University of Dayton Law Review

Volume 17 | Number 1 Article 7

10-1-1991

# Patent Policy + Protection of Inventor's Rights = The Patentability of Mathematical Algorithms

Patrick Edward Beck
*University of Dayton*

# PATENT POLICY + PROTECTION OF INVENTOR'S RIGHTS = THE PATENTABILITY OF MATHEMATICAL ALGORITHMS

## I. INTRODUCTION

The importance of computer software in today's society, as well as the great expense in producing it, has spurred the current interest by the computer industry in the availability of legal protection for computer software.[1] The patent system, developed to advance science and technology,[2] appears to be the ideal system for such computer software protection. This system, however, has not sufficiently protected programmers' rights to computer software. The insufficiencies arise out of judicial exclusion of mathematical algorithms from patentable statutory subject matter.[3]

The United States Supreme Court defines an algorithm as "[a] procedure for solving a given type of mathematical problem."[4] Using this definition, lower courts have been inconsistent with patent claim decisions involving algorithms.[5] Further attempts by the lower courts to clarify this definition have been contradictory and confusing.[6]

This comment discusses the underlying principles used by the courts to exclude mathematical algorithms from statutory subject matter. The complexity and varying definitions of the term "algorithm" are illustrated in the cases evaluated in the background section. The standard developed by the Court of Custom and Patent Appeals

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1. *See, e.g.*, Idelle R. Abrams, *Statutory Protection of the Computer Program: A Comparison of Copyright and Patent Laws*, 9 COMPUTER/L.J. 125, 126 (1989) (increased importance of computer software requires protection by intellectual property law to prevent piracy); Joseph P. Zammit, *Computers, Software and the Law*, 68 A.B.A. J. 970 (1982) (discussion of the prominence of computer software to business and the legal system); Note, *Computer Intellectual Property and Conceptual Severance*, 103 HARV. L. REV. 1046, 1046 (1990) (viable intellectual property protection crucial to protect expensive computer technology from inexpensive copying); Jeffrey S. Goodman, Note, *The Policy Implications of Granting Patent Protection to Computer Software: An Economic Analysis*, 37 VAND. L. REV. 147, 148-49 (1984) (importance of computer software in today's society is wide spread requiring adequate legal protection).

2. *See infra* note 11 and accompanying text.

3. 35 U.S.C. § 101 (1988) (defining patent statutory subject matter as "any new and useful process, machine, manufacture or composition of matter or any new and useful improvement thereof, . . . subject to the conditions and requirements of this title").

4. Gottschalk v. Benson, 409 U.S. 63, 65 (1972).

5. *See infra* notes 179-200 and accompanying text.

6. *See infra* notes 179-180 and accompanying text.

(C.C.P.A.)[7] and further refined by the Court of Appeals for the Federal Circuit (C.A.F.C.)[8] is also discussed and applied in the background section.

This comment submits that mathematical algorithms should be patentable. It further submits that the statutory requirement of nonobviousness[9] would prevent pre-emption of an algorithm by a patent applicant if the algorithm is common knowledge in the particular art.[10] If, however, the algorithm is new and useful, the statutory requirement of nonobviousness would not prevent the applicant from obtaining patent protection.

Allowing patents for processes and apparatuses containing mathematical algorithms would properly reward software programmers and inventors for their skill and hard work in advancing science and technology. This offers an incentive to the inventor to create new and useful processes and apparatuses that would benefit the public.

## II. BACKGROUND

### *A. Patent Policy*

The primary goal of patent law is scientific advancement and public dissemination of such advancement.[11] The patent system achieves this goal by giving the inventor exclusive rights to make, use or sell[12] an invention for a specified period of time,[13] while the public receives full disclosure of the invention.[14] The decision to grant an inventor a patent requires a determination of whether the benefit to the public in obtaining the invention outweighs the burden the public must bear in granting exclusive rights to the inventor.[15]

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7. *See* DONALD S. CHISUM, PATENTS § 11.06[3][B] (1991). The C.C.P.A. had jurisdiction to review decisions of the Board of Patent Appeals. *Id.* The decisions of the C.C.P.A. were directly reviewed by the United States Supreme Court. *Id.* The C.C.P.A. was replaced by the Court of Appeals for the Federal Circuit. *See infra* note 92.

8. Title 28, section 1295 of the United States Code grants the Court of Appeals for the Federal Circuit subject matter jurisdiction over patent issues. 28 U.S.C. § 1295 (1988).

9. 35 U.S.C. § 103 (1988).

10. *See infra* note 20 (defining prior art).

11. Sinclair & Carroll Co. v. Interchemical Corp., 325 U.S. 327, 330-31 (1945). The patent system's "inducement is directed to disclosure of advances in knowledge which will be beneficial to society; it is not a certificate of merit, but an incentive to disclosure." *Id.* at 331.

12. 35 U.S.C. § 271(a) (1988).

13. *See id.* § 154 (current statute allows exclusive rights for seventeen year period).

14. *Id.* § 112 (requirement of full disclosure to the public).

15. *See* WILLIAM C. ROBINSON, 1 ROBINSON ON PATENTS § 33 (1890).

> The creation of a monopoly embracing these extraordinary privileges, with their corresponding limitations of the common right, could not be justified unless the ultimate results of its bestowed were, upon the whole, highly advantageous to the public. That this is true, experience has fully demonstrated. The granting of a patent privilege at once accomplishes

Congress has the constitutional 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."[16] Since 1790, Congress has used this power to grant exclusive patent rights to inventors.[17] Currently, an inventor's patent rights are protected for a seventeen year term.[18] Further, an invention must meet the statutory requirements of patentability. To meet these requirements an invention must be (1) proper statutory subject matter,[19] (2) novel[20] and

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three important objects: it rewards the inventor for his skill and labor in conceiving and perfecting his invention; it stimulates him, as well as others, to still further efforts in the same or different fields; it secures to the public an immediate knowledge of the character and scope of the invention, and an unrestricted right to use it after the patent has expired. Each of these objects, with its consequences, is a public good, and tends directly to the advancement of the industrial arts. Any system of law which attains these results, without the undue restriction of natural rights, is evidently consonant with reason, justice, and sound public policy.

*Id.* (footnote omitted).

16. U.S. CONST. art. I, § 8, cl. 8.

17. Patent Act of 1790, 1 Stat. 109, § 1, *reprinted in* ERNEST B. LIPSCOMB III, 9 WALKER ON PATENTS, app.2 (1984). The eligible subject matter under the 1790 Patent Act included "any useful art, manufacture, engine, machine, or device, or any improvement therein not before known or used . . . ." *Id.*

18. 35 U.S.C. § 154 (1988). The seventeen year term provides:

[T]he right to exclude others from making, using, or selling the invention throughout the United States and, if the invention is a process, of the right to exclude others from using or selling throughout the United States, or importing into the United States, products made by that process,[ ] referring to the specification for the particulars thereof.

*Id.*

19. *Id.* § 101. Statutory subject includes: "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof . . . ." *Id.*

20. *Id.* § 102. The novelty requirement states that a person is entitled to a patent unless:

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

(c) he has abandoned the invention, or

(d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to

(3) not obvious to a person having ordinary skill in the subject matter of the invention.[21] The statute also requires that the patent applicant write a description of the invention in terms that would enable a person skilled in the particular art to recreate and use the invention.[22]

In order to obtain a patent, the applicant must show that the invention falls within proper statutory subject matter.[23] Patent subject matter includes processes, machines, manufactures or compositions of matter.[24] Using these four catigories, courts have excluded from patentability a number of subject matters including laws of nature,[25]

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practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

*Id.*; *see* 130 CONG. REC. H1057 (daily ed. Oct. 1, 1984) (statement of Rep. Kastenmeier) (defining "prior art" as "existing technical information against which patentability of an invention is judged").

21. 35 U.S.C. § 103 (1988). This statute requires that an invention must be non-obvious.

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the difference between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

*Id.*

22. *Id.* § 112; *see* Donald S. Chisum, *Patentability of Algorithms*, 47 U. PITT. L. REV. 959, 962 (1986). Every patent contains one or more claims. Chisum, *supra*, at 962. These claims define the invention, limit the scope of the patent protection, and determine whether an infringement on the patent has occurred. *Id.* at 963.

23. 35 U.S.C. § 101 (1988).

24. *Id.* Title 35, section 100(b) of the United States Code states "[t]he term 'process' means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." *Id.* § 100(b). *See generally* LIPSCOMB, *supra* note 17, § 2.7 (defining and dividing machines into four classes: (1) embraces the entire machine and is better defined as an apparatus; (2) embraces one or more parts of the apparatus but not the apparatus as a whole; (3) embraces both a new element and combination of elements, some of which may be previously known; and (4) all of the elements of the apparatus are known but the invention involves a new combination of the known elements to produce a new and useful invention); *id.* § 2.9 (defining composition of matter as a broad class which "embraces chemical compounds, mechanical or physical mixtures, alloys and a great variety of things"); ROBINSON, *supra* note 15, § 183 (defining a manufacture as "the parts of a machine considered separately from the machine itself, all kinds of tools and fabrics, and every other vendible substance which is neither a complete machine nor produced by a mere union of ingredients").

