NEW MEXICO LAW REVIEW

Volume 29
Issue 1 *Winter 1999*

Winter 1999

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Robert A. Kreiss

PATENT PROTECTION FOR COMPUTER PROGRAMS AND MATHEMATICAL ALGORITHMS: THE CONSTITUTIONAL LIMITATIONS ON PATENTABLE SUBJECT MATTER

ROBERT A. KREISS*

Professor of Law and Director of the Program in Law and Technology, University of Dayton School of Law. J.D. Stanford University, 1977; Ph.D. Mathematics, University of Oregon, 1968; B.A. Reed College, 1963. I am grateful to Andrew Beckerman-Rodau, Dennis Karjala, Mark Lemley, Randall Rader, and D.C. Toedt for their helpful comments on a working draft of this article and to my research assistants, Brenda Smith and David Stitzel, for their valuable research assistance. I am also grateful to Linda Kreiss for her comments on drafts of this article and for her encouragement and support in many other ways.

I. INTRODUCTION

In 1972, the Supreme Court issued its first decision concerning the patentability of mathematical algorithms and, indirectly, computer programs.[1] More than twenty-five years later, courts are still struggling to understand when computer-related inventions and mathematical algorithm-related inventions can be patented.[2]

The perplexing issue has been whether such inventions are patentable subject matter.[3] Section 101 of the Patent Act lists four kinds of things as being patentable subject matter: (1) processes; (2) machines; (3) manufactures; and (4) compositions of matter.[4]

While this list looks straightforward, it is anything but that. First, the Supreme Court has stated that some things are not patentable subject matter.[5] These include natural phenomenon, laws of nature, abstract ideas, and mathematical algorithms.[6]

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1. *See* Gottschalk v. Benson, 409 U.S. 63 (1972).

2. *See, e.g.*, Diamond v. Diehr, 450 U.S. 175 (1981); Parker v. Flook, 437 U.S. 584 (1978); *see also* cases cited *infra* note 71.

3. Throughout this paper, the word "patents" is used as a shorthand for "utility patents." Plant patents and design patents are outside the scope of this article.

4. "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 (1994). This language has been the same since the first patent statute was enacted in 1790 except that, prior to 1952, patent statutes used the word "art" instead of "process." The change to the word "process," however, did not change the meaning.

5. *See, e.g., Benson*, 409 U.S. at 67.

6. In *Benson*, the Supreme Court wrote:

Second, the list should not be read literally. For example, paperback mystery novels, compact discs (CDs) containing musical recordings, and copies of paintings are copyrightable subject matter, not patentable subject matter, notwithstanding the fact that a paperback book with the novel, a CD with the music, and a copy of a painting are each an article of "manufacture."[7] Furthermore, the Supreme Court has held that a "process" for converting binary coded decimal numerals into pure binary numerals was not patentable subject matter, i.e., that this process is not the kind of "process" that is listed in § 101.[8]

Third, the Federal Circuit, which is the appellate court with exclusive jurisdiction over appeals of cases involving patent infringement and patent validity, is internally divided when it comes to interpreting § 101 in cases involving computer-related inventions and mathematical algorithm-related inventions.[9]

Now, more than twenty-five years after the Supreme Court first addressed the issue, we can say with some confidence that courts have no coherent methodology for deciding whether computer-related and mathematical algorithm-related inventions are patentable subject matter. Looking at the words of the statute has not been adequate. The three Supreme Court decisions and decades of decisions by the Court of Customs and Patent Appeals (C.C.P.A.),[10] succeeded by the Federal Circuit, have not sufficed. What is needed is a fresh look at the issue and a new perspective.[11]

> "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." 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.

Id. (footnote omitted) (quoting Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852)).

7. *See* 1 DONALD S. CHISUM, CHISUM ON PATENTS § 1.02[4] (1998) ("Printed matter alone and by itself does not constitute a 'manufacture.'"). Note that the physical media in these cases (blank books, blank CDs, and blank canvases) would be patentable subject matter, but would fail to be patentable on other grounds such as lack of novelty.

8. *See* Benson, 409 U.S. at 63, 71-72 (1972).

9. *See* discussion *infra* Parts III-IV.

10. In 1982, the C.C.P.A. was abolished and the newly created Court of Appeals for the Federal Circuit was given jurisdiction over appeals from the Patent and Trademark Office (PTO).

11. There is a rich literature dealing with the issues raised in this article, although virtually none has grounded the analysis on the Patent Clause of the Constitution. Some of the more recent works are the following: D.C. TOEDT, *Software Patents, in* LAW AND BUSINESS OF COMPUTER SOFTWARE § 6 (1996); Maria T. Arriola, In Re Alappat *and Beyond: A New Approach to the Patentability of Mathematical Algorithms and Computer Programs in the United States?*, 5 FED. CIRCUIT B.J. 293 (1995); Ruben Bains, Note, *A Comparison of the PTO's Computer-Implemented Guidelines with the Current Case Law*, 5 TEX. INTELL. PROP. L.J. 27 (1996); David L. Bohan, Note, *Computer Programs: Abstract Ideas or Patentable Subject Matter?*, 29 SUFFOLK U. L. REV. 809 (1995); John A. Burtis, Comment, *Towards a Rational Jurisprudence of Computer-Related Patentability in Light of* In Re Alappat, 79 MINN. L. REV. 1129 (1995); Vincent Chiappetta, *Patentability of Computer Software Instruction as an "Article of Manufacture": Software as Such as the Right Stuff* 17 J. MARSHALL J. COMPUTER & INFO. L. 89 (1998); Julie E. Cohen, *Reverse Engineering and the Rise of Electronic Vigilantism: Intellectual Property Implications of "Lock-Out" Programs*, 68 S. CAL. L. REV. 1091 (1995); Jeffrey S. Draeger, Comment, *Are Beauregard's Claims Really Valid?*, 17 J. MARSHALL J. COMPUTER & INFO. L. 277 (1998); Nellie A. Fisher, Comment, *The Patent Eligibility of Computer Implemented Processes in the Wake of* In Re Alappat*: The* Diehr *Standard Resurrected*, 32 HOUS. L. REV. 517 (1995); John A. Gibby, *Software Patent Developments: A Programmer's Perspective*, 23 RUTGERS COMPUTER & TECH. L.J. 293 (1997); James R. Goodman et al., *Toward a Fact-Based Standard for Determining Whether Programmed Computers are Patentable Subject Matter: The Scientific Wisdom of* Alappat *and Ignorance of* Trovato, 77 J. PAT & TRADEMARK OFF. SOC'Y 353 (1995); Lee A. Hollaar, *Justice Douglas Was Right: The Need for Congressional Action on Software Patents*, 24 AIPLA Q.J. 283 (1996); Mary S. Kakefuda, Note, *Patent Law—Determining when a Process Invention Contains a Mathematical*

This article reviews the cases and the analysis relating to patentability of mathematical algorithm-related inventions and computer-related inventions and suggests a new approach to these issues. The proposed approach indicates that the Constitution provides guidance when deciding whether something is patentable subject matter.

The Constitution advises us that the purpose of patent law is to "promote the progress of the useful Arts" and Congress is authorized to enact legislation to grant patents only for "discoveries."[12] Among other things, this means that one cannot patent an abstract idea, a natural phenomenon, or a law of nature.[13] Even though these may be useful, they are not the kind of "discoveries" referred to in the Constitution. The constitutional requirements also mean that patents can only issue on inventions that involve applications to some practical end. In addition, the Constitution indicates that patents can only issue on inventions which have practical utility within the "technological arts."[14] This limitation indicates that patents should not issue for material which is primarily within the subject matter of copyrights. These and other constitutional limitations on patentable subject matter are discussed in this article in order to develop a new methodology for evaluating whether a patent claim involving mathematical algorithms or computer programs is patentable subject matter.

In part II, this article reviews the relevant Supreme Court decisions. Part III describes some of the tests developed and used by the C.C.P.A. and the Federal Circuit to analyze the subject matter issue. It shows that different Federal Circuit judges apply these tests to reach conflicting results, indicating that the tests cannot be applied in a coherent and consistent manner. Part IV analyzes a recent district court decision and its reversal by the Federal Circuit, confirming the inadequacy of

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Algorithm and when It Falls within Statutory Subject Matter, In Re Schrader, *22 F.3d 290 (Fed. Cir. 1994)*, 68 TEMPLE L. REV. 507 (1995); Dennis S. Karjala, *The Relative Roles of Patent and Copyright in the Protection of Computer Programs*, 17 J. MARSHALL J. COMPUTER & INFO. L. 41 (1998); Sang Hui Michael Kim, In Re Alappat*: A Strict Statutory Interpretation Determining Patentable Subject Matter Relating to Computer Software?*, 13 J. MARSHALL J. COMPUTER & INFO. L. 635 (1995); Ronald S. Laurie & Joseph K. Siino, *A Bridge Over Troubled Waters? Software Patentability and the PTO's Proposed Guidelines (Part I)*, COMPUTER LAW., Sept. 1995, at 6; Nancy J. Linckand & Karen A. Buchanan, *Patent Protection for Computer-Related Inventions*, 18 HASTINGS COMM. & ENT. L.J. 659 (1996); John E. McGlynn, Note, *Patent Law—Patentable Subject Matter and Computer Software Inventions*—In Re Alappat, *33 F.3d 1526 (Fed. Cir. 1994)*, 14 TEMP. ENVTL. L. & TECH. J. 135 (1995); Maximilian R. Peterson, Note, *Now You See It, Now You Don't: Was It a Patentable Machine or an Unpatentable "Algorithm"? On Principle and Expediency in Current Patent Law Doctrines Relating to Computer-Implemented Inventions*, 64 GEO. WASH. L. REV. 90 (1995); Richard H. Stern, *Solving the Algorithm Conundrum: After 1994 in the Federal Circuit Patent Law Needs a Radical Algorithmectomy*, 22 AIPLA Q.J. 167 (1994); Richard H. Stern, *An Attempt to Rationalize Floppy Disc Claims*, 17 J. MARSHALL J. COMPUTER & INFO. L. 183 (1998) [hereinafter Stern, *An Attempt to Rationalize*]; D.C. Toedt, *Software as "Machine DNA": Arguments for Patenting Useful Computer Disks Per Se*, 77 J. PAT. & TRADEMARK OFF. SOC'Y 275 (1995); Edward A. Uhl, Note, *Sent Back to the Future of Software Patents*, In Re Trovato, *60 F.3d 807 (Fed. Cir. 1995)*, 21 U. DAYTON L. REV. 757 (1996); Brian Richard Yoshida, *Claiming Electronic and Software Technologies: The Effect of the Federal Circuit Decisions in* Alappat, Warmerdam, *and* Lowry *on the Claiming of Mathematical Algorithms and Data Structures*, 45 BUFF. L. REV. 457 (1997).

12. U.S. CONST. art. I, § 8, cl. 8.

13. *See supra* note 6 and accompanying text.

14. *See infra* note 238 and accompanying text.

the Supreme Court and Federal Circuit decisions. Part V discusses the Guidelines issued by the Patent and Trademark Office.[15]

Part VI of this article identifies some untenable statements which courts have made, and then develops a new approach to the issue of patentability that focuses on the Constitution. This alternative focus identifies constitutional constraints on the patent system which have implications for the statutory standards of nonobviousness, usefulness, novelty, and statutory subject matter. The constitutional limitations on patentable subject matter is explored in depth in various subsections of part VI.

II. GUIDANCE FROM THE SUPREME COURT

The Supreme Court has issued three decisions concerning the patentability of mathematical algorithm-related inventions and computer-related inventions.[16] As we shall see, however, these decisions have not provided clear guidance.

The first case was *Gottschalk v. Benson*.[17] The patent application in this case was for a method of converting binary-coded decimal (BCD) numerals into pure binary numerals (i.e., it converted one way of writing a number into another way of writing the same number).[18] The application described the invention as being related "to the processing of data by program and more particularly to the programmed conversion of numerical information."[19]

The Court framed the issue as "whether the method described and claimed is a 'process' within the meaning of the Patent Act,"[20] and answered by saying that the claim was not patentable subject matter because the claim was so broad as to be an attempt to patent an idea:

> It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting BCD numerals to pure binary numerals were patented in this case. 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 pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself.[21]

The Court's analysis was built on a dichotomy between unpatentable subject matter and patentable subject matter. The Court noted that "[p]henomena of nature, . . . mental processes, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work."[22] While these things are not patentable, "the application of the law of nature [to achieve] a new and useful

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15. *See infra* note 173 and accompanying text.

16. *See* Diamond v. Diehr, 450 U.S. 175 (1981); Parker v. Flook, 437 U.S. 584 (1978); Gottschalk v. Benson, 409 U.S. 63 (1972).

17. 409 U.S. 63 (1972).

18. For example, the number we normally write as 125 can be written in binary coded decimal as 0001 0010 0101. It can be written in pure binary as 1111101.

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

20. *Id.*

21. *Id.* at 71-72.

22. *Id.* at 67.

end"[23] or "a novel and useful structure created with the aid of knowledge of scientific truth" can be patentable.[24]

Benson teaches a number of principles. One is that abstract ideas are not patentable; it is the application of those ideas to achieve a new and useful result which can be patented. Another is that basic tools of science and technology, such as laws of nature and their mathematical expression, are not patentable.

A third principle is that overly broad patent claims cannot be maintained. For example, the Court referred to a case involving Samuel Morse, who was allowed a number of claims relating to telegraphy, but whose eighth claim was denied.[25] That claim was exceptionally broad:

> I do not propose to limit myself to the specific machinery, or parts of machinery, described in the foregoing specifications and claims; the essence of my invention being, the use of the motive power of the electric or galvanic current, which I call electro-magnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances.[26]

The *Benson* Court quoted the reasoning for disallowing this claim:

> If this claim can be maintained, it matters not by what process or machinery the result is accomplished. For aught that we now know, some future inventor, in the onward march of science, may discover a mode of writing or printing at a distance by means of the electric or galvanic current without using any part of the process or combination set forth in the plaintiff's specification. His invention may be less complicated—less liable to get out of order—less expensive in construction, and in its operation. But yet, if it is covered by this patent, the inventor could not use it, nor the public have the benefit of it, without the permission of this patentee.[27]

As explained in the *Telephone Cases*, Morse's eighth claim was so broad as to be a claim for "the use of magnetism as a motive power, without regard to the particular process with which it was connected in the patent," which was not allowable.[28]

A fourth principle from *Benson* is that the word "process" as used in the Patent Act, has a special meaning. The Court stated, "transformation and reduction of an article 'to a different state or thing' is the clue to the patentability of a process claim that does not include particular machines."[29] "[T]anning, dyeing, making waterproof cloth, vulcanizing India rubber, [and] smelting ores" involve the use of chemical substances or physical acts to transform something from one physical state to a different state.[30] While the Court expressly refused to say this was a requirement for finding a process to be patentable, it did at least implicitly contrast such

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23. *Id.* (quoting Funk Bros. Seed Co. v. Kalo Co., 333 U.S. 127, 130 (1948)).
24. *Id.* (quoting Le Roy v. Tathum, 55 U.S. (14 How.) 155, 175 (1852)).
25. *Id.* at 68, (citing O'Reilly v. Morse, 56 U.S. (15 How.) 62 (1853)).
26. *Morse*, 56 U.S. (15 How.) at 112.
27. *Benson*, 409 U.S. at 68 (quoting *Morse*, 56 U.S. (15 How.) at 113).
28. *See* 409 U.S. at 68-69, (citing The Telephone Cases, 126 U.S. 1, 534 (1888)).
29. *Id.* at 70.
30. *See id.* at 69 (quoting Corning v. Burden, 56 U.S. (15 How.) 252, 267-68 (1853)).

transformative processes from the claimed process which it thought amounted to no more than an abstract idea.[31]

A fifth idea implicit in *Benson* is that the word "process" in the Patent Act cannot be read literally. The patent claim in question is, of course, a process. It is a process for converting one expression of a number into another expression for the same number.[32] The fact that the claim was, literally, a process, did not suffice to make it patentable subject matter.

The second Supreme Court decision involving computer programs was *Parker v. Flook*.[33] The claim in *Flook* was for a new method of updating an alarm limit for use in the catalytic conversion of hydrocarbons. The Court noted that

> [d]uring 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.[34]

The patent claims were for a three-step method of updating an alarm limit consisting of: (1) measuring the initial value of the variable (e.g., temperature), (2) using a mathematical algorithm to calculate an updated alarm limit, and (3) adjusting the alarm limit to the updated value.

The Court held that the claim in *Flook* was not proper subject matter under § 101 of the Patent Act.[35] The Court's analysis relied on the premise that mathematical algorithms should be treated as "basic tools of scientific and technological work" and "treated as though it were a familiar part of the prior art."[36] For the Court, the claim amounted to an attempt to patent the algorithm, something one cannot do, just as one could not patent a phenomenon of nature.[37] The Court reiterated the idea that one cannot patent scientific truths or phenomenon of nature; one can only patent inventions which involve applications of such things.[38] The reason is that such things, even though not known to humans before, have always existed.[39]

The applicant in *Flook* tried to distinguish *Benson* on the ground that the claim involved not simply a mathematical algorithm, but also involved the additional step

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31. *See id.* at 71.
32. *See id.*
33. 437 U.S. 584 (1978). Unless otherwise stated, the facts that follow are paraphrased from *Flook*, 437 U.S. at 585-86, and refer to this citation.
34. *Id.* at 585.
35. *See id.* at 594-95.
36. *See id.* at 591-92.
37. *See id.* at 593.
38. *See id.* at 591 (quoting from Mackay Radio & Tel. Co. v. Radio Corp. of Am., 306 U.S. 86, 94 (1939) ("While a scientific truth, or the mathematical expression of it, is not patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be."), and Funk Bros. Seed Co. v. Kalo 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. If there is to be invention from such a discovery, it must come from the application of the law of nature to a new and useful end.")).
39. *See id.* at 593 n.15.

of updating the alarm limit.[40] The Court disagreed, stating that simply adding "post-solution" activity would *not always* be sufficient to convert unpatentable subject matter into patentable subject matter.[41] The post-solution activity in the *Flook* claim was not enough to bring the claim into patentable subject matter.

The applicant also tried to distinguish *Benson* on the ground that the claim did not wholly pre-empt the mathematical algorithm involved, because the algorithm could be used outside of the petrochemical and oil-refining industries.[42] The Court implicitly held that a field-of-use restriction recited in the preamble to the patent claims was insufficient to save the claim.[43]

Three justices dissented in *Flook*, arguing that the fact that one part of the method (i.e., the mathematical algorithm) might not be patentable subject matter does not mean that the entire process should fail the subject matter test.[44] The dissenting justices accepted the premise that mathematical formula and algorithms were not patentable subject matter, but argued that the claims were not claiming a patent on the algorithm. Instead, according to the dissent, the claims used the algorithm as one step in a method, which was proper subject matter.[45]

We learn from *Flook* that, although the claim was for a "process" in the ordinary sense of the word, this is not the kind of "process" meant by the Patent Act. As the Court wrote, "[t]he plain language of § 101 does not answer the question."[46] A purely literal reading of § 101 is not possible. This tells us that the word "process" is a term of art.

Flook also shows that mathematical algorithms are to be treated the same as unpatentable laws of nature or abstract principles.

