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Software Patent Protection: A Problem-Solution Theory for Harmonizing the Precedent, 12 *Computer L.J.* 25 (1993)

Lance L. Vietzke

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NOTES

SOFTWARE PATENT PROTECTION: A PROBLEM-SOLUTION THEORY FOR HARMONIZING THE PRECEDENT

by LANCE L. VIETZKE*

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* B.E.E. 1988, University of Minnesota; third year student at William Mitchell College of Law; Law Clerk at Merchant, Gould, Smith, Edell, Welter & Schmidt, P.A., Minneapolis, Minnesota.

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INTRODUCTION

As the software industry has emerged from infancy, it holds a wealth of opportunities and vast potential for continued growth.¹ The United States Commerce Department predicted in 1990 that the software industry would continue to grow by twenty to thirty-five percent each year throughout the 1990s.² Furthermore, worldwide software sales could reach one trillion dollars by the year 2000.³ The numbers alone show the opportunities available for software companies, and, with the increasing amounts of revenue, protecting the valuable software assets of these companies will be critical in the global marketplace.

The United States is the dominant force in the software industry.⁴ In the United States, software companies have increasingly turned to the patent system for protection of their software programs.⁵ Patents provide a stronger and more well-defined method of protection when compared with other forms of protection such as copyrights.⁶ As the software market continues to grow and mature, patents will play a key role in allowing software companies to carve a niche in the market,⁷

1. See, e.g., Whitmeyer, Comment, *A Plea for Due Process: Defining the Proper Scope of Patent Protection for Computer Software*, NW. U.L. REV. 1103 (1991) Goodman, Note, *The Policy Implications of Granting Patent Protection to Computer Software: An Economic Analysis*, VAND. L. REV. 148 (1984). Software is one of the fastest-growing global markets. Burton, *Can U.S. Software Industry Hold Its Lead?; Piracy and Patent Issues Worry Domestic Firms Despite 60% Share of Total Market*, INVESTOR'S DAILY, Apr. 17, 1990, at 1.

2. Burton, *supra* note 1.

3. *Id.*

4. United States software companies held sixty percent of the global software market in 1990. *Id.* It is estimated that United States companies develop seventy percent of the software sold in Europe and fifty percent of the software sold in Japan. *Id.*

5. Busse, *Patents Gain Favor with Software Firms; Vendors Slow to Adopt Old Weapon*, INFOWORLD, Aug. 26, 1991, at 82. In 1990, 6500 computer patent applications were filed with the Patent and Trademark Office, compared with 3200 in 1987. Apple Computer, Inc. applies for about 50 patents each year. *Id.*

6. See Bender, *The Case for Software Patents*, 6 COMPUTER LAW, May 1989, at 4; Sumner & Lundberg, *The Versatility of Software Patent Protection: From Subroutines to Look and Feel*, 3 COMPUTER LAW, June 1986, at 1.

7. See Chisum, *The Patentability of Algorithms*, 47 U. PITT. L. REV. 959, 1016-17 (1986); but see Samuelson, *Benson Revisited: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025, 1136 (1990) (arguing in favor of copyright law as exclusive protection for software).

and, in particular, maintaining the dominance of domestic software companies by providing powerful software protection. This software patent protection will allow, for example, domestic software companies to bar the importation of pirated versions of their programs⁸ or potentially obtain preliminary injunctions against alleged infringers.⁹

The law related to software patents, unfortunately, has not been crystal clear.¹⁰ Even though the Supreme Court has firmly established patent protection for software,¹¹ the Supreme Court precedent related to computer-implemented inventions has been subject to various interpretations.¹² As a result of the confusion and contradictions in the law, the courts may have provided inadequate guidance to the United States Patent and Trademark Office (PTO) regarding the type of software patents that the PTO should issue.¹³ To worsen the situation, the PTO feels a certain sense of external pressure¹⁴ due to emotionalism over the whole software patent debate¹⁵ and, as a result, may often make patentable subject matter an issue in software cases that are already within the boundaries encompassed by patentable subject matter.¹⁶ One cannot necessarily place the blame for this on the PTO, however,

8. See, e.g., *Intel Corp. v. United States Int'l Trade Comm'n*, 946 F.2d 821, 825 (Fed. Cir. 1991) (barring importation of EPROMS manufactured abroad). Piracy has been a serious problem in the software industry. It is estimated that piracy cost the United States software industry \$1.3 billion in lost revenues between 1981 and 1984. R. BENKO, *PROTECTING INTELLECTUAL PROPERTY RIGHTS: ISSUES AND CONTROVERSIES* 39 (1987).

9. Bender, *supra* note 6, at 3.

10. G. DAVIS, *SOFTWARE PROTECTION: PRACTICAL AND LEGAL STEPS OF PROTECT AND MARKET COMPUTER PROGRAMS* 159 (1986).

11. *Diamond v. Diehr*, 450 U.S. 175, 192-93 (1981).

12. See *Arrhythmia Research Tech., Inc. v. Corazonix Corp.*, 958 F.2d 1053, 1057 n.4 (Fed. Cir. 1992).

13. See Barrett, *Patentable Subject Matter: Mathematical Algorithms and Computer Programs*, 1106 OFF. GAZ. U.S. PAT. & TRADEMARK OFF. 5, 11 (1989).

14. G. GOLDBERG, *TOTAL QUALITY MANAGEMENT; POSITION PAPER GROUP 230; CLAIM ANALYSIS & REVIEW 1* (1990) (this document was obtained from the PTO through Freedom of Information Act Request No. 92-116). "The Office, and our group have come 'under fire' for allowing applications that are perceived as being either well know [sic] (unpatentable) or claiming non-statutory subject matter[.]" *Id.* "The whole 'software' question is very sensitive. Congress and many members of the public are and will be watching what we do. If too many patents are issued that are borderline or are perceived as being borderline the unfriendly publicity could adversely affect us." *Id.* at 5. Mr. Goldberg is the director of Group 230 in the PTO, which group is responsible for examining many software patent applications. Mr. Goldberg distributed this position paper to the examiners in Group 230.

15. See, e.g., *The League for Programming Freedom, Viewpoint Against Software Patents*, 35 COM. OF ACM Jan. 1992, at 17.

16. See GOLDBERG, *supra* note 14, at 4.

Claims that deal with "computer programs," equations or mathematical calculations, or methods which might be suspect under the Supreme Court exclusions—such as methods of doing business, abstract intellectual concepts, printed matter

since it may result from a combination of lack of guidance¹⁷ and intense pressure from a watchful public and those opposed to software patent protection.

It is important to determine the exact scope and meaning of the Supreme Court precedent related to computer-implemented inventions. This precedent in part establishes the legal basis for software patents. This Note analyzes the history of patent protection for software inventions. This Note also constructs a synthesized definition for "mathematical algorithm" and sets forth a problem-solution theory for harmonizing the cases related to computer-implemented inventions. Part I discusses the history of computer-implemented inventions as patentable subject matter. Part II explains a definition for "mathematical algorithm" and discusses the problem-solution theory.

I. HISTORY OF SOFTWARE PATENT PROTECTION

A. THE SUPREME COURT PRECEDENT

1. *Gottschalk v. Benson: The Fundamental Rule*

The invention¹⁸ at issue in *Gottschalk v. Benson*¹⁹ related to number conversion. Benson had invented a method of converting binary coded decimal (BCD) numbers into the corresponding pure binary numbers.²⁰ The binary system is a way of representing numbers using

etc., need to be carefully analyzed If the claim is the *least bit suspect* regarding the 101 question—*make the rejection*.

Id. (emphasis added). Supreme Court exclusions for patentable subject matter under 35 U.S.C. § 101 include mathematical algorithms.

17. *See, id.* at 4. If an examiner in the PTO rejects an applicant's claims as being unpatentable subject matter, "[a]pplicant will probably amend his claims to clearly place them in a statutory category which should help avoid criticism. If he does not, and an appeal is filed, we may get guidance from the Board of Appeals decision." *Id.*

18. An "invention" means that which is defined in the patent claims, the legal definition of the invention, and for which the law offers certain rights in exchange for the patentee's public disclosure of the invention. A patent grants to the patentee for seventeen years the "right to exclude others from making, using or selling the invention[.]" 35 U.S.C. § 154 (1991).

19. 409 U.S. 63 (1972).

20. One of the appealed claims 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 reentrant shift register,
- (2) shifting the signals to the right by at least three places, until there is a binary '1' in the second position of said register,
- (3) masking out said binary '1' in said second position of said register,
- (4) adding a binary '1' to the first position of said register,
- (5) shifting the signals to the left by two positions,
- (6) adding a '1' to said first position, and
- (7) shifting the signals to the right by at least three positions in preparation for a succeeding binary '1' in the second position of said register.

only the digits 0 and 1 in what is also referred to as the base-two system.²¹ In comparison, the standard base-ten number system uses ten numerals for representing numbers, and each position of the numeral represents a power of ten. In binary, each position of a numeral represents a power of two.²² For example, the number "4" in base-ten is equal to 100 in binary; the "1" in the third position represents 2². In the BCD system, each base-ten numeral from 0 to 10 can be represented by any four-digit binary number.²³ For example, the base-ten numeral 53 is represented in BCD as 0101 0011, with the first numeral (0101) representing 5 and the second numeral (0011) representing 3. In comparison, base-ten 53 equals binary 110101.²⁴

BCD is a convenient way of representing pure binary numerals. Even though computers operate on binary numbers, BCD is often used by peripheral computer devices. Seven segment decoders, for example, are a common and well-known device that operates on BCD numerals.²⁵ A seven segment decoder is a device that displays characters or numerals. Calculators, for example, often use seven segment decoders for each element of the display, with a separate seven segment decoder displaying each numeral of a calculator output. As the name suggests, a seven segment decoder uses seven individual elements for displaying a numeral. A total of seven segments are required for displaying any numeral between 0 and 9. A seven segment decoder displays the numeral 8, for example, by illuminating or activating all seven of the segments.²⁶

Seven segment decoders typically receive BCD numerals as an input signal.²⁷ Calculators, however, utilize electronics that operate on pure binary numbers. As the calculator user presses the buttons and instructs the calculator to perform various mathematical functions, the electronics inside of the calculator perform the various mathematical functions on pure binary numbers. The calculator may receive BCD input numbers and will then convert²⁸ those numbers to binary for performing the mathematical calculations. When the calculator has obtained the final result for display, the pure binary number must be converted into the corresponding BCD numerals for display by the seven segment decoders. A conversion routine converts the pure binary

Gottschalk v. Benson, 409 U.S. 63, 73-74 (1972).

21. M. MANO, DIGITAL DESIGN 4-6 (1984).

22. *Id.*

23. *Id.* at 17.

24. *Benson*, 409 U.S. at 67.

