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Towards a Rational Jurisprudence of Computer-Related Patentability in Light of In re Alappat

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Comment

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In a 1994 decision, *In re Alappat*, the Federal Circuit extended patent protection to an invention that uses a computer programmed to solve a unique set of mathematical equations.[1] The court ostensibly designed the decision to initiate a cease-fire to the twenty-year war over the patentability of computer software under federal patent law.[2] The Federal Circuit, however, missed the opportunity to establish a coherent doctrine of software patentability and instead issued a fractured opinion rife with unsupported conclusions.[3]

The question whether computer-related inventions driven by mathematically-based software deserve the market protection afforded under federal patent law has vexed both theorists and practitioners since computers entered the marketplace some thirty years ago. Courts continue to struggle to develop a doctrine of patentable subject matter that is at once stable enough to provide predictability to the marketplace, which makes decisions based on the legal protection available to technology, while maintaining sufficient flexibility to keep abreast of ever-changing technological advancement. To date, the judiciary has of-

1. *In re* Alappat, 33 F.3d 1526, 1545 (Fed. Cir. 1994) (en banc).

2. The United States Code governs patentable subject matter: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101 (1988).

3. *Alappat* addressed two distinct issues: first, the Federal Circuit's jurisdiction over the appeal of the case; and second, the merits of the Patent and Trademark Office's final rejection of Alappat's patent application as unpatentable subject matter. 33 F.3d at 1526. Four of the 11 circuit judges did not reach the patentability of Alappat's invention because their decision addressed the court's jurisdiction. *Id.* Two judges dissented on the merits of Alappat's patent application. Thus, the opinion of the remaining five circuit judges constitutes the majority decision. *Id.* This Comment addresses only the issue involving the merits of Alappat's claimed invention as patentable subject matter.

fered only a host of jumbled decisions generally disallowing software patents predicated on the principle that algorithm-based inventions fall somewhere outside the realm of patentable subject matter.[4] Those affected by an enlarged realm of patentable subject matter—developers, manufacturers, and consumers of computer software—need a more coherent resolution of this question.[5]

This Comment argues that the Federal Circuit decided *Alappat* correctly, but failed to provide doctrinal stability to the broader issues it attempted to address. Part I provides a brief history of the legal principles encumbering the definition of patentable subject matter under the patent code, setting three leading Supreme Court cases against the backdrop of Congress's statutory framework. Part II describes *In re Alappat*. Part III argues that the *Alappat* majority, distracted by a narrow issue of patent claim construction, failed to address the broader issue of patentable subject matter while the dissent, which did address the underlying issue, misinterpreted the facts of the case. Part II also, it proposes a model for determining patentable subject matter when elements of a patent claim are directed to

4. Long-standing precedent disallows laws of nature, natural phenomena, and abstract ideas as patentable subject matter. Over the last two decades the Supreme Court has created an additional limitation on patentable subject matter by excluding mathematical algorithms. *See infra* part I.B (discussing the leading Supreme Court cases). Because a mathematical "code" is the heart of any computer software, this limitation essentially disallows software patents. Consequently, copyright has historically been the only intellectual property protection available to software products.

Copyright generally protects only literary aspects of the software code language. Although a copyright covers more than exact duplication or translation of the code, it is limited in scope to protect only the particular expression of the general "idea" of the software package. Computer Associates Int'l, Inc. v. Altai, 982 F.2d 693, 703 (2d Cir. 1992). A patent, by contrast, protects the utilitarian aspects of the software product by covering both its uses and literary attributes. A patent therefore offers broader protection for software and is potentially much more lucrative to industry developers. Of course, the intellectual property rights arising from a patent and a copyright are not mutually exclusive, and both may apply to a single product provided their respective requirements are independently met. David A Einhorn, *Copyright and Patent Protection for Computer Software: Are they Mutually Exclusive?*, SOFTWARE PROTECTION, May 1988, at 1, 6.

5. The issue of software patentability divides the computer industry. *Compare Patent Mania is Hurting the Industry*, P.C. WEEK, July 18, 1988, at 38 ("Those [patent] cases hang over our collective heads like vipers about to strike . . . and [hang] new loads of fear, uncertainty, and doubt onto the backs of the user community.") *with* Randall M. Whitmeyer, *A Plea for Due Processes: Defining the Proper Scope of Patent Protection for Computer Software*, 85 Nw. U. L. REV. 1103, 1123 (1991) ("Patenting software algorithms is consistent with the underlying goals of the policy patent system.").

otherwise unpatentable subject matter. This Comment concludes that this new model, which is premised on well-rooted notions distinguishing unpatentable discovery from patentable invention and which uses a concrete standard to determine a patent claim's scope, brings consistency to the jurisprudence of patentable subject matter while maintaining sufficient flexibility to accommodate new computer-related inventions.

I. PATENTABLE SUBJECT MATTER: ITS HISTORY AND RATIONALE

A. PATENT LAW AND ITS UNDERLYING POLICIES

1. Congress's Mandate

The Constitution grants Congress the power to "promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."[6] Pursuant to this authority, Congress enacted the first Patent Act in 1793, principally authored by Thomas Jefferson.[7] The Act extended patent protection to "any new and useful art, machine, manufacture, or composition of matter, or any new or useful improvement [thereof]."[8] This broad language staking out the territory of patentable subject matter remained unchanged through successive Patent Acts in 1836, 1870, and 1874.[9] In 1952, when Congress recodified this provision into 35 U.S.C. § 101, the present standard for determining patentable subject matter, the only change made was replacing the word "art" with the word "process."[10]

Direct implementation of federal patent law[11] now lies within the exclusive jurisdiction of the Supreme Court and the

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6. U.S. CONST. art. 1, § 8, cl. 8.

7. Diamond v. Chakrabarty, 447 U.S. 303, 308 (1980) (quoting Patent Act of Feb. 21, 1793, § 1, 1 Stat. 319).

8. *Id.*

9. *Id.* at 309.

10. *See* S. REP. No. 1979, 82d Cong., 2d Sess. 5 (1952); H.R. REP. No. 1923, 82d Cong., 2d Sess. 6 (1952); *see also supra* note 2 (quoting § 101).

11. Congress has the exclusive authority to create and administer patent law in the United States. The federal patent code therefore wholly preempts any state attempt to extend patent-like protection to a broader subject matter class. *See, e.g.*, Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 151 (1989) ("The novelty and nonobviousness requirements of patentability embody a congressional understanding, implicit in the Patent Clause itself, that free exploitation of ideas will be the rule, to which the protection of a federal patent is the exception."). State laws protecting trade secrets, however, are not preempted by the patent code because courts do not consider the two areas to be in direct conflict with one another. Kewanee Oil Co. v. Bicron Corp., 416 U.S.

Court of Appeals for the Federal Circuit (CAFC).[12] Anticipating the complexities of patentable subject matter issues, Congress clearly directed reviewing courts to give § 101 a liberal construction.[13] The legislative history of the 1952 Act indicates congressional intent to bring into the realm of § 101 "anything under the sun that is made by man."[14]

2. Basic Policies Underlying Patent Protection of Technology

A patent grants a qualifying individual the right to exclude others from making, using, or selling his or her invention for a limited period of time.[15] To qualify for a patent, an inventor must present and disclose a new, useful, and nonobvious invention[16] to the Patent and Trademark Office (PTO).[17] Patent law

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470, 493 (1974); *see also infra* note 24 and accompanying text (discussing state trade secret doctrines).

12. On October 1, 1982, to stabilize patent law, Congress created under the Federal Courts Improvement Act, the Court of Appeals for the Federal Circuit (CAFC). ROBERT L. HARMON, PATENTS AND THE FEDERAL CIRCUIT ix (2d ed. 1991). The CAFC has exclusive jurisdiction over appeals from final decisions of district courts in those cases where the district court's jurisdiction was based on the patent provisions of 28 U.S.C. § 1338 (1988). *Id.* Previously, the Court of Customs and Patent Appeals (CCPA) heard direct appeals from the Patent and Trademark Office (PTO) regarding the disposition of individual patent applications while the circuit courts of appeals handled all other patent-related issues. *Id.*

13. *See* Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980).

14. *Id.* (citing S. REP. No. 1979, *supra* note 10, at 5; H.R. REP. No. 1923, *supra* note 10, at 6).

15. The Constitution's Patent Clause establishes this right. U.S. CONST. art. 1, § 8, cl. 8; *see also supra* note 6 and accompanying text (quoting the Patent Clause). A time-limited patent strikes a balance between the American distaste for monopolies against a desire to encourage innovation by excluding others from practicing one's invention. Graham v. John Deere Co., 383 U.S. 1, 10-11 (1966).

Three types of patents currently exist: utility patents, design patents, and plant patents. Utility patents, by far the most common, cover new, nonobvious, and useful machines, articles of manufacture, compositions of matter, and processes by protecting the utility of the claimed invention for 17 years. 35 U.S.C. § 154 (1988). Design patents protect the unique appearance or design of articles of manufacture for a term of 14 years. *Id.* §§ 171-73. Plant patents protect certain new asexually reproduced plant varieties for 17 years. §§ 161-64.

16. Newness, utility, and nonobviousness constitute the general requirements of patentability. 35 U.S.C. §§ 101-03 (1988). For a comprehensive discussion of these requirements, see DONALD S. CHISUM, PATENTS: A TREATISE ON THE LAW OF PATENTABILITY, VALIDITY AND INFRINGEMENT §§ 1-4 (1994).

A patent has two parts: a disclosure that describes the invention's workings such that anyone knowledgeable in the relevant art can practice the invention, and claims that define the "metes and bounds" of the property interest in the patent. *Id.* § 16.02(1).

thus serves two purposes: first, it encourages innovation by rewarding diligent inventors for developing certain new and useful ideas;[18] and second, it provides the public with detailed access to emerging technology.[19] These two policy rationales share strong roots in concepts of natural rights,[20] and are in some tension with one another.

This tension results from the natural "right" to draw knowledge from the public domain and appropriate it for private use.[21] One who exercises this right can choose either to use the knowledge as it exists in the public domain or to improve upon it by creating something else novel and useful.[22] If that individual chooses the latter, she is an "inventor" and possesses certain natural rights to her unique creation.[23] Our "inventor" has another choice upon conceiving her idea: she can conceal her creation, choosing to keep the nature of her idea hidden from the

17. The PTO, a part of the Department of Commerce, is the agency responsible for patent administration. 35 U.S.C. § 1 (1988 & Supp. II 1990). The PTO issues a patent after examining an application against the statutory requirements. An examiner who specializes in a particular technologic field makes an initial determination to either allow or reject a pending patent application. A rejected applicant may petition for a review of the examiner's determination to the Patent and Trademark Office Board of Patent Appeals and Interferences, whose ultimate ruling is reviewable by the Court of Appeals for the Federal Circuit. HARMON, *supra* note 12, at 510-11; *see also supra* note 12 and accompanying text (discussing the Federal Courts Improvement Act). A PTO-granted patent is presumed valid. 35 U.S.C. § 282 (1988 & Supp. IV 1992).

18. This purpose is perhaps best explained in terms of contract theory. A qualifying inventor who has complete control over the embodiment of his or her idea has some natural exclusive right to it. *See infra* notes 21-27 and accompanying text (discussing these natural rights). If the public wishes to gain access to full disclosure of that technology, natural principles of equity require it to provide consideration. This consideration takes the form of a monopoly grant for a limited period of time. *See generally* GEORGE T. CURTIS, A TREATISE ON THE LAW OF PATENTS FOR USEFUL INVENTIONS AS ENACTED AND ADMINISTERED IN THE UNITED STATES OF AMERICA ix-xxii, 1-2 (3d ed. 1867) (describing a patent as compensation to an inventor).