25. *See* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948) (requiring that the patent claim must be to a new and useful application of the law of nature); O'Reilley v. Morse, 56 U.S. (15 How.) 62, 112-13 (1853) (explaining that the claim was not patentable because it tried to patent electromagnetism, a law of nature, and was not directed toward any particular apparatus or process that used electromagnetism); LeRoy v. Tatham, 55 U.S. (14 How.) 156 (1852) (holding that no one could claim patent rights to abstract principles because they are fundamental truths).

printed matter,[26] methods for doing business,[27] ideas[28] and mathematical expressions of abstract principles.[29] The inability to patent either laws of nature or mathematical expression of abstract principles limit the patentability of algorithms.

### *B. Judicial Doctrine Limiting the Patentability of Algorithms*

#### 1. Mental Steps Doctrine

The mental steps doctrine was the first limitation directed toward the patentability of processes using mathematical algorithms.[30] This doctrine developed from the C.C.P.A.'s distinction between the nonpatentability of laws of nature and the acceptance of patent claims that apply laws of nature to create new and useful inventions.[31] The doctrine stated that "inventions which require human thought in whole or in part for their practice were judicially considered not to be patentable subject matter."[32]

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26. *See* United States Credit Sys. Co. v. American Credit Indem. Co., 59 F. 139 (2d Cir. 1893) (holding standardized business forms unpatentable); *In re* Russell, 48 F.2d 668, 669 (C.C.P.A. 1931). "[A]rrangement of printed matter on . . . paper does not constitute" any new and useful art. *Russell*, 48 F.2d at 669.

27. *See* Guthrie v. Curlett, 10 F.2d 725, 726 (2d Cir. 1926). A tariff index consolidating all active tariffs for a particular railroad is not patentable. *Id.* Systems for business transactions, for example methods for maintaining restaurant records, are not proper statutory subject matter. Hotel Sec. Checking Co. v. Lorraine Co., 160 F. 467 (2d Cir. 1908); *Ex parte* Murray, 9 U.S.P.Q. 2d. (BNA) 1819 (1988) (explaining that a program which sorts, debits, and totals expenditures in order to issue an expense analysis statement was considered conducting business and, therefore, not proper statutory subject matter). *But see* Paine, Webber, Jackson & Curtis, Inc. v. Merrill Lynch, Pierce, Fenner, & Smith, Inc., 564 F. Supp. 1358, 1369 (D. Del. 1983). The court held computer software developed for the "financial management of individual brokerage accounts" patentable. *Id.* A patent which improves business practices if done by hand is not proper statutory subject matter. *Id.* The software, however, operates on a digital computer which places the patent claim within the technological arts. *Id.*; *In re* Johnston, 502 F.2d 765 (C.C.P.A. 1974), *rev'd on other grounds*, 425 U.S. 219 (1976) (holding computer software for financial record keeping falls within the technological arts and, therefore, patentable).

28. *See* Rubber Tip Pencil Co. v. Howard, 87 U.S. (20 Wall.) 498, 507 (1874). Ideas are not patentable; the ideas must be used in a new device to be patentable. *Id.*

29. *Compare* MacKay Radio & Tel. Co. v. Radio Corp., 306 U.S. 86, 94 (1939) (finding a mathematical expression or a scientific truth, by itself, is not patentable) *with* Eibel Process Co. v. Minnesota & Ontario Paper Co., 261 U.S. 45 (1923) (holding inventor's patent was valid because it did not attempt to patent the law of gravity but the use of gravity to improve on an existing papermaking machine).

30. *See* Jeffrey A. Simenauer, Note, *Patentability of Computer - Related Inventions: A Criticism of the PTO's View on Algorithms*, 54 GEO. WASH. L. REV. 871, 885-86 (1986).

31. Chisum, *supra* note 22, at 967. *See generally* Funk Bros. Seed Co. v. Kalo Inoculant Co., 335 U.S. 127, 130 (1948) (claim must be for new and useful application of the law of nature); O'Reilley v. Morse, 56 U.S. (15 How.) 62, 112-13 (1865) (claim must be directed toward a particular apparatus or process that uses the law of nature).

32. Donald E. Stout, *Protection of Programming in the Aftermath of* Diamond v. Diehr, 4 Computer/L.J. 207, 209 (1983). *See generally In re* Shoa Wen Yuan, 188 F.2d 377, 380-83

In *In re Abrams*,[33] the C.C.P.A. developed an analysis for determining the patentability of a process which contained mental steps.[34] First, if a process claim consisted of only mental steps, it was not patentable.[35] Second, if a process claim included both physical and mental steps, and if the only novel aspects were incorporated in the mental steps, it was not patentable.[36] Finally, if a claim included both physical and mental steps, and the novel portion was incorporated in the physical steps, it was patentable.[37]

The mental steps doctrine created a considerable obstacle for the patentability of computer software.[38] Computers are able to perform functions such as comparing, calculating, storing and sorting with greater accuracy and in less time than human beings.[39] All of these functions, however, can be interpreted as mental steps, since the human mind is able to perform all of these functions.[40] Therefore, as a matter of policy, the Patent and Trademark Office did not allow patents for computer software.[41]

The C.C.P.A., however, completely rejected the mental steps doctrine in *In re Musgrave*.[42] The court determined that the mental steps doctrine was unsound and had no statutory basis.[43] According to the C.C.P.A., all that was necessary to make a sequence of steps patentable was that the claim be both within the statutory definition of a process and be a technological art.[44] Lower courts, therefore, cannot reject a patent claim for computer software merely because all functions performed by the software can be performed in the human mind as well.[45]

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(C.C.P.A. 1953) (mental operations considered unpatentable); *In re* Heritage, 150 F.2d 554, 556-58 (C.C.P.A. 1945) (again establishing mental steps unpatentable); Halliburton Oil Well Co. v. Walker, 146 F.2d 817, 821-23 (9th Cir. 1944), *aff'd*, 326 U.S. 969 (1946) (holding that the invention comprised merely mental steps and, therefore, even if novel, was not patentable).

33. 188 F.2d 165 (C.C.P.A. 1951) (application for analysis of seismic data).

34. *Id.* at 166.

35. *Id.*

36. *Id.*

37. *Id.*

38. *See* Simenauer, *supra* note 30, at 887.

39. *See* Abrams, *supra* note 1, at 130.

40. *Id.*

41. *See* Chisum, *supra* note 22, at 969.

42. 431 F.2d 882 (C.C.P.A. 1970).

43. *Id.* at 889.

44. *Id.* at 893; *see also* Chisum *supra* note 22, at 970 (arguing that the *Musgrave* decision was the pinnacle of rationality in the area of algorithm patentability).

45. *See, e.g.*, Arrythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992) (discussing mental steps doctrine still being applied today).

2. United States Supreme Court Decisions Relating to The Patentability of Algorithms

a. *Gottschalk v. Benson*: Limited Definition of an Algorithm

The Supreme Court's first decision interpreting mathematical algorithms was *Gottschalk v. Benson*.[46] In this case, the patent applicant claimed a program that converts binary-coded decimal numerals into pure binary numerals.[47] The claim was not limited to any particular apparatus as it was intended for any general digital computer.[48] The issue before the Court was whether this programmed conversion could be claimed as a process as defined by the patent statute.[49] The Court rejected the claim stating that it was not proper statutory subject matter under section 101 of the patent statute and, therefore, the program was not a patentable process.[50] The Court stated that a process is patentable if it is "tied to a particular machine or apparatus or [the process] must operate to change articles or materials to a different state or thing."[51] The Supreme Court did not, however, expressly preclude the patentability of all computer software.[52]

*Benson* was significant because the Supreme Court defined "algorithm." The Court determined that an algorithm is "[a] procedure for solving a given type of mathematical problem."[53] This definition created confusion because the common definition of an algorithm—a

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46. 409 U.S. 63 (1972).

47. *Id.* at 64. Claim 8 of the application is representative and 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 the 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 one to the 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.

*Id.* app. at 73-74.

48. *Id.* at 64.

49. *Id.* Title 35, section 100(b) of the United States Code states: "The term 'process' means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." 35 U.S.C. § 100(b) (1988).

50. *Benson*, 409 U.S. at 73.