25. MANO, *supra* note 21, at 151, 444.

26. *Id.*

27. *Id.*

28. Several types of BCD to binary conversion routines are possible. See, e.g., *Benson*, 409 U.S. at 73-74; K. SHORT, MICROPROCESSORS AND PROGRAMMED LOGIC 230-32 (1981).

number into the corresponding series of BCD numerals, and each BCD numeral is then input to the seven segment decoder for the corresponding position on the display. The series of activated seven segment decoders thus displays to the user the final result in base-ten.

Benson had attempted to claim an algorithm for BCD to binary conversion without regard to the purpose for which it was used.²⁹ The Benson invention was not limited to calculators or seven segment decoders, nor was it limited even to display or input devices. Any computer, or computer-related device, implementing Benson's BCD to binary conversion algorithm would have been covered by the claim at issue.

Benson's claims were rejected by the PTO as directed to nonstatutory subject matter.³⁰ The Court of Customs and Patent Appeals (CCPA), however, upheld the claims as statutory. The PTO then sought review in the Supreme Court to determine whether indeed the claims defined patentable subject matter contemplated by the statute.³¹

It was well known even before *Benson* that mathematics *per se* are not patentable.³² It was also known, however, that a computer programmed to operate in a new way is a statutory invention.³³ These two principles thus tend to conflict when a computer is operating to perform mathematical functions. The problem becomes deciding when a computer operating in a new way to perform mathematical functions does not violate the principle that pure mathematical formulas may not be patented.

The Court first recognized the basic principles underlying non-patentable subject matter classes.³⁴ Abstract ideas, scientific principles, and laws of nature are not patentable subject matter.³⁵ These principles have long been in existence and were even used in the days when

29. See *Benson*, 409 U.S. at 68.

30. Patentable subject matter is defined in 35 U.S.C. § 101 (1991) (emphasis added): "Whoever invents or discovers any new and useful *process*, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." "Process," as used in 35 U.S.C. § 101 (1991), 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 (1991).

31. *Benson*, 409 U.S. at 64.

32. See, e.g., *Mackay Co. v. Radio Corp.*, 306 U.S. 86, 94 (1939). Other exceptions to patentable subject matter include scientific principles (*id.*), and ideas (*Rubber-Tip Pencil Co. v. Howard*, 87 U.S. 498, 507 (1874)); *Jennings v. Brenner*, 255 F. Supp. 410, 412 (D.C. 1966); see also *Hughes, The Philosophy of Intellectual Property*, 77 GEO. L.J. 287, 320 (1988) (ideas representing facts about the world are not patentable)).

33. *In re Prater*, 415 F.2d 1393, 1403 n.29 (C.C.P.A. 1969); *In re Bernhart*, 417 F.2d 1395, 1400 (C.C.P.A. 1969).

34. *Benson*, 409 U.S. at 67.

35. See *supra* note 32 and accompanying text.

Samuel Morse developed the telegraph to hold that one of Morse's claims for telegraphy was directed to non-patentable subject matter.³⁶ Morse had obtained many patents on telegraphy, and one of his claims defined the use of "electromagnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances."³⁷ With this claim, Morse was covering not only the embodiments he had disclosed, but also any future, and at the time unknown, embodiments that would produce signs for telegraphy.³⁸

Morse's rejected claim may be viewed as fitting into the non-patentable category of abstract ideas. Specific hardware apparatus for performing telegraphy is certainly a statutory invention, because it is a machine.³⁹ Morse, however, was attempting to patent the abstract idea of using electromagnetism for telegraphy, because his claim would have covered any system that performed the claimed function.⁴⁰

It was also well known at the time of *Benson* that laws of nature and scientific principles are not patentable.⁴¹ Einstein could not have patented his well-known formula that $E=mc^2$. Likewise, Newton could not have patented his law that $F=ma$. Laws of nature, and scientific principles, represent the common tools of science that are available for all to use.⁴² To allow one to patent scientific principles would be contrary to promoting scientific progress.

The Court then applied these well-known principles to Benson's invention.⁴³ Like with Morse's rejected claim, Benson was attempting to patent any use of BCD to binary conversion. The Court recognized that Benson's claim would cover any known and unknown apparatus for performing the claimed number conversion. Furthermore, Benson had set forth no precise application of his invention. As stated by the Court, the end use may vary from the operation of a train to verification of drivers' licenses to researching the law books for precedents.⁴⁴ Allowing Benson a claim for his number conversion would in effect have been allowing the claim for the pure mathematical steps involved. Benson's claim effectively pre-empted the mathematical formula used in the number conversion. The finding of pre-emption means that one

36. *O'Reilly v. Morse*, 56 U.S. 62 (1852).

37. *Id.*

38. *Id.*

39. 35 U.S.C. § 101 (1991); see also *In re Iwahashi*, 888 F.2d 1370, 1375 (Fed. Cir. 1989).

40. *Morse*, 56 U.S. at 113.

41. *Le Roy v. Tatham*, 55 U.S. 156 (1853).

42. *Diamond v. Diehr* 450 U.S. 175, 185 (1981) (citing *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980)).

43. *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972).

44. *Id.* at 68.

could not use the mathematical formula without infringing Benson's claim.⁴⁵

The Court appeared to create a new class of non-patentable subject matter: mathematical algorithms.⁴⁶ The Court defined a mathematical algorithm as a "procedure for solving a given type of mathematical problem."⁴⁷ Benson's claim fit into this category, since the mathematical problem presented was number conversion. The key to avoiding this class of non-patentable subject matter was to avoid pre-emption of the mathematical procedure or formula defined in a particular claim. Ambiguity arose in the scope of the Court's holding, because it was often difficult to determine exactly what is a mathematical problem, and determining what is a mathematical problem is a necessary prerequisite to determining if a claim contains a mathematical algorithm.⁴⁸

Finally, the Court urged to Congress to address the matter.⁴⁹ The Court expressly did not intend to preclude a patent for any computer program. However, the Court seemed hesitant to rush into a new area of technology without congressional approval.

2. *Parker v. Flook: Using Obviousness to Determine Patentable Subject Matter*

In 1978, the Supreme Court in *Parker v. Flook*⁵⁰ added a new twist to the mathematical algorithm rule. The claimed invention at issue de-

45. *See id.* at 72.

46. Software algorithms in general—step-by-step computer-implemented processes—are ordinarily patentable subject matter if no mathematical algorithm is involved in the process. *See In re Maucorps*, 609 F.2d 481, 486 (C.C.P.A. 1979); *In re Sarkar*, 588 F.2d 1330, 1333 (C.C.P.A. 1978); *In re Toma*, 575 F.2d 872, 877 (C.C.P.A. 1978); *In re Freeman*, 573 F.2d 1237, 1245 (C.C.P.A. 1978); *In re Deutsch*, 553 F.2d 689, 693 (C.C.P.A. 1977); *In re Chatfield*, 545 F.2d 152, 158-59 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977). Accordingly, a common approach to demonstrating that a patent claim contains patentable subject matter is to demonstrate that a mathematical algorithm is not involved, *Sarkar*, 588 F.2d at 1333, that patentable subject matter remains if the mathematical algorithm is removed, *In re Noll*, 545 F.2d 141, 147 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977) (claim as a whole must be analyzed for patentable subject matter), or that the mathematical algorithm is not pre-empted but, rather, is applied to a statutory process or system. *Diamond v. Diehr*, 450 U.S. 175, 187 (1981); *See Barrett, supra* note 13, at 10 (interpreting *Diehr*).

47. *Benson*, 409 U.S. at 65.

48. The courts tend to analyze the underlying purpose of a claim so that the *Benson*, rule may not be avoided by ingenious ways of defining inventions. *See Parker v. Flook*, 437 U.S. 584 at 593 (1978) (broadly interpreting *Benson*). Therefore, for example, even if inventions are defined with means-plus-function clauses, 35 U.S.C. § 112, para. 6 (1991), a court may find that the claim is actually directed to the solution of a mathematical algorithm. *See, e.g., In re Abele*, 684 F.2d 902, 910 (C.C.P.A. 1982) (an apparatus included a mathematical algorithm because of the recitation of a "calculating means").

49. *Benson*, 409 U.S. at 72-73.

50. 437 U.S. 584 (1978).

defined a process for updating an alarm limit.⁵¹ One of the steps to the process used a mathematical equation for calculating a new alarm base B_1 . In comparison to *Benson*, however, the claim included more than simply a solution to a mathematical formula. The preamble of the claim specifically set forth an end use for the process—catalytic chemical conversion of hydrocarbons.⁵²

The Court considered whether the claim defined patentable subject matter. The Court more specifically considered whether the additional limitations in Flook's claim were sufficient material to avoid pre-emption of a mathematical formula. The analysis of whether it was patentable, unfortunately, also included determining whether it was both directed to patentable subject matter and novel.⁵³

Pre-emption was non-existent in Flook's claim.⁵⁴ The Court initially followed the *Benson* analysis by determining whether Flook's claim entirely pre-empted the formula for updating an alarm limit. The Court quickly recognized that, while there may be many uses of the alarm limit formula in the petrochemical industry which would be covered by the claim, other uses of formula may exist which would not infringe the claim. Even though the claim would potentially have had a very broad scope, it would not have been in effect a claim on the formula itself. The claim at issue, therefore, did not pre-empt the formula.⁵⁵ This conclusion alone should have been enough to avoid the mathematical algorithm rule of *Benson* and find that the claim defined patentable subject matter.⁵⁶

51. Claim 1 reads:

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

$$B_0 + K$$

wherein B_0 is the current alarm base and K is a predetermined alarm offset which comprises:

(1) Determining the present value of said process variable, said present value being defined as PVL;

(2) Determining a new alarm base B_1 , using the following quotation:

$$B_1 = B_0(1.0-F) + PVL(F)$$

where F is a predetermined number greater than zero and less than 1.0;

(3) Determining an 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.

52. *Id.*

53. *Id.* at 588.

54. *Id.* at 586 (“[the claims] do not, however, cover every conceivable application of the formula”).

55. *Id.*

56. See *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972).

The Court, unfortunately, then diverged into a discussion of novelty.⁵⁷ The Board of Patent Appeals and Interferences in the PTO had determined that the novel element in the claim was the mathematical formula used by process. The formula was the critical element in distinguishing the claim over the prior art. The Court seemed persuaded to use novelty as a means for drawing a line to divide non-patentable scientific principles from patentable processes. This has often been called the "point of novelty approach."⁵⁸

In using the point of novelty approach, the Court assumes that the mathematical algorithm or formula involved is in the prior art.⁵⁹ This follows from the basic principle that scientific principles, laws of nature, and abstract ideas are available for all to use. If these classes of non-patentable subject matter are the basic tools of scientific research, then whatever is in these classes must be assumed to be in the prior art. Since the formula involved in the claim was deemed to be in the prior art, the Court effectively was able to eliminate the only novel element from the claim. All that was left was in the prior art and thus the Court held the claim non-patentable.⁶⁰

Flook was also unsuccessful in arguing that post-solution activity made the claimed process patentable.⁶¹ As defined in the claim, after the process had operated on data by using the formula, additional steps are taken and operations performed on the result of the mathematical formula. These additional steps add limitations to the claim and arguably could avoid the mathematical algorithm rule. The Court did not agree.