19. *See* CURTIS, *supra* note 18, at ix-xxii, 1-2.

20. For a general analysis of patent law in terms of natural rights, see WILLIAM C. ROBINSON, ROBINSON ON PATENTS §§ 24-25 (1890).

21. Natural rights permeated legal thinking when both the Constitution and the federal patent statutes were drafted. No legal thinker of this time was more influential than Thomas Jefferson, the father of American patent law. According to Jefferson, "that ideas should freely spread from one to another over the globe, for the moral and mutual instruction of man, and improvement of his condition, seems to have been peculiarly and benevolently designed by nature." THOMAS JEFFERSON, WRITINGS OF THOMAS JEFFERSON 334 (Saul K. Padover ed., 1967).

22. ROBINSON, *supra* note 20, § 24.

23. *Id.*

public,[24] or she can inject her invention into the public domain.[25] If she chooses to disclose her idea without seeking a patent, she freely dedicates it to the public, where it becomes the common property of all humanity.[26] From this time forward, the public has the right to that idea.[27]

Within this conceptualized framework must lie a recognition that those phenomena describing natural activity alone

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24. State and common law doctrines of trade secrets protect an inventor who chooses to keep and use her invention in secret. The most recent restatement, the Uniform Trade Secret Act (UTSA), has become law in 40 states. MELVIN F. JAGER, TRADE SECRETS LAW § 3.04 (1994). The UTSA defines a trade secret as:

> [I]nformation, including a formula, pattern, compilation, program, devise, method, technique, or process, that:
> (i) Derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by other persons who can use and obtain economic value from its disclosure or use, and
> (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

UTSA § 1(4), 14 U.L.A. 438 (1985). The UTSA provides injunctive remedies and monetary damages for misappropriation of trade secrets. *See generally* JAGER, *supra*, § 3.04 (detailing the UTSA); ROBERT P. MERGES, PATENT LAW AND POLICY: CASES AND MATERIALS 953-85 (1992) (discussing the policies underlying trade secret law and comparing them to patent law).

If an inventor keeps her invention as a trade secret and uses it in the marketplace, she abandons her right to seek a patent unless she files a patent application within one year of its introduction to the public. This is known as a statutory bar. 35 U.S.C. § 102(b) (1988). The statutory bar rests on the notion that the rights secured under patent and trade secret law are inherently inconsistent because the entire justification for government intrusion into the free market by way of the patent system is to secure public access to technology. *See, e.g.*, MacBeth-Evans Glass Co. v. General Elec. Co., 246 F. 695, 698 (6th Cir. 1917) (holding that an inventor who elected to keep his invention a secret instead of applying for a patent could not turn around and assert the inconsistent patent right).

25. An inventor can inject her invention into the public domain in two ways. Because she invented something new and valuable, she can use her natural right to that invention to bargain with the government for a patent. *See supra* note 18 and accompanying text (discussing patent law in terms of contract theory). By receiving a patent, the inventor releases the nature of her invention to the public in return for an exclusive right to make, use, and sell the invention. An inventor can also inject her invention into the public domain by outright dedication. She can dedicate her work voluntarily, such as by publishing an article describing the invention without the intent to seek a patent, or she can dedicate her invention to the public involuntarily by failing to seek a patent within a statutorily prescribed time and falling prey to the statutory bar. *See supra* note 24 (discussing the statutory bar).

26. ROBINSON, *supra* note 20, § 24 ("An idea once communicated can no longer be exclusively appropriated and enjoyed.").

27. *Id.* Once an idea becomes a part of the public domain, all individuals have an equal right to its use.

originate and remain in the public domain.[28] Such "universal tools"[29] of science ought to be available for anyone's purposeful use, and public policy should encourage uses of those tools to promote scientific progress.[30] A distinction here, however, is necessary. Scientific progress properly divides itself into two categories: progress that expands humanity's understanding of the universe (labeled properly as pure "discovery"), and progress that borrows from existing knowledge to develop practical applications in the working world (labeled properly as pure "invention").[31]

Within this framework, a discoverer cannot claim an exclusive right to his "discovery" because it represents a truth that has always existed in the public domain.[32] The discoverer plays the role of a teacher, communicating to the public the workings of its natural surroundings.[33] In contrast, an inventor does have legitimate claim to an exclusive right to her "invention" because

28. Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852) ("A principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an exclusive right.").

29. *See, e.g.*, Gottschalk v. Benson, 409 U.S. 63, 67 (1972) ("Phenomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work."); *see also* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948) ("He who discovers a hitherto unknown phenomenon of nature has no claim to a monopoly of it which the law recognizes.").

30. Of course, this public policy is commanded by the Constitution. *See supra* note 6 and accompanying text (discussing the Patent Clause).

31. The conceptualized distinction between pure discovery and pure invention is one that the courts have never explicitly adopted. This classification, however, is critically important to the understanding of patentable subject matter as it relates to computer-related inventions. It also serves as the basis of the proposed model that this Comment presents and is included at this point to provide the reader a foundation by which to interpret the background case law presented. For a brief discussion of this distinction, see PETER D. ROSENBERG, PATENT LAW BASICS § 1.04 (1994).

32. *See supra* note 21 and accompanying text (discussing the influence of natural rights on American patent law).

33. This educational role rests on the notion that a discovery expands the totality of human understanding. If one accepts that the substance of pure discovery has existed since time immemorial in some pristine form, functioning but utterly unexplained by humanity, and one accepts further that all of humanity claims an interest in those preexisting natural workings, then one is compelled to the conclusion that, irrespective of the amount "sweat" endured by the discoverer in uncovering that truth, she is not entitled to claim that truth as hers alone.

Thus, for example, Einstein's development of the theory of special and general relativity is only an explanation of a phenomena that acted upon the universe for all eternity. Einstein was limited to teaching us this theory rather than claiming a property interest in his discoveries, because they were never his alone, but instead belonged to all humanity.

her invention represents something that humanity did not already possess.[34] The line dividing pure "discovery," which should not be patentable subject matter,[35] and pure "invention," which should,[36] marks the boundary of patentable subject matter. Great difficulty, however, lies in defining this boundary, as reflected in the following discussion.

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34. The paradigmatic pure inventor stands in contrast to the pure discoverer in that she does not, by definition, uncover any new physical "truth." She creates some new, useful, and nonobvious application of the principles of nature whether or not, in fact, those principles are well understood. It is quite possible, in this respect, that reasons for an invention's function remain scientifically unexplained though the invention is of great utility to society. Catalysis is an example. Even today, surface science is largely unexplained theoretically, yet nearly all synthetic chemicals make use of catalysts of all sorts. *See, e.g.*, KUANG-HUI LIN ET AL., PERRY'S CHEMICAL ENGINEERS' HANDBOOK 4-36 to 4-42 (Robert H. Perry & Don W. Green eds., 6th ed. 1984) (discussing the basic properties of catalysts). Medicines yield other classic examples. Many medicinal mechanisms are unexplained in theory, yet in manufactured form, any number of medications are prescribed simply because they bring about the desired physiological effect. *See, e.g.*, THE MERCK INDEX 39 (Susan Budavari ed., 11th ed. 1989) (describing the properties of a common analgesic). In such cases as these, the science of engineering and manufacture leapfrogs progress in theory.

Of course, most modern scientific and technical developments blend discovery and invention. Herein lies the difficulty of determining to what extent such mixed advancements should be afforded patent protection. *See infra* part III.B.1 (discussing the need for a patentability test to distinguish between discovery and invention).

35. Pure discovery lies squarely in the public domain, even to the extent it remains undiscovered. *See supra* note 33 and accompanying text (noting that the fruits of discovery belong to all of humanity). Because anyone uncovering this knowledge cannot claim a property interest in that discovery, that individual possesses nothing with which to bargain with the public for a patent. Theoretically, the public already has complete access to that information.

This conclusion may be somewhat counterintuitive, because the underlying purpose of patent law is to encourage public dissemination and disclosure of knowledge. There seems from this perspective no impediment to giving a commercial advantage to the discoverer willing to share his discovery with the public, for there is no corresponding duty to the discoverer to release the information in his possession. Under the construct of patent law in terms of natural property rights, however, this argument must fail, because the existence of a property interest in that information is a predicate to the right to bargain with the government for a patent. For a more detailed discussion of patent law in terms of contract theory, see ROSENBERG, *supra* note 31, § 1.02.

36. In contrast to pure discovery, pure invention occupies the heart of patentable subject matter, those new, useful, and nonobvious applications of scientific and technical knowledge. *See supra* note 16 and accompanying text (discussing patentability requirements).

B. The Courts' Approaches to Computer-Related Patentability

The Supreme Court has addressed the patentability of computer-related inventions in three principal cases: *Gottschalk v. Benson*,[37] *Parker v. Flook*,[38] and *Diamond v. Diehr*.[39] Although some commentators argue that *Benson* and *Flook* are irreconcilable with *Diehr*,[40] the Court never has explicitly overruled either of the two earlier cases. Flawed as the trilogy may be, it forms the backbone of the current judicial approach to the issue. Not surprisingly, lower courts have had considerable difficulty in implementing the Supreme Court's reasoning and their decisions contribute to the confused state of the law faced by the Federal Circuit in *Alappat*.

1. The Supreme Court Trilogy: *Benson*, *Flook*, and *Diehr*

Although the jurisprudence of patentable subject matter dates back to the original patent legislation,[41] the Supreme Court first considered the patentability of computer software in its landmark 1972 case *Gottschalk v. Benson*.[42] Before *Benson*, the legal framework for patentability under § 101 had evolved into a judicially defined set of principles dictating that such things as laws of nature, natural phenomena, and abstract

37. 409 U.S. 63 (1972).

38. 437 U.S. 584 (1978).

39. 450 U.S. 175 (1981).

40. *See, e.g.*, Gregory J. Maier, *Software Protection—Integrating Patent, Copyright, and Trade Secret Law*, 69 J. Pat. Off. Soc'y 151, 153-56 (1987) (arguing that the cases comprising the Court's trilogy are irreconcilable). *But see* Jur Strobos, *Stalking the Elusive Patentable Software: Are There Still Diehr or Was it Just a Flook?*, 6 Harv. J.L. Tech. 363, 365 (1993) ("[T]he Supreme Court, through the years, has not altered its view of software patentability.").

41. Some of the cases discussing the unpatentablility of abstract ideas and natural truths include The Telephone Cases, 126 U.S. 1, 534-35 (1888) (upholding a patent to Bell's narrowest claim to the telephone); O'Reilly v. Morse, 56 U.S. (15 How.) 62, 112, 119-20 (1853) (denying Morse's broad claim to his invention of the telegraph for the use of "electromagnetism, however developed, for marking or printing intelligible characters, signs, or letters, at any distances"); Le Roy v. Tatham, 55 U.S. (14 How.) 156, 176-77 (1852) (finding a patent exceedingly broad to the extent that it essentially claimed only an idea); Hotel Security Checking Co. v. Lorraine Co., 160 F. 467, 467-70 (2d Cir. 1908) (invalidating a patent claim to a method of doing business to prevent waiter and cashier theft by establishing paper "accounts" with a unique code tracking transactions made by each employee); Detmond v. Reeves, 7 F. Cas. 547, 549 (No. 3,831) (E.D. Pa. 1851) ("The patent must be for a thing—not for an idea merely.").

