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REDEFINING THE LIMITS OF COPYRIGHT LAW
AFTER NEC v. INTEL

I. INTRODUCTION

The Copyright Act\(^1\) has been continually adapted to serve new forms of creative expression. Whereas original copyright law protected only maps, charts, and books,\(^2\) it now encompasses sound recordings, motion pictures, and photographs.\(^3\) In 1980, Congress took a decisive step in amending the Copyright Act to bring computer software programs within the ambit of the statute.\(^4\) Unlike traditional subject matter, computer software programs do not communicate to human beings. Instead, these programs direct the computer to proceed through predetermined functions.\(^5\) Since Congress had, until 1980, limited the application of copyright protection to works that were both expressive and non-utilitarian,\(^6\) the recent extension of copyright protection to computer technology has raised complicated issues of policy. Chief among these issues is whether copyright protection is the correct mechanism by which to protect computer programs and whether such protection furthers the essential purpose of copyright law: to encourage the free dissemination of scientific ideas and information for the advancement of science and the arts. Courts, however, have not adequately addressed these questions. They have neglected substantive policy issues and have instead focused exclusively on interpreting the literal words of the statute.

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3. The subject matter of copyright includes literary, musical, dramatic, choreographic, pictorial, graphic, and sculptural works, motion pictures and other audiovisual works, and sound recordings. 17 U.S.C. § 102(a) (1982).
4. The law that extended copyright protection to machine-readable programs was § 10, subd. (a), (b) of the Act of Dec. 12, 1980, Pub. L. No. 96-517, 94 Stat. 3015, 3028 (codified at 17 U.S.C. §§ 101, 117 (1982)) [hereinafter Copyright Act]. The copyright amendments involved the addition of computer program to § 101, the definitional section of the Copyright Act, and the substitution of a new § 117 that gave owners of copyrighted programs a limited right to modify and to make archival copies of the computer programs.
5. See infra notes 85-97 and accompanying text (explaining the nature and function of computer programs).
Most recently, a federal district court in *NEC Corp. and NEC Electronics, Inc. v. Intel Corp.* brought microcode within the protection of the Copyright Act. In extending copyright protection to microcode, the *NEC* court reasoned that microcode falls within the definition of "computer program" provided by the 1980 amendment to the Act: "a set of statements to be used directly or indirectly within a computer to bring about a certain result." Although microcode may be considered such a "set of statements," it also controls the basic functions of the computer and is decidedly more functional than the software programs contemplated by Congress in 1980. Thus, *NEC v. Intel* signified an abandonment of the traditional notions of nonutility and expressiveness used in applying copyright law to particular types of subject matter—all in an effort to protect a form of new technology.

This Comment explores whether microcode properly belongs within the scope of the Copyright Act. Part II provides a background of the traditional tenets of copyright law and traces the movement of Congress and the courts away from expressiveness and nonutility in copyright subject matter. The background examines Congress' decision to extend copyright protection to software and finds the decision was largely influenced by the recommendation of the National Commission on New Technological Uses of Copyrighted Works (CONTU), a commission that failed to adequately assess the utilitarian nature of computer programs. The Comment next discusses the *NEC v. Intel* decision and the negative policy implications of extending copyright protection to utilitarian and unexpressive subject matter.

The Comment concludes by proposing an alternative scheme of legal protection for microcode. The proposed sui generis law preserves the integrity of copyright law by explicitly removing microcode from the scope of the Copyright Act. Further, it attempts to strike a balance between serving the public and protecting the efforts of the individual microcode author by requiring a greater degree of disclosure from authors and by granting legal protection of a shorter duration than that offered by the Copyright Act. In all, the proposal aims to protect this unique technology while preserving the

8. The case was originally heard by Judge Ingram, Northern District Court of California. *Id.* at 593. Judge Ingram subsequently resigned from the case due to a conflict of interest, and all rulings were vacated. The case was then reassigned to Judge Gray, Central District of California. Trial began in April 1988 but was continued until June 1988.
traditional objectives of copyright law.

II. PRESENT LAW AND TRADITIONAL PRINCIPLES

The 1980 amendment to the Copyright Act was Congress' answer to the call of a rapidly expanding computer industry for protection of its innovations and discoveries. Computer programs fit neatly under neither patent nor copyright law. They lack the novelty demanded by the patent statute, and the courts have struggled to answer whether the programs constitute the "works of authorship" protected by the Copyright Act. In 1973, Congress appointed CONTU to examine whether computer programs fell within the scope of existing laws. The commission concluded that computer programs belonged within the ambit of the Copyright Act and endorsed an amendment explicitly listing the programs as copyrightable subject matter. Some commentators, however, consider CONTU's decision a "forcible wrenching" of computer technology—subject matter patently unlike that traditionally covered by the Copyright Act—into the words of the statute and a deviation from traditional copyright notions of expressiveness and nonutility.

A. Traditional Principles

Copyright law has been compared to a simple bargain in which the interest of the individual and that of the public coincide. The individual derives an economic benefit from holding exclusive rights over his or her expression, and the public benefits from its use of the ideas and information the copyrighted expression conveys. Al-

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10. 17 U.S.C. § 102(a) reads, in pertinent part: "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 communicated, either directly or with the aid of a machine or device." Id.


13. See Hearings on Copyright and Technological Change Before the House Judiciary Subcommittee on Courts, Civil Liberties and the Administration of Justice, 98th Cong., 1st Sess. 60 (1983) ("Copyright is an amalgam of property law principles bent to the service of a rather simple bargain. A limited term of protection against copyright is granted to an author's original expression in exchange for the dedication of that expression to the domain at the end of the term." Id.).

though one may argue the sole purpose of copyright law is to provide incentive for authorship, Congress historically has granted exclusive ownership rights, whether by patent or copyright, only when doing so has conferred a benefit on the public as well as the individual. In fact, both legislative and judicial history clarify that the public is to be considered the primary beneficiary of the social bargain. The Joint Conference Committee of the House and Senate has stated with respect to copyright protection: “Although a copyright belongs to an author during its term, the ultimate purpose of this bargain is not to protect the authors but rather to enrich the public domain.”

The United States Supreme Court similarly asserted in Sony Corp. v. Universal City Studios: “The copyright law, like the patent statute, makes rewards to the owner a secondary consideration.”

Both patent and copyright law requirements operate to preserve this social bargain. Under patent law, an inventor must reveal the process of making and using the invention as *quid pro quo* for exclusive rights over the invention. This comprehensive disclosure, coupled with a relatively short, 17-year, term of protection, assures the public its freedom to practice an art that has not become obsolete by the end of the term.

