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A STATISTICAL ANALYSIS OF THE PATENT BAR: WHERE ARE THE SOFTWARE-SAVVY PATENT ATTORNEYS?

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Among the many factors that impact the declining quality of U.S. patents is the increasing disconnect between the technological education patent bar members have and the fields in which patents are being written. Based on an empirical study, the authors show that too few patent attorneys and agents have relevant experience in the most often patented areas today, such as computer science. An examination of the qualification practices of the U.S. Patent and Trademark Office ("PTO") suggests that an institutional bias exists within the PTO that prevents software-savvy individuals from registering with the Office. The paper concludes with suggestions of how the identified problems can be corrected.

I. INTRODUCTION

A decline in the quality of U.S. patents[1] has been widely

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perceived. Often, patents that claim inventions of dubious novelty are issued while those describing important advancements are held hostage to the inability of the U.S. Patent and Trademark Office to competently process more recently developed technologies.[2] As a consequence, marketplace competition is directly and adversely affected.[3]

Commentators from academia, government, media and industry have identified several significant contributing factors to this problem.[4] One causative factor is the increasing difficulty in

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Thanks also go to Jonathan Gruber, Professor of Economics and MacVicar Faculty Fellow at the Massachusetts Institute of Technology for his invaluable assistance in designing the statistical analysis of the PTO data and to David E. Boundy of Cantor Fitzgerald, L.P., for his contributions with regard to agency use of guidelines.

[1] For readers without significant exposure to patent law, a survey of the procedures used to obtain a U.S. patent and an overview of the rights obtained can be found at Thomas G. Field, Jr., *Intellectual Property Some Practical And Legal Fundamentals*, 35 IDEA 79, 79–82, 86–98 (1994).

[2] *See, e.g.*, Terry Carter, *A Patent on Problems*, A.B.A. J. (forthcoming Mar. 2010), *available at* http://www.abajournal.com/magazine/article/a_patent_on_problems ("[T]he PTO has become a burial ground for potential."); *Patently Ridiculous*, N.Y. TIMES, Mar. 22, 2006, at A24, *available at* http://www .nytimes.com/2006/03/22/opinion/22wed1.html (describing a patent issued to protect a peanut butter and jelly sandwich and bemoaning the staffing problems at the PTO).

[3] *Patently Ridiculous*, *supra* note 2 ("many experts say [that the current patent system is] not only restricting competition, but discouraging research and innovation as well.").

[4] *See, e.g.*, Jay P. Kesan & Andres A. Gallo, *Why "Bad" Patents Survive in the Market and How Should We Change?—The Private and Social Costs of Patents*, 55 EMORY L.J. 61 (2006) (citing a dramatic increase in complex high technology and business method patents and arguing that U.S. patent examination is deficient as compared to other national patent offices as PTO experience in examining some of these types of patents is virtually nonexistent granting patent claims that are broader than what is merited by the invention and the prior art, resulting in so-called "bad or improvidently granted patents."); Robert P. Merges, *As Many as Six Impossible Patents Before Breakfast:*

locating prior art in the face of the changing technologies that are submitted to the Office.[5] A second causative factor is the

Property Rights for Business Concepts and Patent System Reform, 14 BERKELEY TECH. L.J. 577, 589–91 (1999) (concluding "the patent system is in crisis," discussing software and business method patents as "extremely poor quality;" citing data that many of the patents being issued in this area overlook highly relevant prior art; and predicting the error rate for these patents likely to be quite high); Katherine E. White, *An Efficient Way to Improve Patent Quality for Plant Varieties*, 3 NW. J. TECH. & INTELL. PROP. 79, 80 (2004) (citing criticism of PTO for granting overly broad or defective biotechnology patents on inventions that are not new and are obvious in light of the prior art and providing suggestions to improve patent quality including increasing capacity of examiners in specific technical fields); *see also Committee Print Regarding Patent Quality Improvement: Hearing Before the Subcomm. on Courts, the Internet, and Intellectual Property of the H. Comm. on the Judiciary*, 109th Cong. 13–14, 56 (2005) (leading recommendations on patent quality reforms developed by the PTO and a broad cross-section of industry and trade associations involved in the formulation of patent policy to avoid invalid patents: "[T]he chief culprit [(low-quality patents)] seems to be patents in the business methods and software area[;]" recognizing that the PTO cannot maintain the staff it needs to administer reviews or implement new quality initiatives; and recognizing that "patents are often granted on the basis of incomplete prior art information"); Steve Lohr, *Administration Seeks Overhaul of Patent System*, N.Y. TIMES, June 6, 2007, http://www.nytimes.com/2007/06/06/business/07cnd-patent.html (last visited Feb. 20, 2010) (on file with the North Carolina Journal of Law & Technology) (citing "over broad" software and business method patents, the Bush administration sought reform of the U.S. patent system by requiring better information from inventors and allowing public scrutiny of applications creating shared responsibility for patent quality among the patent office, applicants and public hoping to curb the rising wave of patent disputes and lawsuits); *Patently Ridiculous*, *supra* note 2 ("Something has gone very wrong with the United States patent system.").

