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Nelson Moskowitz

THE METAMORPHOSIS OF SOFTWARE-RELATED INVENTION PATENTABILITY

by NELSON MOSKOWITZ*

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* Senior Primary Examiner, Special Laws Division, Examining Group 220 of the Patent and Trademark Office. The statements and opinions in this paper are those of the author and do not necessarily reflect the position or views of the Patent and Trademark Office. The author wishes to thank William S. Lawson, former Director of the Office of Technology Assessment and Forecast (OTAF), Jane S. Myers and John F. Terapane, Senior Analysts of OTAF for their astute technical guidance, information, advice, comments, and proofing of much of this paper.

> [T]he technology is perhaps mathematically awesome, the economic impact of our decision tremendous. . . .[1]
>
> [T]he line of demarcation between a patentable and an unpatentable (or non-patentable) claim does not always shimmer with clarity. . . .[2]

With the advent of the decisions by the United States Supreme Court in *Diamond v. Diehr*[3] and *Diamond v. Bradley*,[4] and the recent decision by the Court of Customs and Patent Appeals (CCPA) in *In re Taner*,[5] over a decade of confusion concerning the patentability of inventions involving computer software and algorithms[6] may be resolved. The United States Patent and Trademark Office (PTO), in following the spirit of these decisions, has reversed its long standing practice of rejecting most claims drawn to computer program or algorithm-related inventions and has drawn guidelines for deciding which categories of these inventions are patentable.[7]

This study will trace the development of the law dealing with the patenting of software and algorithm related inventions, discuss the present status of the law in this field as a result of the 1981 *Bradley* and *Diehr* decisions of the Supreme Court and the 1982 *Taner* decision by the CCPA, and demonstrate how these developments have affected patenting in the exemplary field of seismic data processing.

I. A BRIEF HISTORY

A. MECHANICAL COMPUTERS

The first recorded mechanization of computation involved Gerbert of Aurillac and Magnus in the 10th century.[8] In the 16th century, Emperor Rudolfuss II of the Holy Roman Empire granted a

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1. *In re* Prater, 415 F.2d 1378, 1392 (C.C.P.A. 1968), *modified on reh'g*, 415 F.2d 1393 (C.C.P.A. 1969).

2. Arshal v. United States, 621 F.2d 421, 431 (Ct. Cl. 1980), *cert. denied*, 449 U.S. 1077 (1981).

3. 450 U.S. 175 (1981). Diehr's patent application was assigned to Federal Mogul Corporation.

4. 450 U.S. 381 (1981). Bradley's patent application was assigned to Honeywell Information Systems, Inc.

5. 681 F.2d 787 (C.C.P.A. 1982).

6. *See* Schuyler, *Examination of Patent Applications on Computer Programs—Nature of Decision of Guidelines*, 868 Off. Gaz. Pat. Office 349 (1969); Guidelines to Examination of Programs, 829 Off. Gaz. Pat. Office 1 (1966).

7. Examination of Patent Applications Involving Mathematical Algorithms or Computer Programs, Manual of Patent Examining Procedure § 2110. *See* Appendix for full text. *See also* PAT. TRADEMARK & COPYRIGHT J. (BNA), Oct. 22, 1981, at A-7, E-1.

8. J. ROSENBERG, THE COMPUTER PROPHETS 20-21 (1969).

patent for a programmed recording pedometer which was used in surveying.[9] In the 17th century, mechanical calculators capable of adding, subtracting, multiplying, and dividing were invented. Louis XIV granted a patent to Pascal in 1649 for an arithmetic calculating machine that was programmable for various coinage systems.[10] In 1709, Poleni developed the first calculator that provided a series of answers to appropriate problems.[11] Weaving looms were automated by Jacquard in 1804, by using punched tapes or cards. Between 1833 and 1835, Charles Babbage designed two general purpose digital computers programmed by punch cards, one a "difference engine" and one an "analytical engine."[12]

B. Electromechanical Computers

The first electromechanical computers were developed shortly after World War II by Stiblitz of Bell Laboratories and Aiken of Harvard University with the support of IBM and the Office of Naval Research.[13] Aiken's computer utilized the principles of Babbage's general purpose digital computer but employed electrical circuitry in place of mechanical elements.

C. Electronic Computers

The first general purpose, all electronic digital computer, the ENIAC,[14] was built with vacuum tubes at the University of Pennsylvania in 1946.[15] Over the next ten years vacuum tube computers were built using storage devices such as electrostatic memories,[16] delay line memories,[17] and magnetic drum memories.[18] These early computers were externally programmed using wired control

9. A. Rhode, Die Geschichte der Wissenschaftlichen Instrumente vom Beginn der Renassance bis zum Ausgang des 18, Jahrhunderts (1923).

10. Prager, *Examination of Inventions from the Middle Ages to 1836*, 46 J. Pat. Off. Soc'y 268, 280 (1964).

11. D. Halacy, Charles Babbage, Father of the Computer (1970).

12. Charles Babbage, and His Calculating Engines: Selected Writings (1961).

13. Fagan, *Impact*, Bell Telephone Laboratories 115 (1971).

14. ENIAC stands for Electronic Numerical Integrator And Computer. Patent No. 3,120,606 was granted to Eckert and Mauchly for the ENIAC.

15. Goldstine, *The Electronic Numerical Integrator and Computer*, 2 Mathematical Tables & Other Aids to Computation 97 (1946).

16. Williams, *A Storage System for Use with Binary Digital Computing Machines*, 96 Inst. Elec. Eng'rs Proc. Pt. 3 (1949).

17. Wilkes, *The EDSAC, an Electronic Calculating Machine*, 26 J. Sci. Instrum. 385 (1949).

18. Kilburn, *Digital Computers at Manchester University*, 100 Inst. Elec. Eng'rs Proc. Pt. 2 at 487 (1953).

boards[19] that had to be manually rewired for each different operation or machine code.[20] Later models used internal instruction storage as devised by Von Neumann of Princeton University.[21]

In 1951, the Remington Rand Corporation introduced the first commercial computer, the UNIVAC.[22] The following year, a group of scientists at the Institute for Advanced Study completed MANIAC 1, the first digital computer capable of operating on stored programs instead of hard wired circuitry.[23] In 1953, IBM introduced the Model 650, a vacuum tube computer using a magnetic drum. The first commercial solid state computer was introduced by IBM in 1959 as the model 7090.[24] This computer quickly rendered tube computers obsolete.

D. Software and Algorithms

Computer operations are controlled by *computer programs*—sets of instructions for controlling the computer.[25] Programs may be in a visible format or stored in machine-readable form on punch cards, on a magnetic tape or disc, or in a computer memory. Programs may be categorized as systems programs and applications programs. Systems programs regulate the general operation of the computer and control the allocation of machine resources in order to facilitate the running of applications programs. Applications programs are employed by computer users to perform specific functions for particular applications.

Programs are part of what the industry calls *software*. Software includes programs, data, routines, back-up documentation, flowcharts, and instruction manuals. The physical components of a computer are called *hardware*. A computer operating in accordance

19. MacMillan, *Floating Decimal Calculations on the IBM Card Programmed Electronic Calculator*, 5 Mathematical Tables & Other Aids to Computation 86 (1951).

20. Stiblitz, U.S. patent 2,666,579, filed December 26, 1944 and issued January 19, 1954.

21. Von Neumann, First Draft on a Report on the EDVAC, Rep. on Contract No. W-670-ORD-492, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, PA (1945).

22. Eckert, *The UNIVAC System*, Joint AIEE-IRE Compt. Conf. Proc. 6 (1951).

23. Ulam, *Computers*, 211 Sci. Am. 203 (1964). Digital computers that have circuits physically prewired to each other in a particular manner are generally referred to as special purpose digital computers. These computers perform a limited number of special operations. If the circuits are associated only by a program in the computer, then the computer is referred to as general purpose digital computer.

24. Lanzarotta, *Computing Power at Huntsville*, 6 Datamation 18 (1960).

25. See *In re* Waldbaum, 457 F.2d 997, 998 (C.C.P.A. 1971) for an equivalent judicial definition.

with a program performs an *algorithm* which may generally be defined as the step-by-step procedure for solving a problem in a finite number of steps.[26]

Algorithms for performing the operations of addition, subtraction, multiplication, and division date back to before 3000 B.C. when the abacus was developed.[27] Today, algorithms are typically illustrated as *flowcharts*, stylized diagrams setting forth the steps of the algorithm and their interrelationships. Flowcharts are then used for expressing the algorithm in a manner (or language[28]) that the computer can understand and that directs the hardware in its operation.

In a typical computer operation, a user reads in the data and the programmed set of operations to be performed on that data. The instructions and data are then stored in the computer memory unit. A control unit interprets the instructions and directs the central processing unit (CPU) to perform the designated operations on the data that was read in. The CPU then channels the answers to an output unit that supplies the answer to the user.

E. Patentability of Software

Developing computer software requires an investment of time, money and ingenuity. Once developed, however, such software can be relatively easy to copy. Thus, software manufacturers, in order to protect their interests in the software, often file patent applications for their inventions. The grant of a patent provides the inventor and his heirs or assignees the right to prevent others from making, using, and selling the patented software for a period of seventeen

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26. The judicial definition of the term "algorithm" has varied significance depending upon the person defining the word. The Supreme Court, in Gottschalk v. Benson, 409 U.S. 63, 65 (1972), stated, "[a] procedure for solving a given type of mathematical problem is known as an algorithm." The Court reiterated this definition in Parker v. Flook, 437 U.S. 584, 585 (1978), and in Diamond v. Diehr, 450 U.S. at 186. The CCPA defined the term algorithm as a method of calculating mathematical formulas and mathematical procedures. *In re* Walter, 618 F.2d 758, 761 n.1 (C.C.P.A. 1980). The PTO Board of Appeals used the following dictionary definition in *In re* Toma, 575 F.2d 872, 876 n.4 (C.C.P.A. 1978):

> 1. A fixed step-by-step procedure for accomplishing a given result; usually a simplified procedure for solving a complex problem; also a full statement of a finite number of steps. 2. A defined process or set of rules that leads and assures development of a desired output from a given input. A sequence of formulas and/or algebraic/logical steps to calculate or determine a given task; processing rules.

27. J. Rosenberg, *supra* note 8, at 19.

28. Commonly used computer languages are FORTRAN (FORmula TRANslation), which is a mathematical problem-oriented code, BASIC (Beginners All Purpose Symbolic Instruction Code), ALGOL (ALGOrithmic Language), and COBOL (COmmon Business Oriented Language).

years. The United States Constitution delegates to Congress the power "[t]o promote the Progress of Science and useful Arts, by securing for Limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries . . . ."[29] Under this authority, Congress enacted the Patent Laws (Title 35 of the U.S. Code). The first requirement of this act limits the subject matter of a patent to a "process, machine, manufacture, or composition of matter, or any new and useful improvement thereof. . . ."[30] The second requires the claimed invention to pass four separate conditions of patentability: utility,[31] novelty,[32] nonobviousness,[33] and ad-

29. U.S. CONST. art. I, sec. 8, cl. 8.

30. 35 U.S.C. § 101 (1976). "The term 'process' means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." *Id.* § 100(b). The term "process" has been further defined by the United States Supreme Court as a series of actions upon certain materials that transforms its subject matter from one state into another state or thing. Cochrane v. Deener, 94 U.S. 780 (1877).

31. 35 U.S.C. § 101 (1976).

32. *Id.* §§ 101, 102. Section 102 reads as follows:

> A person shall be entitled to a patent unless—
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or
>
> (c) he has abandoned the invention, or
>
> (d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or
>
> (f) he did not himself invent the subject matter sought to be patented, or
>
> (g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

33. *Id.* § 103. Section 103 states:

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

equacy of disclosure.[34]

It is well settled in patent law that ideas,[35] scientific principles,[36] and laws of nature[37] are not patentable. A process consisting solely of mental steps is unpatentable since it would create a monopoly of a disembodied idea. A novel process, however, is not unpatentable because it incorporates laws of nature.

II. POLICY ISSUES

A. INDUSTRY APPROACH

As stated by the Supreme Court in *Diehr*, "[t]he broad question whether computer programs should be given patent protection involves policy considerations. . . ."[38] Entities that have primary concerns in the development and sale of software, affected by their economic self interest and institutional bias, have favored patent

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subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

34. *Id.* § 112. Section 112 reads:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.
>
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
>
> A claim may be written in independent or, if the nature of the case admits, in dependent or multiple dependent form.
>
> Subject to the following paragraph, a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.
>
> A claim in multiple dependent form shall contain a reference, in the alternative only, to more than one claim previously set forth and then specify a further limitation of the subject matter claimed. A multiple dependent claim shall not serve as a basis for any other multiple dependent claim. A multiple dependent claim shall be construed to incorporate by reference all the limitations of the particular claim in relation to which it is being considered.
>
> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

35. Gottschalk v. Benson, 409 U.S. 63, 67 (1972); Rubber-Tip Pencil Co. v. Howard, 87 U.S. (20 Wall.) 498 (1874).

36. O'Reilly v. Morse, 56 U.S. (15 How.) 402 (1854); LeRoy v. Tatham, 55 U.S. (14 How.) 108 (1853).

37. Eibel Process Co. v. Minnesota & Ontario Paper Co., 261 U.S. 45 (1923).

38. 450 U.S. at 216.

protection for software.[39] Such protection would enable them to compete more effectively with hardware manufacturers who supply free programs with the purchase of their hardware. Since most software manufacturing companies are relatively small, the prospect of having other companies copy their product and offer it free to their customers is dismal.

Software users, such as Bell Telephone Laboratories[40] and the large oil companies, want patent protection to maintain or build their prominence in particular areas of technology. Evidence of such aggressive seeking of patent protection are the numerous appeals to the CCPA that have been filed in the seismic data processing area by major oil companies.[41]

Spokesmen for the patent bar have consistently favored patentability for software.[42] Conversely, large hardware manufacturers, such as IBM, have strongly disapproved of such patentability, since the unrestricted use of their computers serves their best interests.[43]

B. PTO Approach

The United States Patent and Trademark Office, concerned with its ability to effectively process the large number of patent applications that would be filed in this area, has rejected patent applications for software.[44]

During the early 1960's, the PTO found itself with a large backload of patent applications and a four year average pendency for an application before it was issued a patent. Due to budgetary problems and archaic processing methods, the PTO and the patent

39. Amicus Curiae Brief for the Association of Data Processing Service Organizations, Parker v. Flook, 437 U.S. 584 (1978).

40. Bell Telephone Laboratories, *Comments on Study of Computer Program Protection* (Dec. 9, 1968) (response to views solicited by the PTO in 885 Off. Gaz. Pat. Office 555 (1968)).

41. *In re* Walter, 618 F.2d 758 (C.C.P.A. 1980); *In re* Sherwood, 613 F.2d 809 (C.C.P.A. 1980), *cert. denied*, 450 U.S. 994 (1981); *In re* Johnson, 589 F.2d 1070 (C.C.P.A. 1978); *In re* Christensen, 478 F.2d 1392 (C.C.P.A. 1973); *In re* Musgrave, 431 F.2d 882 (C.C.P.A. 1970); *In re* Prater, 415 F.2d 1378 (C.C.P.A. 1968), *modified on reh'g*, 415 F.2d 1393 (C.C.P.A. 1969); *In re* Abrams, 188 F.2d 165 (C.C.P.A. 1951).

42. Amicus Curiae Brief for the Los Angeles Patent Law Association, Diamond v. Bradley, 450 U.S. 381 (1981) and Diamond v. Diehr, 450 U.S. 175 (1981).

43. Amicus Curiae Brief for the Business Equipment Manufacturers Association, Gottschalk v. Benson, 409 U.S. 63 (1972). Amicus briefs supporting the CCPA's conclusion in both *Bradley* and *Diehr* were filed by the American Patent Law Association, the Los Angeles Patent Law Association, Halliburton Services, Applied Data Research, Inc., and Whitlaw Computer Systems, Inc. (joint brief). An amicus brief urging reversal of the CCPA's decisions was filed by the National Semiconductor Corporation.

44. 855 Off. Gaz. Pat. Office 829-30 (1968).

system were experiencing difficulties. Consequently, in 1965, the President's Commission on the Patent System was established to suggest revisions to the Patent Act. The policy considerations of the Patent Office influenced the Commission to recommend against patent protection for computer programs. In its report the Commission stated:

> The Patent Office now cannot examine applications for programs because of the lack of a classification technique and the requisite search files. Even if these were available, reliable searches would not be feasible or economic because of the tremendous volume of prior art being generated. Without this search, the patenting of programs would be tantamount to mere registration and the presumption of validity would be all but nonexistent.[45]

As early as 1964, the PTO denied the patentability of programs because they were "creations in the area of thought."[46] In *Ex parte King and Barton*,[47] the PTO Board of Appeals presented its first published opinion concerning the patentability of a digital computer for mathematically processing, by Polish Notation, data stored within the computer. The Board affirmed the Examiner's rejection of the patent but disagreed with the Examiner's failure to distinguish for patent purposes the computer with the stored program from any other computer absent such a program.

In 1966, the PTO set out to formulate standards for the patentability of software in its proposed first guidelines to Examination of Programs.[48] The guidelines recommended that process claims[49] based solely on computer execution of mathematical formulas be considered unpatentable because they merely provide for the transformation of data from one form to another.[50] These guidelines also set forth another class of process claims called "utility steps."

