorithm (19.1% disagreed; 32.9% neutral). In comparing small companies to large companies only as to 3 of the 12 statements did the strength of their opinions differ noticeably. Concerning the statement that copyright law should prohibit copying code, both groups strongly agreed, but the mean approval rate of small firms was greater. For statements that copyright should be separately copyrightable, the agreement of large firms was greater than that for small firms.

187. The models outlined here are developed in more detail in Oddi, Functionality, supra note 169.

188. The tangential, trinary model may be diagrammatically illustrated as follows:

The circle $C_{smt}$ defines the subject matter area of copyright and the circle $P_{smt}$ defines the subject matter area of patent. The circles do not overlap; thus a given subject matter must be exclusively copyrightable or patentable subject matter or neither.
tion model, where either one or the other of the titles of protection prevails or where neither title is available. An example of the latter would be a mathematical algorithm barred by Benson from being patentable subject matter and by the merger doctrine from being copyrightable subject matter.\textsuperscript{189}

Although the preemption model has defenders,\textsuperscript{190} it does not appear to be the prevailing subject matter legal interface model: Copyrightable subject matter is found expressed in programs at relatively high levels of abstraction (as in Whelan and Lotus) and patentable subject matter is found in computer programs, including mathematical algorithms, if properly claimed as inventions. Thus, at the subject-matter level, there is an overlapping interface, which may be visualized as two overlapping circles—one representing copyrightable and the other patentable subject matter.\textsuperscript{191} This is a quaternary model, where a given computer program may be protected by either: (i) patent or (ii) copyright or (iii) neither or (iv) both. The fact that the same computer program constitutes both patentable and copyrightable subject matter, however, need not cause adverse legal or economic consequences, provided the respective scopes of protection afforded by the separate titles are appropriately constrained. Thus, it is necessary to examine the protection interface with respect to patents and copyrights.

The protection interface defines the relationship between what is to be protected by patent and copyright, respectively, even though the

\textsuperscript{189} An interesting question is whether the mathematical algorithm in Benson, which was held to be analogous to a law of nature, would qualify as copyrightable subject matter: Was there any expression in the algorithm beyond its idea? Was its idea capable of expression in only one or in a very few ways?

\textsuperscript{190} See Samuelson, Survey, supra note 186 at 261-63.

\textsuperscript{191} This may be illustrated diagrammatically by two overlapping circles:

![Diagram of overlapping circles](https://via.placeholder.com/150)

Copyrightable and patentable subject matter are represented, respectively, by the circles $C_{smo}$ and $P_{smo}$, with the overlapping area $A_{smo}$ representing common subject matter.

See Oddi, Functionality, supra note 169, at 177 (Fig. 2).
same subject matter may be covered by either or, indeed, both.\textsuperscript{192} Again, a nonoverlapping or tangential model may be envisioned for the patent/copyright protection interface, wherein the scope of protection afforded by patent to inventions as defined by the claims is independent and different from the scope of protection provided under copyright for the expression.\textsuperscript{193} This is a trinary model that would protect a given computer program by either (i) patent or (ii) copyright or (iii) neither.

Conceptually, this model, as with the trinary model for the subject-matter interface, has a considerable appeal: Copyrights would solely promote "science" (\textit{read}: the liberal arts) by protecting works of authorship, and patents would solely promote the "useful arts" (\textit{read}: technological arts) by protecting inventions. However, cases such as \textit{Whelan} and \textit{Lotus} make such a formalistic model extremely suspect.

A more realistic protection-interface model would again be an overlapping quaternary model, where there is an area protectible by both patent and copyright, in addition to the separate areas of protection and the excluded area.\textsuperscript{194} This model raises concerns about copyright invading the traditional province of patents by protecting ideas in a patent-like manner, and, patents invading the traditional province of copyright in protecting expression in an in rem manner without copying.

The encroachment by copyright into the traditional preserve of patents seems more economically problematic than the converse. If the area of overlap between the protection interface is defined as "de

\begin{itemize}
\item \textsuperscript{192} Id. at 179-182.
\item \textsuperscript{193} This model may be illustrated diagrammatically by two tangential circles:
\begin{center}
\begin{tikzpicture}
\node (P) at (0,0) {\texttt{C}_pt};
\node (C) at (3,0) {\texttt{P}_pt};
\end{tikzpicture}
\end{center}

The circles \texttt{C}_pt and \texttt{P}_pt, respectively, represent the protection afforded by copyrights and patents, which, as shown, are exclusive of one another. See \textit{id.} at 181 (Fig. 3).
\item \textsuperscript{194} This model may be illustrated diagrammatically to be two overlapping circles:
jurute utility” in the sense that utility may be protected by patent, then affording extended protection by copyright to that de jure utility would appear to raise the cost of protecting that program, which presumably could have been induced with a lower incentive.

Even more costly would be the situation where the particular computer program falls outside the scope of protection of patent, because it fails to meet one or more of the qualitative requirements for patentability, or, for that matter, fails to meet a formal requirement or is statutorily barred, e.g., by failure to file a patent application within one year from the “on sale” date of the program. Such programs that fail to satisfy the qualitative or formal requirements for patent protection may still be protectible by copyright, provided they meet the qualitative requirement of originality of the copyright statute. Computer programs that do not satisfy the qualitative or formal requirements of patentability, although not having de jure utility in the sense of being protectible by patent, however, still would have “de facto utility” in the sense of satisfying the subject matter test for patents. Such de facto utility not protectible by patent is normally

Copyright and patent protection are respectively represented by circles $C_{po}$ and $P_{po}$ with the area $A_{po}$ representing dual protection. See id. at 181 (Fig. 4).

195. The area of $A_{po}$, see diagram supra note 194, qualifies for patent protection and thus whatever utility is claimed in the patent may thereby be protected in the de jure sense by the patent; hence the term “de jure utility.” See id. at 180-82.

196. A lesser incentive in the sense that either one or the other would have induced the invention, and hence, there was no need for dual protection.

197. See supra note 130.

198. See supra note 131.

199. The problem associated with protecting de facto utility by copyright may perhaps be better illustrated by modifying the protection interface for the overlapping model as shown below:
freely available to the public upon entering the public domain. However, whether all de facto utility is going into the public domain is far from clear under the present state of copyright law, as exemplified by Whelan and Lotus. If the idea/expression dichotomy is to be made at a high level of abstraction of idea and if there is any de facto utility at a lower level of abstraction, copyright then protects that de facto utility under the guise of expression, even though patent law and public policy seemingly would demand dedication to the public and afford the “right to copy” any de facto utility.

Thus, the greater concern is not whether there is an overlap at the subject-matter interface of patent and copyright system, but, rather, whether there is an overlap at the protection interface. If such is the case, de jure utility may be protected by copyright for the extended copyright term and, more seriously, de facto utility may be protected by the overly broad and abstract scope of protection afforded by copyright.

The dashed circle $U_{df}$ represents de facto utility not protectible by patent, i.e. it is outside of the patent protection circle $P_{po}$. Note, however, the circle $U_{df}$ overlaps the copyright protection circle $C_{po}$, and an area $A_{df}$ possessing de facto utility may be protectible by copyright.

See, Oddi, Functionality, supra note 169, at 182-83 and Fig. 6.

200. Trade secret status, of course, may keep a particular subject matter out of the public domain for the period of secrecy.

201. The “right to copy” was recently re-affirmed in Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 164 (1989)(recognizing the competitive importance of “imitation and refinement.”). Although Bonito Boats applies to state sanctioned encroachments on the “right to copy,” it appears clear that protecting utility has been preempted by patent law, although nonfunctional features of a product may be protected by trademark or unfair competition law. See, e.g., A. Samuel Oddi, Functions of “Functionality” in Trademark Law, 22 Hous. L. Rev., reprinted in 76 TRADEMARK REP. 308 (1985)[hereinafter Oddi, Functions]. Copyright is at least said to protect only expression and not utilitarian features. See Esquire, Inc. v. Ringer, 591 F.2d 796 (D.C. Cir. 1978) cert. denied, 440 U.S. 908 (1979).
right with respect to computer programs. As a consequence, underutilization and increased costs may result, as well as decreased investment in computer programs because of the potential for infringement for copying de jure or even de facto utilitarian features.202

An example from the Lotus case may serve to illustrate the protection of de facto utility by copyright.203 Defendant copied the menu command structure of Lotus 1-2-3, comprising a list of full-word-menu choices that were arranged in predicted frequency of use rather than alphabetically.204 In contrast, the original VisiCalc spreadsheet menu structure arranged individual letters representing commands in alphabetical order.205 Two features of the Lotus arrangement could be categorized as having de facto utility in making the program easier to use, thereby increasing "user efficiency":206 (1) using full words so that the user did not have to remember the letter code or refer to documentation as required in VisiCalc207 and (2) arranging the words in order of predicted frequency of use, which would minimize the time to select the most frequently used commands.208 The court held the arrangement to be expression on the ground that there were alternative

203. The de facto utility that a program may exhibit can be broken down into three functional components. The first may be termed "utility functionality," which would apply to those program features that are essential to its practical operation, e.g., providing a user interface—a screen display. Another category would be features that provide for "maker efficiency," i.e., the programmer minimizes costs of producing a functional program by the employment or certain design techniques. The third category, and a highly important one from the standpoint of program marketability, may be termed "user efficiency;" such features in the program enable the user to save time and avoid frustration.

As summarized by Peter S. Menell, An Analysis of the Scope of Copyright Protection for Application Programs, 41 STAN. L. REV. 1045, 1053-54 (1989):

The field [of computer-human interaction] has identified five human factor goals that programmers should strive to achieve in designing application programs: (1) minimize learning time, (2) maximize speed of performance, (3) minimize rate of user errors, (4) maximize user satisfaction, and (5) maximize user's retention of knowledge over time.

See also Oddi, Functions, supra note 201, (developing of these categories of functionality for use in the context of trademark and unfair competition law).

205. Id.
206. See supra note 203, for the definition of "user efficiency."
207. With the VisiCalc format, once the letter code was memorized, this format would not impede user efficiency. However, with respect to infrequent users or those who used other formats, user efficiency could be impaired by having to refer to documentation or making errors.

208. For example, if the user has to depress the "right" cursor key to obtain a particular function more times than the frequency of use of that function would predict, more than an optional period of time is required by the user. When multiplied over a long period of use, this may provide a considerable user advantage for the Lotus 1-2-3 format over the VisiCalc format.
menu arrangements that could be used.\textsuperscript{209} If a feature that provided for increased efficiency of operation can be categorized as expression rather than idea, the right to copy public domain de facto utility is converted into a duty not to copy under the guise of copyright.\textsuperscript{210}

The economic consequences of an overlapping protection model must also be examined whereby patent protection would extend to expression in the copyright sense and hence would deny access to that expression on an in rem basis, i.e., copying need not be shown. Such a model would theoretically result in underutilization and increased costs. Nonetheless, the replication (even the independent replication) of the expression of the idea does not constitute patent infringement. The claimed invention (idea) must be either made, used or sold to constitute infringement; even if a patent is protecting expression, it also must be protecting the idea in the classic patent law sense. Accordingly, a patent acting like a copyright is still affording only the protection of a patent.\textsuperscript{211} The converse is not true, where a copyright may protect under the current state of the law low-level ideas having de jure or de facto utility.

A practical solution to the overly broad scope of protection currently provided by copyright law for computer programs might be similar to that suggested by Professor Gorman some time ago with respect to factual works.\textsuperscript{212} Statutory subject matter for copyrightability would be broadly interpreted, but infringement would be narrowly interpreted, so that it would be easy to obtain a copyright but difficult to prove infringement.\textsuperscript{213} Under the current state of the law, it is certainly easy to obtain copyrights on computer programs. The problem is that, rather than making infringement difficult to prove, the law has made it easier to prove by defining idea at a high level of abstraction. The consequence is that at least some de facto utility would be protected, such as by copying only the "structure, sequence and organization,"\textsuperscript{214} or unessential "elements of expression,"\textsuperscript{215} or even the

\begin{flushleft}
\textsuperscript{210} To avoid infringement of the Lotus copyright, a competitor may thus be forced to use a less efficient format, with resulting lack of consumer acceptance, to the competitive advantage of Lotus and without the benefit of patent.
\textsuperscript{211} Assume that Lotus had obtained a patent on the idea of arranging the function words in order of frequency of use \textit{but not} on the use of complete words rather than first letters of words, could it be argued that the expression of the idea of using the whole words should be protected by the patent? This question could be extended to where the accused patent infringer independently developed (i.e., did not copy) the use of whole words.
\textsuperscript{212} Gorman, supra note 100.
\textsuperscript{213} Id. at 1575. Limiting infringement to substantially verbatim copying of object code would implement this approach.
\textsuperscript{214} See Whelan Assoc., Inc. v. Jasiow Dental Lab., Inc., 797 F.2d 1222 (3d Cir. 1986).
\end{flushleft}
"look and feel" of a program.

E. Summary

The benefit/cost ratio for the current regime of copyright protection afforded computer programs tends to be affected by the following factors: (1) substantially all programs are protected, which results in a low yield of copyright- to noncopyright-induced programs; (2) at least some de facto utility is being protected against copying by defining idea at a high level of abstraction; and (3) relatively little knowledge concerning the ideas underlying the program is generally made available by expression in low level codes.

Comparatively, the benefit/cost ratio for the current system of patent protection tends to be affected by the following factors: (1) only programs meeting high qualitative standards and warranting the procurement costs are protected, which results in a relatively higher yield of patent- to nonpatent-induced programs; (2) only the claimed idea is protected, albeit on an in rem basis; and (3) sufficient information must be disclosed to enable a person skilled in the art to replicate the invention, with all other disclosed knowledge going into the public domain.

Assuming that the analysis of this Part has some validity, it can reasonably be argued that the economic case for protection of computer programs by patent is stronger than that for protection by copyright. Yet, there has been a strong sentiment against patent protection for computer programs since the earliest days of computer development, which persists today with significant vigor. The next Part will address the general case (legal, policy, and otherwise) that has been made against patent protection for computer programs, with special attention to mathematical algorithms.

III. THE GENERAL CASE

A. Anti-Patent Sentiment

The anti-patent sentiment was reflected early in a President's Commission Report in 1966, which recommended that computer programs be specifically excluded from patent protection. The legal position of the report was that computer programs were not the subject matter that Congress had intended to protect by patent. A policy reason offered was that the computer industry had prospered without patent protection so far and hence did not need it, particularly

\[216. \text{See supra notes 170-171.}
218. \text{President's Commission Report, supra note 26, at 13.}
in view of the potential for other forms of legal protection. Finally, a pragmatic rationale was put forth that the PTO was ill-equipped to process patent applications dealing with computer programs.

Even though Congress did not enact the recommendation of the President's Commission, the PTO implemented this recommendation by rejecting computer program processes on the ground of their not being proper subject matter for patents under § 101. However, the Court of Customs and Patent Appeals (CCPA) (the predecessor court to the CAFC) disagreed, which resulted in a relatively long-lived tension between the PTO and the court.

In 1972, the Supreme Court reversed the CCPA in *Gottschalk v. Benson*, holding an algorithm, which it defined as "[a] procedure for solving a given type of mathematical problem," not to be patentable subject matter. The Court concluded: "Phenomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work." Presumably, the Court was analogizing the algorithm, as claimed in the Benson application, to one of the categories indicated.

In a devastating analysis of the Benson decision, Professor Chisum asserts, "The reasoning in Benson is monstrously bad" and charges the court with an "anti-patent judicial bias." Professor Samuelson, while seeming to admit that Benson is not a masterpiece of judicial reasoning, agrees with the result. The Court, perhaps implicitly un-

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219. Id.
220. Id.
221. In 1966, PTO proposed a set of guidelines, 829 OFFICIAL GAZETTE U.S. PAT. OFF., 865 (1966), which were adopted in 1968. 33 Fed. Reg. 15,609, 15,610 (1968) (stating that program processes that produced "no more than a numerical, statistical or other informational result" was not considered patentable subject matter). Samuelson speculates that the PTO guidelines may have been the reason Congress did not act on the Commission's recommendation. Samuelson, Benson Revisited, supra note 2, at 1039 n.45. It would seem equally as plausible that Congress did not agree with the recommendation or had more important matters on its agenda. Samuelson also suggests that the "1968 guideline position is as far as the Supreme Court [in *Diamond v. Diehr*, 450 U.S. 175 (1981)] has been willing to go toward endorsing computer program patents." Id. at 1040. However, only the dissent in *Diehr* referred to the PTO guidelines. *Diamond v. Diehr*, 450 U.S. 175, 197-98, 197 n.11 (1981). For that matter, nor did the CCPA refer to the guidelines in more than 30 computer program related cases, as indicated by Samuelson. Samuelson, Benson Revisited, supra note 2, at 1039 n.40.
222. Samuelson exhaustively traces the case history before the CCPA. See Samuelson, Benson Revisited, supra note 2, at 1041-48.
224. Id. at 67.
226. Id. at 977-78.
227. Id. at 961.
228. See Samuelson, Benson Revisited, supra note 2, at 1059-62.
of its reasoning, left an escape valve concerning the possibility of future protection of certain types of computer programs in stating: "It is said that the decision precludes a patent for any program servicing a computer. We do not so hold."\(^{229}\)

The anti-patent sentiment continued when the Supreme Court, five years after *Benson*, held in *Parker v. Flook*\(^{230}\) that an algorithm for computing an updated alarm limit did not become patentable subject matter by tacking on to an algorithm insignificant "post-solution activity."\(^{231}\) Again, however, the Court left open the possibility of some patent protection of computer program-related inventions in stating: "[A] process is not unpatentable simply because it contains a law of nature or a mathematical algorithm."\(^{232}\)

In the early 1980's the Court's bias against patents in general, which had persisted over the prior half century, began to erode.\(^{233}\) The shift may be seen as perhaps commencing in 1980 with *Diamond v. Chakrabarty*\(^{234}\) and *Dawson Chemical Co. v. Rohm & Haas Co.*\(^{235}\) and continuing with *Diamond v. Diehr* in 1981.\(^{236}\) In *Diehr* the Court

\(^{230}\) 437 U.S. 584 (1978).
\(^{231}\) Id. at 590.
\(^{232}\) Id.