[5] *See, e.g.*, Joelle Tessler, *U.S. Patent System Taps the Internet to Solve Problems*, SEATTLE TIMES, Sept. 15, 2008, http://seattletimes.nwsource.com/html/businesstechnology/2008179958_btcrowdsource15.html (last visited Feb. 20, 2010) (on file with the North Carolina Journal of Law & Technology) (describing the PTO's testing a peer-to-patent system in an attempt to overcome problems including the difficulty in finding, and the lack of, available prior art sources: "The concept behind the program, called Peer-to-Patent, is straightforward: Publish patent applications on the Web for all to see and let anyone with relevant expertise—academics, colleagues, even potential rivals—offer ideas to be passed along to the Patent Office."). After a two-year test of the peer-to-patent system, it was suspended in June of 2009 to allow the system to be evaluated. *See* J. Nicholas Hoover, *Peer-to-Patent Program Stops*

competence (or lack thereof) of the PTO to examine applications seeking protection for newer technologies with which the Office has little experience.[6] The third causative factor, and the primary topic of this paper, is the increasingly inappropriate technical credentials held by the parties responsible for drafting the vast majority of patents: the patent attorney or agent (collectively referred to as the "patent bar").[7]

The technical credentials of the patent bar are examined using a four-step analysis. First, based on an extensive empirical study, we determine the current composition of the patent bar. Second, we evaluate the current rate of demand for different types of patents in the so-called information age. As expected, software patents are being sought at a blistering, ever increasing pace.

Accepting Applications, INFORMATIONWEEK GOVERNMENT, July 10, 2009, http://www.informationweek.com/news/government/policy/showArticle.jhtml?articleID=218401497 (last visited Feb. 27, 2010) (on file with the North Carolina Journal of Law & Technology). According to news reports, the PTO is likely to adopt the program in the near future. Alex Handy, *USPTO likely to Adopt "Peer-to-Patent"*, SOFTWARE DEVELOPMENT TIMES (Feb. 4, 2010), *available at* http://www.sdtimes.com/link/34113.

[6] *See, e.g.*, Diamond v. Diehr, 450 U.S. 175, 197 (1981) (Stevens, J., dissenting):

> Concern with the patent system's ability to deal with rapidly changing technology in the computer and other fields led to the formation in 1965 of the President's Commission on the Patent System. After studying the question of computer program patentability, the Commission recommended that computer programs be expressly excluded from the coverage of the patent laws; this recommendation was based primarily upon the Patent Office's inability to deal with the administrative burden of examining program applications.

[7] The "patent bar" is often regarded somewhat narrowly to encompass only practitioners who file patent applications on behalf of others. *See, e.g.*, In re Brown, 454 F.2d 999, 1011 (D.C. Cir. 1971); *see also* In re Reuning, 276 Fed. Appx. 983, 988–89 (Fed. Cir. 2008) (nonprecedential) (Linn, concurring) ("I have the utmost respect for the members of the Board, the leadership of the PTO, and the members of the patent bar, and while I would like to believe that this case represents an aberration from the standards of practice I have long admired and have come to expect, I am concerned that it does not."). While this group constitutes the largest component of the patent bar, those active in shaping patent law and policy are also significant members of it. *Cf. e.g.*, Panduit Corp. v. All States Plastic Mfg. Co., Inc., 744 F.2d 1564, 1573–74 (Fed. Cir. 1984) (referencing a survey of patent practitioners).