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45. PRESIDENT'S COMMISSION ON THE PATENT SYSTEM, "TO PROMOTE THE PROGRESS OF . . . USEFUL ARTS" IN AN AGE OF EXPLODING TECHNOLOGY 13 (1966).

46. Puckett, *The Limits of Copyright and Patent Protection for Computer Programs*, 16 COPYRIGHT L. SYMP. (ASCAP) 81, 119 (1968).

47. 146 U.S.P.Q. (BNA) 590 (1964).

48. 829 Off. Gaz. Pat. Office 1 (1966).

49. A patent application must be filed in accordance with 35 U.S.C. §§ 111-13 and 115. Part of the patent application is the specification, which includes a disclosure of the invention and one or more claims defining the invention. The claims legally define the scope of the invention for which an applicant seeks patent protection. Apparatus claims are used to define inventions falling within the statutory classification of a machine. Method claims, also called process claims, are used to define inventions that fall within the statutory classification of a process.

50. The guidelines stated:

> Special problems of patentability arise in the computer, data processing and automatic control field that revolve around mathematical processes and equations. These problems may be more generically stated as the broad field

These could be patented because a transformation in the state of a general purpose computer resulted when operations software controlled the computer.[51] Under these guidelines, apparatus claims for programmable devices were to be patentable if the computer was programmed into a special purpose machine. These guidelines were withdrawn by the PTO[52] after hearings during which they were strenuously opposed to by computer hardware manufacturers who insisted that software users continue to have freedom of access in order to promote and continue advancement in the technology.[53] The software firms, patent practitioners, and geophysical prospecting companies, took the position that computer technology and software were merely other technologies and were entitled to equal protection under the patent laws.

During Senate hearings on the Patent Reform Act of 1967,[54] the recommendations by the PTO were attacked for constituting "class legislation" in that software manufacturers were denied rights equal to those of hardware manufacturers. This reform bill died in com-

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of algorithms which are conclusions based upon a precise or mathematical premise and line of reasoning.

For example the prediction as to the winner in a presidential election made by a programmed 'general purpose' computer is based on an algorithm, . . . which has been evolved from a line of reasoning based on known factors and is analogous to the mathematical formula. Similarly, business practices or methods may be reduced to an algorithm.

Mathematical process discoveries and mathematical formulas used therein may not be patented although they may be of enormous importance (e.g., $E = mc^2$).

829 Off. Gaz. Pat. Office at 1.

51. To distinguish between algorithm and utility processes becomes difficult in the case of a programmed general purpose computer unless the distinction between a *result* of method or apparatus operation and the *function* of the method steps or apparatus components is maintained.

The *result* of a programmed operation of a computer may be the mathematical transformation of data according to an algorithm but the *functioning* of the computer is the change in state of certain electrical or mechanical devices within the computer according to the algorithm, as distinguished from the individual or total computational results of the components thereof.

Thus a process, defined as a series of steps for the manipulation or evaluation of data, even though it is required to be carried out by a programmed computer, would be an algorithm process. A process defined as a series of steps for causing a sequence of changes in state of components of the computer, even though the sequence is dictated by an algorithm, would be a utility process.

Id. at 1-2.

52. 868 Off. Gaz. Pat. Office 349 (1969).

53. Report of the Hearings on the Patent Office's Guidelines to Examination of Programs (1966).

54. *Patent Law Revision*: Hearings on S. 1042 Before the Subcomm. on Patents, Trademarks and Copyrights of the Senate Comm. on the Judiciary, 90th Cong., 1st Sess. (1967).

mittee. During House hearings in 1967, former PTO Commissioner Brenner emphasized that the Patent and Trademark Office had little pertinent prior art available to the examiners since there was a lack of prior art patents and most of the literature was not in the Office's possession.[55] The Commissioner also noted the difficulty of finding qualified examiners for this sophisticated technology, the lack of experienced personnel, and the inadequate examination procedures in this area.

In 1968, the PTO, ignoring distinctions drawn in its 1966 proposal, set up examination guidelines that stated specifically that computer programming, whether claimed as a process or as apparatus, was not patentable unless not obviously combined in an apparatus that affected the physical transformation of a substance.[56] Listed as examples of such transformation were the knitting of a pattern or the shaping of metals. The basic legal theory upon which the Office premised this opinion was that a process that could be implemented by purely mental acts was not within the scope of patentable subject matter and that a "process or method is directed to patentable subject matter only if it is performed on physical materials and produces some appreciable change in their character or condition . . . ."[57] These guidelines were rescinded[58] after the Court of Customs and Patent Appeals specifically rejected them.[59]

In 1970, at the Patent Resources Group Conference, two PTO Examiners proposed rules for governing the patentability of programmable processes.[60] According to these rules, if a programmable process "has an intimate relationship to the machine, depending upon the machine's structure and organization and deriving its significance from its interrelation with or exploitation of features or characteristics of the machine, the process is statutory."[61] Specific applications of these rules to exemplary claims for applications programs, control programs, input/output programs, and real-time processing were provided. The PTO, however, did not officially adopt these proposed rules.

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55. *General Revision of the Patent Laws*, Hearings on H.R. 5924, H.R. 13951, and Related Bills Before Subcomm. No. 3 of the House Comm. on the Judiciary, 90th Cong., 1st Sess., Serial No. 11, Pt. 1 at 37 (1967).

56. 855 Off. Gaz. Pat. Office 829 (1968).

57. *Id.*

58. 858 Off. Gaz. Pat. Office 349 (1969).

59. *In re* Prater, 415 F.2d 1378 (C.C.P.A. 1968), *modified on reh'g*, 415 F.2d 1393 (C.C.P.A. 1969).

60. Conference on Software Patents, March 23-26, 1970, Dorado Hilton, Puerto Rico (Examiners R.D. Bennett and D.C. Kaufman).

61. *Id.* at I-1.

In 1971, the Justice Department, at the behest of private parties who were opposed to patent protection for software, prompted the PTO's appeal in *Gottschalk v. Benson*. The interoffice memorandum sent by the Justice Department Appellate Section to its Patent Section states:

> This memorandum is in response to a request from the Solicitor General to the Civil Division for our recommendation as to appropriate action to be taken with respect to In re Benson and Talbot, Patent Appeal No. 8376 (CCPA, May 6, 1971). *The Patent Office has apparently decided not to seek review of the line of decisions in the Court of Customs and Patent Appeals which hold that computer program methods may be the proper subject matter of a patent.*
>
> The Civil Division of the Department must decide whether we should recommend filing of a petition for certiorari and, whether the Civil Division of the Department of Justice is the proper Government agency to raise this appeal from the Court of Custom and Patent appeals, ... Therefore, if review of the Court of Customs and Patent Appeals' position is not sought at this time, the question will have to be deferred for several years until an inter parties suit ripens into an appeal to the Supreme Court. *Private parties are now urging that certiorari be sought so that they will be relieved of this burden.*[62]

Attempts to formulate official guidelines for the examination and patenting of software-related inventions were then abandoned by the Office.

III. COURT DECISIONS

A. MENTAL STEPS

In 1968, the CCPA began a series of decisions challenging the previously presumed unpatentability of computer software.[63] The early CCPA decisions rejected the Office doctrine of "mental steps"[64] which contended that if the integral part of any process or machine consisted of a "mental step," i.e., a function that was, or could be, carried out in one's mind, then the invention that employed it could not be patented. This doctrine, as applied to software, was based upon the argument that a computer operating on a program implements an algorithm, a step-by-step procedure for solving a problem. Therefore, a patent claim setting forth an al-

62. Interoffice Memorandum (May 27, 1971) (emphasis added).

63. *See, e.g., In re* Prater, 415 F.2d 1378 (C.C.P.A. 1968), *modified on reh'g*, 415 F.2d 1393 (C.C.P.A. 1969); *In re* Bernhart, 417 F.2d 1395 (C.C.P.A. 1969); *In re* Musgrave, 431 F.2d 882 (C.C.P.A. 1970).

64. Substantial legal precedence existed for this doctrine. *In re* Yuan, 188 F.2d 377, (C.C.P.A. 1951); *In re* Abrams, 188 F.2d 165 (C.C.P.A. 1951).

gorithm carried out by a computer would secure patent rights in the practical implementation of the algorithm. This would be, in effect, tantamount to a patent on the algorithm itself since the computer is in the prior art and only the algorithm is novel.

In the CCPA's landmark decision in November, 1968, *In re Prater*,[65] the court held that,

> [P]atent protection for a process disclosed as being a sequence or combination of steps, capable of performance without human intervention and directed to an industrial technology—a "useful art" within the intendment of the Constitution—is not precluded by the mere fact that the process could alternatively be carried out by mental steps.[66]

The invention in that case was the spectrographic analysis of the concentration of elements in a mixture of gases by a set of linear equations to be run in either a general purpose digital computer or a specially designed analog computer. The Patent Examiner found the set of equations to be the sole novel aspect of the invention and rejected both the process and apparatus claims as drawn to an unpatentable mental process that could be carried out with pencil and paper alone. The CCPA distinguished this case from the *Cochrane v. Deener*[67] requirement that a physical transformation take place and the presumption of unpatentable mental steps. The court decided that the definition of "process" as set forth in *Cochrane* and argued for by the Office was misconstrued, was taken out of context, and was inapplicable to the processing of mathematical data. As for the "mental steps" doctrine, the court decided that where a process is capable of performance without human intervention and directed to an industrial technology, it is not precluded from patent protection merely because the process could alternatively be carried out by mental steps. Where both the mechanical means for performing the process are disclosed in the patent application and the mental implementation of the process is unreasonable in light of the description of the invention and the scope of the claims, the invention is patentable subject matter.

This decision was so startling and in such conflict with the Office's position that the Office petitioned and was granted a rehearing on the case.[68] A strenuous dissent on the petition by Judges Rich and Almond accused the Office of being more concerned with the administrative problems and economic impact of the decision than with the substantive issues involved.

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65. 415 F.2d 1378 (C.C.P.A. 1968).
66. *Id.* at 1389.
67. 94 U.S. 780 (1877).
68. 415 F.2d 1393 (C.C.P.A. 1969).

In the second *Prater* decision, the CCPA avoided analyzing the process rejection under 35 U.S.C. § 101 but reaffirmed the right of patent protection for software and the court's reinterpretation of the *Cochrane* decision. The court, however, found that the language of the patent application disclosure failed to limit adequately the claimed process to its machine implementation and, therefore, affirmed the Patent Examiner's rejection of the specific process claim. The apparatus claim, which covered both the analog and the digital mode of implementing the process, was allowed by the court.

In view of this decision, the PTO's 1968 Guidelines were withdrawn. Commissioner Schuyler stated:

> We now will consider patent applications for computer programs on the basis of the merits for the specific inventions sought to be protected rather than refuse consideration for reasons such as those discarded by the Court in the *Prater and Wei* case.[69]

B. IN RE *BERNHART*

Four months after the second *Prater* decision, the CCPA ruled in *In re Bernhart*[70] that a computer that is programmed is physically different from a computer without that program. The invention of *Bernhart* was a method and apparatus for mathematically projecting a three-dimensional figure onto a two-dimensional surface from any desired angle and distance on any desired plane by means of a prior art computer and plotter. A general purpose digital computer was utilized to solve a set of transformation equations. These solutions were used to drive the plotter in drawing the two-dimensional representation. The Examiner had rejected the claims on the basis that the novelty in the invention lay in the equation with which the computer was programmed, and that the programming of the computer was predicated on mental steps and was, therefore, unpatentable. The court, upon review, found that since the apparatus claims contained no recitation of mental steps and did not incorporate human facilities they were within the statutory category of inventions.

In reply to the argument raised by the Examiner that a programmed computer was structurally equivalent to the same computer without that program, and that the addition of new signals to the computer did not make the computer a new machine, the court stated:

> [I]f a machine is programmed in a certain new and unobvious way,

69. Woodcock, *Mental Steps and Computer Programs*, 52 J. PAT. OFF. SOC'Y 275, 284 (1970).

70. 417 F.2d 1395 (C.C.P.A. 1969).

> it is physically different from the machine without that program; its memory elements are differently arranged. The fact that these physical changes are invisible to the eye should not tempt us to conclude that the machine has not been changed. If a new machine has not been invented, certainly a 'new and useful improvement' of the unprogrammed machine has been, and Congress has said in 35 U.S.C. § 101 that such improvements are statutory subject matter for a patent.[71]

As to the method claims, the court found that although they were directed to a statutory category of invention, they would have been obvious to one with ordinary skill in the art.[72]

C. In re *Musgrave*

Within a year of the *Bernhart* decision, the CCPA in *In re Musgrave*,[73] further broadened the categories of inventions that could be patented. Musgrave's invention was a method of obtaining more accurate recordings of seismograms in geophysical exploration by obtaining weathering corrections through the use of a digital computer. The Examiner rejected the claims on the basis that one or more steps in the process could be performed by mental acts and therefore the process did not fall within the categories of patentable inventions. The CCPA, in reversing the Examiner's holding and formulating its own standards for defining a statutory process, stated:

> We cannot agree . . . that these claims . . . are directed to non-statutory processes merely because some or all the steps therein can also be carried out in or with the aid of the human mind or because it may be necessary for one performing the processes to think. *All that is necessary, in our view, to make a sequence of operational steps in a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of 'useful arts.'* Const. Art. 1, sec. 8.[74]

This holding broadened the qualifications for a "process" under 35 U.S.C. § 101 to include any sequence of steps that can be performed by a machine as opposed to a thinking person and that serves to promote the useful arts. As noted by Judge Baldwin in his concurring opinion, "very little remains of the 'mental steps' doctrine."[75] In the next two CCPA opinions in this area,[76] the court

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71. *Id.* at 1400.

72. The standard for obviousness is set forth in 35 U.S.C. § 103 (1976).

73. 431 F.2d 882 (C.C.P.A. 1970).

74. *Id.* at 893 (emphasis added).

75. *Id.* at 895.

76. *In re* McIlroy, 442 F.2d 1397 (C.C.P.A. 1971); *In re* Waldbaum, 457 F.2d 997 (C.C.P.A. 1972).

clearly stated that processes that have no practical value other than enhancing the internal operations of a computer are a proper subject matter under 35 U.S.C. § 101 for patents.

D. *GOTTSCHALK V. BENSON*

The United States Supreme Court first confronted the issue of software patentability in the case of *Gottschalk v. Benson*.[77] Benson and co-inventor Tabbot applied for a patent for a method of converting numerical information from one numerical base (Binary Coded Decimal (BCD)) into another (pure binary) by the use of a programmed digital computer.[78] The patent application specifically stated that the invention resided in the programming algorithm and included the conversion subroutine. The invention was directed to the problem of converting telephone numbers, dialed one digit at a time, into the binary form, which is necessary for telephone interconnection. Each digit, when dialed on a telephone, generates electrical impulses that cause each digit to be stored in binary form. Complete telephone numbers can then be stored in BCD format. This BCD coded number must be converted to pure binary code for it to be processed in conjunction with other telephone processing routines. This process was used in Bell Telephone Systems No. 101 Electronic Switching System for both circuit switching and generalized data processing.[79]

The Patent Examiner rejected the claimed invention because it included within its scope mental and mathematical steps which were unpatentable under 35 U.S.C. § 101.[80]

On appeal, a unanimous CCPA reversed the Examiner and found that the sequence of steps set forth in the claims was within the useful, technological arts, and therefore was patentable as a pro-

77. 409 U.S. 63 (1972).

78. In both BCD and pure binary number systems all numbers are represented by the arrangement of the digits "0" and "1." BCD is a hybrid of both the decimal and the binary system. Like decimal, the digits zero through nine multiply powers of ten to yield the desired number. The individual digits of the number, however, are expressed in binary form.

79. During this time period, IBM developed its own electronic switching system, Model 2750, which was marketed only in Europe. This system was in a competitive position with the Bell Telephone PBX and Centrex systems. *Paper on the IBM 2750 Voices and Data Switching System*, 13 IBM J. RESEARCH & DEV. 408-55 (1969).

80. Only claims 8 and 13 of the patent application were litigated on appeal. They read as follows:

Claim 8. The method of converting signals from binary coded decimal form into binary which comprises the steps of

cess under 35 U.S.C. § 101.[81] Judge Rich, writing the court's opinion, noted that the invention as set forth in claim 8 is to be practiced on a particular apparatus, a reentrant shift register. He also compared the use of digital computers that manipulate signals representing binary numbers with cash registers, bookkeeping machines, and adding machines that manipulate numbers. Since the patentability of these analog machines[82] had not been denied under 35 U.S.C. § 101, he found that no reasonable distinction could be drawn against digital computers. Claim 13, which contained no specific recitation of

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(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.

Claim 13. A data processing method for converting binary coded decimal number representations into binary number representations comprising the steps of

(1) testing each binary digit position '1,' beginning with the least significant binary digit position, of the most significant decimal digit representation for a binary '0' or a binary '1';

(2) if a binary '0' is detected, repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(3) if a binary '1' is detected, adding a binary '1' at the (i + 1) the and (i + 3)th least significant binary digit positions of the next lesser significant decimal digit representation, and repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(4) upon exhausting the binary digit positions of said most significant decimal digit representation, repeating steps (1) through (3) for the next lesser significant decimal digit representation as modified by the previous execution of steps (1) through (3); and

(5) repeating steps (1) through (4) until the second least significant decimal digit representation has been so processed.