\(^{233}\) See, GOLSTEIN, CASEBOOK, *supra* note 1, at 372, where it is indicated in the late 1930's 35% to 40% of litigated patents were held valid, which dropped to 10% in 1942 after the "flash of creative genius test" for "invention" was announced in Cuno Corp. v. Automatic devices Corp., 314 U.S. 84 (1941). Thereafter, the validity rate increased to almost 30% and fell to 3% following A. & P. Tea Co. v. Supermarket Corp., 340 U.S. 147 (1950). With reference to *Benson*, Chisum concludes: "Perhaps the best way to view *Benson* is as a vestige of another era in terms of the attitude of the United States Supreme Court toward the patent system." Chisum, *Algorithms, supra* note 2, at 991. The anti-patent bias of "another era" is well put by Justice Jackson: "[T]he only patent that is valid is one which this Court has not been able to get its hands on." Jungersen v. Ostby & Barton Co., 335 U.S. 560, 572 (1949)(Jackson, J., dissenting).

\(^{234}\) 447 U.S. 303 (1980). The Court held that living matter—a microorganism—was patentable subject matter under 35 U.S.C. § 101. The four-justice dissent argued that the Court should not extend patent protection in the absence of a clear and certain signal from Congress. *Id.* at 322. In Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 531 (1972), the Court had stated: "We would require a clear and certain signal Congress before approving the position of a litigant who . . . argues that the beachhead of privilege is wider, and the area of public use narrower, than courts had previously thought." The "clear and certain signal" test was reinforced in both Gottschalk v. Benson, 409 U.S. 63, 73 (1972) and Parker v. Flook, 437 U.S. 554, 596 (1984).

\(^{235}\) 448 U.S. 176 (1980)(holding that it was not patent misuse for a patent owner to maintain an action for contributory infringement and to refuse to license the use of its process consisting of the new use of a nonstaple article of commerce). For an analysis of the *Dawson* case and the decision as indicative of an evolving pro-patent bias in the Court, see A. Samuel Oddi, *Contributory Infringement/Patent Misuse: Metaphysics and Metamorphosis*, 44 U. FITT. L. REV. 73, 80-81 (1982).

\(^{236}\) 450 U.S. 175 (1981). See also In Re Bradley, 600 F.2d 807 (C.C.P.A. 1979), aff'd by
held that a process for curing synthetic rubber which includes in several of its steps the use of a mathematical formula and a programmed digital computer is patentable subject matter under 35 U.S.C. § 101. 237 The Court tried to clarify why an algorithm was unpatentable subject matter by stating, that in Benson, “we concluded that such an algorithm, or mathematical formula, is like a law of nature, which cannot be the subject of a patent.” 238 The Court relied upon the definition of a process found in Cochrane v. Deener, 239 decided more than a century earlier. This definition had been repeated in Benson, where the Court stated: “Transformation and reduction of an article ‘to a different state or thing’ is the clue to the patentability of a process claim that does not include particular machines.” 240 Because the claimed process in the Diehr application involved the transformation of an article—starting with raw, uncured synthetic rubber that was transformed into cured molded rubber products—it was held to be a process within § 101. 241

More than a decade has passed since Diehr was decided, and the Supreme Court has not been provided with an opportunity—presuming it had an inclination—to revisit the § 101 issue with respect to computer program inventions. 242 Moreover, in view of other patent cases

\[\text{an equally divided Court, Diamond v. Bradley, 450 U.S. 381 (1981)(per curiam)(upholding the patentability of an invention consisting of “a combination of tangible hardware elements a machine including some hardware elements which contain microprogrammed information termed ‘firmware’”)}\]


238. Id. at 186.

239. That a process may be patentable, irrespective of the particular form of the instrumentalities used, cannot be disputed. If one of the steps of a process be that a certain substance is to be reduced to powder, it may not be at all material what instrument or machinery is used to effect that object, whether a hammer, a pestle and mortar, or a mill. Either may be pointed out; but if the patent is not confined to that particular tool or machine, the use of the others would be an infringement, the general process being the same. A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing.

94 U.S. 780, 787-88 (1876)(emphasis added).


242. No petition for certiorari from the CCPA or the CAFC has been filed since Diehr by the PTO or an applicant in a case raising the statutory subject matter issue of computer programs. With respect to the subject matter issue generally, see Alco Standard Corp. v. Tennessee Valley Auth., 808 F.2d 1490 (Fed. Cir. 1986), cert. dismissed, 483 U.S. 1052 (1987)(holding process for turbine rotor inspection patentable subject matter as a process capable of being performed by a machine even though also capable of being performed by a person); Howes v. Great Lakes Press Corp., 879 F.2d 1023 (2d Cir.), cert. denied, 459 U.S. 1038 (1982)(holding heat-transfer fabric printing process patentable subject matter as new use of old material); Hirschfeld v. Banner, 462 F. Supp. 135 (D.D.C. 1978), aff'd mem., 615 F.2d
decided after *Diehr* and the present composition of the court, whatever anti-patent bias or sentiment may have been attributed to the Supreme Court prior to the Reagan-era seems long gone, and,


243. Supreme Court cases decided since *Flook* relating to patents, trademarks and copyrights may be seen as generally favoring intellectual property:


indeed, the CAFC may be perceived as having a pro-patent bias. 244

B. Laws of Nature and Definition of Process

1. Basic Issues

Two basic issues may be distilled from Benson, Flook and Diehr and from the body of law that has been evolving in the CAFC. First, whether a particular algorithm may be properly analogized to a "law of nature." Second, whether the transformation of matter from one form to another is the sine qua non of a process as statutory subject matter. 245


244. Chief Judge (now Dean) Markey admonished the patent bar in a speech delivered to the Section of Patent, Trademark and Copyright Law at the annual meeting of the American Bar Association in Honolulu, Hawaii, August 8, 1989, to refute the "big lie" that statistics, without reference to the merit of individual cases, show the CAFC to be biased in favor of patents. The speech is reprinted 8 PTC Newsletter, Summer/Fall 1989, at 3. Their comments were evidently in response to published statistical analysis of CAFC validity and infringement decisions, see supra note 173.

245. Claims drawn in "apparatus" format using "means plus function" elements (see 35 U.S.C. § 112, ¶6) instead of process steps are treated in the same manner by the CAFC and the PTO. As stated in In re Meyer, 688 F.2d 789, 795 n.3 (C.C.P.A. 1982):

Appellants' apparatus claims differ from the method claims by reciting "means for" performing the steps set forth in the method claims, and "means for displaying" the results. However, for purposes of section 101, such claims are not treated differently from method claims. Such apparatus claims were termed to be in "illusory apparatus format" in In re Walter, 618 F. 2d 758, 769 (C.C.P.A. 1980). Accordingly, when "process" or "method" is used herein, it should be understood as also referring to claims in "illusory apparatus format."

The fact that transformation of matter occurs does not, of course, insure patentability. The claimed invention must also be new, useful and nonobvious. In Diehr, the end product (a molded rubber product) of the claimed process had utility. Compare, however, Brenner v. Manson, 383 U.S. 519 (1966), where the end-product of a process having utility only as an object of further research was found to lack utility in the patent sense. An argument could be made that a process lacks utility unless an end-product is produced that has utility. In Benson, the claimed process converted binary coded decimal signals into pure binary form. Did the pure binary signals have utility? In Flook, the method claimed was for the updating the alarm limit "in a process comprising the catalytic chemical
With respect to the first issue, it is generally agreed that phenomena found in nature or laws of nature are not patentable subject matter. As stated in Chakrabarty: "[A] new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, Einstein could not patent his celebrated law that E=mc\(^2\); nor could Newton have patented the law of gravity."\(^{246}\) This rather clear statement of accepted law, however, does little to help resolve whether a particular algorithm, mathematical or otherwise, can be properly considered a law of nature. Chisum makes the valid point that, if a particular algorithm is devised that represents a law of nature, it would not be patentable, in any event, because it would not be new.\(^{247}\) This point would be consistent with the reasoning in Diehr,

conversion of hydrocarbons.” Was there utility in updating the alarm limit? Would there be utility if the process directly claimed was the catalytic conversion, with the output product of the process being the converted (transformed) hydrocarbons? In any event, opponents of patent protection for nontransformational processes have generally relied upon the definition of a process rather than outcome of the process lacking utility in the Manson sense.

The recent controversy over the patentability of human genes, whose utility has yet to be discovered, may provoke a more vigorous inquiry into the utility requirement in patent law. In June 1991, the National Institute of Health (NIH) filed an application to patent 337 gene sequences, in addition to filing for a patent on a gene finding method which rapidly isolates short segments of genes from human cells. Critics have three primary concerns about a patent issuing on these gene sequences. First, a concern exists that potentially conflicting patent claims and strategies will chill the ongoing international human genome project. This project is an effort to find and decipher all of the 50,000 to 100,000 genes that make up a human blueprint. Already, Britain's Medical Research Council has announced plans to keep secret the gene sequences it has discovered and to sell access to those companies developing commercial products. Second, critics are concerned about a race to gain property rights before any real function of the gene sequences is known. NIH asserts that the discovered gene sequences do have utility because they provide a new starting point for finding genes that cause hereditary diseases and they offer clues about the functionality of a gene. Finally, critics assert that companies and academic researchers will be reluctant to invest time and money in developing gene-based products for fear of an infringement suit by the patent holder of a gene sequence. This may prompt Congress to clarify when researchers can use patented inventions without paying licensing fees to a patent owner through a "research exemption.” See David L. Wheeler, Britain and Congress Respond to Controversy Sparked by NIH Plan to Patent Genes, CHRON. OF HIGHER EDUC., Nov. 27, 1991, at A29; David L. Wheeler, Using Powerful Machines, an NIH Researcher Leads Efforts to Identify Human Genes, CHRON. OF HIGHER EDUC., Feb. 26, 1992, at A6. NIH followed its initial application with additional filings in January 1991 on more than 2,000 genetic material fragments. The fragments identified represent part of the genetic blueprint for the human brain. Again the international biotechnology community is in an uproar about the ethicity of patenting any human product. NIH Seeks Second Controversial Gene Patent, REUTERS, Feb. 12, 1992.

247. Chisum makes the point that “a mathematical or other algorithm is neither a phenomenon of nature nor an abstract concept.” Chisum, Algorithms, supra note 2, at 980. He concludes that if natural phenomena are not patentable, “it may
separating the § 101 statutory subject matter issue from the § 102 novelty and § 103 obviousness issues.248

The issue could perhaps be more traditionally resolved by the dichotomy drawn between "discovering" a particular natural phenomenon or law as compared to "making" a "process, machine, manufacture or composition of matter."249 According to Chakrabarty, a very broad definition of statutory subject matter was intended by Congress to encompass "anything under the sun that is made by man."250 However, this leads to the question of whether a particular algorithm is discovered or is human made. This rather difficult philosophical inquiry is reminiscent of whether judges make or discover law in the absence of controlling constitutional, statutory or decisional law. Long ago, Zechariah Chaffee posed the issue thusly:

Where do the judges get this newly proclaimed law? Do they make it themselves in somewhat the way legislators undoubtedly make statutory rule? Or do they discover it . . . in a body of principles of justice? If so, the judicial process resembles the way Pythagoras discovered the rule that the square of the hypotenuse equals the sum of the square of the other two sides.251

This is not the place to examine whether algorithms, or rules of law for that matter, are floating around in another dimension waiting to be discovered or whether these are really made by humans.252 The basic question seems, rather, to be whether there is a practical way of

simply be because they are not "new" as required by 35 U.S.C. § 101. Id. at 983. Chisum also argues that the question of overly broad claiming can be resolved under 35 U.S.C. § 112 to see that an excessively broad scope of protection is not granted with respect to a particular algorithm. Id. at 984-87.

248. 450 U.S. at 191. Cf. this result however, with the dissent: "[T]oday's holding is a misunderstanding of the applicants' claimed invention and a failure to recognize the critical difference between the 'discovery' requirement in § 101 and the 'novelty' requirement in § 102." Id. at 211 (Stevens J., dissenting)(footnote omitted).

249. 35 U.S.C. § 101 is prefaced by: "Whoever invents or discovers . . . ." § 100 equates an "invention" with an "invention or discovery." § 103 (first sentence, second paragraph) admonishes: "Patentability shall not be negatived by the manner in which the invention was made." This sentence was added in the 1952 Act in order to preclude the application of the "flash of creative genius" test of invention in Cuno Eng'g Corp. v. Automatic Devices Corp., 314 U.S. 84, 91 (1941). See Graham v. John Deere Co., 383 U.S. 1, 15 n.7 (1966).

250. 35 U.S.C. at 309 (quoting H.R. Rep. No. 1923, 82nd Cong., 2d sess. 6 (1952)).


252. See, however, Lord Lloyd of Hampstead & M.D.A. Freeman, Lloyd's Introduction to Jurisprudence 1129 (5th ed. 1985)(footnotes omitted):

Although the views of Dworkin and Sartorius must be treated with respect the general consensus of opinion at the present day is that, within certain narrow and clearly defined limits, new law is created by the judiciary. Attention centres primarily not so much on the fact of judicial legislation but rather on the ways in which this occurs, and the motives.

For a realist view, see Jerome Frank, Law and the Modern Mind Ch. IV (1930).
separating algorithms that may be properly analogized to laws of nature, which are said to be discovered, from those algorithms that are indeed made by humans.

In *Benson*, the Supreme Court concluded in its "nutshell" that the claims directed to an algorithm were not patentable subject matter because they "would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself."253 Based upon this conclusion, the CCPA and now the CAFC have made/discovered/refined a rule for separating algorithms properly analogized to laws of nature from those that are made.254 The rule consists of a two-part test to be applied to claimed subject matter involving algorithms. The first part of the test is to determine whether or not a mathematical algorithm is claimed (either directly or indirectly); if not, it is statutory subject matter, and the § 101 issue is resolved.255 If it is determined that a mathematical algorithm is being claimed, the claim may still pass § 101 muster according to the second part of the test. This part of the test has evolved from a determination of whether the algorithm as claimed would "preempt" the use of that particular mathematical algorithm256 to a more refined test of whether the mathematical algorithm is "applied in any manner to physical elements or process steps . . ."257 The PTO has indicated that it will make the determination of the second step by a guideline, whereby the algorithm would be read out of the claim, and then decide whether what is left would otherwise constitute statutory subject matter.258

Whether the test, as it has evolved, is consistent with *Benson* is

254. See PTO, *Mathematical Algorithms*, supra note 7, 6-7, for the history of the evolution of the current rule.
255. See In re Freeman, 573 F.2d 1237, 1245 (C.C.P.A. 1978):

Determination of whether a claim preempts nonstatutory subject matter as a whole, in the light of *Benson*, requires a two-step analysis. First, it must be determined whether the claim directly or indirectly recites an "algorithm" in the *Benson* sense of that term, for a claim which fails even to recite an algorithm clearly cannot wholly preempt an algorithm. Second, the claim must be further analyzed to ascertain whether in its entirety it wholly preempts that algorithm.

256. *Id.*
257. See In re Abele, 684 F.2d 902, 906-07 (C.C.P.A. 1982), modifying the second part of the test of In re Walter, 618 F.2d 758, 767 (C.C.P.A. 1980), which had modified the preemption test of *Freeman*, which was presumably based on *Benson*. See Arrhythmia Research Technology, Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992), for a discussion of the Freeman-Walter-Abele test and the reiteration that this is not the sole test for statutory subject matter.
arguable. Chisum would read Benson narrowly and indeed has urged that it be overruled. Samuelson has argued strongly for an expansive reading of Benson to exclude all algorithms, because, she argues, all algorithms are deemed to be mathematical in the sense used by computer scientists. In any event, the practical outcome in the PTO is that, if the claims satisfy the first part of the test, or if necessary, the second, they are examined on the merits and the patent may issue if the qualitative standards of patentability are met.