42. 409 U.S. 63 (1972).

ideas[43] fell outside the realm of permissible statutory subject matter.[44] The oft-quoted embodiment of these exceptions is that Albert Einstein could not have patented $E = mc^2$ and Sir Isaac Newton could not have patented the laws of motion.[45]

The *Benson* Court reviewed a patent application disclosing a method for converting binary-coded decimal (BCD) numerals to pure binary numerals,[46] a procedure fundamental to the efficient storage of data in the then-emerging high-speed computer

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43. Diamond v. Diehr, 450 U.S. 175, 185 (1981). These three categories evolved from somewhat more generalized principles. *See, e.g.*, Rubber-Tip Pencil Co. v. Howard, 87 U.S. (20 Wall.) 498, 507 (1874) ("An idea of itself is not patentable, but a new device by which it may be made practically useful is."); *Tatham*, 55 U.S. (15 How.) at 174-75 ("A principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an exclusive right."); *In re* Bergy, 596 F.2d 952, 965 (C.C.P.A. 1979) (finding it well established that "principles, laws of nature, mental processes, intellectual concepts, ideas, natural phenomena, mathematical formulae, methods of calculation, fundamental truths, original causes, motives, [and] the Pythagorean Theorem" do not fall within § 101).

44. The phrase "statutory subject matter" is shorthand for denoting the line drawn by § 101 between those inventions worthy and unworthy of patent protection. Loose use of the phrase, however, has led to some debate concerning tests for defining the line. Strictly construed, the § 101 subject matter question stands as a predicate to the other patentability requirements of novelty, utility, and nonobviousness. *See, e.g.*, *Bergy*, 596 F.2d at 959-61 (characterizing two doors through which an inventor must pass to obtain a patent: the first requires that the inventor have an invention worthy of patenting, and the second requires the invention to meet the other requirements of the patent code). Nevertheless, some tests enunciated to determine patentable subject matter incorporate requirements of novelty, utility, and nonobviousness into the question of whether the invention is of a type deserving patent protection. *See infra* notes 62, 133 and accompanying text (citing such tests).

45. *See, e.g.*, Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980) ("[A] new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, Einstein could not patent his celebrated law that $E=mc^2$; nor could Newton have patented the law of gravity.").

46. *Benson*, 409 U.S. at 64-67. The decimal system expresses a number using 10 digits (0-9) by placing them in sequence by increasing powers. Thus "53" in decimal notation corresponds to $(5x10^1) + (3x10^0)$. The binary system, much more useful to a computer consisting of a complex system of semiconductors acting as on/off switches, uses only two digits ("0" and "1") to express a number in increasing powers of 2. In binary notation, "53" is expressed as 110101, or $(1x2^6) + (1x2^5) + (0x2^4) + (1x2^2) + (0x2^1) + (1x2^0)$. Binary coded decimal numerals, or BCD's, combine elements of both these systems, incorporating the ordering of digits in ascending powers of ten but expressing the individual digits in terms of binary notation. To illustrate by returning to the example of the number "53," the number is expressed in BCD as a five and a three in binary form (0101 and 0011 respectively) next to each other as if in powers of 10, or "0101 0011." *See generally* PAUL HOROWITZ & WINFIELD HILL, THE ART OF ELECTRONICS 476 (2d ed. 1989) (describing BCDs and their utility to the electonics industry).

market.[47] The heart of the claimed invention was a novel mathematical algorithm.[48] After citing to its precedent denying patentability for abstract ideas,[49] the Court denied patentability for this method.[50]

In reaching its decision, the Court touched on two key issues that were to be expanded in subsequent cases.[51] The Court found it important that the claimed steps for computing the result were so broadly recited as to make purely mental processes infringing behavior.[52] Based on this, the Court held that the claimed invention was so broad and abstract that it "wholly preempted" the use of the algorithm[53] and that it covered both known and unknown uses of the BCD-to-pure-binary-conversion.[54] This preemption, therefore, effectively took away from

47. *See, e.g.*, Pamela Samuelson, Benson *Revisited: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025, 1049 (1990) (discussing the significance of this invention to the computer industry).

48. The Court defined a mathematical algorithm as "[a] procedure for solving a given type of mathematical problem." *Benson*, 409 U.S. at 65.

49. *Id.* at 67-71 (citing Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127 (1948); The Telephone Cases, 126 U.S. 1 (1888); O'Reilly v. Morse, 56 U.S. (15 How.) 62 (1853); Le Roy v. Tatham, 55 U.S. (55 How.) 156 (1852)); *see also supra* note 43 (discussing these cases).

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

51. *See infra* notes 56-64 and accompanying text (discussing *Flook*); *infra* notes 65-72 and accompanying text (discussing *Diehr*).

52. *Benson*, 409 U.S. at 67. According to the Court:

> The method sought to be patented varies the ordinary arithmetic steps a human would use by changing the order of the steps, changing the symbolism for writing the multiplier used in some steps, and by taking subtotals after each successive operation . . . . And, as noted, [the mathematical procedures] can also be performed without a computer.

Id.

53. This wholesale preemption rule constituted the Court's "nutshell" holding:

> The mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment below is affirmed, the patent would wholly preempt the mathematical formula and in practical effect would be a patent on the algorithm itself.

Id. at 71-72.

54. The Court stated:

> Here the "process" claim is so abstract and sweeping as to cover both known and unknown uses of the BCD to pure binary conversion. The end use may (1) vary from the operation of a train to verification of drivers' licenses to researching law books for precedents and (2) may be performed through existing machinery or future-devised machinery or without any apparatus.

Id. at 68.

the public something it already possessed, the mathematical "truth" that Benson's algorithm embodied.[55]

The Court revisited these § 101 issues six years later in *Parker v. Flook*.[56] *Flook* involved a patent claim to a method for updating the alarm limits of a petroleum refining process.[57] The claimed invention used a small computer programmed to use a mathematical equation that a group of engineers developed specifically for the process.[58] The patent drafter of the *Flook* invention attempted to avoid the problems of *Benson* simply by writing the patent application in a way that limited the use of the formula to hydrocarbon refining.[59] The drafter hoped that this limitation avoided "wholly preempting" use of the formula in other applications.[60]

In deciding that this invention also failed to meet the statutory subject matter requirements of § 101,[61] the Court retreated

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55. *See supra* part I.A (discussing the tension between discovery and invention).

56. 437 U.S. 584 (1978).

57. The Court characterized the nature of the invention as follows:

> An "alarm limit" is a number. During catalytic conversion processes, operating conditions such as temperature, pressure, and flow rates are constantly monitored. When any of these "process variables" exceeds a predetermined "alarm limit," an alarm may signal the presence of an abnormal condition indicating either inefficiency or perhaps danger. Fixed alarm limits may be appropriate for a steady operation, but during transient operating situations, such as start-up, it may be necessary to "update" the alarm limits periodically.

Id. at 585.

Flook's method invention consisted of three steps: measurement of the process variable at a predetermined interval, solution of a novel equation to produce a new alarm base using the new variable measurement, and the adjustment of the new alarm limit. *Id.* at 597-98. The mathematical equation used in the second step represented the only advancement over the prior art. *Id.* at 585-86.

58. The patent application disclosed the following simple arithmetic equation that uses a weighting factor:

$$B_1 = B_0(1\text{-}F) + PVL(F)$$

where: B_1 = new alarm base
B_0 = original alarm base
PVL = measured present variable level
F = weighting factor between zero and one

The weighting factor, F, is chosen individually by the operator for the process based on experience. The application disclosed no criteria for its selection. *Id.* 597-98.

59. The patent application limited the claims to the use of the disclosed formula for updating alarm limits for any process variable involved in a process comprising the catalytic conversion of hydrocarbons. *Id.* at 586.

60. *Id.*

61. *Id.* at 589.

from its wholesale preemption rule by noting that the only novelty to Flook's invention was the formula itself,[62] and that the inventor could not claim statutory subject matter in insignificant "post-solution" activity or arbitrary field of use limitations.[63] The inventor here simply cleverly used a known mathematical expression, and by so doing attempted to appropriate something already in the public domain.[64]

The Supreme Court's most recent decision concerning patentability of a mathematically-based idea under § 101 is *Diamond v. Diehr*.[65] *Diehr* involved an improvement in the

62. *Id.* at 588 ("We also assume, since respondent does not challenge the examiner's finding, that the formula is the only novel feature of respondent's method.").

The Court took, perhaps unnecessarily, a jump in its interpretation of this fact by announcing a rule that a principle of nature or mathematical formula is "well-known" for the purposes of evaluating § 101. *Id.* at 592. This statement has two possible ramifications. It could be interpreted as importing other statutory notions of novelty and nonobviousness under 35 U.S.C. §§ 102-03 (1988), violating the rule that § 101 stands alone as a predicate for statutory subject matter before other statutory requirements come into play. Alternatively, however, this language could be interpreted as merely establishing the premise that to the degree a given mathematical equation merely expresses an unapplied principle or law of nature, it is taken to exist already in the public domain. *See supra* part I.A (discussing the policies underlying patent law). Thus, although an inventor is free to use that expression as a tool for the development of his craft, he cannot directly claim a patent for it. He can only seek a patent on its application in some form.

63. The majority stated:

> The notion that post-solution activity, no matter how conventional or obvious in itself, can transform an unpatentable principle into a patentable process exalts form over substance. A competent draftsman could attach some form of post-solution activity to almost any mathematical formula; the Pythagorean theorem would not have been patentable, or partially patentable, because a patent application contained a final step indicating that the formula, when solved, could be usefully applied to existing surveying techniques. The concept of patentable subject matter under § 101 is not "like a nose of wax which may be turned and twisted in any direction."

Flook, 437 U.S. at 590 (citations omitted).

Three justices joined in a dissent, largely because of a disagreement over this point. The author of the dissenting opinion, Justice Potter Stewart, distinguished *Benson* on the ground that it stood for the wholesale preemption rule. *Id.* at 599 (Stewart, J., dissenting). Flook's application presented no preemption problems, he argued, because the field of use limitation solution of the algorithm, per se, would not infringe the patent's claim. Justice Stewart noted: "The present case is a far different one. The issue here is whether a claimed process loses its status of subject-matter patentability simply because *one step* in the process would not be patentable subject matter if considered in isolation." *Id.* at 589 (Stewart, J., dissenting) (citations omitted)

64. *See supra* note 31-36 and accompanying text (discussing the distinction between discovery and invention).

65. 450 U.S. 175 (1981).

industrial process for curing rubber by using a version of the Arrhenius equation to continually update process variables.[66] The Court this time upheld the patent, concluding that unlike in *Benson* and *Flook*, the formula was part of an otherwise statutory process[67] with a clearly physical product: cured rubber.[68]

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66. Curing rubber requires placing uncured synthetic rubber into a mold under heat and pressure to produce a shaped and functionally useful end product. Before Diehr's invention, the cure time for the process could not be calculated with certainty because there existed no way to measure the temperature inside of the mold with precision. *Id.* at 177-79. The calculations involved use of the well-known Arrhenius equation:

$$\ln v = CT + x$$

where: v = total cure time
C = activation constant (unique to the process)
T = temperature inside the mold
x = constant (unique to the mold geometry)

Id. at 177 n.2. Because of the difficulty in determining the inside temperature, prior art approximated T in the above equation to calculate the cure time. Diehr invented a way to continuously monitor the temperature inside the mold by use of thermocouples placed inside the operating press, to feed those measurements continuously into a computer that updated the cure time with each new temperature measurement, and to open the press when the recalculated cure time equaled the previous value. *Id.*

67. The majority first examined *Benson* and *Flook* in light of the historical judicial prohibition against the patentability of ideas and natural phenomena. *Id.* at 185 ("Our recent holdings in [*Benson* and *Flook*], both of which are computer-related, stand for no more than these long-established principles."). The Court then turned its attention to Diehr's invention:

> [T]he respondents here do not seek to patent a mathematical formula. Instead, they seek patent protection for a process of curing synthetic rubber. Their process admittedly employs a well-known mathematical equation, but they do not seek to pre-empt the use of that equation. Rather, they seek only to foreclose from others the use of that equation in conjunction with all of the other steps in their claimed process . . . . Obviously, one does not need a "computer" to cure natural or synthetic rubber, but if the computer use incorporated in the process patent significantly lessens the possibility of "overcuring" or "undercuring," the process as a whole does not thereby become unpatentable subject matter.