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

81. *In re* Benson, 441 F.2d 682 (C.C.P.A. 1971), *rev'd*, Gottschalk v. Benson, 409 U.S. 63 (1972).

82. There are two basic types of modern computers, analog and digital. In analog computers, data is represented as physical quantities instead of as numbers, and an analog device computes by measuring the quantities through physical analog to the phenomenon. Examples of simple analog computers are a thermometer and a slide rule.

Digital computers represent data in the form of discrete numbers or digits, instead of physical quantities. Information is represented in the various components of a computer in a form that requires only two distinct states of a storage position: "on" or "off." The circuitry and mechanical apparatus used for storing one number in a computer is known as a register. A shift register is a register within which a number may be reoriented by a circular permutation. D. EADIE, INTRODUCTION TO THE BASIC COMPUTER 4-8 (1968).

apparatus, was interpreted in light of the specifications and was considered to be implemented with a digital computer.

The PTO filed a petition for certiorari for Supreme Court review of this case. In a 6-0 decision delivered by Justice Douglas, the United States Supreme Court reversed the CCPA.[83] The Court cited its decisions construing the meaning of the "process" category of inventions,[84] all of which were decided under previous patent statutes,[85] and which had been superseded by the 1952 patent laws.[86] The Court did not, however, find a conclusive answer in these cases to the question of whether the "process" category was broad enough to include computer programs. The Court found that granting a patent on the claims at issue would, in effect, preempt the idea or algorithm embodied in the method, since the only practical use for the algorithm was in a digital computer. The Court further stated that innovations in the technology of processing data in digital computers are not patentable under the present statutes.

Contrary to the CCPA's decision, and even though claim 8 specifically called for the use of a reentrant shift register, the Supreme Court found that the inventions described in both claims 8 and 13 could be performed without a computer and that these claims were not limited to any particular apparatus. The claims were considered to be so broad in scope that they included all possible applications of the invention, and were thus capable of constituting a monopoly on the algorithm itself.

The Court specifically stated that this decision does not preclude a patent for any program servicing a computer, does not extend to analog computers, and does not limit process patents to old

83. 409 U.S. 63 (1972). Justices Stewart, Blackmun, and Powell did not participate in the decision.

At least 14 organizations filed amicus briefs in *Benson*. Among them were Honeywell, Inc., Burroughs Corp., I.B.M., Institutional Networks Corp., Computer Software Analysts, Inc., Whitlow Computer Systems, Inc., Iowa State University Research Foundation, Inc., Business Equipment Manufacturers Association, Applied Data Research, Inc., and Data Processing Service Organizations, Software Products and Service Section. *Id.* at 63-64. The hardware manufacturers sided with the Patent and Trademark Office, while the software companies, the geophysical exploration industry, and the patent law associations sided with Benson and Tabbot.

84. Smith v. Snow, 294 U.S. 1 (1935); Waxham v. Smith, 294 U.S. 20 (1935); Expanded Metal Co. v. Bradford, 214 U.S. 366 (1909); The Telephone Cases, 126 U.S. 1 (1888); Tilghman v. Proctor, 102 U.S. 707 (1881); Cochrane v. Deener, 94 U.S. 780 (1877); Corning v. Burden, 56 U.S. 503 (15 How.) (1854).

85. Act of July 8, 1870, ch. 230, 16 Stat. 198; Act of July 4, 1836, ch. 357, 5 Stat. 117; Act of April 10, 1790, ch. 7, 1 Stat. 109.

86. Act of July 19, 1952, ch. 950, 66 Stat. 792 (codified as amended at 35 U.S.C. §§ 1-293 (1976 & Supp. IV 1980)).

technologies.[87] No ruling was reached on the mental step doctrine.

The Court failed to cite any of the CCPA's previous decisions and obliquely recognized that the issue at hand was "a policy matter to which we are not competent to speak."[88] Citing several paragraphs from the Report of the President's Commission on the Patent System,[89] the Court concluded its opinion by admonishing the legislature that "considered action by Congress is needed."[90] The reluctance of the Court to formulate new policy and rules may be attributed to the problems attached to appropriate proprietary protection for software, as noted by Judge Rich of the CCPA, "[t]he technology is . . . mathematically awesome, the economic impact of our decision tremendous, and the administrative problems of the Patent Office horrendous . . . ."[91]

In the intervening years between *Benson* and *Dann v. Johnston*,[92] when the Supreme Court again decided to review a case concerning program patentability, the Patent Office continued to reject software claims and relied heavily on *Benson* for authority in maintaining this position. The CCPA, on the other hand, attempted to carve out sections of software technology for which patents could be granted.

E. IN RE *CHRISTENSEN*

The first case decided by the CCPA following *Benson* was *In re Christensen*.[93] The invention in *Christensen* was a process for determining the porosity of a subsurface formation in order to analyze lithologic formations. The claimed method recited a series of prior art steps for obtaining the necessary data and a novel equation for computing the porosity of the formation. The Patent Examiner rejected the claimed invention under 35 U.S.C. § 103 stating that the alleged advance over the prior art resided in nonstatutory subject matter: a novel quadratic equation. The Board of Patent Appeals, in affirming the Examiner's rejection, emphasized that the applicable claims were unpatentable under the provisions of 35 U.S.C. § 101.

The CCPA took this point of novelty approach in analyzing the claims and found the equation, which was the crux of the invention, to be the sole novel step claimed. The claims were therefore held

87. 409 U.S. at 71.
88. *Id.* at 72.
89. Exec. Order No. 11,215, 3 C.F.R. 299 (1965).
90. 409 U.S. at 73.
91. *In re* Prater, 415 F.2d 1378, 1392 (C.C.P.A. 1968) (Rich, J., dissenting).
92. 425 U.S. 219 (1976).
93. 478 F.2d 1392 (C.C.P.A. 1973).

unpatentable. The addition of old and necessary antecedent steps for establishing values for variables to be operated on was not sufficient to render the claimed method patentable.[94]

F. IN RE *JOHNSTON*

The next case that addressed the patentability of a programmable invention, *In re Johnston*,[95] was first decided by the CCPA and then was appealed to and reversed by the Supreme Court. This case was the first among many in which the CCPA overruled the Patent Examiner and permitted patent claims combining apparatus and process where the program was viewed as creating a new machine.[96] In patent applications in which the claims were directed to computational steps per se, the CCPA found the inventions to be

94. The CCPA's point of novelty approach in this case and in the cases of *In re* Abrams, 188 F.2d 165 (C.C.P.A. 1951) and *In re* Yuan, 188 F.2d 377 (C.C.P.A. 1951) were inconsistent in approach with later CCPA decisions. In *Abrams* the invention was directed to a hydrocarbon prospecting method wherein data was processed. The CCPA found that the only technological advance in the claimed method resided in the processing steps of "measuring," "determining," and "comparing" and that these were purely mental steps and thus unpatentable. In *Yuan* the invention was directed to a method of determining the airfoil profile most suitable for particular aerodynamic characteristics by particular mathematical relationships and procedures. The CCPA found these steps to be purely mental and not a patentable process. The CCPA first rejected this approach in *In re* Prater, 415 F.2d 1378 (C.C.P.A. 1968), which was subsequently vacated and replaced by an opinion that did not discuss propriety of the "point of novelty" test. *See In re* Prater, 415 F.2d 1393 (C.C.P.A. 1969). The CCPA reaffirmed its rejection of the "point of novelty" test in *In re* Musgrave, 431 F.2d 882 (C.C.P.A. 1970), and pointed out the fallacy in that test:

> [I]t is our view that [the point of novelty test is] logically unsound. According to [this test], a process containing both 'physical steps' and so-called 'mental steps' constitutes statutory subject matter if the 'alleged novelty or advance in the art resides in' steps deemed to be 'physical' and non-statutory if it resides in steps deemed to be 'mental.' It should be apparent, however, that novelty and advancement of an art are irrelevant to a determination of whether the nature of a process is such that it is encompassed by the meaning of 'process' in 35 U.S.C. § 101. Were that not so, as it would not be if [the point of novelty test] were the law, a given process including both 'physical' and 'mental' steps could be statutory during the infancy of the field of technology to which it pertained, when the physical steps were new, and non-statutory at some later time after the physical steps became old, acquiring prior art status, which would be an absurd result. Logically, the identical process cannot be first within and later without the categories of statutory subject matter, depending on such extraneous factors.

Id. at 889.

95. 502 F.2d 765 (C.C.P.A. 1974), *rev'd sub nom.* Dann v. Johnston, 425 U.S. 219 (1975).

96. Among the others were *In re* Comstock, 481 F.2d 905 (C.C.P.A. 1973); *In re* Knowlton, 481 F.2d 1357 (C.C.P.A. 1973).

unpatentable.[97] Inventions were patentable when the claims used or applied the algorithm to achieve noncomputational results.[98]

In *Johnston*, the invention was a computer program for controlling automated banking devices for machine handling of transactions, in particular, the sorting of checks into prearranged categories. The Examiner had rejected the claims under 35 U.S.C. § 101 as an invention in a nonstatutory category.[99] The CCPA, by a three to two decision, reversed all of the Examiner's rejections and narrowly construed *Benson* to apply only to process type inventions.[100] Chief Judge Markey, in the dissent, found the claimed invention to be obvious in view of the prior art to those skilled in the art of record keeping machines,[101] a position that the Supreme Court later shared.

The Supreme Court reversed the majority opinion of the CCPA but did not directly address the issues presented under 35 U.S.C. § 101.[102] The Court decided that Johnston's invention was obvious and noted that its decision in *Benson* was a limited holding.

The PTO tried three times almost immediately thereafter to have the Supreme Court address the issue of the patentability of software related inventions. The first two attempts, *In re Chatfield*[103] and *In re Noll*,[104] were unsuccessful. The Supreme Court declined to consider the cases on the grounds that the Office's petitions in *Chatfield* were not timely filed and that the *Noll* application was expressly abandoned by the applicant. The third petition, *In re Flook*,[105] was accepted by the Supreme Court.

G. In re *Flook*

The invention in *Flook* was a three step method for updating alarm limits. A mathematical algorithm was used to compute the values of environmental limits such as temperature, pressure, and

97. *In re* Richman, 563 F.2d 1026 (C.C.P.A. 1977); *In re* de Castelet, 562 F.2d 1236 (C.C.P.A. 1977). *See also In re* Christensen, 478 F.2d 1392 (C.C.P.A. 1973).

98. *In re* Deutsch, 553 F.2d 689 (C.C.P.A. 1977); *In re* Flook, 559 F.2d 21 (C.C.P.A. 1977), *rev'd sub nom.* Parker v. Flook, 437 U.S. 584 (1978); *In re* Waldbaum, 457 F.2d 997 (C.C.P.A. 1972).

99. Other rejections were made under 35 U.S.C. § 112, for indefiniteness, and under 35 U.S.C. § 103, for obviousness to one of ordinary skill in the art. A rejection that banking is a social science and therefore not a patentable technological art was added by the PTO Board of Appeals.

100. 502 F.2d at 771.

101. *Id.* at 772.

102. Dann v. Johnston, 425 U.S. 219 (1975).

103. 545 F.2d 152 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977).

104. 545 F.2d 141 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977).

105. 559 F.2d 21 (C.C.P.A. 1977), *rev'd sub nom.* Parker v. Flook, 437 U.S. 584 (1978).

flow rates in a catalytic hydrocarbon conversion process. These values were then used to update the process alarm limits. The first step of the process measured the process variables value. The second step calculated an updated alarm limit value. The third step replaced the old alarm limit with the newly computed value.

The sole novelty in the claimed invention[106] was the mathematical algorithm used in computing the updated alarm limit value. Although the claims covered a large variety of potential uses of the invention, they did not cover every conceivable application of the algorithm. The Examiner rejected the claimed invention as a nonstatutory subject matter.

The CCPA reversed the Examiner on the basis that although the claim recited an algorithm to be used in carrying out the invention, it did not preempt the algorithm. The court also noted that a sufficient step was present to render the claims patentable by making an adjustment to the alarm limit after solving the algorithm.

The PTO and Justice Department found this decision particularly unpalatable since knowledgeable patent practitioners could easily draft claims for software related inventions by reciting a post-solution activity broad enough to cover an entire field of technology.[107] A patent on such claims would then preempt virtually all uses of such claimed inventions.

The Supreme Court, in January of 1978, granted certiorari. Justice Stevens, writing for the majority in a 6-3 decision, reversed the decision of the CCPA and disallowed the patent claims. The Court found the invention unpatentable because the algorithm, like a law of nature or a scientific principle, is assumed to be in the prior art. The claimed invention, therefore, considered as a whole, contained

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106. Claim 1 of Flook reads:

> 1. A method for updating the value of at least one alarm limit on at least one process variable involved in a process comprising the catalytic chemical conversion of hydrocarbons wherein said alarm limit has a current value of
>
> $$Bo + K$$
>
> wherein Bo is the current alarm base and K is a predetermined alarm offset which comprises:
>
> (1) Determining the present value of said process variable, said present value being defined as PVL_1;
>
> (2) Determining a new alarm base B^1, using the following equation:
>
> $$B^1=Bo\ (1.0-F) + PVL\ (F)$$
>
> 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.

437 U.S. at 596-97.

107. The Acting Commissioner of the Patent and Trademark Office stated that the CCPA decision would have a debilitating effect on the software industry and would require the Office to handle thousands of additional patent applications. *Id.* at 587.

no patentable subject matter.[108]

The Court further rejected the CCPA ruling that post-solution activity in and of itself was sufficient to transform an unpatentable invention into a patentable one. The test set forth for patentability is whether the complete process as claimed, not just the algorithm or formula, is new and useful. Laws of nature, such as algorithms, could not be patented because they reveal a relationship that always existed and as such are not the type of discoveries for which patent rights were provided.

The Court, however, agreed with the CCPA that Flook's claims would not wholly preempt the algorithm and would not in practical effect be a patent on the algorithm. The Court, in affirming that some computer programs may be patentable, stated that this decision should not be interpreted as "reflecting a judgment that patent protection of certain novel and useful computer programs will not promote the progress of science and the useful arts, or that such protection is undesirable as a matter of policy."[109]

The Court again noted its concern as to which software is suitable for patent protection and requested Congress to settle this difficult policy issue.

H. *HIRSCHFELD V. BANNER*

The first case to come up for review following *Flook* was *Hirschfeld v. Banner*.[110] Chief Judge Markey of the CCPA, sitting by designation in the district court, found that an invention increasing the dynamic range for a digitally controlled television camera tube whose output signals were stored in a digital computer was statutory subject matter. The court found that since the claims did not directly or indirectly recite a mathematical algorithm the claimed invention could not be directed to a mathematical algorithm.

I. IN RE *SARKAR*

Soon thereafter, Chief Judge Markey wrote the CCPA's first post-*Flook* interpretive opinion in *In re Sarkar*.[111] The invention in

108. By considering the algorithm in the "prior art," the Court interjected considerations of novelty and obviousness under 35 U.S.C. § 102 and 35 U.S.C. § 103. This tended to obfuscate the issues. In Nickola v. Peterson, 580 F.2d 898 (6th Cir. 1978), decided one day after the Supreme Court decision in *Flook*, Judge Markey of the CCPA, sitting by designation, repudiated any consideration of novelty under 35 U.S.C. § 101.

109. 437 U.S. at 595.

110. 462 F. Supp. 135 (D.D.C. 1978), *aff'd mem.*, 615 F.2d 1368 (D.C. Cir. 1980), *cert. denied*, 450 U.S. 994 (1981).

111. 588 F.2d 1330 (C.C.P.A. 1978).

Sarkar was a technique for mathematically modeling the flow parameters of an open channel of a river obstructed by dams or bridges, and which experiences flooding, has lateral or upstream inflow, or empties into a tidal body.

The CCPA affirmed the Examiner's rejection of the claimed invention as not being directed to a process within the scope of 35 U.S.C. § 101. The court found that Sarkar's claimed invention as a whole consisted of a mathematical exercise, and as such did not constitute an *invented* process for section 101 purposes. "Sets of steps occurring only in the mind have not been made subject to patenting because mental processes are but disembodied thoughts, whereas inventions which Congress is constitutionally empowered to make patentable are tangible embodiments of ideas in the useful, or technological arts."[112] The court also found the novelty or nonobviousness of the process to be irrelevant to its patentability under section 101.

J. IN RE *JOHNSON*

The next case decided by the CCPA was *In re Johnson*.[113] The invention in *Johnson* was a computer-implemented method of filtering noise from data obtained in seismic prospecting by analysis and comparison of different parts of collected data. The Patent Examiner rejected all the claims under 35 U.S.C. § 101 as directed to nonstatutory subject matter. The CCPA, in a unanimous opinion, reversed the Examiner. The court decided that Johnson's invention was not merely a novel mathematical formula, as in *Flook*, but a process designed to produce a recording of noiseless seismic traces. Thus, since the result of the process was not just mathematical values, Johnson's claims passed statutory muster under the *Flook* criterion.