The last of the Supreme Court cases to confront the issue of whether computer-related inventions qualify as patentable subject matter was *Diamond v. Diehr*.[47] The claimed invention in *Diehr* was a process for molding raw, uncured, synthetic rubber into cured molded products. The process included constantly monitoring the temperature of the mold, repetitively calculating the proper cure time using the temperature, and opening the mold automatically when the cure time indicated that the synthetic rubber was cured. The claim involved the use of a well-known mathematical equation and the use of a computer to calculate the cure time. In a 5-4 decision, the Court held that the process claimed was proper subject matter under § 101, notwithstanding the fact that the claim included calculations using a mathematical formula.[48]

The Court framed the issue by saying that "claims must be considered as a whole."[49] They contrasted this approach to that of the dissent, which dissected the

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40. *See id.* at 593.
41. *See id.* at 590.
42. *See id.*
43. *See id.*
44. *See id.* at 598-600 (Stewart, J., dissenting).
45. *See id.* at 598 (Stewart, J., dissenting).
46. *Id.* at 588.
47. 450 U.S. 175 (1981). Unless otherwise stated, the facts that follow are paraphrased from *Diehr*, 450 U.S. at 177-81, and refer to this citation.
48. *See id.* at 184.
49. *Id.* at 188.

claims into old and new elements, looking for that which was the newly invented portion of the claim.[50] The majority noted that a process claim to a combination of steps may be patented even though all of the constituents were well known.[51]

The Court's analysis began by looking at the text of the statute and stated that "[u]nless otherwise defined, 'words will be interpreted as taking their ordinary, contemporary, common meaning.'"[52] The issue involved the meaning of the word "process" as used in the Patent Act, and the Court concluded from the Committee Reports accompanying the 1952 Act that "Congress intended statutory subject matter to 'include anything under the sun that is made by man.'"[53]

The Court in *Diehr* reiterated its view in *Benson* that "[t]ransformation and reduction of an article 'to a different state or thing' is the clue to the patentability of a process claim that does not include particular machines."[54] Given this definition, the majority of the Court had little difficulty finding that a process for transforming uncured rubber into cured rubber products falls within the § 101 category of being a "process."[55]

The *Diehr* Court explained *Benson* and *Flook* as standing for the long-established principles that laws of nature, natural phenomena, and abstract ideas are not patentable. According to *Diehr, Benson* held that a mathematical formula or mathematical algorithm "is like a law of nature, which cannot be the subject of a patent."[56] According to *Diehr,* the respondent in *Flook* sought to patent a mathematical formula for computing an alarm limit, i.e., for computing a number.[57]

The Court in *Diehr* emphasized that "a claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula, computer program, or digital computer."[58] The application of laws of nature or mathematical formulae to known structures or processes can qualify for patent protection. The mathematical equation used in the *Diehr* process would not be patentable subject matter by itself, 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."[59]

The *Diehr* dissenters asserted, as one of their arguments, that the major claims in *Diehr* were legally indistinguishable from those in *Flook.*[60] Both cases involve repetitively calculating updated numbers: in *Flook,* the numbers were new alarm limits; in *Diehr,* they were new cure times. Both cases involve field of use restrictions: in *Flook,* the invention dealt with catalytic conversion of hydrocarbons; in *Diehr,* the invention dealt with curing rubber. Both cases involve post-solution

50. *See id.* at 192-93 & n.15 (referencing Justice Stevens' dissent at 193-220).
51. *See id.* at 192.
52. *See id.* at 182 (quoting Perrin v. United States, 444 U.S. 37 (1979)).
53. *See id.* at 182 (quoting S. REP. NO. 82-1979, at 5 (1952) and H.R. REP. NO. 82-1923, at 6 (1952)).
54. *Id.* at 184 (quoting Gottschalk v. Benson, 409 U.S. 63, 70 (1972)).
55. *See id.*
56. *See id.* at 185-86.
57. *See id.* at 186.
58. *Id.* at 187.
59. *Id.* at 188.
60. *See id.* at 209-210 (Stevens, J., dissenting).

activity: in *Flook*, it involved changing an alarm limit; in *Diehr*, it involved opening the mold.[61]

Whether or not *Diehr* is distinguishable from *Flook*, *Diehr* was an important case. For many attorneys, it represented a green-light from the Court, indicating that patent claims that included computer programs and mathematical algorithms could be patentable subject matter. Because the earlier Supreme Court cases—*Benson* and *Flook*—had held that the claims in those cases were not patentable subject matter, this issue had remained in doubt until *Diehr*.

Importantly, *Diehr* enunciated the test for patentable subject matter as requiring an examination of the "claims as a whole."[62] The Court said that one should not dissect claims into old and new elements searching for something novel; novelty can be found, for example, in a new combination of well-known elements.[63] It applied this test to find that a claim for a process for molding rubber products was patentable subject matter, even though it included mathematical calculations as part of the claim.[64]

Unfortunately, the Court emphasized that the analysis should begin by looking at the language of § 101 and that words should be given their "'ordinary, contemporary, common meaning'" unless otherwise defined.[65] The Court also quoted the congressional committee statement indicating that statutory subject matter should "include anything under the sun that is made by man."[66]

These broad statements have done more harm than good. A moment's thought will show that neither can be taken at face value. First, *Benson* already showed us that the words of § 101 cannot be taken in their "ordinary, contemporary, common meaning."[67] The claim in *Benson* was a "process" in the common meaning of the term, yet the Court held that it was not proper subject matter.[68] This indicates that the terms in § 101 are terms of art and it is unfortunate that the *Diehr* decision suggests otherwise.[69]

As to the congressional statement, copyrighted works (e.g., books, paintings, sculpture, and music) are "made by man," but that does not make them patentable subject matter. Congress surely had a more limited meaning when it talked about "anything under the sun that is made by man." Later in this article, we return to the idea that the words of § 101 are terms of art in order to better gauge their meaning and interpret the congressional statement.

Since 1981, the Supreme Court has not again addressed the issue of when computer-related and mathematical algorithm-related inventions can be patentable subject matter. Instead, this task has fallen on the lower courts, particularly the

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61. Some people believe that *Diehr* effectively overruled *Flook* because the facts of *Flook* and *Diehr* seem so similar. *See infra* notes 293-94. Because the *Diehr* decision distinguishes *Flook* rather than expressly overruling it, this article proceeds on the assumption that *Flook* remains good law.

62. *See generally Diehr*, 450 U.S. 175 (1981).

63. *See id.* at 188.

64. *See id.*

65. *See id.* at 182 (quoting Perrin v. United States, 444 U.S. 37, 42 (1979)).

66. *Id.* (quoting S. REP. NO. 82-1979, at 5 (1952) and H.R. REP. NO. 82-1923, at 6 (1952)).

67. *See supra* text accompanying note 32.

68. *See id.*

69. One can multiply the examples. Paperback books with novels and CDs with music are articles of "manufacture," but they are not patentable subject matter. *See supra* note 7 and accompanying text.

C.C.P.A. and its successor, the Federal Circuit. As we shall see, resolving these issues has been difficult.

III. THE C.C.P.A. & FEDERAL CIRCUIT DEVELOP TESTS, BUT APPLY THEM INCONSISTENTLY

While the Supreme Court was developing its theory as to what inventions were proper subject matter for a patent, the lower courts were developing their own theory. The Federal Circuit initially adopted the precedents of the C.C.P.A.[70] Since the creation of the Federal Circuit Court of Appeals in 1982, it has developed and refined its views as to the proper subject matter for patents.[71] Unfortunately, the court has been unable to apply its tests in a consistent manner.

A. The Freeman-Walter-Abele Test

In the years following *Benson*, the C.C.P.A. recognized that the Supreme Court's holding in that case—that the algorithm for converting binary coded decimal to binary was not proper subject matter—was not a barrier to the patentability of algorithms in general; rather, it was only a barrier to the patenting of some *mathematical* algorithms.[72]

The reason for this conclusion is straightforward. An algorithm is a "step-by-step procedure for solving a problem or accomplishing some end."[73] Thus, every process involves an "algorithm." Section 101 expressly states that processes can be patentable subject matter.[74] If *Benson* established that no algorithm could be patentable, it would have written process patents out of the statute; something that the Court surely did not intend to do. Therefore, from an early stage, the C.C.P.A. limited the holding of *Benson* to mathematical algorithms.

The C.C.P.A. also developed a two-step methodology for deciding whether a patent claim on a process involved unpatentable subject matter. The methodology is often called the *Freeman-Walter-Abele* test, named after the three cases that developed and refined the test.[75] The first step is to determine whether a mathematical algorithm or formula is recited directly or indirectly in the patent claim.[76] If a mathematical formula or algorithm is recited, then the second step is applied. The second step is to determine whether the claimed invention is directed to that formula

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70. *See supra* note 10.

71. There are many reported cases dealing with patentable subject matter relating to mathematical algorithms and computer-related inventions. *See, e.g.*, State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368 (Fed. Cir. 1998); *In re* Trovato, 42 F.3d 1376 (Fed. Cir. 1994), *withdrawn on reh'g en banc*, 60 F.3d 807 (Fed. Cir. 1995); *In re* Lowry, 32 F.3d 1579 (Fed. Cir. 1994); *In re* Warmerdam, 33 F.3d 1354 (Fed. Cir. 1994); *In re* Alappat, 33 F.3d 1526 (Fed. Cir. 1994); *In re* Schrader, 22 F.3d 290 (Fed. Cir. 1994); Arrhythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992); *In re* Iwahashi, 888 F.2d 1370 (Fed. Cir. 1989); *In re* Grams, 888 F.2d 835 (Fed. Cir. 1989); *In re* Meyer, 688 F.2d 789 (C.C.P.A. 1982); *In re* Abele, 684 F.2d 902 (C.C.P.A. 1982); *In re* Walter, 618 F.2d 758 (C.C.P.A. 1980); *In re* Maucorps, 609 F.2d 481 (C.C.P.A. 1979); *In re* Freeman, 573 F.2d 1237 (C.C.P.A. 1978); *In re* Chatfield, 545 F.2d 152 (C.C.P.A. 1976).

72. *See, e.g.*, *In re* Chatfield, 545 F.2d 152 (C.C.P.A. 1976).

73. *Id.* at 156 n.5.

74. *See* 35 U.S.C. § 101 (1994); *see also supra* note 4 (quoting § 101 in full).

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

76. *See Abele*, 684 F.2d at 905.

or algorithm itself.[77] If it is, then the claim is nonstatutory.[78] On the other hand, if the mathematical formula or algorithm is applied to, or limited by, physical elements or process steps, then the claim is statutory under § 101.[79]

The examples of *Benson* and *Diehr* may make this methodology more clear. *Benson* involved a claim for converting binary coded decimal numbers into binary numbers.[80] This is a mathematical algorithm, thus satisfying the first step of the *Freeman-Walter-Abele* test. Moreover, the claim is directed to that algorithm itself; there are no physical elements or processes to which the algorithm applies. Thus, the claim in *Benson* is nonstatutory under this test.

Diehr involved a claim for a process for molding rubber products.[81] The claim included the use of a mathematical formula for calculating the cure time, thus, satisfying the first step of the *Freeman-Walter-Abele* test. However, the claim was not simply a claim for the mathematical formula itself, as the formula was used in the physical process of molding rubber.[82] Thus, the claim in *Diehr* is statutory under this test.

1. *Freeman-Walter-Abele*—Version One

Although the Federal Circuit has adopted the *Freeman-Walter-Abele* test, the test has been difficult to apply.[83] For example, the court reached opposite conclusions in two cases having extremely similar claims for new processes.[84] *In re Grams*[85] involved claims for a method of diagnosing an abnormal condition in an individual. The method requires (1) the gathering of data about an individual through clinical laboratory tests, and (2) analyzing that data to determine whether it indicates any abnormality and, if so, what kind of abnormality. The analysis involved comparing the gathered data with predetermined data showing normal conditions for the various parameters tested and filtering the data to focus on only the portions of the gathered data responsible for the abnormal condition. The specification in the patent application describes the method as one to be done using a computer program.

Applying the *Freeman-Walter-Abele* test, the court found that the claim included a mathematical algorithm and that the only physical process step was that of performing clinical tests to gather data for the algorithm.[86] The addition of a data gathering step was not sufficient to find the method statutory.[87] In essence, the court

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77. *See id.*
78. *See id.*
79. *See id.*
80. *See* Gottschalk v. Benson, 409 U.S. 63 (1972); *see also supra* notes 18-19 and accompanying text.
81. *See* Diamond v. Diehr, 450 U.S. 175 (1981); *see also supra* note 47 and accompanying text.
82. *See* Diehr, 450 U.S. at 177, 191, 192-93; *see also supra* notes 47-48 and accompanying text.
83. The Federal Circuit has also adopted other approaches to determine whether these kinds of claims represent patentable subject matter, and at times has questioned the validity of the *Freeman-Walter-Abele* test. *See infra* Parts III.A.4 and III.B.
84. *See* Arrhythmia Research Technology, Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992); *In re* Grams, 888 F.2d 835 (Fed. Cir. 1989).
85. 888 F.2d 835 (Fed. Cir. 1989). Unless otherwise stated, the facts that follow are paraphrased from *In re Grams*, 888 F.2d at 836-37, and refer to this citation.
86. *See Grams*, 888 F.2d at 839-40.
87. *See id.* at 839. The court quoted the following from *In re Sarkar*, 588 F.2d 1330, 1335 (C.C.P.A. 1978), as giving the reason why a data gathering step is insufficient:

found that the patent claim was for the mathematical algorithm itself, therefore, rendering the patent claim unpatentable.[88]

2. *Freeman-Walter-Abele*—Version Two

Three years later, in *Arrhythmia Research Technology, Inc. v. Corazonix*,[89] the Federal Circuit found a very similar method claim to be within the scope of patentable subject matter.[90] *Arrhythmia* involved claims for a method and apparatus to determine whether a patient was at risk for ventricular tachycardia, a type of heart arrhythmia which can strike heart attack victims. The method claim requires 1) the gathering of electrocardiograph data about an individual and 2) analyzing that data to determine whether it indicates a risk of ventricular tachycardia. The analysis involved converting the data from an analog form to a digital form, filtering the data so as to focus on only one portion of the data, computing the value of the amplitude of the filtered data, and comparing that value to a predetermined level.

The Federal Circuit court found that the claim was drawn to statutory subject matter.[91] The court assumed, without discussion, that the method claim included a mathematical algorithm.[92] It found, however, that the claim did not wholly preempt the algorithm.[93] The process claimed was a "method for analyzing electrocardiograph signals to determine the presence or absence of a predetermined level of high-frequency energy in the late QRS signal," and the court noted that this limitation "is not ignored."[94] The court determined that "[t]hese input signals are not abstractions; they are related to the patient's heart function."[95] The results of the mathematical calculations in *Arrhythmia* indicated whether the patient was at a high risk for ventricular tachycardia. This "resultant output is not an abstract number, but is a signal related to the patient's heart activity."[96]

The *Arrhythmia* court then noted that the "claimed steps of 'converting,' 'applying,' 'determining,' and 'comparing' are physical process steps that transform one physical, electrical signal into another. The view that "there is nothing necessarily physical about 'signals' is incorrect."[97] According to the court's

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> No mathematical equation can be used, as a practical matter, without establishing and substituting values for the variables expressed therein. Substitution of values dictated by the formula has thus been viewed as a form of mathematical step. If the steps of gathering and substituting values were alone sufficient, every mathematical equation, formula, or algorithm having any practical use would be per se subject to patenting as a "process" under § 101. Consideration of whether the substitution of specific values is enough to convert the disembodied ideas present in the formula into an embodiment of those ideas, or into an application of the formula, is foreclosed by the current state of the law.

Id.

88. *See Grams*, 888 F.2d at 841.

89. 958 F.2d 1053 (Fed. Cir. 1992). Unless otherwise stated, the facts that follow are paraphrased from *Arrhythmia*, 958 F.2d at 1054-56, and refer to this citation.

90. *See id.* at 1054.

91. *See id.* at 1058-59.

92. *See id.* at 1055. This satisfies the first step in the *Freeman-Walter-Abele* methodology.

93. *See id.* at 1059.

94. *See id.*

95. *Id.*

96. *Id.*

97. *Id.* at 1059 (citing *In re* Taner, 681 F.2d 787, 790 (C.C.P.A. 1982)).

analysis, the claimed method was statutory, because it "comprise[d] an otherwise statutory process whose mathematical procedures are applied to physical process steps."[98]

3. Evaluation of the *Freeman-Walter-Abele* Test

It is difficult to understand why *Arrhythmia* reaches a different result than that reached in *Grams*. The method claimed in *Arrhythmia* looks virtually identical to the claim rejected in *Grams*:[99] Both claims were for methods of diagnosing abnormal medical conditions in patients; both involved data-gathering steps; both involved numerical processing of that data to determine whether the patient has an abnormal condition; both involved the use of a computer; and both methods provided useful information to doctors.

Arrhythmia stated that changing one electrical signal into another is physical,[100] but the computer operations in *Grams* would equally have involved such changes. *Grams*, however, said that such a step did not qualify as an appropriate physical process under the *Freeman-Walter-Abele* test.[101] As a result, the cases are inconsistent on that point.

Arrhythmia stated that the result of the process was not something "abstract" but was an indication that the patient was at a high risk for ventricular tachycardia.[102] But, of course, the result of the process in *Grams* was an indication of an abnormal condition in a patient, and, hence, equally abstract or non-abstract.[103]

Furthermore, both processes involve gathering data about an individual. The *Arrhythmia* court found that the electrocardiograph signal data is not to be ignored in determining whether the claim was for patentable subject matter.[104] In contrast, the *Grams* court said that the clinical laboratory data gathering steps are virtually irrelevant.[105]

In addition to the similarities mentioned above, it is significant to note that both cases were from the Federal Circuit and both cases applied the *Freeman-Walter-Abele* test. There is no apparent reason why the court should have reached opposite conclusions in the two cases.

4. Applicability of the *Freeman-Walter-Abele* Test Is Questioned

Although the *Freeman-Walter-Abele* test was created and has been used by the C.C.P.A. and the Federal Circuit, its current vitality has been called into question by more recent decisions. One such case, *In re Alappat*,[106] was a 1994 case which used a different test. In *Alappat*, the Federal Circuit stated:

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98. *See id.*

99. *Compare Arrhythmia*, 958 F.2d at 1054-56, *and* discussion *supra* Part III.A.2., *with In re* Grams, 888 F.2d 835, 836-37 (Fed. Cir. 1989), *and* discussion *supra* Part III.A.1.

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

101. *See Grams*, 888 F.2d at 840.

102. *See Arrhythmia*, 958 F.2d at 1054.

103. *See Grams*, 888 F.2d at 836.

104. *See Arrhythmia*, 958 F.2d at 1055.

105. *See Grams*, 888 F.2d at 840.

106. 33 F.3d 1526 (Fed. Cir. 1994); *cf. In re* Warmerdam, 33 F.3d 1354 (Fed. Cir. 1994) (suggesting that it might be better to simply return to the statutory language and the guidance of Supreme Court cases).

> It is thus not necessary to determine whether a claim contains, as merely a part of the whole, any mathematical subject matter which standing alone would not be entitled to patent protection. Indeed, because the dispositive inquiry is whether the claim *as a whole* is directed to statutory subject matter, it is irrelevant that a claim may contain, as a part of the whole, subject matter which would not be patentable by itself.[107]

While this statement appears to be a rejection of the *Freeman-Walter-Abele* test,[108] the Federal Circuit observed in a footnote that attempting to identify whether any part of a claim recites mathematical subject matter was "not an improper analysis" and might be "helpful under some circumstances."[109] These conflicting messages within one opinion do nothing to clarify the analysis which lower courts are supposed to use in determining patentable subject matter.

The Federal Circuit's most recent case, *State Street Bank & Trust Co. v. Signature Financial Group, Inc.*,[110] also appears to reject the *Freeman-Walter-Abele* test. The court said that the "district court erred by applying the *Freeman-Walter-Abele* test to determine whether the claimed subject matter was an unpatentable abstract idea. . . . After *Diehr* and *Chakrabarty*, the *Freeman-Walter-Abele* test has little, if any, applicability to determine the presence of statutory subject matter."[111] While these statements strongly suggest that the *Freeman-Walter-Abele* test is no longer applicable, they seem to leave open the possibility for the test's use, suggesting that the test may not be completely dead.

B. The Claims-as-a-Whole Test

Another test used by the Federal Circuit draws on language from *Diehr* which states that the inquiry requires an examination of the "claim as a whole."[112] It fares no better, however, than the *Freeman-Walter-Abele* test in providing clear and workable methods for determining whether a claim falls within patentable subject matter.

In re Alappat[113] was a six-to-two en banc decision (on the merits) by the Federal Circuit, in which both the majority and dissent used the Claims-as-a-Whole test.[114] The procedural posture of the case was such that not all members of the court addressed the § 101 issue, but the eight members of the court that did address this issue produced strikingly different views of how the Claims-as-a-Whole test should be applied.

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107. *Id.* at 1543.

108. The idea that the analysis should focus on the "claim as a whole" was taken from *Diehr*. *See supra* text accompanying note 49.

109. *See Alappat*, 33 F.3d at 1543 n.21.

110. 149 F.3d 1368 (Fed. Cir. 1998).

111. *Id.* at 1373-74. The court also noted that the test has been the source of much confusion. *See id.* at 1374 n.5.

112. *See* 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*.") (emphasis added).

113. 33 F.3d 1526 (Fed. Cir. 1994) (en banc). Unless otherwise stated, the facts that follow are paraphrased from *Alappat*, 33 F.3d at 1530-40, and refer to this citation.

114. *Compare id.* at 1543 (majority opinion) *with id.* at 1582-83 (Archer, C.J. dissenting).

1. Claims-as-a-Whole Test—Version One

In a sense, the invention in *Alappat* was almost a purely mathematical calculation invention. It was drafted, however, as a claim to an apparatus which would do the calculation. For the majority, this fact by itself was almost determinative in reaching the conclusion that the claim was for statutory subject matter.[115] For the dissent, the crucial fact was that the claim covered mathematical calculations.[116] The dissent felt that one should not be able to evade the proscription on patenting mathematical algorithms by drafting claims in apparatus form.[117]

The invention in *Alappat* involved a way to generate a smooth waveform on the screen of an oscilloscope. The screen is at the front of a cathode-ray tube (CRT) and is made up of an array (or raster) of pixels arranged in vertical columns and horizontal rows. To produce an image on the screen, appropriate sets of these pixels are illuminated. Prior to this invention, a waveform displayed on the screen might appear jagged or appear to oscillate. This effect is called "aliasing."

The *Alappat* invention was an anti-aliasing system which involved varying the illumination intensity of the pixels in order to make the waveform display appear to be smooth and continuous. In particular, the invention was one for calculating the various intensities for each of the pixels in the display.[118]

The principal claim was drafted in apparatus form. It was a claim for a rasterizer, an apparatus which was made up of four elements, drafted in "means for" language. As described by the court, the four elements were: two arithmetic logic circuits, a pair of barrel shifters, and a read-only memory, or, in each case, their equivalents. The elements were required to perform mathematical calculations and to put out the resulting data.

The majority found that the claim was for statutory subject matter.[119] The majority's analysis began with the observation that the claim was for a "machine," which is one of the four categories listed as subject matter in § 101.[120] Although perhaps tempted to stop with that short answer to the issue, the majority went on to consider whether the claim might be barred by the "mathematical algorithm" exception.[121]

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115. *See id.* at 1542. The majority emphasized that the claim fell within the literal words of § 101, but they did not rest their decision on this point. *See id.*

116. *See id.* at 1554 (Archer, C.J., dissenting on the merits).