51. *Id.* at 71. The Court stated, however, that this holding did not mean that all processes which did not fit within this definition would not be patentable. *Id.*

52. *Id.*

53. *Id.* at 65.

sequence of steps for solving a problem—encompasses both mathematical and nonmathematical material.[54] This confusion is well illustrated by the Court's rationale in *Benson*. The claimed invention in *Benson*, the conversion of binary-coded decimal numbers into pure binary numbers, is more of a translation problem (nonmathematical) than a mathematical problem.[55] Applying the newly expounded definition of an algorithm to the *Benson* scenario, the Court could have easily accepted the patent application presented there.[56]

b. *Parker v. Flook*: Patent Claims For Processes Containing Algorithms

The Supreme Court next considered the patentability of algorithms in *Parker v. Flook*.[57] In *Flook*, the applicant claimed a method

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54. *See* Allen Newell, *Response: The Models are Broken, The Models are Broken*, 47 U. PITT. L. REV. 1023, 1024 (1986). "[A]n algorithm is an unambiguous specification of a conditional sequence of steps for solving a class of problems." *Id.*; Abrams, *supra* note 1, at 132. The Court in *Benson* did not differentiate the mathematical algorithm, a formula, from the programming algorithm, a step by step sequence to solve a problem. Newell, *supra*, at 1024; Chisum, *supra* note 22, at 976. "It is true that algorithms are often devised to solve problems of a mathematical nature. But algorithms may also be devised to solve all sorts of nonmathematical problems." Chisum, supra note 22, at 976 (footnotes omitted); *see, e.g.*, Thomas G. Rickert, *Algorithms as an Approach to Learning*, 12 JURIMETRICS J. 170 (1971) (flow chart algorithm illustrating the reasoning process a lawyer uses in determining the enforceability of a promise).

55. *See* Chisum, *supra* note 22, at 977. The *Benson* algorithm involves mathematical steps, however, the actual problem being solved is not mathematical. *Id.*

56. *Id.* For decisions by the C.C.P.A. interpreting the Supreme Court's definition of algorithm in *Benson* see *In re Christensen*. 478 F.2d 1392 (C.C.P.A. 1973). The applicant claimed a method of gathering data on subsurface formation conditions then, by the use of a mathematical formula devised by the applicant, determine the porosity of the formation. *Id.* at 1394. The court held that the novelty of the claim was in the applicant's mathematical formula and that the data gathering steps were well known in the particular art. *Id.* The court rejected the claim, thereby, holding that it was nothing more than the solving of a mathematical equation. *Id.*; *see also In re* Chatfield, 545 F.2d 152, 158 (C.C.P.A. 1976) (determining that patent claims must be analyzed in their entirety); *In re* Johnston, 502 F.2d 765 (C.C.P.A. 1974) (financial record keeping system that used a digital computer held patentable subject matter because it did not encompass a law of nature, a mathematical formula, or an algorithm and therefore not considered an algorithm under the *Benson* definition). The *Chatfield* court stated:

> Our reference in *Christensen* to a mathematical equation as being "at the point of novelty" does not equate to holding that the claim may be dissected, the claim components searched in prior art, and, if the only component found novel is outside the statutory classes of invention, the claim may be rejected under 35 U.S.C § 101. That procedure is neither correct nor within the intent of Congress . . . .

*Chatfield*, 545 F.2d at 158.

A comparison of *In re Christensen* to *In re Chatfield* demonstrates the C.C.P.A.'s attempt to allow more processes containing algorithms to be proper statutory subject matter. The Supreme Court quickly curtailed this pattern by its decision in *Parker v. Flook*. 437 U.S. 584 (1977); *see infra* notes 57-71 and accompanying text.

57. 437 U.S. 584 (1977).

for updating alarm limits on process variables during catalytic conversion of hydrocarbons.[58] The Court determined that the applicant's method consisted of three steps.[59] The first step measured the current value of the process variables.[60] The second step incorporated an algorithm that calculated and updated the alarm limit value.[61] The final step adjusted the alarm limit to the updated value.[62]

The Supreme Court stated that the applicant was not pre-empting the use of the mathematical algorithm.[63] Instead, the claim specifically limited the use of the formula to catalytic conversion of hydrocarbons.[64] The Court also stated that the claim had specific post-solution activity which further demonstrated that the claim did not wholly pre-empt the use of the algorithm.[65] The Supreme Court, however, rejected the application as improper statutory subject matter under section 101.[66] The process involved in catalytic conversion of hydrocarbons was

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58. *Id.* at 585. During the catalytic conversion process, operating conditions must be measured. *Id.* When any process variable exceeds a predetermined alarm limit an alarm indicates the abnormal condition. *Id.* For example, when the temperature exceeds a predetermined temperature range, the alarm sounds indicating the abnormal condition. *Id.* During steady operations, fixed alarm limits are appropriate, but transient situations may require updating of the alarm limits. *Id.* The applicant's claim is for a method which updates alarm limits. *Id.*

Claim 1 of the patent described the method as follows:

> 1. A method for updating the value 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
>
> $B_0 + K$
>
> wherein $B_0$ is the current alarm base and K is the 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 $B_1$, using the following equation:
>
> $B_1 = B_0(1.0 - F) + PVL(F)$
>
> where F is a predetermined number greater than zero and less than 1.0;
>
> (3) Determining the updated alarm limit which is defined as $B_1 + K$; and thereafter
>
> (4) Adjusting said alarm limit to said updated alarm limit value.

*Id.* at 596-97 (quoting app. 63A).

59. *Id.* at 585.

60. *Id.* An example of a measured current variable would be the process temperature. *Id.*

61. *Id.* The Court used the identical definition of algorithm incorporated in *Gottschalk v. Benson*. *Id.*; *see* Gottschalk v. Benson, 409 U.S. 63 (1972); *see also supra* text accompanying note 53 (*Benson* definition of algorithm).

62. *Flook*, 437 U.S. at 585.

63. *Id.* at 589-590; *see* Gottschalk, 409 U.S. at 71-72. A patent claim wholly pre-empts an algorithm when the claim covers all potential uses for the algorithm. *Benson*, 409 U.S. at 71-72.

64. *Flook*, 437 U.S. at 590.

65. *Id.* The applicant claimed that the presence of a post solution activity, the adjustment of the updated alarm-limit value based on the final result of the algorithm, made the claimed process patentable. *Id. See generally* Chisum, *supra* note 22, at 993 n.125 (defining post-solution activity as "activity after [the] use of the equation").

66. *Flook*, 437 U.S. at 594. The Supreme Court stated that mere post solution activity could not "transform an unpatentable principle into a patentable process . . . ." *Id.* at 590. Pat-

well known and, therefore, within the prior art.[67] Both monitoring the process variables and adjusting alarm systems were also within the prior art.[68] The Supreme Court determined that the only new step in the process claim was the method for calculating alarm limit values.[69] The method for calculating alarm limits was a mathematical algorithm and, therefore, not proper statutory subject matter.[70] Thus, the Supreme Court held that the claim contained no patentable invention.[71]

c. *Diamond v. Diehr*: Approval of A Process Containing an Algorithm - Court Looks to the Patent Claim in Its Entirety

In *Diamond v. Diehr*,[72] the United States Supreme Court held that the applicant's process claim for curing synthetic rubber was patentable.[73] The process included the use of a mathematical algorithm[74] and a programmed digital computer to improve the method for molding rubber products.[75]

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ent draftsman, the Court reasoned, could attach a post solution activity to almost any mathematical formula thereby making it patentable. *Id.*

67. *Id.* at 594; *see supra* note 20 (defining prior art).

68. *Flook*, 437 U.S. at 594.

69. *Id.* at 594-95.

70. *Id.*

71. *Id.* at 596. The dissenting opinion argued that one unpatentable step in a process should not render the entire process improper statutory subject matter. *Id.* at 599 (Stewart, J., dissenting). A patent process should be looked at in its entirety. *Id.* The dissenting opinion correctly argued that a claim process should not lose its subject matter patentability because of one unpatentable isolated step. *Id.*

72. 450 U.S. 175 (1981).

73. *Id.* at 192-93.

74. The mathematical algorithm used in the process was a common formula known as the Arrhenius equation.

The equation can be expressed as follows:

$$\ln v = CZ + x$$

wherein ln v is the natural logarithm of v, the total required cure time; C is the activation constant, a unique figure for each batch of each compound being molded . . .; Z is the temperature in the mold; and x is a constant dependent on the geometry of the particular mold [being used in the process].

*Id.* at 177-78 n.2.