However the first issue may be resolved between mathematical and nonmathematical algorithms, as far as it can be resolved, the second issue remains of whether in order to qualify as a process under § 101 there must be a transformation of matter. The PTO and CAFC seemingly have resolved this issue as not requiring a transformation, provided the invention is claimed in a formally correct manner.

259. It is far from clear that the Court deciding Benson in 1972 had in mind such a narrow definition for algorithms and what constituted preemption.

260. Chisum, Algorithms, supra note 2, at 1020. See also Stern, Algorithm War, supra note 2, at 376, “Iwahashi [888 F.2d 1370 (Fed. Cir. 1989)], for all practical purpose goes back to the CCPA’s immediately pre-Benson standard... After Iwahashi, virtually any algorithm can be patented if the claims draftsman will use the proper format.”

261. See Newell, supra note 5, at 1024-33.

262. An interesting example of the interplay and continued tension between the PTO and the CAFC is In re Iwahashi, 888 F.2d 1370 (Fed. Cir. 1989), where the PTO’s rejection of the claims as being merely a mathematical algorithm was reversed by the court, holding that the recitation of a “read only memory” saved the claim from the perjury of nonstatutory subject matter while presumably a “means plus function” recitation would have condemned it there. See PTO, Notice Interpreting Iwahashi (Fed. Cir. 1989), 112 OFFICIAL GAZETTE U.S. PAT. & TRADEMARK OFF. 16 (1990)[hereinafter PTO, Notice], where the PTO attempts to limit Iwahashi to claim recitations that do not “encompass any and every means for performing” the recited function and placing the burden on the applicant to show a narrower scope. But see Stern, Algorithm War supra note 2, at 384-87 (critiquing the PTO interpretation). See also, Arrhythmia Research Technology, Inc. v. Corazonix Corp., 958 F.2d 1053, 1059 (Fed. Cir. 1992), where the CAFC based on claiming an algorithm reversed a summary judgement by the district court in an infringement action, finding statutory subject matter in method and “illusory apparatus” (all means plus function elements) formats for “analyzing electrocardiograph signals in order to determine a specified heart activity.”

263. Chisum, Algorithm, supra note 2, at 970, cites Musgrave as setting, prior to Benson, “the high water mark of rationality,” quoting from Musgrave:

All that is necessary, in our view, to make a sequence of operational steps a statutory “process” within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of “useful arts.”

431 F.2d at 893. In contrast, Samuelson cites a competing line of cases. She agrees that cases like Musgrave; In re Toma, 575 F.2d 872 (C.C.P.A. 1978); and Peine, Webber, Jackson & Curtis, Inc. v. Merrill Lynch, Pierce, Fenner & Smith, Inc., 564 F. Supp. 1358 (D. Del. 1983), support a nontransformation view of process, while, on the other hand, cases like In re Grams, 888 F.2d 835 (Fed. Cir. 1989) and In re Meyer, 688 F.2d 789 (C.C.P.A. 1982) are in her view more consistent with the
Such an interpretation, of course, expands the definition of statutory subject matter well beyond that recognized in *Diehr*, which relies upon the hoary *Cochrane v. Deener* transformation definition. In *Diehr*, however, the Supreme Court was faced only with the issue of whether the particular claims before it constituted a process within § 101, and, as this transformational process fit rather nicely into the *Cochrane* definition, there was no need to go any further. The issue remains unresolved by the Supreme Court whether transformation is the sine qua non of a process or whether there need be only a "translating" of information, *e.g.*, in the form of processing or other manipulation.

One argument advanced against a translation definition would seem to focus upon the breadth of such processes as preempting too great a scope of protection. However, if this were the case, presumably with respect to a mathematical algorithm, the second step in the PTO guideline should foreclose patentability. With respect to a nonmathematical algorithm, it would then appear that § 112 would preclude overly broad claiming and hence would prevent excessive preemption. Certainly, once having met the test of not being properly analogized to a discovered law of nature and hence being made, it would seem consistent with *Chakrabarty*, as reiterated in *Diehr*, that a broad definition of statutory subject matter consistent with "anything under the sun that is made by man" should reflect public policy.

Samuelson argues that the "anything under the sun" definition of

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philosophy underlying *Benson* and correctly interpreting *Diehr* as implicating a narrow definition of process. Samuelson, *Benson Revisited*, *supra* note 2, at 1113-33.


265. The PTO Report, *Mathematical Algorithms*, *supra* note 7, at 9 deals with this issue rather cryptically, under the heading "Transformation of something physical," stating:

In determining whether the claim recites a statutory process or a nonstatutory mathematical algorithm, it is useful to analyze whether there is a transformation of something physical into a different form. One distinction is made between transformation of a physical "signals" from one physical state to a different physical state, a statutory process in the electrical arts, and mere mathematical manipulation of "data" which, by itself, if not a statutory process.

Evidently, the conclusion is drawn that analog electrical signals are "transformed," while digital ones, perhaps representing the same information, are "manipulated."


267. *See supra*, text accompanying notes 255-258 for a discussion of the second part of the PTO test.
Chakrabarty is “dicta at most.”268 Moreover, she asserts that the decision in Diehr “provides a fragile base for supporting the patentability” of translation-type algorithms, particularly since the composition of the Court has changed.269 Perhaps, in a strict legal sense, the Chakrabarty/Diehr formulation is dicta;270 nonetheless, at least it does give some indication that the Court would tend to construe § 101 broadly rather than narrowly and would support it by the legislative history of the Patent Act. Moreover, even though Diehr was a five-to-four decision, one does not have to be an ardent Court-watcher to predict with some degree of confidence that the current composition of the Supreme Court is more likely to be favorable to protection of intellectual property than any Court over the past half-century.271

2. Infringement by Thinking: “Mechanomorphic” View of the Brain

Another argument raised by Samuelson is that, if patents are granted on algorithms involving no transformation of matter, this would raise the specter of infringement by thinking.272 Samuelson’s position on this issue appears largely based on the views of Professor Allen Newell.273 Giving a computer scientist’s perspective on the is-

268. Samuelson, Benson Revisited, supra note 2, at 1131.
269. Id. at 1102. Judge Rader concurring in Arrhythmia Research Technology, Inc. v. Corazonix Corp., 958 F.2d 1053, 1065 (Fed. Cir. 1992) found the base of Diehr much more sturdy, concluding: “Thus, Diehr limited Benson and its progeny to three classes of unpatentable subject matter—laws of nature, natural phenomena, and abstract ideas.”
270. The Court in Chakrabarty, of course, need not have adopted such a broad definition of statutory subject matter to decide that a microorganism was either a manufacture or a composition of matter under § 101. Nonetheless, congressional intent played a role, indeed, it would appear a significant one, because the majority was faced with a strong dissent arguing that there was no “clear and certain signal” from Congress to expand protection to living matter. But see supra note 234.
271. In the first instance, one might notice that Justices Blackman and Stevens, who dissented in Diehr, voted with the majority in Chakrabarty. Chief Justice Rehnquist and Justice O’Connor, who were in the majority in Diehr, remain on the Court. One could speculate that obtaining three votes from a pool consisting of Justices Scalia, Kennedy, Souter, Thomas and Ginsburg might not be such a “fragile base” to join with the Chief Justice and Justices O’Connor in upholding property rights (intellectual or otherwise). See supra note 243 (discussing the pro-intellectual property position of the Court commencing with Chakrabarty).
272. Samuelson, Benson Revisited supra note 2, at 1108-09, 1123-1128.
273. Professor Newell is V.A. and Helen Whitaker University Professor of Computer Science at Carnegie-Mellon University. He has written extensively in the area of computer science, artificial intelligence and cognitive psychology. A brief biography of Professor Newell is found accompanying Allen Newell, Fairy Tales, in THE AGE OF INTELLIGENT MACHINES 420 (Raymond Kurzweil ed., 1990). Among the recent publications of Professor Newell are: ALLEN NEWELL, UNIFIED THEORIES OF COGNITION (1990); ALLEN NEWELL ET AL., UNIVERSAL SUBGOALING AND
sue of the patentability of algorithms, Newell asserts: "The models we have for understanding the entire arena of the patentability of algorithms are inadequate—not just somewhat inadequate, but fundamentally so. They are broken."274 The models, or at least some of them, may well be broken if forced into the perspective of a computer scientist. One of the broken models, according to Newell, is that it is impossible to separate mathematical from nonmathematical algorithms as is attempted in patent law.275 The dichotomy between mathematical and nonmathematical algorithms may indeed be unfortunate; however, acceptance of this model does not in any way resolve the question of whether or not algorithms in general should fall within or without patentable subject matter.276

Newell further asserts that a patent system that "tries to distinguish algorithms as one sort of thing and mental steps as another, will ultimately end up in a quagmire."277 This conclusion is reached by relying on a theoretical model of cognitive psychology that posits that the internal workings of a thinking human brain involve computation. Although later admitting that there may be some controversy in psychology over this model, Newell concludes from the model: "We model what is going on inside the thinking human brain, as the carrying out of computational steps. Therefore, humans think by means of algorithms. Sequences of mental steps and algorithms are the same thing."278 Samuelson endorses this model, indeed italicizing the three

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\text{CHUNKING—THE AUTOMATIC GENERATION AND LEARNING OF GOAL HIERARCHIES (1986); ALLEN NEWELL ET AL., THE PSYCHOLOGY OF HUMAN COMPUTER INTERACTION (1983).}
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274. Newell, supra note 5, at 1024.
275. Id. at 1024-25.
276. The premise that all algorithms are mathematical as a matter of scientific definition does not lead to the conclusion that all algorithms must therefore be denied patent protection. This is the issue that the second part of the PTO test is supposed to resolve when an admittedly mathematical algorithm is found in a claim. See supra notes 255-257.
277. Newell, supra note 5, at 1025.
278. Id. Immediately following the sentences quoted in the text Newell states:

Any attempt in the law to make distinctions that depend upon contrasting mental steps versus algorithms is doomed to eventual confusion. It is not important whether you accept this computational view of human thinking. There can be controversy about whether such an approach is the correct one for psychology. What is important is that such a view is a major one in the study of the human mind—that many psychologists see the mind this way and that thousands of technical papers are written from within this view, covering large expanses of psychological phenomena.

While not depreciating from the conclusion that this computational model is an important one for psychological study, it would follow that should the law refuse to take the step of accepting this view and instead takes the very pragmatic step of simply holding that a patent cannot be infringed by merely mental steps, that "quagmire" of trying to distinguish algorithms from mental steps is avoided.
After accepting this model of equating mental steps with algorithms, the next logical conclusion to be drawn is that infringement of patents covering algorithms may occur by thinking.

Whatever controversy may be raging in cognitive psychology, presuming or urging that intellectual property law has or should accept a "mechanomorphic" model of the functioning of the human brain should not rest on such a fragile base. It may be true that computer programs including algorithms may be devised according to a model of how the devisor thinks the brain works. However, this anthropomorphic aspect of program design does not lead to the converse conclusion that the brain actually is working according to that model.

For that matter, even if mental steps are equated with algorithms,

279. Samuelson, Benson Revisited, supra note 2, at 1123. The sentence following these, however, was elided. This sentence is: "There can be controversy about whether such an approach is the correct one for psychology." See supra note 278 for the complete quotation.

280. Newell, supra note 5, at 1025; Samuelson, Benson Revisited, supra note 2, at 1124.

281. Postulating human behavior as computational, Newell concludes: "Therefore, humans think by means of algorithms." Newell, supra note 5, at 1025. The model posited for the brain evidently is a mechanistic one with the brain undertaking the same sequential steps that would a computer performing the same functions.

282. See, e.g., Clapes, Lynch & Sternberg, supra note 2, for a detailed description of the context in which programs are written and process used in writing a program, identifying the following phases: product definition, generalized design, intermediate design, detailed design and coding. The authors draw a musical composition analogy: "[T]he programmer's view would be analogous to that of the composer." Id. at 1511. In the context of the thought process employed by programmers, the authors state:

"High-level languages are based on the notion that the job of translating a program written the way people think (high-level) into a program written the way computers are designed (low-level) could be mechanized if the high-level language was sufficiently formalized.

Id. at 1522.

283. The views of Frances Crick, who received the Nobel Prize, along with James D. Watson, and Maurice H.F. Wilkins, in 1962, for decoding the structure of DNA, on the brain-as-computer model are reported as follows:

[Crick] has warned, for example, of the "pernicious influence" of the computer as a model of the brain. Computers are designed according to logical and mathematical precepts, he observes, whereas natural selection cobbles organisms together with "gimmicks and mechanisms," with whatever works.


As a result of their research, many neuroscientists now believe that the brain is not like a computer or a machine, at least not like any machine that anyone has ever encountered. It has no definable boundaries (neuroregulatory hormones are dispersed throughout the body). Its parts can break down through disuse or mishap, and yet its functioning may not be perceptively altered. For example, we're losing neurons throughout our lifetime (about fifty thousand cells per day, about ten
any problems ensuing are hardly cataclysmic. Some examples from cases where patents were denied may illustrate this. With respect to algorithm claims where computer hardware components are directly recited, as in Benson, it would take a surprisingly liberal application of the doctrine of equivalents to find that the step of "storing the binary coded decimal signals in a re-entrant shift register" occurred in the brain. In Flook could it seriously be argued that the claimed step of "adjusting said alarm limit to said updated alarm limit value" could be read on what is taking place in the brain?

If claims are cast in broad conceptual terms without reference to a computer or computer components, such as may be the case in "expert thousand synapses per second), yet our mental capacities improve, or at least hold steady, until late in our lives.

In addition, the brain's status as a wet organ endows it with the capacity to communicate by releasing chemicals into the environment that act at sites other than the synapse.

284. Outside of academic circles, at least, one would expect any infringement to occur with the use of a computer.

285. See supra note 150.

286. Claim 8 of the Benson application reads:

The method of converting signals from binary coded decimal form into binary which comprises the steps of
(1) storing the binary coded decimal signals in a re-entrant shift register,
(2) shifting the signals to the right by at least three places, until there is a binary '1' in the second position of said register,
(3) masking out said binary '1' in said second position of said register,
(4) adding a binary '1' to the first position of said register,
(5) shifting the signals to the left by two positions,
(6) adding a '1' to said first position, and
(7) shifting the signals to the right by at least three positions in preparation for a succeeding binary '1' in the second position of said register.

409 U.S. at 73,74 (Appendix).

287. Appearing in the insignificant post solution step in claim 1 of the Flook application, which reads:

1. A method for updating the value of at least one alarm limit on at least one process variable involved in a process comprising the catalytic chemical conversion of hydrocarbons wherein said alarm limit has a current value of

Bo+K

wherein Bo is the current alarm base and K is a predetermined alarm offset which comprises:
(1) Determining the present value of said process variable, said present value being defined as PVL;
(2) Determining a new alarm base B, using the following equation:

B,=Bo(1.0−F)+VL(F)

where F is a predetermined number greater than zero and less than 1.0;
(3) Determining an updated alarm limit which is defined as B,+K; and thereafter
(4) Adjusting said alarm limit to said updated alarm limit value.

437 U.S. at 596-97 (Appendix).
systems,” then the question must be asked whether the brain is capable of undertaking steps, such as claimed in *In re Grams*: “[a] performing said plurality of clinical laboratory tests on the individual to measure the values of the set of parameters;... [c] comparing the first quantity to a predetermined value to determine whether the individual's condition is abnormal....” If “subjective judgment” is involved, then, according to *In re Musgrave*, § 112 would be an appropriate ground for rejection of the claims, because the invention was not “distinctly” claimed. In *Grams* the CAFC did not reach this issue because it held that the algorithm claimed was mathematical and hence barred by *Benson*.

In addition, there is a built-in antidote to any fear that granting patents on inventions that might be infringed by thinking will retard the useful arts. Detecting infringement of a process patent is often difficult, even when a product is produced by the process. This difficulty would be significantly compounded when no product is being produced and the patent owner must prove what is going on in the alleged infringer's mind. Hence, it would seem that secrecy, rather than patent, would be the protection of choice for such processes.

Finally, even if a claim could be read on the functioning of the human brain without involving “subjective judgment,” if such thinking only involves experimentation without commercial exploitation, then the exception to infringement of “experimental use” may be invoked. If the individual is commercially exploiting the claimed in-

288. See Samuelson, *Benson Revisited*, supra note 2, at 1115-17, for a discussion of expert systems.

289. 888 F.2d 835, 836 (Fed. Cir. 1989). The step of “performing... clinical laboratory tests,” involved at least some physical acts. *Id.* The step of “comparing” may be very mechanical; e.g. whether the binary state is a one or a zero, or it may involve a great deal of substantive knowledge to ascertain “abnormality.” The court relied, in part, upon *In re Meyer*, 688 F.2d 789, 792 (C.C.P.A. 1982), where a “process for indentifying [sic] locations of probable malfunction in a complex system” evidently was a human being and the process was to be used as a neurological diagnostic test. The process included the steps of: “(c) testing the complex system for a response... ; (d) determining whether said response of the complex system was at least partially effective or ineffective... .” *Id.* at 792.