Id. at 187. In distinguishing *Flook*, decided only three terms earlier, the *Diehr* majority, three of whom were the *Flook* dissenters, recognized that "a mathematical formula as such is not accorded the protection of our patent laws" and that field of use limitations and insignificant post-solution activity will not rescue a claim from this principle. *Id.* at 191-92. The Court went on to note that

> [w]hen 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.

Id. at 192.

68. *Id.* at 184.

The Court recited that the existence of a mathematical expression in the patent alone does not bring the invention outside § 101.[69] It is only when the inventor attempts either directly or indirectly to patent the formula itself,[70] and not merely its application within a broader invention.[71] that § 101 problems arise.[72]

2. Lower Courts' Implementation of the Supreme Court Trilogy

With respect to patentability standards for computer-related inventions,[73] the Federal Circuit seems to have adopted the two-part *Freeman-Walter-Abele* test developed by its predecessor, the Court of Customs and Patent Appeals, to implement the broad patentability guidelines set out in the Supreme Court's trilogy.[74] The *Freeman-Walter-Abele* test first asks whether a mathematical algorithm is either directly or indirectly expressed by the claim language.[75] If an algorithm is present, the test then looks to the claim as a whole to determine whether it is no more than the algorithm itself.[76] That is, if the algorithm is applied in one or more steps of an otherwise statutory process claim,[77] or one or more elements of an otherwise

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69. "Arrhenius' equation is not patentable in isolation, but when a process for curing rubber is devised which incorporates in it a more efficient solution of the equation, that process is at the very least not barred at the threshold by § 101." *Id.* at 188.

70. This raises *Benson* preemption problems. *Id.* at 191 ("We recognize of course that 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.").

71. *Id.* at 188 (quoting Mackay Radio & Tel. Co. v. Radio of Am., 306 U.S. 86, 94 (1939)) ("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 knowledge of scientific truth may be.").

72. *Id.* at 189.

73. The term computer-related merely denotes that familiar *Benson* problems exist in the claim, at least partially because principles of nature in the form of mathematical expressions are recited.

74. *See, e.g.*, Arrhythmia Res. Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1058 (Fed. Cir. 1992) (applying the *Freeman-Walter-Abele* test). The test derives its name from three cases: *In re* Freeman, 573 F.2d 1237 (C.C.P.A. 1978), *In re* Walter, 618 F.2d 758 (C.C.P.A. 1980), and *In re* Abele, 684 F.2d 902 (C.C.P.A. 1982). The Federal Circuit deviates somewhat from the comprehensive application of the test. *See infra* notes 78, 96 and accompanying text (discussing the Federal Circuit's application of the test).

75. *Abele*, 684 F.2d at 905.

76. *Id.* at 905-06.

77. "Otherwise statutory" is used in the sense that the claimed invention, absent the algorithm, falls within a § 101 category of permissible subject matter. This does not mean that the claimed invention must otherwise satisfy the

statutory apparatus claim,[78] the requirements of § 101 are met.[79] Although no case exists in which a claim determined to fail the *Freeman-Walter-Abele* test ultimately survived § 101, the Federal Circuit has nonetheless indicated that failure to meet the test will not necessarily defeat the claim.[80]

Interestingly, although the *Alappat* court did not apply the *Freeman-Walter-Abele* test,[81] the test enjoys an active life in the Patent Office. In a case decided after *Alappat*, *In re Trovato*,[82] a Federal Ciruit panel affirmed a PTO rejection of claims to a method of solution to the so-called "shortest path problem."[83] The PTO Board of Patent Appeals and Interferences affirmed

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statutory requirements of newness, utility, and nonobviousness. *See, e.g.*, *Arrhythmia*, 958 F.2d at 1058 (noting that the *Freeman-Walter-Abele* test is distinct from other tests of patentability).

78. Application of the *Freeman-Walter-Abele* test is a bit less uniform in such cases because *true* apparatus claims, by definition, do not invoke any § 101 problems. *See infra* notes 90-92 and accompanying text (describing apparatus claims). A court must recognize that abstract ideas and laws of nature can be wily crafted as apparatus claims, particularly when drafted in accordance with 35 U.S.C. § 112 ¶ 6 (1988), before it will subject these claims to the heightened scrutiny of the *Freeman-Walter-Abele* test. *See Ex parte* Alappat, 23 U.S.P.Q.2d 1340, 1341 (B.P.I.A. 1992) ("[I]t is recognized that the form of the claim is not dispositive, especially where the claims are drafted in means-plus-function ('means for') terms."); *see also infra* note 87 (defining means-plus-function claims).

79. *Arrhythmia*, 958 F.2d at 1058.

80. *In re* Grams, 888 F.2d 835, 839 (Fed. Cir. 1989).

81. *See infra* part II (discussing *Alappat*).

82. 33 U.S.P.Q.2d 1194 (Fed. Cir. 1994). Judge Nies, an *Alappat* dissenter, authored the panel's decision in *Trovato*.

83. Karen I. Trovato and Leendart Dorst developed a method to determine the shortest, or optimal, path between two locations given any number of relevant criteria, including distance, cost, capacity, and time. *Id.* at 1194-95. To this end, they modeled possible object movements in the real world by using a graph called a "configuration space," stored in a "data structure," wherein each node of the graph respresents a state of conditions. *Id.* at 1194. Using this graphic model, an optimal path to a particular "goal" state is determined by exploring neighboring states along the graph in successive "waves" calculating for each a lowest optimal pathway to the "goal" state through a number of intermediate states. *Id.* at 1194-95. The patent application disclosed a number of uses for this method such as developing a routing system for emergency vehicles using an electronic geographic map. *Id.* at 1196 n.2.

A representative claim to this method recites the following:

> 1. A method for determining motion of an object comprising the steps of:
>
> a) storing a configuration space data structure representing a physical space, the configuration space data structure including representations of the object and its environment; and
>
> b) propogating cost waves, in the configuration space data structure, to fill the configuration space data structure with cost values according to a space variant metric.

the examiner's rejection of this method under § 101 by applying the *Freeman-Walter-Abele* test.[84] The Board, finding that the claims indirectly recited a mathematical algorithm, asserted that the claims as a whole were directed to no more than the algorithm itself.[85]

C. Adding to the Confusion: "Means-Plus-Function" Claim Drafting

A workable model by which to determine statutory subject matter for inventions that disclose a mathematical algorithm must consistently and rationally construct a patent claim and determine its true scope. Although the Supreme Court trilogy outlined above suggests the limits of the permissible scope of patent claims to a process based in whole or in part on a mathematical algorithm, the Court has never applied this reasoning to the distinct, but common, practice of claiming an apparatus solely by reference to the processes it performs.[86] *Alappat* represents the Federal Circuit's first review of a claim to an apparatus drafted entirely in "means-plus-function" language.[87]

Section 112 ¶ 6 of the patent code allows an inventor to claim elements of a patentable apparatus invention in language describing the means for performing the functions of those elements.[88] For example, an inventor may claim a device for hing-

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Id. at 1195. Other independent claims to the method were drafted in "means plus function" format. *Id.* at 1196; *see also infra* part I.C (discussing the unique aspects of this claim drafting format).

84. 33 U.S.P.Q.2d at 1195-96.

85. *Id.* The Federal Circuit panel affirmed the decision on independent grounds, but did not overrule the *Freeman-Walter-Abele* test as applied by the PTO. *Id.* at 1198-1200.

86. *See infra* notes 87-88 and accompanying text (describing the process of naming an apparatus by describing its function).

87. "Means-plus-function" refers to the practice of claiming an apparatus element of an invention in terms of the means to accomplish its function. *See infra* notes 88-89 and accompanying text (describing "means-plus-function"). This drafting technique avoids awkward lexicography for unique aspects of an invention and more efficiently communicates its nature. Although drafters commonly use this mechanism to describe single elements within a claim, *Alappat* was the first time the Federal Circuit reviewed a claim written entirely in this format. *See infra* note 100 (quoting Alappat's claim). The result is unfortunately some distance away from enunciating a coherent conceptual framework.

88. The statutory provision provides:

> 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.

ing one portion of a piece of hardware to another as "means for attaching piece A to piece B." Rather than encompassing all possible means of attaching the two pieces of hardware, the statutory language demands that these claims "be construed to cover the corresponding structure, material, or acts described in the specification *and equivalents thereof*."[89]

Functionally defined apparatus claims pose particular interpretive difficulties in examining statutory subject matter requirements because they blur the distinction between apparatus and process patents. Generally speaking, true apparatus claims will not fall prey to the judicially created mathematical algorithm limitation to § 101 subject matter.[90] Because all "machines" operate according to the laws of nature, and machines by definition apply those laws to produce a useful physical result,[91] these apparatus claims lie at the very heart of patentable subject matter.[92] Conversely, a patent claim to a process can be written so vaguely as to divorce the idea from its physical embodiment,[93] thereby running into the preemption concerns of *Benson* and its progeny.[94]

Apparatus claims written in functional language organizationally fall somewhere between pure apparatus and pure process claims. Any rule defining patentability for these claims that does not investigate the true nature of the invention runs grave risks of looking only to the form of the claim language,

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35 U.S.C. § 112 ¶ 6 (1988).

89. *Id.* (emphasis added). For example, if the specification to the hypothetical claim for attaching the two pieces of hardware showed the use of a nail, the claim as properly construed would be limited to attachment of the two pieces with a nail or an equivalent structure. *See, e.g.*, Liatram Corp. v. Rexnord Inc., 939 F.2d 1533, 1535 (Fed. Cir. 1991) (concluding that legal equivalency requires the accused structure to set forth every limitation as the disclosed structure exactly or by a substantial equivalent); De Graffenried v. United States, 16 U.S.P.Q.2d 1321, 1339 (Cl. Ct. 1990) (concluding that the term "equivalents" in § 112 ¶ 6 illustrates congressional intent to incorporate equivalence standards generally recognized in patent law); *see also* MERGES, supra note 24, at 715-16 (comparing the doctrine of equivalents and § 112 ¶ 6).

90. *See, e.g., Ex parte* Alappat, 23 U.S.P.Q.2d 1340, 1341 (B.P.A.I. 1992) ("Claims truly directed to apparatus as a 'machine' or 'manufacture' under § 101 do not fall within the judicially determined mathematical algorithm exception since the calculation method remains free for use by anyone not employing the specific apparatus.").

91. One dictionary defines a machine as "[a] device consisting of fixed and moving parts that modifies mechanical energy and transmits it in a more useful form." AMERICAN HERITAGE COLLEGE DICTIONARY 811 (3d ed. 1993).

92. *See supra* part I.A.1 (discussing the history of American patent law).

93. *See supra* part I.B.1 (discussing *Benson* and its progeny).