Third, we determine, in comparative terms, whether the growth of the software-savvy fraction of the patent bar is matching the demand; we conclude that it is not. Fourth, we discuss the causes of this imbalanced patent bar composition. From our analysis, the PTO's unique credentialing process and the requirement that applicants pass a unique agency-administered bar examination (hereinafter "patent bar exam") excludes many of the brightest and best-trained computer science graduates from patent bar membership.[8]

Building on the analysis and our conclusions from it, we consider how the PTO has rejected past suggestions of potential problems. Accordingly, we propose ways that the PTO might be induced to solve the problem by recalibrating its criteria for admission into the patent bar.

II. THE NON-LEGAL EDUCATION OF CURRENT PATENT BAR MEMBERS

To determine the educational background of those admitted to practice before the PTO in patent cases, a Freedom of Information Act[9] request was submitted to the Office for selected information from each application form filed by all current members of the

[8] Currently computer science graduates are acceptable if their degrees were conferred by specially accredited institutions. *See* U.S. PATENT AND TRADEMARK OFFICE, GENERAL REQUIREMENTS BULLETIN FOR ADMISSION TO THE EXAMINATION FOR REGISTRATION TO PRACTICE IN PATENT CASES BEFORE THE U.S. PATENT AND TRADEMARK OFFICE § III(A) (Jan. 2008), *available at* http://www.uspto.gov/web/offices/dcom/olia/oed/grb.pdf [hereinafter "GRB"]. As discussed in Part V of this paper, the GRB is a guide for applicants revised from time to time and published by the PTO Office of Enrollment and Discipline (OED). For many years, however, the PTO refused to accept computer science as a major. *See, e.g.*, Michelle J. Burke & Thomas G. Field, Jr., *Promulgating Requirements for Admission to Prosecute Patent Applications*, 36 IDEA 145, 157 (1995) (recounting a 1989 exchange between the chair of an ABA software patent subcommittee and the PTO Commissioner, wherein the latter refused to consider a request that computer science majors be permitted to sit for the patent bar exam).

[9] 5 U.S.C. § 552 (2006). The Act allows for the request for the full or partial disclosure of previously unreleased information and documents controlled by the United States Government and its agencies, including the Patent and Trademark Office.

patent bar.[10] The information sought included all educational institutions listed by the applicant and the degrees earned with the date it was awarded as well as the date upon which the applicant was admitted to the patent bar.[11] In response, over the next year and a half, the PTO provided 54,897 pages of scanned images of the application forms filed by the 26,735 then-current members (as of May 5, 2006) of the patent bar.[12] Converting the PDF files into a computer-readable form, proofreading and normalizing the data,[13] building a database, and doing the statistical analysis took considerable time.[14]

The top-fifty reported nonlegal fields of study of the people admitted to the patent bar are reflected in Table A. The most common degrees are in the hard sciences and engineering.[15] When practitioners are grouped into five broad categories as reflected in

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[10] Letter from Ralph D. Clifford to USPTO FOIA Officer (May 5, 2006) (on file with Professor Clifford).

[11] *Id.*

[12] Letter from Robert Fawcett, USPTO FOIA Officer to Ralph D. Clifford (Mar. 30, 2007) (transmitting 11,483 pages of information); Letter from Robert Fawcett, USPTO FOIA Officer to Ralph D. Clifford (May 18, 2007) (transmitting 9,589 pages of information); Letter from Robert Fawcett, USPTO FOIA Officer to Ralph D. Clifford (Aug. 24, 2007) (transmitting 14,689 pages of information); Letter from Robert Fawcett, USPTO FOIA Officer to Ralph D. Clifford (Sept. 13, 2007) (transmitting 19,136 pages of information) (all on file with Professor Clifford). The information was provided as Adobe Acrobat (PDF) files on CDs. *See* PTO PDF FILES, *available at* http://ipmall.info /hosted_resources/ip_patent_bar.asp. The authors assume that the PTO provided the data for all current members of the patent bar as had been requested.