Copyright law likewise demands a *quid pro quo*: namely, that

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15. The Constitution states that the purpose of granting exclusive rights to authors and inventors is “[t]o promote the Progress of Science and useful Arts.” U.S. CONST. art. I, § 8, cl. 8.

16. H.R. REP. No. 781, supra note 14, at 5759. In fact, The United States Supreme Court has consistently treated copyright law as a social policy tool rather than as a natural right. See, e.g., Justice Stewart’s opinion in Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 156 (1975) (stating that “the immediate effect of our copyright law is to secure a fair return for an ‘author’s’ creative labor. But the ultimate aim is, by this incentive, to stimulate artistic creativity for the public good.”) (emphasis added)); See also H.R. REP. No. 781, supra note 14, at 5753 (the Joint Conference Committee of the House and Senate expressing a similar view: “The monopoly privileges that Congress may confer are neither unlimited nor are primarily designed to provide a private benefit. Rather, the limited grant is a means by which an important public purpose may be achieved.”) (emphasis added)).


18. Id. at 429 (quoting Fox Film v. Doyal, 286 U.S. 123, 127 (1923)).

19. An inventor must submit a specification with the patent application. 35 U.S.C. § 111 (1982). The specification must 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 is most clearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention. Id. § 112.

20. Id. § 154.
the protected matter itself disclose ideas and information to the public. This disclosure requirement is implied by section 102, which requires that works of authorship be fixed in any tangible "medium of expression" from which they can be perceived, reproduced, or "otherwise communicated." "Medium of expression" indicates any literary, musical, graphic, or artistic form in which the author expresses intellectual concepts. The form may be one not contemplated at the time the Copyright Act was enacted, but at a minimum, it must be tangible, thereby permitting the work of authorship to be perceived. In other words, the Copyright Act confers copyright protection only to works that ultimately communicate ideas and information to a human audience.

This dissemination of ideas and information is central to copyright law. As the Supreme Court stated in Baker v. Selden, "[t]he very object of publishing a book . . . is to communicate to the world the useful knowledge which it contains."

The Copyright Act, in fact, does not demand novelty or ingenuity of expression; rather, its aim is to draw into the public domain an abundance of expressions, targeting a wide variety of audiences with differing tastes. As the Court concluded in Twentieth Century Music Corp. v. Aiken, the copyright law "must ultimately serve the cause of promoting broad public availability of literature, music, and the other arts."

In addition to disclosure, or "expressiveness," the Copyright Act demands that the works of authorship be non-utilitarian: they must

21. "Copyright protection subsists . . . in original works of authorship fixed in any tangible medium of expression known or later developed, from which it can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device." 17 U.S.C. § 102 (1982).
22. H.R. REP. NO. 1476, supra note 2, at 5 ("[Copyright] pertains to the literary, musical, graphic, or artistic form in which the author expressed intellectual concepts.").
23. The Copyright Act refers to tangible mediums of expression now "known or later developed." 17 U.S.C. § 102 (1982). In drafting the bill, Congress did not want to freeze the scope of copyrightable subject matter at the present stage of communications technology. H.R. REP. NO. 1476, supra note 2, at 3.
24. H.R. REP. NO. 1476, supra note 2 ("The work of authorship must be embodied in a form sufficiently permanent or stable to permit the work to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration.").
26. Goldstein, Infringement of Copyright in Computer Programs, 47 U. Pitt. L. REV. 1119, 1123 (1986) ("Literature and the arts are centrifugal, aiming at a wide variety of audiences with different tastes. . . . The aim of copyright is to direct investment toward abundant . . . expression.").
27. 422 U.S. 151, 156 (1975).
28. See H.R. REP. NO. 781, supra note 14, at 5757 (referring to the prohibition against copyright in useful articles as a "fundamental principle" of copyright law).
not have an intrinsic function other than to depict the appearance of the article or convey information. Section 102 of the Copyright Act expressly prescribes that although an expression may be protected, any idea, procedure, process, system, method of operation, concept, principle, or discovery described by the expression may not. This prohibition against copyrights in utilitarian articles preserves the integrity of patent law by denying protection to useful articles that do not meet the standards of inventiveness and novelty set by the patent statute. Patent law protects only true inventions; copyright law, on the other hand, imposes no such requirement of novelty or ingenuity. Conferring copyright protection on utilitarian articles, then, would allow wholesale circumvention of the more demanding requirements of patent law.

Courts traditionally have respected both the expressiveness and nonutility requirements set forth by the copyright statute. They have emphasized disclosure and dissemination of an author's ideas as the immediate aim of copyright law and have drawn careful distinctions between the expressive and utilitarian features of works of authorship presented for copyright protection. In Mazer v. Stein, the Supreme Court held that copyright protection extends only to those features of a utilitarian object that can independently exist as copyrightable works. In considering whether a sculpted lamp base should receive copyright protection, the Court limited copyright protection to the lamp's statuette (the only expressive feature) and denied copyright protection to the wiring (the utilitarian feature).

The extension of copyright protection to computer programs in 1980 disturbed these settled principles, as computer programs are

29. The Copyright Act defines a "useful article," to which it explicitly denies protection, as "an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information." 17 U.S.C. § 101 (1982). An expressive article, then, does no more than portray its appearance or convey information.

30. 17 U.S.C. § 102(b) reads in full: "In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery regardless of the form in which it is described, explained, illustrated, or embodied in such work." Id. In contrast, the patent law protects any new and useful process, machine, manufacture, or composition of matter. 35 U.S.C. § 101 (1982).

31. Again, only a "new and useful process, machine, manufacture, or composition of matter" may be patented. Id. Moreover, subject matter offered for patent protection must be non-obvious, or sufficiently different than prior art. Id. § 103.

32. H.R. REP. NO. 1476, supra note 2, at 1 ("[The copyright] standard does not include requirements of novelty, ingenuity, or aesthetic merit.


34. 347 U.S. 201 (1954).

35. Id. at 217-18.
both utilitarian and unexpressive. The sections below describe how legislative and judicial migration from traditional copyright principles was largely premised on an under-estimation both of the utilitarian nature of computer programs and of the consequences resulting from their inclusion in the Copyright Act.