117. *See id.* at 1561-62.

118. It should be noted that the claim was directed solely at the means for doing the mathematical calculations. The claims did not include the waveform that could be generated nor the display screen on which the waveform would be displayed. In other words, while the claims produced numerical representations which could be used to generate an anti-aliased waveform, they did not involve generating the waveform or displaying it.

Recent decisions of the Federal Circuit contain language which suggests that the *Alappat* claims include displaying a waveform on a monitor. *See, e.g.*, State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368, 1373 (Fed. Cir. 1998) ("In *Alappat*, we held that data, transformed by a machine through a series of mathematical calculations to produce a smooth waveform display on a rasterizer monitor . . . ."). Such an interpretation of *Alappat* is incorrect.

119. *See Alappat*, 33 F.3d at 1536.

120. *See id.*

121. *See id.* at 1542. The majority raised the issue of whether this exception even applies to apparatus claims, but provided two reasons for not considering this issue. *See id.* First, the court's own precedent (and perhaps Supreme Court analysis) seemed to suggest that the exception does apply. *See id.* Second, even if the exception applies to apparatus claims, the subject matter in this case did not fall within the exception. *See id.*

The majority interpreted § 101 expansively, noting that "*any*" new and useful process or machine may be patented and that the Supreme Court has stated that § 101 extends to "anything under the sun that is made by man."[122] Acknowledging that the Supreme Court has carved out some exceptions to an overly expansive reading, the court interpreted Supreme Court decisions as stating that there are three categories of subject matter that cannot be patented: laws of nature, natural phenomena, and abstract ideas.[123]

Mathematical algorithms, according to the majority, are not a fourth excluded category.[124] Instead, only some kinds of mathematical subject matter are excluded, such as mathematical subject matter which, "standing alone, represents nothing more than *abstract ideas* until reduced to some type of practical application."[125]

The majority then applied the Claims-as-a-Whole test and proceeded to examine Alappat's claims "to see whether the claimed subject matter *as a whole* is a disembodied mathematical concept, whether categorized as a mathematical formula, mathematical equation, mathematical algorithm, or the like, which in essence represents nothing more than a 'law of nature,' 'natural phenomenon,' or 'abstract idea.'"[126] Although the four claimed means elements are used to transform one set of data into another set of data, the majority found that the claim was not for a disembodied mathematical concept which might be considered as an "abstract idea."[127] Rather, the claim was for "a specific machine to produce a useful, concrete, and tangible result."[128]

The methodology used by the majority in *Alappat* looks very much like that of the *Arrhythmia* court. The *Alappat* court acknowledged that the claim involved numerical calculations, but focused on whether the numbers so calculated had any real-world meaning and whether the calculation was useful.[129]

2. Claims-as-a-Whole Test—Version Two

The dissent's analysis could hardly be more different. The dissent notes that the terms used in § 101—"process," "machine," "manufacture," and "composition of matter"—are terms of art which must be interpreted, not in their literal sense, but in accord with the context of patent law.[130] For example, a claim to a compact disc or piano roll containing a newly discovered song does not become patentable subject matter simply by virtue of being regarded as a "manufacture."[131]

Analyzing the Supreme Court trilogy of *Benson*, *Flook*, and *Diehr*, the dissent found that the posing and solving of a mathematical function is nonstatutory subject

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122. *Id.* at 1542 (quoting Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980)) (emphasis added).
123. *See id.*
124. *See id.* at 1543.
125. *Id.*
126. *Id.* at 1544.
127. *See id.*
128. *Id.*
129. *See id.* at 1542-44.
130. *See id.* at 1553. (Archer, C.J., dissenting on the merits).
131. *See id.* at 1553-54. The dissent also notes that abstract ideas, laws of nature, and natural phenomena are not patentable subject matter, but emphasizes that it is erroneous to characterize non-patentable subject matter as an "exception" to § 101. *See id.* at 1553 n.13. Instead, "[d]efining patentable subject matter is the *raison d'etre* of § 101." *Id.* In this article, we need not be concerned with the label placed on non-patentable subject matter.

matter.[132] It remains nonstatutory even if the mathematics are limited to performance in a computer, the mathematical operations have some application in a specific technology, or the solution of the function "represents" something of physical or technological relevance.[133]

The dissent, like the majority, examined the claims "as a whole."[134] For the dissent, the invention in this case is the rasterizer, which is an arrangement of circuitry elements for converting data into other data.[135] The rasterizer begins with two numbers and ends up with an array of numbers, produced by the use of a mathematical process.[136] The dissent found that this dooms the claim to the category of nonstatutory subject matter. The invention is simply the mathematical operation and the fact that it is claimed by means of the apparatus which will do the calculation is simply a "charade."[137]

3. Evaluation of the Claims-as-a-Whole Test

The striking thing about the majority and dissenting opinions in *Alappat* is that they are both compelling. The majority is clearly correct that the claim is for a machine, which is, therefore, literally within the statutory language of § 101. The majority is also correct that the mathematical calculations in this case are put to practical use in creating a smooth waveform on the screen of an oscilloscope. On the other hand, the dissent is equally correct in saying that the invention is simply for a machine which converts one set of numbers into another set of numbers. The dissent is also correct in observing that the majority analysis would presumably allow a patent for a compact disc or piano roll containing a newly discovered song.

Put simply, looking at the Claims-as-a-Whole does not seem to be a touchstone for determining whether a mathematical algorithm-related claim or a computer-related claim passes the test for being statutory subject matter.

IV. A DISTRICT COURT TRIES TO APPLY THE TESTS AND IS REVERSED

The *Freeman-Walter-Abele* and Claims-as-a-Whole tests do not provide clear methods of analysis. Different judges on the Federal Circuit reach inconsistent results when they use these tests. It is not surprising that lower courts would also have difficulty applying these tests.

While there are almost no district court decisions dealing with whether mathematical algorithm-related patents or computer-related patents are patentable subject matter, in 1996 the district court in Massachusetts addressed this issue in *State Street Bank & Trust Co. v. Signature Financial Group, Inc.*[138] Despite

132. *See id.* at 1557.
133. *See id.*
134. *Compare id.* (dissenting view of Archer, C.J.) *with id.* at 1543 (majority view).
135. *See id.* at 1563.
136. *See supra* note 118 and accompanying text.
137. *See Alappat*, 33 F.3d at 1564.
138. 927 F. Supp. 502 (D. Mass. 1996), *rev'd*, 149 F.3d 1368 (Fed. Cir. 1998).

applying the *Freeman-Walter-Abele* test in good faith, the district court was reversed in 1998 by a panel of the Federal Circuit.[139]

A. *The District Court Decision in State Street*

The invention claimed in *State Street.*[140] is a data processing system for a particular kind of investment vehicle—a so-called "Hub and Spoke Financial Services Configuration." Signature Financial Group ("Signature") acts as an administrator and accounting agent for mutual funds. In a "Hub and Spoke" arrangement, a family of mutual funds (the "Spokes") pools its assets into a partnership (the "Hub"). This kind of arrangement provides for economies of scale with regard to the costs of fund administration and has beneficial tax consequences.

Signature obtained a patent on the data processing system needed to administer this kind of "Hub and Spoke" arrangement. The accounting requires a daily allocation of income, capital gains, and expenses or investment losses, as well as keeping track of changes in assets as individual investors add or withdraw funds from their accounts and as the market value of the assets in the funds fluctuate.

Signature's patent was drafted in means-plus-function language as an apparatus.[141] The "means-for" language of the claims is interpreted to refer to devices or apparatus disclosed in the specification. In this case, the specification disclosed that the patent relates to a personal computer and associated computer programs.

In a nutshell, the patent is for the computer and computer programs which perform the accounting functions of a "Hub and Spoke" family of mutual funds. These accounting functions are mathematical calculations. The programs take a set of mathematical data and generate other mathematical data. The resulting data represent the increases or decreases in the assets of the partnership and the distinct funds in the partnership; the daily income, expenses, gains and losses for the partnership and each of the funds; and the year-end income, expenses, and capital gains or losses for the partnership and each of the funds in the partnership.

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139. *See* 149 F.3d 1368 (Fed. Cir. 1998).

140. 927 F. Supp. 502 (D. Mass. 1996). Unless otherwise noted, the facts that follow are paraphrased from the district court decision, *State Street*, 927 F. Supp. at 504-06, and refer to this citation.

141. Claim one reads:

> (1) A data processing system for managing a financial services configuration of a portfolio established as a partnership, each partner being one of a plurality of funds, comprising:
>
> a) computer processor means for processing data;
>
> b) storage means for storing data on a storage medium;
>
> c) first means for initializing the storage medium;
>
> d) second means for processing data regarding assets in the portfolio and each of the funds from a previous day and data regarding increases or decreases in each of the funds, assets and for allocating the percentage share that each fund holds in the portfolio;
>
> e) third means for processing data regarding daily incremental income, expenses, and net realized gain or loss for the portfolio and for allocating such data among each fund;
>
> f) fourth means for processing data regarding daily net unrealized gain or loss for the portfolio and for allocating such data among each fund; and
>
> g) fifth means for processing data regarding aggregate year-end income, expenses, and capital gain or loss for the portfolio and each of the funds.

State Street Bank & Trust Co. ("State Street") also administers and acts as an accounting agent for mutual funds. State Street brought a declaratory judgment action against Signature seeking to have the patent declared invalid.

The district court held the patent invalid. It began its analysis by reviewing the statutory language, the trilogy of Supreme Court decisions, the *Freeman-Walter-Abele* test, other Federal Circuit precedent, and the Guidelines issued by the Patent and Trademark Office ("PTO").[142] The district court used the *Freeman-Walter-Abele* test or a close variant thereof, referring to it as "the best clue to patentability."[143]

The first step in the district court's analysis was to determine whether the claims recited, directly or indirectly, a mathematical algorithm. The claims were "means-for" claims, meaning that they were for devices or apparatus. Even so, the court found that the apparatus was designed to solve a mathematical problem—to make the accounting calculations necessary in order to administer the "Hub and Spoke" mutual fund system.[144]

The second step in the analysis was to determine whether the claimed invention was applied or limited by physical elements or process steps. The court looked to whether the invention transforms or reduces subject matter to a different state or thing—i.e., whether there has been a physical transformation of something.

The court concluded that there was no physical transformation.[145] The invention merely changed one set of numbers into another. The court distinguished *Arrhythmia* by saying that the patent in that case measured physical objects or phenomena (i.e., electrocardiograph signals), and distinguished *Alappat* by saying that the patent in that case physically converted data into a different form (i.e., into the display of a smooth wave-form).[146]

The district court reinforced its decision by applying the so-called "business methods exception" and it reached the same conclusion.[147] The court noted that methods of doing business and business plans are not patentable, citing to a number of patent treatises[148] and cases.[149] The court further noted that allowing a patent on this business method would mean that any other company seeking to implement a "Hub and Spoke" configuration would be required to obtain permission from Signature.[150] According to the court, "patenting an accounting system necessary to carry on a certain type of business is tantamount to a patent on the business itself."[151] This should not be allowed because this would be like a patent on the abstract idea of this kind of business, and abstract ideas are not patentable.

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142. *See State Street*, 927 F. Supp. at 507-12.
143. *See id.* at 511.
144. *See id.* at 513.
145. *See id.* at 514.
146. *See id.*
147. *See id.* at 515.
148. *See id.* (citing 1 DONALD S. CHISUM, PATENTS: A TREATISE ON THE LAW OF PATENTABILITY, VALIDITY AND INFRINGEMENT, § 1.03[5], at 1-75 (1990); 1 ERNEST BANKBRIDGE LIPSCOMB III, WALKER ON PATENTS § 2:17, at 171 (3d ed. 1984); 1 PETER D. ROSENBERG, PATENT LAW FUNDAMENTALS § 6.02[3], at 6-82 (2d ed. 1995)).
149. *See id.* (citing Loew's Drive-In Theatres, Inc. v. Park-In Theatres, Inc., 174 F.2d 547, 552 (1st Cir. 1949); Hotel Security Checking Co. v. Lorraine Co., 160 F. 467, 469 (2d Cir. 1908)).
150. *See id.* at 516.
151. *See id.*

B. *The Federal Circuit Reverses*

A draft of this article was prepared before the Federal Circuit decided *State Street*.[152] In that draft, I had written:

> One can readily predict that the Federal Circuit will either affirm or reverse this case depending upon which line of cases and mode of analysis the particular panel chooses to follow.
>
> If the Federal Circuit panel follows the reasoning of *Grams* or of the *Alappat* dissent, the panel will affirm. It will agree that the patent involves nothing more than mathematical calculations and that drafting the claims so that the patent claims an apparatus for doing these calculations cannot change the outcome.
>
> On the other hand, if the Federal Circuit panel follows the reasoning of *Arrhythmia* or of the *Alappat* majority, it will reverse. It will note that the claims are for an apparatus, which on its face is one of the categories of patentable subject matter. It will continue by noting that these are not purely abstract mathematical calculations. Instead, these calculations represent physical phenomena—assets held by a partnership and the funds in the partnership. The calculations involve physical transformations of one physical set of data into another set of data. Moreover, this claim does not wholly preempt the mathematical algorithm, because it is limited to the specific apparatus disclosed in the specifications. The claim, as a whole, is not to a disembodied mathematical formula which represents a law of nature, natural phenomenon, or abstract idea. Rather, it is to a specific device.
>
> At this place in this article, my point is not to say that one or another of these panels would be right or wrong. My point is that either result is possible given the methods of analysis that are presently being used. In fact, it is likely that the result will be determined more by the panel which is drawn than by any principled analysis.[153]

Now that the decision has been issued, we see that the panel chose to follow the method of analysis done by the majority in *Alappat*. Therefore, the panel reversed the district court. The court's logic was virtually identical to that predicted for this mode of analysis.

The court indicated that the claims were directed to a "machine," one of the categories of statutory subject matter allowed under § 101.[154] Following the analysis in *Alappat*, the court stated that Congress intended for § 101 to be read without any restrictions, noting that it states that "*any*" new and useful process or machine may be patented and that the Supreme Court has stated that § 101 extends to "anything under the sun that is made by man."[155]

Acknowledging that the Supreme Court has carved out some exceptions to an overly expansive reading, the court interpreted Supreme Court decisions as stating that there are three categories of subject matter that cannot be patented: laws of

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152. 149 F.3d 1368 (Fed. Cir. 1998), *cert. denied*, 119 S. Ct. 851 (1999).

153. *See infra* note 289 and accompanying text.

154. The "means-for" language of the claims was interpreted to refer to devices or apparatus (and their equivalents) disclosed in the specification. *See State Street*, 149 F.3d at 1376. In this case, the specification disclosed that the patent related to a personal computer, a data disk, and four arithmetic logic circuits.

155. *State Street*, 149 F.3d at 1373.

nature, natural phenomena, and abstract ideas.[156] The court further stated that "the [Supreme Court] has held that mathematical algorithms are not patentable subject matter to the extent that they are merely abstract ideas."[157]

The key to the opinion is the court's observation that "[u]npatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not 'useful.' From a practical standpoint, this means that to be patentable an algorithm must be applied in a 'useful' way."[158]

The court held that the mathematical calculations in the patent claims are transformations of data, representing discrete dollar amounts.[159] Such transformations are a practical application of the mathematical algorithm and are "useful." This means that the claims are proper statutory subject matter.

In commenting on the district court's analysis, the panel rejected use of the *Freeman-Walter-Abele* test and, instead, used the Claims-as-a-Whole test.[160] The panel also stated that the "business method" exception to patentable subject matter was no longer a valid doctrine.[161]

C. *Comments on the Federal Circuit Decision*

The method of analysis used by this panel was not surprising. What was unknown before the decision issued was whether the court would use this mode of analysis or the one used by other judges of the Federal Circuit.

Unfortunately, this decision breaks no new ground in its mode of analysis and does little to clarify the issues involved. It is a straightforward matter to lay out problems with the analysis. They are the same problems pointed out by the dissent in *Alappat*.[162]

First, the *State Street* panel treats § 101 as if it could be read literally and the decision repeats the language from the Committee Reports that "anything under the sun made by man" is patentable subject matter.[163] A little common sense shows that this cannot possibly be true.[164]

Second, the *State Street* decision interprets Supreme Court decisions as saying that there are three classes of non-patentable subject matter—abstract ideas, natural phenomena, and laws of nature—and that mathematical algorithms are excluded

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156. *See id.*
157. *Id.*
158. *Id.*
159. *See id.*
160. *See id.* at 1373-74.
161. *See id.* at 1375. The court noted that neither the Federal Circuit nor the C.C.P.A. ever invoked the business method exception to deem an invention unpatentable. *See id.* Every case in which the business methods doctrine was mentioned was decided on other grounds. *See id.*
162. *See supra* Part III.B.2.
163. *See State Street*, 149 F.3d at 1373 n.3 (citing S. REP. NO. 82-1979 at 5 (1952) and H.R. REP. NO. 82-1923 at 6 (1952)).
164. As the *Alappat* dissent noted, new music on CDs is something new created by man and it is a "manufacture," but it would not be new patentable subject matter. *See In re* Alappat, 33 F.3d 1526, 1553-54 (Fed. Cir. 1994). In addition, Supreme Court cases teach that the word "process" in the statute cannot be given its literal interpretation. *See* Gottschalk v. Benson, 409 U.S. 63 (1972) (holding that a process claim was not patentable subject matter); Parker v. Flook, 437 U.S. 584 (1978) (holding that a process claim was not patentable subject matter); *see also infra* notes 187-96 and accompanying text.

only to the extent that they are abstract ideas. The Supreme Court decisions, however, say quite clearly that mathematical algorithms are non-patentable subject matter.[165]

Third, the *State Street* decision states that "the [Supreme Court] has held that mathematical algorithms are not patentable subject matter to the extent that they are merely abstract ideas."[166] In fact, the Supreme Court went much further than that in *Flook*, stating that mathematical algorithms are "treated as though [they] were a familiar part of the prior art,"[167] indicating that mathematical algorithms are not patentable subject matter whether or not they are abstract ideas and whether or not they have been previously known. Nothing in the Court's later decision in *Diehr* repudiates this idea.[168]

Fourth, the core of the *State Street* opinion is the court's observation that "[u]npatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not 'useful.' From a practical standpoint, this means that to be patentable, an algorithm must be applied in a 'useful' way."[169] The problem with this statement is that it is inconsistent with the Supreme Court's decision in *Flook*.[170] The patent claims in *Flook* were for a method of updating an alarm limit in the catalytic conversion of hydrocarbons.[171] The mathematical algorithms in those claims were certainly applied in a "useful way" in the sense meant by the Federal Circuit in *State Street*, yet the Supreme Court held the *Flook* patent invalid for lack of patentable subject matter.[172]

In short, the *State Street* decision contains a conclusion, but does not contain adequate reasoning. The Federal Circuit makes statements which do not withstand cursory thought and either interprets or ignores Supreme Court decisions in order to justify the result it wants to reach.

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165. *See supra* text accompanying note 36.

166. *State Street*, 149 F.3d at 1373 (Fed. Cir. 1998).

167. Parker v. Flook, 437 U.S. 584, 591-92 (1978).

168. *See* Diamond v. Diehr, 450 U.S. 175 (1981).

169. *State Street*, 149 F.3d at 1373.

170. The Federal Circuit's practice of disregarding *Flook* continues a trend begun more than twenty years ago by the C.C.P.A. that elated this comment from Justice Stevens, in his *Diehr* dissent:

> Although the Court of Customs and Patent Appeals in several post-*Flook* decisions held that program-related inventions were not patentable subject matter under § 101, in general *Flook* was not enthusiastically received by that court. In *In re Bergy*, the majority engaged in an extensive critique of *Flook*, concluding that this Court had erroneously commingled "distinct statutory provisions which are conceptually unrelated." In subsequent cases, the court construed *Flook* as resting on nothing more than the way in which the patent claims had been drafted, and it expressly declined to use the method of claim analysis spelled out in that decision. The Court of Customs and Patent Appeals has taken the position that, if an application is drafted in a way that discloses an entire process as novel, it defines patentable subject matter even if the only novel element that the inventor claims to have discovered is a new computer program. The court interpreted *Flook* in this manner in its opinion in this case. In my judgment, this reading of *Flook*—although entirely consistent with the lower court's expansive approach to § 101 during the past 12 years—trivializes the holding in *Flook*, the principle that underlies *Benson*, and the settled line of authority reviewed in those opinions.

Diehr, 450 U.S. at 204-05 (Stevens, J., dissenting) (citations omitted).

171. *See Flook*, 437 U.S. at 586.

172. *Compare State Street*, 149 F.3d at 1373, *with Flook*, 437 U.S. at 595.

V. THE PATENT AND TRADEMARK OFFICE GUIDELINES

The PTO issued guidelines to its examiners in evaluating patent applications which include computer programs and mathematical algorithms.[173] The charitable view would be that, since the reasoning used in the cases is unhelpful and the cases are not consistent with one another, the PTO, which has to try to follow the law as interpreted by the Supreme Court and the Federal Circuit, was put in an impossible position. Thus, the Guidelines are muddled because they track the inconsistency and the poor reasoning.[174]

A closer reading, however, suggests that the PTO has deliberately adopted a view minimizing, if not quite eliminating, the subject matter inquiry.[175] This means that the Guidelines now err on the side of minimizing the chances of a claimed computer-related or mathematical algorithm-related invention being rejected as lacking patentable subject matter.