[13] The data received from the PTO required substantial normalization before they could be combined into a database. For example, some applicants would indicate that they had attended "Yale," others would say "Yale College," while another group stated "Yale University." All of these were changed to indicate "Yale Univ" so that the counts would be accurate. The same normalization was done with the degree earned and the major field of study. During this process, keypunching errors were found that were also corrected.

[14] A description of the statistical analysis that was used can be found in section IV. *See infra* Part IV and accompanying text.

[15] The top three listed major fields were electrical engineering (6,520 occurrences), chemistry (5,733), and biology (4,201). *See infra* Table A. The highest three listed non-science or engineering degrees were business (1,033 occurrences), political science (232), and economics (183). *Id.*

Table B, an interesting, but not unexpected, pattern emerges.[16] Approximately one quarter of the membership was primarily trained in chemical, mechanical, and biological studies; one sixth falls into the electrical sciences; and only one twentieth was educated in computer technology.[17] In other words, approximately ninety percent of the patent bar is trained in chemical, mechanical, biological or electrical fields while less than five percent are trained directly in computer-related fields.[18]

That such a breakdown is unsurprising, however, does not mean that it meets current societal needs.

III. THE CHANGING FACE OF TECHNOLOGY

When the first patent act was adopted in 1790,[19] inventions primarily covered the structure, manufacture, and use of mechanical devices.[20] The dominance of such physical technologies[21] continued into the early twentieth century even as

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[16] Less useful information can be gleaned from the actual degrees earned or the institution attended. Information about this is reflected in Tables C & D, respectively, however. It is hardly surprising, for example, that Bachelor of Science degrees far outnumber other degrees as that degree is completely consistent with the kind of technical training preferred by the PTO. More surprising, perhaps, is that over a thousand patent bar members reported having a business degree (MBA) or that more than a hundred physicians are included among the patent bar roles. The data concerning which university was attended likewise is unsurprising. No institution dominates the bar with the top fifty institutions varying from just over two hundred graduates to just over nine hundred.

[17] *See infra* Table B.

[18] *See id.*

[19] *See* Patent Act of 1790 § 1, 1 STAT. 109 (1790), *available at* http://www.ipmall.info/hosted_resources/lipa/patents/Patent_Act_of_1790.pdf.

[20] *See* Malla Pollack, *The Multiple Unconstitutionality of Business Method Patents: Common Sense, Congressional Consideration, and Constitutional History*, 28 RUTGERS COMPUTER & TECH. L. J. 61, 86 (2002) ("What would an eighteenth century American reader of the Constitution understand to be the limits of 'useful arts'? While not provable beyond any doubt, the best answer seems the mechanical arts, which do not include the mysteries by which merchants conduct commerce.").

[21] For example, the first patents issued in the U.S. all involve mechanical devices or processes. *See, e.g.*, U.S. Patents No. 1–50. The expectation that patents address mechanical inventions continued in the courts well into the

the use of electricity began to emerge.[22] Since the end of the twentieth century, however, the increasing power and speed of computer technology has facilitated expanding uses of software[23] to accomplish tasks that would be otherwise unachievable.

Although nonmechanical technologies have been the subject of many patents over the last few decades,[24] the patentability of an invention that only processes information has not always been recognized[25] and today remains controversial.[26] Beginning at least

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twentieth century. *See, e.g.*, Manhattan General Const. Co. v. Helios-Upton Co., 135 F. 785, 788 (C.C.E.D. Pa. 1905).

[22] *See, e.g.*, Dolbear v. Am. Bell Tel. Co., 126 U.S. 1 (1888) (interpreting the telephone patent); O'Reilly v. Morse, 56 U.S. 62 (1853) (interpreting the telegraph patent). Of course, electronic technology is just as physical as the earlier inventions. Whether it is the flow of water through a water wheel or the flow of electrons through a circuit, physical transformations are occurring.

[23] Unlike earlier technology, computer software is inherently nonphysical. *See* Saul Rosen, *Software*, in ENCYCLOPEDIA OF COMPUTER SCI. 1599 (Anthony Ralston, Edwin D. Reilly & David Hemmendinger, eds. 4th ed. 2000). The term "software" was coined to stand in opposition to the physical part of a computer—the "hardware." *Compare* WEBSTER'S NEW WORLD DICTIONARY OF COMPUTER TERMS 228 (6th ed. 1997) (defining "hardware" as a "[t]he electronic components, board, peripherals, and equipment . . . distinguished from the programs (software) that tell these components what to do").