The Court considered the post-solution activity argument to be a rule that could potentially have disastrous effects. If the Court were to allow post-solution activity to be a limitation that could bring a mathematical formula into the realm of patentable subject matter, a patent claim drafter could add post-solution activity to any scientific principle in order to potentially obtain a patent on such a process. As an example, the Court stated, as is not disputed, that the Pythagorean theorem is not patentable, since it is a scientific principle. However, a patent claim drafter could add additional post-solution activity steps to the result of the Pythagorean theorem. And, these additional steps would not create a process that defines patentable subject matter.⁶²

57. *Flook*, 437 U.S. at 594-95.

58. *See, e.g., In re Freeman*, 573 F.2d 1237, 1243 (1978) (rejecting the "point of novelty" approach).

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

60. *Id.*

61. *Id.* at 590.

62. *Id.*; *see also In re Abele*, 684 F.2d 902, 909 (C.C.P.A. 1982); *In re Walter*, 618 F.2d 758, 767-68 (C.C.P.A. 1980); *In re Gelnovatch*, 595 F.2d 32, 41 n.7 (C.C.P.A. 1979); *In re*

At the time it was decided, *Flook* contained two significant holdings. First, the Court reaffirmed the basic mathematical algorithm rule of *Benson*.⁶³ Second, the Court introduced considerations of novelty and non-obviousness into the analysis under § 101 of whether a claim defines patentable subject matter.⁶⁴ Once again, the Court urged Congress to address the matter and set forth policy as to whether computer programs should be eligible for patent protection.⁶⁵ Once again, Congress would not take up the matter and the Court would be left on its own.

If *Benson* had confused the law regarding the patentability of computer-implemented processes, *Flook* made it even worse. *Flook* complicated the § 101 pre-emption analysis by including an analysis of non-obviousness, which has developed from an entirely different line of cases. Patentable subject matter and non-obviousness had been separable requirements for patentability.⁶⁶

3. *Diamond v. Diehr: Rejecting the Obviousness Approach and Clarifying the Fundamental Rule*

Three years after *Flook*, the Supreme Court in *Diamond v. Diehr*⁶⁷ finally clarified the state of the law. The Court upheld as statutory subject matter a claim defining a process for curing rubber, which included a mathematical formula as one of the steps.⁶⁸ The Court also reaffirmed *Benson* and overruled the point of novelty principle expounded in *Flook*.

Sarkar, 588 F.2d 1330, 1332 (C.C.P.A. 1978); *In re Richman*, 563 F.2d 1026, 1030 (C.C.P.A. 1977).

63. *Flook*, 437 U.S. at 589.

64. *Id.* at 594-95.

65. *Id.* at 596.

66. *See, e.g., id.* at 600 (Stewart, J., dissenting).

67. 450 U.S. 175 (1981).

68. Claim 1 reads:

Diehr solved a problem that had plagued the industry.⁶⁹ Diehr invented a method for precisely and reliably molding raw, uncured, synthetic rubber into cured precision products. Previously, the industry had difficulty in consistently obtaining uniformly accurate cures of rubber, because the temperature inside of the rubber molding press, which determines how long to mold the rubber, often was a variable that could not be precisely known. The Diehr invention utilized a thermocouple connected to the press to determine and monitor the temperature inside of the press. Using the known Arrhenius equation, Diehr was able to repeatedly calculate the equation using continually upgraded temperature variables. The Arrhenius equation provided a press operator with a precise calculation of how long to cure the synthetic rubber. By continually re-calculating the equation with upgraded temperature variables, the press operator would obtain a precise indication of when to stop the molding process.⁷⁰

The Court had to consider the mathematical pre-emption rule as applied to the Diehr claim. The claim at issue included a mathematical formula, which alone could not define patentable subject matter. Did the claim at issue include sufficient matter, beyond the Arrhenius equation, to become statutory and still allow anyone to use the equation without infringing the claim? Furthermore, the Court was also faced with the *stare decisis* effect of the point of novelty approach set forth by the *Flook* court. Was novelty an appropriate factor in a § 101 patentable subject matter analysis?

-
1. A method of operating a rubber-molding press for precision molded compounds with the aid of a digital computer, comprising:
 - providing said computer with a data base for said press including at least, natural logarithm 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,
 - 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 a said comparison indicates equivalence.

Id. at 179 n.5.

69. *Id.* at 177-78.

70. *Id.*

The Court began with a bit of legislative history.⁷¹ Even though the *Benson* and *Flook* courts had urged Congress to address the matter, Congress had not in response amended the statute and had remained relatively silent on the issue. Perhaps since Congress had not taken up the issue, the Court analyzed the legislative history behind the term "process" in the statute defining patentable subject matter. In view of a decision in the previous term, *Diamond v. Chakrabarty*,⁷² the Court recognized that courts should not read limitations and conditions into the statute defining patentable subject matter which Congress has not expressed.⁷³ Congress had intended statutory subject matter to "include anything under the sun that is made by man."⁷⁴ Aside from the traditionally known exclusions to the statute, such as laws of nature and scientific principles, the Court was not in a position to create new classes of non-statutory subject matter, since the Court would effectively be reading severe limitations into the statute without any congressional indication that such limitations were proper or appropriate.

In view of legislative history, the Court reaffirmed and clarified the *Benson* rule.⁷⁵ *Benson* stood for the long established principle that abstract ideas, scientific principles, and laws of nature are not patentable, and *Benson* stood for no more than this. The Court reaffirmed this basic proposition of *Benson*, while limiting the holding of *Benson* to those traditionally-recognized classes of non-patentable subject matter.⁷⁶

The mathematical algorithm pre-emption rule still controlled claims with suspect subject matter. As applied Diehr's claim, however, no pre-emption existed. Diehr claimed a specific process for curing rubber, and this process used, but did not pre-empt, a mathematical equation. The Court characterized the claim as having "industrial application." Since no pre-emption existed, the claim survived the *Benson* mathematical algorithm rule.⁷⁷

The Court was still faced with the "point of novelty" approach set forth in *Flook*. Instead of reaffirming this portion of *Flook*, the Court effectively overruled this requirement and eliminated novelty and non-obviousness as requirements for patentable subject matter.⁷⁸ *Flook* had

71. *Id.* at 182-84 (discussing the Patent Acts of 1793 and 1952).

72. 447 U.S. 303 (1980).

73. *Diehr*, 450 U.S. at 182.

74. *Id.* (quoting S. REP. NO. 1979, 82d Cong., 2d Sess., 5 (1952); H.R. REP. NO. 1923, 82d Cong., 2d Sess., 6 (1952), U.S. CODE CONG. & ADMIN. NEWS 2394, 2399 (1952)).

75. *Id.* at 185.

76. *Id.*

77. *Id.* at 188.

78. *Id.* at 188-89 ("The 'novelty' of any element or steps in a process, or even of the process itself, is of no relevance in determining whether the subject matter of a claim falls within the § 101 categories of possibly patentable subject matter."). The CCPA had consistently rejected the "point of novelty" analysis. See *In re Chatfield*, 545 F.2d 152, 157

mandated that anything within the non-patentable subject matter classes, such as abstract mathematical formulas, were deemed to be in the prior art. With this in mind, the claims were then divided into old and new matter to determine if what remained, when the mathematical formulas were removed, was patentable subject matter. The *Diehr* court recognized that patentable subject matter is a distinct and separable requirement from novelty. Novelty has no place in a patentable subject matter analysis. The overruling of the point of novelty approach by the *Diehr* court avoids confusing an analysis of patentable subject matter with the often complex determinations of novelty and non-obviousness under sections 102 and 103.

B. LOWER COURT DEVELOPMENTS

1. *Pre-Diamond v. Diehr*

a. *In re Freeman: The Two-Part Test*

Six years after *Benson*, the CCPA in *In re Freeman*⁷⁹ explained the *Benson* rule by setting forth a two-part test.⁸⁰ While *Benson* established that mathematical algorithms are not patentable subject matter, *Benson* did not provide a well-defined test for evaluating claimed inventions.⁸¹ The *Freeman* court, therefore, constructed a two-part test as a tool for analyzing claims under the fundamental rule announced in *Benson*.⁸²

The invention in *Freeman* covered a computer-based method of typesetting information, including mathematical formulas.⁸³ The method provided an advantage over prior typesetting methods by posi-

(C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977); *In re Deutsch* 553 F.2d 689, 693 (C.C.P.A. 1977); *In re de Castelet*, 562 F.2d 1236, 1240 (C.C.P.A. 1977); *In re Freeman*, 573 F.2d 1237, 1243 (C.C.P.A. 1978); *In re Sarkar*, 588 F.2d 1330, 1333 (C.C.P.A. 1978); *In re Musgrave*, 431 F.2d 882, 889 (C.C.P.A. 1970).

79. 573 F.2d 1237 (C.C.P.A. 1978).

80. *Id.* at 1245.

81. *See In re Toma* 575 F.2d 872, 877 (C.C.P.A. 1978) (creating classes of claims in a search for the meaning of *Benson*); *In re Chatfield* 545 F.2d 152, 158 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977) (interpreting *Benson*, to mean that steps for solving an equation constitute non-patentable subject matter); *In re Waldbaum* 559 F.2d 611, 617 (C.C.P.A. 1977) (interpreting *Benson*, to mean that a mathematical formula must not preempt an otherwise statutory algorithm); *see also In re Johnston*, 502 F.2d 765, 774 (C.C.P.A. 1974); *rev'd*, 425 U.S. 219 (1976) (Rich, J., dissenting and requesting that the Supreme Court set limits on *Benson*).

82. *Freeman*, 573 F.2d at 1245. The two-part test is effectively a summary of previous CCPA decisions which had interpreted *Benson*. *See In re Deutsch* 553 F.2d 689, 692 (C.C.P.A. 1977). In *Deutsch*, the court distinguished the appealed claims over *Benson*, by finding that the invention at issue, a process for operating multi-unit plants, was a specific application of a mathematical formula and that only those using the formula for this specific process would be barred from using the formula itself. *Id.* at 692.

83. Claim 1 reads:

tioning symbols in a mathematical formula according to their appearance, which created a more visually appealing display.⁸⁴ The claimed process included three steps: (1) building a tree structure of symbols based on input codes; (2) creating concatenation point positions of the symbols using a local positioning algorithm; and (3) generating an image of the collection of symbols, which comprise an expression, on an output device such as a monitor.⁸⁵

The Board of Patent Appeals and Interferences in the PTO appeared to have misconstrued the meaning of "mathematical algorithm." In affirming a rejection of the claims, the Board of Appeals seemed to equate "algorithm" in the *Benson* sense with any programmed computer. The CCPA in response focused part of the analysis of the appealed claims on the meaning of "mathematical algorithm." The *Benson* holding required that the CCPA first determine what is a mathematical algorithm and then decide if the claims pre-empted such an algorithm.