291. 888 F.2d 835, 840-41. In *In re Meyer*, discussed supra note 290, the claims also were rejected on the basis of *Benson* as being directed to a mathematical algorithm. In *Meyer*, 688 F.2d 789, 795-96 (C.C.P.A. 1982). The question of novelty may also be raised in cases such as *Grams* and *Meyer*. As evidenced, for example, in *Meyer*: "In fact, the Solicitor indicated that these standard tests have been employed for many years and that the more experienced the doctor and the better his memory, the less would be his need (if any) for this invention." *In re Meyer*, 688 F.2d 789, 793 (C.C.P.A. 1982).

292. On the experimental use defense, see in particular, Chisum, *Algorithms*, supra
vention by thinking and reaps profits from its use, it is not apparent why the result should be any different whether a computer or other machine or the brain is involved.

If there was commercial exploitation and the algorithm was new, useful and nonobvious, the goal of the patent system may indeed be achieved by affording the patent owner exclusive use for the advancement of the useful arts. It would be difficult to conceive that this would have more economic or social impact than granting a patent for curing cancer or AIDS. Perhaps the matter of infringement by


293. Is it also not apparent why it should make any difference whether or not the expert system is both claimed in a patent and also described in a book. Samuelson raises the hypothetical of an algorithm for analyzing and resolving certain types of contract disputes that was patented as an expert system and also expressed in a book. Samuelson, Benson Revisited, supra note 2, at 1126-27. As long ago as Baker v. Selden, 101 U.S. 99 (1879), the Court made clear that the copyright on a book including blank forms did not preclude the use of those forms to practice a particular accounting method expressed in that book. If the accounting method were patentable and patented, what public policy would be served by excluding enforcement because a user of the method read it in the book? Samuelson then asks whether lawyers who use the algorithm in legal briefs would be patent infringers. Samuelson, Benson Revisited, supra note 2, at 1127. Presuming the patent is valid, infringed, and there is no exception or defense to the infringement, why should this use be treated any differently than using a process for curing AIDS or cancer? If the algorithm was also described in a book, copyright infringement could also be found, presuming there was access and substantial copying of expression, and no merger of idea and expression. See also Richard H. Stern, Copyright in Computer Programming Languages, 17 RUTGERS COMP. & TECH. L.J. 321, 347-64 (1991)(discussing the issue of the scope of copyright protection for programming language, described in a book or in computer program for translating the language or a program using the language).

294. The interesting question is whether the owner of such a patent could refuse to use it and enjoin others from using the cure. See discussion of the Paper Bag case, supra note 38. 35 U.S.C. § 283 authorizes federal courts to "grant injunctions in accordance with principles of equity. . . ." Courts have occasionally refused to grant injunctions against infringement on equitable grounds. In Vitamin Technologies, Inc. v. Wisconsin Alumni Res. Found., 146 F.2d 941, 946 (9th Cir. 1944), cert denied, 325 U.S. 876 (1945), the court said in dictum:

We know of no case in the Supreme Court since the Paper Bag case [210 U.S. 405 (1908)], which has considered the patentee's refusal to license the use of its patent to protect the health of great numbers of the public
thinking could be best resolved according to the admonition of Chief Justice Brian more than five hundred years ago: "The thought of man shall not be tried for the devil himself knoweth not the thought of man."295

3. Perceived Models of the Patent System

Perhaps more troubling are Newell’s perceived models of the economic foundations of the patent system. An underlying premise of Newell’s argument that the models are broken is that computer science is distinct from other forms of science and technology. He asserts: “One model underlying the patent system posits the existence of a gap between general scientific discovery and its application to matters of social and economic value.”296 He then posits that natural curiosity and a quest for fame may be adequate incentives for scientists to search for laws of nature, but that, because discovery of such natural laws “does not wear its practical application on its sleeve, so to speak,” it is necessary for the patent system to provide an additional economic incentive for application inventions to be made.297 His argument then runs that, because all computer science is related to use, there is no gap between pure and applied science for computer science, and asks the rhetorical question: “Hence where is the rewardable, risky, inventive effort?”298

such as are here shown to be suffering with rickets. It is strongly arguable that such a suppression of the patent’s use is vastly more against the public interest than its use for a mere control of prices as in United States v. Masonite Corp. [316 U.S. 265 (1942)], or the tying of unpatented with patented material in Mercoid Corp. v. Mid-Continent Co. [320 U.S. 661 (1944)].

See also, Foster v. American Mach. and Foundry Co., 492 F.2d 1317, 1324 (2d Cir.), cert denied, 419 U.S. 833 (1974); City of Milwaukee v. Activated Sludge, Inc., 69 F.2d 577 (7th Cir.), cert denied, 293 U.S. 576 (1934), where the court refused to enjoin the city from operating an infringing sewage treatment plant, which, if closed, would result in raw sewage being dumped into Lake Michigan; money damages were considered an adequate remedy.

Also, governmental use may not be enjoined and eminent domain may be invoked for “taking” a patent or a license thereunder, in the public interest. See, e.g., Pitcairn v. United States, 547 F.2d 1106, 1114 (Ct. Cl. 1976); N. V. Philips’ Gloeilampenfabrieken v. Atomic Energy Comm’n, 316 F.2d 401, 407 (D.C. Cir. 1963). See also Evan Ackiron, Note, Patents for Critical Pharmaceuticals: The AZT Case, 17 AM. J. LAW & MED. 145 (1991)(discussing the issue of injunctions, compulsory licenses and expropriation with respect to alleged monopoly pricing of AZT).

295. Y.B. 7 Edw. IV, F.2, pl. 2 (1468), quoted in WILLIAM L. PROSSER, JOHN W. WADE & VICTOR E. SCHWARTZ, CASES AND MATERIALS ON TORTS 2 (8th ed. 1988). Perhaps Matthew 5:28 is also relevant: “That whosoever looketh on a woman to lust after her hath committed adultery already in his heart.”

296. Newell, supra note 5, at 1028.

297. Id.

298. Id.
In the first instance, it is not intuitively obvious why computer science should be put into the binary category of pure rather than applied science, if indeed there is no gap. Do all algorithms define natural laws? Are they only induced by curiosity or fame? Second, it is not difficult to find examples of discoveries in other fields of the physical sciences that may indeed carry their application on their sleeves, so to speak, or at least such applications as may well be obvious to a person skilled in a particular art once the fundamental truth is discovered.299 One example that comes to mind is the recent discovery that certain compositions of matter exhibit superconductive behavior at temperatures well above absolute zero, indeed approaching room temperatures.300 The obvious applications are legion; how-

299. The invention of the transistor led to its substitution for vacuum tubes as had the vacuum tube replaced electro-mechanical relays in various applications including computers. The vacuum tube and transistor have been classified as among the greatest inventions. See G. Harry Stine, The Untold Story of the Computer Revolution 60,66 (1985). See Joel Shurkin, Engines of the Mind: A History of the Computer 9 (1984), listing the atomic bomb, transistor and computer as the three most important inventions of the twentieth century, and viewing the marriage of the computer and transistor as effecting a transformation unmatched since the Industrial Revolution. Magnetic core memory technology also was considered key to the development of the modern computer. See Shirley Thomas, Computers: Their History, Present Applications, and Future 68 (1965). One of the negative tests of "invention" prior to the enactment of the nonobvious standard in the 1952 Patent Act (35 U.S.C. § 103) was the substitution of materials. See, e.g., Hotchkiss v. Greenwood, 52 U.S. (11 How.) 248 (1850)(substitution of a clay or porcelain knob for a wood or metal one not invention) Also see Anthony W. Deller, The Problem of Invention in the Law of Patents, 28 J. Pat. Off. Soc'y 797 (1946)(listing 14 negative tests).

300. In 1911, Heike Kamerlingh Onnes discovered superconductivity when he found that mercury cooled to near absolute zero (0 K; -460F; 1273C) lost almost all electrical resistance. Alan M. Wolsky et al., The New Superconductors: Prospects for Applications, Sci. Am., Feb. 1989, at 60. After this initial discovery, progress in increasing the critical temperature, the temperature at which superconductivity could be achieved, was exceedingly slow. The first breakthrough came in 1986, when two scientists in Switzerland began experimenting with ceramics and reported superconductivity at 35K (-396F; -238C), the first increase in critical temperature in fifteen years. Simon Foner & Terry Orlando, Superconducting: The Long Road Ahead, TECHNOLOGY REV., Feb./Mar. 1988, at 36, 39 (former high critical temperature 23K). The next major breakthrough came one year later when researchers at two American universities discovered a particular ceramic which exhibited superconductivity above 77K (-321F; -196C). This discovery was particularly important as a superconductor with a critical temperature above 77K could be cooled using liquid nitrogen instead of the much more expensive liquid helium which had been used to reach temperatures near absolute zero. Wolsky et al., supra, at 62. Thus began the age of "high temperature" superconductors. Foner & Orlando, supra, at 39. Progress since that time has been slow but continuous. By 1990, the highest critical temperature achievable for ceramic materials appeared to be in the neighborhood of 130 K for materials made from either thallium or vanadium oxides. Michael Cross, Vanadium Takes Superconductors to New Heights, NEW SCIENTIST, Sept. 29, 1990, at 30 (critical temperature 130K: -225F; -143C); Japanese Lab Develops Highest-Temperature Superconductor, Ky-
ever, practical implementation of those applications may be far from obvious.\footnote{302}

If there is, in fact, no continuum between pure and applied science, then patent law surely provides a significant incentive along with that of natural curiosity and the quest for fame. Even the most pure of scientists might be tempted by the economic incentive.\footnote{303} Even after


\footnote{301} Applications for superconducting materials have been suggested in many different areas: electrical motors and transmission devices (e.g., high voltage power lines) providing and transmitting electric power at improved performance levels and decreased cost because of decreased losses to electrical resistance in the conducting material; high speed trains using magnetic forces to levitate above the track; energy storage devices storing large amounts of electrical energy in zero-loss grids against peak demand periods. \textit{See} Foner & Orlando, \textit{supra} note 300, at 40-46; Wolsky et al., \textit{supra} note 300, at 62-66.

With respect to computer technology, it has been suggested that superconductor technology be "married" to semiconductor technology to produce extremely fast and highly accurate computer chips. \textit{Gallium Arsenide Chips; Half Way to Paradise}, \textit{Economist}, June 15, 1991, at 83. The semiconducting material would control the logic of the chip while the superconducting material would allow for lighting-fast connections between areas of semiconducting material. \textit{Id.}

Another possible computer-related application of superconducting materials involves the use of "Josephson junctions." Josephson junctions are essentially layers of superconducting and insulating materials which can be used to switch voltages very quickly while consuming far less energy than conventional devices. Wolsky et al., \textit{supra} note 300, at 65. Use of these junctions in computer hardware circuitry would allow communication limited only by the speed of light. \textit{Id.}

Problems with the manufacture of memory cells using Josephson junctions have caused American concerns to abandon research in this field in favor of semiconductor research. However, the Japanese have continued to experiment in this area. \textit{Id.}

\footnote{302} Significant problems still exist with regard to the commercialization of such superconductor applications, specially with regard to the purity and durability of the ceramics. \textit{See} e.g., \textit{Half Way to Paradise}, \textit{supra} note 301, at 83. However, industry is catching up with the state of the art in high-temperature superconductors. New materials and manufacturing process are being found to improve the purity and ductility of the high-temperature materials. \textit{Superconducting Motors: Getting Warmer}, \textit{Bus. Wk.}, Aug. 26, 1991, at 64 ("melt recrystallization" process); Edmund L. Andrews, \textit{Superconductors Made in Bulk Quantities}, \textit{N.Y. Times}, July 13, 1991, § 1, at 34 (processing improves purity in ductile 1-2-4 materials). Other processes are being found to improve the bulk performance of these superconductors. \textit{Superconductors: A Step Closer to Mass Production?}, \textit{Bus. Wk.}, June 11, 1990, at 75.

\footnote{303} Disputes over ownership of intellectual property are not uncommon. For example, when a physics professor at California Institute of Technology (Caltech) developed a computer program in the course of his research, a debate arose over whether Caltech had an ownership interest in the program when the professor wanted to license it. \textit{See} Gina Kolata, \textit{Caltech Torn by Dispute Over Software}, 220
the discovery has been made in computer science, one would expect that the protection of both copyright and patent may provide the needed incentive to perfect the application by revisions, debugging, etc.304

In a further attempt to distinguish computer science from other technology, Newell posits the basic model of the patent system to induce inventions that are "consumable" to the net benefit of society.305 Newell then offers an alternative model whose thesis would appear to be that, because some computer scientists in the past have had free access to the programs of others, they have been able to improve them and, because the patent system may deny access, further improvement and development may be inhibited.306

Although Newell states that he does "not seriously defend this al-

304. Debugging costs are difficult to estimate:

The variability of the human element in software development is probably the principal cause of the lack of quantification in the claims associated with structured programming and other related issues. . . . Even the same programmer may perform quite differently on different occasions due to such factors as health, motivation, or familiarity with the program.

S.D. Conte, ET AL., SOFTWARE ENGINEERING METRICS AND MODELS § 3.1, at 113 (1986). However, a comparison can be made between the cost of errors found while designing the software and those errors found during maintenance of the software. The costs of repairing errors found during maintenance may be 100 times more expensive than if the errors were found during design. Id. § 2.8.4, at 105 (citing B.W. BOEHM, SOFTWARE ENGINEERING ECONOMICS (1981)). Therefore because of the cost differential, an incentive exists to eliminate as many bugs as possible during the design phase. See supra text note 77 (discussing the incentive needed to complete development).

305. Newell, supra note 5, at 1033.

306. Id. at 1033-34.
ternative model,” it would appear that the alternative model is far closer to the generally accepted model for the patent system. It is only the conclusion that is different. Certainly, the patent system envisions the creation of a product that is consumable, but, in addition, it also envisions the social contract of the public dissemination of knowledge with respect to the invention to enable a person skilled in the art to replicate it. The general theory is that, rather than inhibiting improvement inventions, the publication of technical knowledge concerning the invention (even though it may never be marketed for consumption) will spur on others to invent improvements or to transfer the knowledge to other fields of technology. It should be remembered that many patented inventions are never marketed for consumption. This same fate may also be expected of computer programs.

The common industry practice of distributing programs only in object code may be having a far more inhibitory effect on program improvement than may be attributed to patents on program inventions. With respect to such patents, the ideas underlying the program must, at least, be made available to the public in a commonly-understandable form in an enabling disclosure.

In sum, the broken models may not be those under which the patent system has been operating for over five hundred years. However uneasily some may assert that computer programs fit into the patent system, the system over time has been able to accommodate all technologies as they have evolved, even if by stretching uncomfortably at times to force the seams. The patent system may not be fully compatible with scientists who desire free and immediate access to all knowledge, but the tension between access and incentive is the

307. Id. at 1034. He concludes:

I do not seriously defend this alternative model. My goal is more modest—to point out that the world of algorithms and computers may have a different character than the standard economic model of incentives that underlies the patent law. Even this model may be broken.

308. See supra, text accompanying notes 60-63.

309. See supra text accompanying notes 58 and 59.

310. In an industry survey conducted in the early 1950s, it was concluded that: “The overall utilization rate of patents in current use, used in the past, and reported about to be used is 57 to 58%.” Barkev S. Sanders et al., Patent Acquisition by Corporations, 3 PAT. TRADEMARK AND COPYRIGHT J. RES. AND EDUC. 217, 239 (1959). The survey consisted of over 1,000 questionnaires returned by companies concerning their use of patents. The study further concluded that the patent utilization rate is significantly higher for smaller companies (over 75%) compared to larger companies (close to 50%). Id. at 218.

311. A recent example is the patenting of life forms. See generally, 1 CHUSUM, PATENTS, supra note 44, § 1.02[7][d] and n.24 (collecting articles); Patenting of Life Forms, BANBURY REPORT 10 (David W. Plant et al. eds., 1982). See also supra note 245, on the current controversy over the patentability of human genes.
model. This model is, perhaps, strained by computer program inventions, as well as by other evolving technologies, but it is hardly broken.

4. The Service Economy: Methods of Doing Business

The black-letter rule of nineteenth and early twentieth century patent law that methods of doing business or business systems are not patentable subject matter continues to have some vitality. The rationale for such a rule is obscure, as is the definition of what constitutes a method of doing business. In terms of benefit to society, any attempt to distinguish a method for producing a product more efficiently from a method of doing business that enables a product or ser-

312. As stated by Professor Goldstein:

The Constitution's authorization to Congress to grant patent and copyright protection represents a judgment that, although short-range competitive interests would benefit from immediate and free public access to technological and artistic innovation, to permit such access would destroy incentive to innovate; new products and works would not be introduced into the market and consequently the long-range competitive situation would decline. Paul Goldstein, The Competition Mandate: From Sears to Lear, 59 CAL. L. REV. 873, 878 (1971).