[24] *See e.g.*, U.S. Patent No. 5,920,845 (filed Apr. 4, 1997) (claiming a method of matchmaking that uses ID numbers rather than names); U.S. Patent No. 5,851,117 (filed Apr. 23, 1997) (claiming a method of training janitors by using pictures along with oral instructions); U.S. Patent No. 6,993,502 (filed Nov. 10, 2000) (claiming a tax collection system and method). Of course, the Supreme Court's upcoming ruling in In re Bilski, 545 F.3d 943 (Fed. Cir. 2008) (*en banc*) (disallowing business method patent), *cert. granted*, 129 S. Ct. 2735 (2009), may ultimately invalidate these patents.

[25] *See* Hotel Security Checking Co. v. Lorraine Co., 160 F. 467 (2d Cir. 1908) (holding that a method of conducting business that is not coupled with a machine to achieve that method is not patentable).

[26] The continuing controversy can be identified by the differing treatment that the courts have given software-based patents since the 1970s. Initially, the Supreme Court rejected such patents. *See* Parker v. Flook, 437 U.S. 584 (1978) (disallowing software patent for an alarm system relating to the catalytic converter process); Gottschalk v. Benson, 409 U.S. 63 (1972) (disallowing software patent for and programmed conversion of numerical information in general-purpose digital computers). Later, the Court seemed to reverse its position. *See* Diamond v. Diehr, 450 U.S. 175 (1981) (allowing software-based patent that helped in the processing of molding raw, uncured synthetic rubber

as early as the Johnson administration,[27] patents for such technology have been repeatedly opposed by the PTO.[28] As this paper is written, the scope of patents that are appropriate for software- and business-related inventions is again before the Supreme Court in the *Bilski*[29] case.

In the Federal Circuit's en banc *Bilski* opinion, the court adopts a "machine-or-transformation" test supposedly derived from Supreme Court precedent but says:

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into cured precision products). This position was expanded upon by the Federal Circuit. *See, e.g.*, Arrhythmia Research Technology, Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992) (allowing software patent that analyzed electrocardiographic signals).

The same confusion exists with patents that claim a process of doing business. Initially the courts were hostile to such claims. *See* In re Schrader, 22 F.3d 290 (Fed. Cir. 1994) (invalidating business method patent for competitively bidding, collating, and combining bids on a plurality of related items); Hotel Security Checking Co. v. Lorraine Co., 160 F. 467 (2d Cir. 1908) (invalidating business method patent, a cash-registering and account-checking designed to prevent fraud by waiters). This position, too, was subsequently reversed. *See* State Street Bank & Trust Co. v. Signature Financial Group, Inc., 149 F.3d 1368 (Fed. Cir. 1998) (finding a combination software and business method patent valid). Recently, though, the Federal Circuit has reversed position again. *See* In re Bilski, 545 F.3d 943 (Fed. Cir. 2008) (*en banc*) (disallowing business method patent), *cert. granted,* 129 S. Ct. 2735 (2009).

For a broader discussion of these issues, see Ralph D. Clifford, *The Federal Circuit's Cruise to Uncharted Waters: How Patent Protection for Algorithms and Business Methods May Sink the UCITA and State Intellectual Property Protection*, 73 TEMPLE L. REV. 1241, 1241–60 (2000).

[27] See the quotation from *Diehr*, 450 U.S. at 218, *supra* note 6, discussing the commission set up by President Johnson and headed by then-Commissioner Brenner. A copy of the commission's report is on file with Professor Field.

[28] *See Diehr*, 450 U.S. at 218. Dissenting from the majority decision, Justice Stevens writes:

> Within the Federal Government, patterns of decision have also emerged. Gottschalk, Dann, Parker, and Diamond were not ordinary litigants—each was serving as Commissioner of Patents and Trademarks when he opposed the availability of patent protection for a program-related invention. No doubt each may have been motivated by a concern about the ability of the Patent Office to process effectively the flood of applications that would inevitably flow from a decision that computer programs are patentable.

Id.

[29] *See* Bilski v. Doll, 129 S. Ct. 2735 (2009) (granting cert).