B. The Nature and Function of Computer Programs

The computer is predominantly a decision-making machine that responds to changes in internal voltage levels in order to execute the series of steps necessary to solve predetermined problems. The computer's decision-making process is surprisingly familiar. Consider the decisions a taxpayer must make in computing taxable income. Internal Revenue Form 1040 instructs the taxpayer to compare an amount entered on line 67 of the form to the amount entered on line 59. If the amount on line 67 is greater than the amount on line 59, the taxpayer must enter the difference on line 68. If instead the amount on line 67 is less than the amount on line 59, the taxpayer must enter the difference on line 71. These decisions are based on a computation (the addition of values entered on lines 59 and 67) and a simple condition (if line 67 is greater than line 59, that amount must be entered on line 68; if line 67 is less than line 59, that amount must be entered on line 71).

A computer programmer can represent this same set of instructions as an algorithm, which in turn is either engrafted upon the computer hardware or implemented as a software program. Using a flow chart as a graphical blueprint for constructing the hardware circuitry or software program, the programmer can instruct the computer to perform the mathematical calculations required by


38. Patterson, supra note 36, at 50-51 (explaining how a computer can be programmed to complete Internal Revenue Service Form 1040).

39. The Dictionary of New Information Technology 157 (2nd ed. 1986) (defining an algorithm as "a procedure, or rule, for the solution of a problem in a finite number of steps" Id.).

40. Before the programmer writes any code, he or she develops the program flow logic, the logical sequence of steps the program will perform to accomplish its functions. See R. Banks & A. Doupnik, Introduction to Computer Science ch. 3 (1976).
Form 1040 and store the results at specific addresses in the computer's memory. The programmer can then direct the computer to compare the appropriate sums and, based on that comparison, either execute the steps necessary to determine the amount of taxes overpaid or underpaid.

As mentioned, the programmer can implement the algorithm in either hardware or software. In fact, early computers were comprised entirely of hardware, and in order to alter the sequences of high- and low-voltage impulses that direct the computer, programmers had to actually rewire it. Software introduced an alternative to this cumbersome rewiring process by permitting programmers to represent the desired electronic impulses symbolically. Thus, a programmer may now alter the operations performed by the computer either by restructuring the hardware circuitry or, more simply, by changing the software instructions.

Initially, programmers could write programs only in binary code, with "1"s and "0"s representing high- and low-voltage impulses, respectively. The advent of computer languages such as FORTRAN, BASIC, and COBOL made programming easier by substituting the strings of "1"s and "0"s with commands written in the English language. Most programmers write software in these more accessible languages, or "source code," but computers can only comprehend "object code," the series of electrical impulses executed within the computer that direct the computer through the desired decision-making process. Physical compilers and translators

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41. Patterson, supra note 36, at 50. The computer's memory is a device which retrieves data, holds and, at a later time, returns data. Various phenomena, such as electrostatic, magnetic, electrical, and mechanical, are used to effect memory. Standard Dictionary, supra note 36, at 328.

42. Rewiring the first general purpose electronic computer, pioneered in 1946, was done by setting thousands of switches and plugging in hundreds of cables, hand by hand, one at a time. Its pioneers called it a "one way ticket to a madhouse." S. Augarten, Bit by Bit: An Illustrated History of Computers 128 (1984).


44. An example of a BASIC instruction is "GOTO 150," which causes the computer to carry out the instruction on line 150 of the program. Stern, Another Look at Copyright Protection of Software: Did the 1980 Act Do Anything for Object Code?, 3 Comp. L.J. 1, 2 n.5 (1981).

45. CONTU Report, supra note 11, at 76 n.109 (1981) (referring to "source code" as a computer program written in any of several programming languages employed by computer programmers).

46. Every program is eventually reduced to object code, which is expressed in binary (base 2) numbers, as a series of "0"s and "1"s that represent open and closed switches within the computer's circuits. Object code, in either its binary form or in the silicon chip form, is not
within the computer translate the source code into the object code.

C. CONTU's Recommendation to Congress

In considering whether the Copyright Act should be amended to include computer programs, CONTU failed to appreciate that the sole function of computer programs is to direct the physical workings of the computer. This failure turned out to be a fatal error. In its report to Congress, CONTU offered Congress several reasons for bringing computer programs within the Copyright Act: (1) computer programs are valued highly by society;\(^{47}\) (2) programs are relatively easy to copy;\(^ {48}\) and (3) trade secret and patent laws are unfeasible forms of protection.\(^ {49}\) CONTU premised its recommendation on a belief that extending copyright protection to computer programs would comport with both the spirit of the Constitution and the language of the Copyright Act, reasoning that the Copyright Act has been continually expanded to accommodate changes in communication technology, such as the advent of motion pictures, and concluding that its further adaptation to computer technology would comply with constitutional mandate.\(^ {50}\)

Although CONTU's majority correctly stated that the Copyright Act has an expansive history, it failed to note that its scope prior to 1980 was only broadened to include subject matter that communicates to human beings. Dissenting members of the committee quickly pointed to this weakness in the majority report. Commissioner Hershey wrote:

> Copyright has always protected the means of expression of various forms of “writing” which were perceived, in every case, by the human sense for which they were intended: written words by the human eye, music by the ear, paintings by the eye. Here, for the first time, the protection of copyright would be offered to a “communication” with a machine.\(^ {51}\)

Commissioner Hershey argued that, although programmers may read each other’s preparatory writings, the programs cease to be “expressive” once software instructions are embodied in a silicon designed to be read by humans. It is the machine’s language. Apple Computer, Inc. v. Franklin Computer Corp., 545 F. Supp. 812, 814 (E.D. Pa. 1982), rev’d, 714 F.2d 1240 (3d Cir. 1983).

47. CONTU Report, supra note 11, at 56.
48. CONTU Report, supra note 11, at 58.
49. CONTU Report, supra note 11, at 68-71.
50. CONTU Report, supra note 11, at 67.
51. CONTU Report, supra note 11, at 101.
chip. He wrote: "If a skilled programmer can 'read' a program in its mature, machine-readable form, it is only in the sense that a skilled home-appliance technician can 'read' the equally mechanical printed circuits of a television receiver."\(^{53}\)

Besides failing to note a difference between matter that communicates with human beings and that which communicates solely with machines, CONTU also misread the Copyright Act as unambiguously applying to computer programs.\(^ {53}\) Again, the Copyright Act, which Congress most recently amended in 1976, extends copyright protection only to "works of authorship fixed in a tangible medium of expression." CONTU argued copyright protection attaches at the moment instructions written in program language (the work of authorship)\(^ {54}\) become fixed onto a ROM chip (the tangible medium of expression).\(^ {55}\) However, CONTU never considered whether ROM chips, which Commissioner Hershey deemed to be as "readable" as printed circuits, are in fact a medium of expression. The majority instead appeared satisfied that ROM's are a "tangible medium of expression" merely because they are "tangible." It never asked, however, whether ROM's are indeed "expressive" and ultimately serve to disseminate the ideas and information embodied in the program, the purported "work of authorship."