The court then applied its two-pronged test, first formulated in *In re Freeman*,[114] to determine whether the claims recited non-statutory subject matter. First, the claims were reviewed to determine whether they directly or indirectly recited process steps which were themselves calculations, formulae, or equations. Second, the claims were analyzed to see if they wholly preempt these calculations, formulae, or equations. As to the first test, the court found language in the claims that suggested the execution of a mathematical algorithm and, although no formula was specifically set out in the claims, one was implicitly required. The court found that the claims did not

112. *Id.* at 1333.
113. 589 F.2d 1070 (C.C.P.A. 1978).
114. 573 F.2d 1237 (C.C.P.A. 1978).

merely define a method of solving a mathematical algorithm and that the algorithmic steps of "determining" and "computing" were incidental to producing a noise-free seismic trace.

K. In re *Gelnovatch*

The next two cases decided before the Supreme Court decisions of *Diehr* and *Bradley* were *In re Gelnovatch*[115] and *Arshal v. United States*.[116] In *Gelnovatch*, a divided CCPA affirmed the Examiner's rejection of the claimed invention as directed to a nonstatutory process. The invention was a process for determining a set of values for use in a mathematical model of a microwave circuit. The model used mathematical equations to describe the functional characteristics of the circuit components and the manner in which the components interrelated. Electrical components that matched those of the model would permit building such a circuit and would have a specified response.

The court found the claimed invention similar to that in *Flook*. Although the equations claimed did not determine an output value from input values, this was not considered significant since in the instant invention the answer was specified prior to performing the calculations. The court stated that where "the claims solely recite a method whereby a set of numbers is computed from a different set of numbers by merely performing a series of mathematical computations, the claims do not set forth a statutory process."[117]

L. *Arshal v. United States*

In *Arshal v. United States*, the Court of Claims considered an infringement[118] suit against the United States. Arshal alleged that the

115. 595 F.2d 32 (C.C.P.A. 1979).

116. 621 F.2d 421 (Ct. Cl. 1980), *cert. denied*, 449 U.S. 1077 (1981).

117. *Gelnovatch*, 595 F.2d at 42.

118. Section 271 of Title 35 is entitled "Infringement of patent" and provides:

(a) Except as otherwise provided in this title, whoever without authority makes, uses or sells any patented invention, within the United States during the term of the patent therefor, infringes the patent.

(b) Whoever actively induces infringement of a patent shall be liable as an infringer.

(c) Whoever sells a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial noninfringing use, shall be liable as a contributory infringer.

(d) No patent owner otherwise entitled to relief for infringement or contributory infringement of a patent shall be denied relief or deemed guilty of misuse or illegal extension of the patent right by reason of his having done

U.S. Department of the Navy had infringed his patent[119] to a directional computer.

The court found the situation here similar to that in *Christensen* and granted the government's request for summary judgment. Particularly noteworthy in this decision are the court's statements that although the claims at issue were in apparatus format and the claims' preamble called for a "directional computer," the claims were not within the statutory categories of invention because they would nonetheless preempt the mathematical equation. This had the effect of reducing the significance of the distinction between apparatus and process claims in cases of this sort.

This distinction between apparatus and process claims was also dispensed with by the CCPA in *In re Maucorps*[120] in which the court stated that since the form of a claim is often an exercise in drafting, the test for patentability under 35 U.S.C. § 101 applies without regard to such format use in the claims.

M. In re *Walter*

Of the two remaining cases decided by the CCPA,[121] *In re Walter* is more significant. Walter's invention was a method and apparatus for the processing of seismic exploration data using Fourier transforms and cross-correlation by Cooley-Tukey algorithms. The Patent Examiner rejected the claims on the basis that they were directed to the mathematical procedure outlined in the specification for cross-correlating the sets of seismic signals.

In his opinion for the court, Judge Rich stated:

> The determination of statutory subject matter under § 101 in the field here involved has proved to be one of the most difficult and controversial issues in patent law. The problem here, as we see it, is not one of computer-related inventions per se; it is one of mathematics-related inventions.[122]

In analyzing the claims the court found that the specific end use recited, seismic surveying, did not save the claims from the holding in *Flook*, since they were drawn solely to improve methods of calcula-

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one or more of the following: (1) derived revenue from acts which if performed by another without his consent would constitute contributory infringement of the patent; (2) licensed or authorized another to perform acts which if performed without his consent would constitute contributory infringement of the patent; (3) sought to enforce his patent rights against infringement or contributory infringement.

119. U.S. Patent No. 3,319,052, issued May 9, 1967.

120. 609 F.2d 481 (C.C.P.A. 1979).

121. *In re* Walter, 618 F.2d 758 (C.C.P.A. 1980); *In re* Philips, 608 F.2d 879 (C.C.P.A. 1979).

122. 618 F.2d at 764.

tion. The court distinguished *Johnson* by noting that in *Johnson* a noiseless seismic trace was produced, a physical product, while here no physical product resulted.

The court also noted that *Flook* did not require a literal preemption of the algorithm of the invention. It found no conflict between this and its *Freeman* test, which had been stated in terms of preemption, but went on to restate the second step of that test as follows:

> Once a mathematical algorithm has been found, the claim *as a whole* must be further analyzed. If it appears that the mathematical algorithm is implemented in a specific manner to define structural relationships between the physical elements of the claim (in apparatus claims) or to refine or limit claim steps (in process claims), the claim passes muster under § 101. If, however, the mathematical algorithm is merely presented and solved by the claimed invention, as was the case in *Benson* and *Flook*, and is not applied in any manner to physical elements or process steps, no amount of post-solution activity will render the claim statutory; nor is it saved by a preamble merely reciting the field of use of the mathematical algorithm.
>
> Various indicia are helpful in determining whether a claim as a whole calls merely for the solution of a mathematical algorithm. For instance, if the end-product of a claimed invention is a *pure number*, as in *Benson* and *Flook*, the invention is nonstatutory regardless of any post-solution activity which makes it available for use by a person or machine for other purposes. If, however, the claimed invention produces a physical thing, such as the noiseless seismic trace in *In re Johnson*, supra, the fact that it is represented in numerical form does not render the claim nonstatutory. (emphasis in original).[123]

This new test requires the mathematical algorithm to be implemented to define a structural relationship between the claimed elements, or to refine the claimed elements, or to refine or limit physical process steps.

It was the applications of *Bradley* and *Diehr* that finally provided the impetus of the policy changes necessary to clarify and simplify the categories of software-related inventions subject to patent protection.

IV. RECENT SUPREME COURT DECISIONS

A. *DIAMOND V. BRADLEY*

On April 21, 1975, John S. Bradley and Benjamin S. Franklin ap-

123. *Id.* at 767-68.

plied for a patent on an invention for firmware,[124] which directs the transfer of data within a computer.[125] A computer's hardware includes a main memory that has a system base[126] with which the computer programmer can communicate. In high performance computers, where speed of operation is important, certain information that is part of the system base may be stored in storage components commonly called "scratchpad registers." Because these registers are not, however, normally accessible to the programmer by means of computer programs, changing the data they contain had been a problem.[127]

Bradley and Franklin claimed an invention that provided an improved method for changing the data in the registers. In addition to certain hardware elements, it employed firmware instructions. When activated by software, the instructions caused a particular se-

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124. Firmware has been defined as microprograms (programs that determine how a computer interprets an instruction in machine language) resident in the computer's control memory. Opler, *Fourth Generation Software*, 13 DATAMATION 22 (1967).

The term is generally used more broadly to define microprograms for multifarious uses so long as the physical mode of the program causes a particular sequence of computer operations to take place.

125. Bradley's claimed invention, as described in Claim 1, states:

> 1. In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said main memory, said (CPU) controlling the state of a plurality of groups of processes being in a running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:
>
> (a) first means in said data structure and communicating with said operating system for storing coded signals indicative of an address for a selected one of said processes;
>
> (b) second means in said first means for storing coded signals indicating priority of said selected one of said processes in relation to others of said processes for obtaining control of said CPU when ready;
>
> (c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes, and,
>
> (d) fourth means coupled to said data structure and said scratchpad registers, for generating signals causing the changing of information in said data structure and said scratchpad registers.

In re Bradley, 600 F.2d 807, 809 (C.C.P.A. 1979), *aff'd per curiam by an equally divided Court sub nom.*, Diamond v. Bradley, 450 U.S. 381 (1981).

126. The system base controls the operation of the computer. It contains the process information used by the computer to carry out programmed operations.

127. To change the data in the scratchpad registers the programmer had to reprogram the entire system base, a time consuming task, or use software limited to that particular computer model, an option unacceptable to many computer users.

quence of computer operations to take place.[128] An instruction in the firmware developed by Bradley and Franklin permitted the programmer to communicate with the scratchpad registers and to switch data back and forth between the registers and the system base in the main memory.[129]

The Patent Examiner rejected the claimed invention as drawn to nonstatutory subject matter under 35 U.S.C. § 101. He noted that the hardware arrangement to which the claims referred—"a main memory, central processing unit, and scratchpad registers"—were "well-known components" that were "admittedly old in the art."[130] The examiner found that the only novel aspect of the invention resided in an algorithm designed to control the multiprogramming computer to solve the particular problem indicated. He concluded that this "program implemented algorithm" was not patentable under 35 U.S.C. § 101.[131]

The Patent and Trademark Office Board of Appeals agreed with the Examiner. It found that except for the microprogramming, Bradley and Franklin's arrangement of hardware was old in the art. It ruled that the fact that their claims were in "apparatus," rather than "method," format did not make them any less "related to an algorithm." The Board added, "[a] claim for an improved method of calculation, even when tied to a specific end use, is unpatentable."[132]

The CCPA unanimously reversed the Board, observing that Bradley and Franklin were claiming a machine or apparatus composed of a combination of hardware elements that fell "literally within the boundaries of § 101."[133] The court recognized that this combination also involves a portion of the computer's control store that is microprogrammed in a particular manner and left standing the Board's determination that the apparatus was old in the art and that only the microprogram was new. It did, however, reject the Board's "distillation of [the] claim down to the information contained in the firmware."[134]

The proper analysis, said the court, involves determining

128. Bradley's firmware is stored in a control memory of the programmable read only memory (PROM) type, which can be microprogrammed by the user.

129. When the programmer activates a "switch system base instruction," this initiates the execution of a microprogram that transfers the data.

130. 600 F.2d at 809-10.

131. The Examiner further noted in his answer before the Patent and Trademark Office Board of Appeals that microprogrammed control units like Bradley's were also old in the art.

132. 600 F.2d at 810-11.

133. *Id.* at 812.

134. *Id.* at 813.

whether the claimed invention preempts the use of an algorithm. Applying this test, it stated that there was no mathematical algorithm here. Although certain calculations were made, they did not "transform the invention as a whole into a method of calculation"[135] because after the invention's task was completed there was no solution of an equation.

In essence, the court found the invention to lie in the combination of tangible hardware elements and not in the information embodied in these elements. The court then applied its two-pronged test first formulated in *In re Freeman*.[136] First, the claims were reviewed to determine whether they directly or indirectly recited process steps which were calculations, formulae, or equations. Secondly, the claims were analyzed to see if they wholly preempted these calculations, formulae, or equations. Using this test the court found that no mathematical algorithm was present and that the invention as a whole was not a method of calculation.

The PTO then petitioned the Supreme Court for certiorari, citing the need for efficient administration of the patent system and the CCPA's unwillingness to apply the analysis of the claims required by the Supreme Court under *Flook*. The PTO noted its difficult position in this situation, stating:

> *The importance of this case transcends its particular facts and the lower court's evident unwillingness to apply Parker v. Flook.* That unwillingness is confirmed by a number of other cases in which the CCPA has similarly adhered to the analysis of the dissent in *Flook*, rather than the opinion of the Court. In re Gelnovatch, 595 F.2d 32 (1979); In re Johnson, 589 F.2d 1070, 1081 (1978); In re Sarkar, 588 F.2d 1330, 1332-1333 (1979). The CCPA's interpretation of *Benson* and *Flook* is highlighted in In re Diehr, 602 F.2d 982 (CCPA 1979), reh. denied (Oct. 18, 1979), a case involving a mathematical algorithm similar to the one involved in *Flook*. We plan to file a petition for a writ of certiorari in *Diehr* shortly. We suggest that it be considered with this case, and that it would be desirable for the two cases either to be consolidated for argument in this Court or to be heard in tandem.
>
> In light of the consistent rejection of *Flook* by the court below, *review of this Court is of prime importance to efficient administration of the patent system. The Patent and Trademark Office presently has pending more than 3000 patent applications in which the patentability of computer software or firmware is a potential issue.* Some *1200 applications* involve mathematical algorithms; *over 1800* involve nonmathematical algorithms. Unless this Court grants re-

135. *Id.*

136. 573 F.2d 1237 (C.C.P.A. 1978). *Freeman* was decided prior to the Supreme Court decision in *Flook*; however, the test was not affected by the *Flook* decision.

> view now, the CCPA's approach, exemplified by the decision below, puts the Commissioner in an untenable position. Should he follow the analysis required by the CCPA, he would be untrue to *Flook*, would usurp congressional function by expanding the scope of the patent laws (see Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 531 (1972)) and withal would settle nothing in the law, for the issues of patentability would remain to be litigated in infringement suits (see 35 USC 281 et seq.; 28 USC 1338). On the other hand, should he continue to adhere to his view that computer programs are themselves unpatentable, there is the *gloomy prospect of years repeated, costly and unsuccessful litigation in the Court of Customs and Patent Appeals*. This Court in *Flook* strongly intimated that computer programs are not patentable under current law. See 437 U.S. at 595. A definitive ruling to that effect would correctly leave to Congress the decision whether and how to extend the patent laws to computer programs, would greatly facilitate administration of the patent system, and would forestall the unsettling effects of a proliferation in the economy of unauthorized (and ultimately invalid) patents on computer programming.[137]

An equally divided Supreme Court affirmed the CCPA's decision, but made no statements as to their reasons or the merits of the arguments presented.[138]

B. *Diamond v. Diehr*

The invention in *Diehr* is a process that uses a computer for regulating the curing time of raw rubber in a mold press. Rubber products produced from a mold press are cured under heat and pressure in the press for a specified time. The time needed to obtain a good cure depends in part on the temperature inside the press, which is regulated by a thermostat.[139] It is possible, using well-known time, temperature, and cure relationships, to calculate when to open the press and remove the cured product. Nonetheless, uncontrolled variables present in the actual curing process, such as heat loss during loading of the press, make it difficult to calculate exact temperature. For this reason, the industry practice is to calculate the cure time as the shortest time in which all parts of the product definitely will be cured, assuming a "reasonable amount of mold-opening time" during loading and unloading. The disadvantages of this practice are that erring on the side of caution will usually lead to

137. Petition for certiorari, Diamond v. Bradley, at 12 (emphasis added).

138. 450 U.S. 381 (1981) (per curiam). Chief Justice Burger took no part in the consideration or decision of this case.

139. The geometric configuration of the press and the viscosity of the rubber when it enters the press are important factors in computing the cure time.

overcuring the rubber, while keeping the mold open for more than a "reasonable" time will often result in undercuring.

Diehr's claimed invention employs a digital computer to determine a more precise cure time.[140] Measurements of the temperature in the closed, heated press are made at frequent intervals. Each measurement is automatically fed into the computer which then recalculates the cure time. When the recalculated cure time equals the actual time that has elapsed since the press was closed, the computer signals a device to open the press.

The Patent Examiner rejected the claimed invention on the sole ground that the claims were drawn to nonstatutory subject matter under 35 U.S.C. § 101. He determined that those steps in Diehr's claims that are carried out by computer under control of a stored program are nonstatutory under the Supreme Court's decision in *Benson* which held that innovations in the technology of processing data in digital computers are unpatentable. The remaining steps—which relate generally to the method of manufacturing precision molded articles, such as the opening, closing, and heating of the mold—the Examiner found to be "conventional." The Examiner concluded that the claims defined and sought protection of a computer program for operating a rubber molding press.

The Patent and Trademark Office Board of Appeals agreed with the Examiner and unanimously affirmed the rejection. In analyzing the claims, the Board found much that was either within the prior

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140. Claim 1 of the 11 claims appealed reads:

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.

In re Diehr, 602 F.2d 982, 983-84 (C.C.P.A. 1979).

art, such as the constant measurement of the mold temperature, or that involved post-solution activity, such as the automatic opening of the press. The "calculation" recited in the claims, observed the Board, showed that Diehr's system employed an algorithm. The Board summarized: "[T]he only difference between the conventional methods of operating a molding press and that claimed . . . rests in those steps . . . which related to the calculation incident to the solution of the mathematical problem or formula."[141] The Board concluded that this calculation, Diehr's "contribution," was a "computer program of the character" that is nonstatutory.[142]

The CCPA reversed the Board of Appeals.[143] It agreed with the Board that Diehr had "disclosed a computer program," but it stated that this "does nothing to aid in the determination of compliance with § 101" and is not "of any significance."[144] It held that the Supreme Court's decision in *Flook* (if a claim recites an algorithm, then the algorithm is to be considered as part of the prior art) was merely a convenient vehicle for finding that the method of calculation used in *Flook* was nonstatutory. The case did not establish a general test for determining compliance with 35 U.S.C. § 101. Thus, the court refused to identify and set aside, as had the Board, those steps in the claim that were old in the art, stressing that, "considerations of novelty and obviousness have no bearing on compliance with § 101."[145] The CCPA instead considered the claims, as a whole, and found that they recite a process or method for molding rubber articles at whose "heart" is a molding press, not an equation or method of calculation. Since this process constituted an improvement over prior processes, and since those processes were patentable, the court concluded that Diehr's process was likewise patentable.