The PTO does this by selecting which cases to follow and which language in those cases it wishes to follow. Four examples indicate this tendency. First, the Guidelines quote a Supreme Court decision, stating that "a complete definition of the scope of § 101, reflecting congressional intent, is that any new and useful process, machine, manufacture or composition of matter under the sun that is made by man is the proper subject matter of a patent."[176] As this article will show,[177] the language that patentable subject matter should include "anything under the sun that is made by man" is, rather obviously, overly broad and cannot be taken literally, notwithstanding the use of that phrase by congressional committees and the Supreme Court. By simply accepting this overly broad statement as accurate, the PTO minimizes the inquiry into patentable subject matter, thereby increasing the risk of issuing patents for claims that should be rejected for lack of patentable subject matter.

Second, the PTO furthers this tendency toward minimizing the § 101 subject matter inquiry by its selection of quotations from specific cases. This occurs, for example, in a footnote where the Guidelines cite *Alappat*, stating that the Federal Circuit has adopted what can be characterized as a simple textualist view of § 101: "The plain and unambiguous meaning of § 101 is that any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may be patented if it meets the requirements for patentability set forth in Title 35, such as those found in §§ 102, 103, and 112."[178]

This statement suffers from numerous defects. For example, while *Alappat* was an en banc decision, the entire court did not address the issue of patentable subject

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173. Examination Guidelines for Computer-Related Inventions, 61 Fed. Reg. 7478 (1996) [hereinafter Guidelines].

174. Others have also commented on inconsistencies within the Guidelines. *See, e.g.*, Mark A. Lemley & David W. O'Brien, *Encouraging Software Reuse*, 49 STAN. L. REV. 255, 282-84 (1997).

175. This has been noted by others. *See, e.g.*, Julie E. Cohen, *Reverse Engineering and the Rise of Electronic Vigilantism: Intellectual Property Implications of "Lock-Out" Programs*, 68 S. CAL. L. REV. 1091, 1162 n.369 (1995).

176. Guidelines, 61 Fed. Reg. at 7481 (quoting Diamond v. Chakrabarty, 447 U.S. 303, 308-09 (1980)).

177. *See infra* notes 187-96 and accompanying text.

178. Guidelines, 61 Fed. Reg. at 7481 n.21 (quoting *In re* Alappat, 33 F.3d 1526, 1542 (Fed. Cir. 1994)).

matter because some members felt that the court did not have jurisdiction.[179] One should not, therefore, cite *Alappat* as representing the views of the Federal Circuit. Additionally, some members of the Federal Circuit believe that the terms used in § 101 are terms of art, rather than being "plain and unambiguous."[180] The Guidelines fail to note this discrepancy. Finally, a moment's reflection shows that the terms in § 101 are anything but "plain and unambiguous." This idea is developed below,[181] but the point here is simply that the Guidelines engage in selective quotation in order to produce a certain point of view rather than presenting a fair and unbiased cross-section of relevant views.

Third, the Guidelines cite and seemingly try to follow numerous cases. Interestingly, the Guidelines cite *Arrhythmia* numerous times, but do not cite *Grams* at all. The Guidelines give no indication that *Grams* and *Arrhythmia* are inconsistent and nothing is said about how or why the PTO chose the viewpoint represented by *Arrhythmia* rather than by *Grams*.[182] By its choice of which cases to cite, the PTO indicates that it intends to minimize rejections based on subject matter grounds.

A fourth indication of the same tendency toward minimizing the subject matter inquiry is the fact that, at one point near the beginning of the Guidelines, the subject matter requirement is treated as equivalent with the requirement that the invention be useful.[183] Such an approach would entirely eliminate the issue of patentable subject matter. Fortunately, other portions of the Guidelines don't follow this approach, the PTO presumably recognizing that the Patent Act contains these as distinct requirements.[184]

What implications can we draw from the Guidelines and its approach to patentable subject matter? Initially, it should be observed that nothing in the Guidelines prove that it correctly interprets the law. As observed, the Guidelines have selectively interpreted cases and indicate that the PTO has adopted a certain policy toward the subject matter inquiry.

In addition, we should not conclude that the subject matter issue is moot. Because of the Guidelines, there will be few new cases coming to the Federal Circuit through appeals from the patent examination process in the PTO. Instead, cases involving patentable subject matter for computer-related and mathematical algorithm-related inventions will have to be raised in infringement or declaratory judgment actions. *State Street*[185] is one such case. The subject matter issue remains a very real issue, but it will now be raised primarily in contested proceedings rather

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179. *See Alappat*, 33 F.3d at 1530 (identifying five of the eleven members of the en banc court as declining to join the opinion of the court addressing the issue of patentable subject matter (three dissented and two did not reach the issue)).

180. *See id.* at 553 (Archer, C.J., dissenting on the merits).

181. *See infra* notes 187-96 and accompanying text.

182. Other commentators have repeatedly pointed out inconsistencies in the decisions of the courts on this issue and perhaps it is not proper for an administrative agency to tell the courts that its decisions are inconsistent. *See* sources cited *infra* note 289.

183. *See infra* note 307.

184. *See infra* notes 302-07 and accompanying text.

185. 149 F.3d 1368, 1370 (Fed. Cir. 1998), *cert. denied*, 119 S. Ct. 851 (1999).

than in ex parte proceedings. One hopes that this will produce clearer thinking and analysis in the future.

VI. STATUTORY AND CONSTITUTIONAL INTERPRETATION

The starting point in determining patentable subject matter is the language of the statute. Section 101 lists four classes of patentable subject matter. They are "process," "machine," "manufacture," and "composition of matter."[186]

This starting point should not be mistaken for a complete and final answer. In fact, as we quickly realize, it does not get us very far. In the sections that follow, we clear away some possible misconceptions and develop a framework for analyzing the subject matter issue.

A. *The Words in Section 101 Are Terms of Art; They Cannot Be Understood by Using Their Ordinary Meaning*

Case law has provided two conflicting kinds of statements about the meaning of the words in § 101. Some cases say that these words are terms of art and have to be understood in the context of patent law. Other cases say that the words should be understood as having their ordinary common meaning. It is time to eliminate this conflict. A little reflection shows that the words are terms of art and cannot be given their common meaning.

In *Parker v. Flook*,[187] the question was whether a process for updating alarm limits was patentable subject matter. The Court wrote:

> The plain language of § 101 does not answer the question. It is true, as respondent argues, that his method is a "process" in the ordinary sense of the word. But that was also true for the algorithm, which described a method of converting binary-coded decimal numerals into pure binary numerals, that was involved in *Gottschalk v. Benson*. The holding that the discovery of that method could not be patented as a "process" forecloses a purely literal reading of § 101.[188]

On the other hand, in *Diehr*, the Court used a plain meaning analysis of § 101. "In cases of statutory construction, we begin with the language of the statute. Unless otherwise defined, 'words will be interpreted as taking their ordinary, contemporary, common meaning.'"[189]

Similarly, judges on the Federal Circuit have expressed polar opposite thoughts about whether the terms in § 101 can be read literally or not.[190]

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186. *See supra* note 4.

187. 437 U.S. 584 (1978).

188. *See Flook*, 437 U.S. at 588-89.

189. *Diehr*, 450 U.S. at 182 (quoting Perrin v. United States, 444 U.S. 37, 42 (1979)).

190. *Compare, e.g., In re* Alappat, 33 F.3d 1526, 1553 (Fed. Cir. 1994) (Archer, C.J., dissenting) (the words in § 101 are terms of art), *with* State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368, 1372 (Fed. Cir. 1998) (§ 101 is plain and unambiguous); *In re* Alappat, 33 F.3d 1526, 1542 (Fed. Cir. 1994) (§ 101 is "plain and unambiguous"); Arrhythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1061-62, 1064 (Fed. Cir. 1992) (Rader, J., concurring) ("The language of section 101 conveys no implication that the Act extends patent protection to some subcategories of machines or processes and not to others. . . . Courts should give 'process' its literal and predictable meaning").

It is evident that a "plain meaning" or literalist approach to § 101 will not work. A compact disc containing a newly created song is not patentable subject matter even though, literally, the disc is a "manufacture." A paperback book containing a newly written novel is not patentable even though the book is a "manufacture."[191] A purely mental method of improving gymnastic performances by having the gymnast repeatedly mentally visualize his or her entire routine prior to performing it should not qualify as patentable subject matter even though, literally, this method is a "process."[192] And a machine containing acrylic cams that guide a mechanical hand to write the word "faster" over and over again as the wheels spin should not qualify as patentable subject matter even though, literally, this is a "machine."[193] Congress could not have intended a plain meaning interpretation for these words.[194]

To be sure, the word "any" in § 101 means that the words "process," "machine," etc., are to be interpreted broadly, but a broad interpretation is not the same as a literal interpretation. The words "process," "machine," etc., must be interpreted within the confines of their meanings as terms of art. The difficult issue is determining their meaning as terms of art.[195]

Put simply, in every case, one must ask not whether the invention falls within the ordinary meaning of the words of § 101, but whether the invention falls within the meaning of the words of § 101 understood as terms of art.[196] The time is overdue for courts to recognize this point.

B. *Not Everything Under the Sun That Is Made by Man Is Patentable Subject Matter*

The legislative history regarding the meaning of the terms in § 101 provides no guidance in determining the meaning of those words as terms of art. In *Diamond v. Diehr*,[197] the Supreme Court sought to interpret the word "process" in the Patent Act. In doing so, it stated:

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191. *See* 1 CHISUM, *supra* note 7, § 1.02[4] and accompanying text.

192. In addition, in both *Gottschalk v. Benson*, 409 U.S. 63 (1972), and *Parker v. Flook*, 437 U.S. 584 (1978), the Court held that the claimed "processes" were not statutory subject matter.

193. Such a "machine" is described in a recent article concerning artistic expression. *See* Julie Flaherty, *Technical Art That Exalts Ideas*, N.Y. TIMES, May 7, 1998, at G1. This kind of "machine" does nothing useful and would be unpatentable for lack of utility. Furthermore, such an apparatus fails the test for patentable subject matter because it is not the kind of machine which is meant by the Patent Act. The patent system is limited to new discoveries which promote the progress of "useful arts." *See* Graham v. John Deere Co., 383 U.S. 1, 5-6 (1966); *see also infra* text accompanying notes 206-34.

194. Similarly, § 101 provides that anyone who "invents or *discovers*" anything within one of the four categories satisfies the subject matter requirement. *See* 35 U.S.C. § 101 (1994) (emphasis added). Courts have consistently stated that "discoveries" of naturally occurring substances do not qualify as the right kind of "inventions" because the substance existed prior to its discovery. *See, e.g., Flook*, 437 U.S. at 588-89, 591 (1978). A literalist interpretation of the word "discover," however, would negate such an objection.

195. Professor Samuelson has noted that the meaning of the word "process" has long been debated. *See* Pamela Samuelson, Benson *Revisited: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025, 1033 n.23 (1990). If a literalist meaning had been intended from the beginning, this debate would not have existed.

196. Section 101 of the Patent Act also uses the word "discovers." *See* 35 U.S.C. § 101 (1994). A literal interpretation of § 101 would indicate that someone who discovered a new naturally-occurring chemical would pass the subject matter test. Such an interpretation of § 101 is foreclosed by the Supreme Court's statements that natural phenomena are not patentable subject matter. *See Flook*, 437 U.S. at 593 (1978).

197. 450 U.S. 175 (1981).

> [I]n order to determine its meaning we may not be unmindful of the Committee Reports accompanying the 1952 Act which inform us that Congress intended statutory subject matter to "include anything under the sun that is made by man."[198]

The Court made this comment while emphasizing that the categories of statutory subject matter are to be read expansively.[199]

While it might be tempting to take the Committee Reports' statement literally, the same examples as those given above show that the statement is not literally true. A new novel or play, new music, and new paintings are all new creations and may deserve intellectual property protection. That protection, however, should be under the copyright system, not the patent system. These examples show that there are new creations "made by man" which are not patentable subject matter.[200] The Committee Reports' language reinforces the idea that the scope of patentable subject matter should be interpreted broadly, but we must still determine that breadth. The Committee Reports do not provide guidance for determining the limits of that breadth.

C. Constitutional Limits on Patentability

This article has shown that the words "process," "machine," "manufacture," and "composition of matter" are terms of art and that neither the statutory language of § 101 nor the legislative history concerning that section can be relied upon to determine the scope of meaning of these words.

In addition, on many occasions the Court has stated that patents cannot issue for laws of nature, natural phenomena, or abstract ideas.[201] These statements are interesting because they indicate a class of additional limitations on patentable subject matter. These are additional limitations because, for the most part, laws of nature, natural phenomena, and abstract ideas do not fall within any of the four classes of patentable subject matter listed in § 101. For example, a law of nature

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198. *Diehr*, 450 U.S. at 182 (quoting S. REP. NO. 82-1979, at 5 (1952) and H.R. REP. NO. 82-1923, at 6 (1952)).

199. *See id.*; *see also* Diamond v. Chakrabarty, 447 U.S. 303, 308 (1980) (noting that "Congress plainly contemplated that the patent laws would be given wide scope.").

200. *Accord* Chiappetta, *supra* note 11, at 130; Stern 1998 article, *supra* note 11, at 186 n.12.

201. *See, e.g.*, *Diehr*, 450 U.S. at 185 ("Excluded from such patent protection are laws of nature, natural phenomena, and abstract ideas."); 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"); Funk Bros. Seed Co. v. Kalo Co., 333 U.S. 127, 130 (1948) ([P]atents cannot issue for the discovery of the phenomena of nature. . . .They are manifestations of laws of nature, free to all men and reserved exclusively to none. He who discovers a hitherto unknown phenomenon of nature has no claim to a monopoly of it which the law recognizes.); Mackay Radio & Tel. Co. v. Radio Corp. of Am., 306 U.S. 86, 94 (1939) ("While a scientific truth, or the mathematical expression of it, is not patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be."); Rubber-Tip Pencil Co. v. Howard, 87 U.S. (20 Wall.) 498, 507 (1874) ("An idea of itself is not patentable . . . ."); O'Reilly v. Morse, 56 U.S. (15 How.) 62, 116 (1853) ("[T]he discovery of a principle in natural philosophy or physical science, is not patentable."); 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.").

such as $e=mc^2$ is not a process, machine, manufacture, or composition of matter under the ordinary meanings of those terms.

To determine the meaning of the terms in § 101 and to understand the additional limitations on patentable subject matter announced by the Supreme Court, we look to the Constitution.[202] One might say that "[w]hen all else fails, read the Constitution."[203]

The Constitution states that "Congress shall have 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."[204] This provision is the underpinning of our copyright and patent laws.

The Supreme Court has repeatedly considered the Constitution in construing patent statutes. For example, in one of the most important cases construing the present Patent Act, *Graham v. John Deere Co.*,[205] the Court wrote that:

> The [patent] clause is both a grant of power and a limitation. This qualified authority . . . is limited to the promotion of advances in the "useful arts." . . . Congress in the exercise of the patent power may not overreach the restraints imposed by the stated constitutional purpose. Nor may it enlarge the patent monopoly without regard to the innovation, advancement or social benefit gained thereby. Moreover, Congress may not authorize the issuance of patents whose effects are to remove existent knowledge from the public domain, or to restrict free access to materials already available. Innovation, advancement, and things which add to the sum of useful knowledge are inherent requisites in a patent system which by constitutional command must "promote the Progress of . . . useful Arts." *This is the standard expressed in the Constitution and it may not be ignored.*[206]

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202. Statutory interpretation is often done by looking (1) at the statutory language, (2) at congressional intent as shown by legislative history, and (3) at the policies which the legislation is designed to further. This article has already shown that neither the statutory language nor the legislative history can be used in this area.

A policy-oriented approach could go a long way toward explaining many of the statements made by the Supreme Court which are discussed in this article. For example, one policy underlying the Patent Act is that a patent must provide a benefit to society. This policy certainly underlies the Court's statements that while one cannot patent a law of nature, one may patent an innovative application of a law of nature. *See infra* note 223 and accompanying text.

Other policies underlying the Patent Act are that patents provide an incentive for inventors to create new patentable inventions; that patents should not withdraw anything from the public domain; and that a patent must represent a significant advance in applied knowledge.

It might be that one could produce an acceptable theory of patentable subject matter by relying on these kinds of policies, but this seems doubtful, unless the broad-brush kinds of policy statements just given can be refined into more specific ones. Since the Patent Act does not provide any guidance for making such refinements, this does not seem to be feasible without resort to the Constitution. For this reason, this article appeals directly to the Constitution, rather than using a two-step argument from the Constitution through policy to deal with the issues involved.

203. With apologies to the late Judge Helen Nies of the Federal Circuit, who wrote "[w]hen all else fails, read the statute." Hilton Davis Chem. Co. v. Warner-Jenkins Co., 62 F.3d 1512, 1559 (Fed. Cir. 1995) (Nies, J., dissenting). Judge Nies was echoing Judge Randall Rader of the same court, who had written, "when all else fails . . . , consult the statute." Arrhythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1066 (Fed. Cir. 1992) (Rader, J., concurring).

204. U.S. CONST. art. I, § 8, cl. 8.

205. 383 U.S. 1 (1966).

206. *Id.* at 5-6 (emphasis added).

Similarly, the Court construed earlier patent statutes as incorporating constitutional standards. For example, in determining whether a device was an "invention" or "discovery," constituting patentability, the Court, in *Cuno Engineering Corp. v. Automatic Devices Corp.*,[207] relied on the constitutional standards. "We cannot conclude that his skill in making this contribution reached the level of inventive genius which the Constitution, Art. I, § 8, authorizes Congress to reward."[208]

The *Graham* and *Cuno* cases trace back to *Hotchkiss v. Greenwood*,[209] in which the Court held that a mere substitution of materials was not enough to sustain a patent. The Court said that "the improvement is the work of the skilful mechanic, not that of the *inventor*."[210] While *Hotchkiss* did not explicitly mention the Constitution, the "invention" requirement was not based on the statute. The explicit constitutional references in *Graham* and *Cuno*, cases that build on *Hotchkiss*, indicate that *Hotchkiss* was using a constitutional analysis.

The *Hotchkiss* requirement of "invention" has now been codified as the "obviousness" requirement.[211] It is important to realize, however, that the Court has indicated that this requirement began as a constitutional requirement. In fact, the Court in *Graham* reiterated that the statutory requirement must meet constitutional minimums: "This is the *standard expressed in the Constitution* and it may not be ignored."[212]

The "invention" requirement, imposed by the Constitution for a work to be patentable, is analogous to the "originality" requirement imposed by the Constitution as a minimum standard for a work to be copyrightable.[213] Both of these standards indicate that the Constitution imposes some minimal standards of creativity in order for a work to be protected by copyright or patent.

The language in *Graham* goes further than a reference to the "invention" requirement. The Court noted that "Congress may not authorize the issuance of patents whose effects are to remove existent knowledge from the public domain, or to restrict free access to materials already available."[214]

This statement implies a second constitutional standard for patentability. The Court reads the Constitution as limiting us to a patent system in which there must be a quid pro quo of public benefit in order for a patent to issue.[215] A new patent must "promote the Progress of . . . useful Arts."[216] This requirement can be stated in terms of the constitutional word "discoveries." There is no "discovery" by someone who seeks a patent that would remove existing knowledge from the public

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207. 314 U.S. 84 (1941), *modified on other grounds*, 314 U.S. 587 (1942) (mem.).
208. *Id.* at 91.
209. 52 U.S. (11 How.) 248 (1850).
210. *Id.* at 267 (emphasis added).
211. 35 U.S.C. § 103 (1994).
212. Graham v. John Deere Co., 383 U.S. 1, 6 (1966) (emphasis added).
213. *See* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340 (1991); *see also infra* notes 234-35 and accompanying text.
214. *Graham*, 383 U.S. at 6.
215. *See id.*
216. U.S. CONST. art. I, § 8, cl. 8.

domain.[217] Congress cannot enact a patent law that would allow this to happen.[218] In the present Patent Act, this constitutional requirement is codified in part by the novelty requirements.[219]

In *Graham*, the Court noted that congressional authority under the Patent Clause is constitutionally limited in another way. "Innovation, advancement, and things which add to the sum of useful knowledge are inherent requisites in a patent system which by constitutional command must 'promote the Progress of . . . useful Arts.'"[220] The same point was made in *The Telephone Cases*:[221] "[I]t is only useful arts—arts which may be used to advantage—that can be made the subject of a patent."[222]

Such statements by the Court indicate two additional constitutional constraints on patentability. The third constitutional constraint is that a work must involve a *useful application* of knowledge. For example, laws of nature, natural phenomena, and abstract ideas are not patentable. To have an invention, one must create a practical application of laws of nature, natural phenomena, or ideas. This limit dates back more than one hundred years to *Rubber-Tip Pencil Co. v. Howard*, where the Court wrote, "[a]n idea of itself is not patentable; but a new device by which it may be made practically useful is."[223]

In part, this constitutional requirement has been codified as the requirement that a new invention has to be "useful" in order to be patentable.[224] The observation that the patent system deals with inventions having practical utility is commonplace, but it is less understood that this statutory requirement rests on constitutional requirements.