75. *Id.* at 180-81. Claim 2 is a representative claim and provides:

"1. A method for operating arubber-molding press for precision molded compounds with the aid of a digital computer, comprising:

providing said computer for a data base for said press including at least, '

natural logarithms conversion data (ln),

the activation energy constant (C) unique to each batch of said compound being molded, and

a constant (x) dependent upon the geometry of the particular mold of the press,

initiating an interval timer in said computer upon the closure of the press for monitoring the elapsed time of said closure,

constantly determining the temperature (Z) of the mold at a location closely adjacent to the mold cavity in the press during molding,

Prior to the applicant's invention, the rubber molding industry had not been able to make uniformly accurate cures[76] because the molding press temperature could not be precisely measured, thus creating difficulty in determining cure time.[77] The patent application claimed a process which constantly measured the interior temperature of the mold.[78] These temperatures were fed directly into a digital computer which constantly recalculated the cure time by using a mathematical algorithm.[79] When the calculated time equalled the actual cure time, the computer signalled the press to open.[80]

The majority in *Diehr* found it inappropriate to dissect the claim into old and new elements and subsequently ignore the old elements as being prior art.[81] The Court stated that dissecting the claim in this fashion was particularly inappropriate when looking at a process claim because "a process may be patentable even though all the constituents of the combination were well known and in common use before the combination was made."[82] The novelty of any particular old or new

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constantly providing the computer with the temperature (Z),

repetitively calculating in the computer, at frequent intervals during each cure, the Arrhenius equation for reaction time during the cure, which is

$\ln v = CZ + x$

where v is the total required cure time,

repetitively comparing in the computer at said frequent intervals during the cure each said calculation of the total required cure time calculated with the Arrhenius equation and said elapsed time, and

opening the press automatically when said comparison indicates equivalence.

2. The method of claim 1 including measuring the activation energy constant for the compound being molded in the press with a rheometer and automatically updating said data base within the computer in the event of changes in the compound being molded in said press as measured by said rheometer."

*Id.* at 179-80 n.5 (quoting the patent application claim). *See generally* Robert A. Kreiss, *The Theory of Overclaiming and Its Application to* Diamond v. Diehr, 5 CARDOZO L. REV. 97, 127-28 (1983). The problem with the *Diehr* claim was that it failed to comply with the particularity requirement of title 35, section 112 of the United States Code. *Id.* The drafted claims were so broad, the Court had difficulty determining what was actually trying to be protected. *Id.* at 142-44.

76. *See Diehr*, 450 U.S at 177 n.1.

A "cure" is obtained by mixing curing agents into the uncured polymer in advance of molding, and then applying heat over a period of time. If the synthetic rubber is cured for the right length of time at the right temperature, it becomes a usable product.

*Id.*

77. *Id.* at 178. Cure time may be defined as the amount of time required for the rubber product to have desired physical properties. *Id.*

78. *Id.*

79. *Id.*

80. *Id.* at 179.

81. *Id.* at 188.

82. *Id.* Title 35, section 100(b) of the United States Code states that a process "includes a new use of a known process, machine, manufacture, composition of matter or material." 35 U.S.C. § 100(b) (1988).

element is irrelevant when determining the subject matter of a claim.[83] The Court held that an improved process for molding synthetic rubber was proper statutory subject matter.[84] The application did not seek to pre-empt the use of a mathematical algorithm; it only foreclosed others from the use of the algorithm in conjunction with all other steps in the applicant's process.[85]

The *Diehr* dissent took the *Flook* approach and argued that a mathematical algorithm for subject matter analysis should be treated as prior art.[86] The claim can then be examined to determine if there was any other new and useful concept in the process.[87] The dissent concluded that nothing new was added to the physical process with the exception of "a method of using a digital computer to determine the amount of time that a rubber molding press should remain closed during the synthetic rubber curing process."[88] The computer estimated the cure time "by repetitively recalculating that time pursuant to a well-known mathematical formula in response to variations in temperature within the mold."[89] The dissent, therefore, concluded that the application made no contribution to the art and should not be considered proper statutory subject matter.[90]

### C. *Patenting Algorithms Since* Diamond v. Diehr

Although the Supreme Court has not addressed the question of mathematical algorithms since *Diehr*, the C.C.P.A. and the Court of Appeals for the Federal Circuit (C.A.F.C.)[91] have had numerous occasions to examine claims involving mathematical algorithms. A discussion of the significant lower court cases exemplifies the confusion these

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83. *Diehr*, 450 U.S. at 188-89.

84. *Id.* at 187.

85. *Id.* The majority in *Diehr* correctly held that an industrial rubber process was proper patent subject matter. *See* Chisum, *supra* note 22, at 997. The use of a computer to improve the process did not make the process unpatentable. *Id.* The Supreme Court's decision in *Diehr* is similar to the excellent opinion of the C.C.P.A. in *In re Richman* and helps clarify the confusion caused by the *Flook* decision. David A. Blumenthal, *Supreme Court Sets Guidelines For Patentability of Computer Related Inventions*, 63 J. PAT. OFF. SOC'Y 117, 122 (1981).

86. *Diehr*, 450 U.S. at 204 (Stevens, J., dissenting).

87. *Id.*

88. *Id.* at 208.

89. *Id.* at 209.

90. *Id.* at 220. Justice Stevens stated:

> [C]oncerns would be better addressed by (1) an unequivocal holding that no program-related invention is a patentable process under § 101 unless it makes a contribution to the art that is not dependent entirely on the utilization of a computer, and (2) an unequivocal explanation that the term "algorithm" as used in this case, as in *Benson* and *Flook*, is synonymous with the term "computer program."

*Id.* at 219 (Stevens, J., dissenting) (footnote omitted).

91. In 1982, the C.C.P.A. became the C.A.F.C. The C.A.F.C. has subject jurisdiction over patent issues. 28 U.S.C. § 1295 (1988).

courts have confronted in determining whether a process or apparatus containing a mathematical algorithm is patentable. First, however, a standard to determine whether a process or apparatus containing an algorithm was patentable had to be developed.

1. The *Freeman-Walter* Test: An Attempt to Develop a Standard for the Patentability of Algorithms

In *In re Freeman*,[92] the C.C.P.A. developed a test for determining whether a claim which included an algorithm[93] constituted proper statutory subject matter. The court used a two-step analysis. "First, it must be determined whether a claim directly or indirectly recites an 'algorithm' . . . ."[94] Second, if a claim recites an algorithm, then it must be further analyzed to determine "whether [the claim] in its entirety wholly pre-empts that algorithm."[95] If the algorithm is wholly pre-empted, then the patent claim must be rejected as improper statutory subject matter.[96]

The C.C.P.A. tried to further clarify the second step of the *Freeman* test in its decision in *In re Walter*.[97] The court stated that a claim constitutes proper statutory subject matter if the algorithm defines "structural relationships between the physical elements of the claim (in apparatus[98] claims) or . . . refine[s] or limit[s] claim steps (in process[99] claims) . . . ."[100] If an algorithm, however, is merely presented

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92. 573 F.2d 1237 (C.C.P.A. 1978). The patent claim was a "system for typesetting alphanumeric information, using computer-based control system in conjunction with a phototypesetter of conventional design." *Id.* at 1238. The claim was extremely useful in printing complex mathematical formulae. *Id.* at 1238-39.

93. *See* Gottschalk v. Benson, 409 U.S. 63, 65 (1972) (defining algorithm as a procedure for solving a mathematical problem).

94. *Freeman*, 573 F.2d at 1245.

95. *Id.* The C.C.P.A. held that the patent application did not directly or indirectly contain a mathematical algorithm. *Id.* The court used the definition of algorithm given in *Benson*, "a procedure for solving a given type of mathematical formula." *See supra* note 53 and accompanying text. The C.C.P.A. went further, stating that a broader definition of algorithm to include step by step processes for problem solving would effectively eliminate all processes from proper statutory subject matter. *Freeman*, 573 F.2d at 1245-46. This would be an absurd interpretation; therefore; the decision in *Benson* can only be directed to claims that recite mathematical algorithms. *Id.*

96. *Id.*

97. 618 F.2d 758 (C.C.P.A. 1980).

98. *See* LIPSCOMB, *supra* note 17, § 2.7 (defining apparatus as a specific type of machine which embraces the entire machine and not the parts that make up the entire machine).

99. *See* Cochrane v. Deener, 94 U.S. 780, 788 (1876).

> 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 subject-matter to be transformed and reduced to a different state or thing . . . . The process requires that certain things should be done with certain substances, and in certain order; but the tools to be used in doing this may be of secondary consequence.

*Id.*

and solved by the claim and is not applied to "physical elements or process steps, no amount of post solution activity[101] will render the claim statutory."[102]

2. Lower Court Decisions Since *Diamond v. Diehr*

The first significant lower court decision after *Diamond v. Diehr* was *In re Taner*.[103] In the applicants' claimed process, seismic data was

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100. *Walter*, 618 F.2d at 767.

101. *See supra* note 65 (defining post solution activity).

102. *Walter*, 617 F.2d at 767. The C.C.P.A. felt obligated to change the second step in the *Freeman* analysis after the Supreme Court decision in *Parker v. Flook*. Simenauer, *supra* note 30, at 893. The clarification of the second step in the *Freeman* test was an attempt to harmonize the test with the *Flook* decision. *See generally* Chisum, *supra* note 22, at 1003.