Commissioner Nimmer suggested in his concurrence that Congress could fulfill the "expressiveness" requirement by limiting copyright protection to programs that produce independently copyrightable works.\(^ {56}\) Computer games, which produce a relatively static video image that resembles a conventional photograph, are an example of such a work.\(^ {57}\) However, the majority dismissed this distinction between programs that do and those that do not produce expressive output and recommended copyright protection for all computer programs, including those programs that provide little or no overt

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52. CONTU Report, supra note 11, at 90.
53. The majority seemed confident that its conclusions were demanded by the words and history of the 1976 Copyright Act. See CONTU Report, supra note 11, at 71-78. Commissioner Hersey, however, believed that the 1976 Copyright Act could not be clear on the issue of computer programs, if only because the conventional terms of the statute (e.g., "copy," "tangible means of expression") were inappropriate to the new technology. See CONTU Report, supra note 11, at 93-97.
54. CONTU Report, supra note 11, at 76.
55. CONTU Report, supra note 11, at 57.
56. CONTU Report, supra note 11, at 85 (stating that it may prove desirable to limit copyright protection for software to those computer programs that produce works which themselves qualify for copyright protection).
57. Compare a computer game with, for example, a wordprocessing program, which produces a video image that continually changes with the introduction of new data.
communication to the computer user. It reasoned that the ultimate use to which computer programs are put is irrelevant, contending that computer programs satisfy the requirements of the Copyright Act once software instructions become fixed onto ROM. The majority also argued that copyrights traditionally have been extended to works of authorship, regardless of their ultimate use.  

However, the majority rested its conclusion on the faulty assumption discussed above: that ROM's are "mediums of expression." Moreover, the majority failed to recognize that, unlike traditional subject matter such as books, computer programs are not expressive in their own right, but become so only upon producing expressive output. Programs operating traffic signals, for instance, can be viewed as utilitarian machine processes to which the Copyright Act expressly denies copyright protection. Contrary to the majority's assertions, then, the ultimate use to which a computer program is put is indeed critical.

In addition to its failure to accurately assess whether computer programs are expressive, the CONTU majority never determined whether, notwithstanding any expressive output, they are too utilitarian under the proscriptions of the Copyright Act to be properly brought within the statute. Commissioner Hershey argued: "the program itself, in its mature and useable form, is a machine-control element, a mechanical device, having no purpose beyond being engaged in a computer to perform mechanical work." The majority rebutted the assertion that the program is utilitarian by stating that copyrights will not be denied simply because an object has some utilitarian aspect. Although, as the majority correctly noted, courts generally do not refuse copyright protection on grounds that an object possesses some utilitarian features, courts do limit protection to the expressive features alone, and only to the extent those features can be identified separately from, and are capable of existing inde-

58. The CONTU majority states: This distinction between [those computer programs that do and do not lead to copyrighted output] is not consistent with the design of the Act of 1976, which was clearly to protect all works of authorship from the moment of their fixation in any tangible means of expression. Further, it does not square with copyright practice past and present, which recognizes copyright protection for a work of authorship regardless of the uses to which it may be put.

CONTU Report, supra note 11, at 75-76.

59. CONTU Report, supra note 11, at 87.

60. CONTU Report, supra note 11, at 76 ("Nor has copyright been denied to works simply because of their utilitarian aspects.").
pendently of, the utilitarian aspects of the object. The CONTU majority failed to answer whether, or which, computer programs have independent, expressive features.

In sum, the CONTU report reveals a lack of reverence for the expressiveness and nonutility requirements of copyright law. This disregard for traditional copyright tenets was perpetuated by Congress in 1980 when it adopted CONTU's recommendation and amended the Copyright Act to include computer programs. As discussed below, courts subsequently interpreting the 1980 Copyright Act generally have not questioned the wisdom of Congress' decision to amend the statute. Instead, they have focused almost exclusively on construing the term "computer program" as defined by the Copyright Act and have neglected broader questions of policy. The court in Apple Computer, Inc. v. Franklin Computer, for instance, extended copyright protection to a computer program written in object code, which is unintelligible to human beings. Other courts have extended copyright protection beyond the computer program to the result the program was designed to achieve, or to the program's utilitarian function.

D. The Courts and the 1980 Amendment

The 1980 amendment defines a computer program as "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." Initially, courts considered this language as covering only those programs written in source code, such as FORTRAN. The third circuit court in Apple Computer, however, broadened the definition to include programs expressed in object code, which is a machine-readable language unintelligible to human beings.

In conferring copyright protection to object code, the court rejected the lower court's argument that works must be intelligible to human beings in order to be worthy of copyright protection. The court seems to have concluded that the 1976 amendment to the

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63. See infra notes 71-78.
65. 714 F.2d at 1248. Programmers typically write software in source code, and as discussed, translators or compilers translate the source code into the machine-level language the computer can execute. The result of the translation is an electromagnetic configuration that can be symbolized in binary number form as a series of "0"s and "1"s. This manifestation of the program is the object code. R. Nimmer, The Law of Computer Technology 1-13 (1985).
Copyright Act, which extended copyrights to works of authorship fixed in any tangible medium of expression from which they can be perceived either directly or "with the aid of a machine or device," discarded the requirement that subject matter communicate to human beings. The court also considered the inclusion of computer programs in the Copyright Act as a clear indication that Congress intended to confer copyright protection to all computer programs, regardless of whether they are expressed in source code or machine language.

However, the 1976 amendment was merely intended to bring records and audio tapes, which operate in "machines or devices," within the Copyright Act and plainly emphasizing ultimate perception of an author's work by a human audience. Moreover, CONTU and, by extension, Congress did not unequivocally consider object code a proper subject of copyright. CONTU, in its report to Congress, mentioned object code only in one conclusory statement and was clearly divided on whether copyright protection should extend to machine-level language. Commissioner Hershey in fact urged that all computer programs be denied copyright protection and Commissioner Nimmer advocated copyright protection only for those programs that create copyrightable works. Both Commissioner Hershey and Nimmer, then, argued the Copyright Act should not apply to programs that do not produce communication to a human audience.