Important as the "usefulness" statutory requirement is, however, it does not quite codify the constitutional requirement. Professor Chisum, in his treatise, says that to comply with the utility requirement,

> an invention must meet three tests. First, it must be operable and capable of use. It must operate to perform the functions and secure the result intended. Second,

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217. The quid pro quo requirement may also, in part, underlie the Court's decisions that one cannot claim too broadly. *See infra* notes 268-78 and accompanying text.

218. In commenting on a draft of this article, Professor Mark Lemley inquired about what this mode of analysis implied as to copyright law. A complete discussion of this, however, would probably be a suitable subject for an entire article in and of itself. The important point is that the Supreme Court has determined that the constitutional term "Writings," which is the copyright analog to the constitutional term "Discoveries," sets limits on what kinds of works can be protected by Congress under a copyright statute. *See Feist Publications*, 499 U.S. at 344-61; *see also infra* notes 234-35 and accompanying text.

219. 35 U.S.C. § 102 (1994).

220. *Graham*, 383 U.S. at 6 (quoting U.S. CONST. art. I, § 8, cl. 8).

221. 126 U.S. 1 (1888).

222. *Id.* at 533.

223. 87 U.S. (20 Wall.) 498, 507 (1874); *see also* Parker v. Flook, 437 U.S. 584, 594 (1978) ("Even though a phenomenon of nature or mathematical formula may be well known, an inventive application of the principle may be patented. Conversely, the discovery of such a phenomenon cannot support a patent unless there is some other inventive concept in its application."); Funk Bros. Seed Co. v. Kalo Co., 333 U.S. 127, 130 (1948) ("If there is to be invention from such a discovery [of a phenomenon of nature], it must come from the application of the law of nature to a new and useful end."); Mackay Radio & Tel. Co. v. Radio Corp. of Am., 306 U.S. 86, 94 (1939) ("While a scientific truth, or the mathematical expression of it, is not patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be.").

224. *See* 35 U.S.C. § 101 (1994).

> it must operate to achieve some minimum human purpose. Third, it must achieve a human purpose that is not illegal, immoral or contrary to public policy.[225]

Examples illustrate the point that there are creative works that are "useful," but which are not patentable. Maps provide useful information and movies entertain people. New creative maps and movies satisfy the three tests for being "useful," yet would not be considered to be patentable subject matter. These examples show that the constitutional requirement that an invention add to the sum of useful knowledge and promote the progress of useful arts goes beyond a "usefulness" requirement.[226]

This brings us to the fourth constitutional requirement for patentability—that the invention be within the proper subject matter for the grant of a patent. In everyday language, one would say that the fourth requirement is that the invention be the proper "kind" of invention. A new map may be useful, but it is not the right kind of invention to be the subject of a patent.[227]

The quotes above from *Graham* and the *Telephone Cases*,[228] are instructive as to this fourth constitutional requirement for patentability. They say that the subject matter of patents is limited to the "useful arts"[229] which some courts and commentators have equated with the "technological arts."[230]

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225. 1 CHISUM, *supra* note 7, § 4.01.

226. For additional comments about the "usefulness" requirement, *see infra* notes 301-07 and accompanying text.

227. *See, e.g., Flook*, 437 U.S. at 593 ("The rule that the discovery of a law of nature cannot be patented rests, not on the notion that natural phenomena are not processes, but rather on the more fundamental understanding that they are not *the kind* of 'discoveries' that the statute was designed to protect.") (emphasis added).

228. *See supra* text accompanying notes 217-19.

229. *Accord* Chiappetta, *supra* note 11, at 128-29 (writing that the Constitution establishes the "outer boundary" for the patent power of Congress); Samuelson, *supra* note 195, at 1033 n.24 (writing that the Constitution constrains patent statutes to promoting the progress of the useful arts, which "is understood to be the realm of technological and industrial improvements"); Edward C. Walterscheid, *Charting a Novel Course: The Creation of the Patent Act of 1790*, 25 AIPLA Q.J. 445, 453 (1997) ("The constitutional language that empowered the Congress to issue patents . . . obligated the Congress to use that power within certain specific constraints. Thus, the exclusive right known as a patent could only be given for the purpose of 'promoting the Progress of Science and useful arts' and it could only be for a 'limited' term. In addition, it could only be given to 'Inventors' for 'their . . . Discoveries.'")

Not all commentators agree that the "useful arts" requirement exists constitutionally. *See* Arthur H. Seidel, *The Constitution and a Standard of Patentability*, 48 J. PAT. OFF. SOC'Y 5 (1966) (arguing that the Constitution imposes only a novelty requirement and that cases suggesting other constitutional requirements are in error).

230. *See, e.g., In re* Waldbaum, 457 F.2d 997, 1003 (C.C.P.A. 1972) ("[W]hether appellant's process is a 'statutory' invention depends upon whether it is within the 'technological arts.'"); *In re* Musgrave, 431 F.2d 882, 893 (C.C.P.A. 1970) ("All that is necessary . . . to make a sequence of operational steps a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of "useful arts.'"); 1 CHISUM, *supra* note 7, at 23 of glossary [hereinafter Gl-23] (identifying "technological arts" as being synonymous with "useful arts"). Professor Chiappetta similarly writes that the "useful arts" involved "technology" or "industrial arts." *See* Chiappetta, *supra* note 11, at 129-30.

The PTO states that "[t]he utility of an invention must be within the 'technological arts,'" *see* Guidelines, 61 Fed. Reg. 7478, 7479 (1996), and says that "[t]he definition of 'technology' is the 'application of science and engineering to the development of machines and procedures in order to enhance or improve human conditions, or at least to improve human efficiency in some respect.'" *Id.* at 7488 n.7 (quoting COMPUTER DICTIONARY 384 (Microsoft Press, 2d ed. 1994)).

One commentator had difficulty accepting *Musgrave*'s point that "technological arts" and "useful arts" are the same and that statutory subject matter is limited to them. He noted that if the terms are equated, then "every inquiry as to the patentability of a computer-implemented invention [would be] a constitutional question." *See* Maximilian

The "useful arts" limitation is directly derived from the Patent and Copyright Clause of the Constitution, which expressly limits Congress to granting copyrights and patents for "Writings and Discoveries."[231] If something is not a "discovery" within the meaning of the Constitution, it is not the proper subject matter for a patent. The purpose of patents and copyrights is to "promote the Progress of Science and useful arts," so a "discovery" must be within the "useful arts."

The importance of *Graham* and the *Telephone Cases* is that they remind us of the constitutional requirements—that patents can only issue to "inventors" for things that meet the constitutional standard of being "discoveries." These constitutional terms are each a term of art, and interrelated. One person may invent a new machine; another may discover a law of nature. If the machine meets the tests for patentability, the first person would be treated as an "inventor" and the invention would be a patentable "discovery" within the "useful arts." For the other person, we attach none of those labels.[232] The law of nature does not fall within the "useful arts" and, consequently, the discoverer is not an "inventor" nor is the discovery a "discovery" within the constitutional terms.

Put simply, the subject matter of patents is limited to the "discoveries" which must be in the "useful arts," and vice versa. One who makes such a discovery is an "inventor," and one cannot be an "inventor" unless one makes a "discovery."

One must acknowledge that the conventional view is that the Constitution sets no standards for patentability,[233] other than that patents can only issue for "limited times," a restriction that does not concern this article. This conventional view is probably wrong, just as the analogous view in copyright proved wrong. Until 1991, the conventional view of copyright law was that the Constitution set no standards for copyright ability, other than the "limited times" provision. For example, the conventional view of copyright law was that the standard for "originality" was solely a statutory one. This view of the Copyright Clause of the Constitution was

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R. Peterson, Note, *Now You See It, Now You Don't: Was It a Patentable Machine or an Unpatentable "Algorithm"? On Principle and Expediency in Current Patent Law Doctrines Relating to Computer-Implemented Inventions*, 64 GEO. WASH. L. REV. 90, 97 (1995). Apparently, because of this concern, he did not discuss the matter further. Although he may be uncomfortable with the implications of *Musgrave* and of the analysis given in this article, Mr. Peterson correctly identified the fact that the statutory subject matter issue is a constitutional one.

Other commentators have also referred to the same language from *Musgrave*, but then improperly stated that this subject matter requirement would be satisfied so long as the claimed subject matter is "useful." *See In re* Schrader, 22 F.3d 290, 297 (Fed. Cir. 1994) (Newman, J., dissenting); TOEDT, *supra* note 11, at §§ 6.02[a], 6.04. The "subject matter" and "useful" requirements are distinct requirements for patentability. *See infra* notes 302-07 and accompanying text.

231. U.S. CONST. art. I, § 8, cl. 8.

232. 1 WALKER, A TREATISE ON THE LAW OF PATENTS 23 (6th ed. 1929).

233. *See In re* Bergy, 596 F.2d 952, 958 (C.C.P.A. 1979); *see also* TOEDT, *supra* note 11, at § 6.02[c][2] (arguing that the Supreme Court abandoned a constitutional-based standard in Diamond v. Chakrabarty, 447 U.S. 303 (1980)); Seidel, *supra* note 229, at 5 (arguing that the Constitution imposes only a novelty requirement and that cases suggesting other constitutional requirements are in error).

Perhaps the best indication of the conventional wisdom is a negative inference based on the articles previously listed in note 11. If the conventional wisdom was that the Constitution was relevant to the analysis of the patentability of mathematical algorithm-related and computer-program-related inventions, then one would expect those articles to contain a discussion of the constitutional issues. The fact that virtually none of the articles does so indicates that the conventional wisdom does not regard the Constitution as important to the analysis. *But see* Cohen, *supra* note 175, at 1164 (1995) (arguing that the exclusion of mathematical formulae from patentability is "of constitutional stature"); *see also* sources cited *supra* note 229.

proved wrong in *Feist Publications, Inc. v. Rural Telephone Service Co., Inc.*,[234] where the Court held that a garden-variety White Pages telephone directory did not constitute copyrightable expression on the grounds that there was insufficient originality to qualify such a work as a "writing" and that the creators of the work could not be considered "authors."[235] The Court expressly used these constitutional terms and grounded its decision on the Constitution rather than on the statutory standard of "originality." *Feist* was a surprising decision because the Court invoked the Constitution in deciding a copyright case, in spite of a two-hundred-year history of not doing so.

The constitutional standards addressed in *Feist* dealt both with the level of creativity required for a work to be copyrighted and the kinds of works that can be copyrighted. The analogous standards for patents would be the "inventiveness" requirement (now codified as the nonobviousness standard in § 103) and the subject matter requirement (codified in part in § 101). In discussing these requirements, *Feist* noted that the constitutional dimensions of the terms "authors" and "writings" were discussed in the *Trade-Mark Cases* more than one hundred years earlier.[236]

The fact that the Supreme Court has infrequently addressed the constitutional dimensions of copyright (and patent) law does not mean that there are no constitutional dimensions. As *Feist* shows, the conventional wisdom about the Patent and Copyright Clause of the Constitution may well be wrong. And, in fact, the Court is willing and able to invoke the Constitution to decide cases under the Patent and Copyright Clause despite years of not doing so.

D. *"Useful Arts" and "Discoveries" Are Terms of Art; The "Useful Arts" Are Limited to Certain Fields of Creativity*

What do the terms "useful arts" and "discoveries" mean?" It is important that these terms are not defined in the Constitution. It is difficult to imagine a literalist interpretation of the phrase "useful arts." More importantly, however, it seems that a literalist meaning of the word "discoveries" was not intended.[237]

The "useful arts," from a constitutional perspective, are limited to certain fields of creativity. Professor Chisum, in his treatise, writes that "useful arts is synony-

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234. 499 U.S. 340 (1991).

235. *See id.* at 363-64.

236. The *Feist* Court wrote:

> [O]riginality is a constitutional requirement. . . . In two decisions from the late 19th Century—*The Trade-Mark Cases* and *Burrow-Giles Lithographic Co. v. Sarony*—this Court defined the crucial terms "authors" and "writings." In so doing, the Court made it unmistakably clear that these terms presuppose a degree of originality.
>
> In *The Trade-Mark Cases*, the court addressed the constitutional scope of "writings." For a particular work to be classified "under the head of writings of authors," the Court determined, "originality is required." The Court explained that originality requires independent creation plus a modicum of creativity: "[W]hile the word *writings* may be liberally construed, as it has been, to include original designs for engraving, prints, etc., it is only such as are *original*, and are founded in the creative powers of the mind. The writings which are to be protected are *the fruits of intellectual labor*, embodied in the form of books, prints, engravings, and the like."

Feist, 499 U.S. at 346 (quoting the Trade-Mark Cases, 100 U.S. 82, 94 (1879)) (citations omitted).

237. One might "discover" a naturally-occurring organism or a law of nature, but these are not the kind of "discoveries" meant by the Constitution. Discoveries are limited to applications of natural phenomena or laws of nature. *See* discussion *infra* Parts VI.E-F.

mous with the contemporary concept of technological arts and is contrasted with 'Science,' the promotion of which is the object of the copyright system."[238] Thus, if one writes a new book or composes a new song, one would obtain a copyright for this work, yet no one would imagine obtaining a patent for the work. Such works are outside the subject matter of patents. This and other such excluded fields will be discussed below.

Other authors have endeavored to explain what fields are within the subject of the "useful arts." Edward Walterscheid explained that the phrase "useful arts" in the Constitution meant "helpful or valuable trades."[239] According to Pamela Samuelson, "'useful Arts' is understood to be the realm of technological and industrial improvements."[240] Arthur H. Seidel wrote that "useful arts" refers to "useful trades," which "will include many mundane fields, like household chores, building trades, and keeping business data."[241] Vincent Chiappetta characterizes the "useful arts" as "limited to the practical application of knowledge and learning to the industrial arts, that is to the creation of specific tools, products and procedures for performing activities such as the creation of new things, arrangements of things or relationships between things."[242]

We can gain a sense of the original scope of the "useful arts" by looking at the types of things for which patents were first issued. Individuals filed eighteen patent petitions with the First Congress in 1789-90 for "inventions relating to propelling boats, steamboats, steam engines, determining longitude, making nails, threshing and reaping grain, deepening docks, revolution and vibration counters, making buttons, mills, and, marking a species of inventor which seems to be always with us, lightning proof umbrellas."[243]

Indeed, even prior to the first United States patent act, there are indications of the kinds of subject matter that were thought of as being within the "useful arts." For example, in addressing Congress on January 8, 1790, President George Washington spoke of the need for a patent act in order to advance "agriculture, commerce, and manufactur[ing]."[244] Congress concurred, with the House replying, "We concur with

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238. 1 CHISUM, *supra* note 7, at Gl-23; *accord In re* Schrader, 22 F.3d 290, 297 (Fed. Cir. 1994) (Newman, J., dissenting); *In re* Bergy, 596 F.2d 952, 959 (C.C.P.A. 1979); *In re* Waldbaum, 457 F.2d 997, 1003 (C.C.P.A. 1972); *In re* Musgrave, 431 F.2d 882, 893 (C.C.P.A. 1970). The Guidelines provide that "[t]he utility of an invention must be within the 'technological' arts." *See* Guidelines, 61 Fed. Reg. 7478, 7479 (1996). "The definition of 'technology' is the 'application of science and engineering to the development of machines and procedures in order to enhance or improve human conditions, or at least to improve human efficiency in some respect.'" *Id.* at 7488 n.7 (quoting COMPUTER DICTIONARY 384 (Microsoft Press, 2d ed. 1994).

239. Edward C. Walterscheid, *To Promote the Progress of Science and Useful Arts: The Background and Origin of the Intellectual Property Clause of the United States Constitution*, 2 J. INTELL. PROP. L. 1, 52 (1994).

240. Samuelson, *supra* note 195, at 1033 n.24.

241. Seidel, *supra* note 229, at 13.

242. Chiappetta, *supra* note 11, at 129.

243. *See* P. J. Federico, *The Patent Act of 1790, in Outline of the History of the United States Patent Office*, J. PAT. OFF. SOC'Y (July 1936) 59, 60. [EDITOR'S NOTE: While this journal is normally consecutively paginated, this citation refers to the July 1936 special centennial issue entitled "Outline of the History of the United States Patent Office," in which Federico's work appears on page 59. This issue, although bound in Volume 18, is not consecutively paginated.]

244. *See* P. J. Federico, *The First Patent Act*, 14 J. PAT. OFF. SOC'Y 237, 243 (1932) (quoting 1 ANNALS OF CONG. 970 (Joseph Gales ed., 1834)).

you in the sentiment that agriculture, commerce, and manufactur[ing], are entitled to legislative protection," and the Senate replying in similar language.[245]

E. Patentable Subject Matter Expands to Include New Technologies

While George Washington spoke of patentable subject matter in terms of "agriculture, commerce, and manufactur[ing],"[246] patentable subject matter should not be limited to those areas. The goal of the patent system is to promote the public welfare by encouraging inventions in areas of technological development. To limit those areas to known areas is counter to the underlying goals of the patent system. Telephony, electronics, nuclear technologies, biotechnologies, and computers were unknown in the eighteenth century, yet we want to encourage innovation in these areas. Therefore, the subject matter of patents can and should expand to include these new areas.[247]

In today's world, information processing and computer technologies are a major portion of the economy. There is no reason why the constitutional terms "discoveries" and "inventors" should not be expanded to include significant portions of these areas.

Copyright law has witnessed an analogous expansion of subject matter. The first copyright act allowed copyrights for books, maps, and charts.[248] Copyright has since expanded to include musical works, movies, choreographic works, sculpture, engravings, prints, advertising, code books, computer programs, and architectural works. There does not seem to be any constitutional impediment to including all of these kinds of works within the constitutional term "writings."[249] Similarly, the constitutional term "discoveries" should be given wide scope.

F. Laws of Nature, Natural Phenomenon, and Abstract Ideas Are Not Patentable Subject Matter

The scope of patentable "discoveries" and the "useful arts" is large and growing, but there are limits. The Supreme Court has provided guidance in understanding these constitutional limits. On many occasions the Court has stated that patents cannot issue for laws of nature, natural phenomena, or abstract ideas.[250] Rather, the "useful arts" involve solving technological problems. Discoveries of laws of nature and natural phenomena may be valuable and useful, but they are not the kind of

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245. *See id.* at 243-44 (quoting 1 ANNALS OF CONG. 1089 (Joseph Gales ed., 1834)).

246. *See supra* note 244 and accompanying text.

247. *See, e.g.*, Diamond v. Chakrabarty, 447 U.S. 303, 315-16 (1980) (rejecting the idea that the patent statute should be limited unless Congress explicitly extended it into new technological areas).

248. *See* Act of May 31, 1790, ch. 15, 1 Stat. 124; *see also* Denise R. Polivy, *Feist Applied: Imagination Protects, but Perspiration Persists—The Bases of Copyright Protection for Factual Compilations*, 8 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 773, 779 (1998).

249. *See, e.g.*, Bleistein v. Donaldson Lithographing Co., 188 U.S. 239 (1903) (allowing protection for colored lithograph advertising posters).

250. *See supra* note 201.

discoveries for which patents can issue.[251] Similarly, abstract ideas may be important and useful, but they are not the kind of things for which patents can issue.

Two comments about this limitation are worth making. First, this shows that the word "discoveries" in the Constitution is a term of art. In its common, ordinary meaning, it would appear that one who discovered a law of nature or a "naturally occurring" substance might be within the scope of patentable subject matter. The Court, however, has indicated that this ordinary meaning is not intended.[252] And, since "discoveries" and "useful arts" are integrally related concepts, one must infer that "useful arts" is also a term of art.[253]

Second, it is hard to know whether the Court correctly interpreted the word "discoveries" in the Constitution, either on linguistic or on policy grounds. Even at the time the Constitution was written, the meaning of "discover" included finding new natural phenomena,[254] so the Court's interpretation does not seem to be based on the common meaning of the word at the time the Constitution was written.

Trying to justify the Court's interpretation on policy grounds is equally problematic. The issue of what kinds of inventions are desirable and the appropriate kinds and amounts of stimuli needed to encourage new invention is challenging.[255] Arguably, these may be the kinds of issues that Congress could investigate through the legislative process. After such an investigation, Congress might decide, for example, that more research and discoveries of naturally-occurring chemicals from plants is needed in order to be able to investigate their pharmacological properties. Congress, therefore, might wish to include naturally-occurring chemicals from plants within patentable subject matter.[256] Then, one would assume that the Supreme Court would defer to such congressional investigation and legislation passed in response to such an investigation. What is interesting is that the Court seems to have foreclosed this approach through its pronouncements that laws of nature, natural phenomena, and abstract ideas are not patentable subject matter.[257]

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251. *See, e.g.*, Parker v. Flook, 437 U.S. 584, 593 (1978) ("The rule that the discovery of a law of nature cannot be patented rests, not on the notion that natural phenomenon [sic] are not processes, but rather on the more fundamental understanding that they are not the kind of 'discoveries' that the statute was designed to protect.").

The mathematical equation $e=mc^2$, showing the relationship between energy and matter is one example of a law of nature. The existence of statistical correlations between a particular biological test and a particular genetic or biological condition is another example of a law of nature. These are not patentable subject matter.

252. *See supra* note 196.

253. Section 101 of the Patent Act also uses the word "discovers." *See supra* note 4. A literal interpretation of § 101 would indicate that someone who discovered a new naturally-occurring chemical would pass the subject matter test. This literal interpretation is foreclosed by the Supreme Court's statements that natural phenomena are not patentable subject matter. *See, e.g.*, Diamond v. Diehr, 450 U.S. 175, 185 (1981).