The C.C.P.A. continued to interpret the Supreme Court's definition of algorithm in conjunction with the *Flook* decision. It also began using the *Freeman* test to determine statutory subject matter under title 35, section 101 of the United States Code. *See, e.g., In re* Maucorps, 609 F.2d 481, 485-86 (C.C.P.A. 1979). The *Maucorps* court used the *Freeman* test. *Id.* at 485. Using the first step of the test, the court determined that the claim contained a mathematical algorithm. *Id.* Using the second step of the test, the court found the applicant's process comprised a solution technique for a set of equations. *Id.* at 486. The C.C.P.A. held that the applicant's claim would, therefore, wholly pre-empt the algorithm in the claim. *Id.* The claim, therefore, was not proper statutory subject matter. *Id.* In *In re Bradley*, the applicant's claim for an invention that relates to altering and repositioning information in a computer system base for a more efficient operation of a multisystem format was held to be proper statutory subject matter. 600 F.2d 807, 808 (C.C.P.A. 1979). The court looked at the first step of the *Freeman* test and determined that the claim contained no mathematical algorithm. *Id.* at 811. The C.C.P.A. stated that the Patent and Trademark Office was confusing what the computer does with how it is doing it. *Id.*

> It is of course true that a modern digital computer manipulates data, usually in binary form, by performing mathematical operations, such as addition, subtraction, multiplication, division or bit shifting on data. But this is only *how* the computer does what it does. Of importance is the significance of the data and their manipulation in the real world, i.e., *what* the computer is doing. It may represent the solution of the Pythagorean theorem . . . in which case the computer is performing a mathematical algorithm and solving an equation . . . . On the other hand, it may be that the data and manipulations performed thereon by the computer, when viewed on the human level, represent[s] . . . the text of a court opinion retrieved by a computerized law service. Such information is utterly devoid of mathematical significance.

*Id.* at 812. In *In re Sakar*, the applicant's claim contained a mathematical algorithm. 588 F.2d 1330, 1334 (C.C.P.A. 1978). The physical steps required in the claim were nothing more than old and necessary data gathering steps required to solve the mathematical algorithm. *Id.* at 1335. Thus, the claim failed to meet proper statutory subject matter. *Id.* at 1336. *But see In re* Toma, 575 F.2d 872 (1978) (holding that a method which enabled a computer to translate from Russian to English was patentable subject matter because no mathematical algorithm was claimed).

103. 681 F.2d 787 (C.C.P.A. 1982). This decision overruled *In re Christensen*, 478 F.2d 1392 (C.C.P.A. 1973). *In re Christensen* held that a claim which contained no more than the known data gathering steps establishing values for variables to be placed in a mathematical algorithm was not patentable subject matter. *Id.* at 1394.

*In re Taner* overruled the holding in *Christensen*, but unfortunately did not give the exact portion of the holding that was being overruled. 681 F.2d 787, 791 (C.C.P.A. 1982). *But see In re* Grams, 888 F.2d 835, 839 (Fed. Cir. 1989). The portion of *Christensen* being overruled was the point of novelty approach. *Grams*, 888 F.2d at 839. This approach required the new and useful portion of the process to be a physical step. *Id.* The decision was not overruling that physical data

collected in a well known manner and placed into a mathematical algorithm which converted the signal into a simulated planer or cylindrical seismic wave.[104] This mathematical conversion was beneficial because it reduced required data correction.[105] The court held that although the claim recited an algorithm, the applicant was not trying to patent the algorithm.[106] The claim stated that the process took conventional seismic signals and converted them into another form.[107] The claim, therefore, fit into the definition of a process and was patentable subject matter.[108]

*In re Abele*[109] represented the C.C.P.A.'s first significant decision using the *Freeman-Walter* test.[110] In *Abele*, the applicant claimed an improved CAT scan imaging technique which reduced overall body exposure to radiation.[111] Using the first step of the *Freeman-Walter* test, the court determined that the applicant's process claim contained a mathematical algorithm.[112] Applying the second step of the test, the C.C.P.A. held that the applicant had developed an application of a mathematical algorithm to process steps which significantly improved the overall CAT scan process.[113] The claim used the mathematical formula as a step within the context of the entire process which encompassed considerably more than the algorithm alone.[114] The C.C.P.A.

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gathering steps that amount to nothing more than variables to be placed in a mathematical algorithm are not proper statutory subject matter. *Id.*

104. *Taner*, 681 F.2d at 778.

105. *Id.*

106. *Id.*

107. *Id.* at 790.

108. *Id.* at 791. The C.C.P.A., in holding this claim a process, relied heavily on the fact that the claim transformed or reduced the article to a different state. *Id.* This definition of a process is consistent with the Supreme Court's definition in *Cochrane v. Deener*. 94 U.S. 780, 788 (1877). The Supreme Court in *Cochrane* held that a process "is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing." *Id.*

109. 684 F.2d 902 (C.C.P.A. 1982).

110. *See also In re* Pardo, 684 F.2d 912 (C.C.P.A. 1982). In *Pardo*, the court again used the *Freeman-Walter* test and held that a method for controlling internal operations of a computer was proper statutory subject matter. *Id.* at 915. The court determined that the claim contained a computer algorithm and not a mathematical algorithm as defined by the Supreme Court. *Id.* Therefore, the applicant's claim was not within the mathematical algorithm exception to patent subject matter. *Id.*

111. *Abele*, 684 F.2d at 904. CAT is defined as computerized axial tomography. *Id.* at 903. This apparatus basically provides an image representing a transverse slice of the body. *Id.* The computer mathematically interprets the data and then reconstructs the transverse slice on a television screen. *Id.*

112. *Id.* at 907.

113. *Id.* at 909. The C.C.P.A. compared the improved CAT scan process to the improved process for curing rubber in *Diamond v. Diehr*. *Id.*

114. *Id.*

therefore held that the process claim was proper statutory subject matter.[115]

The C.C.P.A. decision in *In re Meyer*[116] broadened the definition of a mathematical algorithm.[117] The applicant claimed a process whereby a number of neurological diagnostic tests were performed and the resulting data was input into a computer.[118] The computer stored and accumulated test responses and, through the applicant's process, narrowed the neurological malfunction possibilities.[119] The court characterized the invention as a "memory aid for physicians."[120] It also stressed that the process merely narrowed neurological malfunction possibilities and did not "conduct a diagnosis in and of itself."[121]

Applying the first step of the *Freeman-Walter* test, the *Meyer* court held that the applicant used a mathematical algorithm.[122] The C.C.P.A. stated that the computer used an algorithm to partially replace the thinking process (mental step) of the neurologist.[123] This replacement of thinking processes through the computer's use of an algorithm was, in the court's opinion, sufficient representation of a mathematical algorithm.[124] The court then applied the second step of the *Freeman-Walter* test.[125] Since the patent application involved a process, the test required that the algorithm be applied to physical elements or steps.[126] Because the claim failed to apply the algorithm to physical elements or steps, it did not constitute proper statutory subject matter and thus was not patentable.[127]

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115. *Id.*

116. 688 F.2d 789 (C.C.P.A. 1982).

117. *Id.* at 794-95. The court broadened the definition of mathematical algorithm to include mental processes used in solving complex problems thereby excluding more from statutory subject matter. *Id.*; *see* Chisum, *supra* note 22, at 1008-09. The court defined mathematical algorithm as any mental process that can be represented by a mathematical algorithm. *Meyer*, 688 F.2d at 794-95.

118. *Id.* at 793.

119. *Id.*

120. *Id.*

121. *Id.*

122. *Id.* at 794.

123. *Id.* at 795.

124. *Id.* at 796. The Board of Appeals determined that the repetition of the data entry steps at the very least would require "successive incrementation and/or decrementation [which would involve] addition and/or subtraction." *Id.* at 794.

125. *Id.* at 796.

126. *Id.*

127. *Id.* The Patent and Trademark Office's determination that the process was directed to a mathematical algorithm was based on the premise that all the physical steps in the process leading up to the mathematical algorithm were nothing more than data gathering steps. *Id.* at 793. The C.C.P.A. agreed that these steps "cannot make an otherwise nonstatutory claim statutory." *Id.* at 794.

Seven years later, the C.A.F.C. decided *In re Grams*,[128] a patent claim substantially similar to that in *In re Meyer*.[129] Not surprisingly, the result was the same. The court rejected the patent application.[130] The applicant claimed a process that tested a system to determine whether an abnormal condition was present.[131] The applicant further claimed that the invention could be applied to any complex system including systems which were "electrical, mechanical, chemical, biological or combinations thereof."[132] The process first required data from a number of clinical laboratory tests.[133] The remaining steps consisted of a method for analyzing the data to determine whether an abnormality existed.[134]

The *Grams* court looked to the decision of *In re Meyer*[135] in order to properly apply the *Freeman-Walter* test.[136] First, the court determined that the claim indirectly recited a mathematical algorithm.[137] Next, the court determined that the process was not applied to any physical elements or steps.[138] The C.A.F.C. found that the applicant's process claim comprised no more than a gathering of data to be used as variables in a mathematical equation.[139] The claim sought protection for an algorithm and, therefore, the process was not proper statutory subject matter under section 101 of the patent statute.[140]

In *In re Iwahashi*,[141] the C.A.F.C. held that the applicant's apparatus claim was proper patent subject matter.[142] The applicant claimed an apparatus that calculated the auto correlation coefficient.[143] At the

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128. 888 F.2d 835 (Fed. Cir. 1989).