94. *Id.*

allowing inventors to manipulate subject matter limitations merely by casting their claims in some arbitrarily sanctioned form. Consequently, early decisions of the Court of Customs and Patent Appeals[95] applied the *Freeman-Walter-Abele* test to all claims, regardless of whether those claims were drafted to a process or an apparatus.[96] The *Walter* court announced that "if the functionally-defined disclosed means and their equivalents are so broad that they encompass any and every means for performing the recited functions, the apparatus claim is an attempt to exalt form over substance since the claim is really to the method or series of functions itself."[97] "Means-plus-function" claiming under § 112 ¶ 6 is therefore properly understood merely as a patent drafter's tool, and is not intended as a means to expand the scope of an invention. The choice of whether to make use of this tool should be of no ultimate consequence to a determination of patentability under § 101.

II. *IN RE ALAPPAT*

Kuriappan P. Alappat, Edward E. Averill, and James G. Larsen[98] devised a way to create a smooth waveform on the screen of an oscilloscope.[99] At the heart of their invention was a

95. The CCPA was the forerunner to the Court of Appeals for the Federal Circuit. *See supra* note 12 (discussing the CAFC's origins).

96. *See, e.g., In re* Walter, 618 F.2d 758, 768 (C.C.P.A. 1980) (concluding that some method and apparatus claims are indistinguishable). Interestingly, the Federal Circuit apparently has failed to adopt this uniform approach towards applying the *Freeman-Walter-Abele* test. Despite paying lip service to such an approach in a recent case by restating the test as requiring that an algorithm be applied in one or more steps of an otherwise statutory process claim or one or more elements of an otherwise statutory apparatus claim to satisfy the requirements of § 101, the court failed to apply the test to the apparatus claims at issue in the case. Arrhythmia Res. Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1058 (Fed. Cir. 1992); *see also supra* notes 75-80 and accompanying text (discussing application of the *Freeman-Walter-Abele* test).

97. *Walter*, 618 F.2d at 768.

98. This Comment uses "Alappat" to refer collectively to Kuriappan P. Alappat, Edward E. Averill, and James G. Larsen, all of whom were named as inventors of the subject matter at issue in *Alappat*.

99. More precisely, the invention related to a means of presenting data on a finite pixel cathode-ray tube (CRT), a visual screen like that of a television. Such a screen is limited in its ability to show a smooth curve line because it has only a fixed number of pixels, or illumination points. As a result, when the screen is configured to display a data curve, rapidly rising and falling portions of the curve, or waveform, appear jagged and discontinuous. Data "noise" also causes similar visual difficulties. These negative effects are collectively known as aliasing. *In re* Alappat, 33 F.3d 1526, 1537 (Fed. Cir. 1994) (en banc).

Alappat and his colleagues developed a set of anti-aliasing mathematical equations by which to manipulate, or normalize, the data before being fed to a

set of mathematical equations, which in their patent application was claimed entirely in "means-plus function" language.[100] The Reconsideration Board of the PTO upheld the examiner's final rejection of the invention under § 101, finding the claim so broad as to encompass any and all means of performing the stated functions.[101] Despite the § 112 ¶ 6 requirement limiting means-plus-function apparatus claims to the disclosed structure,[102] the Board stated that, absent compelling arguments to the contrary, such broad claims should be construed to encompass all methods of performing the recited functions.[103] The Board construed Alappat's invention to be a broad claim to the mathematical equations that preempted all use of the equations and therefore held it unpatentable under *Benson*.[104]

The Federal Circuit held the PTO Board accountable for ignoring the statutory narrowing of means language to the struc-

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CRT, such that when modified, the data present a smooth waveform. They programmed the set of equations in an electronic circuit board comprising well-known circuitry elements and labelled the resulting circuit board as a "rasterizer." *Id.* at 1537-39.

100. The relevant independent claim to the rasterizer, Claim 15, reads:

> A rasterizer for converting vector list data representing sample magnitudes of an input waveform into anti-aliased pixel illumination intensity data to be displayed on a display means comprising:
>
> (a) means for determining the vertical distance between the endpoints of each of the vectors in the data list;
>
> (b) means for determining the elevation of a row of pixels that is spanned by the vector;
>
> (c) means for normalizing the vertical distance and elevation; and
>
> (d) means for outputting illumination intensity data as a predetermined function of the normalized vertical distance and elevation.

Id. at 1538-39.

101. The PTO's analyses has its basis in the *Freeman-Walter-Abele* test. *See supra* note 97 and accompanying text (discussing the *Freeman-Walter-Abele* test). *See generally In re* Walter, 618 F.2d 758, 768 (C.C.P.A. 1980) (lending its name to the test).

102. *See supra* note 88 (quoting § 112 ¶ 6).

103. The Board majority stated:

> In computer-related inventions, the recited means often perform the function of "number crunching" (solving mathematical algorithms and making calculations). In such cases the burden must be placed on the applicant to demonstrate that the claims are truly drawn to specific apparatus distinct from other apparatus capable of performing the identical functions.
>
> If this burden has not been discharged, the apparatus will be treated as if it were drawn to the method or process which encompasses all of the claimed "means."

Ex parte Alappat, 23 U.S.P.Q.2d 1340, 1342 (B.P.A.I. 1992) (citing *Walter*, 618 F.2d at 768).

104. *See supra* part I.B.1 (discussing *Benson*).

ture disclosed in the application[105] and quoted congressional intent for broad construction of § 101.[106] The court then asserted that, as narrowed to the disclosed structure, the rasterizer "is not a disembodied mathematical concept which may be characterized as an 'abstract idea,' but rather a specific machine to produce a useful, concrete, and tangible result."[107] The court answered the PTO Board's concerns that the claims, though technically to an apparatus, embodied all means of practicing the equations by summarizing the Supreme Court's trilogy in a single sentence:

> [A]t the core of the Court's analysis in each of [the] cases lies an attempt by the Court to explain a rather straightforward concept, namely, that certain types of mathematical subject matter, standing alone, represent nothing more than *abstract ideas* until reduced to some type of practical application, and thus that subject matter is not, in and of itself, entitled to patent protection.[108]

In analyzing the claim in light of the disclosed structure and the *equivalents thereof*,[109] the majority was undisturbed that the claim as upheld reads[110] on a general purpose computer programmed to calculate the same equation.[111] Judge Giles S. Rich, writing for the majority, asserted that "a general purpose computer in effect becomes a special purpose computer once it is programmed to perform particular functions pursuant to instruction from program software . . . . In any case, a computer, like a rasterizer, is apparatus not mathematics."[112]

Chief Judge Glenn L. Archer, joined by Judge Helen W. Nies, dissented.[113] Chief Judge Archer agreed with the majority that the PTO Reconsideration Board erred in failing to limit Alappat's invention to the disclosed structure as statutorily de-

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105. *In re* Alappat, 33 F.3d 1526, 1539-41 (Fed. Cir. 1994) (en banc) (citing *In re* Donaldson, 16 F.3d 1189, 1193 (Fed. Cir. 1994)). All of the judges reaching the merits concurred on this point, interpreting "means" language under § 112 ¶ 6 as limited to the disclosed structure and its equivalents. *Id.* at 1541.

106. *Id.* at 1542 ("Indeed the Supreme Court has acknowledged that Congress intended § 101 to extend to 'anything under the sun made by man.'") (quoting Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980)).

107. *Id.* at 1544.

108. *Id.* at 1543.

109. *See supra* note 88 (quoting § 112 ¶ 6).

110. "Reading" is shorthand for denoting the scope of a patent claim. If a practice or invention "reads" on a patent, it simply means that the invention or practice constitutes infringing behavior.

111. *Alappat*, 33 F.3d at 1545.

112. *Id.*

113. Chief Judge Archer and Judge Nies both concurred with the majority's jurisdictional decision. *Id.* at 1545.

manded.[114] After examining the Supreme Court trilogy in some depth,[115] however, Chief Judge Archer criticized the majority for finding patentability based solely on the recitation of physical structure.[116] In arguing that Alappat's invention as narrowed to the disclosed structure and its equivalent still failed the § 101 test, Chief Judge Archer contended that finding equivalency in a general purpose computer programmed with the equations proved the nonstatutory nature of the invention.[117]

III. TOWARD A COMPREHENSIVE PATENTABILITY TEST FOR COMPUTER-RELATED INVENTIONS

The patentability of computer-related inventions that make use of mathematics presents an enormous theoretical quagmire that courts and academics have for decades been unable to resolve. *Alappat*'s majority opinion, in this light, seems to be an exasperated declaration that any computer program, once embodied in a physical form, is patentable. Perhaps this approach will placate industrial concerns and provide the stability so long sought to the issue. Nevertheless, a return to basic principles, without a painstaking attempt to harmonize often inconsistent precedent, can yield a much sounder result.

A. A Frustrated Federal Circuit Decides *Alappat*

The *Alappat* majority's opinion is obscured by its near obsession with the PTO's unwillingness to narrow the means-plus-function claim to disclosed structure as demanded by the language of § 112 ¶ 6.[118] As a result of its frustration, the majority

114. *Id.* at 1561 (Archer, C.J., dissenting) ("Of course, I agree that the means-for-function elements in Claim 15 must be construed to cover the corresponding structure described in Alappat's specification and equivalents thereof.").

115. *Id.* at 1555-57 (Archer, C.J., dissenting).

116. *Id.* at 1557 (Archer, C.J., dissenting). Chief Judge Archer eloquently placed his point in the context of the Supreme Court's doctrine:

> Thus the dispositive issue is not whether the claim recites on its face something more physical than just abstract mathematics. If it were, *Benson* and *Flook* would have come out the other way and *Diehr* would have been a very short opinion. The dispositive issue is whether the invention or discovery *for* which an award of patent is sought is more than just a discovery in abstract mathematics.

Id. (Archer, C.J., dissenting).

117. *Id.* at 1566 (Archer, C.J., dissenting) ("To find equivalence based solely on the identity of mathematical function, with absolute disregard for the particular claimed circuitry, therefore, is to concede that Alappat's claimed circuitry is irrelevant and nonstatutory.").

118. *See supra* note 88 (quoting § 112).

errs by devoting its entire short opinion on the merits of the case to arguments on why the disclosed interrelated elements define a "machine."[119] Although the court correctly recognizes that the disclosed apparatus is limited in scope to accomplish a given task, namely, presenting a smooth waveform on a CRT screen, this point is not relevant to its analysis. The court's reasoning instead implies that any claim that is drafted in "means-plus-function" language and discloses physical structure constitutes a "machine" and is therefore statutory subject matter under § 101.[120] *Benson* and *Flook* teach otherwise.[121] The court's approach is flawed because it fails to characterize adequately the nature of the challenged claim reciting a mathematical algorithm, determine its true scope, and apply the claim as interpreted to established principles of patentability.[122]

Furthermore, the court's willingness to define patentability merely by applying a label of "machine" on the claim at issue serves only to substitute one confusion for another. Previously existing doctrine, bedrocked upon the "wholesale preemption" rule, admittedly contorts itself through ambiguous definitions of the classical unpatentable categories of abstract ideas, laws of nature, and natural phenomena. The majority's approach is similarly flawed in that it only defines patentability by negative reference to these definitions, holding patentable any matter not

119. *See supra* notes 107-108 and accompanying text (quoting the *Alappat* majority).

120. Chief Judge Archer's dissent points out this flaw in the majority's reasoning by arguing that it amounts to an attempt to resurrect precedent expressly overruled by the Supreme Court, which held that a claim is outside § 101 only if it recites mathematics on its face and in its entirety. *Alappat*, 33 F.3d at 1561 (Archer, C.J., dissenting) (citing *In re* Freeman, 573 F.2d 1237 (C.C.P.A. 1978); *In re* Chatfield, 545 F.2d 152 (C.C.P.A. 1976); *In re* Bernhart, 417 F.2d 1395 (C.C.P.A. 1969)).