Based on its misapprehension of legislative intent, the Apple Computer court limited its inquiry to the issue of whether object code falls within the definition of "computer program," concluding that, as "sets of statements" used "directly" in a computer in order to bring about a certain result, it does. By focusing exclusively on semantics, however, the court failed to address whether protection of machine-level language, undecipherable by human beings, promotes the underlying objective of copyright law: to encourage the "free dissemination of ideas and information." In so doing, the court refuted the traditional requirement that subject matter be expressive.

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66. *Apple Computer*, 714 F.2d at 1248. The court stated, "[t]he answer to defendant's contention [that copyrightable works must be intelligible to human beings] is in the words of the statute itself." *Id.*
67. *Id.*
69. The *Apple Computer* court stated: "[The CONTU majority] clearly took the position that object codes are proper subjects of copyright." 714 F.2d at 1248.
70. CONTU Report, *supra* note 11, at 76 ("Flow charts, source codes, and object codes are works of authorship in which copyrights subsist. . . .").
71. 714 F.2d at 1248.
Other courts have also neglected the nonutility requirement. As the following cases illustrate, it is often inherently difficult, if not impossible, to extend copyright protection to computer programs without also protecting an underlying idea, process, or procedure. The Copyright Act protects only expressions. Thus, the scope of a copyright depends on what a court deems as the computer program's "expression." Courts can either limit the protected "expression" to the precise line-by-line program code or, instead, extend the definition to include the logic, design, structure, performance, or output of the computer program. Courts generally have leaned toward a broad interpretation of "expression" that includes the actual processes implemented by a program.

In *Whelan Associates, Inc. v. Jaslow Dental Laboratory, Inc.*, both the plaintiff and defendant developed a computer program intended for use in dental laboratories. However, they wrote their respective programs in different source codes: the plaintiff in EDL and the defendant in BASIC. In developing a program that accomplished the same task as the plaintiff's, the defendant did not simply translate the plaintiff's program into one written in EDL. Such a direct translation is virtually impossible. Instead, the defendant studied the manner in which the computer employing the plaintiff's program received, assembled, calculated, held, retrieved, and communicated data. Once the defendant understood the process underlying the program, he wrote his own computer program.

Although the defendant did not copy the plaintiff's program by translation, the court nevertheless found him guilty of copyright infringement. In reaching its conclusion, the court reasoned that the copyrightable "expression" of software programs embodies the manner in which the programs operate, control and regulate the computer in receiving, assembling, calculating, retaining, correlating, and producing useful information. The Whelan court's broad interpretation, however, would allow a court to extend copyright protection to the logic underlying the computer program.

Similarly, the court in *Williams v. Arndt* granted broad copyright protection, suggesting that infringement can occur simply where programs achieve similar results, regardless of whether similarity exists between program codes. In Williams, the defendant de-

73. Id. at 1320 ("The evidence establishes that it would be very difficult if not impossible to literally translate a program written in EDL to a program written in BASIC.").
74. Id.
developed a computer program designed to perform commodities trading according to the step-by-step method explained by the plaintiff in his book. In concluding that the defendant had impermissibly copied the plaintiff’s book, the court clearly used copyrights to protect a method, as opposed to merely an “expression,” or the plaintiff’s particular explanation of the commodities trading method.

Finally, the court in *SAS Institute v. S & H Computer Systems, Inc.*, stressed that a mere similarity in “overall structure” between one computer program and another could constitute infringement. There, the court found infringement, although only 44/186,000ths of the code constituting the defendant’s program resembled the code comprising the plaintiff’s program.

Under a traditional construction of the Copyright Act, none of these rulings are permitted since section 102 unambiguously denies copyright protection to any idea, procedure, process, system, method of operation, concept, principle, or discovery underlying a copyrightable expression. This distinction between a copyrightable expression and an uncopyrightable idea, method, or process was articulated by the Supreme Court in *Baker v. Selden*. There, the Court denied copyright protection to a set of forms supplied with a book describing the plaintiff’s bookkeeping method, because those very forms had to be used in order to employ the bookkeeping method. In denying copyright protection to the forms, the Court reasoned that protecting the forms would effectively confer a monopoly over the bookkeeping method itself. The Court wrote: “The description of the art in a book, though entitled to the benefit of copyright, lays no foundation for an exclusive claim to the art itself. The object of the one is explanation; the object of the other is use. [Only] the former may be secured by copyright.”

However, this distinction between “the book, as such, and the art it is intended to illustrate” becomes impossible when the work of authorship is a computer program. Unlike a recipe, or any work that instructs people on how to accomplish a task, computer programs do the task. They embody both the expression and the art. In many instances it is impossible to protect so little as the line-by-line program without also protecting an underlying idea or process. If copyright protection extends to a method of achieving a certain re-

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78. 101 U.S. (Otto 11) 99 (1879).
79. Id. at 105.
80. Id. at 104.
suit, innovators are precluded from creating programs that differ in
detail, but which implement and perhaps improve on existing com-
puter programs. Thus, broad copyright protection ultimately frus-
trates, rather than promotes, the development of science and the arts.

In sum, courts interpreting the Copyright Act have dismissed
the expressiveness and nonutility requirements traditionally de-
manded by copyright law. Courts have not required meaningful
communication to human beings and have extended copyright pro-
tection to ideas, methods, and processes. NEC v. Intel threatens a
continued progression towards utility and lack of expressiveness in
copyright subject matter.

III. Present Law and Microcode

The physical similarities between microcode and computer pro-
grams currently protected by the Copyright Act tempt an extension
of copyright by analogy. In fact, the court initially considering NEC
v. Intel based its decision to grant copyright protection for
microcode largely on the physical similarities between
microprograms and software programs. However, by focusing on a
comparison of physical similarities, the court lost sight of copyright
policy and failed to examine the probable consequences of extending
copyright protection to microcode.

Copyright protection of some software has resulted in protection
of processes underlying the programs. Since microprograms consti-
tute an integral part of the microprocessor, copyright protection in
this instance would effectively confer exclusive rights over the ma-
chine itself. Before granting copyright protection to microprograms,
the courts should consider the substantive policy issues and redirect
the present course of copyright law.