The CCPA devised a two-part test for analyzing claims under the *Benson* holding. The first part of the *Freeman* test simply involved determining if the invention at issue contains a mathematical algorithm as defined in *Benson*.⁸⁶ If an invention contains a mathematical algorithm, then the invention triggers the second part of the test. Under the second part, a court analyzes an invention to determine, in a sense, whether the algorithm is the primary focus of the invention. If the claimed invention covers a patentable process that makes use of a mathematical algorithm, the invention is patentable subject matter.⁸⁷ If the invention, however, focuses on solving a mathematical formula without

1. In a computer display system comprising

(A) a display device for generating relatively-positioned symbol images in response to applied sequences of signals specifying the shape and position of said images,

(B) a data processor comprising . . . the improvement comprising means for storing additional information specifying spatial coordinate positions, relative to a reference point on a corresponding symbol, of a plurality of concatenation points associated with said corresponding symbol, and

means responsive to said control program for generating and transferring to said display device data signals specifying the coincidence of at least one specified concatenation points [sic] on adjacent symbols.

Freeman, 573 F.2d at 1240-41.

84. *Id.*

85. *Id.* at 1240.

86. *Id.* at 1245.

87. *Id.*; see *In re Taner* 681 F.2d 787, 790 (C.C.P.A. 1982) (seismic exploration using cylindrical or planar waves); *In re Sherwood* 613 F.2d 809, 818-19 (C.C.P.A. 1980), *cert. denied*, 450 U.S. 994 (1981) (converting seismic traces into a subterranean cross-sectional map); *In re Phillips* 608 F.2d 879, 883 (C.C.P.A. 1979) (process for preparing architectural specifications); *In re Toma* 575 F.2d 872, 877 (C.C.P.A. 1978) (language translation).

utilizing the formula for a particular application, the invention is not patentable subject matter.⁸⁸

In applying the test, the CCPA concluded that Freeman's invention did not even contain a mathematical algorithm.⁸⁹ The local positioning algorithm was a step-by-step process for achieving a result, which, while meeting the standard definition of an algorithm,⁹⁰ was not a step-by-step process for solving a *mathematical* problem, which is a mathematical algorithm as defined by *Benson*.⁹¹ Since the invention did not contain a mathematical algorithm, the CCPA did not apply the second part of the test. Accordingly, the second part of the two-part test originated as mere dicta from *Freeman*.

b. In re Walter: Modifying the Freeman Test

In re Walter,⁹² decided two years after *Freeman*, modified the second part of the two-part test. *Walter* clarified the analysis for determining when an invention wholly pre-empts a mathematical formula.⁹³ This analysis involves removing the mathematical algorithm from the claimed invention and then determining if what remains in the claim is patentable subject matter.⁹⁴ If a mathematical formula or algorithm has completely pre-empted the invention, then removing the algorithm will leave nothing in the claim that is statutory subject matter.⁹⁵

88. *Freeman*, 573 F.2d at 1245: The invention must not pre-empt the mathematical algorithm.

89. *Id.* at 1246.

90. A broad definition of algorithm is "a step-by-step procedure for solving a problem or accomplishing some end." WEBSTER'S NINTH NEW COLLEGIATE DICTIONARY 70 (1989); see also *In re Chatfield* 545 F.2d 152, n.5 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977).

91. *Freeman*, 573 F.2d at 1246.

92. 618 F.2d 758 (C.C.P.A. 1980).

93. The court restated the second part of the *Freeman* test. In analyzing a claim as a whole, the claim must define a specific implementation on an invention in terms of either structural relationships or process steps in order for the claimed invention to be patentable subject matter. *Id.* at 767. A specific implementation of a mathematical algorithm is analogous to applying a mathematical algorithm to an otherwise patentable process, which the Supreme Court analyzed a year later in *Diamond v. Diehr*, 450 U.S. 175 (1981).

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

95. Methods of calculating, for example, are not patentable subject matter in and of themselves. *In re Gelnovatch*, 595 F.2d 32, 41-41 (C.C.P.A. 1979); see *In re Richman*, 563 F.2d 1026, 1030 (C.C.P.A. 1977) (calculating an aircraft's velocity component); *In re de Castelet*, 562 F.2d 1236, 1244 (C.C.P.A. 1977) (solving equations to obtain a set of points along a curve); *In re Christensen*, 478 F.2d 1392 (C.C.P.A. 1973) (method of computing porosity of subsurface formations). The invention in *de Castelet* was implemented by specified hardware components that interfaced a drawing machine which produced the curves based upon calculations performed by the hardware. *de Castelet*, 562 F.2d at 1238. If the invention had been claimed as an application of the methods of calculating curves to the specific embodiment, i.e., a drafting machine, the patentee's claims would have been pat-

The invention in *Walter* was a method of unscrambling electronic signals in a seismic prospecting apparatus.⁹⁶ The apparatus generated "chirp" signals, which were transmitted downward into the earth. Various subsurface features in the earth reflected these signals at varying depths. The apparatus received these reflected signals, which were scrambled since the apparatus received the reflections at different instants in time and may have received only a portion of the original chirp signal. The invention in *Walter* cross-correlated the reflected return signals with the original chirp signal in order to unscramble the return signals.⁹⁷ The cross-correlation used mathematical techniques of comparing the return signals to the transmitted signals,⁹⁸ and these techniques further included Fourier transforms, which are a mathematical method of analyzing the components of a signal.⁹⁹

The issue in *Walter* required the CCPA to refine the second part of the two-part test. The claims at issue unambiguously included a mathematical algorithm due to the mathematical computations that the claim defined. The claims met the first part of the two-part test. Applying the second part of the two-part test would be more difficult, however, since *Freeman* had not addressed the second part of the test. The *Walter* court, therefore, seemed to inquire how the *Freeman* court would have applied the second part of the two-test.

The *Walter* modification examines how an invention uses a mathematical algorithm.¹⁰⁰ An invention is not *per se* non-patentable by simply incorporating a mathematical formula and using the formula as part of a calculation for a statutory process.¹⁰¹ An invention is, however,

entable subject matter, since the mathematical algorithms would have been applied to an otherwise patentable process.

96. The basic steps of the claim read:

7. In a method of seismic surveying . . .

the improved method of correlating . . . that comprises

a) converting said series of sample signals into an augmented series of sample signals . . .

b) forming a Fourier transform FTS_i of each respective series of signals . . .

c) forming a combined segment of each segment C_i of said reference signals . . .

d) forming a corresponding Fourier transform FTC_i of each said combined segment . . .

e) forming the non-zero conjugate complex vector products of pairs of the respective Fourier transforms and adding them together

. . . .

Walter, 618 F.2d at 761.

97. *Id.*

98. *Id.* at 769.

99. R. ZIEMER, SIGNALS AND SYSTEMS: CONTINUOUS AND DISCRETE 117-19 (1983).

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

101. *See id.* at 766; *see also* *Diamond v. Diehr*, 450 U.S. 175 (1981).

outside the scope of § 101 if it merely presents a method of solving a mathematical formula.

The court concluded that the claimed invention at issue did not define patentable subject matter. The claimed cross-correlation technique merely solved a "mathematical algorithm" in the *Benson* sense of the term.¹⁰² In applying the second part of the *Freeman* test, the court found that the invention pre-empted a mathematical algorithm because the algorithm essentially was the invention.¹⁰³ If the mathematical steps were removed from the invention, nothing remained that was patentable subject matter.¹⁰⁴ The court determined that even though a specific end use—seismology—was recited in the claim, the entire claim was directed to calculations and was thus nonstatutory.

The court also stated that the end-product of an invention is a factor to consider in the analysis. If the result is a pure number, as in this case, then the invention is not patentable subject matter. Throughout the opinion, the court used the end-product theme to distinguish the invention of *Walter* over cases in which the courts found inventions incorporating mathematical formulas to be patentable subject matter.¹⁰⁵

2. *The Aftermath of Diamond v. Diehr*

a. *In re Abele: Clarifying the Freeman Test*

*In re Abele*¹⁰⁶ clarified and explained the second part of the *Freeman* two-part test as modified by *Walter*. The invention at issue in *Abele* related to computerized axial tomography (CAT scans). CAT scans involve rotating a radiation source and detector around an area of interest to be viewed. Generally, the x-ray or radiation source must subtend the entire body, which subjects the patient's body to a considerable amount of radiation. Abele's method of processing CAT scan data allowed the use of a much narrower x-ray beam, which subjected the patient to a decreased amount of radiation.¹⁰⁷

102. *Walter*, 618 F.2d at 769. The court reasoned that the invention (method) merely solved a mathematical problem of cross-correlation. "The calculations are the beginning and end of the claims [invention]." *Id.*

103. *Id.* Even though the invention included the specific application to seismic prospecting, a court does not generally consider an end use to be a limitation of an invention when the invention is described in terms of a method. *See id.*; but see J. LANDIS, MECHANICS OF PATENT CLAIM DRAFTING 82 (2d ed. 1974).

104. *Walter*, 618 F.2d at 769; *see also* *Parker v. Flook*, 437 U.S. 584, 595 (1978). "[I]f a claim is directed essentially to a method of calculating, using a mathematical formula, even if the solution is for a specific purpose, the claimed method is nonstatutory." *Id.* (quoting *In re Richman*, 563 F.2d 1026, 1030 (1977)).

105. *Walter*, 618 F.2d at 769.

106. 684 F.2d 902 (C.C.P.A. 1982).

107. *Id.* at 903-04.

In the broadest claim, Abele included two steps, calculating and displaying.¹⁰⁸ The CAT scan data processing electronics used this method for displaying the resulting CAT scan data. The claim, however, was not limited to any particular type of data. Dependent claim 6 limited the method of claim 5 to x-ray attenuation data used in the CAT scan process.¹⁰⁹

The court had to decide whether either of these two broad claims pre-empted a mathematical algorithm processing CAT scan data. *Walter* had modified the second part of the *Freeman* test such that a mathematical algorithm must be implemented in a specific manner to define structural relationships or to limit or refine claim steps in order to be statutory.¹¹⁰ Considering the broad scope of the claims at issue, in particular claim 5, the court had to decide how far the *Walter* modification could reach to define statutory subject matter without infringing upon the fundamental rule announced in *Benson*.