For substantially the same reasons set forth in its petition for certiorari in *Bradley*, the PTO petitioned the Supreme Court for review in *Diehr*. The Supreme Court published its opinion in *Diehr* almost one week prior to its decision in *Bradley*. In *Diehr*, a 5-4 decision with Justice Rehnquist writing for the majority, the Supreme Court affirmed the CCPA's decision and found the claimed invention could be statutorily categorized as an invention. The Court began its decision by noting its portentious decision from the previous term, *Diamond v. Chakrabarty*,[146] in which it held that an

141. *Id.* at 984.
142. *Id.*
143. *Id.* at 989.
144. *Id.* at 985.
145. *Id.* at 987.
146. 447 U.S. 303 (1980). The affirmance of the CCPA position was by a 5-4 major-

invention of a man-made bacterium for breaking down crude oil was within the statutory categories of invention set forth in 35 U.S.C. § 101. The Court also rejected the PTO argument that living things were excluded from patent protection under section 101 until Congress expressly authorizes their patentability.

As in *Chakrabarty*, the *Diehr* Court analyzed 35 U.S.C. § 101 and cautioned, courts "should not read into the patent laws limitations and conditions which the legislature has not expressed."[147] In considering the category of invention of "process," the Court equated the term "process" with the term "art," a category of invention in the Patent Act of 1793,[148] and noted that the terms were interchangeable. For example, analysis of the eligibility of a patent claim for a "process' does not change when the term "process" is exchanged for the term "art" in 35 U.S.C. § 101. The Court cited the Congressional Committee Reports, which accompanied the 1952 Patent Act, as indicative that Congress intended patentable subject matter to "include *anything under the sun that is made by man.*" (emphasis added).[149]

Diehr's claimed invention involved the transformation of an article, raw uncured synthetic rubber, into a different state or thing. The Court thus differentiated Diehr's invention from the inventions in *Benson* and *Flook*. The sole practical application of the mathematical algorithm in *Benson* was its connection with the programming of a general purpose digital computer. Such an algorithm was considered similar to a law of nature and consequently not subject to patent protection. Flook's invention was directed to computing an alarm limit (a number). The claims in *Flook* sought to protect the formula for computing that number. *Diehr*, on the other hand, was found not to be generally preempting the mathematical equation employed in his process except in conjunction with all the other steps of his claimed process.

The basic position of the PTO was that the claim should be dissected under a point of novelty approach and that the algorithm should be considered as part of the prior art. The Court emphatically stated that the claims must be considered "as a whole."[150] The analysis suggested by the Office, noted the Court, would undermine

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ity, led by Chief Justice Burger. The assignee of the patent is the General Electric Company.

147. *Id.* at 308 (quoting United States v. Dubilier Condenser Corp., 289 U.S. 178, 199 (1933)).

148. Act of Feb. 21, 1793, ch. 11, 1 Stat. 318, § 1.

149. H.R. REP. No. 1923, 82d Cong., 2d Sess. 6; S. REP. No. 1979, 82d Cong., 2d Sess. 5, *reprinted in* [1952] U.S. CODE CONG. & AD. NEWS 2394, 2399.

150. 450 U.S. 175, 188 (1981).

earlier decisions regarding the criteria that should be considered in determining eligibility of a process for patent protection. Furthermore, contrary to its indication in *Flook*, the *Diehr* Court found that considerations of novelty under 35 U.S.C. § 102 are "wholly apart from whether the invention falls into a category of statutory subject matter."[151]

In regard to post-solution activity, the Court ruled that insignificant post-solution activity will not transform an unpatentable principle into a patentable process. Citing *Flook* in this regard, the Court stated:

> A mathematical formula does not suddenly become patentable subject matter simply by having the applicant acquiesce to limiting the reach of the patent for the formula to a particular technological use. A mathematical formula in the abstract is nonstatutory subject matter regardless of whether the patent is intended to cover all uses of the formula or only limited uses. Similarly, a mathematical formula does not become patentable subject matter merely by including in the claim for the formula token postsolution activity such as the type claimed in *Flook*.[152]

The four dissenting Justices began their opinion with a review of the history of computers and computer-related patent law. This review consisted of a critical analysis and summary of the CCPA decisions beginning with *In re Tarczy-Hornoch*[153] and ending with *In re Diehr*.[154] The dissent found the CCPA's approach to 35 U.S.C. § 101 throughout the twelve year duration between these cases to be "expansive."[155] The *Diehr* dissent also found that the CCPA's post-*Flook* decisions tended to "trivialize" the Court's holding in *Flook*.[156]

The dissent believed that Diehr had invented an improved method of calculating the time that a mold should remain closed during the curing process and not, as held by the majority, a method of constantly measuring the actual temperature inside a rubber molding press. This conclusion was based upon three reasons. First, Diehr's patent application fails to assert that there is anything unusual about the temperature reading devices used in this process. Second, devices for constantly measuring actual temperature were well-known in the prior art. Third, the sole difference between con-

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151. *Id.* at 190 (quoting *In re* Bergy, 596 F.2d 952, 961 (C.C.P.A. 1979)).

152. *Id.* at 192 n.14.

153. 397 F.2d 856 (C.C.P.A. 1968).

154. 602 F.2d 982 (C.C.P.A. 1979), *aff'd sub nom.* Diamond v. Diehr, 450 U.S. 175 (1981).

155. 450 U.S. at 205.

156. *Id.*

ventional methods of operating a molding press and Diehr's method relates to the calculation of the mathematical problem or formula used to control the mold heater and the automatic opening of the press. Thus, the dissent found that Diehr's discovery is a method of using a digital computer to determine the amount of time that a rubber molding press should remain closed during the synthetic rubber curing process. This determination of the time parameter was found to be similar to the computed alarm limit value in *Flook*. The essence of the inventions in both *Diehr* and *Flook* were therefore found to be in their respective algorithms which could be programmed on a digital computer.

The correct mode of analysis under 35 U.S.C. § 101 to determine what constitutes a patentable process, according to the dissent, is to assume that all of the steps of the process are novel, unobvious, and useful. The claimed invention is then reviewed in order to ascertain what the inventor considers his inventive concept to be. If the invention is found to be a mathematical algorithm, then it is unpatentable since an algorithm is a law of nature and as such is not a patentable process within the meaning of section 101.

The dissent in *Diehr* did not grant any legal significance to the post-solution activity of the algorithm because such activity did not constitute any part of what the applicants actually discovered. Since such activity was not novel, it was argued that it should be legally inconsequential regardless of whether or not it was significant.

In reference to the broader question of whether computer programs, per se, should be given patent protection, the dissent reiterated the Court's previous position in *Benson* and *Flook* that because of the complex policy considerations involved, the Court is not authorized to address the issue. The dissent concluded that the decision should be made in its appropriate forum—Congress.

C. PTO Practice After *Bradley* and *Diehr*

By mid-March, 1981, less than one month after the Supreme Court decisions, a committee had been formed by the PTO to draft new guideline proposals for patent examination in software-related cases.[157] Meanwhile, the Patent and Trademark Office Board of Appeals reviewed the apposite cases then under appeal in light of the Supreme Court decisions in *Bradley* and *Diehr*. By August 1, 1982, at least thirty-eight applications had been reviewed and decisions rendered. These decisions by the Board indicate that a majority of the Board members desire a change in policy toward more favorable

157. Mark Nusbaum, a Senior Primary Examiner, was named Chairman of the Committee.

treatment in the patenting of software-related inventions. Of the thirty-eight appeals decided by the Board, twenty-one were reversals of the Examiner's position, fifteen were affirmances of the Examiner, and two were affirmances in part. The ratio of reversals to affirmances was substantially higher than it was before the Supreme Court decisions in *Bradley* and *Diehr*.

In the majority of appealed applications, the Board applied the two-part test of *Freeman* as modified by the CCPA in *Walter*.[158] The claims were first analyzed to determine if they recited nonstatutory mathematical algorithms as defined in *Benson*. Claimed inventions not containing such algorithms were found to be within the statutory categories of invention. If the claims did recite mathematical algorithms, then they were considered as a whole to determine whether the algorithm transformed at least one element of the invention into a different state or thing. If such a transformation occurred, then the claims were considered to be within the statutory categories of invention.

Inventions that concern processes for modeling physical events or elements and that claim to perform mathematical operations have been found to be unpatentable by the Board. The Board particularly emphasized that operations on synthetic (hypothetical) signals, the results of which have no necessary relationship to actual signals that might be derived from actual measurements, are nonstatutory subject matter.

Inventions that derive values of physical parameters of an entity by mathematically processing data obtained by actual measurements have been found unpatentable by the Board. The Board considered the derivation to be a simulation of something physical by a process akin to mathematical modeling and in line with the CCPA's pre-*Diehr* decision in *Walter*. The Board found that inventions directed at the filtering of data by mathematical algorithm processing were patentable in view of the CCPA's ruling in *Johnson* and that inventions directed to determining the direction and identity of targets emitting radiation were patentable since the end product was not a pure number.

In considering whether a "physical conversion" had taken place, the Board looked to both the environment and the post-solution activity of the claimed invention. Secondary factors, such as the recitation of necessary antecedent steps that establish or provide values for variables in a mathematical algorithm, were found not to convert an otherwise nonstatutory method into one that is statutory. In one

158. 618 F.2d 758, 767 (C.C.P.A. 1980).

Board opinion,[159] the majority opined that a numerical end product of an algorithm can be considered a "physical thing" if it indicates physical aspects of an entity. Similarly, limiting the claimed invention to a particular art or technology and/or claiming merely the recording of the output of the mathematical algorithm did not render otherwise nonstatutory subject matter a statutory category of invention.

In one of the four dissenting opinions of the thirty-eight Board decisions reviewed, one Board member admonished the Board to be cautious in applying precedents of the CCPA that were decided before *Diehr*. In this Board member's view, *Diehr* should be taken as the last word, "the new testament," of the Supreme Court and all reasoning should stem directly from that opinion until the CCPA has an opportunity to interpret it on a case-by-case basis.[160]

This dissenting Board member reversed his pre-*Diehr* Board decision which had affirmed the Examiner's rejection of the claimed invention under 35 U.S.C. § 101 as directed to a nonstatutory category of invention. Analyzing the claimed invention as to whether patent protection was being sought for an algorithm in the abstract, he found that the appellant was not seeking a patent merely for a mathematical formula. As the environment of the invention was set forth in the claims, the dissenting member argued that citizens who perform the algorithm per se are not infringing on appellant's claims. The opinion concluded with the note that "Congress intended statutory subject matter to 'include anything under the sun that is made by man'; *Diehr*, 209 USPQ at page 6, quoting the Committee Reports accompanying the 1952 Act."[161]

D. IN RE *TANER*

The validity and viability of this dissenting opinion was upheld by the CCPA in *In re Taner*.[162] The invention in *Taner* is a method of seismic exploration by which substantially plane or cylindrical seismic energy waves are simulated by combining (summing) reflected signal traces engendered by conventional spherical seismic waves.[163]

159. Claims that the Board finds unallowable, such as the ones discussed in this section, are "abandoned." These Board decisions, therefore, are not made a matter of public record.

160. Not public record.

161. Not public record.

162. 681 F.2d 787 (C.C.P.A. 1982).

163. Taner's claimed invention, as defined in his first claim, reads:

1. A method of seismic exploration by simulating from substantially spherical seismic waves the reflection response of the earth to seismic energy having a sub-

In conventional seismic exploration methods, seismic sources generate seismic energy waves that radiate through the earth in spherical or near-spherical wavefronts. Reflections of the spherical waves are detected and recorded. The recorded signals, which contain information concerning geological substrata traversed, are processed in order to make the information more discernible. Taner's invention implemented the repeated use of a specific arrangement of a seismic source and a group of detectors along a line of survey so that the reflection signals obtained by the detectors for each source position were combined. The combined signal represents the response of the earth to a substantially continuous wavefront over an extension of seismic source or receiver positions of dimensions that are large with respect to the wavelength of the seismic energy. Thus, although the seismic source produces substantially spherical waves, the combined signal represents, for a point along the seismic line, the reflection response of the earth to a downwardly traveling plane or cylindrical wave having vertical ray paths.

The Patent Examiner rejected the claimed invention because the method of seismic data treatment operated on general purpose computers and recited a mathematical algorithm that does not constitute patentable subject matter under 35 U.S.C. § 101.[164] He reasoned that since the claims define a method of seismic data treatment that is not limited to any apparatus, the claims preempt all implementations of the claimed mathematical and manipulative operations upon the seismic data.

The PTO Board of Appeals initially applied the test established by the CCPA in *Freeman* and *Walter* and affirmed the Examiner's rejection. This decision was formally rendered one week after the

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stantially continuous wavefront over an extent of an area being explored having at least one dimension which is large relative to a seismic wavelength, comprising the steps of:

(a) imparting the spherical seismic energy waves into the earth from a seismic source at a source position;

(b) generating a plurality of reflection signals in response to the seismic energy waves at a set of receiver positions spaced in an array over an extent having at least one dimension which is large relative to a seismic wavelength; and

(c) summing the reflection signals to form for the source position a signal simulating the reflection response of the earth to seismic energy having a substantially continuous wavefront over at least one dimension which is large relative to seismic energy wavelength.

681 F.2d at 788.

164. The Examiner additionally rejected the claimed invention under 35 U.S.C. § 103 as obvious to one of ordinary skill in the art. This rejection was affirmed by the PTO Board of Appeals and reversed by the CCPA. *Id.* at 788-89.

Supreme Court's decision in *Diehr*. In response to a post hearing brief filed by the applicants, the Board reviewed its prior decision. A majority of the tribunal reaffirmed their prior decision and found that the claims recited a mathematical algorithm and that since no close relationship existed between the algorithm and the other process steps, except that the signals to be summed are generated by the precedent process steps, the claims would preempt the algorithm. The Board found that limiting the claimed invention to geophysical prospecting, and thus not literally preempting the algorithm, was insufficient to render the claim statutory.[165]

The applicants attributed the dissenting member of the Board with "excellent vision" in that he "did not see the emperor's new clothes which the majority insisted were still in existence despite the *Diamond v. Diehr* denouncement."[166]

The CCPA began its opinion with a reiteration of the principal that laws of nature, physical phenomena, and abstract ideas are unpatentable since they are not embraced within the terms of 35 U.S.C. § 101. Taner's claimed invention, however, was found to be directed to a technique of seismic exploration that involves a mathematical algorithm and not merely to the solution of a mathematical algorithm and consequently to the obtaining of a patent for the algorithm in the abstract. The court found that the conversion of spherical seismic signals into a form representing the earth's response to cylindrical or plane waves was a statutory process under section 101 even though the signals were mathematically expressed physical apparitions.[167]

The court's previous decision in *Christensen*, which utilized the "point of novelty" approach in affirming the rejection of a claimed invention to determine subsurface formation porosity by prior art data collection and a mathematical equation, was specifically overruled in view of the Supreme Court's decision in *Diehr*.[168]

E. *ABELE, PARDO* AND *MEYER*

Presently pending before the CCPA are at least three cases which bear directly on the issue of the patentability of software-related inventions. The claimed inventions at issue in these appeals are image processing[169] by computed tomographic[170] scanners, a method of controlling the internal operations of a programmed com-

165. *Id.*

166. Appellant's Brief at 11, *In re* Taner, 681 F.2d 787 (C.C.P.A. 1982).

167. 681 F.2d at 790.

168. *Id.* at 791.

169. "Image processing" has been defined as the capture, storage, an interpreta-

puter, and a process and apparatus for identifying locations of probable function and/or malfunction in a complex system.

In *In re Abele*,[171] the majority of the Board of Appeals affirmed the Examiner's rejection of the claims directed to image processing where the actual value of each point in the X-ray image is subtracted in a digital filter from the average value of all image points in a surrounding region. This differential value is substituted for the actual value of the image point and is displayed as a gray scale value. The Board applied the two-part test of *Freeman* and *Walter* and found that the claimed invention fell into a nonstatutory category of invention. On appeal to the CCPA, Abele characterized his invention as a direct visual representation of internal organs,[172] while the PTO Solicitor characterized the invention as a mathematical model or simulation of conventional moving film tomography.

In *In re Pardo*,[173] the PTO Board of Appeals affirmed the Examiner's rejection of the claimed invention, stating that the claims constituted a proscribed algorithm even though the algorithm was not, prima facia, mathematical. Pardo contends that the claimed invention controls the internal operations of a programmed computer in a nonsequential mode and thereby improves the computer itself. The PTO solicitor, in addition to supporting the Board's opinion, argues that since Pardo's entire specification is addressed to businessmen and their needs and that the only example provided in the specification concerns sales accounting, the process claimed should be considered a method of doing business, which is nonpatentable subject matter.[174]

In *In re Meyer*,[175] the PTO Board of Appeals affirmed the Examiner's rejection of the claimed invention[176] basing its decision on the two-step test of *Freeman* and *Walter*. The PTO Solicitor further characterized Meyer's invention as "[a]t most, . . . a FORTRAN pro-

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tion of information in the form of an image, and the improvement of images that are not of optimum utility for the purposes at hand.