A. NEC v. Intel: The First Round

In December 1984, NEC Corporation and its California sub-
sidiary brought an action against Intel Corporation seeking a decla-
ration that the microcode portion of the Intel 8086/8088

81. Id. at 103 ("The very object of publishing a book on science or the useful arts is to
communicate to the world the useful knowledge which it contains. But that object would be
frustrated if the knowledge could not be used without incurring the guilt of piracy of the
book.").

82. Again, the case was originally heard by Judge Ingram, Northern District Court of
California, who later disqualified himself on conflict of interest grounds.
microprocessor is not subject to copyright protection.\textsuperscript{83} The dispute arose from a previously amicable relationship between the two companies that began in 1976 when they entered into a patent licensing agreement. In 1978, Intel introduced its 8086 microprocessor. NEC became an alternate source for the 8086 upon the alleged encouragement of Intel, who purportedly sought a second source for its product in order to facilitate the 8086's acceptance into the market. NEC engaged in a two-year reverse-engineering effort and in 1981 introduced its counterpart to Intel's 8086, the NEC uPD8086 microprocessor.

Subsequently in 1984, NEC developed its own microprocessors, the V-Series. NEC sought a declaratory judgment pronouncing Intel's 8086/8088 microprocessors uncopyrightable in response to Intel's contention that NEC had copied and derived the V-Series microprograms from Intel's microprocessors. In its counterclaim, Intel sought an injunction prohibiting NEC from infringing Intel's alleged copyrights in the microprocessors.

In September 1986, after a three-month trial, the U.S. District Court, Northern District of California, issued partial findings of fact and conclusions of law. The court held Intel's 8086/8088 microprograms copyrightable.\textsuperscript{84} The court rested its conclusion exclusively on a determination that the Intel microprograms resembled software programs currently protected under the 1980 amendment, noting that microprograms, just like software programs, are written in source code and translated into object code and are often imbedded in ROM chips.\textsuperscript{85}

However, microcode and software programs perform very different functions despite their superficial physical similarities. Software programs prescribe the task a computer is to perform, whereas microprograms determine how the computer will interpret and execute the software instructions.\textsuperscript{86} The function of the microprogram bears directly on the propriety of copyright protection.


\textsuperscript{84} The court bifurcated the issues of copyrightability and infringement and did not issue a judgment on the infringement issue.

\textsuperscript{85} \textit{NEC}, 645 F. Supp. at 593.

\textsuperscript{86} In programming language, to "execute" is to interpret a computer instruction and carry out the operations specified by the instruction. \textit{STANDARD DICTIONARY}, supra note 36, at 147.
as it determines the ultimate scope of copyright protection.

B. **Microcode: Nature and Function**

Microcode is embodied in the computer's Central Processing Unit (CPU), which contains the circuits controlling the interpretation and execution of software instructions. Each software instruction elicits a pattern of electronic signals that are sent to the CPU. The CPU routes these signals among the computer's hardware components. The CPU comprises two major parts: the arithmetic logic unit (ALU) and the control unit. The ALU is the portion of the computer containing circuits that perform arithmetic and logic operations. The control unit contains the circuits responsible for directing the flow of electric signals within the computer.

The control unit channels electric signals along control lines, which may be compared to plumbing connecting the computer's hardware devices. The control unit directs the flow by sending "on" and "off" control signals that respectively open or close valve-like electronic devices called "gates." The ultimate function of the control unit is to select and retrieve the software instructions, interpret them, and transform them into control signals.

The control unit responds to different software instructions by generating different sequences of control signals. The control unit's response to any one particular software instruction can be altered in two ways. Where the control unit is completely "hardwired," or permanently laid down in the CPU's electronic circuitry, the circuits can be configured to generate the desired control signals. However, this alteration is cumbersome, as modification of the control unit requires a complete "rewiring."

Microprogramming offers an alternative. The sequence of

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87. The CPU contains the circuits that control the interpretation and execution of the software instructions. STANDARD DICTIONARY, supra note 36, at 369.
88. Patterson, supra note 36, at 53.
89. Patterson, supra note 36, at 53.
90. Patterson, supra note 36, at 53.
91. A control line is a transmission line along which electronic signals are sent. STANDARD DICTIONARY, supra note 36, at 206.
92. These "gates" must be opened and closed at the right moment to get information (the electrical signals) to the right place. The control signals must be precisely timed and the rhythm of the entire processor is therefore synchronized to an internal clock. Put simply, the function of the control system is to supply the control signals during the right clock cycles. Patterson, supra note 36, at 52.
93. Patterson, supra note 36, at 52.
94. Microprograms are often called firmware, indicating their intermediate status between hardware and software.
paths the engineer wishes the electric signals to follow may be embodied in a software program stored in a separate memory unit incorporated into the CPU. This set of control instructions is the microprogram, which is written in microcode. The result is flexibility: just as software allows programmers to change the task performed by the computer, microprograms allow programmers to alter the CPU—and thus the computer's interpretation and execution of software—without rewiring the computer.

The similarity between microprograms and software lies in their programmability. Both contain a series of instructions stored in a memory, to be carried out by the computer. Microprograms, however, more closely resemble hardware because they become physically fixed in the computer and are usually unalterable in the normal course of operations. Like hardware, microprograms are invisible to the user. But perhaps most importantly, microprograms resemble hardware in their functional aspects: they control the basic functions essential to the execution of the software instructions and thereby determine the nature of the computer itself. Microprogramming thus represents manipulation at the most elementary level of the computer.

Two aspects of microcode have direct implications on copyright law. Microprograms are decidedly functional: they become inseparable from the computer's control unit and from the computer itself. They therefore may be properly considered utilitarian articles, which are explicitly denied protection under the Copyright Act. Furthermore, microprograms operate at the most elementary level of the computer and are unintelligible to most users. In fact, computer users are normally unaware of what, if any, microprograms are being employed in their particular computers. Ross, supra note 94, at 756.

Microprograms are ordinarily used to control the execution of software instructions. Less frequently, they are used to perform mathematical operations. Ross, supra note 95, at 757.

95. Patterson, supra note 36, at 54-55. Some examples of microprograms include: (1) Read Only Memory (ROM): a chip in which a permanent, unalterable microcode has been embedded. A ROM is programmed by the manufacturer; (2) Programmable ROM (PROM): a ROM that can be programmed once by the user; (3) Erasable PROM (EPROM): a ROM that may be erased and reprogrammed by the user. To be erased, the EPROM must be removed from the computer and exposed to ultraviolet light. See Ross, The Patentability of Computer "Firmware," 59 J. PATENT OFF. SOC'Y 731, 759-62 (1977).