The court broadened the *Walter* analysis.¹¹¹ Focusing on the theme of applied mathematical algorithms, the court stated that *Walter* did not expressly require that the claim define, limit or refine structural relationships or process steps in order to be within the realm of patentable subject matter. On the contrary, the mathematical algorithm need only be "applied in any manner to physical elements or process steps."¹¹² Mere post-solution activity or field of use limitations, however, will not be sufficient, under *Abele*, to meet the requirements of an applied mathematical algorithm.¹¹³

The applied mathematical algorithm rule fits with the *Benson* holding. *Benson* basically stated that a claim must not pre-empt a mathematical algorithm.¹¹⁴ If the mathematical algorithm is applied to a specific process, the process arguably cannot pre-empt the mathematical algorithm, because mere use of the mathematical algorithm without the

108. Claim 5 reads:

5. A method of displaying data in a field comprising the steps of calculating the difference between the local value of the data at a data point in the field and the average value of the data in a region of the field which surrounds said point for each point in said field, and displaying the value of said difference as a signed gray scale at a point in a picture which corresponds to said data point.

Id. at 908.

109. Claim 6 reads:

6. The method of claim 5 wherein said data is X-ray attenuation data produced in a two dimensional field by a computed tomography scanner.

Id.

110. *In re Walter*, 618 F.2d 758, 767 (C.C.P.A. 1980).

111. *Abele*, 684 F.2d at 907.

112. *Id.*

113. *Id.*

114. *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972).

process in which it is applied would not infringe a claim defining that specific process.

Abele's claimed invention included a mathematical algorithm. The calculating step of claim 5 was on its face a mathematical operation. A mathematical step alone was sufficient to find that the claim contained a mathematical algorithm, which required that one further analyze the claim under the second part of the *Freeman* test.¹¹⁵

The court set forth a statutory subject matter line between claims 5 and 6.¹¹⁶ Claim 5 merely presented and solved a mathematical algorithm for calculating a number. The step of displaying the result was akin to post-solution activity and thus not a sufficient limitation to pass the second part of the *Freeman* test. The mathematical algorithm of calculating, as presented in claim 5, was not applied to any specific process or further limited or defined in any way. The court thus held that claim 5 defined non-statutory subject matter.¹¹⁷

The court reached the opposite result with respect to claim 6.¹¹⁸ This claim did not pre-empt the mathematical algorithm for calculating a number, because claim 6 specified that the mathematical algorithm was operating on x-ray attenuation data produced in a CAT scan process. With this limitation, others would be free to use the algorithm, provided that it was not used in conjunction with CAT scanning. In comparing claim 6 to the improved rubber curing process of *Diehr*, the court found that *Abele* had invented an improved method of CAT scanning.¹¹⁹ Claim 6 thus defined statutory subject matter.

b. In re Grams: The Overbreadth Doctrine

*In re Grams*¹²⁰ involved a method of testing for abnormal conditions in individuals. The method involved using data derived from clinical laboratory tests on the individual. The test data was compared with predetermined values to determine an abnormal condition. If this comparison indicated an abnormality, the method further successively tested different combinations of constituents of the individual in order

115. See *In re Walter*, 618 F.2d 758, 767 (1980); *In re Freeman*, 573 F.2d 1237, 1245 (1978).

116. *Abele*, 684 F.2d at 908-09.

117. *Id.* at 909.

118. *Id.* at 908.

119. *Id.* at 909. One may view the additional limitation, at least in part, as a data gathering step. The inclusion of data gathering steps with a mathematical algorithm, however, does not necessarily result in a statutory process. See, e.g., *In re Meyer*, 688 F.2d 789 (C.C.P.A. 1982); *In re Sarkar*, 588 F.2d 1330 (C.C.P.A. 1978); *In re Richman*, 563 F.2d 1026 (C.C.P.A. 1977); *In re Chatfield*, 545 F.2d 152 (1976), *cert. denied*, 434 U.S. 875 (1977); *In re Christensen*, 478 F.2d 1392 (C.C.P.A. 1973).

120. 888 F.2d 835 (Fed. Cir. 1989).

to effectively eliminate potential abnormalities and thus narrow the class of abnormalities which could apply to the individual.¹²¹

This claim was of the type that appeared on its face to be on the borderline of patentable and non-patentable subject matter. Once again, the court had to decide how little matter, or few limitations, could be added to a mathematical algorithm in order to produce a statutory claim.

The mathematical algorithm dominated Grams' claims.¹²² Each step, with the exception of the first step, involved a mathematical operation. These mathematical steps involved the computations of comparing data which produced a result in a finding of an abnormal condition. Only the first step, performing clinical laboratory tests, was deemed to be not within the mathematical algorithm included in the claim. The step of performing clinical laboratory tests, however, was not a sufficient limitation to produce a claim that defined the application of a mathematical algorithm to an otherwise statutory process. The first step was actually a data gathering step. The clinical laboratory tests provided data to the mathematical algorithm. The court characterized the mathematical algorithm as the focus of the claim and the data gathering step to be only incidental to the solution of the mathematical algorithm.¹²³ A data gathering step is similar to the post-solution activity or field of use limitations in that it was determined to be not a sufficient limitation to move a mathematical algorithm into the scope of patentable subject matter. Unlike the "improved" processes claimed by *Diehr* and *Abele*, the court did not consider Grams' claim an improvement over any known processes.¹²⁴

c. *In re Iwahashi: The Elusive ROM*

Four days after the *Grams* decision, the Court of Appeals for the Federal Circuit (CAFC) held a claim statutory in *In re Iwahashi*.¹²⁵

121. The basic steps in the method read:

1. A method of diagnosing an abnormal condition in an individual . . . *the method comprising* [a] performing said plurality of clinical laboratory tests on the individual to measure the values of the set of parameters; [b] producing . . . a first quantity representative of the condition of the individual; [c] comparing the first quantity to a first predetermined value . . . [d] upon determining from said comparison that the individual's condition is abnormal, successively testing a plurality of different combinations of the constituents of the individual by eliminating parameters from the set to form subsets corresponding to said combinations . . . and [e] identifying as a result of said testing a complementary subset of parameters . . .

Id. at 837 (emphasis and bracketed letters in original).

122. *Id.* at 840.

123. *Id.*

124. *Id.*

125. 888 F.2d 1370 (Fed. Cir. 1989).

Iwahashi had invented hardware apparatus for performing auto-correlation. The auto-correlation circuitry was intended for use in pattern recognition. Each element of the claim defined a mathematical function, except the element of a read only memory (ROM).¹²⁶ The ROM performed the function of generating square values. A first adder performed the function of adding sample values and then applied the result to the ROM. In response, the ROM generated the square values of the inputs. Additional circuitry, coupled to the ROM, then performed additional mathematical computations to complete the auto-correlation algorithm.

The claim included a mathematical algorithm.¹²⁷ Each of the claimed elements, with the exception of the ROM, defined a specific mathematical operation. The court considered whether the claim contained sufficient structural or apparatus limitations to avoid pre-empting the auto-correlation algorithm.

Computer hardware, such as that disclosed in *Iwahashi*, is patentable subject matter as a machine.¹²⁸ Furthermore, a specific hardware apparatus for calculating a mathematical algorithm will in general not pre-empt the algorithm, since other hardware embodiments are available for calculating the algorithm. In cursory fashion, the court concluded that the claim defined an apparatus that would qualify as a machine and thus be patentable subject matter.¹²⁹ The court analyzed

126. The appealed claim reads:

An auto-correlation unit for providing auto-correlation coefficients for use as feature parameters in pattern recognition for N pieces of sampled input values X_n ($n=0$ to $N-1$), said unit comprising:

means for extracting N pieces of sample input values X_n from a series of sample values in an input pattern expressed with an accuracy of optional multi-bits;

means for calculating the sum of the sample values X_n and $X_n - Z$ ($t = 0 - P$, $P < N$);

a read only memory associated with said means for calculating;

means for feeding to said read only memory the sum of the sampled input values as an address signal;

means for storing in said read only memory the squared value of each sum, $(X_n + X_n - Z)^2$

means for fetching and outputting the squared values of each such sum of the sample input values from said read only memory when said memory is addressed by the sum of the sample input values; and

means responsive to the output $(X_n + X_n - Z)^2$ of said read only memory for providing an auto-correlation coefficient for use as feature parameter according to the following formula

Id. at 1373.

127. *Id.*

128. 35 U.S.C. § 101 (1991).

129. *Iwahashi*, 888 F.2d at 1375: "The claim as a whole certainly defines apparatus in the form of a combination of interrelated means and we cannot discern any logical reason why it should not be deemed statutory subject matter as either a machine or a manufacture as specified in § 101." The court's treatment of the apparatus claim that included a

the means-plus-function clauses in the claim in view of the specific hardware embodiment disclosed in the specification in accordance with the requirement of 35 U.S.C. § 112, ¶ 6. In this analysis, the claimed elements did not pre-empt the mathematical algorithm, since the means-plus-function elements are construed to cover the corresponding disclosed structure and their equivalents. Thus, each of these elements does not cover all hardware apparatus for performing the specified function.¹³⁰

d. Arrhythmia Research Technology, Inc. v. Corazonix Corp.: Claims that Define a Solution to a Specific Problem

The CAFC in *Arrhythmia Research Technology, Inc. v. Corazonix Corp.*¹³¹ acknowledged the underlying premise in the Supreme Court precedent. Abstract ideas, laws of nature, and scientific principles may not be patented.¹³² Mathematical equations *per se* are outside the realm of patentable subject matter. Applications of abstract mathematics to a specific process, however, may be patented.

Arrhythmia Research sued Corazonix for infringement of U.S. Patent No. 4,422,459 (Simson patent).¹³³ The district court granted Corazonix summary judgment, holding that the Simson patent was invalid for failing to claim patentable subject matter. Arrhythmia Research appealed. The CAFC reversed the district court, holding that the Simson patent claims defined patentable subject matter.¹³⁴

The Simson patent related to the analysis of electrocardiographic signals. Heart attack victims are vulnerable to a type of heart arrhythmia, known as ventricular tachycardia, shortly following the heart attack. The system and process claimed by the Simson patent can determine which heart attack patients are at risk for ventricular tachycardia. A particular type of signal, called "late potentials," appears in the QRS segment of electrocardiographic signals in patients vulnerable to ventricular tachycardia. The Simson invention detected these late potentials to determine which patients are at risk.¹³⁵

mathematical formula and the hardware element of a ROM has led some commentators to ponder whether the ROM was a critical element in producing a statutory claim. See, e.g., Samuelson, *Should Program Algorithms Be Patented; Legal Debate*, 33 COM. ACM Aug. 1990, at 23 ("Based upon the reading of this case, one wonders whether all it takes now to render a claim for a computer program-related innovation patentable is to draft it in apparatus form and mention a ROM").

130. *Id.*

131. 958 F.2d 1053 (1992).

132. See *supra* note 32 and accompanying text.

133. *Arrhythmia*, 958 F.2d at 1054.