121. Undoubtedly *Benson* and its progeny require a more detailed inquiry into claims reciting a mathematical algorithm under § 101. In fact, *Alappat* goes against the very result in *Benson*, where one of the challenged process claims recited physical structure, a reentrant shift register. Gottschalk v. Benson, 409 U.S. 63, 73-74 (1972). Likewise, although the Court upheld Diehr's process claim, its analysis went far beyond sole reliance on the recitation of a computer in the claim itself. Diamond v. Diehr, 450 U.S. 175, 179 n.5 (1981).

Whether Alappat's claim was to an apparatus using "means-plus-function" language should be of no consequence to § 101 analysis. Federal Circuit cases recognize that both apparatus and process claims require a similar treatment under § 101. *See, e.g.*, Arrhythmia Res. Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1058 (Fed. Cir. 1992) (applauding the *Freeman-Walter-Abele* test's examination of both process and apparatus claims for statutory subject matter when either recites a mathematical algorithm).

122. *See supra* part I.A.2 (discussing the policy considerations underlying patent law).

determined to fall within one of the three categories. Instead of articulating any new ideas for defining § 101, the majority therefore dangerously adds an extra layer to an already cluttered legal issue. The Federal Circuit accidentally reached the correct result in this case, but its analysis, if widely followed, will prove disastrous in the future by creating an extremely malleable ad hoc definitional test that will inevitably reach inconsistent factual determinations and ultimately result in incorrect patentability decisions.

Chief Judge Archer's dissent better characterizes precedent and correctly chastises the majority for failing to to go beyond the recitation of structure in its analysis.[123] Nonetheless, he errs himself by misconstruing Alappat's invention after failing to ascertain adequately the scope of the claim. By not identifying the overall purpose of the claimed "machine"—to produce a smooth waveform on a CRT screen—and by failing to incorporate that characterization into his analysis, he incorrectly asserts that "[t]he calculations are the beginning and end of the claim."[124] This assertion leads him toward an incorrect conclusion that the claim encompasses all uses of the disclosed mathematical algorithm and must therefore fall prey to the preemption concerns of *Benson*. In short, by failing to acknowledge the limitations of the invention as claimed, Chief Judge Archer simply ends up getting the case wrong.

The historical prohibition on the patentability of natural principles and abstract ideas detailed in Chief Archer's dissent lacks a theoretical basis. His castigation of the majority for its reliance on claiming form is well placed, but his strict reliance on preemption concerns leads him to the wrong conclusion. Chief Judge Archer, unfortunately, lacked rationally premised principles defining unpatentable subject matter upon which to base his preemption concerns.

Both approaches taken by the Federal Circuit in *Alappat* only further confuse the jurisprudence of § 101. This area of law cries out for a new approach, faithful to Supreme Court precedent yet not unnecessarily constrained by a wealth of inconsistent lower court doctrines.[125] Section 101 cannot stand in fear of

123. *Alappat*, 33 F.3d at 1563 (Archer, C.J., dissenting).

124. *Id.* at 1564 (Archer, C.J., dissenting) (quoting *In re* Walter, 618 F.2d 758, 769 (1980)).

125. It is virtually impossible to harmonize early applications of the *Freeman-Walter-Abele* test by the CCPA with modern Federal Circuit decisions. *See, e.g.*, *In re* Iwahashi, 888 F.2d 1370, 1374-75 (Fed. Cir. 1989) (involving a claim to an apparatus relating to voice recognition technology drafted using

the development of computer-related technology. Computers pose no threat to the public policy underlying patent law nor does a workable test for determining statutory subject matter under § 101 require altering 200 years of policy development.

B. An Interpretive Approach to Statutory Subject Matter for Claims Incorporating a Mathematical Expression

This Comment presents a two-part test for determining the patentability of any claim reciting a mathematical algorithm. The test first determines the true nature of a claim by defining the scope of the recited algorithm to include other inventions that use that algorithm to reach the same ultimate result using substantially similar means in a substantially similar way. Armed with the interpreted claim, the test then applies that claim to principles that divide discovery from invention, thereby characterizing it as either patentable or unpatentable subject matter under § 101. The proposed test thus provides a doctrinally sound premise for determining statutory subject matter based on well-rooted principles distinguishing patentable from unpatentable subject matter, adequately characterizes the role of mathematics within this distinction, and presents a concrete method for assessing individual fact situations.

1. "Discovery" vs. "Invention": A Distinction Lost By the Courts

A tightly-defined test built on a robust discovery and invention distinction can shed much of the uncertainty from the doctrine of patentable subject matter.[126] Unfortunately, courts banter the terms "discovery" and "invention" back and forth sloppily and blur their fundamental meanings.[127] As stated pre-

means-plus-function language, that recited a mathematical algorithm, and ruling it statutory subject matter).

126. Courts and academics unfortunately have never developed this conceptualization, relying instead on broad inventive categorization under headings such as natural laws and abstract ideas, which can be both under- and over-inclusive. *See supra* note 43 and accompanying text (describing the broad statutory inventive classifications).

127. Nearly all § 101 cases recklessly use the terms "discovery" and "invention." *Benson*, for example, quoted an earlier Supreme Court decision proclaiming: "One may *discover* a new and useful improvement in the process of tanning, dyeing, etc." Gottschalk v. Benson, 409 U.S. 63, 69 (1972) (emphasis added) (quoting Corning v. Burden, 56 U.S. (15 How.) 252, 267-68 (1853)). Under the principles discussed in this Comment, one must invent such an improvement because that improvement is an application of an idea.

viously, the conceptualized distinction between pure "discovery" and pure "invention" is critically important to a comprehensive interpretation of § 101.[128] Restated briefly, pure discovery reflects the uncovering of natural truths, presumed to be forever in the public domain of knowledge.[129] This material is placed beyond the realm of patentability despite the otherwise broad reach of the patent laws to new subject matter.[130] Pure invention, on the other hand, represents the physical laws of nature, which may or may not yet be fully explained by discovery, placed in practical use in the working world.[131] This subject matter defines the heart of § 101.

The inventive process frequently includes elements of discovery, and any patentability test must carefully distinguish between the two. Importantly, the current § 101 controversy does not center on any fundamental misunderstanding of the basic policies underlying patent law, for these policies have been firmly established since the origin of the American patent system.[132] Nevertheless, courts have failed to develop fully a useful model for dealing with cases that fall within the continuum between pure invention and pure discovery that carefully distinguishes elements of the two without impermissibly importing concepts of novelty and nonobviousness into § 101.[133] *Alappat*

Admittedly, much of this confusion comes from the language of § 101 itself that proclaims "[w]hoever *invents* or *discovers* any new and useful process, machine, manufacture, or composition of matter" may obtain a patent. 35 U.S.C. § 101 (1988) (emphasis added). This choice of language, while unfortunate, cannot cloud principles distinguishing pure "discovery" from pure "invention."

128. *See supra* part I.A.2 (outlining the distinction between discovery and invention based on the policies underlying patent protection of technology).

129. *See supra* note 35 and accompanying text (defining pure discovery).

130. *See supra* notes 13-14 and accompanying text (describing congressional intent of liberal construction of § 101).

131. *See supra* note 34 and accompanying text (explaining an inventor's legitimate claim to an exclusive right to her invention).

132. The Jeffersonian principles of subject matter patentability under which the American patent system was formed over two centuries ago have remained remarkably unchanged, as evidenced by the consistency of § 101's language. *See supra* notes 6-10 and accompanying text (describing the legislative history of § 101). Today most still agree with the basic premise that one cannot obtain a patent for the discovery of a law of nature. *Cf. In re* Alappat, 33 F.3d 1526, 1542 (Fed. Cir. 1994) (en banc) (classifying laws of nature, natural phenomena, and abstract ideas as unpatentable subject matter).

133. A number of judicially-crafted tests examining mathematical algorithms in the context of § 101 have imported concepts of novelty and nonobviousness. *Flook*, for example, seemed to resurrect the CCPA's "point of novelty" test for patent claims reciting a mathematical algorithm. Parker v. Flook, 437 U.S. 584, 591 (1978). This test in essence removed the algorithm from the claim

illustrates this inability: the court found patentable an invention clearly incorporating elements of both invention and discovery without enunciating a reasoned decision.[134]

Perhaps the best illustration of the distinction between invention and discovery may be made using a series of simple examples. One of humanity's first inventions, the wheel, was unquestionably developed without a complete understanding of the physical truths embodied by Newtonian mechanics (competing forces, friction, and the like). Nonetheless, this pioneering invention proved itself useful in a multitude of daily tasks and has enjoyed millennia of use and improvement. The wheel was thus pure invention—an advancement virtually unexplained by its developers. At the opposite extreme, the development of early quantum mechanics by such noteworthy scientists as Niels Bohr and Erwin Schrödinger[135] showed little inventive utility until the explosion of the first atomic weapon decades later.[136] Quantum mechanics was therefore pure discovery—a theoretical advancement without immediate utility. In the middle of this broad spectrum lies most of today's industrial work. Scientists and engineers now work synergetically in international industry to expand humanity's understanding of the physical world and develop new products for the ever-expanding marketplace.[137]

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and asked whether what was left was either well known or obvious to the art. The claim would fail if the algorithm was the sole novel or nonobvious element of the claim. *Id.* at 594. For a discussion of these cases, see MERGES, *supra* note 24, at 66.

The *Flook* Court apparently based its decision on the supposition that the equation used in the method for updating a process alarm limit was the sole point of novelty in the patent claim. 437 U.S. at 588. The Court, however, was careful to reiterate that § 101 stands as a predicate to the other patentability requirements of novelty and nonobviousness. *Id.* at 593. In addition, the Court, only a few years later in *Diehr*, reiterated its construction of § 101 as a predicate test by stating: "The question . . . of whether a particular invention is novel is wholly apart from whether the invention falls into a category of statutory subject matter." Diamond v. Diehr, 450 U.S. 175, 190 (1981) (quotation omitted); *see also supra* note 62 and accompanying text (exploring this issue).

134. *Alappat*, 33 F.3d at 1437-39, 1544-45.

135. Bohr's atomic model and Schrödinger's equation are fundamentals of modern quantum mechanics. For a discussion of these marvelous scientific advancements, see generally RICHARD P. FEYNMAN ET AL., THE FEYNMAN LECTURES ON PHYSICS: QUANTUM MECHANICS (1965).

136. The explosion of the first atomic bomb on July 16, 1945, was the first real application of quantum mechanics and atomic theory. THE CONCISE COLUMBIA ENCYCLOPEDIA 52 (2d ed. 1989).

137. The 3M Company illustrates a successful model of corporate technology development that uses this synergy. By hiring basic researchers who are experts in a particular scientific field and disseminating their findings to product

Developing a comprehensive test for § 101 requires recognition of today's scientific and industrial realities. It is axiomatic that all inventions operate according to the collective physical laws of nature even if their underlying truths are not yet fully understood by discovery.[138] The key to identifying a new idea as patentable or unpatentable is to carefully analyze the workings of the disclosed product or process to determine the nature and function of each claimed element. In accordance with analyzing the claim as a whole,[139] the invention can fall within § 101 only if the elements of that claim perform a valid function within the claim apart from the mere explanatory recitation of an abstract truth or law of nature.

2. Mathematics as a Proxy for Natural "Truths"

At some point in the tortured history of the interpretation of § 101,[140] all of mathematics was tossed into the bin of nonstatutory subject matter, apparently on the assumption that any mathematical expression functions only to describe a natural truth.[141] Taking a step back, mathematics is best characterized

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developers, an information network is created throughout 3M. *See, e.g.*, Thomas J. Martin, *Ten Commandments for Managing Creative People*, FORTUNE, Jan. 16, 1995, at 135 (praising 3M's innovative infrastructure).