96. Programming is the science of planning the solution of problems by reducing the plan to a set of instructions that can direct the actions of a computer. STANDARD DICTIONARY, supra note 36, at 275.

97. Most computer users are probably unaware of what, if any, microprograms are being employed in their particular computers. Ross, supra note 94, at 756.

98. Microprograms are ordinarily used to control the execution of software instructions.
ing employed in their particular computers. This raises the issue of whether microprograms are expressive in the copyright sense.

C. Probable Consequences

The utilitarian nature of some software renders it an uneasy subject of copyright protection. Problems associated with copyright protection of computer technology become even more pronounced with respect to microprograms due to their more fundamental role within the computer’s operation. Microprograms constitute an integral part of the CPU. Whereas software dictates a task to the computer, microprograms determine how the computer’s control system will interpret and execute those software instructions. This difference in function has serious ramifications for copyright law, as protecting microprograms would threaten to confer exclusive rights over the machine and its most primitive functions.

Computer designers often use microcode to create software-compatible computers: where the hardware of computers A and B differ, computer designers implement different microprograms into the computers in order to enable them to run identical software. Problems arise, though, in instances where computers have similar hardware. There, the computers need similar microprograms in order to run similar software.

Consider the following example: Company A microprograms its microprocessor to run software Z. Company B’s hardware, which was designed through legitimate reverse engineering technique, resembles that of Company A. Given this similarity between hardware, Company B needs a microprogram nearly identical to that implemented by Company A in order to run software Z in its computers. Should Company A hold copyrights in the microprogram, Company B would be precluded from implementing a similar microprogram into its microprocessor and designing a machine that functions similarly to that of Company A.

As this example illustrates, copyrights would preclude computer companies from adapting their machines to the wide range of software programs available on the market. Thus, a competitor wishing to offer a functionally compatible microprocessor, which does not infringe any patents given to the original microprocessor, would be charged with copyright infringement solely on the basis of

99. Ross, supra note 95, at 756.
100. See Patterson, supra note 36, at 56.
similarity in function. NEC has, in fact, advanced this argument.\(^{101}\)

NEC has also argued that copyright protection of microcode may defeat legitimate competition by precluding computer designers from studying another's product, learning how it works, and then using that knowledge to design a similar but improved product.\(^{102}\) NEC's fears appear legitimate in light of Whelan Associates. There, the court found the defendant guilty of infringement even though he had not directly copied the plaintiff's program. Instead, he had written his own program based on an understanding of the way in which the plaintiff's program functioned.\(^{103}\)

The series of software cases cited above have demonstrated that copyright law cannot successfully be applied to utilitarian articles. With respect to software, exclusive rights in the expression, or the source and object codes, sometimes confers rights over the underlying process, or the task the computer performs. The extension of copyright protection to microcode threatens to perpetuate a distortion of copyright law by surreptitiously conferring exclusive rights over the microprocessor itself.

D. *A Possible Alternative*

During its debate over extending legal protection to another element of computer technology—the semiconductor chip—Congress expressed substantial concern about the distortion of copyright doctrine.\(^{104}\) The semiconductor chip is an element into which electronic circuits are embedded, and it performs electronic circuitry functions.\(^{105}\) Troubled by its utilitarian nature, Congress in 1984 opted for a sui generis\(^{106}\) scheme of legal protection rather than granting

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\(^{101}\) Hinckley, *supra* note 83, at 34-38. Counsel for NEC stated: "Any competitor wishing to offer a functionally compatible computer or microprocessor could easily be charged with copyright infringement by the original developer solely on the basis of similarity in function." *Hinckley, supra* note 83, at 38.

\(^{102}\) *Hinckley, supra* note 83, at 37 ("The cost to society of a copyright monopoly for industrial products may be high. In some circumstances copyright may well discourage the creation of new and better products. In many industries companies study competitors' products, learn from them, and use that knowledge to develop better products.").


\(^{104}\) H.R. REP. NO. 781, *supra* note 14, at 5754. "Where technological changes have occurred, and those changes have had an impact on the lives of millions of people (as is the case for semiconductor chips), Congress must be extremely careful that its approach be reasonable and workable." *Id.*

\(^{105}\) *STANDARD DICTIONARY, supra* note 36, at 70. Note also that a microprocessor is a particular kind of semiconductor chip.

the semiconductor chip protection under the Copyright Act.\textsuperscript{107} Some commentators were puzzled by this decision, as it appeared directly inconsistent with Congress' seeming lack of concern for the utilitarian nature of the computer programs it had just recently brought within the scope of the Copyright Act.\textsuperscript{108} One commentator contends that Congress' decision to deny copyrights in semiconductor chips due to their utilitarian nature indicates that Congress misunderstood the utilitarian nature of computer programs at the time it enacted the 1980 amendment.\textsuperscript{109} Congress' repeated references to the chips' utilitarian nature when discussing the infeasibility of copyright protection lends support to this argument.

However, whether or not the Semiconductor Chip Act signals an attempt by Congress to rectify a prior error in misapprehending the utilitarian aspect of computer programs, it clearly indicates Congress' present unwillingness to extend the Copyright Act to cover additional utilitarian elements of computer technology. It also shows a decided preference for a sui generis scheme of legal protection for computer technology that escapes the proper boundaries of copyright law. As Congress stated during the semiconductor chip debates, a sui generis approach avoids doctrinal distortion and frees the Legislature from the copyright framework, enabling it to devise a law better-suited to the particular computer technology at hand.\textsuperscript{110}

Microcode presents the same problems posed by semiconductor chips as it too falls in the gap that exists between the patent and copyright laws. The creativity involved in developing microcode does not meet the level of inventiveness required by the patent law. Moreover, microcode can be considered an algorithm, to which the patent law explicitly denies protection.\textsuperscript{111} Finally, patents, even if possible, would nevertheless be impractical given the long delays inherent in the patenting process and the rapid rate at which computer technology develops.\textsuperscript{112} With respect to copyright law, microcode is unexpressive and utilitarian. As discussed above, it does not communicate with human beings and routes electric signals within the machine. These functional parallels between microcode and semiconductor chips and

\begin{footnotesize}
\begin{enumerate}
\item Stat. 3347 (codified at 17 U.S.C. §§ 901-914 (Supp. II 1984)).
\item See generally H.R. Rep. No. 781, supra note 14 (discussing Congress' decision to adopt a Semiconductor Chip Act).
\item Id.
\item H.R. Rep. No. 781, supra note 14, at 5755.
\item H.R. Rep. No. 781, supra note 14, at 5753.
\end{enumerate}
\end{footnotesize}
the common problems they present with respect to existing patent and copyright laws, then, suggest Congress would be amenable to a sui generis scheme of legal protection.