313. See generally, 1 CHISUM, PATENTS, supra note 44 § 1.03 (5). In criticism of Paine, Webber, Jackson & Curtis, Inc. v. Merrill Lynch, Pierce, Fenner & Smith, Inc., 564 F. Supp. 1358 (D. Del. 1983), which upheld a patent claiming a "system for processing and supervising a plurality of composite subscriber [cash management] accounts" against a defense that it was a "business method", Samuelson notes: "The court did not discuss a single 'business method' case, nor did it inquire about the reasons that might underlie the rule against patenting business methods." Samuelson, Benson Revisited, supra note 2, at 1121 n. 384. See also, In re Johnston, 502 F.2d 765 (C.C.P.A. 1974), rev'd on other grounds, sub. nom. Dann v. Johnston, 425 U.S. 219 (1976), holding an automated financial record keeping system to be within the technological arts. See also, PTO, Mathematical Algorithms, supra note 7, at 11, which appears to agree with Paine, Webber.

314. The leading case on the business method/systems rule appears to be Hotel Security Checking Co. v. Lorraine Co., 160 F. 467 (2d Cir. 1908), relating to a method for keeping restaurant records to avoid fraud by waiters and cashiers. Chisum notes that the court provides "no precise reason for such an exclusion." Chisum, Algorithms, supra note 2, at 964. Rather cryptically in Hotel Security Judge Coxe states: "A system of transacting business disconnected from the means of carrying out the system is not, within the most liberal interpretation of the term, an art. Advice is not patentable." Presumably, he would have had no problem if as a means for carrying out the system were connected and met the qualitative requirements for patentability. Chisum also notes that, "Rejection of business plans is often grounded alternatively on the 'printed matter' rule." 1 CHISUM, PATENTS, supra note 44, at 1-76. More in line with the transformational view of processes, is Professor Robinson's rationale for not protecting business methods given a century ago: "Every invention, when applied according to the design of its inventor, must accomplish some change in the character or condition of material objects. This is as essential in a patentable art as in an instrument." 1 WILLIAM C. ROBINSON, THE LAW OF PATENTS FOR USEFUL INVENTIONS 249 (1890).
vice to be marketed more efficiently may be as evasive as distinguishing idea from expression.

From an economic policy standpoint, a strong argument can be made that it would be in the best interests of the United States to provide incentives for creating inventions advancing the service area of the economy, which would include methods and systems of doing business, particularly those implementable by means of computer technology. At the present time, over 75 percent of jobs in the United States are in the service sector and the remainder are in manufacturing and farming.315 This situation is the reverse of a century ago, when 75 percent of the work force was engaged in agriculture.316 By the year 2000, it is predicted that the percentage in the service sector will increase to 80%, with substantially all new jobs being created in service industries.317 In terms of the gross national product of goods and services, the percentage attributable to services has been steadily increasing since the end of World War II.318 If the patent system indeed works in providing a net benefit to society, it would seem that the protection of nontransformational service inventions would serve the beneficial purpose of inducing investment in one of the few areas where the United States remains a technological leader.319 Moreover, as there are technological developments in the service sector, it would

315. See LOUIS REKEYSER'S BUSINESS ALMANAC 199 (L. Rekeyser & J. Cooney, eds., 1988)[hereinafter BUSINESS ALMANAC]. In 1952, 59% of U.S. workers were employed in the service sector, increasing to 68% in 1972. Id.
316. Id. at 24-26, 199-200
317. Id. at 24, 199.
318. In 1950, services constituted approximately 33% of the total, compared to 40.5% in 1960, 44% in 1970, 48% in 1980, and 54.2% in 1990. See STATISTICAL ABSTRACT OF THE UNITED STATES 431 (No. 698)(111th ed. 1991)[hereinafter STATISTICAL ABSTRACT] for 1950-1980 figures. See 71 SURVEY OF CURRENT BUSINESS 5 (Table 1.1), July 1991, for 1990 figures. See also infra note 319 for sources attributing even a higher percentage to the service sector.
319. In 1988, services accounted for 71% of the United States' output, and the U.S. was the leader in the international market's service sector. Christopher Chipello, Abstract, WALL ST. J., Mar. 21, 1988, § 1, at 1, col. 6. In 1990, the service industry provided $130.62 billion in export trade for the United States, up from $47.584 billion in 1980. STATISTICAL ABSTRACT, supra note 318, Table 790. See also, U.S. Department of Commerce, U.S. INDUSTRIAL OUTLOOK '92 (1992)("The U.S. data processing and network services industry is the world's largest."); Introducing a New List: The World's Largest Service Companies, FORTUNE, Aug. 26, 1991, at 166-67 ("Among the 25 countries represented [in the international market service sector], the U.S. has the most companies, with 150...[clearly] the U.S. is the leader...."); James Quinn, Serving the Service Industry, ISSUES IN SCIENCE AND TECHNOLOGY, Summer 1989, at 74-80:

The service sector has increasingly emerged as the critical force driving the U.S. economy. Service industries...employ three out of four Americans and account for 72 percent of the GNP...International trade services will play a growing role in the global economy. Services currently account for at least $700 billion of the world's international trade.
seem quite logical that intellectual property should be ready to accommodate rather than to limit the ability of the system to promote advances in the most rapidly increasing segment of the economy. To the extent that computer programs are to be used in industrial processes for the transformation of matter, such as in *Diehr*, the old traditional manufacturing model of processes would certainly continue; however, now that the translation of information and the manipulation of data have become of paramount concern to the service economy, it would seem that intellectual property should accommodate itself accordingly, if its historical purpose is to be implemented. Although a sound service economy requires a sound industrial base, it may well be foolhardy to ignore the reality of a service-dominated economy and to pigeonhole on the basis of an outdated conception of the patentability of business methods or systems.321


321. In criticism of Chisum's advocating the patentability of business systems, evidently ironically, Samuelson states: "Eliminating these impediments to patentability would, of course, have far broader consequences than simply opening the patent system to the protection of all computer program innovations. Michael Milken could now patent his method for junk bond offerings." Samuelson, *Benson Revisited*, supra note 2, at 1131 n.423.

It is far from apparent that granting Milken a patent on his method of junk bond offerings would have had adverse economic consequences, particularly if the patent system had induced the invention. If one assumes junk bonds are bad for the economy, underutilization as a result of the patent may have reduced any harm. Nonetheless, the jury is still out on the value of junk bonds. *See*, e.g., Fredrik Dahl, *Nobel Economics Laureate Praise Junk Bonds*, LBOS, REUTERS, Dec. 11, 1990:

Co-winner of the 1990 Nobel prize in economics, Merton Miller, praised the use of junk bonds and leveraged buyouts (BLOs) in corporate finance and denied they encouraged excessive debt and manipulation. Miller praised Michael Milken, who has been called the king of junk bonds, as a financial innovator. "He saw a gap in the financial structure and he was able to fill it... And he did it very well. The market performed some useful functions," said Miller.

*See also*, Not Such Junk; Economic Viability of Junk Bonds, NAT'L REV., June 24, 1991 at 13: "[Milken's] genius turned [the junk bond market] into a financial breeding ground for start-up companies. The transformation gave the 95% of American Corporations that are too small, too new, or too unknown for investment-grade credit ratings... access to credit markets for the first time in history." *See also* Michael D. Floyd, Comment, *Junk Bonds: Do They Have a Value?,* 35 EMORY L.J. 921 (1986).

Of course, Milken's crime was not coveting a patent on junk bonds. He was sentenced to 10 years in prison after pleading guilty to 6 of 98 changes of racketeering and securities fraud. *See* James W. Michaels, *My Story—Michael Milken*, FORBES, Mar. 16, 1992, at 79. Milken has also settled a multimillion dollar law suit involving a host of civil suits, with Milken required to pay $900 million of the
C. Algorithms as Liberal Arts

The question of whether algorithms, mathematical or otherwise, are the statutory subject matter of patents has generally been considered a question of statutory construction and, hence, within the purview of the courts to so construe. Congress has elected not to specifically exclude or include algorithms within the definition of patentable statutory subject matter in the Patent Act, while at least a definition of "computer program" has been added by amendment to the Copyright Act. The argument has been raised in a number of contexts and a variety of ways, however, that the question of whether an algorithm constitutes patentable subject matter should be decided at the constitutional level, hence requiring an interpretation of the Patent/Copyright Clause.

§1.3 billion settlement. Milken already has paid $400 million in connection with another settlement made with the Securities and Exchange Commission in 1990. See Judge Approves $1.3 Billion Settlement Between FDIC, Milken, Drexel Officials, VNA's BANKING REPORT, March 16, 1992, at 476. The settlement would reportedly leave Milken with well over $500 million. See Allan Sloan, Crying Over Spilled Milken, NEWSDAY, Mar. 15, 1992, at 56. The estimate of his net worth probably does not take into account his prison wages of 30 cents per hour.

322. In Supreme Court cases considering the 35 U.S.C. § 101 issue of patentable subject matter, the issue has been whether Congress has or intended to extend patent protection to particular subject matter, not whether such extension was within the power of Congress. For example, in Benson, the Court states: "It may be that the patent laws should be extended to cover these programs, a policy matter to which we are not competent to speak." Gottschalk v. Benson, 409 U.S. 63, 72 (1972). In Chakrabarty, the Court states: "The Constitution grants Congress broad power to legislate to "promote the Progress of Science and the useful Arts ...." Diamond v. Chakrabarty, 447 U.S. 303, 307 (1980)(emphasis added). In the next paragraph, the Court goes on: "The question before us is a narrow one of statutory interpretation requiring us to construe 35 U.S.C.A. § 101...." Id. (emphasis added). In Diehr, Justice Stevens, in dissent, states: "The broad question whether computer programs should be given patent protection involves policy considerations that this Court is not authorized to address." Diamond v. Diehr, 450 U.S. 175, 216-17 (1981).

323. See supra note 4 for the definition.

324. For example, the issue was raised in In re Musgrave, 431 F.2d 882, 893 (C.C.P.A. 1970):

All that is necessary, in our view, to make a sequence of operational steps a statutory "process" within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of "useful arts."

Judge Baldwin concurred in result in Musgrave but was concerned about a rule that would find "claims drawn entirely to purely mental processes to be statutory...." Id. at 896 (emphasis added). He then hypothesized on the possible difficulties of such a rule:

It should not require much imagination to see the many problems sure to be involved in trying to decide whether a step requiring certain human judgment evaluations is definite or not.

As one more example, suppose a claim happens to contain a sequence of operational steps which can reasonably be read to cover a process per-
This argument appears to be based on a number of premises. The major premise is that a strict parallel construction must be given to the Patent/Copyright Clause. Accordingly, "writings" must exclusively promote "science" (read—liberal arts) in order to qualify for copyright protection and "inventions" must exclusively promote the "useful arts" (read—technological arts) in order to qualify for patent protection.\(^3\)\(^2\)\(^5\) The second premise is that "mathematics" falls exclusively within the liberal arts.\(^3\)\(^2\)\(^6\) The third premise is that all algorithms are mathematical in nature.\(^3\)\(^2\)\(^7\) If these premises are accepted, the conclusion may then be drawn that algorithms should not be the subject matter of patents, because being mathematical they promote the liberal arts and not the useful arts.

Even if the third premise is accepted—that all algorithms are mathematical in nature—there is no clear indication that mathematics in general or algorithms in particular, in the intellectual property sense, should be exclusively allocated to the liberal arts. Laws of nature expressed by mathematical equations are categorized as unprotectible subject matter because of their preemptive nature, not because they are or can be expressed mathematically.\(^3\)\(^2\)\(^8\) Moreover,

formable both within and without the technological arts? This is not too far fetched. Would such a claim be statutory? Would it comply with section 112? We will have to face these problems some day.

*Id.* Compare In re Toma, 575 F.2d 872, 877-78 (C.C.P.A. 1978), where Judge Baldwin, writing for the court, stated:

First, we hold that the method for enabling a computer to translate natural languages is in the technological arts, i.e., it is a method of operating a machine. The "technological" or "useful" arts inquiry must focus on whether the claimed subject matter (a method of operating a machine to translate) is statutory, not on whether the product of the claimed subject matter (a translated text) is statutory, nor on whether the prior art which the claimed subject matter purports to replace (translation by human mind) is statutory, and not on whether the claimed subject matter is presently perceived to be an improvement over the prior art, e.g., whether it "enhances" the operation of a machine. This was the law prior to *Benson* and was not changed by *Benson*. (emphasis added)

In Gottschalk v. Benson, 409 U.S. 63 (1972), the argument was raised in an amicus brief that since a mathematical algorithm was claimed and mathematics is part of the "liberal arts" and not the "useful arts", it could not be the subject matter of a patent. The Court did not take the bait and relied upon the preemption of the entire mathematical algorithm. See Samuelson, *Benson Revisited*, supra note 2, at 1055 n.97 (quoting Amicus Brief Burroughs Corp. at 9-10) and at 1054 n.96 and 1055 (discussing the interpretation of the mathematical issue in the *Benson* case).

The constitutional issue may also be raised in the context of the patent/copyright interface as to whether a computer program may be the subject matter both patent or copyright or must be restricted to one or the other. See supra text accompanying notes 186-191.

325. See supra note 10 for the parallel construction of the patent/copyright clause.

326. Samuelson, *Benson Revisited*, supra note 2, at 1112: "Mathematics has traditionally been considered part of the 'liberal arts' " (footnote omitted).


328. As stated in *Benson*, "Phenomena of nature, though just discovered, mental
the application of a law of nature, in the form of a mathematical equation or an algorithm in apparatus or a process, obviously may be statutory subject matter. It is separation of the algorithm per se from its use that creates the problem with which the courts are now struggling. In essence, the issue again boils down to whether transformation of matter is necessary to qualify as patentable subject matter.

Implicit in the first premise is the assumption that the Patent/Copyright Clause must be given a strict parallel construction so that there can be no overlap between patentable and copyrightable subject matter. A given subject matter accordingly must promote either the liberal or the useful arts, but it cannot promote both. The strict pigeonholing of the two constitutional titles of protection is reminiscent of the formalistic jurisprudence of the late nineteenth and early twentieth centuries. Such an approach finds little support in court deci-

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329. As stated in Diehr, "It is now commonplace that an application of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection." Diamond v. Diehr, 450 U.S. 175, 187 (1981). The Court then quotes from Mackay Radio Corp. & Telegraph Co. v. Radio Corp. of America, 306 U.S. 618, 626 (1939).

330. Samuelson would distinguish Benson and other non-transformational cases from cases like Mackay Radio, on the basis that primary "instantiation" of the algorithm in Mackay Radio was in the physical parameters of an antenna, while algorithms in computer program related inventions have their primary "instantiation" in the program implementing them. She then analogizes the "instantiation" of its algorithm to "printed matter" and concludes such has "traditionally been regarded as outside the bounds of the patent system." Samuelson, Benson Revisited, supra note 2, at 1112. This analogy, of course, does not explain Diehr, unless it can be argued that the Arrhenius equation found its summary "instantiation" in the molded rubber products rather than in the control of the rubber molding process. Note also that in Toma, Judge Baldwin admonished that the subject matter decision should be based on what is claimed (a machine or method) and not on the utility served by the invention, whose primary instantiation could be a writing (a translated text). In re Toma, 575 F.2d 872, 877 (C.C.P.A. 1978). See supra note 324.

331. The period of formalism is generally considered to run roughly from the end of the Civil War until World War I. See Grant Gilmore, The Ages of American Law 11, 60-64 (1977). Gilmore summarizes the judicial approach of that time:

The post-Civil War judicial product seems to start from the assumption that the law is a closed, logical system. Judges do not make law: they merely declare the law which, in some Platonic sense, already exists. The judicial function has nothing to do with the adaptation of rules of law to changing conditions; it is restricted to the discovery of what the
sions or legislation. In fact, care has been taken in the Copyright Act to avoid the use of the constitutional language "writings" in specifying copyrightable subject: the Act employs the narrower term "works of authorship." The Supreme Court also made clear in  that, because a lamp base would qualify as the subject mat-

true rules of law are and indeed always have been. Past error can be exposed and in that way minor corrections can be made, but the truth, once arrived at, is immutable and eternal. Change can only be legislative and even legislative change will be treated with a wary and hostile distrust. A statute in derogation of the common law—as what statute is not?—will be strictly construed even if it cannot be set aside on constitutional grounds as beyond the power of the legislature to enact.

Id. at 62 (footnote omitted).