129. *See infra* notes 178-185 and accompanying text (similar because both cases are patent claims for expert systems).

130. *Grams*, 888 F.2d at 841. The Federal Circuit stated that the exclusion of a mathematical algorithm was "at odds" with the liberal view of title 35, section 101 of the United States Code applied in *Diamond v. Chakrabarty*, 447 U.S. 303 (1980). *Grams*, 888 F.2d at 837. Congress intended statutory subject matter to include " 'anything under the sun that is made by man.' " *Id.* (quoting *Chakrabarty*, 447 U.S. at 308-09).

131. *Id.* at 836.

132. *Id.*

133. *Id.*

134. *Id.*

135. 688 F.2d 789 (C.C.P.A. 1982).

136. *Grams*, 888 F.2d at 840. The antecedent physical steps, unless novel and nonobvious that merely determine values of variables used in a mathematical formula, are not sufficient to make the entire process proper statutory subject matter. *Id.*

137. *Id.* at 837.

138. *Id.* at 839. The Court used a modified second step of the *Freeman-Walter* test. *Id.* After determining that the claim directly or indirectly recites a mathematical algorithm, the second step requires "no more than that the algorithm be 'applied in any manner to physical elements or process steps.' " *Id.* (quoting *In re* Abele, 684 F.2d 902, 907 (C.C.P.A. 1982)).

139. *Id.*

140. *Id.* at 840.

141. 888 F.2d 1370 (Fed. Cir. 1989).

142. *Id.* at 1375.

143. *Id.* at 1371. Auto correlation coefficients are used for pattern recognition such as voice

time of the application, the state of the art apparatus used to calculate auto correlation coefficients required expensive multipliers and complicated circuitry.[144] The applicant's invention reduced the amount of complex circuitry and determined the desired coefficient without the use of an expensive multiplier.[145] The applicant admitted that the claim contained a mathematical algorithm, but argued that the claim was limited to a specific apparatus and would not wholly pre-empt the algorithm.[146] The C.A.F.C. agreed and held that the claim fit within the definition of a machine or manufacture and was thus proper patent subject matter.[147]

## III. ANALYSIS

The Supreme Court's failure to concisely define a mathematical algorithm has caused inconsistencies and contradictions in lower court decisions.[148] This lack of predictability requires, at the very least, a change in the definition of an algorithm to clarify when patent applications will be denied as being based upon mathematical algorithms. Further, the courts should construe mathematical algorithms to be proper patent statutory subject matter under the definition of a process and exclude only those algorithms which are obvious to someone of ordinary skill in that art.[149]

### *A. Judicial Exclusion of Mathematical Algorithms*

The Supreme Court defines an algorithm as "[a] procedure for solving a given type of mathematical problem."[150] This definition is problematic because it is inconsistent with the common definition of the term "algorithm."[151] An algorithm is commonly defined as "a step-by-

144. *Id.*

145. *Id.*

146. *Id.* at 1374-75.

147. *Id. See generally* Pamela Samuelson, *Benson Revisited: The Case Against Patent Protection For Algorithms and Other Computer Program Related Inventions*, 39 EMORY L.J. 1024, 1102 n.294 (1990). The Federal Circuit's ruling in *In re Iwahashi* demonstrates that the form of the claim of apparatus instead of process can make a difference in deciding patent subject matter. *Id.* The court ruled in favor of the claim because it contained reference to a unit which contained specific structured limitations which satisfied the *Freeman-Walter* test. *Id.*

148. *See infra* notes 178-200 and accompanying text.

149. 35 U.S.C. § 103 (1988).

150. Gottschalk v. Benson, 409 U.S. 63, 65 (1972).

151. *See* Paine, Webber, Jackson & Curtis, Inc. v. Merrill Lynch, Pierce, Fenner & Smith, Inc., 564 F. Supp. 1358, 1366 (D. Del. 1983). The term algorithm has been misinterpreted due to different uses of the term depending on the area of expertise. *Id.* The general definition of the term algorithm may be misleading and unnecessarily detrimental to our patent system. *In re* Chatfield, 545 F.2d 152, 156 n.5 (C.C.P.A. 1976).

step procedure for solving a problem or accomplishing some end."[152] The confusion resulting from the Supreme Court's definition, along with inconsistent lower court interpretations, requires at least a more precise definition[153] or a complete elimination of the algorithm exception[154] to statutory subject matter.

The mathematical algorithm exception to patent subject matter developed out of the established rule that an idea itself is not patentable.[155] Although a novel and useful application of a scientific truth or mathematical expression is patentable, the truth or the expression in the abstract cannot be patented.[156] The practical reason for nonpatentability of mathematical formulae is that an algorithm, in the abstract, is a basic tool required for all scientific and technological work.[157] By permitting patent claims that pre-empt[158] mathematical algorithms, the law would allow a seventeen year monopoly on basic abstract ideas that are the foundational tools required for further scientific or technological development.[159] The United States Supreme Court in *Gottschalk v. Benson*[160] used this basic premise to define a mathematical algorithm and to exclude patent applications with statutory subject matter process and apparatus claims that pre-empt mathematical algorithms.[161]

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152. WEBSTER'S NINTH NEW COLLEGIATE DICTIONARY 70 (1988).

153. *See* Diamond v. Diehr, 450 U.S. 175, 219 (1980) (Stevens, J., dissenting) (equating algorithm with the term computer program). The *Benson* decision created problems because the court tried to create a legal distinction between "mathematical and non-mathematical" and "algorithms and mental steps." Newell, *supra* note 54, at 1024. "The Court did not acknowledge that the term 'algorithm' is 'used in differing ways in mathematics (as a formula) and in programming (a structural sequence to solve a problem).' This has had a long term effect on the protection of computer software." Abrams, *supra* note 1, at 132 (footnote omitted). The determination of patentability of computer software "turns on the meaning of the term 'mathematical algorithm': identifying this creature, and thus the initial limits of what is patentable software-related subject matter, has posed substantial difficulties for the courts." CARY H. SHERMAN, HAMISH R. SANDISON & MARC D. GUREN, COMPUTER SOFTWARE PROTECTION LAW, § 403.1(c)(1) (1989).

154. *See In re* Grams 888 F.2d 835, 837 (Fed. Cir. 1990). An application of an algorithm seems to indicate a type of process which should be contemplated as proper statutory subject matter under title 35, section 101 of the United States Code. *Id.* The *Benson* decision, holding mathematical algorithms unpatentable was poorly reasoned and irreconcilable with the case law since the decision. Chisum, *supra* note 22, at 961.

155. *See supra* notes 28-29 and accompanying text; *see also* Chisum, *supra* note 22, at 967 (mental steps, one of the limitations on the scope of the patentability of algorithms, developed out of difference between abstract ideas and application of abstract ideas).

156. MacKay Radio & Tel. Co. v. Radio Corp., 306 U.S. 86, 94 (1938).

157. LeRoy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852).

158. *See supra* note 63 (defining pre-emption of an algorithm).

159. *See* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948). The Court stated basically that one who discovers an unknown phenomenon of nature has no right to monopolize the discovery. *Id.*

160. 409 U.S. 63, 67 (1972).

161. *See* Chisum, *supra* note 22, at 978-980 (describing Court's rationale in determining that the mathematical algorithm is a law of nature).

The mathematical algorithm exception to patent subject matter has received considerable criticism.[162] This criticism is warranted in light of the Supreme Court's decision in *Diamond v. Chakrabarty*.[163] In that decision, the Court held that man-made microorganisms were statutory subject matter under the term "manufacture or composition of matter."[164] The Supreme Court looked to the words of section 101 of the patent statute.[165] This section states: "[w]hoever invents or discovers *any* new or useful process, machine, manufacture or composition of matter . . . may obtain a patent."[166] The Supreme Court stated that the use of such comprehensive areas of coverage modified by the term "*any*" meant that Congress intended patent law subject matter to be given a wide scope.[167] The Supreme Court went on to say that Congress intended patent law subject matter "to include 'anything under the sun that is made by man.' "[168]

By its very definition, a mathematical algorithm—which is a procedure for solving a given type of mathematical problem—constitutes a process.[169] In *Cochrane v. Deener*,[170] the Supreme Court defined a process as "an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing."[171] When a

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162. *See In re* Grams, 888 F.2d 835, 837 (Fed. Cir. 1989) (algorithms are step-by-step processes which seem to fit within the patent statute's subject matter); Richard L. Torczon, *Copyright, Patent and The Virtual Machine*, 9 COMPUTER/L.J. 321, 347 (1989) (a program or a reified algorithm meet the definition of a patent process).