IV. PROPOSAL FOR A SUI GENERIS LAW

The aim of a sui generis law should be two-fold: (1) to secure the social bargain; and (2) to provide a law better suited to the unusual nature of microcode. Although a sui generis law would stand apart from the copyright and patent laws, it should be supported by the same policy objective that dictates that exclusive proprietary rights should be granted only insofar as they advance the public welfare. The law would recognize the decidedly utilitarian nature of microcode, realize the shortcomings of patent and copyright protection, and offer a feasible alternative.

A. Disclosure and Learning

Both copyright and patent laws require meaningful public disclosure of the matter protected as a *quid pro quo* for exclusive rights. Under patent law, the patent holder must file with the patent office a specification, including drawings and explanations of the invention. Under copyright law, traditional expressive subject matter, such as books, inherently discloses to the public the ideas and information it contains.

Computer programs, as microprograms prospectively would, create a unique concern in this respect since, however, their expression is not disclosed when they are published. The program does not communicate to human beings, and although the Copyright Office requires those who wish to register their computer programs to deposit with the Office the first and last twenty-five pages of the source code of the program, this does not result in meaningful public disclosure. As one author writes:

> It is very easy for someone who wishes to disclose nothing about his source code to the Copyright Office to do just that. All that person must do is write fifty pages of “comments” [which are not part of the program instructions], twenty-five of which will be tacked on to the front and twenty-five to the end of the source code. . . . [And], even if there is no intentional evasion, the creative portions of a program are unlikely to be disclosed in

114. For a discussion of the disclosure issues surrounding computer programs, see Samuelson, supra note 12.
the first twenty-five or last twenty-five pages of the source code.\textsuperscript{118}

In this way, a computer program discloses almost nothing in return for the protection of the law.\textsuperscript{116}

The sui generis law should recognize the importance of disclosure to the "social bargain." The sui generis law would require the proprietor of the program to submit a complete description of the program in order to obtain protection. The description would require a conceptual description of the program, detailed enough so that a skilled programmer could take the descriptive material and write a program utilizing the concepts described to perform substantially the same task as is performed by the registered program.\textsuperscript{117} The registrar would make public the description, together with a copy of the program in source or object code, from the beginning of the term of the protection.

B. Reverse Engineering as an Alternative to Complete Disclosure

The public can also learn from a computer program by copying it from its storage medium (such as the ROM) and analyzing its logic flow and organization. Unlike copyright law, which prohibits this direct copying, the sui generis law would allow reverse engineering as a form of "fair use."\textsuperscript{118} In this way, the law would permit knowledge and techniques to be communicated to programmers while prohibiting wholesale appropriation of another's work. This arrangement would satisfy the full disclosure traditionally demanded by both copyright and patent laws.

C. Term of Protection

It has been stated that the public benefits twice from the social

\textsuperscript{115} Samuelson, supra note 12, at 715-16.

\textsuperscript{116} Samuelson, supra note 12, at 710.

\textsuperscript{117} This is similar to the disclosure required by patent law. See supra note 111; see also Galbi, Proposal for New Legislation to Protect Computer Programming, 17 BULL. COPYRIGHT SOC'Y 280, 284 (1970) (summarizing the proposal submitted to the Patent Office by I.B.M in 1968).

\textsuperscript{118} The "fair use" doctrine prescribes that a copyrighted work may be copied in limited circumstances without fear of infringement. Section 117 of the Copyright Act reads:

\begin{quote}
[1] It is not an infringement for the owner of a copy of a computer program to make . . . a copy or adaptation of that computer program provided . . . that such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other manner.
\end{quote}

bargain: once when the original expression is first created, and again when the expression is added to the public domain from which anyone may borrow freely to fashion new works. Under patent law, for instance, the public benefits first from the original patented item and again at the end of the term of seventeen years, when it is free to create works that improve on the original. Unlike many other industries, the computer industry develops products and discovers technologies at a tremendous pace. The term of protection should be calculated accordingly. The public can benefit after legal protection ceases only if the protected art has not become obsolete during the term of protection. A term of ten or fewer years would most likely achieve this purpose while providing substantial protection to the proprietor of the program.\footnote{119}

\section{International Protection}

During congressional debates on the Semiconductor Chip Act, some legislators preferred Copyright protection over a sui generis law, reasoning that the Copyright Act might allow international protection under the existing copyright conventions. They also argued that 200 years of legal precedents under the copyright law might provide certainty regarding the scope of semiconductor chip protection.\footnote{120}

However, Congress rebutted the arguments posed by the proponents of the copyright approach. With respect to international considerations, Congress reasoned that any protection of the semiconductor chips under the Uniform Copyright Convention (UCC) would be speculative due to the technical problems inherent in fitting chips under the UCC. Specifically, Congress was uncertain as to whether a chip would constitute a “copy” according to UCC terminology and whether it would be treated as a work of applied art so as to justify its ten-year term of protection.\footnote{121} Moreover, since other countries did not protect semiconductor chips, Congress could not be assured they would agree to protect the functional features of a semiconductor chip under their copyright laws. If the United States enacted legislation to protect the works, it would be required to offer protection to all foreign nationals without being certain that it would

\footnote{119. Ten years is also the term of protection under the Semiconductor Chip Act. See \textit{supra} note 106.}
\footnote{120. See H.R. Rep. No. 781, \textit{supra} note 14, at 5756.}
\footnote{121. H.R. Rep. No. 781, \textit{supra} note 14, at 5756.}
receive reciprocal protection in foreign courts.\footnote{122} Congress concluded, however, that it would instead seek international protection via bilateral or multilateral agreements consistent with the General Agreement on Tariffs and Trade (GATT).\footnote{128}

V. CONCLUSION

A sui generis approach offers a definitive advantage of allowing the Legislature to fashion a law matching the sophistication of microcode technology. The law would use precise terms of art and thereby avoid the conceptual confusion inherent in any attempt to force microcode into the copyright statute. A sui generis scheme would thus render the law not only more exact, but more certain of compliance.

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\footnote{122}{H.R. Rep. No. 781, \textit{supra} note 14, at 5757. This principle is referred to as “national treatment” and is fundamental to the UCC.}
\footnote{123}{Id.}