134. *Id.*

135. Claim 1 is the broadest method claim.

The Simson invention used steps involving mathematical equations. The invention first performed an analog-to-digital conversion of the QRS signal segments. The digitized QRS segments were then applied in reverse time order, i.e., backwards, to a high pass filter. The filter output was averaged. Finally, a comparison of the average value to a predetermined level indicated if the patient was at risk.¹³⁶

Corazonix argued that claim 1 merely defined an abstract mathematical algorithm that calculates a number. Arrhythmia Research countered by stating that the claimed invention is a specific method of analyzing electrocardiographic signals. The court was thus presented with the issue of whether the Simson patent claims defined patentable subject matter.¹³⁷

The CAFC in *Arrhythmia Research* first recognized that *Diehr* superseded portions of the *Benson* and *Flook* holdings.¹³⁸ *Diehr* explained that the algorithm rule of *Benson* stands for the long-standing principle that laws of nature, scientific principles, and abstract ideas are not patentable.¹³⁹ This theory is a reasonable interpretation of *Diehr* and places a severe limitation on the original mathematical algorithm exception set forth in *Benson*.¹⁴⁰

The CAFC then applied the *Freeman-Walter-Abele* two-part test to the appealed claims. First, the method claim included a mathematical algorithm due to mathematical equations in the Simson patent specification which support some of the process steps. Under the second part

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1. A method for analyzing electrocardiographic signals to determine the presence or absence of a predetermined level of high frequency energy in the late QRS signal, comprising the steps of:
 - converting a series of QRS signals to time segments, each segment having a digital value equivalent to the analog value of said signals at said time;
 - applying a portion of said time segments in reverse time order to high pass filter means;
 - determining an arithmetic value of the amplitude of the output of said filter;and
comparing said value with said predetermined level.

Id. at 1055.

136. *Id.*

137. *Id.* at 1058.

138. *Id.* at 1057 n.4.

139. *Diamond v. Diehr*, 450 U.S. 175, 185 (1981).

140. The CCPA and CAFC have tended to narrowly interpret *Benson* and limit its reach. See *In re Iwahashi*, 888 F.2d 1371, 1374 (1989) (interpreting the meaning of "algorithm"); *In re Taner*, 681 F.2d 787, 791 (C.C.P.A. 1982); *In re Pardo*, 684 F.2d 912, 916-17 (C.C.P.A. 1982); *In re Walter*, 618 F.2d 758, 765 (1980); *In re Sherwood*, 613 F.2d 809, 818-19 (C.C.P.A. 1980); *cert. denied*, 450 U.S. 994 (1981); *In re Phillips*, 608 F.2d 879, 882-83 (C.C.P.A. 1979); *In re Toma*, 575 F.2d 872, 877 (C.C.P.A. 1978); *In re Freeman*, 573 F.2d 1237, 1244 (1978); *In re Deutsch*, 553 F.2d 689, 693 (C.C.P.A. 1977); *In re Chatfield*, 545 F.2d 152, 159 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977); *In re Noll*, 545 F.2d 141, 148 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977) (limiting *Benson* to the claims appealed in that case).

of the test, the court held that the claim defined an otherwise statutory process, since the equations are applied to a specific method for analyzing electrocardiograph signals.¹⁴¹

At least two aspects of the court's reasoning are significant. The court placed emphasis on the claim preamble in determining what the claimed steps do. As recited in the preamble, the claim was a specific "method for analyzing electrocardiographic signals" and defined a solution to the problem of determining which heart attack victims are at risk for ventricular tachycardia.¹⁴² It was not an abstract method of solving a mathematical equation. The preamble seemed to indicate a "field of use," which is a specific application of the claimed method. In prior cases, arguing a field of use was not always successful in attempting to show that a claim was statutory.¹⁴³ The court has, however, emphasized that one must analyze a claim "as a whole" to determine patentable subject matter.¹⁴⁴ Accordingly, the claim preamble must not be ignored in analyzing what the claim defines.¹⁴⁵

The court also addressed Corazonix's argument that the claim merely presented and solved a formula, since the output was simply a number. This argument had been successful in previous cases to show that a claim did not define patentable subject matter.¹⁴⁶ The court, however, rejected the argument. The output (end result) was not an abstract number; it represented a voltage that measured heart activity and indicated the risk of ventricular tachycardia.¹⁴⁷ Number processing inherently forms a part of computer-implemented software algorithms. Whether the end result is a number is not even a factor in determining patentable subject matter.

The *Arrhythmia Research* decision shows the increasing strength of software patent protection.¹⁴⁸ The CAFC has repeatedly recognized that the *Diehr* decision severely limited the far-reaching mathematical

141. *Arrhythmia*, 958 F.2d at 159-60.

142. *Id.* at 1059.

143. *See, e.g.*, *Parker v. Flook*, 437 U.S. 584, 595 (1978); *In re Walter*, 618 F.2d 758, 769 (C.C.P.A. 1980).

144. *In re Noll*, 545 F.2d 141, 147 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977).

145. *See Arrhythmia*, 958 F.2d at 1059.

146. *See, e.g.*, *Parker v. Flook*, 437 U.S. 584, 590 (1978); *In re Abele*, 684 F.2d 902, 909 (C.C.P.A. 1982); *In re Walter*, 618 F.2d 758, 770 (1980); *In re Gelnovatch*, 595 F.2d 32, 41 n.7 (C.C.P.A. 1979).

147. *Arrhythmia*, 958 F.2d at 1060.

148. Judge Rader wrote a concurring opinion in which he adopted a statutory construction approach, analyzing the language of § 101. He stated that *Diehr* limited *Benson* to three classes of non-patentable subject matter: laws of nature, natural phenomena, and abstract ideas. Since the mathematical algorithm rule of *Benson* had failed, *Diehr* mandated that one should consult the statutory language for determining patentable subject matter instead of using judicially-created tests. *Id.* at 1066.

algorithm rule of *Benson*.¹⁴⁹ It is only the highly abstract and non-specific claimed algorithms incorporating mathematical steps that are outside the realm of patentable subject matter. This follows from the basic premise that laws of nature, abstract ideas, and scientific principles may not be patented.¹⁵⁰ Nearly all software programs are a solution to a specific problem and will, therefore, be within the scope of patentable subject matter.

II. ANALYSIS

A. SYNTHESIS OF THE BENSON-FLOOK-DIEHR TRILOGY

1. *A Reasonable Meaning for "Mathematical Algorithm"*

Determining the meaning of "mathematical algorithm" is critically important in a § 101 analysis of claims that incorporate mathematical formulas.¹⁵¹ It is a mathematical algorithm which cannot be pre-empted under the *Diehr* holding.¹⁵² The Supreme Court defined a mathematical algorithm as "a procedure for solving a given type of mathematical problem."¹⁵³ Other courts have struggled with determining precisely the extent of this definition.¹⁵⁴

149. See, e.g., *id.* at 1057 n.4; *In re Grams*, 888 F.2d 835, 839 (Fed. Cir. 1989).

150. See *supra* note 32 and accompanying text.

151. See *Diamond v. Diehr*, 450 U.S. 175, 187 (1981) (discussing applied mathematical equations); *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972) (discussing pre-emption of mathematical formulas); *In re Freeman*, 573 F.2d 1237, 1245 (1978). Under *Freeman*, one must first analyze a claim to determine if it includes a mathematical algorithm.

152. *Diehr*, 450 U.S. at 191 (stating that abstract mathematical formulas may not be patented).

153. *Benson*, 409 U.S. at 65.

154. See *In re Meyer*, 688 F.2d 789, 794-95 (C.C.P.A. 1982); *In re Pardo*, 684 F.2d 912, 915-16 (C.C.P.A. 1982); *In re Walter*, 618 F.2d 758, 764-65 (C.C.P.A. 1980); *In re Gelnovatch*, 595 F.2d 32, 45 (C.C.P.A. 1979); *In re Toma*, 575 F.2d 872, 877 (C.C.P.A. 1978); *In re Freeman*, 573 F.2d 1237, 1245 (C.C.P.A. 1978); *In re Chatfield*, 545 F.2d 152, 156 n.5 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977).

The recitation of a solution to a mathematical problem is not always readily apparent from the claims. See, e.g., *In re Grams*, 888 F.2d 835, 836-37 (Fed. Cir. 1988) (method of diagnosing abnormal condition in an individual recited a mathematical algorithm); *In re de Castelet*, 562 F.2d 1236, 1239 (C.C.P.A. 1977) (indirectly reciting equations for generating curves); compare *In re Waldbaum*, 559 F.2d 611, 616 (C.C.P.A. 1977) (controlling a data processor was a mathematical problem) with *In re Deutsch*, 553 F.2d 689 (C.C.P.A. 1977) (controlling a system of multi-unit plants was *not* a mathematical problem).

The court in *Waldbaum* distinguished *Deutsch* by stating that the algorithms in *Deutsch* were applied to a specific method of operating manufacturing plants, *Waldbaum*, 559 F.2d at 617, and the claims at issue in *Waldbaum* covered any use of the algorithms for controlling a processor. *Id.* at 616.

The Supreme Court's definition, unfortunately, is both hopelessly vague and overly broad.¹⁵⁵ The term "mathematical problem" creates a dichotomy in a determination of which algorithms are mathematical algorithms. A mathematical problem encompasses at least the solution to mathematical formulas. Mathematical problems, however, may also encompass many inventions which are indisputably patentable subject matter. Since mathematics describe the way things work, a mechanical invention could feasibly be a mathematical problem.

A reasonable definition for mathematical algorithm follows from the common theme of all § 101 cases. Abstract ideas, scientific principles, and laws of nature cannot be patented.¹⁵⁶ These are the basic tools of research and historically have been excluded from patentable subject matter. When one applies this theme to computer programming,¹⁵⁷ which was present in the issues of *Benson*, *Flook*, and *Diehr*, a more practical definition for mathematical algorithm becomes apparent.

A "mathematical algorithm" is a computer-implemented solution to an abstract scientific principle or law of nature. This workable definition of mathematical algorithm addresses both the issue of computer programming present in the cases as well as acknowledging the *stare decisis* effect of the traditionally recognized non-patentable classes of subject matter. Abstract mathematical formulas are encompassed by this definition, since they would be within either the scientific principles or laws of nature's classes of unpatentable subject matter.¹⁵⁸ If a

155. See, e.g., *In re Pardo*, 684 F.2d 912 (C.C.P.A. 1982). The claims at issue, which did not even contain a mathematical algorithm, covered a method of controlling the execution of program steps in a computer. The claimed process basically involved three steps: (1) examining formulas in a data storage area of a processor to determine which formulas could be designated as defined; (2) executing the designated formulas in the order in which they were designated as defined; and (3) repeating steps (1) and (2) for the undefined formulas until these formulas have been defined and executed. *Id.* at 913.