170. "Computed tomography" is the art of producing cross-section images of the interior of a plane through measurements made along lines lying in the plane through a body from a series of projected images which depicts integral plane. Typically X-rays are projected through the body along a large number of paths and the integrated attenuation of the radiation along each path is measured. The measured data is to determine separately an attenuation coefficient at each of a large number of points in the plane.

171. *Appeal docketed*, No. 81-618 (C.C.P.A. 1982).

172. Brief for Abele at 3, *In re* Abele, *appeal docketed*, No. 81-618 (C.C.P.A. 1982).

173. *Appeal docketed*, No. 81-619 (C.C.P.A. 1982).

174. *In re* Wart, 73 F.2d 982 (C.C.P.A. 1934).

175. *Appeal docketed*, No. 82-510 (C.C.P.A. 1982).

176. Claim 1 reads:

gram for a general purpose digital computer" that results in a set of numbers which designates the locations of probable function and malfunction in complex systems.[177] Meyer, on the other hand, contends that the claimed invention would not wholly preempt the algorithm recited and that the numerical output should be considered similar to digital displays on common testing or measuring apparatus such as volt meters.

These three cases will allow the CCPA to make further clarifications and guidelines regarding the patentability of software and firmware-related inventions, although *Diehr*, *Bradley*, and *Taner* already indicate the court's broadening scope in this area.

F. GUIDELINES

The following guidelines may be helpful in drafting or reviewing claims directed to algorithm or other software-related inventions.

(1) Prospective claims should be analyzed to see if they "directly or indirectly" recite a mathematical algorithm, whether it is in mathematical symbology or in prose format. If the claims at issue fail to "directly" recite a mathematical algorithm, then reference should be made to the specification to determine whether claim language indirectly recites mathematical calculations, formulas, or equations. If no mathematical algorithm is recited, then the claims have passed the first of the dual *Freeman* tests required by the CCPA and no further inquiry into this issue is necessary.

(2) If the reviewed claim is found to recite a mathematical algorithm, then further inquiry should be made as to whether or not the claim seeks patent protection for a formula in the abstract. For this investigation, the claim should be viewed as a whole, without

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A process for identifying locations of probable malfunction in a complex system, said process comprising the steps of:

(a) selecting a plurality of elements in the complex system, said elements having known locations;

(b) initializing a factor associated with each of said elements;

(c) testing the complex system for a response, which response, if effective, requires proper functioning of certain said elements, the probable identity of at least some of these certain elements being known;

(d) determining whether said response of the complex system was at least partially effective or ineffective;

(e) modifying the factor associated with at least some of said elements known to be possibly involved in the response in accordance with the effectiveness of the response; and

(f) repeating steps (c), (d) and (e) for further responses of the complex system to obtain resultant factors for at least some of said elements, whereby said resultant factors are indicative of probable malfunction of their associated elements and thereby indicative of probable malfunction at the locations of these elements.

U.S. PTO Application No. 465574 (filed Apr. 30, 1974).

177. Brief for the Patent and Trademark Office at 4.

dissecting the claim into old (prior art) and new elements and then ignoring the old elements in the analysis. In order to avoid stating a claim that is essentially a mathematical calculation in the abstract, the claim should set forth transformations of articles, signals, or physical steps into different states or entities and the interrelationship between the algorithm and articles, signals, or physical steps. The addition of such physical manipulations or transformations to the claim indicates that the algorithm is only a part of the overall process or apparatus and not an abstract method of calculating.

(3) Significant environmental background, such as the specific technology and/or the use of the invention's apparatus should be recited to narrow the scope of the claims so that they will not preempt the algorithm per se. Setting forth claim limitations that are directed to the particular type of computer used in processing the algorithm is not sufficient to make the invention patentable. The Board has found that regardless of the type of computer used, the invention may be unpatentable, since it " . . . defies logic to urge that a process is directed to a mathematical algorithm when practiced on a general purpose digital computer but is not directed to a mathematical algorithm when practiced on a special purpose digital computer."[178] Since there is substantial question whether words in a preamble that do not appear in the body of a claim may be used to limit the scope of the claim, unambiguous terminology should be used.

For example, in *Arshal*,[179] in which the United States Court of Claims considered the validity of a software-related invention, the term "directional computer" was found to be ambiguous concerning the exact technology to which that invention was directed.

(4) The recitation of presolution activity that includes more than just the necessary antecedent steps for obtaining values required for the algorithm can be evidence that the algorithm is only a portion of the invention. The addition of old (prior art) and necessary antecedent steps of establishing values for variables in the mathematical algorithm may not convert an unpatentable method or apparatus into patentable subject matter. Even the recitation of data gathering steps that are novel and unobvious, in combination with mathematical computing steps, may be insufficient to give rise to a patentable claim under 35 U.S.C. § 101.[180]

(5) Significant post-solution activity, clearly defined in the claim, is a factor indicating that the algorithm is part of a process. Necessary post-solution steps, such as displaying output data, are generally not considered significant. For example, updating alarm limits by transmitting electrical signals that represent the results of

178. Not public record.

179. Arshal v. United States, 621 F.2d 421 (Ct. Cl. 1980), *cert. denied*, 449 U.S. 1077.

180. *See, e.g., In re* Richman, 563 F.2d 1026 (C.C.P.A. 1977).

calculations obtained by an algorithm was found by the Supreme Court in *Flook* to be insignificant post-solution activity. On the other hand, deriving specific temperatures and times for curing rubber using an algorithm was found by the Supreme Court in *Diehr* to constitute significant post-solution activity.

(6) Claims that are otherwise equivalent to process claims but that are drafted in an apparatus type format of "means for" (functional) terminology, should be analyzed in the same manner that process claims are analyzed. The fact that these function type claims may be categorized as directed to a machine is irrelevent to considerations under the *Freeman* test.

The Court of Claims observed in *Arshal* that "the line of demarcation between a patentable and an unpatentable (or non-patentable) claim does not always shimmer with clarity."[181] Following the above recommendations can help prevent drafting claims that would preempt the algorithm rather than define an invention which is performing a function that the patent laws were designed to protect.

V. PATENT ACTIVITY ANALYSIS

The present legal status of patentability of software-related inventions has been explored. The patenting process in a typical software "technology," seismic data processing, will not be discussed. Of primary interest is the effect that the changing legal status surrounding patentability of this technology has had on patents granted in this area. Also of interest are the actors in the technology, the country or state from which the patents originate, and the activity trends in this technology.

Due to the difficulty of obtaining patents for inventions in certain areas of data processing, it would be expected that many developments in methods of seismic data processing are not patented. Furthermore, the propensity to patent in this area should be affected by the changing judicial opinion during the period from 1960 to 1978. Favorable judicial opinions should encourage filings, whereas unfavorable opinions should have the opposite effect.

In the analysis which follows, the characteristics and trends in seismic data processing are identified. Also examined is the impact of conflicting court decisions and questionable patentability on the number of patent applications filed.

A previous OTAF publication reported on patent activity trends in all of seismic data processing.[182] This report focuses only on seis-

181. 621 F.2d at 431.

182. *See* PATENT AND TRADEMARK OFFICE, U.S. DEP'T OF COMMERCE, PUB. NO. 78-22895, TECHNOLOGY ASSESSMENT AND FORECAST, EIGHTH REPORT 85 (1978).

mic data processing patents in which software-related technology is an issue.

A. Subject Area

Seismic exploration can be defined broadly as the analysis of the earth's structure and composition using physical measurements of acoustic or shock waves (seismic waves) taken at or near the area to be studied. Generally, the area to be studied is hidden from direct view and lies under thousands of feet of soil and rock. Such exploration is used primarily in prospecting for valuable natural resources, including hydrocarbons (oil, gas, coal), minerals, and water.

In a typical seismic survey, measurements of reflected or refracted seismic waves are made over the earth's surface, parallel to it, or in a wellhole. These measurements contain variations in space, amplitude, and time of the seismic waves. The nature of the seismic waves is determined in part by the nature and structure of the subsurface. Due to their complexity, received seismic waves must be quantitatively processed to help determine the nature of the substrata. This complexity is caused by many factors, including the numerous types of seismic waves, the different velocities and paths travelled by the seismic waves, and the variations in their attenuation.

Improvement of the usefulness and quality of received seismic wave data is achieved by a number of processes, some simple and others fairly specialized and sophisticated. Seismic signal processing inventions for which patents were filed prior to 1960 were generally fixed arrangements of circuit components (analog systems) designed to perform the claimed methods. During the 1960's digital processing techniques were introduced. Due to their generally higher speed, lower expense, and greater versatility, these techniques displaced most analog processing systems. Thus, modern seismic exploration typically uses digital computers to control field operations, facilitate digital recording and handling of data, process the data, and provide modes of data display that permit faster and more accurate data interpretation.

This area of technology was selected for discussion purposes for a number of reasons. First, it is an area of widespread interest and impact. During 1980, more than three billion dollars was spent by the free world for geophysical exploration.[183] Ninety-four percent of this amount was spent on seismic exploration, while the remaining

183. Senti, *Geophysical Activity in 1980*, 46 Geophysics 1316 (1981).

six percent was spent on electromagnetic, magnetic, radiometric, and gravitational exploration. Almost one-half of the expenditures for geophysical exploration during 1980 took place in the United States. This represents an increase of forty percent over spending in the field during 1979. Secondly, seismic data processing is basically a United States technology, thereby minimizing the problem of data error resulting from omission of foreign technological developments that are not patented in the United States.

B. Procedure

The first step in the patent analysis was to identify software-related patents. This was done by defining the area of seismic data processing in terms of subclasses, the smallest units of the Patent Classification System. Once this was accomplished, these subclasses were manually searched to identify software-related patents. The patent data obtained was cross-checked by comparing the data to United States patents that have International Patent Classification designations which relate solely to processing seismic data. Then, the listing of software-related patents granted between January, 1960 and December, 1980 was used to generate standard OTAF profile reports containing the following patent information:

Patent Activity Data—Patent activity was tabulated by the patents' application filing date. Patents distributed by application filing date are referred to in this study as *patented applications*. For the most part, the analyses utilize these patented application data because the application filing date more accurately reflects when the technology was developed and when the inventor or assignee had the propensity to seek patent rights.

In general, patented application data is available for the period 1960-1978. Data for 1979-1981 is incomplete because many patent applications that were filed in these years are still pending final approval by the Patent and Trademark Office.

Assignment Data—Assigned patents in this technology were extracted and tabulated by assignee and application filing date.

Foreign Activity Data—For each patent the country of origin, as indicated by the residence of the first listed inventor, was recorded. Data was tabulated by the year of application filing and is reported as a percentage ("percent foreign") of the total patented applications filed in the area in each year. This information is useful in determining the position of the United States in this technology compared to foreign countries.

State of the Inventor Data—The state of residence of the first listed inventor was recorded for all patented applications that originated in the United States. The percentage of patents granted to each particular state to the total patents granted was calculated. this in-

formation is of interest in determining the level of activity in this technology for particular states.

C. Trend Analysis

The graph in Figure 1 shows the variance in numbers of patented applications (solid line) for each year from 1960 through 1978, the timing of judicial and policy decisions affecting the patentability of software, and the number of seismic crews searching for oil and gas in the United States by crew months (dotted line). The number of seismic crews prospecting is considered to be a leading indicator of oil and gas exploration activity.[184] An increase in the number of active seismic prospecting crews engenders an increase in the amount of seismic data obtained. As more data is obtained, the demand for data processing increases. In the face of mounting data processing requirements, better techniques have been developed through innovation in processing of the data. Thus, a correlation might be expected to exist between seismic exploration activity and the number of patented applications filed for inventions in this field.

In the early 1960's, the number of patented applications increased from a low of twenty-eight in 1961 to a high of sixty-five in 1966, a dramatic increase of 132%. During this period no judicial decision directly related to the issue of software patentability was rendered, permitting inventors normal access to patent protection. Only the PTO Board of Appeals' 1964 decision in *Ex parte King and Barton*[185] obliquely addressed this issue at that time. The rejection in that case was under 35 U.S.C. § 103 and questioned the obvious nature of the invention. The Board, in dictum, stated that a computer with a program stored within it is patentably distinct from other computers without such a program.[186]

In 1966, the PTO proposed guidelines[187] would have permitted patenting of "utility step" inventions, i.e., inventions that cause a

184. 46 Geophysics at A-64, A-65 (1981). These figures are compiled from data reported by oil companies operating company-owned seismic exploration crews and by contract seismic exploration companies.

185. 146 U.S.P.Q. (BNA) 590 (1964).

186. *Id.* at 591.

187. 829 Off. Gaz. Pat. Office 1 (1966).

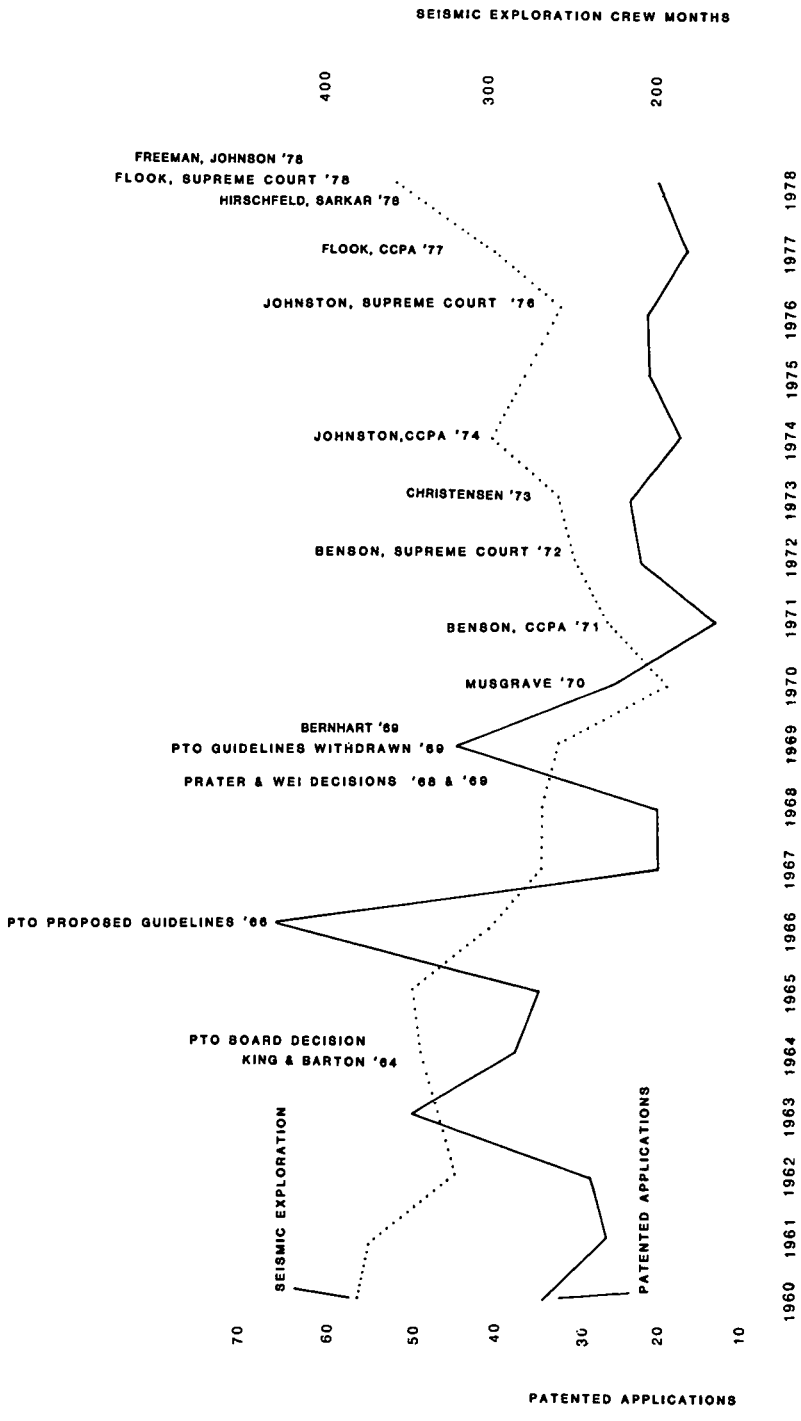


FIGURE 1
COMPARISON OF PATENTED APPLICATION ACTIVITY
IN SEISMIC DATA PROCESSING WITH SEISMIC EXPLORATION ACTIVITY,
JUDICIAL DECISIONS AND POLICY GUIDELINES

transformation in the state of the computer. The guidelines would not, however, permit patents for claims based on computer execution of mathematical formulas. In the two year period following these proposed guidelines, the number of patented applications dropped precipitously from sixty-five to twenty, a decline of 69%.

A portion of this decrease may be attributed to the decline in the number of seismic crew months over this period. In 1966, 300 crew months of exploration took place, while in 1968, there were only 270 crew months. This trend of decreasing exploration activity continued until 1970 when it reached a low of 190 crew months of exploration. From 1970 to 1978, the number of seismic crew months increased to 350. As depicted by Figure 1, however, the number of patented applications over this eight year period remained fairly steady at approximately twenty-two patented applications per year.

The lack of increased patented applications in this field after 1969 also appears to be related to the PTO's continued rejection of claimed software-related inventions following the withdrawal of its 1966 proposed guidelines.