> The [patent] statutory scheme, includes within its subject matter the category of "processes" in a broad sense. In the *Flook* decision, the Supreme Court admitted that a mathematical algorithm came within the normal definition of a process. Given that literal inclusion of algorithms within the patent system, the burden of proof on the excludibility of algorithms in a judicial or administrative forum should shift to the side that seeks exclusion.

Chisum, *supra* note 22, at 1011 (footnotes omitted).

163. 447 U.S. 303 (1980).

164. *Id.* at 308-09. The patent claim was for a *Pseudomonas* bacterium with 2 energy generating plasmids, each plasmid breaking down crude oil by a separate degradative pathway. *Id.* at 305. A plasmid is defined as a heredity unit separate from the chromosome of the cell. *Id.* at 305 n.1. The bacteria were man-made and valuable in the treatment of oil spills. *Id.* at 305.

165. *Id.* at 308.

166. 35 U.S.C. § 101 (1988) (emphasis added).

167. *Chakrabarty*, 447 U.S. at 308. The Court also looked at the legislative history and found support for a broad construction. *Id.* From the Patent Act of 1793, the Court determined that the statute embodied Jefferson's philosophy that ingenuity should receive liberal encouragement. *Id.*

168. *Id.* at 309 (quoting S. REP. No. 1979, 82d Cong., 2d Sess. 6 (1952), *reprinted in* 1952 U.S.C.C.A.N. 2394).

169. *See* Parker v. Flook, 437 U.S. 584 (1978). The Court conceded that the applicant's claim is a process in the ordinary sense of the word. *Id.* at 588.

170. 94 U.S. 780 (1876).

171. *Id.* at 788. Several recent Supreme Court decisions on the subject of algorithms still use this definition. *E.g.*, Diamond v. Diehr, 450 U.S. 175, 182-83 (1980); Gottschalk v. Benson, 409 U.S. 63, 69-70 (1972).

mathematical algorithm is applied to data, the data is transformed into a different state; this transformation fits within the definition of a process.[172] The United States Supreme Court in *Chakrabarty* stated that Congress intended to include a wide range of subject matter within the scope of patent protection by indicating that "*any*" process that is new and useful should be considered proper statutory subject matter.[173]

It has been argued that mathematical algorithms are basic tools necessary to perform scientific and technological work.[174] Therefore, even though a mathematical algorithm can be considered a process, it should not be considered proper statutory subject matter because it would monopolize the basic tools for scientific work.[175] This premise, however, is inconsistent with the way the patent system operates. The basic tools of research are those within the common knowledge of individuals in that particular art or science.[176] Any basic tool that is within the common knowledge of individuals in a particular art or science, including a mathematical algorithm, would be obvious and not patentable under section 103 of the patent statute.[177] If, however, the basic tool was new and useful, then it would be patentable.

### *B. Confusion in Defining a Mathematical Algorithm: The Incorrect Interpretation in Expert Systems*[178]

Another significant problem with the algorithm exception to patent subject matter is the lack of a clear definition of "mathematical

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172. *See In re* Grams, 888 F.2d 835, 837 (Fed. Cir. 1989). An algorithm, even without physical steps, appears to be a type of process. *Id.*

173. Diamond v. Chakrabarty, 447 U.S. 303, 308 (1980).

174. *See Benson*, 409 U.S. at 67 (citing LeRoy v. Tatham, 55 U.S. (14 How.) 156 (1852)).

175. *See* Parker v. Flook, 437 U.S. 584, 591 (1978) (stating that an algorithm is a basic tool needed for "scientific and technological work").

176. *See* Chisum, *supra* note 22, at 983.

177. *Id.* The author gives the example of a microscope being a basic tool in science. *Id.* A new and improved microscope would always be within the scope of patent law. *Id.* The author also considers the agreement that a mathematical algorithm is an abstract idea and therefore is not proper subject matter. *Id.* at 984. If a patent claim were too abstract it would be rejected because it would not meet the "disclosure and clear claiming requirements of the patent statute." *Id.* at 984 (footnote omitted). *See generally* Kreiss, *supra* note 75 (discussing the problem of unclear patent claims and overclaiming in applications).

178. *See* Samuelson, *supra* note 147, at 1115. An expert system is defined as "a computer program or set of programs containing a body of knowledge . . . for the application . . . to specific problems." *Id.* These systems allow the user to call on the knowledge of human experts in a particular field, for example medical diagnosis, in order to assist in solving a specific problem in that field. *Id.* at 1115-16. The computer program is set up using two experts, one with a computer science background, the other with knowledge in the area of expertise. *Id.* The computer scientist uses procedures, strategies and rules developed by the area expert to develop a data base which represents the knowledge required to solve problems in his area of expertise. *Id.* The programs are used as aids for individuals responsible for problem solving in that area of expertise. *Id. See*

algorithm."[179] The courts' definition of a procedure for solving a given type of mathematical problem is insufficient in that it fails to separate an unpatentable mathematical algorithm from a patentable process.[180] Although both the C.A.F.C. and its predecessor, the C.C.P.A., have attempted to use the *Freeman-Walter* test to categorize claims as either patentable processes or unpatentable mathematical algorithms, their decisions cannot be consistently reconciled with previous opinions. The lower courts' determination that expert systems[181] are unpatentable mathematical algorithms demonstrates the confusion and inconsistencies with previous decisions.[182]

*In re Meyer*[183] and *In re Grams*[184] represent two expert system claims rejected as being mathematical algorithms.[185] These decisions extend the definition of mathematical algorithm to reject an application that should have been patentable as a process.[186] In *In re Chatfield*,[187] the C.C.P.A. differentiated a mathematical algorithm from the broader term "algorithm."[188] The court determined that a "step-by-step procedure for solving a problem" is not the definition that the Supreme Court desired.[189] *In re Pardo*[190] took this rationale one step further and stated that the Supreme Court's definition of algorithm must be construed as only dealing with mathematical algorithms, because, if the extension included the common definition of the term "algorithm," it

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*generally* Tod M. Turley, Comment, *Expert Software Systems: The Legal Implications*, 8 COMPUTER/L.J. 455 (1988) (fully describing and discussing expert systems).

179. *See* Newell, *supra* note 54, at 1023 (stating that no matter what definition of algorithm the Supreme Court decided to use in *Benson*, it was doomed to fail because of the way algorithms are conceptualized by the public).

180. *See* Parker v. Flook, 437 U.S. 584, 589 (1978). The Supreme Court stated that "[t]he line between a patentable 'process' and an unpatentable 'principle' is not always clear. Both are 'conceptions of the mind, seen only by their effects when being executed or performed.'" *Id.* (quoting Tilghman v. Proctor, 102 U.S. 707, 728 (1880)).

181. *See supra* note 178 and accompanying text.

182. *See In re* Pardo, 684 F.2d 912, 915 (C.C.P.A. 1982) (stating that the Supreme Court's definition only excludes mathematical algorithms); *In re* Musgrave, 431 F.2d 882, 889 (C.C.P.A. 1970) (rejecting patent claims because some or all steps could be performed by the human mind is unsound and has no statutory basis). The definition of mathematical algorithm is quite different in cases involving expert system or their previously decided cases. Samuelson, *supra* note 147, at 1119-20. A case involving an expert system broadened the definition of mathematical algorithm to include mental processes. Chisum, *supra* note 22, at 1008.

183. 688 F.2d 789 (C.C.P.A. 1982).

184. 888 F.2d 835 (Fed. Cir. 1989).

185. *See generally* Samuelson, *supra* note 147, at 1113. The Patent Trademark Office has issued patents for expert systems innovations. *Id.*

186. *See* Chisum, *supra* note 22, at 1009.

187. 545 F.2d 152 (C.C.P.A. 1976).

188. *Id.* at 156 n.5.

189. *Id.* To define a mathematical algorithm in its common usage would be "unnecessarily detrimental to our patent system . . . ." *Id.*

190. 684 F.2d 912 (C.C.P.A. 1982).

would exclude all processes from patentability.[191] A process by its very definition represents a step-by-step process.[192]

*In re Meyer* and *In re Grams* are both examples of a step-by-step process for solving a given problem. Because the *In re Grams* opinion is based on *In re Meyer*, the remainder of this argument will focus on the *Meyer* decision. The *Meyer* claim was for an expert system useful in assisting in the diagnosis of neurological disorders.[193] The system took the results of many neurological tests, analyzed the results, and then narrowed the possible neurological ailments.[194] The claim basically acted as a "memory aid" for physicians.[195] The court concluded that minimal mathematical calculation was involved in the process.[196] The rejection was based on the fact that the applicant's process claim represented "mental processes . . . for communicating possible solutions to complex problems."[197] In coming to this conclusion, the C.C.P.A. equated mathematical algorithms with mental processes, a correlation clearly outside the definition of mathematical algorithms as defined in *Pardo*.[198] This definition is more in line with the mental steps

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191. *Id.* at 915.