The *Benson* decision created havoc for the unfortunate patent applicant. During prosecution of the patent application, which was filed in 1970 and received a notice of allowance in 1972, the release of the *Benson* decision reopened prosecution, removing the notice of allowance. The applicant's specification described part of the invention as an "algorithm." The PTO used that fact to state that the applicant made an admission that the invention covered a mathematical algorithm and was, therefore, not patentable subject matter. *Id.* at 914. Ten years after the applicant had originally received a notice of allowance, the CCPA summarily disposed of the PTO's position by stating that the appealed claims did not even contain a mathematical algorithm. *Id.* at 916.

156. See, e.g., *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972); *Le Roy v. Tatham*, 55 U.S. 156, 174 (1853); *In re Walter* 618 F.2d 758, 765 (C.C.P.A. 1980).

157. The § 101 issues have revolved around claims for computer-related inventions that include mathematics. *Walter*, 618 F.2d at 764 n.4.

158. See *Diamond v. Diehr*, 450 U.S. 175, 186 (1981); but see *In re Meyer*, 688 F.2d 789, 794-95 (C.C.P.A. 1982). The court *Meyer* first stated that laws of nature and scientific principles can be expressed in mathematical format. The court then stated that "some mathematical algorithms and formulae do not represent scientific principles or laws of na-

process for solving an abstract scientific principle or law of nature is not computer-implemented, then it would fall within the mental steps category of unpatentable subject matter.¹⁵⁹

The *Benson* decision supports this definition. In particular, the facts of the *Benson* case reveal that the *Benson* invention was no more than the solution to an abstract mathematical formula. The following is the *Benson* claim 1 rewritten with the equivalent mathematical steps.

The method of converting signals from binary coded decimal form into binary which comprises the steps of

- (1) *storing* the BCD number in a reentrant shift register,
- (2) *dividing* the BCD number by at least 8,
- (3) logically *ANDing* the BCD number with 1101_2 ,
- (4) *adding* 1 to the BCD number,
- (5) *multiplying* the BCD number by 4,
- (6) *adding* 1 to the BCD number, and
- (7) *dividing* the BCD number by at least 8.

Each step of the rewritten claim, with the exception of the storing step, represents a pure mathematical function. The steps of shifting a number contained within a shift register represent a multiply or divide operation.¹⁶⁰ Shifting the number in the shift register to the right performs division on the number by multiples of two, depending upon how many places the number is shifted. Shifting the number to the left performs multiplication of the number by multiples of two.¹⁶¹ For example, the number 1010_2 (10_{10}) shifted to the right one position becomes 101_2 (5_{10}) which is 10 divided by 2. Shifting the number 101_2 one position to the left would result in a number 1010_2 (10_{10}), which is 5×2 . Shifting the number 1010_2 one more position to the left would result in the number 10100_2 (20_{10}), which is 5×4 .

The third step of masking out the second position of the register may be accomplished by *ANDing* the contents of the register with 1101_2 (13_{10}).¹⁶² With a "1" in the first, third and fourth positions, the logical *AND* operation will simply result in a number already present in those

ture; they represent ideas or mental processes and are simply logical vehicles for communicating possible solutions to complex problems." *Id.* This statement does not necessarily destroy the harmonizing effect of the synthesized definition. If indeed a mathematical algorithm is simply an idea or mental process, as indicated by *Meyer*, then it is not computer-implemented and would be non-patentable subject matter under the traditionally excluded classes. The *Benson* and *Diehr* holdings arguably only related to computer-implemented inventions. See *Diehr*, 450 U.S. at 185.

159. *In re Prater*, 415 F.2d 1393, 1402 n.22 (C.C.P.A. 1969).

160. *SHORT*, *supra* note 28, at 221-23.

161. *Id.*

162. *Id.* at 124.

positions of the register, while the "0" in the second position ensures a "0" in the result of the AND operation.

With the claim written in this equivalent form, it is apparent that the claim actually defines no more than a solution to a pure mathematical formula. The step of storing simply defines computer memory capability, which is required in any computer programming. The equivalent claim shown above may furthermore be represented by a pure mathematical formula, using base-ten numerals, as follows:

$$(((BCD \text{ number} / 8) \cdot 13) + 1) 4 + 1] / 8 = \text{binary number}$$

This equation represents the solution defined by Benson's claim. The claim merely solved an abstract formula for number conversion.

A further significant aspect of the *Benson* holding is what it is not.¹⁶³ The Court recognized that Benson's claim pre-empted a mathematical formula, and, as shown above, the claim defined no more than a solution to a mathematical formula.¹⁶⁴ It was the attempt to patent an abstract mathematical formula which concerned the Court. Mathematics *per se* are not patentable under the *Benson* holding. The Court, however, expressly made it clear that they did not intend to preclude patent protection for any computer-implemented invention. "It is said that the decision precludes a patent for any program servicing a computer. We do not so hold."¹⁶⁵ The *Benson* holding, therefore, cannot preclude all patent protection for computer-implemented inventions.

Diehr also supports the definition of "mathematical algorithm" explained above. *Diehr* stated that *Benson* stood for no more than the long established principle that abstract ideas, scientific principles, and law of nature cannot be patented.¹⁶⁶ Furthermore, the *Diehr* court, in discussing *Flook*, recognized that the claims at issue in *Flook* defined no more than the solution to a formula for calculating an alarm limit.¹⁶⁷ Therefore, *Diehr* implicitly recognized that it is only processes for solving abstract mathematical formulas that are exempt from patent protection, which is based upon the traditionally recognized classes of non-patentable subject matter.

163. *Gottschalk v. Benson*, 409 U.S. 63, 71 (1972); *See, e.g., Diamond v. Diehr*, 450 U.S. 175, 187 (1981) (citing *Benson* for the proposition that "a claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula, computer program, or digital computer").

164. *Benson*, 409 U.S. at 71-72.

165. *Id.* at 71.

166. *Diehr*, 450 U.S. at 185.

167. *Id.* at 186-87.

2. *A Problem-Solution Approach to Determining Mathematical Algorithm Pre-emption*

Pre-emption is a key element in § 101 analysis.¹⁶⁸ In order to be statutory, a claim must define subject matter that does not pre-empt a mathematical algorithm.¹⁶⁹ Once it has been determined exactly what is a mathematical algorithm, one must analyze claims containing suspect subject matter to determine whether pre-emption exists. While the Supreme Court has focused primarily on pre-emption itself,¹⁷⁰ the lower courts have devised tools of analysis for determining pre-emption, such as the *Freeman-Walter-Abele* two-part test.¹⁷¹

The two-part test is not the only test for determining patentable subject matter.¹⁷² Furthermore, the Supreme Court in *Diehr* did not expressly adopt the two-part test. In fact, the Court did not even cite the *Freeman* or *Walter* decisions. In discussing the invention at issue in *Diehr*, however, the Court emphasized that the mathematical formula used by the invention was applied to a specific process and solved a *problem* that had existed in the industry.¹⁷³ The *Diehr* decision, therefore, supports the proposition that a claim for an invention which includes a mathematical algorithm will not pre-empt the mathematical algorithm if the claim defines a solution to a specific problem, without regard to whether the solution is new or non-obviousness. Stated in another way, a claim that incorporates a mathematical algorithm and defines the solution to a specific problem, and not merely the solution to a mathematical formula, will define patentable subject matter. This is a problem-solution approach.

Fundamental Supreme Court precedent from the mid-1800s supports the problem-solution approach. The Supreme Court in the 1861 *Le Roy v. Tatham*¹⁷⁴ decision, which the *Diehr* court cited,¹⁷⁵ hinted at

168. *Id.* at 185-86; *Parker v. Flook*, 437 U.S. 584, 590-91 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972).

169. See cases cited *supra* note 168.

170. See cases cited *supra* note 168.

171. See *In re Abele*, 684 F.2d 902, 907 (C.C.P.A. 1982); *In re Walter*, 618 F.2d 758, 767 (C.C.P.A. 1980); *In re Freeman*, 573 F.2d 1237, 1245 (C.C.P.A. 1978).

172. *Arrhythmia Research Tech., Inc. v. Corazonix Corp.*, 958 F.2d 1053, 1058 (Fed. Cir. 1992); *In re Meyer*, 688 F.2d 789, 796 (C.C.P.A. 1982). Furthermore, if a claim fails to meet the two-part test, it is possible that the claim could still define patentable subject matter. *Arrhythmia*, 958 F.2d at 1058; *In re Grams*, 888 F.2d 835, 839 (Fed. Cir. 1989).

173. *Diamond v. Diehr*, 450 U.S. 175, 187 (1981).

174. 63 U.S. 132 (1861).

175. *Diehr*, 450 U.S. at 185, 188. *Diehr*, cited the earlier decision of *Le Roy v. Tatham*, 55 U.S. 156 (1853). The same fundamental principles of patentable subject matter are discussed in both *Le Roy* decisions.

using a problem-solution approach in holding that an improved method of making lead pipe defined patentable subject matter.¹⁷⁶

The patentee in *Le Roy* discovered a principle of lead that allowed the invention to be possible.¹⁷⁷ Prior art techniques of making pipe had involved forming the pipe in a mold.¹⁷⁸ The patentee discovered that superior pipe could be developed from heat and constriction of the metal from a set or solid state.¹⁷⁹ In comparison to the prior art, lead pipe or pipe of other soft metals formed according to the improved method could be made in any required length, contained much fewer defects, and was capable of withstanding greater pressures.¹⁸⁰

One issue before the Court involved determining if this improved method defined patentable subject matter.¹⁸¹ The patentee's invention operated according to a newly discovered principle of soft metals.¹⁸² Principles in the abstract, however, had been traditionally excluded from patent protection.¹⁸³ The Court considered whether the patentee's use of the principle was the proper subject matter for a patent.

The Court recognized that the patentee's method of making lead pipe solved a problem.¹⁸⁴ The patentee had not simply discovered a new principle of metal that allowed the invention to be possible, but instead had applied the principle to a specific method to produce lead pipe. The invention solved the problem that had existed in the industry of reliably and consistently producing quality lead pipe.¹⁸⁵ The Court emphasized that scientific principles are not patentable and must be applied to a practical purpose to effectuate a result in order to define patentable subject matter. A specific problem defines a "purpose," and a solution to that problem is the effectuation of a "result."

176. *Le Roy*, 63 U.S. at 135-37.

177. *Id.* at 137.

178. *Id.* at 135.

179. *Id.*

180. *Id.* The claim read:

The combination of the following parts above described is claimed, to wit, the core and bridge, or guide-piece, with the cylinder, the piston, the chamber, and the die, *when used to form pipes of metal, under heat and pressure*, in the manner set forth, or in any other mode substantially the same.

Id. at 138 (emphasis added).

181. *Id.* at 137.

182. *Id.*

183. *Id.* (quoting *Househill Company v. Neilson*, Webster's Patent Cases, 683): "It is quite true, that a patent cannot be taken out solely for an abstract philosophical principle—for instance, for any law of nature or any property of matter, apart from any mode of turning it to account".

184. *Id.* at 135.