Samuelson asserts that the legal system has generally assumed that an intellectual product is either a writing (and hence copyrightable) or a machine (and hence patentable), but not both at the same time. Samuelson, Benson Revisited, supra note 2, at 1129. (Emphasis added, footnote 414 omitted). In her footnote 414, reference is made to the parallel construction of the patent/copyright clause and the recognition of this parallelism in the OTA BACKGROUND PAPER, supra note 4, at 34. Also, cited in footnote 414 is an article, Michael J. Kline, Requiring an Election of Protection for Patentable/Copyrightable Computer Programs, 6 COMPUTER/L.J. 607 (1986), with a specific citation to 647 nn. 185-186 as "citing authorities on this point." These "authorities" include cases such as Penneck v. Dialogue, 27 U.S. 1 (1829) and Great Atlantic & Pacific Tea Co. v. Suremarket Equip. Corp., 340 U.S. 147 (1950)(Douglas, J. concurring) where inventions were constituted to promote both "science and the useful art." Not included in the "authorities" is Bleistein v. Donaldson Lithographing Co., 188 U.S. 239, (1903), where in the context of the copyrightability of circus posters, Justice Holmes states:

We shall do no more than mention the suggestion that painting and engraving, unless for a mechanical end, are not among the useful arts, the progress of which Congress is empowered by the Constitution to promote. The Constitution does not limit the useful to that which satisfies immediate bodily needs.

Id. at 249. One would surmise that Justice Holmes would support the proposition that copyrights may promote the useful arts.

Copyright Law Revision, H.R. REP. No. 94-1476, 94th Cong., 2d Sess. 51 (1976):

In using the phrase "original works of authorship," rather than "all the writings of an author" now in section 4 of the statute, the committee’s purpose is to avoid exhausting the constitutional power of Congress to legislate in this field, and to eliminate the uncertainties arising from the latter phrase. Since the present statutory language is substantially the same as the empowering language of the Constitution, a recurring question has been whether the statutory and the constitutional provisions are coextensive. If so, the courts would be faced with the alternative of holding copyrightable something that Congress clearly did not intend to protect, or of holding constitutionally incapable of copyright something that Congress might one day want to protect. To avoid these equally undesirable results, the courts have indicated that "all the writings of an author" under the present statute is narrower in scope than the "writings" of "authors" referred to in the Constitution. The bill avoids this dilemma by using a different phrase—"original works of authorship"—in characterizing the general subject matter of statutory copyright protection.
ter of a design patent (an ornamental design presumably promoting the useful arts), this would not preclude its also qualifying as a subject matter of copyright (a sculpture promoting the liberal arts). Moreover, the fact that a lamp base may also serve a utilitarian function and could thus qualify as a "machine" for patentable subject matter purposes need not preclude copyright protection of its artistic expression but only of its utilitarian aspects.

The overlapping model of patent and copyright also has been the modern approach of the CCPA and now the CAFC. These courts have also consistently held that protection of a three-dimensional product by patent does not preclude its protection by trademark, as a separate title of protection advancing over policy goals.

334. 347 U.S. 201 (1954)
335. Excluded from the definition of "pictorial, graphic and sculptural works" are their "mechanical or utilitarian aspects" and "the design of a useful article" can fall within this definition "only if, and only to the extent that, such design incorporates pictorial, graphic, or sculptural features that can be identified separately from, and are capable of existing independently of the utilitarian aspects of this article." 17 U.S.C. § 101. The definition of a "useful article" is one "having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information. An article that is unusually a part of a useful article is considered a useful article." Id. See supra notes 104-106 for cases relating to the utilitarian issue.

336. See In re Yardley, 493 F.2d 1389 (C.C.P.A. 1974), where the court held that there was an overlap in statutory subject matter between copyright and design patents, citing Mazer v. Stein as so holding. The CCPA decided that the prior grant of a copyright on a watch face design (a caricature of former Vice President Spiro Agnew) did not bar the grant of a design patent on the same subject matter and the applicant did not have to elect one or the other title of protection. Compare Regulations for Registration of Claims to Copyright, 37 C.F.R. § 202.10(a)(1992), with respect to pictorial, graphic, and sculptural works, that a "copyright claim on a patented design or in the drawings or photographs in a patent application will not be registered after the patent has been issued." This would seem to estop a registration of such a work appearing in either a design or utility patent. The regulation is, of course, easily circumvented by registering the work prior to issuance of the patent. Nonetheless, it seems rather peculiar that a registration should be denied an original work when "copyright protection subsists" from the time it is "fixed in any tangible medium of expression," (17 U.S.C. § 102(a)), which presumably would include a patent application. See Douglas R. Wolf, Note, The Doctrine of Elections: Has the Need to Choose Been Lost?, 9 CARDOZO ARTS & ENT. L.J. 439 (1991)(considerating the election doctrine and its application by the Copyright Office).

337. In In re Mogan David Wine Corp. (Mogan David I), 328 F.2d 925 (C.C.P.A. 1964), the court held that the ownership of a design patent on the ornamental design of a decanter did not bar its registration as a trademark, provided the decanter design functioned "a trademark to indicate origin." Id. at 932. The case was remanded and the PTO again refused registration on the ground, inter alia, that Sears, Roebuck & Co. v. Stiffel Co., 376 U.S. 225 (1964), and Compco Corp. v. Day-Bright Lighting, Inc., 376 U.S. 234 (1964), precluded registration because the trademark, if granted, would continue to provide protection of the container after the design patent had expired. This argument was rejected in In re Mogan David Wine Corp. (Mogan David II), 372 F.2d 539 (C.C.P.A. 1967), on the ground there
The argument that the domains of patentable and copyright subject matter should be kept exclusive has some formalistic appeal. However, as a realistic approach to the resolution of the problem of algorithms, it offers little advantage. Surely a published article describing an invention advances the useful/technological arts in detailing how the invention may be implemented and also advances the liberal arts in its expression of that implementation. Conversely, if the same description appeared in a patent application, would only the technological arts and not the liberal arts also be advanced?\textsuperscript{333}

Samuelson expresses concern that a method for analyzing the structure of a novel might be considered patentable, particularly if implemented on a computer.\textsuperscript{339} The concern evidently stems from the presumption that literary works and their structuring are to be solely allocated to the liberal arts. Without this presumption, provided the method of analyzing the structure of a novel or other literary work is new, useful, and nonobvious, society presumably benefits at the margin, particularly if the patent system induced the method. The more interesting question is whether the method is performable only by the mind, which, as previously discussed, need not raise a § 101 statutory subject matter issue, but rather a § 112 definiteness issue.\textsuperscript{340}

Finally, in the context of the respective spheres of technology and the liberal arts, it must be recognized that, from a technical standpoint, hardware and software are often interchangeable.\textsuperscript{341} If the use

\textsuperscript{333} The patent document itself is presumably a "work of the United States Government" under 15 U.S.C. § 105 (1988) and hence not subject to copyright protection. However, nothing precludes the publication of the patent application (in whole or in part) in an article, or book or otherwise.

\textsuperscript{339} Samuelson, Benson Revisited, supra note 2, at 1125-26 n. 401.

\textsuperscript{340} See supra note 290.

\textsuperscript{341} See, e.g., T. Pratt, Programming Languages: Design and Implementation 19 (2d ed. 1984):

Given a precise definition of a computer, it is always possible to realize the computer in hardware—that is, to construct a hardware device whose machine language is precisely that of the defined computer. . . . In suggesting this possibility we are appealing to the important basic principle behind computer design: Any precisely defined algorithm or data structure may be realized in hardware. Because a computer is simply a collection of algorithms and data structures, we may assume that its hardware realization is a possibility, regardless of the complexity of the computer or its associate machine language.
of software or hardware to perform a particular function is one of design choice, it stretches credibility to argue that the software implementation of an algorithm promotes only the liberal arts but that, when the implementation is firmed-up, the technological arts now are solely promoted.342

In sum, it cannot be said with any degree of certitude that §101 as presently construed by the CAFC and the PTO is an unreasonable interpretation. Whether Benson is being ignored and the law returned to a pre-Benson state is debatable.343 However, certainly under the supervisory authority of the Supreme Court, the CAFC can be brought back into line or, indeed, Congress can resolve the issue one way or another by amending the Patent Act or enacting other legislation. Such being the case, there are still a number of policy reasons that bear upon whether or not algorithms should be protectible by patents.

D. Post Hoc Ergo Propter Hoc

One of the major policy arguments that has been raised against protecting computer programs by patents is that such protection is unnecessary because the computer software industry has grown significantly over the years without patent protection and with other available protection, especially copyright. This point was raised in the 1966 President's Commission Report,344 was mentioned in dissent in Diehr345 and continues to be repeated.346 This type of reasoning is

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342. Samuelson recognizes the problem that the technical interchangeability of hardware and software may present for a system of sui generis protection for software but concludes: "Although these problems may be difficult, they do not seem to be inherently unresolvable." Samuelson, CONTU Revisited, supra note 2, at 768. See infra note 391.

343. See supra notes 260, 262.

344. PRESIDENT'S COMMISSION REPORT, supra note 26, at 13.


346. In setting out the position for reliance only on copyright for software protection, Samuelson states: "The fact that this growth has occurred without the aid of patent protection is powerful evidence that patent protection is not necessary for the software industry to thrive." Samuelson, Benson Revisited, supra note 2, at 1136 (emphasis added). Compare Chisum's conclusion based upon detailed hypothetical findings, which he strongly suspects closely track reality, that denying patent protection to algorithms will adversely affect investment in software development. Chisum, Algorithms, supra note 2, at 1014-15. See also NRC, SOFTWARE ISSUES supra note 65, at 60 (indicating the conclusion of an IBM vice
still another example of the "hydraheaded heresy" of post hoc ergo propter hoc reasoning. As stated a half century ago by Justice Griffith:

There is one heresy in the judicial forum which appears to be Hydra-headed, and although cut off again and again, has the characteristic of an endless renewal. That heresy is that proof that a past event possibly happened, or that a certain result was possibly caused by a past event, is sufficient, in probative force to take the question to a jury. ... 'Post hoc ergo propter hoc' is not sound as evidence or argument.347

The fact that copyright protection existed as a "past event" has a causal connection with a "certain result"—the rapid growth of the computer software industry—is, in Judge Griffith's words, "not sound evidence or argument." The mere availability of copyrights for computer programs cannot be given credit for the creation of all computer programs. All programs induced by other than the Copyright Act must be excluded.348 Indeed, the fact may be that the growth of the industry has been or may be inhibited by the scope of copyright protection afforded under cases like Whelan and Lotus. A fortiori, the absence of patent protection during the critical period hardly provides a causal link to the growth of the software industry. Samuelson recognizes this but dismisses the contention that there would have been even greater growth had there been patent protection.349 The absence of patent protection is no more proof for the growth of the industry than is the presence of copyright protection.

president that "the software industry has prospered under the current intellectual property system.").

The use of post hoc reasoning has also been used as a general justification for the patent system; see, e.g., Robert C. Brown, Jr., Whither Goes the United States Patent System?, 9 IDEA 251, 256 (1965): "Nothing succeeds like success itself, and the effectiveness of the United States patent system has been strongly evidenced by the place that the United States holds in scientific and industrial progress."

347. Kramer Serv., Inc. v. Wilkins, 184 Miss. 483, 186 So. 625, 627 (1939). Generations of torts students will remember this case from Dean Prosser's casebook, now in its eighth edition. WILLIAM L. PROSSER ET AL., supra note 295 at 270. In Kramer, plaintiff received a cut on his forehead from defendants' negligently maintained transom. Plaintiff developed skin cancer at location of the cut on his forehead. The issue was whether there was a causal conduct between the past event (the cut from the glass in the negligently maintained transom) and a certain result (skin cancer).

348. See supra text accompanying notes 97-129 (discussing noncopyright-induced programs).

349. Samuelson, Benson Revisited, supra note 2, at 1142-43:

The most powerful argument against patents for program-related inventions is that the industry has grown from being a nonexistent industry to a major, flourishing, and highly innovative industry without patent protection. It is no answer to say, as some patent lawyers might be tempted, "Just think how innovative it would have been had patents been in place." The absence of patents allowed the rapid spread of ideas about programming computers.

This conclusion is contrary to one of the inducements for obtaining patents, viz., the incentive to disclose. See supra notes 58, 59 and 77 and accompanying text.
As the figures in the margin indicate, growth in the computer software industry has been continuous, but the annual growth rate of the 1990's is projected to be less than half that of the 1980's.\footnote{350} Studies by Kenneth Flamm indicate that the primary driving force for the growth of computer software industry in the early years was government funding of research and development.\footnote{351} The market then was demand driven, with increases in the performance/cost ratio of computers making them desirable to a widening spectrum of consumers.\footnote{352} The performance/cost advancements in the computer field have been dramatically put: "[I]f the automobile and airplane businesses had developed like the computer business, a Rolls Royce would cost \$2.75 and run for 3 million miles on one gallon of gas. And a Boeing 767 would cost just \$500 and circle the globe in 20 minutes on five gallons of gas."\footnote{353} Daniel Bricklin maintains that new software products will be purchased when "they are perceived to have a very good

\footnote{350} From 1970 through 1980, expenditures increased from $500 million to $2.85 billion, an annual compound-rate increase of 19%. From 1980 to 1990, the increase was $2.85 billion to $42.5 billion, an average annual compound rate increase of 31%. For the period 1990 to 2000, the projected figures are from $42.5 to $174.6 billion, with an average annual compound rate of 15.2%. CBEMA, THE INFORMATION TECHNOLOGY INDUSTRY DATA BOOK: 1960-2000, Table 4-7 at 100 (1990)(the figure for 1990 is taken from CBEMA, THE INFORMATION TECHNOLOGY INDUSTRY DATA BOOK: 1960-2001, Table 4-7 (1991)). One could speculate that the decrease in the rate of growth projected for 1900-2000, may be related to the availability of patent protection for computer programs. One could also speculate that the decrease may be related to the scope of copyright protection afforded under decisions such as Whelan and Lotus. More probably, the decrease is related to the maturing of the software industry. See Scherer, Innovation, supra note 77, at 265; NRC, Software Issues supra note 65, at 6.

\footnote{351} Flamm points out that the market was driven by increased demand that was a result of lower prices and increased performance, that in turn was driven by heavy U.S. investment into R & D. Flamm concludes: "The federal government has enormously influenced the development of computer hardware in the U.S. at both the micro and macro levels." Kenneth Flamm, Targeting the Computer 123 (1987). Flamm stated that this enormous influence was the result of heavy public investment in computer research and development, the pace of technological progress would not have been as strong." Flamm also suggested that tax breaks and incentives by the U.S. government had a direct affect on the computer industry's growth. Id. at 110.

\footnote{352} Flamm observes that after heavy investment by the U.S. government fostered the growth of the U.S. computer industry, other forces began to drive the market. One such force was technological advance: "As technological advance continuously lowered the costs of information processing, successful entrants to the industry have pioneered new markets and applications, with new products tailored to those markets." Kenneth Flamm, Creating the Computer (1988). Flamm also noted the importance that increased computer compatibility had on the market. Id. at 212-213. Flamm's studies have shown a 25% price/performance improvement every year from 1957 to 1978 and suggests higher improvements since then. See Linda Runyan, 40 Years on the Frontier: History of Computing, 37 Datamation 34 (1991).

\footnote{353} The Information Technology Revolution xiii (Tom Forester ed., 1985).
cost-benefit ratio” and “products take off only when they are so much better than what went before that buyers are forced to make a purchase. Success requires a productivity improvement of roughly 100 times or, measured differently, a three-week payback.”

Another reason that may be advanced for the rapid growth of the industry is standardization, with customer demand and competition increasing with the compatibility and interoperability of components and programs.

In short, whether the presence of copyright or the absence of patent protection had any significant impact on the growth of the computer software industry is unknown and probably unknowable.

E. The Industry Position

Another argument raised is that many in the computer software industry believe that patent protection on computer programs will be harmful to the industry. This assertion may be the modern day version of “What is good for GM is good for the country.”

The assertion of industry preference is at best anecdotal and appears to present the view of a limited segment of the entire industry and, indeed, includes some individuals who now or previously opposed or advocated a low level of copyright protection for programs.