254. III OXFORD ENGLISH DICTIONARY 431-32 (1933).

255. Presumably, this would entail considerable empirical research and careful mathematical modeling.

256. Alternatively, Congress might reach the opposite conclusion. Were we to give a patent monopoly to one who discovers a new organism or naturally-occurring substance, others might hesitate to undertake research to determine whether that organism or substance could be put to practical use until the first monopoly expired. This might well delay finding applications of the new organism or substance.

Thus, Congress could decide that, while the existing system may lead to less investment in finding new organisms or substances, it is likely to lead to more rapid exploitation of such things, and to their exploitation in a variety of fields, once they are found. Given a choice between these two alternatives, Congress could decide to limit the patent monopoly to those who show how such organisms or substances can be used to solve problems which confront humans.

257. It would be interesting to see what would happen if Congress engaged in serious fact-finding and

G. *Purely Mathematical Algorithms and Calculations Are Not Patentable Subject Matter*

Purely mathematical algorithms provide one illustration of the theory that abstract ideas are not patentable. By a purely mathematical algorithm, we mean a mathematical calculation done for its own sake and divorced from any utilitarian process.[258] Such algorithms should be distinguished from a mathematical algorithm which is part of a utilitarian process. The former falls on the abstract idea side of the line and is not proper patentable subject matter; the latter falls on the utilitarian side of the line and should be treated as patentable subject matter.

An example of a purely mathematical algorithm is that of the patent claim in *Benson*.[259] The claim was for a process which could convert binary coded decimal numbers into pure binary numbers.[260] That is a purely mathematical algorithm.[261] It is not part of a utilitarian process.[262] The Court stated, "It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting BCD numerals to pure binary numerals were patented in this case."[263]

An example of a mathematical calculation which was part of a utilitarian process is that of the patent claim in *Diehr*.[264] The claim was for a process of molding rubber products in which the cure time was calculated using the Arrhenius

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decided that natural phenomena should be included within patentable subject matter in order to stimulate more pure scientific research. Such fact-finding and legislation would squarely present the issue of whether the word "discoveries" has the constitutional meaning given it by the Court.

Congress has not yet done this. No fact-finding along these lines was done by Congress when it passed the present Patent Act in the 1950s. Notwithstanding the statement in Committee Reports that statutory subject matter should "include anything under the sun that is made by man," there is no indication that Congress even considered, much less desired to overrule, the numerous Supreme Court decisions stating that abstract ideas, natural phenomena, and laws of nature are not patentable subject matter. *See* S. REP. NO. 82-1979 at 5 (1952); H.R. REP. NO. 82-1923, at 6 (1952).

Copyright law presents an analogous problem. In *Feist Publications, Inc. v. Rural Tel. Serv. Co.*, 499 U.S. 340 (1991), the Supreme Court decided that the constitutional term "Writings" (which is the copyright term that is equivalent to the patent term "Discoveries" in the Copyright and Patent Clause) established a minimum level of originality which had to be met for a work to be copyrightable. This decision implies that some kinds of databases will not be copyrightable. Congress is currently engaged in considering whether those kinds of databases (as well as databases which are already protected by copyright) need some form of protection from being copied. Rather than presenting a direct challenge to the Court's interpretation of the Copyright and Patent Clause of the Constitution, Congress is apparently trying to draft legislation which would protect databases under the Commerce Clause or some other part of the Constitution. The fact that Congress is not directly challenging the Court in this copyright context lends further support to the point that Congress did not try to directly challenge the Court when it passed the Patent Act of 1952.

258. This definition becomes important later. *See infra* text accompanying note 294.

259. Gottschalk v. Benson, 409 U.S. 63 (1972). For a more in-depth discussion of *Benson*, *see supra* text accompanying notes 17-32.

260. *See Benson*, 409 U.S. at 74.

261. *See id.* at 65, 71-72.

262. In commenting on a draft of this article, Professor Lemley wrote that this algorithm has applications in computer science. Assuming that it does, and further assuming that the computer science involved can be applied to some useful human purpose, the statement in the text is incorrect and this algorithm is not a proper example of a purely mathematical algorithm. With those assumptions, perhaps the Supreme Court didn't seem to be aware of such practical applications when it wrote its opinion.

263. *Id.* at 71; *see also In re* Waldbaum, 559 F.2d 611, 616 (C.C.P.A. 1977) (rejecting mathematical algorithm claims as being "abstract and sweeping").

264. Diamond v. Diehr, 450 U.S. 175 (1981).

equation.[265] This was not simply calculating numbers for their own sake. Rather, it was calculating numbers in order to know when the molded rubber product was properly cured, with the precise kind of calculation done as part of an industrial process.[266] Therefore, the industrial process is patentable subject matter.[267]

Between the extremes of *Benson* and *Diehr* are many other inventions involving mathematical algorithms. Below, we will return to the issue of whether mathematical algorithms can be patentable subject matter.

H. Claiming Too Broadly May Exceed Patentable Subject Matter

O'Reilly v. Morse[268] illustrates another category of subject matter which is not patentable. In *Morse*, several of Samuel Morse's claims relating to telegraphy were allowed, but the Supreme Court held that Morse's eighth claim was not patentable.[269] That eighth claim was for "the use of the motive power of the electric or galvanic current, . . . call[ed] electromagnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances."[270]

The Court reasoned:

> If this claim can be maintained, it matters not by what process or machinery the result is accomplished. For aught that we now know, some future inventor, in the onward march of science, may discover a mode of writing or printing at a distance by means of the electric or galvanic current without using any part of the process or combination set forth in the plaintiff's specification. His invention may be less complicated—less liable to get out of order—less expensive in construction, and in its operation. But yet, if it is covered by this patent, the inventor could not use it, nor the public have the benefit of it, without the permission of this patentee.[271]

The Court's analysis indicates that Morse's claim was too broad. He was claiming more than he invented. Instead of claiming a particular process or machinery to accomplish some result, he was claiming an effect no matter what process or machines were used. Such a claim was not patentable.[272]

At least two constitutional theories seem to underlie the doctrine set forth in *O'Reilly v. Morse*. One is that the claim in *Morse* falls into the category of a claim for an abstract idea rather than a specific application of that idea. As such, it is not patentable subject matter.[273]

A second constitutional theory is that the breadth of the claim offends the constitutional requirement that there be an appropriate quid pro quo of public benefit in exchange for the grant of the patent. If a patent were to issue for a claim

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265. *See id.* at 177.
266. *See id.* at 191-92.
267. *See id.* at 192-93.
268. 56 U.S. (15 How.) 62 (1853).
269. *See id.* at 124.
270. *See id.* at 112.
271. *Id.* at 68.
272. *See* The Telephone Cases, 126 U.S. 1, 534 (1888) (commenting on *Morse*).
273. Professor Chisum argues that claims of undue breadth probably also violate the statutory requirement of enabling disclosure. *See* Donald S. Chisum, *The Patentability of Algorithms*, 47 U. PITT. L. REV. 959, 982 & n.83 (1986). *Accord,* Stern, *An Attempt to Rationalize, supra* note 11, at 190.

this broad, the private benefit to the patentee would be so great that it would dwarf the public benefit from the disclosure of the invention. The Court may be implying that, while there is great latitude in the quid pro quo that is permissible under the patent system, there are limits, and a patent claim of this breadth exceeds those constitutional limits.[274] It should be noted, however, that this doctrine has rarely been applied. Indeed, in the *Telephone Cases*,[275] a claim of almost equal breadth was allowed.[276]

Patent attorneys are trained to draft some of their claims quite broadly. *Morse* teaches that there is a line beyond which a claim will fail because it is too broad and too abstract.[277] One cannot specify where that line is, requiring that cases be decided on their own facts and merits.[278]

I. Further Reflections on Mathematical Algorithms: It is Time to Limit or Reverse Flook

As discussed above,[279] purely mathematical algorithms—i.e., mathematical calculations divorced from any practical application—are treated as if they are abstract ideas and thus not patentable subject matter because they are not part of the "useful arts." On the other hand, utilitarian processes, such as molding rubber products, are patentable subject matter even though they contain mathematical calculations.

The only Supreme Court decision that falls "in-between" these two extremes is *Parker v. Flook*,[280] in which the Court held that a process for updating an alarm limit for use in the catalytic conversion of hydrocarbons was not patentable subject matter.[281] Both the majority and dissenting opinions in *Flook* agreed that mathematical formulas and purely mathematical algorithms are not patentable subject matter, but they disagreed on whether *Flook* involved such a claim.[282] The three dissenting Justices thought that the process in *Flook* was a utilitarian process within patentable subject matter and that the mathematical algorithm was just one step in that process.[283]

The majority held that the method claimed would amount to a patent on the algorithm.[284] For the majority, the claim in *Flook* looked like a pure mathematical

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274. The author has previously written about the quid pro quo permissible under the copyright system. *See* Robert A. Kreiss, *Accessibility and Commercialization in Copyright Theory*, 43 UCLA L. REV. 1 (1995); Robert A. Kreiss, *Copyright Fair Use of Standardized Tests*, 48 RUTGERS L. REV. 1043 (1996).

275. 126 U.S. 1 (1888).

276. *See generally* 1 CHISUM, *supra* note 7, § 1.03[2][c].

277. *See* O'Reilly v. Morse, 56 U.S. (15 How.) 62, 68 (1853).

278. Copyright law has long faced the same issue. Expression is copyrightable, but ideas are not. The line between the two cannot be specified, yet courts have successfully dealt with this issue on a case-by-case basis for many years.

279. *See supra* Part VI.G.

280. 437 U.S. 584 (1978).

281. *See id.* at 594-95.

282. *Compare id.* at 594-95 with *id.* at 598-99. For a more in-depth discussion of *Flook*, see *supra* text accompanying notes 33-46.

283. *See id.* at 598-99.

284. *See id.* at 593-94.

algorithm claim.[285] The Court stated that mathematical calculations should be treated as "basic tools of scientific and technological work" and "treated as though it were a familiar part of the prior art."[286] The Court repeated the idea that scientific truths or phenomena of nature are not patentable; one can only patent subject matter which involves applications of such things.[287]

The different perspectives shown by the majority and the dissent in *Flook* are echoed today by the different perspectives of the judges on the Federal Circuit.[288] *Flook* involved the calculation of numbers—alarm limits—and some judges on the Federal Circuit read the Supreme Court decisions to preclude any patent where the claim amounts to the use of a mathematical algorithm or formula in order to calculate a number or numbers. Other judges on the Federal Circuit believe that if the numbers so calculated are not just abstract numbers, but, instead, represent real-world conditions or things, then the claims are not purely mathematical algorithms.[289] These judges interpret the Supreme Court decisions to say that "there are three categories of subject matter for which one cannot obtain patent protection, namely 'laws of nature, natural phenomenon, and abstract ideas.'"[290] Mathematical algorithms do not represent a fourth category of excluded matter. Instead, the only mathematical algorithm-related inventions that are not patentable subject matter are the equivalent of abstract ideas, and these are the purely mathematical algorithm claims.[291] These judges seemingly agree with the dissenters in *Flook*[292] and may believe that the Supreme Court today will either limit *Flook* to its facts, as the outer limit of the idea that purely mathematical calculations are not patentable subject matter, or will overrule *Flook*.[293]

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285. In *Diamond v. Diehr*, 450 U.S. 175 (1981), the Court reiterated that *Flook* just involved claims for a method to compute a number. *See id.* at 186.

286. *Flook*, 437 U.S. at 591-92.

287. *See id.* at 584.

288. *See supra* notes 83-105, 112-37, and accompanying text.

289. In reality, the views of the judges on the Federal Circuit do not fit neatly into two distinct groups. *See, e.g.*, Ruben Bains, Note, *A Comparison of the PTO's Computer-Implemented Guidelines with the Current Case Law*, 5 TEX. INTELL. PROP. L.J. 27, 29-30 (1996); Ronald S. Laurie & Joseph K. Siino, *A Bridge Over Troubled Waters? Software Patentability and the PTO's Proposed Guidelines (Part I)*, COMPUTER LAWYER Sept. 1995 at 6; Richard H. Stern, *Solving the Algorithm Conundrum: After 1994 in the Federal Circuit Patent Law Needs a Radical Algorithmectomy*, 22 AIPLA Q.J. 167, 206-08 (1994). While this article suggests that there are two groups, it does so for purposes of simplicity in order to focus on the larger issues.

290. *See, e.g., In re* Alappat, 33 F.3d 1526, 1542 (Fed. Cir. 1994) (quoting Diamond v. Diehr, 450 U.S. 175, 185 (1981)).

291. *See id.*, 33 F.3d at 1543.

292. *See generally Flook*, 437 U.S. at 598-600 (Stewart, J., dissenting).

293. Some people believe that *Diamond v. Diehr*, 450 U.S. 175 (1981), has already overruled *Flook*. *See supra* note 61 and accompanying text; *infra* note 294.

What did the Supreme Court mean in *Flook*? While the issue is far from clear,[294] it is plausible to believe that the Supreme Court in *Flook* was signaling that any claim which amounts to the use of a mathematical algorithm or formula in order to calculate a number or numbers is not patentable subject matter. The Supreme Court seemingly adopted this view of *Flook* in *Diehr*. In *Diehr*, the Court stated that the application in *Flook* sought to protect a formula for computing an alarm limit—"a number."[295] This was contrasted to the claims in *Diehr*, which the Court characterized as a claim directed to a process for curing rubber. It therefore appears as if *Benson*, *Flook*, and *Diehr* proscribe a patent where the claim amounts to the use of a mathematical algorithm or formula in order to calculate a number or numbers.

Such an interpretation would mean that *Grams* was properly decided and the district court decision in *State Street* should have been affirmed; it means that *Arrhythmia*, *Alappat*, and the Federal Circuit's *State Street* decision are inconsistent with the Supreme Court decisions to date. In each of those cases, the patent claims are for mathematical algorithms that calculate numbers, or for machinery that does the calculation. The fact that numbers so calculated represent real-world conditions or things would not seem to be sufficient to save the claim, as shown by *Flook*. Thus, the group of Federal Circuit judges who follow this interpretation of the Supreme Court decisions is more accurate in its reading.

Notwithstanding this reading of existing Supreme Court cases, this article urges the Supreme Court to overrule *Flook* and move in the direction taken by the *Flook* dissenters and the judges on the Federal Circuit who have apparently decided that they need not follow *Flook*.[296] In its next decision, the Court should decide that claims involving mathematical calculations will generally be treated as patentable subject matter if those numbers are part of technological processes and represent real-world phenomena. The only exception would be that claims drawn to purely mathematical algorithms would remain outside the boundaries of patentable subject matter.[297]

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294. It is unclear because *Flook* indicates that one should proceed as if the algorithm were already known. *See Flook*, 437 U.S. at 591-92. "[O]nce that algorithm is assumed to be within the prior art, the application, considered as a whole, contains no patentable invention." *Id.* at 594. Although disclaimed by the Court, this language seems more appropriate in a discussion of novelty under § 102 or obviousness under § 103.

Other commentators focus on different aspects of the Supreme Court decisions in showing a lack of clarity. Some, for example, have argued that *Benson* and *Flook* were part of an early era of Supreme Court decisions and that the Court abandoned those cases in deciding *Chakrabarty* and *Diehr*. *See, e.g.*, TOEDT, *supra* note 227, at § 6.02; Chisum, *supra* note 273. For these authors, no reconciliation of the cases is necessary, as *Flook* can be considered to be overruled in fact if not in word.

Some judges on the Federal Circuit have also argued that *Flook* has been superseded by the analysis in *Diehr*. *See, e.g.*, Arrhythmia Research Tech., Inc. v. Corazonix Corp., 958 F.2d 1053, 1061 (Fed. Cir. 1992) (Rader, J., concurring) (arguing that the *Diehr* court "turned away from the *Benson* algorithm rule"); *cf. Arrhythmia*, 958 F.2d at 1057 n.4 (Newman, J., opinion of the court) (noting that "it appears to be generally agreed that [*Benson*, *Flook*, and *Diehr*] represent evolving views of the Court, and that the reasoning in *Diehr* not only elaborated on, but in part superseded, that of *Benson* and *Flook*").

Because the *Diehr* decision distinguishes *Flook* rather than expressly overruling it, this article proceeds on the assumption that *Flook* remains good law.

295. *See Diehr*, 450 U.S. at 186.

296. As noted previously, some people believe that the Supreme Court has already done this. *See supra* note 61 and accompanying text.

297. *See supra* text accompanying note 258.

Such an interpretation would greatly reduce the applicability of the doctrine that purely mathematical algorithms are like abstract ideas and cannot be patented. This is because patent attorneys drafting patent claims will almost always be able to draft a claim so that the numerical calculations involved have real-world meaning.

There are several reasons for urging the Court to either overrule *Flook* or narrowly limit it to its facts. First, patents can stimulate the further development and use of computers to produce applications of great benefit to humans. Some of these applications may involve replacing manual labor with machine labor. Other applications may involve doing things that would have been impossible with manual calculation methods. For example, air traffic controllers use computers to determine the location and speed of airplanes so that more flights can occupy a given amount of air space safely. Doctors can use computers to do real-time analyses of a patient's condition so that medical treatment can be more timely and more effective. MRI machines use computers to create pictures of cross-sections of a person in order to locate and diagnose abnormal conditions. Geologists can use computers to analyze seismograms in order to locate commercially valuable mineral or petroleum deposits. Accountants can use computers to do daily calculations of assets and liabilities of a company or to do up-to-the-minute calculations of account balances. Insurance companies can use computers to detect insurance fraud by doing sophisticated cross-checking of insurance claim records. The examples could be multiplied. These examples involve very practical uses of computers and are the kind of things that the patent system should encourage. It seems counter-productive to leave these things outside the subject matter of patents simply because they are primarily just mathematical calculations.

Second, this approach appears to be more consistent with the Court's treatment of the other categories of excluded subject matter—laws of nature, natural phenomena, and abstract ideas. For example, the Court has stated that *applications of laws of nature and natural phenomena* within the technological arts are treated as patentable subject matter even though the natural law or natural phenomenon would not be.[298] Mathematical algorithms should be treated similarly; *applications of mathematical algorithms* within the technological arts should be considered patentable subject matter even though the pure mathematical algorithm would not be. In other words, the standard applied should be the same for laws of nature, natural phenomena, abstract ideas, and mathematical algorithms.

Consistent application of this standard would indicate that a claim to the use of a mathematical algorithm should not be barred, even if the claim involves the use of an algorithm to calculate a number or numbers, so long as the claim is directed to a real-world application.[299] This article agrees with the dissenters in *Flook* that

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298. *See, e.g.*, Diamond v. Chakrabarty, 447 U.S. 303, 308-10 (1980).

299. *See* Chiappetta, *supra* note 11, at 154 *passim*. Professor Dennis Karjala has argued that, while a mathematical algorithm that calculates numerical results from numerical inputs might sometimes be rejected as nonstatutory subject matter on the grounds that it is abstract theory, a computer program implementing that algorithm should be treated as patentable subject matter and the inquiry as to patentability should focus on issues of novelty and nonobviousness. *See* Karjala, *supra* note 11, at 60-61. He contends that the computer program involves applications of laws of nature just as other technological processes do and it therefore should be accorded the same treatment in patent law that other applications of laws of nature receive. Program object codes on a diskette represent physical signals (high or low voltages or magnetic field strengths), not ones or zeros that may

the claims in that case used the algorithm as one step in a method that was proper subject matter.

Third, experience over the past twenty-five years has shown that it is difficult to find a line which distinguishes those mathematical algorithm-related claims which are patentable from those which are not. Drawing the line between "purely" mathematical algorithms and algorithms which are part of utilitarian processes will have its own problems, but it may be a much more tractable problem than the present one.

Fourth, as a practical matter, we are almost there already. Recent decisions of the PTO and the Federal Circuit have allowed quite a few such patents and it will be difficult to undo this fact of life.[300]

J. The "Useful Arts" Do Not Include Everything that Is Useful

In determining the scope of the constitutional phrase, "useful arts," we should not fall into the trap of thinking that they comprise all that is useful.[301] A map is useful in helping one go from point A to point B; a toy may be useful in keeping a child occupied or entertained; a book may contain a great deal of useful information. Yet none of these items would be considered to be within the "useful arts" as that term is used in the Constitution. Instead, those items would be considered to be within the ambit of copyrightable subject matter.

The concept of "usefulness," as that word is used ordinarily, does not distinguish patentable subject matter from copyrightable subject matter. Therefore, a different boundary must be used to distinguish copyrights from patents and to help define "useful arts."

K. The "Useful Arts" Subject Matter Requirement Is Distinct from the Requirement that an Invention Be "Useful"

Similarly, the issue of patentable subject matter is different from the statutory requirement that an invention be "useful."[302] Although this requirement may overlap to some extent with the subject matter requirement, they are distinct requirements.[303]

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be readable by humans. These physical signals may be used by the computer to produce other physical signals. The operations of the computer in doing this are those which the computer is forced to do by the laws of nature. For Karjala, computer programs involve applications of laws of nature and the subject matter issue should never have arisen. *See id.* at 63-65.

Professor Julie Cohen has also urged that more attention be placed on §§ 102 and 103 issues. *See* Cohen, *supra* note 175, at 1168-81.