In 1970, the CCPA decision in *In re Musgrave*[188] allowed claims relating to a method for obtaining better seismograms. The process at issue in *Musgrave* used a digital computer to obtain weathering layer corrections for seismic data. This decision, for a brief period of over one year, broadened the scope of patentable software-related inventions.

The Supreme Court's decision in *Gottschalk v. Benson*[189] reversed the CCPA's allowance of claims directed to a method of converting numerical information from one numerical base into another. Although the Supreme Court specifically stated that its decision did not preclude a patent for any program servicing a computer and did not extend to analog computers, it failed to specify the types of software-related inventions that would be patentable. Thus, the decision severely curtailed the prior standards of patentable invention set forth by the CCPA in *Musgrave*.

Only a small drop in patented applications occurred in the two year period following the Supreme Court's decision in *Benson*. In view of the sharp increase in seismic crew activity for this period, the slight change may be indicative of the large number of patented applications that normally would have been filed.

From 1973 to 1978, the CCPA sought to set up parameters by which the patentability of software-related inventions could be determined. During this period, the PTO appealed four of the CCPA

188. 431 F.2d 882 (C.C.P.A. 1970).
189. 409 U.S. 63 (1972).

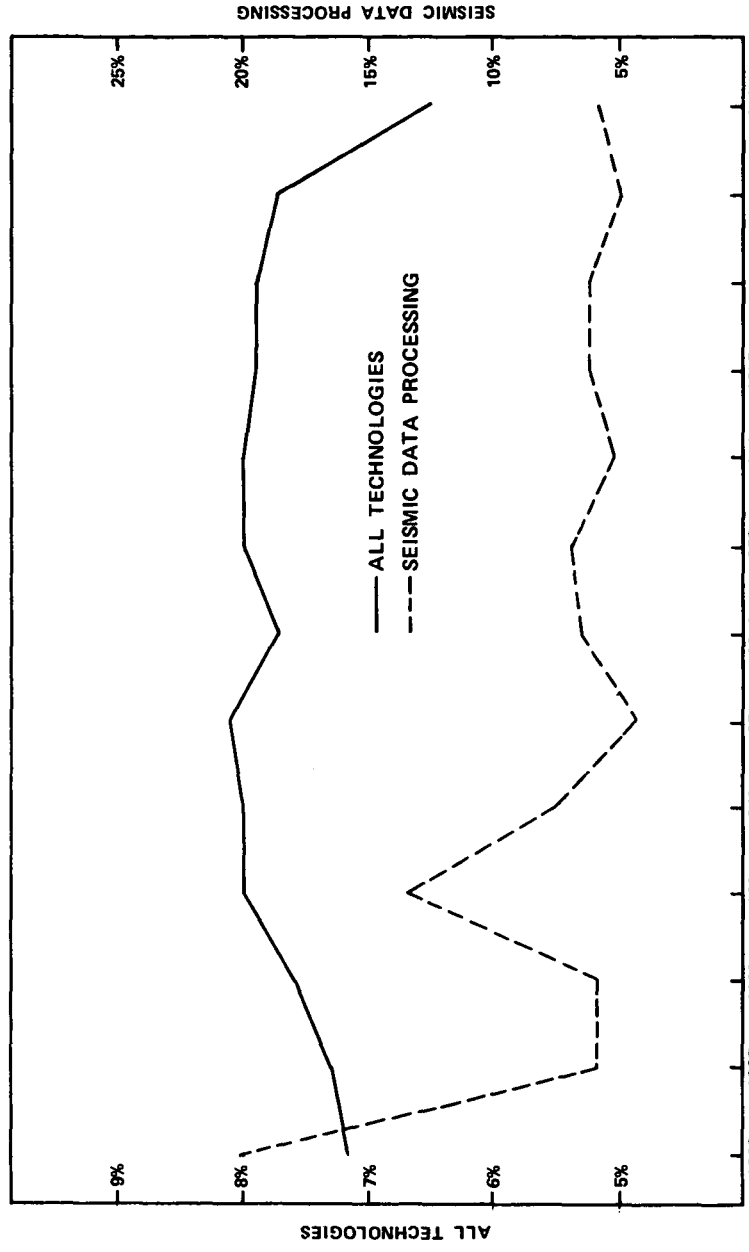


FIGURE 2
YEARLY PERCENT SHARE OF 1966-1978 TOTAL U.S. PATENTED APPLICATIONS:
SEISMIC DATA PROCESSING vs. ALL TECHNOLOGIES

decisions to the Supreme Court.[190] In the two cases that the Supreme Court decided to hear the CCPA was reversed and the claimed inventions were found not patentable.[191] Thus, for the decade from 1968 to 1978, the continuous changes in the metes and bounds of what constitutes a patentable software-related process may have discouraged the filing for patents in this area. Although prospecting activity during this time almost doubled, the patenting decreased.

Figure 2 indicates the yearly percent share[192] of the total patented applications from 1966 to 1978 for seismic data processing and for all technologies. During this period, 329 patented applications were received for seismic data processing and 824,300 patented applications were received for all technologies.

The trends indicated by this graph for seismic data processing are analagous to those in Figure 1, except that they are presented here as yearly percent shares, rather than as numbers of patented applications. An additional dimension of comparison is presented by observing the fairly level rate of patented applications for all technologies during this time period in comparison to the erratic changes in the seismic data processing area. Of the total patented applications in the area of seismic data processing, 21% were filed in 1966, while 6.1% were filed in 1978. The 1.2% drop in patented applications for all technologies from 1977 to 1978 is partially attributable to the pendency period for applications filed in 1978 and the lower than normal number of patents granted in 1979. A number of such applications, significant enough to affect this 1.2% drop, may still be pending in the PTO and awaiting issuance. In light of this, the increase in patents relating to seismic data processing from 1977 to 1978 may be even larger than indicated and may portend a significant upward trend in the patenting of software technologies.

D. Ownership Activity[193]

Which firms are obtaining patents for seismic data processing-

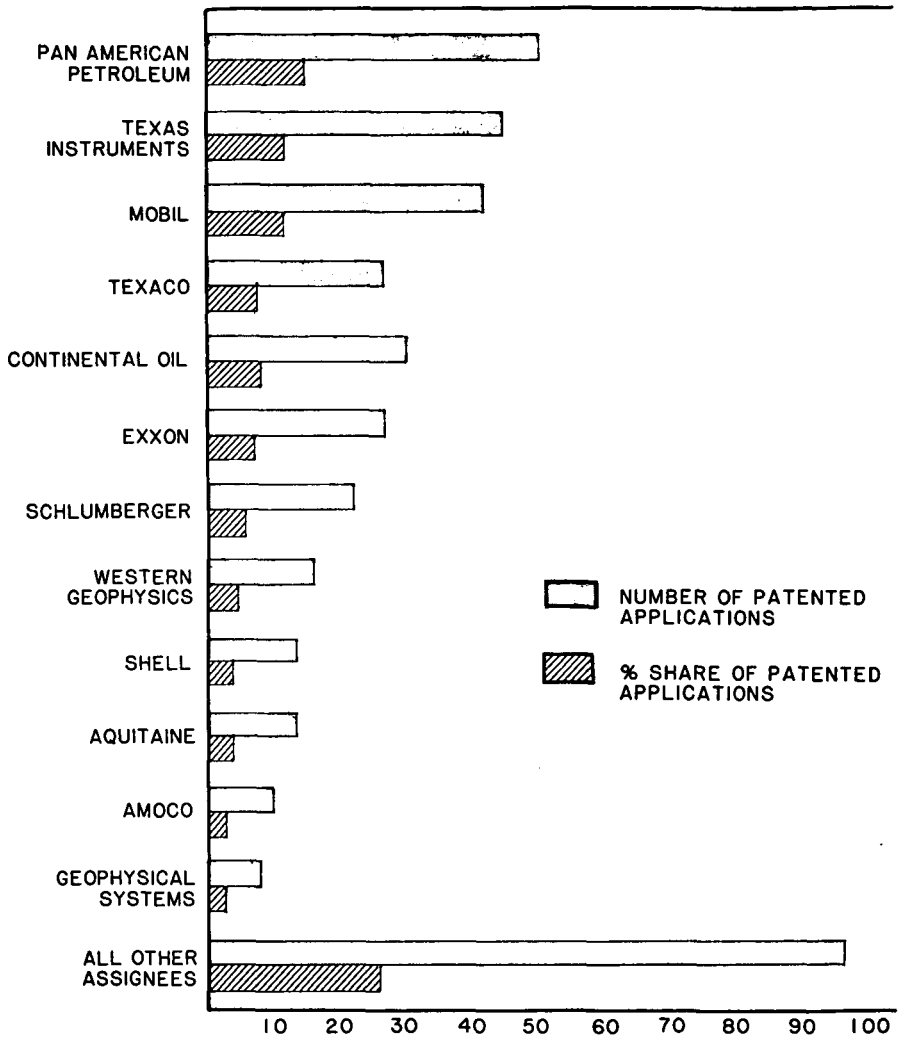
190. *In re* Flook, 559 F.2d 21 (C.C.P.A. 1977), *rev'd sub nom.* Parker v. Flook, 437 U.S. 584 (1978); *In re* Noll, 545 F.2d 141 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977); *In re* Chatfield, 545 F.2d 152 (C.C.P.A. 1976), *cert. denied*, 434 U.S. 875 (1977); *In re* Johnston, 502 F.2d 765 (C.C.P.A. 1974), *rev'd sub nom.* Dann v. Johnston, 425 U.S. 219 (1976).

191. Parker v. Flook, 437 U.S. 584 (1978); Dann v. Johnston, 425 U.S. 219 (1976).

192. "Percent share" equals the number of patented applications per year divided by the total for the 1966-1978 period times 100. For example, a constant level (same number of patent applications per year) over a 10-year period would result in a straight line graph at the 10% level.

193. Patenting for corporations mentioned in this section includes that of

FIGURE 3
1960 – 1978 CORPORATE PATENTING IN
SEISMIC DATA PROCESSING
NUMBER AND % SHARE OF ASSIGNED PATENTED APPLICATIONS



related inventions that use computer software and/or algorithms?

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subsidiaries where they could be identified. For example, "Schlumberger" includes patents assigned to Schlumberger Technology Corp., Schlumberger Instruments et Systemes, Schlumberger Ltd., Schlumberger N.V., Schlumberger Overseas

As expected, the large oil companies, such as Pan American Petroleum, Mobil, Texaco, Continental, Exxon, and Shell, are obtaining the major share of patents issued.

As shown in Figure 3, Pan American Petroleum owns the largest share of patents in this field; however, companies that specialize in providing seismic instrumentation and field service, such as Texas Instruments, Schlumberger, and Western Geophysics, own a substantial portion of the patents granted. Of all the major assignees in this area, only one, Societe Nationale Des Petroles D'Aquitaine, is clearly a foreign-based corporation, although Shell and Schlumberger are U.S. affiliates of foreign multinational corporations. Of the sixty-five different assignees for the almost 400 patents considered, thirty-two assignees owned only one patent each. Thus, approximately one-half of the assignees own approximately 92% of the patents in this technology.

For the three year period from 1976 to 1978, 84% of all patented applications in this field were assigned to corporations. This is only 12% more than the 72% average for all technologies over the same period. Approximately 8.8% of the patents during this time were assigned to the United States or foreign governments. This is almost seven times more than the all-technology average of 1.3% for the same time period.

Ownership of foreign origin inventions by United States companies is substantially higher in this area of technology than the overall technology average of 8.7%. Of the patented applications granted to foreign resident inventors during this same three year period, 70% are assigned to U.S. corporations or other U.S. business entities. Not included in this figure is the number of patents that were assigned to foreign business entities owned wholly or in part by U.S. companies. The inclusion of such patent data in this ownership activity assessment would indicate that an even larger share of foreign origin patents are owned or controlled by the United States. This reflects the substantial amount of research and development of this technology in foreign countries that is sponsored by U.S. companies.

E. Foreign Patent Activity

The percentage of patented applications in this field granted to foreign resident inventors for the three year period from 1976 to 1978 is only 12%, or about one-third of the all-technology average of 37.7%.

Messgeratebau UndVertrieb, Schlumberger Well Surveying Corp., and Schlumberger N. & Cie.

Figure 4 discloses the country of origin of foreign developed technology as identified by the residence of the first named inventor on U.S. patents. French residents received the largest number of patents granted to foreign resident applicants in this area—41%. Residents of the United Kingdom and Canada received 31% and 18% of the patents, respectively. Resident inventors of West Germany, the U.S.S.R. and the Netherlands received the remaining 10% of these patents. Residents of Japan, who were awarded more patents between 1963 and 1980 than any other foreign country except West Germany, received no patents in the area of seismic data processing. Likewise, Switzerland, which ranks fifth among foreign countries for the number of U.S. patents received, had no patents in this technology awarded to its resident inventors. Thus, if innovation in this technology is exemplified by patenting, then the residents of the United States, France, the United Kingdom, and Canada dominate the field.

FIGURE 4
FOREIGN ORIGIN PATENTING IN
SEISMIC DATA PROCESSING
1960 - 1978

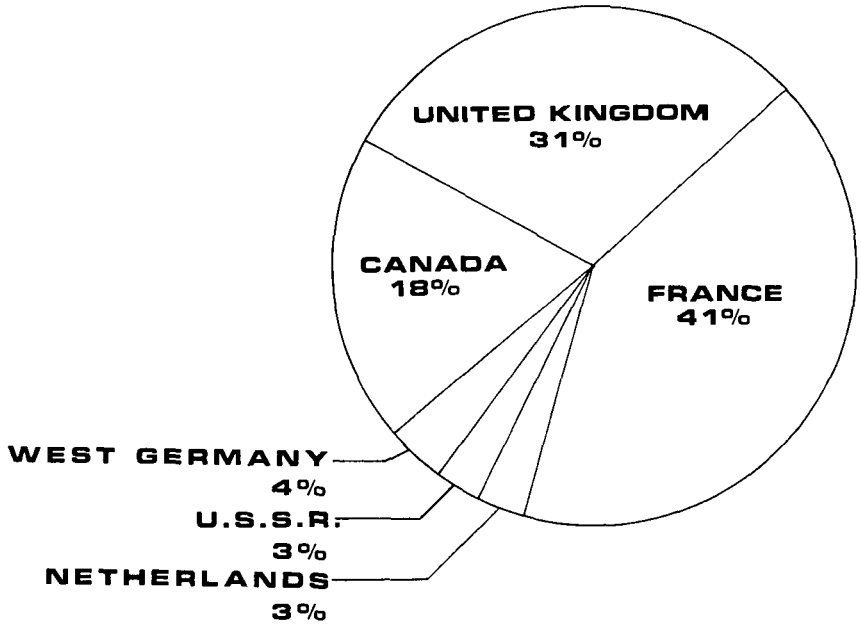
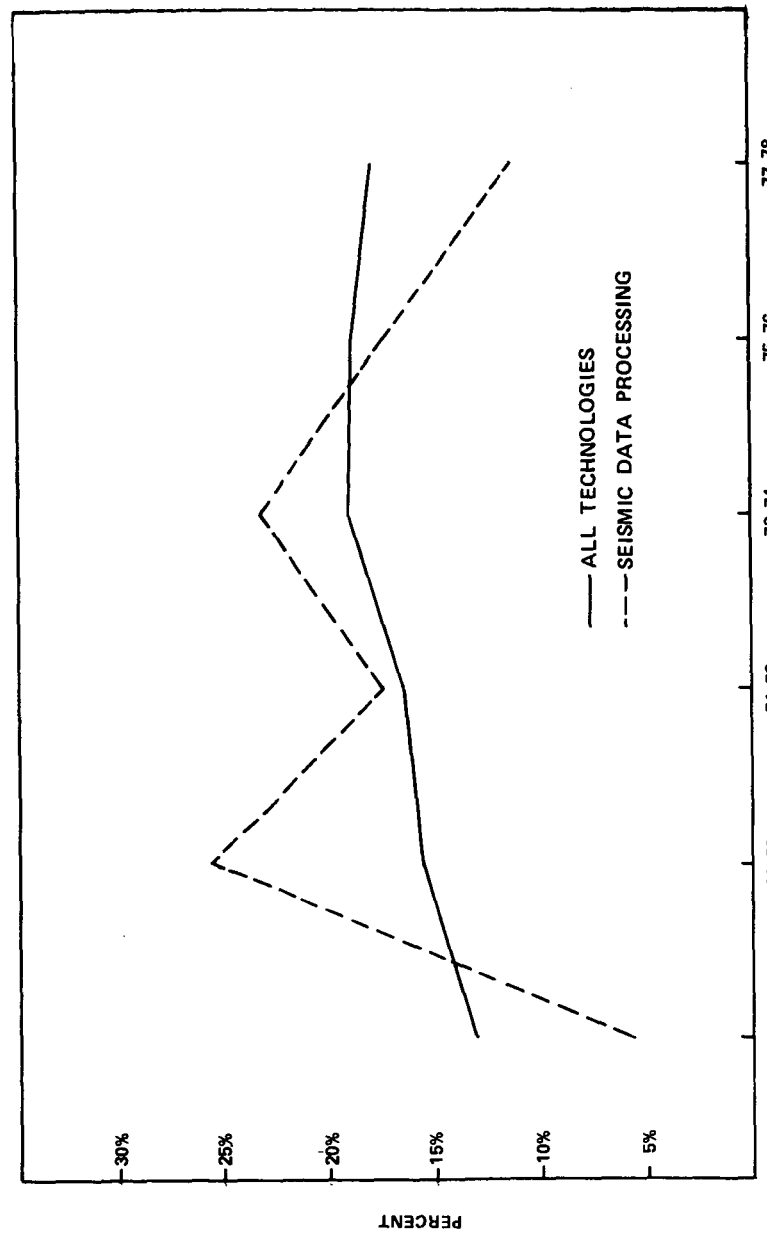


Figure 5 compares the two-year percent shares of the 1967-1978 totals of foreign origin patented applications in seismic data

FIGURE 5
TWO-YEAR PERCENT SHARE OF 1967-1978 TOTAL FOREIGN ORIGIN PATENTED APPLICATIONS: SEISMIC DATA PROCESSING vs. ALL TECHNOLOGIES



processing and in the all-technology category. The rapid growth rate of foreign origin patented application filings in seismic data processing during the 1967-1974 period is shown by the increase in percent share from 5.7% in the 1967-1968 time period to 22.9% for the 1973-1974 period. From 1974 to 1978, however, the percent share declined steadily to a low of 11.4%. This decline can be partially attributed to the reluctance of inventors and assignees to file patent applications relating to software or algorithms when the PTO is rejecting such inventions.