Copyright protection, of course, provides significant advantages to

355. See NRC, SOFTWARE ISSUES supra note 65, at 66-72.
356. As stated by Samuelson: “Accepting an expansive realm for software patents requires ignoring that many in the software industry itself are strongly opposed to patents for software innovations.” Samuelson, Benson Revisited, supra note 2, at 1048 (footnote omitted); see also id. 1133-39 and accompanying notes for industry view.
357. The quote is attributed to Charles Wilson, then President of General Motors, in testifying at a Senate hearing in 1953 prior to being appointed secretary of Defense. GM public relations tried to clarify the “misquote” up until the 1970’s. In response to a question concerning a potential conflict between GM stockholders and the country Wilson stated: “I cannot conceive of one because for years I thought that what was good for the country was good for General Motors, and vice versa. The difference did not exist Our company is too big. It goes with the welfare of the country. Our contribution to the nation is quite considerable. . .” See PR Imbroglios Seem to Haunt General Motors, PR SERVICES, Oct. 1990, at 16.
358. See, e.g., Mitchell Kapor, Litigation v. Innovation, BYTE, Sept. 1990, at 520: “Overprotection of intellectual property is as pernicious as underprotection in its stifling effects on innovation and the consequent loss to society. Unfortunately, the computer industry is experiencing an unsteady but stubborn march to extend the scope of copyright. . .”; Daniel J. Lyons, IBM and Software Developers Resale Pros and cons of copyright Protection, PC WEEK, June 5, 1989, at 72(1): “You don’t have the right to own everything, my view is, let’s have as little protection as possible', said Daniel Bricklin. “The software industry will do best with some protection, but not much.”
small software houses because it is inexpensive to acquire, provides an
ambiguous patent-like scope of protection, and does not require appreci-
cable disclosure of the underlying ideas when distributed only in ob-
ject code. The major fears of those opposing patent protection appear
to be that they will be barred from using broad basic ideas, they will be
subject to the "time bomb" of the late-issuing patents, and powerful
companies like IBM will dominate patent ownership.\textsuperscript{359}

Another argument advanced is that the rules have been changed,
so that if programs can now be protected by patents, this will have an
ex post facto effect; thus, expectations of free access are defeated.\textsuperscript{360}
The unfairness in the evolution of rules by the common law method
leads again into the controversy over whether courts make or discover
the law.\textsuperscript{361} On the other hand, it may be argued that industry expecta-
tions may also have been defeated when copyright protection was
given a broad patent-like scope of protection in cases like Whelan and
Lotus. Although some or all of these fears may be justified, the issue
would seem to be better framed in terms of what would be in the best
interests of the country in implementing the patent/copyright clause,
rather than in terms of self-perceived interests.\textsuperscript{362}

F. Generic Anti-Patent Arguments

Other arguments illustrating the anti-patent sentiment to patent
protection for computer programs appear to be basically generic anti-
patent arguments. One argument raised is that of late issuing patents
(the "time bomb") resulting in wasted resources from independent de-
development.\textsuperscript{363} This problem, however, is not exclusive to the com-
puter software industry, but is common to all industries. It has long
been recognized as one of the costs of the patent system, which pre-
sumably is counterbalanced by the "lottery" incentive of patent grant-
ing in rem exclusive rights to the first inventor. Indeed, a strong case
can be made that many industries face more significant costs because
of higher capital investment and longer development times compared
to the software industry.\textsuperscript{364}

\textsuperscript{359} See Samuelson, Benson Revisited, supra note 2, at 1137-38 n.440, IBM is reported
as acquiring 200 patents per year on "software-related inventions." See, Software
Patents: A Horrible Mistake?, MASSACHUSETTS INSTITUTE OF TECHNOLOGY COM-
munications Forum, Seminar Notes, Mar. 23, 1989, at 6 (summary of comments
by Stephen Kahn)[hereinafter MIT Notes].

\textsuperscript{360} See NRC, SOFTWARE ISSUES supra note 65, at 33.

\textsuperscript{361} See supra text accompanying note 252.

\textsuperscript{362} It is not surprising that interface designers are opposed to patent or broad "look
and feel" protection or that computer scientists would be opposed to protection of
algorithms.

\textsuperscript{363} See supra text accompanying notes 48-49.

\textsuperscript{364} For example, it has been estimated that the interval between invention (concep-
tion) and innovation (commercialization) was 11 years in the petroleum industry.
Another generic anti-patent argument is that the availability of patents on various aspects of computer programs would increase the cost of program development because licenses would be required for the individual components. However, this again is a problem common to any industry that is producing systems, machines or processes involving multiple parts or components, whether they be automobiles, television sets or mouse traps.

A related generic argument, that patents may inhibit entry into the field, is a particularly weak one with respect to computer programs.

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365. See Samuelson, Benson Revisited, supra note 2, at 1137, (citing MIT Notes, supra note 359, at 15).

366. A producer has the option of purchasing the needed parts or components and receiving a patent and copyright infringement indemnity from the supplier or may manufacture the part or component itself and acquire a license, if needed, from the intellectual property owner. It is an economic decision and transactions costs will, of course, enter into the decision.

367. See Samuelson, Benson Revisited, supra note 2, at 1137 and 1137 n.439 (arguing that the cost of patent acquisition may inhibit small firms from developing programs). However, if the program development is important enough and a patent is obtained, the patent owner has the option of granting licenses or probably mar-
To the contrary, it can be argued that the availability of patents protecting components of computer systems would be more likely to provide entry into the market for small software houses, who may produce components that provide unique advantages, which a producer would be desirous of using in a computer system or broader computer program. The producer may find it economically desirable to take licenses rather than to engage in independent development to invent around.\textsuperscript{368}

Another argument advanced is that the PTO lacks the technical expertise to examine effectively applications claiming computer program inventions.\textsuperscript{369} This, of course, is not a problem unique to the computer software industry.\textsuperscript{370} Nonetheless, there is no question that many patents issued in all technical fields are of dubious validity.\textsuperscript{371} Certainly, if there is a question of infringement of a patent, the accused infringer will have great economic incentive to make further investigation into the validity of the patent and, presumably, will have access to the sufficient expertise required to defend an infringement suit. The economics of this situation are hardly different from those

\textsuperscript{368} The producer may be placed at a competitive disadvantage if it does not provide the patented invention or a noninfringing substitute. One could argue that small software houses may be the principal beneficiaries of patent protection in the sense that a patent would provide them with a much stronger title of protection to license than a copyright.

\textsuperscript{369} This is a recurring theme starting with the President's Commission Report, supra note 26, at 26, and continuing to Samuelson, Benson Revisited, supra note 2, at 1138-39. Indeed, Samuelson offers a potential solution to the problem of proposing a "scientific advisory board" to assist the PTO so that the software industry "would gain confidence in the Office's decision making." Id. at 1146. It is not apparent why the industry would need the intervention of a board, when, after all, the industry is the one who would be acquiring the patents and presumably would be "skilled in the art."

\textsuperscript{370} See, e.g., G. S. Churbuck & David C. Churbuck, Whose Invention Is It Anyway, FORBES, Aug. 19, 1991, at 114, who report that the PTO is understaffed in technologically developing areas of biotechnology, computer software, superconducting materials, and artificial intelligence, exacerbated by a high turnover rate among examiners—recently above 50% a year in certain units. See also David L. Wilson, New Inventions in the United States, NAT'L J., Mar. 2, 1991, at 553, who reports that the number of bio-tech applications is increasing at twice the average rate and the disposal of bio-tech applications is 8 months longer than average. The main reason for the difficulty with bio-tech applications according to a General Accounting Office study is that the PTO lacks enough skilled examiners to handle the increased load in this evolving area of technology. From October 1988 to June 1990, the number of bio-tech examiners increased from 91 to 112, but of those 112 examiners, only 14% have at least six years experience. Id.

\textsuperscript{371} Of the patents important enough to be litigated and appealed to the CAFC almost one-half are still found invalid. See supra note 173.
Another argument raised, which reflects an anti-patent sentiment or, perhaps more accurately, an anti-patent attorney bias, is that patent attorneys in general (or at least certain patent attorneys) are strongly advocating the patent protection of computer programs for their own selfish gain. Although it may, at times, be difficult to separate self-interest from advocated public interest, ad hominem argumentation has perhaps too glibly married the two. It may be simpler to explain such advocacy as reflecting faith in the patent system or, even more mundanely, as protecting against a charge of malpractice.

It has also been suggested that this controversy may be a turf battle between patent and copyright attorneys; it is not apparent, how-

372. Indeed, the litigation expenses in copyright infringement cases involving computer programs may be approaching that of patent litigation, when considering the extent of discovery being undertaken and the use of expert witnesses. For example, it is reported that defendant Paperback Software spent more than $600,000 in pre-trial expenses in a losing cause in Lotus Development Corp. v. Paperback Software Int'l, 740 F. Supp. 37 (D. Mass. 1990). Lotus is likely to have expended considerably more. Lotus had sales of over $400 million in 1987 compared to Paperback's sales of $4.7 million that year. See William H. Wright, Comment, Litigation as a Mechanism for Inefficiency in Software Copyright Law, 39 UCLA L. REV. 397, 399-400 n.9 (1991). See supra note 32 (considering litigation expenses).

373. See, e.g., O'Connor, supra note 137, at 8, who reports: "'Lawyers are running around our industry asking people if they'd like to patent something,' said Ken Wasch, executive director of the Software Publishers Association in Washington, D.C. 'It's gotten worse than ambulance chasing, and we don't think it's a positive development.'" This theme is picked up in Samuelson, Benson Revisited, supra note 2, at 1031-32 n.16: "[I]ntellectual property law is supposed to give incentives to invest in innovation to those who develop computer software—not to patent lawyers." (emphasis added). One could ask with some trepidation whether this would apply to law professors (who might happen to have been patent attorneys in a prior life) who advocate patent protection for computer programs. One could ask is there a different incentive motivating others, including law professors, who attack both patent and copyright protection for computer programs to promote sui generis protection? Posner notes:

[Man]y writers receive nonmonetary rewards from writing—fame, prestige, the hope of immortality, therapy, inner satisfaction. These rewards reduce the cost of writing; and some of them, notably fame, can be translated into money.

POSNER, LITERATURE, supra note 52, at 339.

374. So far at least, law professors have not had to face malpractice for the negligent writing of law review articles. The courts have uniformly denied recovery on the basis of educational malpractice. See generally, J. COLLIS, EDUCATIONAL MALPRACTICE (1990); Richard Funston, Educational Malpractice: A Cause of Action in Search of a Theory, 18 SAN DIEGO L. REV. 743 (1981).

375. See Samuelson, Benson Revisited, supra note 2, at 1147 n.474. Many patent attorneys, of course, hold themselves out as intellectual property law specialists qualified to provide legal services related not only to patents, but also including trademarks, copyrights, trade secrets, and sui generis protection. Copyright at-
ever, how the availability of patents for computer programs would in any way diminish the availability of copyright protection for the same programs. It is only in that narrow area of overlap that dual protection may be asserted; provided these titles of protection protect, respectively, the claimed invention and the expression of the work, no significant conflict should exist. For that matter, if sui generis protection of computer programs is adopted, the turf battle will probably be expanded to the likely economic gain of patent, copyright and newly self-proclaimed sui generis attorneys.  

G. Sui Generis Advocacy

In terms of advocacy, there are those who are opposed not only to patent protection of computer programs but also to copyright protection. A principal advocate taking this position is Professor Samuelson, who has long urged the adoption of a sui generis system of protection for computer programs.  

The basic argument appears to be based upon the premise that computer programs just do not nicely fit into either a copyright pigeonhole or a patent pigeonhole; therefore, a third sui generis pigeonhole is needed to accommodate them. In her recent Benson Revisited article, Samuelson states: “Programs are, in truth, too much of a mechanical process to fit comfortably in the copyright system and too much of a writing to fit comfortably in the patent system.”

The underlying assumption of this advocacy position is that there is something unique about a computer program not shared by other technologies. In the first instance, it is not intuitively obvious that programs are “in truth” too much of a mechanical process to fit com-

376. This may depend on how the interfaces between patent/copyright/sui generis are defined. For example, with broad preemptive in favor of the sui generis system, this could adversely affect patent attorneys if most programs are excluded from patent protection. On the other hand, it is interesting to note that both patent and copyright attorneys have bemoaned the lack of infringement litigation under the Semiconductor Chip Protection Act of 1984 (17 U.S.C. §§ 901-914 (1988). See Ronald S. Laurie, The First Year's Experience Under the Chip Protection Act or "Where are the Pirates Now That We Need Them?", COMPUTER LAW, Feb. 1986, at 13-14, and Jon Baumgarten voicing the same concern two years later: "Where are the pirates when we need them?", Jon Baumgarten, Chip Protection, 35 Pat. Trademark & Copyright J. (BNA) 444 (1988). See infra text accompanying notes 412-414 (discussing this Act as a prototype for sui generis protection and note 385 for its rationale).

377. See Samuelson, Benson Revisited, supra note 2, at 1148-53; Samuelson, Creating a New Kind of Intellectual Property, supra note 2; Samuelson, CONTU Revisited, supra note 2.

378. Samuelson, Benson Revisited, supra note 2, at 1128-29. See also id. at 1148 (introducing the sentence with the phrase “If it is true that”, “in truth” is deleted, and “mechanical process” is replaced with “machine”).
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fortably in the copyright system. The expression of a mechanical process (or other expression of an invention) certainly is a writing (a work of authorship), and it quite comfortably fits there, whether in standard English or source or object code. This expression may be fixed in copies in various tangible media of expression.

The converse, that a program is too much a writing to fit into the patent system, again begs the question of why the expression of an invention (computer program or otherwise) becomes any less of a writing when put into a patent specification including the claims. Rather than being a hybrid, a more plausible analogy might reflect the dualistic character of a computer program, of being a writing when fixed in a tangible medium of expression and of being an invention when appropriately claimed as a process or machine.

Samuelson's view that programs are "a hybrid—both writing and machine," requiring "hybrid" treatment, is based on the assumption, which she attributes to the legal system, that something that can fit the definition of both copyrightable and patentable subject matter cannot be protectible by both. If this assumption is not so easily made, the hybrid aspect of programs fits much more neatly into either or both titles of protection.

It is also particularly interesting that the argument for sui generis protection for computer programs is not based on the inability of programs to meet the qualitative standards for protection by either patent, copyright or both. This is in contrast to the position taken with respect to separate protection for industrial designs and semicon-

379. In Baker v. Seldon, 101 U.S. 99 (1879), the copyrightability of Seldon's book explaining the system of bookkeeping was not challenged. What was not copyrightable were the blank forms which would preclude others from practicing the system.

380. It is irrelevant whether the program is creatively expressed in prose in a book or in magnetically recorded binary code on a floppy disk.

381. While many may prefer to read a novel by Balzac to a patent specification, especially the claims, most would find more literary expressiveness there than in a print-out of object code.

382. Samuelson's expression of this idea is quoted in the text supra note 378.

383. Indeed urging the hybrid nature of a computer program is somewhat inconsistent with the argument that such programs are exclusively writings for the promotion of the liberal arts and are therefore excluded from patent protection. See supra text accompanying notes 322-343 (discussing the constitutional issue).

384. Because the nonobvious standard applies for design patent protection (see 35 U.S.C.A. §§ 171-73) relatively few individual designs qualify for protection. In this regard since 1914 more than 70 industrial design protection bills have been introduced into Congress. See Esquire, Inc. v. Ringer, 591 F.2d 796, 801 n.12 (D.C. Cir. 1978), cert. denied, 440 U.S. 908 (1979). There currently is a bill before Congress for industrial design protection. H.R. 1790, 102d Cong., 1st Sess. (1991). Legislation known as the Design Innovation and Technology Act of 1991 was introduced on April 15, 1991, to give ten year protection to industrial designs that are inadequately protected under patent, trademark, or copyright law. The re-
ductor chips.\textsuperscript{385} There is no question that certain computer programs can meet the qualitative standards for patent protection and that substantially all do for copyright protection.\textsuperscript{386} It is only a question of whether they should be protected even though they are original and new, useful, and nonobvious. In short, a mechanistic, binary view of the Patent/Copyright Clause would appear to be a weak base indeed to support the denial of full intellectual property protection to programs that completely satisfy the respective formal and qualitative standards for protection.

Even assuming that preempting computer programs, in whole or in part, from copyright and patent protection can be justified, there are still significant problems in devising a sui generis system that will achieve the presumably desired instrumentalist goal of inducing an adequate number of computer programs with adequate incentives so that a net societal benefit can be achieved. Unfortunately, this cannot be known with any degree of exactitude aside from rational analysis of drafted legislation includes an original design standard in § 1001 which requires "a distinguishable variation over prior work pertaining to similar articles which is more than merely trivial and has not been copied from another source." In addition, a new provision (§ 1022(b)) was added to permit a seller or distributor to sue "for lost profits, cost of materials, loss of good will, and punitive damages in instances where the injunctive relief was sought in bad faith." Also, § 1002(5) added a provision, similar to the public use bar in patent law, which specifies that protection does not extend to designs "embodied in a useful article that was made public by the designer or owner in the United States or a foreign country more than 1 year before the date of the application for registration under this chapter." For recent studies of industrial design protection and U.S. practice compared to other countries, see Reichman, Computer Programs, supra note 2; J.H. Reichman, Design Protection and the New Technologies: The United States Experience in a Transnational Prospective, 19 U. BALT. L. REV. 6 (1989).

\textsuperscript{385} The underlying rationale of the Semiconductor Chip Protection Act of 1984 [hereinafter SCPA], 17 U.S.C. §§ 901-914 (1988), has been summarized as follows: The purpose of the statute is to protect the investment necessary to design integrated circuits to be embodied in particular semiconductor designs. A firm could spend thousands or even millions of dollars on the engineering for a chip to perform a particular function—to act as a processor for a computer, or to control the functions of a microwave oven or a television set—and a competitor could simply photograph the chip and use the photograph together with available techniques and machinery to make an exact copy. Although the engineering of the chip was expensive, it employed known design methods and hence was probably unpatentable because "obvious" to one skilled in that art. Since the "form" of the circuit was dictated not by design considerations, but by the functional imperatives of the circuit components, it was not copyrightable. Congress passed the statute in order to protect the private incentive to design such chips in spite of the fact that they could be so easily copied.