192. *Id.*

193. *In re* Meyer, 688 F.2d 789, 793 (C.C.P.A. 1982). Claim 1 is representative of the claim and states:

> 1. A process for identifying [*sic*] locations of probable malfunction in a complex system, said process comprising the steps of:
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> (a) selecting a plurality of elements in the complex system, said elements having known locations;
>
> (b) initializing a factor associated with each of said elements;
>
> (c) testing the complex system for a response, which response, if effective, requires proper functioning of certain said elements, the probable identity [*sic*] of at least some of these certain elements being known;
>
> (d) determining whether said response of the complex system was at least partially effective or ineffective;
>
> (e) modifying the factor associated with at least some of said elements known to be possible [*sic*] involved in the response in accordance with the effectiveness of the response; and
>
> (f) repeating steps (c), (d) and (e) for further responses of the complex system to obtain resultant factors for at least some of said elements,
>
> whereby said resultant factors are indicative of probable malfunction of their associated elements and thereby indicative of probable malfunction at the location of these elements.

*Id.* at 792-93. It is clear that the method claimed does not contain a specific mathematical content.

194. *Id.* at 790.

195. *Id.* at 793.

196. *Id.* at 794. The court determined that repeating several steps in the process required at least addition and subtraction. *Id.*

197. *Id.* at 794-95.

198. *Id.* at 794; *see In re* Pardo, 684 F.2d 912, 915 (C.C.P.A. 1982). The court stated " 'a refusal to recognize that *Benson* was concerned only with mathematical algorithms leads to the absurd view that the Court was reading the word "process" out of the statute.' " *Id.* (quoting *In re* Freeman, 573 F.2d 1237, 1246 (C.C.P.A. 1978)).

doctrine which the C.C.P.A. has subsequently abandoned.[199] The considerable inconsistencies in these cases demonstrate the difficulty in defining the term "mathematical algorithm."[200]

### C. *Nonobviousness: A Method for Excluding Certain Algorithms*

If a process or apparatus containing an algorithm is determined to be proper statutory subject matter, the application is further analyzed under sections 102[201] and 103[202] to determine if the claim is novel and nonobvious. The nonobvious requirement is an effective way to eliminate claims containing algorithms that would be obvious to someone of ordinary skill in that art.[203]

The use of the nonobvious requirement to eliminate a claim containing an algorithm is exemplified in *Ex Parte Bonne*.[204] The applicant claimed an apparatus used to determine the combustion efficiency of a burner.[205] The apparatus contained sensors that determined the temperature and oxygen content of the burner's exhaust.[206] The sensor data was incorporated into a computer which applied a mathematical

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199. *See supra* notes 42-45 and accompanying text (stating mental steps doctrine is unsound and has no statutory basis).

200. *See also In re* Toma, 575 F.2d 872 (C.C.P.A. 1978). The C.C.P.A. held that a method for operating a digital computer to translate from one natural language to another specified natural language was patentable subject matter. *Id.* at 874. The fact that translation can be done in a human mind does not make the claim invalid. *Id.* at 877-78. To determine statutory subject matter, one should not look to how the computer operates (addition, subtraction, multiplication, division), but what the computer is doing. *In re* Bradley, 600 F.2d 807, 812 (C.C.P.A. 1979). If data is manipulated in the computer and the final result is a page of a telephone directory, it would be patentable subject matter because the final information does not have mathematical consequences. *Id.*

201. 35 U.S.C. § 102 (1988); *see supra* note 20 (for entire text of section 102).

202. 35 U.S.C. § 103 (1988); *see supra* note 21 (for text of section 103).

203. *See* Graham v. John Deere Co., 383 U.S. 1 (1966). The Court determined that the legislature intended to codify judicial precedent. *Id.* at 15. In order to determine the obviousness of the claim, the court must look to the scope and content of the prior art; the difference between the prior art and the applicant's invention; and the level of ordinary skill in that art. *Id.* at 17. The Federal Circuit court lists six factors used to determine ordinary skill in the art: educational level of the inventor; particular problems encountered in the art; prior solutions to those problems; how rapidly innovations are made; sophistication of the technology; and educational level of workers in the field. Orthopedic Equip. Co., v. All Orthopedic Appliances, Inc., 707 F.2d 1376, 1381-82 (Fed. Cir. 1983). Because of the Supreme Court decision in *Diamond v. Diehr* allowing computer software to be statutory subject matter, "[n]ovelty and nonobviousness will become the critical parameters for [computer software] and statutory subject matter will recede into the background." R. O. Nimtz, Diamond v. Diehr: *A Turning Point*, 8 RUTGERS COMPUTER & TECH. L.J. 267, 267 (1981).

204. PTO Serial No. 885,070 (PTO Board of Appeals Dec. 28, 1981) (unpublished opinion), *reprinted in* Simenauer, *supra* note 30, at 911.

205. *Id.*

206. *Id.*

algorithm to determine the combustion efficiency.[207] At the time the application was submitted, another apparatus which had sensors that measured the identical parameters was already patented.[208] The sole difference between the prior art and the new application was the computer computation of the mathematical algorithm.[209] The Board of Appeals determined that one of ordinary skill in the art, aware of the previously known algorithm[210] and faced with the same problem, would have found it obvious to employ the applicant's apparatus claim.[211] The Board of Appeals, therefore, rejected the application under section 103 of the patent statute.[212]

Although few patent claims containing algorithms have been challenged under section 103, this requirement remains a viable means of preventing pre-emption of an algorithm that is common knowledge in a particular art.[213] At the same time, challenges under the nonobviousness requisite would allow a new and useful algorithm to be properly patented under section 101 as a process.

An approach consistent with the underlying policies of patent law would recognize mathematical algorithms as proper statutory subject matter and exclude only those algorithms that would be obvious to someone of ordinary skill in that art. This approach rewards an inventor's skill and labor by granting exclusive rights to the invention for a specified term[214] and creates an incentive for inventors to use their skill and labor to further scientific advancement.[215] These advancements, especially in the field of computer software, are inhibited by the exclusion of mathematical algorithms from proper patent statutory subject matter. Since the invention containing a mathematical algorithm may not receive patent protection, the incentives for inventors to produce such scientific advancements are lessened.

Public benefit must be a consideration in granting an inventor exclusive rights to an invention.[216] Prior to granting a patent, courts must

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207. *Id.* at 912.

208. *Id.* at 913-14.

209. *Id.* at 914.

210. *Id.* The algorithm, regardless of its novelty, was within the prior art. *Id.* The outcome, however, would be identical if the algorithm was actually of common knowledge in the prior art. *Id.*

211. *Id.*

212. *Id.*

213. *See In re* Pardo, 684 F.2d 912, 917 (C.C.P.A. 1982). The claimed invention containing an algorithm would not be obvious to a person of ordinary skills in the art. *Id.* The application, therefore, was held to be valid. *Id.*

214. Title 35, section 154 of the United States Code provides an inventor the exclusive rights to use and sell an invention for a seventeen year term. 35 U.S.C. § 154 (1988).

215. *See supra* note 15 and accompanying text.

216. Sinclair & Carroll v. Interchemical Corp., 328 U.S. 327, 330-31 (1945).

determine whether the benefit to the public in obtaining disclosure of the invention outweighs the burden to the public in granting the inventor exclusive rights to the invention.[217] If a mathematical algorithm is obvious to a person of ordinary skill in that art, the benefit to the public in obtaining that invention would not outweigh the burden that the public would bear in granting exclusive rights. The underlying policies of the patent system are better achieved by excluding only algorithms that are obvious to a person with ordinary skill in the art under section 103.

## IV. CONCLUSION

An algorithm, whether considered mathematical or nonmathematical, is a process. As a process, it should be patentable subject matter under section 101 of the patent statute if it is new and useful. The judicial exclusion of mathematical algorithms from statutory subject matter is inconsistent with the Supreme Court's broad interpretation of patent subject matter. The fact that lower courts are unable to clearly define a mathematical algorithm demonstrates the need to abandon judicial reliance on such terms for determining patentability. By permitting mathematical algorithms to be patent statutory subject matter and excluding algorithms obvious to one with ordinary skill in that art, the policies underlying the patent system are more adequately fulfilled. Patent applicants, courts, and the public would benefit from the abandonment of the mathematical algorithm exclusion.

*Patrick Edward Beck*

217. *See supra* note 15 and accompanying text.