As depicted by Figure 5, all technologies, as a group, consistently increased in yearly percent of patented applications from 1967 to 1974, and then recorded a slight decline of 1.2% from 1974 to 1978. Thus, it can be seen that the fluctuations in patented application filing shown in the seismic data processing field are not merely a reflection of the trend in all areas of technology.

F. Patent Activity By State

FIGURE 6
STATE SHARE OF U.S. PATENTED APPLICATIONS
IN SEISMIC DATA PROCESSING
1960 - 1978

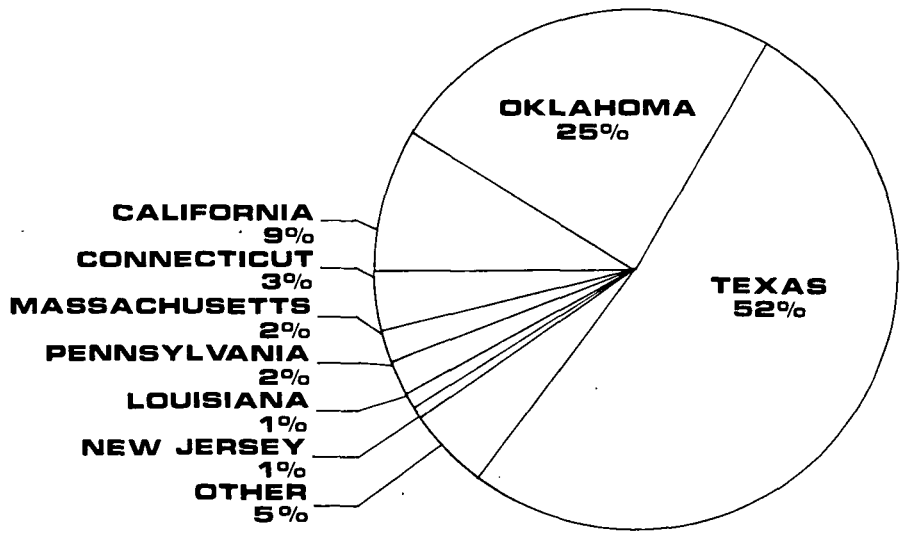


Figure 6 illustrates the percentage of patented applications by U.S. inventors from 1960 though 1978, categorized by the state of the first listed inventor. Except for Alaska, the states having the largest

commercial gas and oil fields had the largest number of patented inventions related to processing seismic exploration data. Texas and Oklahoma together received 77% of all patents in this area. Other oil and gas producing states, such as California, Pennsylvania, and Louisiana, together received only 12% of the patents. Connecticut, where the Schlumberger Technology Research Center is located, and Massachusetts, where various university research centers are located, received 3% and 2% of the patents, respectively. California, the state having the largest number of resident patentees for all technologies over this time period, received 9% of the patents in this technology. New York's resident inventors, who received the second largest number of patents for all technologies over this time period, received less than 1% of the patents in this technology.

VI. CONCLUSION

The rapid growth of general purpose computer usage over the last decade, for both industrial and home use, has resulted in a greater demand for software. This growth, along with innovations developed to apply software to new and existing technologies, has led to an increased number of patent applications in the many fields that utilize computers. The Supreme Court's decisions in *Diehr* and *Bradley* and the CCPA's recent decision in *Taner* have opened new vistas for artisans seeking to protect their software-related inventions through the use of the patent system. Viewing these factors together with the world's expanding need for information acquisition, processing, display, and control systems, the prospect of a sizeable increase in patent applications regarding software-related inventions seems inevitable.

APPENDIX*

MANUAL OF PATENT EXAMINING PROCEDURE SECTION 2110: PATENTABLE SUBJECT MATTER— MATHEMATICAL ALGORITHMS OR COMPUTER PROGRAMS

The U.S. Supreme Court decision in *Diamond v. Diehr*, 450 U.S. 175, 209 USPQ 1 (1981) and *Diamond v. Bradley*, 450 U.S. 381, 209 USPQ 97 (1981) significantly affect an examiner's analysis under 35 U.S.C. 101 of patent applications involving mathematical equations, mathematical algorithms and computer programs.

In 35 U.S.C. 101, Congress has set forth the categories of inventions or discoveries which may be patentable as consisting of "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof." Inventions involving mathematical equations, mathematical algorithms or computer programs, if statutory at all, would fall into the categories of statutory subject matter as processes, machines or manufactures. In constructing 35 U.S.C. 101, the Supreme Court in *Diamond v. Diehr*, 450 U.S. 175, 209 USPQ 1, 6 (1981) and *Diamond v. Chakrabarty*, 447 U.S. 303, 206 USPQ 193 (1980), has applied a broad interpretation to statutory subject matter so as "to include anything under the sun that is made by man."

The Supreme Court also reiterated that certain categories of inventive activity should not be considered statutory subject matter. As set forth in *Diamond v. Diehr*, 209 USPQ 1, 7 (1981), "Excluded from such patent protection are laws of nature, physical phenomena, and abstract ideas." Citing *Parker v. Flook*, 437 U.S. 584, 198 USPQ 193 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 175 USPQ 673 (1972). A "scientific truth, or the mathematical expression of it, is not a patentable invention," *Mackay Radio Corp. & Telegraph Co. v. Radio Corp. of America*, 306 U.S. 86, 94, 40 USPQ 199, 202 (1939). In *Gottschalk v. Benson*, supra, the Court concluded that an "algorithm, or mathematical formula, is like a law of nature, which cannot be the subject of a patent." Similarly, the Court in *Parker v. Flook*, supra, held that an improved "method for computing 'an alarm limit'," where the application "did not purport to explain how the variables used in the formula were to be selected, nor did the application contain any disclosure relating to the chemical processes at work or the means of setting off an alarm of adjusting

* The following section is reprinted from the MANUAL OF PATENT EXAMINING PROCEDURE § 2110 (1982).

the alarm limit," is unpatentable subject matter under 35 U.S.C. 101. (See *Diamond v. Diehr*, 209 USPQ 1, 10 (1981)).

If the claims of an application are directed solely to one of the above judicially excluded areas of inventive activity, it is clear that a patent shall not issue. However, a claim is not unpatentable under 35 U.S.C. 101 merely because it includes a step(s) or element(s) directed to a law of nature, mathematical algorithm, formula or computer program so long as the claim as a whole is drawn to subject matter otherwise statutory. In this regard, the following significant points of law may be gleaned from the *Diamond v. Diehr*, 209 USPQ 1 (1981) decision:

1. The "claims must be considered as a whole. It is inappropriate to dissect the claim into old and new elements and then to ignore the presence of the old elements in the analysis." . . ." 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." (emphasis added).

2. "When a claim containing a mathematical formula implements or applies that formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to protect (e.g., transforming or reducing an article to a different state or thing), then the claim satisfies the requirements of § 101."

3. "When a claim recites a mathematical formula (or scientific principle or phenomenon of nature), an inquiry must be made into whether the claim is seeking patent protection for that formula in the abstract." (If the claim does not seek protection for such a mathematical formula, it would be non-statutory under 35 U.S.C. 101).

4. "A mathematical formula as such is not accorded the protection of our patent laws, . . . and this principle cannot be circumvented by attempting to limit the use of the formula to a particular technological environment." . . . "Similarly, insignificant post solution activity will not transform an unpatentable principle into a patentable process."

5. When a claim as in *Parker v. Flook*, 198 USPQ 193 (1978), is drawn "to a method for computing an 'alarm limit' (which) is simply a number," the claim is non-statutory under 35 U.S.C. 101 because *Flook* "sought to protect a formula for computing this number."

6. "It is now commonplace that an *application* of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection." Citing *Funk Bros. Seed Co.*

v. Kalo Co., 333 U.S. 127, 76 USPQ 280 (1948); *Eibel Process Co. v. Minnesota and Ontario Paper Co.*, 261 U.S. 45 (1923); *Cochrane v. Deener*, 94 U.S. 780 (1876); *O'Reilly v. Morse*, 15 How. 62 (1853); and *LeRoy v. Tatham*, 14 How. 156 (1852).

35 U.S.C. 101 Claim Analysis

In determining eligibility for patent protection under 35 U.S.C. 101, the Supreme Court in *Diamond v. Diehr*, 209 USPQ 1 (1981), requires that the "claims must be considered as a whole." Consistent with this requirement, the Court concluded that "a claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula, a computer program, or digital computer." Thus, the fact that a claim specifies that a computer performs certain calculation steps is irrelevant for the purpose of determining whether statutory subject matter has been recited. The fact that an application discloses that a mathematical formula is implemented solely by computer programming is likewise immaterial for this purpose.

The Court's requirement that the "claims must be considered as a whole" in effect leaves viable the CCPA's two-step procedure set forth in *In re Freeman*, 197 USPQ 464, (CCPA, 1978), as an appropriate test for determining if a claim involving mathematics and/or computer programming is in compliance with 35 U.S.C. 101. See also *In re Walter*, 205 USPQ 397 at 407 (CCPA, 1980) for clarification of the second *Freeman* step. In accordance with the first step of such analysis, each method or apparatus claim must be analyzed to determine whether a mathematical algorithm is either "directly" or "indirectly" recited. If the claim at issue fails to directly recite a mathematical algorithm, reference must be made to the specification in order to determine whether claim language indirectly recites mathematical calculations, formulas, or equations.

If a given claim directly or indirectly recites a mathematical algorithm, the second step of the analysis must be applied. Under this step, a determination must be made as to whether the claim as a *whole*, including all its steps or apparatus elements, merely recites a mathematical algorithm, or method of calculation. If so, the claim does not recite statutory subject matter under 35 U.S.C. 101.

The Supreme Court in *Diamond v. Diehr*, 209 USPQ 1 (1981), provides some guidance in determining whether the claim as a whole merely recites a mathematical algorithm or method of calculation. The Court suggests that if "a *claim* containing a mathematical formula implements or applies that formula in a structure or process which, when *considered as a whole*, is performing a function

which the patent laws were designed to protect (e.g., transforming or reducing an article to a different state or thing), then the claim satisfies the requirements of § 101." (emphasis added)

Focusing on the application or implementation of a mathematical algorithm, the Supreme Court in *Diehr*, 209 USPQ 1 at 89 (1981), citing *Mackay Radio Corp. and Telegraph Co. v. Radio Corp. of America*, 306 US 86, 94, 40 USPQ 199, 202 (1939), explained that "while a scientific truth, or the mathematical expression of it, is not a patentable invention, a novel and useful structure created with the aid of a scientific truth may be." In this regard, the CCPA noted in *In re Walter*, 205 USPQ 397 at 407, (CCPA, 1980), that "If it appears that the mathematical algorithm is implemented in a specific manner to define structural relationships between the physical elements of the claim (in apparatus claims) or to refine or limit claim steps (in process claims), the claim being otherwise statutory, the claim passes muster under § 101."

The Supreme Court in *Diehr* also indicated that "insignificant post-solution activity will not transform an unpatentable principle into a patentable process." The claims in *Parker v. Flook*, which were held to be nonstatutory, recited a post-solution activity of updating a number (i.e., an alarm limit), a step relating more to a method of calculation than to the physical process alluded to in the claim preamble. In *Diehr*, the Supreme Court characterized the post calculation activity of the type claimed in *Parker v. Flook* as being "token post-solution activity." In contrast, the post-solution activity in the *Diehr* claims consisted of automatically opening a rubber molding press, a step clearly tied in with the physical process of rubber molding. As stated by the CCPA in *In re Walter*, 205 USPQ 397 at 407, (CCPA, 1980), "if the end-product of a claimed invention is a *pure number*, as in *Benson* and *Flook*, the invention is non-statutory regardless of any post-solution activity which makes it available for use by a person or machine for other purposes."

It must also be recognized that even though a claim contains an application limiting preamble, even though it does not cover every conceivable application of a formula, or even though it does not totally preempt the formula, such a claim would be non-statutory, if, when considered as a whole, it merely recites a mathematical algorithm or method of calculation. As stated by the Supreme Court in *Diehr*, 209 USPQ 1 at 10, (1981), "A mathematical formula does not suddenly become patentable subject matter simply by having the applicant acquiesce to limiting the reach of that formula to a particular technological use." Similarly, the CCPA pointed out in *Walter*, 205 USPQ 397 at 409 (1980) that "although the class preambles relate the claimed invention to the art of seismic prospecting,

the claims themselves are not drawn to methods of or apparatus for seismic prospecting; they are drawn to improved mathematical methods for interpreting the results of seismic prospecting. The specific end use recited in the preamble does not save the claims from the holding in *Flook*, since they are drawn to methods of calculation, albeit improved. Examination of each claim demonstrates that each has no substance apart from the calculations involved."

Also, in *Walter*, a Jepson preamble was not regarded as limiting the "subject matter as a whole," so as to avoid the § 101 rejection. Similarly, preliminary data gathering steps may not affect the "subject matter as a whole" assessment. *In re Richman*, 195 USPQ 340, (CCPA 1977). Moreover, even the concluding step of building a bridge or dam may not suffice. *In re Sarker*, 200 USPQ 132 (CCPA, 1978). In other words, for purposes here, the "subject matter as a whole" must be viewed in context on a case by case basis.

In analyzing computer program related claims, it is essential to recognize that computer implemented "processes are encompassed within 35 U.S.C. 101 under the same principles as other machine implemented processes, subject to judicially determined exceptions, inter alia, mathematical formulas, methods of calculation, and mere ideas." *In re Johnson et al*, 200 USPQ 199 at 210, 211 (CCPA, 1978). In accordance with the two-step procedure outlined above, claims seeking coverage for a computer program would be non-statutory under 35 USC 101, only if, when considered as a whole, they merely recite a mathematical algorithm, or a method of calculation. Such an approach is the same as that contemplated for apparatus claims by the CCPA in *In re Bradley and Franklin*, 202 USPQ 480 (CCPA, 1979).

Certain computer program related claims may be non-statutory under 35 U.S.C. 101 as falling within judicially determined exceptions outside the mathematics area. For example, consider the following claims:

(1) "A computer program comprising the steps of:
   a) associating treatment rendered to a patient with a fee, and
   b) billing said patient in accordance with the fee."

Here the computer program is claimed, not in terms of a specific instruction set, but alternatively as a series of steps broadly defining what the program is designed to accomplish. Such a claim should be viewed as nonstatutory under 35 U.S.C. 101 as reciting a method of doing business.

2) "A computer program for comparing array A(N) with array B(M) to generate array C comprising the steps of:

Do 70 N = 1, 10
Do 80 M = 1, 20

If A(N) = B(N) then C(M) = B(M)
80 Continue
70 Continue * * *"

This bare set of instructions fails to recite subject matter that falls within any statutory category. In this regard, a bare set of computer instructions does not set forth a sequence of steps which could be viewed as a statutory process. Such a computer language listing of instructions, when not associated with a computing machine to accomplish a specific purpose, would not constitute a machine implemented process, but would constitute non-statutory subject matter as the mere idea or abstract intellectual concept of a programmer, or as a collection of printed matter.

Further guidance on handling 35 U.S.C. 101 issues may also be gleaned from the CCPA's detailed claim analysis in the following decisions: *In re Chatfield*, 191 USPQ 730 (CCPA, 1976); *In re Johnson, Parrack and Lundsford*, 200 USPQ 199 (CCPA, 1979); *In re Sarker*, 200 USPQ 132 (CCPA, 1978); *In re Gelovatch and Arell*, 201 USPQ 136 (CCPA, 1979); *In re Bradley and Franklin*, 202 USPQ 480 (CCPA, 1979); *In re Walter*, 205 USPQ 397 (CCPA, 1980).

In addition to handling 35 U.S.C. 101 issues in accordance with the above analytical approach, it should be emphasized that examiners must also carefully examine mathematical algorithm or computer programming related applications to insure that they comply with the disclosure requirements of Section 112 as well as the novelty and unobviousness requirements of Sections 102 and 103.