\textsuperscript{386} See, e.g., supra text accompanying notes 131-136.
the component parts of any proposed sui generis system, which should, of course, discount the political compromises attendant to such legislative proposals.387

At a fundamental level, a sui generis system of protection presents the same basic problems of any system of intellectual property, namely, the definition of protectible subject matter, the qualitative standards for protectability, and the scope of protection granted.

The statutory subject matter issue for a sui generis system may prove even more difficult than that for patents. Are all computer programs to be preempted for a sui generis system? How will the interfaces of the sui generis system with the patent and copyright systems be defined? For example, at the extreme margins: would the program-controlled process found patentable subject matter in *Diehr* be forced into the sui generis system, even though there is transformation of matter?388 Would a computer program described in a book including flow charts and algorithms be denied copyright protection and be limited to sui generis protection?389 In any event, it is far from clear that a sui generis system would provide bright lines at the interfaces of patent and copyright, and this system may indeed complicate an already unclear situation with respect to the interrelationships of these titles of protection.

Samuelson’s view on the sui generis interface with the copyright and patent system has evolved over time. In her original article advocating a sui generis system for programs, she would only preempt object code for sui generis protection, and leave the rest to copyright.390 With respect to the patent/sui generis interface, she would require an election between one or the other.391

In her latest article, she would expand sui generis subject matter to

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387. It may be recalled that it took 20 years for the present Copyright Act of 1976 to be enacted. *See Goldstein, Casebook*, supra note 1, at 528-29, for a brief history of the enactment of this Act. It took 10 years for the Semiconductor Chip Protection Act; *see* Robert L. Risberg, Jr., Comment, *Five Years Without Infringement Litigation Under the Semiconductor Chip Protection Act: Unmasking the Spectre of Chip Piracy in an Era of Diverse and Incompatible Process Technologies*, 1990 Wis. L. Rev. 241 (1990). We still do not have industrial design protection even though bills began to be introduced 75 years ago. *See supra* note 384.

388. Samuelson appears willing to cede “industrial processes and machines” applying computer programs to patents but is wary of patent attorneys who may not “claim software-related innovations in a straightforward manner” and of the PTO’s ability to draw lines. *See* Samuelson, *Benson Revisited*, supra note 2, at 1140-42.

389. Presumably documentation and instruction manuals would still be copyrightable subject matter.


391. *Id.* at 768. If sui generis protection is not limited to object code, the problem of the interchangeability of software and hardware would seem somewhat more “unsolvable” at the copyright/patent interface. *See supra* notes 341-342 (discussing the interchangeability of software and hardware).
include source code previously allocated to copyright,\textsuperscript{392} and would limit patent protection to "traditional industrial or physical processes utilizing computer programs or elements."\textsuperscript{393} Hence, the sui generis protection would preempt significant areas presently allocated to copyright or patent or perhaps both.

Stern has suggested a possible solution to the patent/sui generis interface problem.\textsuperscript{394} Under his proposed test for separating patentable algorithm-related inventions from nonpatentable ones, knowledge of the algorithm would be assumed and the question would be asked whether it would be obvious to select and adapt the algorithm for use in the claimed invention.\textsuperscript{395} Adopting the fiction of prescience implicitly accepts a discovery theory of algorithms and "remorselessly applies"\textsuperscript{396} it against its discoverer. Nonetheless, according to this test, obvious selections and adaptions of algorithms would still be eligible for some form of protection.\textsuperscript{397} It is not really apparent why an incentive should be provided for obvious algorithms, except for the protection of their original expression (if any) under copyright.

A second fundamental issue is the qualitative standard to be applied in the sui generis system. Would originality be sufficient, such as in the current copyright protection, or should a higher standard be imposed, e.g., "hard work" or "brilliant work," as has been suggested?\textsuperscript{398} The "hard work" standard seems to imply a "sweat-of-the-brow" theory.\textsuperscript{399} The adoption of a "brilliant work" standard raises

\textsuperscript{392} See Samuelson, Benson Revisited, supra note 2, at 1150.

\textsuperscript{393} Id. at 1094.

\textsuperscript{394} Stern, Algorithm War, supra note 2, at 384-96. He only addresses the patent/sui generis interface and evidently presumes the copyright/sui generis interface will resolve itself under the merger doctrine. But see supra note 8.

\textsuperscript{395} Stern, Algorithm War, supra note 2 at 395. A test involving assumed knowledge of an algorithm is found in Flook, where the Court quotes and italicizes the following sentence from O'Reilly v. Morse, 55 U.S. (15 How.) 62, 115 (1854): "We think the case must be considered as if the principle being well known, the plaintiff had first invented a mode of applying it . . . ." The Flook Court added "mathematical formulas" to "principle." Parker v. Flook, 437 U.S. 584, 592 (1978).

\textsuperscript{396} This approach is reflective of the formalistic period of the law. See supra note 331. It is also reminiscent of John Chipman Gray's famous rule, in disregard of reality, that the Rule Against Perpetuities was to be "remorselessly applied." JOHN CHIPMAN GRAY, THE RULE AGAINST PERPETUITIES § 62a (4th ed. 1942).

\textsuperscript{397} Stern, Algorithm War, supra note 2, at 390-91, suggests amending the Patent Act or enacting utility model legislation, the essential features being a registration system, limited term (e.g. 10 years), and a different qualitative standard.

\textsuperscript{398} Robert Spinrad of Xerox Corp. has suggested two forms of coverage for computer software one for "hard work" and the other for "brilliant work." See Samuelson, Benson Revisited, supra note 2, at 1149. Samuelson favors sui generis protection "for minimally 'original' program source and object code . . . (Spinrad's 'hard work' coverage)." Id. at 1150. She also raises the possibility of protecting "brilliant work" according to a "modified patent approach" but questions the ability of the PTO to be up to the task. Id. at 1151.

\textsuperscript{399} In Feist Publishing Co. v. Rural Tele. Serv. Co., 111 S.Ct. 1282 (1991) the Supreme
even more interesting question.

Presumably, a “brilliant work” standard would be higher than a nonobvious standard of patent law for which in rem protection is granted.\(^{400}\) If “brilliant” can be equated with “revolutionary,” in the sense as described above of revolutionizing production or consumption patterns,\(^{401}\) then it should follow that society would want to provide relatively great incentives for the creation of such programs. Indeed, if the patent system is functioning as intended, “brilliant work,” such as Karmarkar’s Linear Program, which Stern indicates “is said to be the veritable \(E=mc^2\) of linear programming,”\(^{402}\) would be classified as revolutionary and theoretically should provide significant societal benefits in excess of costs. It may be anticipated that Bell Labs would have a greater incentive to invest in the development of such brilliant work when in rem protection can be obtained compared to some form of watered-down sui generis protection.\(^{403}\)

A critical issue in any sui generis system would be the scope of protection/infringement issue. One aspect of this issue is the permissible scope of reverse engineering, which is presently haunting the field.\(^{404}\) A related issue is the nature of the remedy to be provided for infringement. Would the sui generis right be treated as property in the patent or copyright sense, and would an injunctive remedy be available? Or would the sui generis right be treated as “quasi-property”\(^{405}\) or be subject to compulsory licenses?\(^{406}\)

The in rem property treatment of a patent, in particular, has proved troubling to many. For example, Stern would find it preferable for Bell Labs, as the owner of the Karmarkar patent, to license it (i.e., be compelled to license it) at a reasonable royalty rate rather than maintaining full exclusivity.\(^{407}\) If Bell Labs were forced to grant compulsory licenses, this would, of course, diminish the incentive for

\(^{400}\) It is not apparent whether the “brilliant work” standard would be higher or lower than the “flash of creative genius” test for patentability of Cuno Eng’g Corp. v. Automatic Devices Corp., 314 U.S. 84 (1941).

\(^{401}\) See supra text accompanying notes 80-84 (discussing revolutionary inventions).

\(^{402}\) Stern, Algorithm War, supra note 2, at 387.

\(^{403}\) See Oddi, Beyond Obviousness, supra note 12, at 1137-41 (proposing that such revolutionary inventions be granted augmented protection over utility patents).


\(^{405}\) This term was introduced into the common law branch of intellectual property when the Supreme Court upheld enjoining the copying of “hot” uncopyrightable news until the news has lost its value. International News Serv. v. Associated Press, 248 U.S. 215, 236 (1918).

\(^{406}\) See supra note 38 and infra note 409.

\(^{407}\) Stern, Algorithm War, supra note 2, at 387-88.
it to invest in the creation of such inventions, admitted to be of a brilliant/revolutionary type. It is far from established that society would benefit more from a system imposing compulsory licenses at a reasonable royalty compared to the incentive of exclusivity and the in rem treatment of the patent system.408

The question of the remedy to be afforded for intellectual property infringement has been considered by the Supreme Court several times in the last decade. In Dawson Chemical Co. v. Rohm & Haas Co., the Court observed that compulsory licenses were a rarity in the U.S. patent system and refused to order one for alleged patent misuse.409 In Sony Corp. v. Universal City Studios (the Betamax case), Justice Blackmun, in dissent, urged that it was not so much a question of right as one of the remedy, which should at least entitle the copyright owner to royalties if not an injunction against home copying of off-the-air television programs.410 There would thus appear to be no indication that the Supreme Court, at least in the near future, is likely to relax its property treatment of patents, although Congress has been more amenable to compulsory licenses with respect to certain activities under the Copyright Act.411

A word of caution may also be voiced concerning the adoption of sui generis systems of protection for so-called hybrid technologies, if anything is to be learned from the less-than-inspiring history of the Semiconductor Chip Protection Act.412 A great deal of time, effort and money was expended by interest groups and other advocates to convince a receptive Congress to solve what proved to be virtually a nonexistent problem.413 Technological advancements appear to have

408. See Bowman, supra note 44, at 243-49 (1973)(evaluating the effectiveness of compulsory license as a remedy for antitrust or misuse violations and concluding that such license might be used as a remedy "as a last resort" in the absence of other alternatives). For a recent study, see Mark W. Lauroesch, General Compulsory Patent Licensing in the United States: Good in Theory, But Not Necessary in Practice, 6 SANTA CLARA COMPUTER & HIGH TECH. L.J. 41 (1990).


412. The history of the SCPA is detailed in Risberg, supra note 387, at 254-260.

413. To date only one case has been decided under the SCPA, Brooktree Corp. v. Advanced Micro Devices, Inc., 757 F. Supp. 1088 (S.D. Cal. 1990) aff'd 977 F.2d 1555 (Fed. Cir. 1992). In this case the district court upheld a jury verdict of over $25 million for mask work infringement under the SCPA and patent infringement of three of plaintiff's patents. The court held that there was sufficient evidence for the jury to find that defendant had not proven its reverse engineering defense.
left whatever copyists there may have been in the lurch, and chip designers presently appear to find patents a congenial title of protection.  

This is not to say that there is not considerable merit in a finely tuned sui generis system of protection for computer programs, as would also be the case for all other fields of technology, e.g., separate titles for genetics, pharmaceuticals, oil prospecting, pollution control, etc. Certainly, a title of protection specifically devised to meet the needs for inducing developments in the respective technical fields at exactly the right level of incentive, with the right scope of protection (including the duration) would be ideal for optimizing benefit. Unfortunately, devising such systems with any degree of certitude of result appears beyond the present state of knowledge, even if political consideration could be disregarded. Thus, to attack the refusal to change the status quo and urge the adoption a sui generis system requires a leap of faith to believe that a substitute sui generis system will provide greater benefits than costs compared to the title or titles of protection that it preempts.

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Plaintiff was entitled to prejudgment inteval for patent infringement but not under the SCPA. 757 F. Supp. at 1099. The district court then conditioned plaintiff's recovery of prejudgment interest for patent infringement upon whether "it can successfully segregate the damage award between the patent and mask work damages." Id. at 1100. Such an allocation may prove difficult if the mask work registration provides only redundant coverage to the patents. The Federal Circuit affirmed both the jury verdict and district court rulings that an extensive paper trail does not incontrovertibly prove the originality of the end product or the absence of copying to establish a reverse engineering defense under the SCPA. Brooktree Corp. v. Advanced Micro Devices, Inc., 977 F.2d 1555 (Fed. Cir. 1992).

The following reasons have been offered for the lack of reliance on the SCPA: current sophisticated chip designs do not lend themselves to direct copying; greater availability of licenses to competitors; improved climate for patent protection; and the availability of computer-aided design for chips and reduced incentive to copy because of an increasing market for semicustom chips. See, Risberg, supra note 387.

The number of applications under the SCPA has remained approximately constant at about 1000-1200 per year. U.S. Copyright Office, FEDERAL STATUTORY PROTECTION FOR MASK WORKS, Circular 100 (April 1991)(attachment). Chip designers appear to be relying on patents to protect their specialized processes. See Risberg, supra note 387, at 263-69.

The need for such sui generis protection may be based on the degree of uniqueness or the relative importance of the subject matter or perhaps the clout of a particular interest group.

See Machlup, supra note 11 (citing economic studies on optimal duration).

See supra note 72 and accompanying text.

Compare Samuelson's position:

Apart from the conceptual integrity that a sui generis law would finally introduce to intellectual property law as applied to computer programs, a key advantage of sui generis legislation is that it would be accompanied by an increased certainty in the field about what is and is not protected.
The current agnostic approach may not produce optimal benefits in the short or even the long run, but it has been evolving in a period of extraordinary technological growth. The common law method takes a great deal of time to fill in the contours of any field of law, including statutory interpretation as in copyright and patent law. On the other hand, if Judge Posner is correct and the common law eventually produces efficient results, this method may well be the desirable way of dealing with the problem of defining the parameters of patent and copyright protection for computer programs. This is especially so when there are no clear indications that the present approach to protecting computer programs is producing the dire consequences that certain spokespersons for the software industry and advocates of sui generis protection have asserted. Presumably, both the patent and copyright systems have served this nation well for over two hundred years. It is hardly demonstrable that the development of computers and computer programs over the last four decades would

and under what conditions protection is available. It is unfortunate that so many intellectual property lawyers are content to wait decades for the existing laws to be applied in a case-by-case fashion so that the contours of the law of software protection will be revealed by the "genius" of the common law. Firms in the software market today are probably less than pleased at the prospect of being the guinea pigs in this common law process and want to know the answers to protection questions now. Unfortunately, the answer they get now will depend on which lawyer they ask.

Benson Revisited, supra note 2, at 1152-53 (footnote omitted).

419. No cause and effect relationship is claimed between this growth and the "agnostic approach" for fear of Hydra growing a new head. See supra text accompanying notes 346-355.

420. As concluded by Posner: "Although the correlation is far from perfect, judge-made rules tend to be efficiency promoting while those made by legislatures tend to be efficiency-reducing" (footnotes omitted). POSNER, ECONOMIC ANALYSIS, supra note 53, at 495. Although patents are created by statute, the rule that computer programs or algorithms are patentable subject matter is a judge-made one in the absence of a specific statutory rule.

Posner makes the argument that inefficient rules are likely to be litigated in order to reach an efficient result. Insufficient interest and stare decisis may stand in the way of this. Id. at 522-28. The same can be said for the interpretation of a statute. A particular interpretation may be challenged until finally decided, hopefully in an efficient manner. But see id. at 500-07, (concerning statutory interpretation). This would seem to suggest that the interpretation of statutory subject matter and infringement should be left to the courts in a common law capacity rather than having the legislation reach a political compromise based when the relative power of the interest groups.

Posner also indicates that the costs of legislative enactments are high, but suggests that sometimes the benefits may exceed the costs by having narrow rules. Id. at 512-14. See supra note 387 (indicating the number of years required to enact intellectual property legislation).

421. See supra note 350 (indicating projected growth of the software industry to the new century). There are also the qualitative and cost barriers to the acquisition of patents.
have been better served by a sui generis system; whether the next generation would be better served is pure speculation.

IV. CONCLUSION

An attempt has been made in this article to analyze the relative benefits and costs of the current protection afforded computer programs by the copyright and patent systems. The conclusion drawn from this comparative analysis is that the economic case for copyright protection of computer programs is somewhat uneasier than is that for patent protection.

The conclusion is also drawn that no easier case can be made for the preemptive protection of computer programs by copyright or by a sui generis system on the basis of the legal and policy arguments made against patent protection. In this context, Professor Machlup's classic study of the patent system may provide some helpful insight. Machlup concluded that, if a patent system already exists, it would be irresponsible, on the basis of present knowledge of its economic consequences, to recommend terminating it; on the other hand, if one did not exist, it would be irresponsible for the same reason to recommend instituting one.422 Accordingly, although it may be quite responsible to advocate that the protection of computer programs (or other particular forms of technology) be preempted by an existing title of protection or that a sui generis system be created for such protection, far less than a compelling case has been made to date for those propositions.

422. Machlup, supra note 11, at 80.