185. *Id.*

By analogy to *Le Roy*, the *Diehr* court stated that the claimed invention had solved a problem.¹⁸⁶ The invention of *Diehr* solved the problem that had existed in the industry of consistently obtaining quality cures of synthetic rubber.¹⁸⁷ In setting forth its reasoning, the *Diehr* court did not adopt the *Freeman* two-part test, but instead cited fundamental patentable subject matter precedent stated in *Le Roy*.¹⁸⁸ The *Diehr* holding is an extension of these basic principles and includes analyzing claims to determine what an applicant has invented. A claim that defines a solution to a specific problem evidences the application of scientific principles and is within the realm of patentable subject matter.

The *Benson* decision also supports the problem-solution approach to determining patentable subject matter. As described above, Benson's claim defined no more than the solution to a mathematical formula for performing number conversion. As recognized by the Court, Benson's invention for number conversion was not applied to any specific problem.¹⁸⁹ One may argue that Benson's invention solved the problem of converting BCD numerals into binary numbers. A response, however, would be to ask why number conversion is useful in the first place. Benson did not claim the use of BCD to binary number conversion in a solution to a particular problem. Benson merely claimed the solution to a mathematical formula.¹⁹⁰

The problem-solution approach also harmonizes reasoning used within the post-*Diehr* lower court decisions. In *Abele*, the claimed invention solved the problem of displaying x-ray attenuation data received while using a CAT scan process that exposed the body to much less radiation than in the prior art.¹⁹¹ The non-statutory claim 5, however, was not directed to any particular technology and merely defined a method of displaying data using the mathematical step of calculating.¹⁹² An inspection of claim 5 does not reveal any particular problem solved by the mathematical algorithm incorporated into claim 5. Claim 6 further limited claim 5 to the display of x-ray attenuation data produced in a two-dimensional field by a computed tomography scanner.¹⁹³ Claim 6 thus adds a limitation to claim 5 which makes it apparent a problem solved by the claimed invention: display of x-ray attenuation data obtained from a narrower x-ray beam.

186. *Diamond v. Diehr*, 450 U.S. 175, 178 (1981).

187. *Id.*

188. *Id.* at 185, 188 (citing the earlier decision of *Le Roy v. Tatham*, 55 U.S. 156 (1853)).

189. *Gottschalk v. Benson*, 409 U.S. 63, 68 (1972).

190. *Id.* at 68, 71.

191. *In re Abele*, 684 F.2d 902, 904 (C.C.P.A. 1982).

192. *Id.* at 908.

193. *Id.*

In *Grams*, the claimed method of diagnosing an abnormal condition focused on the solution to a mathematical formula.¹⁹⁴ The claimed steps of the method, with the exception of the step of performing clinical laboratory tests, each constituted a mathematical operation. It is not apparent from the claim in *Grams* how the solution to the mathematical algorithm for identifying an abnormal condition is applied to any specific process for solving a particular problem. The specification of *Grams* even asserts that the mathematical algorithm may be applied to *any* complex system, whether it be electrical, mechanical, chemical or biological.¹⁹⁵ The claimed method, however, did not solve a specific problem in any particular complex system; it merely solved a formula.

The *Iwahashi* invention presents more difficulty, but still fits within a problem-solution theory. One may argue that *Iwahashi*'s claimed invention merely solved a formula for auto-correlation. At least two responses are possible to overcome this argument. First, *Iwahashi*'s claimed method for performing auto-correlation may be viewed as solving the problem of increasing the speed of auto-correlation computations when compared with a general purpose computer. If *Iwahashi*'s method had merely been implemented on a general purpose computer, the claim would have been non-statutory as pre-empting the mathematical formula. The specialized hardware included as limitations in *Iwahashi*'s claim provided a distinct benefit. "[T]his invention offers a highly cost-effective auto-correlation unit for pattern recognition with simple circuitry without the need to use an expensive multiplier, but which has comparatively high accuracy and can, moreover, calculate auto-correlation coefficients at high speed."¹⁹⁶ Under a problem-solution theory, *Iwahashi*'s claimed method solved the problem of a need for specialized hardware that efficiently, accurately, and at high speed solves auto-correlation functions.

Second, *Iwahashi*'s claim may be viewed as a statutory "machine."¹⁹⁷ The claim included specific hardware and structural limitations which distinguished it over a general purpose computer. Even though a ROM is the only actual physical element in the claim, the means-plus-function clauses are construed to cover the disclosed structure and their equivalents.¹⁹⁸ Therefore, even the means-plus-function clauses distinguish over a general purpose computer by covering only *Iwahashi*'s particular hardware disclosed in the specification as well as the equivalents.

194. *In re Grams*, 888 F.2d 835, 840 (Fed. Cir. 1989).

195. *Id.*

196. *See In re Iwahashi*, 888 F.2d 1370, 1371-72 (Fed. Cir. 1989).

197. *Id.* at 1375; *see* 35 U.S.C. 101 (1991).

198. 35 U.S.C. § 112, para. 6 (1991).

Finally, in *Arrhythmia*, the CAFC emphasized a problem solved by the claimed invention.¹⁹⁹ The claimed method included mathematical steps, such as digital filtering and comparisons, in performing an analysis of electrocardiograph signals. The invention, however, was not simply a collection of mathematical steps; it solved a particular problem by using a specific method. The inventor, Dr. Simson, had sought a solution to the problem of determining which heart attack victims were at high risk for ventricular tachycardia.²⁰⁰ The court focused on the solution set forth in the claim preamble to hold that the claim was statutory and did not pre-empt abstract mathematical computations.²⁰¹

B. THE FUTURE OF SOFTWARE PATENT PROTECTION

Some commentators have either criticized *Benson* or argued that the decision should be overruled.²⁰² The underlying premise of *Benson* is that scientific principles, law of nature, and abstract ideas may not be patented.²⁰³ *Benson* further refined these classes of non-patentable subject matter to hold that mathematical formulas *per se* may not be patented.²⁰⁴ Overruling *Benson* would mean tampering with long established principles and allowing at least some patent protection for mathematical formulas.

Presently, non-statutory computer-implemented inventions are fairly well discernable under *Diehr*. If mathematical formulas can be patented, developing tools of analysis for determining which formulas may be patented and which may not would be an exceedingly difficult task. One would have to determine when an abstract mathematical formula would become a statutory process, and this analysis would tend to conflict with the basic rule that scientific principles may not be patented, since abstract mathematical formulas may be viewed as falling within the scientific principles category.²⁰⁵

199. *Arrhythmia Research Tech., Inc. v. Corazonix Corp.* 958 F.2d 1053, 1054 (Fed. Cir. 1992).

200. *Id.*

201. *Id.* at 1059.

202. See, e.g., Bruzga, *A Review of the Benson-Flook-Diehr Trilogy: Can the "Subject Matter" Validity of Patent Claims Reciting Mathematical Formulae be Determined Under 35 U.S.C. Section 112?*, J. PAT. & TRADEMARK OFF. SOC'Y 197, 205 (1987) (stating how the *Benson* claims could have been upheld as statutory); Chisum, *supra* note 7, at 959; Goodman, *supra* note 1, at 172-73 (criticizing the *Benson* definition of algorithm).

203. *Diamond v. Diehr*, 450 U.S. 175, 185 (1981).

204. *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972).

205. See *supra* note 158 and accompanying text.

Certain anti-software groups argue that software patent protection has a relatively weak legal basis.²⁰⁶ This is not true. *Diehr* firmly supports much patent protection for software,²⁰⁷ and *Benson* supports at least some software patent protection.²⁰⁸ Even without *Diehr*, though, most software inventions would not be subject to the *Benson* rule. Software inventions typically do not include a mathematical algorithm and thus could not pre-empt an abstract mathematical formula. These types of inventions include, for example, database structures,²⁰⁹ program algorithms,²¹⁰ and user-interfaces.²¹¹ Even before *Benson*, the courts had established that a computer programmed in a new way is a statutory invention.²¹² The *Benson* court did not tamper with this principle and expressly did not extend the holding to pre-empt any patent protection for computer programming.²¹³

CONCLUSION

Patent protection for software inventions has been mired in controversy. The Supreme Court precedent related to software, and other

206. See, e.g., Garfinkle, *Why Patents are Bad for Software*, ISSUES IN SCIENCE AND TECHNOLOGY, fall 1991, at 50, 51.

Those opposing software patent protection often also argue that allowing patent protection for mathematical algorithms will result in the PTO granting patents on "obvious" algorithms and basic building blocks of software. Schrage, *The Patently Absurd Way We Protect Software and Biotech Innovations*, WASH. POST, Oct. 25, 1991, at F3. The concern over the patenting of basic software building blocks hinges not on patentable subject matter, but on other statutory requirements for patentability, such as non-obviousness.

The Software Patent Institute is currently working on assembling a public database of issued software patents and related information, which could include fundamental algorithms, that would be made available to the PTO for prior art searching. Busse, *Software Floods the Patent Office*, INFOWORLD, Sept. 30, 1991, at 39. The PTO is also taking steps to maintain pace with the increased filings of software patent applications. These steps include: (1) a revised classification system to help divide up software patents into more specific categories; (2) new training and specialization among examiners so that the examiners work on related applications instead of working on many unrelated software patent applications; and (3) a computerized search system to replace an outdated microfiche database. *Id.*; Burke, *U.S. Agency Revamps Software Patent System*; *U.S. Patent Office*, PC WEEK, May 27, 1991, at 145.

207. *Diamond v. Diehr*, 450 U.S. 175, 187 (1981).

208. *Gottschalk v. Benson*, 409 U.S. 63, 71 (1972).

209. See, e.g., U.S. Patent No. 4,926,344 (entitled "Data Storage Structure of Garment Patterns to Enable Subsequent Computerized Prealteration").

210. See, e.g., U.S. Patent No. 4,791,583 (entitled "Method for Global Blending of Computer Modeled Solid Objects Using a Convolution Integral").

211. See, e.g., U.S. Patent No. 5,075,675 (entitled "Method and Apparatus for Dynamic Promotion of Background Window Displays in Multi-Tasking Computer Systems").

212. *In re Prater*, 415 F.2d 1393, 1403 n.29 (1969); *In re Bernhart*, 417 F.2d 1395, 1400 (C.C.P.A. 1969).

213. *Gottschalk v. Benson*, 409 U.S. 63, 71 (1972).

computer-implemented inventions, is subject to various interpretations. Lower courts have sometimes struggled with determining the scope of patent protection for computer-implemented inventions under the Supreme Court precedent. The PTO also seems to want more guidance regarding the types of software inventions that qualify as patentable subject matter.

A problem-solution approach effectively harmonizes and fits with the Supreme Court precedent. The courts have often inquired in a patentable subject matter analysis as to whether a claim at issue defines a solution to a particular problem. Under the Supreme Court precedent, a claim will be within the realm of patentable subject matter if it defines a solution to a specific problem, and not merely the solution to an abstract mathematical formula.