300. See, for example, the patents listed in Stephen D. Kahn & Leslie Spencer, *PTO's New Training Materials for Examination of Computer-Related Applications Complete a Year of Significant Developments for Patents and Financial Services*, J. PROPRIETARY RTS. Dec. 1998, at 2.

301. *See, e.g., In re* Schrader, 22 F.3d 290, 295 (Fed. Cir. 1994) (Newman, J., dissenting) (arguing that "a statutory 'process' is limited only in that it must be technologically useful"); TOEDT, *supra* note 11, at § 6.04 (arguing that the sole test for statutory subject matter should be whether the claimed subject matter is "useful").

302. *See* 35 U.S.C. § 101 (1994).

303. *Cf.* TOEDT, *supra* note 11, at § 6.04 (arguing that the sole test for statutory subject matter should be whether the claimed subject matter is "useful").

Professor Chisum, in his treatise, says that to comply with the utility requirement,

> an invention must meet three tests. First, it must be operable and capable of use. It must operate to perform the functions and secure the result intended. Second, it must operate to achieve some minimum human purpose. Third, it must achieve a human purpose that is not illegal, immoral or contrary to public policy.[304]

Some of these requirements trace back to Justice Story's decision in *Lowell v. Lewis*.[305] As this article has previously noted, the "usefulness" requirement is constitutionally mandated.[306]

The Supreme Court has stated that laws of nature are not patentable subject matter. For example, if Einstein had attempted to patent the formula $e=mc^2$, it would have been rejected as lacking patentable subject matter. In addition, the PTO also could have rejected this claim on the grounds of lack of utility—there is no human purpose served by this information. This indicates that there is some overlap between these statutory requirements.

Easy examples involving laws of nature and natural phenomena show, however, that the subject matter and utility requirements each have areas not covered by the other. For example, gravity is another law of nature, hence barred for lack of patentable subject matter, but gravity has many human uses (for example, in a guillotine or a grandfather clock whose mechanism involves a falling weight to make the wheels turn), so it would not be barred for lack of utility.

Chemical compounds also provide good examples. If a chemical compound is derived from a plant, animal, or bacterium, it might fail the subject matter test because it is a phenomenon of nature. If there are no known human uses, the compound would also fail the utility test.

For a compound found in a plant or animal or bacterium, a purified form of the compound would pass the subject matter test (the pure form is not a phenomenon of nature), but still fail the utility test if there are no known human uses. If a chemical compound is not found in nature, it would be proper subject matter (a composition of matter), but its ability to pass the utility requirement would depend upon whether human uses have been found.

These examples show that there are things which are useful but not subject matter (gravity), things which are subject matter but not useful (purified chemical compositions from plants or animals with no known uses), and things which are neither subject matter nor useful ($e=mc^2$ and naturally occurring chemical compounds with no known uses). For this reason, the analysis of patentable subject matter has to be done separately from that of the utility requirement.[307]

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304. 1 CHISUM, *supra* note 7, § 4.01.
305. 15 F. Cas. 1018 (C.C.D. Mass. 1817) (No. 8568).
306. *See supra* notes 220-26 and accompanying text.
307. The Guidelines confuse and conflate these two requirements.

> [A] complete disclosure should contain some indication of the practical application for the claimed invention, i.e., why the applicant believes the claimed invention is useful.
>
> The utility of an invention must be within the "technological" arts. A computer-related invention is within the technological arts. A practical application of a computer-related invention is statutory subject matter. This requirement can be discerned from the variously phrased prohibitions against the patenting of abstract ideas, laws of nature or natural

L. Generally, Patentable Subject Matter Is Distinct from Copyrightable Subject Matter

It is generally understood that patentable subject matter is distinct from copyrightable subject matter.[308] Although the Constitution does not require this distinction,[309] it can be traced back to the Constitution.

The Constitution contains a grant of authority for Congress to enact copyright legislation and patent legislation. While it is contained in a single clause,[310] there are two distinct provisions:[311]

> [(a) (for patents)] The Congress shall have Power . . . To promote the Progress of . . . useful Arts, by securing for limited Times to . . . Inventors the exclusive Right to their . . . Discoveries.[312]
>
> [(b) (for copyrights)] The Congress shall have Power . . . To promote the Progress of Science . . ., by securing for limited Times to Authors . . . the exclusive Right to their . . . Writings . . . .[313]

Each provision is a distinct grant of authority and has distinct subject matter. The Constitution speaks of "useful Arts," "Inventors," and "Discoveries" when it refers

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phenomena. An invention that has a practical application in the technological arts satisfies the utility requirement.

The applicant is in the best position to explain why an invention is believed to be useful. Guidelines, 61 Fed. Reg. 7478, 7479-80 (1996).

This quotation shows that the PTO has confused the utility and subject matter requirements. References to the "technological arts" (which the PTO equates with the "useful arts") and to "abstract ideas, laws of nature or natural phenomena" are references that are relevant to the analysis of patentable subject matter. References to an invention being "useful" and to "the utility requirement" are references to a different issue entirely—that of whether the invention is useful.

Others have also confused "technological arts" with "usefulness." *See, e.g., In re* Schrader, 22 F.3d 290, 297 (Fed. Cir. 1994) (Newman, J., dissenting) (equating *In re* Musgrave's statement that patentable subject matter must be within the "technological arts" as a requirement that the subject matter of the claim be "useful").

308. Professor Chisum writes, "Useful Arts is synonymous with the contemporary concept of technological arts and is contrasted with 'Science' the promotion of which is the object of the copyright system." 1 CHISUM, *supra* note 7, at GI-23; *see also* BEIRNE STEDMAN, PATENTS 6 (1939) ("There is a wide distinction between a patent and a copyright."); Lloyd L. Weinreb, *Copyright for Functional Expression*, 111 HARV. L. REV. 1149, 1180 (1998) ("[T]he essential distinction [between copyright and patent] had been between books, broadly conceived, and machines.").

The distinction drawn here is between utility patents and copyrights. Design patents, in which protection is given to the ornamental appearance of an object, were arbitrarily placed in the patent statute and are administered by the PTO, but have a subject matter which is more closely allied to copyrights.

309. The Constitution permits, but does not require, either a patent or copyright statute. Congress has placed protecting ornamental designs within the Patent Act as design patents rather than within the Copyright Act, and nothing in the Constitution suggests that this was impermissible. Likewise, nothing in the Constitution suggests that Congress would be prevented from replacing the present Copyright and Patent Acts with a unified system in which all creative works are subject to an administrative determination of their worthiness for protection. Indeed, Congress placed the set of instructions in computer programs within the Copyright Act notwithstanding the fact that such instruction sets are the kind of utilitarian works we customarily associate with the patent system.

310. *See supra* text accompanying note 204.

311. Others have noted that this is the appropriate manner to read the clause. *See, e.g.*, 1 CHISUM, *supra* note 7, at 3 of the overview section [hereinafter § OV-3]; Walterscheid, *supra* note 239, at 51; Weinreb, *supra* note 308, at 1181 n.125.

312. U.S. CONST. art. I, § 8, cl. 8.

313. *Id.*

to patentable subject matter.[314] When referring to copyrightable subject matter, the Constitution speaks of "Science," "Authors," and "Writings."[315]

Therefore, patentable subject matter should be distinguished from copyrightable subject matter unless there is a clear congressional indication otherwise.[316] If someone creates a new kind of ceramic material, we would expect her to apply for a patent on that material and we would not allow her to obtain a copyright on that material. On the other hand, if someone creates a new musical composition, we would expect him to obtain a copyright on that work and would not allow him to obtain a patent for it.[317]

The reason for this is rooted in history and our common understanding of the differences between copyright and patent. In general, copyright has to do with conveying information, entertaining, and portraying appearances. Patent, in contrast, has to do with utilitarian functionality.[318] When the Constitution was written, the writers of that document distinguished between copyright and patent along these lines and used different sets of words to describe these different subjects.[319] This is corroborated by looking at the historical record. Early patents dealt with a variety of machinery and other technological products and processes.[320] The first copyright statute limited protection to maps, charts, and books—all nonfunctional works.[321]

In copyright cases, courts have attempted to maintain a distinction between the functional aspects of a work and the nonfunctional aspects. This distinction can be traced back at least as far as *Baker v. Selden*.[322]

In *Baker*, the Supreme Court held that a person who used a system of bookkeeping did not infringe the copyright held by the person who had first described the system.[323] The system involved the use of ruled lines and headings and the accused

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314. *See id.*

315. *See id.*

316. *See supra* note 309 and accompanying text.

317. Some works, such as lamp bases and computer programs, may combine copyrightable subject matter and patentable subject matter. Copyright law attempts to distinguish the portions of such works which represent copyrightable subject matter from the portions which are within the realm of the patent system. *See, e.g., infra* note 318.

318. Copyright law attempts to capture the flavor of the distinction between copyrights and patents in determining the copyrightable aspects of some works which combine copyrightable subject matter and patentable subject matter. The Copyright Act defines a "useful article" as "an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information." *See* 17 U.S.C. § 101 (1994). For such an article, copyright protects:

> works of artistic craftsmanship insofar as their form but not their mechanical or utilitarian aspects are concerned; the design of a useful article, as defined in this section, shall be considered a pictorial, graphic, or sculptural work only if, and only to the extent that, such design incorporates pictorial, graphic, or sculptural features that can be identified separately from and are capable of existing independently of, the utilitarian aspects of the article.

Id.

319. Professor Chisum agrees. He writes, "Useful Arts is synonymous with the contemporary concept of technological arts and is contrasted with 'Science' the promotion of which is the object of the copyright system." 1 CHISUM, *supra* note 7, at GI-23.

320. *See supra* text accompanying note 243.

321. Act of May 31, 1790, ch. 15, 1 Stat. 124.

322. 101 U.S. 99 (1879). Unless otherwise stated, the facts that follow are paraphrased from *Baker*, 101 U.S. at 99-101, and refer to this citation.

323. *See id.* at 104.

person had used essentially the same kind of lines and headings. The Court held that the copyright on the book only covered the explanation of the bookkeeping system; it did not prevent anyone from using the system.[324] The court gave examples of books concerning the composition and use of medicines, or on the construction and use of ploughs, or watches, or churns. From all of these, the Court deduced the general principle:

> But the principle is the same in all. The description of the art in a book, though entitled to the benefit of copyright, lays no foundation for an exclusive claim to the art itself. The object of the one is explanation; the object of the other is use. The former may be secured by copyright. The latter can only be secured, if it can be secured at all, by letters-patent.[325]

In other copyright cases, other courts have made the same observations of the difference between copyrights and patents. For example, in *Bateman v. Mnemonics, Inc.*,[326] the Eleventh Circuit, in dictum, wrote:

> Where a portion of the computer program constitutes an unprotectable method of operation or process, it is not an expressive part of the work. It is particularly important to exclude methods of operation and processes from the scope of copyright in computer programs because much of the contents of computer programs is patentable. Were we to permit an author to claim copyright protection for those elements of the work that should be the province of patent law, we would be undermining the competitive principles that are fundamental to the patent system.[327]

The court cited a number of cases, including *Atari Games Corp. v. Nintendo of America, Inc.*[328] In *Atari*, the Federal Circuit expressed a similar thought: "[P]atent and copyright laws protect distinct aspects of a computer program."[329] Patent law "provides protection for the process or method performed by a computer in accordance with a program," whereas copyright law protects only "the expression of that process or method."[330] When the Federal Circuit speaks of "the expression of that process," it should be understood that it is talking about the copyrightable aspects of the work.[331]

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324. *See id.*
325. *Id.* at 105.
326. 79 F.3d 1532 (11th Cir. 1996).
327. *Id.* at 1541 n.21.
328. 975 F.2d 832 (Fed. Cir. 1992).
329. *Id.* at 839.
330. *Id.*
331. The word "expression" is often used in copyright cases in opposition to the word "idea" in order to suggest the difference between uncopyrightable ideas and copyrightable expressions of ideas. Thus, the word "expression" is associated in intellectual property law with copyrightable material. Perhaps this is why the Federal Circuit used the term in this quotation. However, it is not clear that the word "expression" distinguishes patents from copyrights. Both patents and copyrights involve creativity and there is probably no difference in the kind of creativity required for either of them. By the same token, it seems difficult to imagine why an inventor's "expression" of a patent idea would be different in kind from an author's "expression" of a copyright idea.

The Copyright Act also embodies this distinction by limiting protection for "pictorial, graphic, and sculptural works" to their "form but not their mechanical or utilitarian aspects."[332]

Courts in patent cases should follow the lead of the courts in copyright cases and not allow patentable subject matter to expand to include copyrightable subject matter unless there is a clear congressional indication otherwise. Determining the boundary between these two realms is the subject of the next section.

M. "Discoveries" in the "Useful Arts" Are Generally Limited to Things that Are "Functional"

The concept that best describes the boundary between patentable subject matter and copyrightable subject matter is that of "functionality." Functionality requires a careful definition. As we have seen, the concept of "usefulness" is inappropriate as both copyrighted works and patented works can be useful. Similarly, one cannot attempt to define patentable subject matter in general terms such as "creativity" because that term is broad enough to include both copyrighted and patented works.

A work is categorized as functional . . . if it performs some utilitarian task other than to inform, entertain, or portray an appearance to human beings."[333] In contrast, a work is nonfunctional if its only purpose is to inform, entertain, or portray an appearance to human beings.

Nonfunctional works are not the proper subject matter of patents. Instead, they are the proper subject matter for copyrights. Books and maps inform. Music, dance, and games entertain.[334] Pictures portray an appearance to human beings. The definition of "functionality" accurately places them on the copyright side of the boundary between patents and copyrights. All of these things are copyrightable subject matter, not patentable subject matter.

On the other hand, a process for manufacturing ethanol, a machine for manufacturing disk brakes, and a computer keyboard all perform utilitarian tasks other than to inform, entertain, or portray an appearance to human beings. The definition accurately places them on the patent side of the boundary.

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332. *See* 17 U.S.C. § 101 (1994); *see also, e.g.*, Mazer v. Stein, 347 U.S. 201 (1954) (stating that "works of artistic craftmanship, insofar as their form but not their mechanical or utilitarian aspects are concerned" are copyrightable).

333. Dennis S. Karjala, *A Coherent Theory for the Copyright Protection of Computer Software and Recent Judicial Interpretations*, 66 U. CIN. L. REV. 53, 59 (1997) [hereinafter Karjala 1997]. This definition was put forward by Professor Karjala in order to distinguish between patent and copyright subject matter. *See also* Dennis S. Karjala, *Copyright Protection of Computer Software, Reverse Engineering, and Professor Miller*, 19 U. DAYTON L. REV. 975, 977 (1994) [hereinafter Karjala 1994]. Professor Karjala's 1994 article was originally published under the erroneous title *Copyright Protection of Computer Documents, Reverse Engineering, and Professor Miller*.

334. This suggests that patents on games and game equipment, such as that in *Callison v. Dean*, 70 F.2d 55 (10th. Cir. 1934), should be refused as not being patentable subject matter. Their only purpose is to entertain. In *Callison*, the patent was for an amusement device that utilized a coin-controlled pistol to propel a ball to a target, after which the ball would return by rolling down an inclined plane. *See id.* at 56. The case held that the patent was "useful" within the meaning of the patent statute. *See id.* at 58. Apparently, the issue of whether the device was patentable subject matter was not raised. The issue of whether entertainment equipment and methods should be patentable subject matter is discussed more extensively later in this article. *See infra* notes 348-65 and accompanying text.

Unless there is a clear congressional indication otherwise, patentable subject matter should remain limited to the realm of functional works. That does not mean that everything that is functional is patentable subject matter.

The boundary between functional and nonfunctional works is not perfect.[335] For example, the set of instructions in the source code of a computer program can be functional,[336] yet Congress has placed them within the subject matter of copyright.[337] There are good reasons for doing this, as discussed by Professor Karjala in his excellent article.[338] What is interesting is that while courts have honored this congressional determination and have extended copyright protection to the source code and object code of computer programs, courts have generally refused to extend copyright protection to specific functional features of computer programs.[339] In other words, although Congress placed the instructions of computer

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335. Professor Karjala, who put forth the functionality definition, admits this imperfection, but comments on why the definition is helpful:

> The functionality-nonfunctionality distinction between patent and copyright is therefore not historically perfect. It is surely correct to say, however, that copyright has in the main eschewed protection of function, and judicial and legislative efforts to allow copyright to control markets for functional products have almost always been met with fierce debate. Patent and copyright have evolved alongside one another for a period of several hundred years, and yet the protection schemes are very different. There must be some reason other than inertia that the two have coexisted so long. Only functionality explains this dichotomy in any fundamental way.

See Karjala 1997, *supra* note 333, at 65 (footnote omitted).

Others have written about alternative legal regimes that might be better suited to the protection of kinds of works that are found at the boundary between copyright and patent and about the indefiniteness of that boundary. *See, e.g.*, Rochelle Cooper Dreyfuss, *A Wiseguy's Approach to Information Products: Muscling Copyright and Patent into a Unitary Theory of Intellectual Property*, 1992 SUP. CT. REV. 195 (1992); J.H. Reichman, *Charting the Collapse of the Patent-Copyright Dichotomy: Premises for a Restructured International Intellectual Property System*, 13 CARDOZO ARTS & ENT. L.J. 475 (1995); J.H. Reichman, *Electronic Information Tools—The Outer Edge of World Intellectual Property Law*, 17 U. DAYTON L. REV. 797 (1992); J.H. Reichman & Pamela Samuelson, *Intellectual Property Rights in Data?*, 50 VAND. L. REV. 51 (1997); J.H. Reichman, *Legal Hybrids between the Patent and Copyright Paradigms*, 94 COLUM. L. REV. 2432 (1994).

336. A source code listing of a program, on paper, only provides information to humans and is nonfunctional. When assembled and compiled and stored in a computer, the set of instructions may provide information to humans, but that is not its intended function and extracting the information for humans to understand is very difficult. In this form, the instructions are used in a computer to perform various tasks. At this point, they are functional under the definition here.

The Guidelines reach the same result in their discussion of "nonfunctional descriptive material" and "functional descriptive material." *See* Guidelines, 61 Fed. Reg. 7478, 7479-80 (1996).

337. A "computer program" is defined in the Copyright Act as "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." 17 U.S.C. § 101 (1994). The definition is limited to the instructions in the program and not to other features such as the user interface or the set of functions which the program can perform. These other features may be protected by copyright or patent law, but they do not fall within this particular definition.

338. *See* Karjala 1997, *supra* note 333. This article builds upon the ideas of one of Professor Karjala's earlier works. *See* Karjala 1994, *supra* note 333.

339. *Compare* Bateman v. Mnemonics, Inc., 79 F.3d 1532 (11th Cir. 1996), Lotus Dev. Corp. v. Borland Int'l, Inc., 49 F.3d 807 (1st Cir. 1995), *aff'd by an equally divided Court*, 516 U.S. 233 (1996) (per curiam), Gates Rubber Co. v. Bando Chem. Indus., Ltd., 9 F.3d 823 (10th Cir. 1993), and Computer Assocs. Int'l., Inc. v. Altai, Inc., 982 F.2d 693 (2d Cir. 1992) *with* Whelan Assocs., Inc. v. Jaslow Dental Lab., Inc., 797 F.2d 1222 (3rd Cir. 1986).

In part, courts may be responding to the fact that when Congress extended protection to computer programs, it defined computer programs as the "set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." *See* 17 U.S.C. § 101 (1994). This would serve to bring the object code and the set of instructions in the source code into copyright, while leaving the set of functions that the program performs outside copyright. *See generally* Karjala 1997, *supra* note 333.

programs inside copyright, courts have been reluctant to allow any significant expansion of copyright subject matter beyond this limited amount. Thus, the fact that copyrightable subject matter has expanded into the functional realm in this instance does not undermine the general validity of the functionality/non-functionality dichotomy between patents and copyrights.

Courts deciding patent cases should follow the lead of the courts in copyright cases and distinguish between the functional aspects of a work and the nonfunctional aspects.[340] Works that are nonfunctional, as defined here, fall on the copyright side of the boundary between copyright and patent subject matter. Only works that are functional can fall on the patent side of the boundary. The following sections explore various implications of this idea.

N. *Printed Matter Is Usually Not Patentable Subject Matter because It Is "Nonfunctional"*

One application of the distinction between copyright subject matter and patent subject matter is that of "printed matter."[341] Historically, copyrights have been the home to books, maps, charts, musical compositions, and other "printed matter." These things are "nonfunctional." They fall into the category of copyright subject matter.[342]

"Printed matter" has generally not been considered to be patentable subject matter.[343] Printed matter may be informative, but it is usually not "functional" in the sense we are using that term. The fact that printed matter may be useful does not mean that it falls within the "useful arts."

Although printed matter is generally not patentable subject matter, patentable inventions may contain printed matter. This distinction is readily understood by reference to the concept of "functionality." If a newly created work "performs some utilitarian task other than to inform, entertain, or portray an appearance to human beings," then it falls on the patentable subject matter side of the line.[344] One has to

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340. Courts have recognized that other works also have both functional and non-functional aspects, and that the patent and copyright systems can protect different aspects of such works. *See, e.g.*, Mazer v. Stein, 347 U.S. 201 (1954) (dealing with protection for lamp bases).

341. *See* Samuelson, *supra* note 195, at 1037 n.36 (stating that "printed matter is among the set of things that are 'writings' protectible by copyright law, not inventions in the 'useful arts'").