138. The collective laws of physics have governed all matter within the universe since its creation; nothing can escape these forces. Interestingly, Chief Judge Archer's *Alappat* dissent begins with a lengthy quote from an 1873 patent law treatise detailing this concept. 33 F.3d at 1551-52 (Archer, C.J., dissenting) (quoting GEORGE CURTIS, A TREATISE ON THE LAW OF PATENTS FOR USEFUL INVENTIONS xxiii-xxv (4th ed. 1873)).

139. The Supreme Court has clearly mandated the interpretation of a claim as a whole. Diamond v. Diehr, 450 U.S. 175, 188 (1981) ("In determining the eligibility of respondents' claimed process for patent protection under § 101, their claims must be considered as a whole.").

140. *See supra* part I.B.1 (describing the Supreme Court's interpretations of § 101).

141. *Benson* dealt with the patentability of a mathematical expression, but one can question whether, because the Court meticulously traced the history of patentable subject matter standards through the prism of traditional prohibitions of laws of nature and abstract ideas, only those mathematical expressions uniquely describing a law of nature or an abstract idea were placed beyond § 101. Of course, broadly speaking, the Court enunciated its rules with respect to mathematical algorithms, which it defined as "[a] procedure for solving a given type of mathematical problem." Gottschalk v. Benson, 409 U.S. 63, 65 (1972). In *Flook* the Court was more direct, expanding *Benson* by stating: "In [*Benson*], we held that the discovery of a novel and useful mathematical formula may not be patented." Parker v. Flook, 437 U.S. 584, 585 (1978).

For a detailed discussion of the Court's identification of mathematics with laws of nature and abstract ideas, see Irah H. Donner & J. Randall Beckers, *Throwing Out Baby* Benson *with the Bath Water: Proposing a New Test For Determining Statutory Subject Matter*, COMPUTER LAW., Jan. 1993, at 8, 10-12.

as a tool of science, a mere means of expression. Mathematics serves as a universal language whose utility allows both inventors and discoverers alike to describe and transcribe their work, and because of this utility, means-plus-function claim drafting allowable under § 112 ¶ 6 becomes a convenient mode for efficient patent writing.[142]

Mathematical expressions may be used to describe both discovered and invented subject matter and are therefore imperfect proxies for mathematical truths and other laws of nature. No one could doubt, for example, that Einstein's $E = mc^2$ describes a natural law. The equation states an hypothesized truth: that energy and mass are directly proportional by the speed of light squared. Its recitation standing alone says nothing of any particular process or object. It instead speaks broadly of the behavior of any body of mass. Conversely, suppose that a machine exists such that, for whatever reason, two parameters must be set for its efficient operation. One may set the first parameter by choosing from some range of values, but once the first is set, the second must be twice the first. In other words, letting the first parameter value be denoted by the letter "a" and the second by the letter "b," the relationship between the two may be expressed as "$a = 2b$," a simple mathematical equation. In this case, the recited mathematical expression is purely empirical, particular to the process it describes. If recited in a patent claim to that process, absent the absurd argument that the claim is

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Donner and Beckers present an interesting test predicated on the notion that certain equations do not uniquely describe a law of nature and therefore should constitute patentable subject matter under § 101. *Id.* at 13. The authors argue that the far reach of the applications of the BCD to binary conversion method claimed in the patent primarily threatened the Supreme Court in *Benson*. *Id.* at 9. From this argument they craft a test allowing for the patentability of equations characterized as "engineering approximations" if they allow sufficiently available alternatives for other applications. *Id.* at 11.

Although this test has some practical utility, its results are unjustified under principles of patent law governing the distinction between discovery and invention. Instead of carefully examining the nature of the claim as a whole, this test concerns itself only with practical concerns of available alternatives. Like *Flook*'s prohibition of arbitrary field of use limitations, a mathematical expression does not magically become patentable subject matter simply because, ipso facto, it is expressly narrowed to the context of its intended use. *See supra* note 63 and accompanying text (discussing *Flook*). If the equation constitutes a discovery, it is unpatentable regardless of the scope of its utility. The challenge is to find a coherent way to determine if a patent claim reciting a mathematical equation covers subject matter best characterized as discovery or invention.

142. This is the method of claim drafting Alappat chose. *See supra* part I.C (describing means-plus-function language).

intended to encompass all multiplication by two, the algorithm is patentable as part of the claimed process, because it is serving only as a tool to express its operation.

Some finesse is therefore required to arrive at a subject matter test for inventions using mathematical algorithms. Again, no generalized rule makes sense if divorced from the context of the invention at hand, but one may envision categories of purely empirical equations so completely unique to a given invention that they merely describe an applied process or apparatus.[143] Thus, to determine the patentability of a claim involving mathematics, one must first in some way identify the scope of the function of the mathematical expression recited in the patent claim. If that scope is so broad that it fully includes the expression of an abstract truth or idea, the claim is unpatentable under well-settled principles of patent law.[144] If, instead, the scope is limited to the communication or description of a portion of the invention performing some application of a broader idea, it is clearly patentable under equally well-settled patent law principles.[145]

3. The Penumbra of a Patent Claim

American patent law characterizes a patent claim as a property right whose language attempts to assert the extent, or scope, of the invention it discloses.[146] Paradoxically, however, it is impossible to define precisely the boundaries of a patent's scope at any time during its lifetime, because the boundaries are carved out inch by inch as the patented product or process interacts with the marketplace.[147] This process occurs because others build upon a patent's disclosure by developing competing

143. In principle it does not matter whether a claim recites a process or an apparatus. *See supra* note 121 (explaining that Federal Circuit cases recognize that both apparatus and process claims may fail § 101).

144. Such a broad expression must be classified as a discovery. *See supra* notes 32-36 and accompanying text (distinguishing discovery from invention). Of course, courts have implicitly recognized this concept by their long-standing prohibition on patents directed to an abstract idea or a law of nature. *See supra* note 41 and accompanying text (tracing the prohibition's historical stability).

145. Such a narrow expression must be classified as invention. *See supra* notes 32-36 and accompanying text (distinguishing invention from discovery).

146. The claims of a patent assert the "metes & bounds" of the property right. *See supra* note 16 (describing the parts of a patent).

147. Because the primary purpose behind awarding patents is to encourage public dissemination of emerging technology, this is indeed a designed and publicly beneficial effect. *See supra* notes 18-19 and accompanying text (outlining the purposes underlying patent protection).

technologies once that patent becomes public knowledge,[148] and it is only when a patent owner reacts to the competition by asserting his or her patent rights in individual challenges that the scope of a patent begins to take shape.[149] A penumbra therefore envelops the literal description of any invention, a sphere of uncertainty clouding the meaning of any individual element. Certainty comes only by way of a series of later ad hoc factual comparisons by courts with other specific embodiments.

In attempting to define sufficiently this penumbra within the narrow context of a single infringement case, courts are aided by a doctrine of equivalents.[150] A basic test of equivalency[151] brings another invention, one similar but not literally identical to the invention embodied by the patent,[152] into the patent's penumbra if the accused invention performs substantially the same function in substantially the same way to obtain the same result.[153] Although the nuances of the full and

148. *See supra* note 18 and accompanying text (describing public access to emerging technology as one of the purposes of patent law).

149. In other words, to enforce her property right, a patent owner must bring an infringement suit against someone she believes is practicing her patent as claimed.

150. When a patent owner brings an infringement suit she must demonstrate that the defendant's practice falls within her patent's claim. She can do this in two ways. She can demonstrate that the language of her claim literally covers the defendant's practice in which case that practice literally infringes the patent. Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 607 (1950). Alternatively, she can assert that the defendant's practice, though not literally identical to the claim language, nonetheless falls within a range of legally-defined equivalents. *Id.* The test governing this legally-defined range of equivalents is known as the doctrine of equivalents. *Id.* at 608. Although a detailed discussion of this doctrine commands many articles of its own, its elements aid in the development of a test governing statutory subject matter. For a general discussion on patent infringement and the doctrine of equivalents, see JOHN W. SCHLICHER, PATENT LAW: LEGAL AND ECONOMIC PRINCIPLES § 7.04 (1994).

151. This basic equivalency standard is borrowed from the context of infringement as enumerated in the seminal case *Graver Tank*, 339 U.S. at 607-09. It is important to note here that using an equivalency test to interpret the entire scope of the claim prior to the issue of a patent and using the test in a narrow contest between two comparative examples in the context of infringement are very different beasts. The basic test of equivalency, so termed in this Comment, is borrowed from the infringement context and used only to approximate the outer boundaries of a claim to determine its patentability.

152. Again, an invention identical to that embodied by a patent claim literally infringes that patent. For a discussion of literal infringement, see SCHLICHER, *supra* note 150, § 7.04.

153. *Graver Tank*, 339 U.S. at 608; *see also* SCHLICHER, *supra* note 150, § 7.04(16) (noting *Graver Tank* as the seminal case regarding the doctrine of equivalents)

elaborate doctrine of equivalents are by no means self-evident,[154] its basic tenets allow one to at least conceptually sketch the boundaries of a patent claim. With this conceptualization at hand, the scope of a claim reciting a mathematical algorithm may be estimated, and this estimation helps address the central preemption concerns of *Benson* and its progeny without unnecessarily incorporating novelty and nonobviousness elements beyond the scope of § 101.[155]

4. A Functionality-Based Test of Statutory Subject Matter

A rational statutory subject matter test under § 101 for claims reciting a mathematical algorithm must connect the estimation of a claim's scope, determined by the basic equivalency test, with the distinction between discovery and invention.[156] A two-part test emerges from this union that will define the scope and function of any suspicious claim element and subsequently compare that element to nonpatentable abstract ideas and laws of nature. Hence, the first part of the test borrows the basic test of equivalency to determine the scope of a claim. Armed with the interpreted claim's scope, the second part of the test applies that claim to principles dividing discovery from invention to characterize it as either patentable or unpatentable subject matter under § 101. Although this test can cover any type of claim,[157] it proves of greatest value for evaluating claims reciting a mathematical algorithm.

Application of the test requires first an inquiry into the true nature and function of a recited mathematical algorithm within a claim by examining the range of that claim's legal

154. *See, e.g.*, Martin J. Adelman & Gary L. Francione, *The Doctrine of Equivalents in Patent Law: Questions that* Pennwalt *Did Not Answer*, 137 U. PA. L. REV 673, 680-03 (1989) (pointing out flaws in the doctrine of equivalents).

155. *See supra* note 133 (discussing the incorporation of novelty and nonobviousness into § 101).

156. *See supra* part III.B.1 (discussing this conceptualized distinction).

157. The proposed test may also prove useful in other areas of patentability not immediately within the scope of this Comment. The scope of a claim to a method of doing business, for example, can also be estimated by examining other methods whose elements perform substantially the same function in substantially the same manner to achieve the same result. *See, e.g.*, Hotel Security Checking Co. v. Lorraine Co., 160 F. 46, 47 (2d Cir. 1908) (discussing the classic arguments surrounding the patentability of business methods). If this scope, thus defined, constitutes nothing more than a general idea, it must fail § 101. On the other hand, if that scope defines a specific application of an idea, then it constitutes a valid invention.

equivalents.[158] If that range of equivalents fully encompasses a mathematical algorithm that describes a natural truth, then that claim must fail, because it crosses the line to pure discovery. If, instead, that range of equivalents encompasses only a specific application of a natural law, that claim permissibly recites patentable inventive subject matter.

Again, the test is best illustrated by its application. Consider the previous example involving the process incorporating the "$a = 2b$" equation.[159] Suppose the claim to the entire process, whatever it may be, were written to incorporate the equation within the claim as "including a method for selecting the value of parameter b such that $b = a/2$." Applying the basic equivalency test to this claim,[160] its scope only encompasses other processes that achieve the same result as the process of the claim by using elements performing substantially the same function in substantially the same way.[161] Whatever the precise embodiments of these equivalents, clearly not all multiplication by two comes within the definition, because to find equivalency, the accused process must at the very least select specific parameters and apply them to a process with the same result as the one claimed. Recognizing this functionality demonstrates that the mathematical algorithm does more than recite a natural truth and that the claim as a whole is inventive.

Applying the test to the claims at issue in *Benson*,[162] no inconsistency arises with the Supreme Court's result in that case. Benson's claim recited a method for converting a binary coded

158. The term "legal equivalents" is based on the application of the standard the Supreme Court enunciated in *Graver Tank*. *See supra* note 153 and accompanying text (detailing this standard).

159. *See supra* part III.B.2 (demonstrating that mathematical expressions are imperfect proxies for laws of nature).

160. The test is applied to the claim as a whole in accordance with *Diehr*. *See supra* note 139 (quoting *Diehr*).

161. Again, this is the application of the *Graver Tank* standard. *See supra* note 151 (discussing the standard's origins). Whether this standard requires a finding of equivalency element-by-element or is applied to the claim as a whole remains controversial. *Compare* Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 939 (Fed. Cir.), *cert. denied*, 485 U.S. 1009 (1987) (holding that an accused fruit sorting machine did not infringe the patent because not all of the elements of the machine were equivalent) *with* Corning Glass Works v. Sumitomo Elec. U.S.A., Inc., 868 F.2d 1251, 1253 (Fed. Cir. 1989) (holding that optical fibers that substituted a negative dopant for the positive dopant constituted patent infringement under the doctrine of equivalents).

162. Gottschalk v. Benson, 409 U.S. 63 (1972); *see also supra* part I.B.1 (discussing *Benson*). The *Benson* Court found the claims to a method for converting binary coded decimal numerals to binary numerals did not constitute statutory subject matter. 409 U.S. at 71-02.

decimal (BCD) numerical expression into a pure binary numerical expression.[163] The scope of this claim, again, may be interpreted to include other processes that achieve the same result using elements performing substantially the same function in substantially the same way.[164] Here, any method for converting a BCD to a binary expression achieves an identical result. In addition, these other methods will necessarily use substantially identical means, all placing numerical "1"s in designated positions, whether within or without the context of shift registers. The scope of Benson's claims, therefore, fully encompasses a mathematical truth, namely, that BCDs may uniquely find a numerically equivalent binary expression. Finding this truth, the test reveals that the claim is directed to a discovery, not an invention.

Applying the test next to the claim at issue in *Diehr*,[165] the results are once more consistent with the Supreme Court's finding that the claim presented statutory subject matter.[166] Diehr claimed a method of operating a rubber-molding press with the aid of a digital computer programmed to calculate a form of the Arrhenius equation.[167] Again the equivalency test applied to this claim extends the scope of this claim only to other processes resulting in the operation of a press that use elements perform-

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163. *See supra* notes 46-55 and accompanying text (discussing the case in detail). One of the two similar rejected claims provided:

> Claim 8:
>
> The method of converting signals from binary coded decimal form into binary which comprises the steps of
>
> (1) storing the binary coded decimal signals in a reentrant shift register,
>
> (2) shifting the signals to the right by at least three places, until there is a binary '1' in the second position of said register,
>
> (3) masking out said binary '1' in said second position of said register,
>
> (4) adding a binary '1' to the first position of said register,
>
> (5) shifting the signals to the left by two positions,
>
> (6) adding a '1' to said first position, and
>
> (7) shifting the signals to the right by at least three positions in preparation for a succeeding binary '1' in the second position of said register.

Benson, 409 U.S. at 73-74.

164. *See supra* note 153 and accompanying text (enunciating the equivalency standard).

165. Diamond v. Diehr, 450 U.S. 175, 188 (1981); *see also supra* part I.B.1 (discussing *Diehr*).

166. The *Diehr* Court ruled that the claims at issue constituted statutory subject matter under § 101. 450 U.S. at 191-92.

167. *See supra* note 66 and accompanying text (describing Diehr's invention).

ing substantially the same functions in substantially the same way.[168] Here, processes falling within the scope do not include all solutions of a generic Arrhenius equation because, like the first presented example, infringing embodiments must select parameters for use in the equation and apply them to the operation of a press before a finding of equivalency is justified.[169] Because the claim does not fully encompass a natural truth, it may legitimately command the label of invention and enjoy status as statutory subject matter under § 101.[170]

Finally, the test's rationality and predictability are confirmed by applying it to *In re Trovato*.[171] *Trovato* involved the development of a method having broad utility, potentially valuable as a way to optimize any number of physical problems.[172] Using the first part of the test to sketch the scope of the claim as presented,[173] its breadth may be appreciated, as any optimization process using elements performing substantially the same function in substantially the same way will fall within the claim's penumbra. This claim, as drafted, therefore incorporates any method of optimization comprising a graphical representation of a physical problem, like a street map, wherein a "goal" state or point may be reached along any number of paths and wherein the optimal path is determined by logical deduction accounting for any number of desired variables (cost, distance, etc.).[174] At the test's next level, the claim does not constitute

168. *See supra* note 153 and accompanying text (enunciating the equivalency standard).

169. This limitation on the scope of the generic Arrhenius equation is not a mere arbitrary field of use limitation; rather, it is a limitation on the scope of the claim based upon the functionality of the Arrhenius equations as used in the claimed process. Of course, there indeed may be a fine line distinguishing the outcomes of *Diehr*, 450 U.S. at 191-03, and *Flook*, 437 U.S. at 600, but those two cases, decided within three years of each other, were decided by narrow margins largely split over a dispute concerning the proper role of field of use limitations. *See supra* note 63 and accompanying text (setting forth the arguments of the majority and dissent in *Flook*).

170. Of course, to eventually qualify for protection as a patent, the invention must subsequently satisfy the other statutory requirements of novelty and nonobviousness. *See supra* note 16 and accompanying text (setting forth these statutory requirements).

171. 33 U.S.P.Q.2d 1194 (Fed. Cir. 1994); *see also supra* note 82-85 and accompanying text (discussing *Trovato*).

172. *See supra* note 83 and accompanying text (describing the invention).

173. *See supra* note 83 (quoting a representative claim).

174. Of course any patent claim is construed in light of and is defined by the specification's disclosure. Here, however, the specification disclosed only flow charts and program code computing the least cost path to a given goal state based on data in a configuration space. 33 U.S.P.Q.2d at 1197.

patentable subject matter because it is discovery. All optimization processes incorporate some "shortest path" solution. The discoverers here uncovered and explained a systematic method of data structure and graphical analysis useful for any such process.

Although the application presented to the Patent Office in *Travato* failed to disclose a patentable "invention," one was not far from hand. If the application had explained and claimed a method unique to a given physical optimization process so that the equations presented by the specification were empirical to that process, it would have disclosed an invention. This would be true regardless of whether the equations were embodied by physical structure, programmed into physical hardware, and could be classifed as a "machine" under § 101.[175] The applicants, for example, could have disclosed a method for determining the shortest and most cost-efficient path for emergency vehicles, presenting a set of empirical, mathematically-based algorithms that overcame problems unique to that process. Comparing once more to the hypothetical process having the "*a=2b*" relationship between two variables,[176] perhaps some similar relationship exists for plotting the movement of emergency vehicles. Given the number of vehicles stored in a facility, perhaps an alternative relationship exists between that number and the shortest path that may be explained by a mathematical relationship.[177] If such were the case, the applicants' method would exploit their discovery and place it in practical use to achieve a physical result in the working world. This "invention" would therefore constitute patentable subject matter under § 101.

C. An Alternative Analysis of Alappat's Claim Using the Functionality-Based Test

Alappat drafted the claim to his apparatus by taking advantage of means-plus-function claim language.[178] That Alappat chose to use this language has no effect on the application of the

175. *See supra* note 2 (quoting § 101).

176. *See supra* part III.B.2 (presenting this example).

177. If it were determined, for example, that the number of vehicles kept in the storage facility was directly proportional to the ultimate time required to reach the "goal" point, the following mathematical relationship would then govern the relationship:

Ultimate Time = x * No. of Vehicles

where x = some proportionality constant

178. *See supra* note 100 (quoting the disputed claim).

presented test; indeed, in the special case of means language formatting, some notion of equivalency is statutorily mandated.[179] Although, as discussed previously, the Federal Circuit mentioned the scope of equivalency under Alappat's claim,[180] it instead decided the case on the premise that all genuine apparatus claims satisfy the requirements of § 101.[181]

In applying the approach of the functionality test to Alappat's rasterizer claim, the first step is to determine the scope of the recited mathematical algorithm in the context of the claim as a whole using the basic test of equivalency described by this Comment. As disclosed in the specification, Alappat's rasterizer used a circuit board programmed to solve a unique set of equations developed to yield desired anti-aliasing effects on a finite pixel cathode-ray tube (CRT).[182] Applying the equivalency test to the disclosed structure, the claim's scope extends to any apparatus producing an anti-aliasing waveform on a CRT screen using elements performing substantially the same function in substantially the same way.

Taken in this direction the similarity to the invention of *Diehr* becomes evident, as both encompass a programmed computer to obtain a specified result.[183] In taking the model the next step further, the cases exactly parallel one another. Alappat's claim, like Diehr's, is not drawn to an algorithm qua algorithm. Instead, these equations have an integral relationship with the invention's purpose and have within them an implicit, but real, use limitation. Because infringing embodiments of Alappat's claim must make use of an equation *to produce a specified result*, the algorithm recited by the claim does not identically describe a natural law or abstract idea, and the line of invention is crossed. Alappat may have discovered the algorithm he chose, but he and his colleagues put that algorithm

179. 35 U.S.C. § 112 ¶ 6 (1988); *see also supra* note 88 (quoting § 112 ¶ 6). Although the doctrine of equivalents used in the context of infringement and the equivalency governing § 112 ¶ 6 are not identical, the basic concepts are the same. *See supra* notes 150-152 and accompanying text (discussing these two standards).

180. The majority mentioned this only in passing. *In re* Alappat, 33 F.3d 1526, 1545 (Fed. Cir. 1994) (en banc).

181. *See supra* part II (discussing *Alappat*).

182. *See supra* note 99 (detailing Alappat's invention).

183. Diehr's invention used a computer programmed with a form of the Arrhenius equation to cure rubber, and Alappat used a programmed computer to produce a smooth waveform on the screen of an oscilloscope. *See supra* notes 66, 99 and accompanying text (discussing these two inventions in detail).

to work in an invention to produce a useful result. That invention therefore deserves the protection that only a patent affords.

CONCLUSION

The Federal Circuit's approach to the patentability of computer-related inventions in *In re Alappat* fails to bring the consistency to § 101 that is desperately needed in an era of rapidly changing technology. Developers, manufactures, and consumers of computer-related technologies require a stable and reliable way to make market choices based to a large degree on the protection afforded these products under intellectual property law. Patent law must indeed walk a fine line, providing a requisite predictability commanded by our Anglo-American legal system while always presiding over a world of new and changing technologies. The interpretive test of patentable subject matter presented in this Comment rationally estimates the scope of a patent claim and applies that estimation to a well-defined relationship distinguishing discovery from invention. This test, which is predicated on more than 200 years of legal foundation, can define the necessary fine line and, in so doing, provide a more meaningful and comfortable result for Kuriappan Alappat and his colleagues.