342. The source code of a computer program represents an exception to this general statement, as a computer uses the instructions in the computer program to perform tasks. The computer program is functional because it is not simply matter that provides information to humans.

343. *See* Bloomstein v. Paramount Pictures Corp., 1998 U.S. Dist. LEXIS 20839 (N.D. Cal. March 10, 1998); *In re* Russell, 48 F.2d 668 (C.C.P.A. 1931); *see generally* 1 CHISUM, *supra* note 7, § 1.02[4] (discussing patentable subject matter, and stating that "[p]rinted matter alone and by itself does not constitute a 'manufacture' and is not within the statutory classes of patentable subject matter").

In re Gulack, 703 F.2d 1381 (Fed. Cir. 1983), is sometimes mentioned as a case in which printed matter was allowed. The claims in *Gulack* were for an endless band of material with certain numbers printed on it. *See id.* at 1382-83. The numbers had to be selected in a certain way to make the device into "an educational and recreational mathematical device." *See id.* at 1383. Although the examiner had rejected the claims under both §§ 101 and 103, the board, for reasons not given in the appellate case, reversed the § 101 rejection, so the Federal Circuit only addressed the obviousness rejection under § 103. *See id.* Although we don't know what the Federal Circuit would have said about the § 101 issue, it seems clear that the claims in the case are nonfunctional—they only provide information to human beings. They fall on the copyright side of the boundary, and the claims should have been rejected as unpatentable subject matter.

344. This does not mean that programs are always within patentable subject matter. *See, e.g.*, Gottschalk v.

examine an invention to determine whether it performs some utilitarian task even though the printed matter in the invention may also provide information to us.

Computer programs represent an excellent example of printed matter that is functional. A computer program can be read by programmers and therefore serves to inform. The program, however, also performs other tasks when used in a computer.[345] Therefore, computer programs are functional.[346]

As the above discussion illustrates, the concept of functionality provides a principled way for courts to avoid extending patent protection to books and other nonfunctional printed matter. If a work is nonfunctional, it falls on the copyright side of the boundary and is not patentable subject matter. Books, music on CDs, maps, charts, and other traditional copyright subject matter fall into this category of nonfunctional works.[347]

O. *Further Reflections on the Boundaries of the "Discoveries" in the "Useful Arts:" Of Entertainment Methods and Equipment, Accounting Systems, and Methods of Doing Business*

The phrase "useful arts" generally conjures up images of engineers toiling in laboratories. We often think of the useful arts as involving "technological arts" and contrast this area of creativity with that of copyright.[348] Patents regularly issue, however, for creative works that are outside the realm of traditional electrical, mechanical, chemical and other fields of engineering.

This subsection explores some subject matter areas which, historically, have been considered outside the scope of patentable subject matter or which might be considered to be outside the scope.

Benson, 409 U.S. 63 (1972) (holding that a program for converting binary coded decimal numerals to pure binary numerals is not patentable subject matter).

345. *See, e.g., In re* Lowry, 32 F.3d 1579 (Fed. Cir. 1994). *Lowry* was an important case in which the Federal Circuit reversed a "printed matter" rejection to the patentability of a system of organizing data in a computer memory. *See id.* at 1584. Claim one was for a computer memory which contained data stored in accordance with the system. *See id.* at 1581. Other claims included data processing systems using such a computer memory. *See id.* at 1581-82. The claimed memory is "functional" because it does more than provide information to human beings; it is an organizational structure. *See id.* at 1583. A user may or may not be aware of that structure, showing that the structure, per se, is not information.

Professor Karjala argues that the computer memory is designed for processing information by a machine, and hence that it is functional because it does more than provide information to human beings. *See* Karjala 1997, *supra* note 296, at 60 n.21. This author respectfully disagrees with that method of analysis. Music recorded on a digital compact disc is also designed solely for being processed by a machine, yet that is not a reason why such music should be classified as being functional.

Unfortunately, the Federal Circuit relied on the same ground (that the matter was designed for processing by a machine) in holding that the claim was not "printed matter." *See Lowry*, 32 F.3d at 1582. The example of a digital music recording shows that this analytical approach fails.

346. Professor Weinreb writes:

> However we may have regarded programs two decades ago, it is apparent now that they are valuable for the work that they do and not for what they by themselves communicate to us. To prefer the "bookish" aspects of a program to its functional nature is surely to elevate the incidental over the essential.

Weinreb, *supra* note 308, at 1250.

347. A literalist might try to call these works patentable subject matter on the grounds that they are "manufactures." We have already seen that such a literal reading of § 101 is untenable. *See supra* notes 187-96 and accompanying text.

348. *See supra* note 238 and accompanying text.

One such area is that of "business methods." A number of courts have, sometimes in dictum, indicated that business systems are not patentable subject matter, suggesting that such systems are not within the "useful arts."[349] However, a recent district court decision which used the business methods doctrine to invalidate patent claims was reversed on appeal.[350]

In its *State Street* decision, the Federal Circuit expressly repudiated the "business method" doctrine.[351] The court stated that "[s]ince the 1952 Patent Act, business methods have been, and should have been, subject to the same legal requirements for patentability as applied to any other process or method."[352]

Unfortunately, this reasoning is lacking. It acts as if the words of § 101 were meant literally, rather than as terms of art. As this article has already shown, such a literal reading of the word "process" in § 101 is impermissible.[353] One has to dig deeper into the meaning of the words "machine" and "process" in § 101 before deciding whether business methods should not be patentable subject matter.

This raises the question of whether there is any constitutional basis for thinking that business methods are not the kind of "discoveries" within the "useful arts" that Congress can protect under the patent system.

Another category of creativity is that of the entertainment industry. Are new golf clubs, new methods of doing slam dunks, new video arcade equipment, new gambling procedures, or new techniques for doing computer animation for use in motion pictures patentable subject matter? That they involve creativity is beyond question. That they can fall within the literal terms of the classes of patentable subject matter in § 101 is also apparent. That they are "useful" in the broadest sense of that word is also the case. But these truths do not answer the question of whether they meet the constitutional test of being "discoveries" within the "useful arts."

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349. *See, e.g., Ex parte* Murray, 9 U.S.P.Q.2d (BNA) 1819 (Bd. Pat. App. & Inter. 1988) (rejecting a claim for an accounting method as unpatentable subject matter on the grounds that it was a method of doing business); Hotel Sec. Checking Co. v. Lorraine, 160 F. 467, 469 (2d Cir. 1908) ("A system of transacting business disconnected from the means for carrying out the system is not, within the most liberal interpretation of the term, an art."). *But see* State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 149 F.3d 1368 (Fed. Cir. 1998) (repudiating the business methods exception); Paine, Webber, Jackson & Curtis, Inc. v. Merrill Lynch, Pierce, Fenner & Smith, Inc., 564 F. Supp. 1358 (D. Del. 1983) (finding that a claim for a system of combining three kinds of customer accounts (a charge card account, a money market account, and a brokerage account) was patentable subject matter).

Some have pointed out that the cases do not articulate a principled basis for the business methods doctrine, or that the doctrine is unworkable in practice. *See, e.g.*, Rinaldo Del Gallo, III, *Are "Methods of Doing Business" Finally Out of Business as a Statutory Rejection?*, 38 IDEA 403 (1998); Chiappetta, *supra* note 11, at 131.

350. *See* State St. Bank & Trust Co. v. Signature Fin. Group, Inc., 927 F. Supp. 502 (D. Mass. 1996), *rev'd*, 149 F.3d 1368 (Fed. Cir. 1998).

351. *See State Street*, 149 F.3d at 1375.

352. *Id.* The decision also notes that the PTO seems to have abandoned use of this ground for rejecting patents. Former sections of the Manual of Patent Examining Procedures contained § 706.03(a) which said that "[t]hough seemingly within the category of process or method, a method of doing business can be rejected as not being within the statutory classes." *See State Street*, 149 F.3d at 1397. This section has now been deleted. *See id.* The recent Guidelines indicate the new position of the PTO: "Office personnel have had difficulty in properly treating claims directed to methods of doing business. Claims should not be categorized as methods of doing business. Instead, such claims should be treated like any other process claims, pursuant to these Guidelines when relevant." Guidelines, 61 Fed. Reg. 7478, 7479-80 (1996).

353. *See supra* notes 187-96 and accompanying text.

We have seen that although the categories of patentable subject matter—the "useful arts"—can be expanded to include new technologies,[354] these classes are not infinitely malleable. For example, the "useful arts" does not include new books, music, or other subject matter that traditionally has fallen within the subject matter of copyright.

The evidence for what the drafters of the Constitution had in mind by the term "useful arts" is meager. We only have a limited indication of what the first patent applications covered.[355] More generally, President George Washington, in addressing Congress on January 8, 1790, spoke of the need for a patent act in order to advance "agriculture, commerce, and manufacturing."[356] Both houses of Congress concurred.[357]

The term "useful arts," however, should not be limited to the areas of technology that were known in the late eighteenth century. Indeed, one of the major benefits of the patent system is to encourage the development of new technological areas.

One possible argument is that the categories of patentable subject matter should not expand to include categories that were in existence at the time of the Constitution but were not included as patentable subject matter at that time.[358] If it is accurate to say that business methods, accounting systems, and entertainment equipment and processes existed but were not contemplated as being within the "useful arts" at that time,[359] then that might be an appropriate ground for excluding them from being patentable subject matter.

A look at the analogous question in copyright law suggests that this argument may not succeed. The constitutional mandate of copyright is to "promote the Progress of Science."[360] The word "Science" in the Constitution does not have its present meanings for fields such as biology, chemistry, and physics. Instead, in the Constitution, "Science" means learning and knowledge.[361]

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354. *See supra* Part VI.D.-E.

355. *See supra* text accompanying note 243.

356. *See supra* note 244 and accompanying text.

357. *See supra* note 245 and accompanying text.

358. A secondary reason for excluding these kinds of creativity might be found on policy grounds. An underlying policy of the patent system is that it is designed to encourage investments in research and development which might not otherwise be made. It would be most interesting to know whether such an incentive is needed to encourage the development of new business methods or new entertainment equipment and methods.

On purely intuitive grounds, it would seem likely that new business systems typically do not require the incentives offered by the patent system nor do they typically require large amounts of money in research and development. Consider the first idea for franchise systems, for drive-in movies, for the combination of a securities brokerage/cash management system, for systems to prevent fraud by employees of restaurants, or for a checking account with an attached line of credit. One might well believe that new business methods such as these are likely to arise quite naturally in the course of a competitive economy as businesses attempt to thrive. If this is the case, then extending patent protection to new business methods would do more to hamper a free economy than to promote innovation.

Similarly, one would wonder whether incentives are needed to encourage people to develop new methods of holding golf clubs or dunking basketballs, to create new golf clubs, or to develop new gambling systems.

359. Of course, it may be quite difficult to determine whether the drafters of the Constitution included these kinds of subject matter within the term "useful arts."

360. *See supra* note 204 and accompanying text.

361. *See* Infodek, Inc. v. Meredith-Webb Printing Co., 830 F. Supp. 614, 621 n.8 (N.D. Ga. 1993); American Geophysical Union v. Texaco, Inc., 802 F. Supp. 1, 9 (S.D.N.Y. 1992).

The first copyright statute authorized copyrights for books, maps, and charts, thus establishing a fairly narrow range of copyrightable subject matter.[362] Today, copyright subject matter has expanded enormously, including areas such as choreography, sculpture, music, advertisements, computer programs, and architecture. At least some of these areas (sculpture, music, advertisements and architecture) existed in the late eighteenth century, and one might harbor some doubts as to whether the authors of the Constitution would have thought that all of these subject matter areas would advance learning and knowledge. Yet, the Supreme Court has held that advertisements are within the scope of permissible copyrightable subject matter,[363] suggesting that something that existed, but was outside the scope of the term "writings" at the time of the drafting of the Constitution, could later be made part of copyrightable subject matter.

Even if the argument fails that the categories of patentable subject matter can expand to include subject matter that was not included at the time the Constitution was written, that does not mean that the concepts of "discoveries" and "useful arts" can or should be expanded to include inventions which are business methods, accounting systems, entertainment methods, or entertainment equipment. It may simply mean that it is difficult to articulate the reason why a given kind of subject matter should be excluded.

A second reason for limiting the scope of patentable subject matter is at once more nebulous and more compelling. Our common understanding of what is patentable suggests these limits. Concededly, this is similar to the "I know it when I see it" approach, but is grounded on the slightly firmer basis of a societal understanding. Professor Weinreb, in analyzing whether certain facets of computer programs can and should be protected as copyrightable subject matter, argues that copyright theories are unable to help us define the boundaries of copyrightable matter and that we are left with, and must ultimately rely upon, our conventional understanding that copyrights deal with book-like things.[364] This same argument would seem to apply equally to the question of the boundaries of patentable subject matter. Our conventional understanding of patents is that they apply to machines and machine-like processes and things. Our failure to find a theory that justifies this understanding does not mean that the understanding is incorrect. It may be that the understanding should be treated as correct unless we can find a theory that indicates a need to change that understanding.

This article has argued that the Constitution provides the limits of patentable subject matter, but the possibility that the Constitution may be indeterminate should not be ignored. If it is indeterminate, then we should rely upon our conventional understanding of what kinds of things must be patentable. In this context, the repeated comments made by courts, commentators, and the PTO over the years to the effect that business methods are not patentable subject matter should be taken as strong evidence that business systems are perceived to be far outside the bounds

362. *See supra* note 248.

363. *See supra* note 249 and accompanying text.

364. *See* Weinreb, *supra* note 308, at 1153. By "conventional," Professor Weinreb "mean[s] only that what is so described is generally unquestioned, not because the evidence or arguments for it are especially convincing, but simply because it is and has been accepted." *Id.* at 1153 n.7.

of the "useful arts."[365] Similarly, the fact that patents have virtually never been sought for accounting systems and sports moves suggests that these should also be treated as far outside the scope of patentable subject matter. Sports and entertainment equipment, on the other hand, have been accepted as patentable subject matter for a long time and a deference to this conventional view is equally appropriate.

P. Purely Mental Processes Are Not Patentable Subject Matter

Although this article has discussed constitutional limits on patentable subject matter based on the Patent Clause of the Constitution, it is appropriate to consider other constitutional provisions. Another constraint on patentable subject matter is the First Amendment. Although written to prohibit governmental interference with freedom of speech, the First Amendment also prevents the government from interfering with freedom of thought.[366] Thus, a patent that purports to cover a process that can be done mentally should be prohibited.[367]

For example, a claimed patent on a process for improving gymnastics performances by mentally visualizing the entire routine prior to performing it should be barred from patentable subject matter on First Amendment grounds.[368] Similarly, a patent for a process of mathematical calculations should be prohibited unless it is confined to cover only machine-implemented versions of the method.[369]

On the other hand, the patent system should encourage innovations that replace human labor, including mental labor, with machines. Thus, a patent for a process done by machines should generally be patentable subject matter even though the same process was formerly done mentally.[370]

If *In re Musgrave*[371] suggested that the mental steps doctrine is inapplicable to the issue of patentable subject matter, this author respectfully disagrees. In *Musgrave*, the court discussed a claim for a process intended to be implemented entirely by machine, but which process, in theory,[372] might have been done by

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365. *Cf.* Samuelson, *supra* note 195, at 1036 n.34 (commenting that the lack of explanation for the mental steps doctrine "may be a sign of how far outside the bounds of the patent system mental processes are perceived to be"). Until recently, the PTO rejected claims drawn to business methods. *See supra* note 352.

366. *See* Wooley v. Maynard, 430 U.S. 705, 714 (1976); Griswold v. Connecticut, 381 U.S. 479, 482 (1965); Palko v. Connecticut, 302 U.S. 319, 326-327 (1937); *cf. In re* Prater, 415 F.2d 1393, 1400 n.20 (C.C.P.A. 1969) (discussing the PTO's argument that "'a patent containing process claims of such breadth as to confer upon a patentee the right to exclude others from thinking in a certain manner' would run afoul of the First, Ninth, and Tenth Amendments to the Constitution").

367. *See, e.g., Ex parte* Hitchins, 99 U.S.P.Q. (BNA) 288, 292 (Bd. Pat. App. 1953).

368. In addition, such a claim could probably be rejected on grounds of vagueness or indefiniteness, as it may rely on subjective or emotional responses of people. These responses would vary from person to person. *See, e.g.*, Katherine P. Ambrose, Comment, *The Mental Steps Doctrine*, TENN. L. REV. 903 (1981); Norman D. McClaskey, *The Mental Process Doctrine: Its Origin, Legal Basis, and Scope*, IOWA L. REV. 1148 (1970).

The indefiniteness and vagueness grounds would not apply to a claim which involved definite, objective steps. The First Amendment objection to such a claim, however, would remain valid.

369. *Cf. In re* Prater, 415 F.2d 1393 (C.C.P.A. 1969) (holding invalid a patent claim for a process said to be limited to machine implementation, but not expressly made so, because of failure to particularly point out and distinctly claim the subject matter regarded as applicant's invention).

370. This general statement is subject to exceptions for certain mathematical calculations and other nonfunctional processes. *See, e.g.*, Gottschalk v. Benson, 409 U.S. 63 (1972).

371. 431 F.2d 882 (C.C.P.A. 1970).

372. In the real-world, it is unlikely that the claims could have been done by mental steps aided by pencil and paper.

mental steps.[373] The court seems to dismiss the mental steps doctrine by writing, "All that is necessary, in our view, to make a sequence of operational steps a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of 'useful arts.'"[374] If the court was suggesting that the First Amendment can be ignored in determining patentable subject matter, the court has gone farther than is warranted.[375]

VII. CONCLUSION

The Supreme Court has issued three decisions concerning mathematical algorithm-related inventions and computer-related inventions and those decisions have failed to provide appropriate guidance to lower courts. The Federal Circuit (and earlier, the C.C.P.A.) tried to understand and follow those cases, but has been unable to do so in a consistent and principled manner. They have developed the *Freeman-Walter-Abele* test and the Claims-as-a-Whole test, but different panels of the Federal Circuit apply these tests in different ways, so that no one knows what the result will be in any particular case until a particular panel of judges makes a decision.

A major problem with the analysis being used by some panels of the Federal Circuit is that they read the words of § 101 of the Patent Act literally. Instead, the words in § 101 are terms of art and must be construed in a manner that is consistent with the Constitution.

This article goes beyond the current debates and analyses and puts forth an analysis of patentable matter that is grounded in the Constitution. It notes that there are at least four constitutionally-based requirements for patentability. One is that a new creative work must involve "invention," a constitutional requirement that is now partially codified by the non-obviousness requirement of the Patent Act.

The second constitutional requirement is that there must be a proper quid pro quo of public benefit in order for a patent to issue. This requirement, codified in part in the novelty requirements of the Patent Act, bars patents that would remove something from the public domain. This constitutionally-required quid pro quo might also account for the Supreme Court's decisions that one cannot claim so broadly that the private benefit of a patent monopoly would far exceed the public benefit from the particular invention made.

The third constitutional requirement is that a work must involve a useful application of knowledge. In part, this constitutional requirement has been codified as the requirement that a new invention has to be "useful" in order to be patentable.

The fourth constitutional requirement is that a new invention must be a "discovery" within the "useful arts"—that it be the proper kind of work to be

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373. *See Musgrave*, 431 F.2d at 885-88.

374. *See id.* at 893.

375. Justice Stevens, dissenting in *Diamond v. Diehr*, 450 U.S. 175, 195-201 (1981), comments on the mental steps doctrine and one has the impression that he was troubled by the most recent C.C.P.A. decisions which seemingly rejected this doctrine. Professor Samuelson, commenting on the lack of doctrinal basis for the mental steps doctrine, notes that "this lack of explanation instead may be a sign of how far outside the bounds of the patent system mental processes are perceived to be." Samuelson, *supra* note 195, at 1036 n.34.

subject to a patent. Historically, books, maps, and musical works have been excluded from the subject matter of patents and the Supreme Court has identified other kinds of discoveries that are not subject to patentability, such as laws of nature, natural phenomena, abstract ideas, and mathematical algorithms.

The Supreme Court has not addressed the question of whether such non-technologically-oriented areas as business systems, accounting methods, and entertainment equipment and methods are the proper kind of "discoveries" to fall within the "useful arts." This article discussed some possible arguments for why they might be excluded from being patentable subject matter.

In addition to the constitutional constraints posed by the Patent Clause of the Constitution, the article also noted that the First Amendment imposes additional constraints—in particular, that purely mental processes are not patentable subject matter.

The most difficult determination is which mathematical algorithm-related inventions are patentable subject matter. As this is a constitutional issue, it is up to the Supreme Court to resolve it. The Court, in deciding *Flook* and the related cases involving mathematical algorithms, sent confusing signals about where the line should be drawn between those mathematical algorithm-related inventions that are patentable subject matter and those that are not. This article suggests that *Flook* probably indicates that any patent claim is not patentable subject matter where the claim amounts to the use of a mathematical algorithm or formula in order to calculate a number or numbers.

Notwithstanding that interpretation of *Flook*, this article urges the Court to adopt a different test—one which holds that claims involving mathematical calculations will generally be treated as patentable subject matter if those numbers are part of technological processes and represent real-world phenomena. This test comports better with the other subject matter restrictions and would acknowledge that the application of mathematical calculations in computers is an important arena for patents within the "useful arts."