> future developments in technology and the sciences may present difficult challenges to the machine-or-transformation test, just as the widespread use of computers and the advent of the Internet has begun to challenge it in the past decade. Thus, we recognize that the Supreme Court may ultimately decide to alter or perhaps even set aside this test to accommodate emerging technologies. And we certainly do not rule out the possibility that this court may in the future refine or augment the test or how it is applied. At present, however, and certainly for the present case, we see no need for such a departure . . . .[30]

Judge Mayer dissented, saying:

> The en banc order in this case asked: "Whether it is appropriate to reconsider *State Street Bank & Trust Co. v. Signature Financial Group, Inc.*, 149 F.3d 1368 (Fed. Cir. 1998), and *AT & T Corp. v. Excel Communications, Inc.*, 172 F.3d 1352 (Fed. Cir. 1999), in this case and, if so, whether those cases should be overruled in any respect?" I would answer that question with an emphatic "yes." . . . Affording patent protection to business methods lacks constitutional and statutory support, serves to hinder rather than promote innovation and usurps that which rightfully belongs in the public domain.[31]

The final observation in that dissent is, however, difficult to reconcile with 35 U.S.C. § 273. It explicitly provides a defense for infringers of business method patents.[32]

As found in the *State Street Bank* case referenced by Judge Mayer, most business-method patents are essentially software patents.[33] In stark contrast is the dissent of Judge Newman, who writes:

> The now-discarded criterion of a "useful, concrete, and tangible result" has proved to be of ready and comprehensible applicability in a large variety of processes of the information and digital ages. The court in *State Street Bank* reinforced the thesis that there is no reason, in statute or policy, to exclude computer-implemented and information-based inventions from access to patentability. The holdings and reasoning of *Alappat* and *State Street Bank* guided the inventions of the electronic age into the patent system, while remaining faithful to the *Diehr*

[30] *In re* Bilski, 545 F.3d 943, 956 (Fed. Cir. 2008) (*en banc*), *cert. granted*, 129 S. Ct. 2735 (2009).

[31] *Id.* at 998.

[32] *See* 35 U.S.C. § 273(a)(3) (2006) (defining "method" to mean "a method of doing or conducting business") and *id.* § 273(b)(1) (establishing a defense to a claim if the "method" had been in use for at least one year before the filing date of the patent).

[33] *See Bilski*, 545 F.3d at 960 n. 23.

> distinction between abstract ideas such as mathematical formulae and their application in a particular process for a specified purpose. And patentability has always required compliance with all of the requirements of the statute, including novelty, non-obviousness, utility, and the provisions of Section 112.[34]

Regardless of the decision rendered by the Supreme Court in *Bilski,* it is clear that the patent bar will be called upon to continue to deal with software-based technologies for the foreseeable future. The relative magnitude of that task can be determined by examining the quantity of patents being issued in various areas of technology.[35] Using the data collected from the PTO, Table A12[36] lists the number of patents issued by year according to technological classes established by the Office.[37] A *multi-way cross-tabulation*[38] was constructed to connect each such class to the nonlegal background of individuals most apt to understand the

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[34] *Id.* at 991–92.

[35] The Office maintains helpful tables that provide counts of how many patents are issued in each technological area. *See* U.S. PATENT AND TRADEMARK OFFICE, PATENT COUNTS BY CLASS BY YEAR (May 5, 2009), http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cbcby.htm (last visited Mar. 22, 2010) (on file with the North Carolina Journal of Law & Technology) [hereinafter "*PTO Patent Counts*"]. For the purposes of this paper, only the data through 2006 was used as that was the cut-off date for the Freedom of Information Act request that provided data on practitioners.

[36] *Id.* Some patents overlap two or more technologies. Those we regard as reasonably understood by individuals with training in any of the technologies. Consequently, to account for the technological overlap that can be present in a patent, Table A1–2 was used for this article as it counts patents based on all technologies present, not just the primary one.

[37] *Id.*

[38] A cross-tabulation is a technique used to relate two or more categorical variables. *See Cross-tabulation Tables*, STATISTICS.COM, http://www.statistics.com/resources/glossary/c/crosstabtbl.php (last visited Feb. 22, 2010) (on file with the North Carolina Journal of Law & Technology). For the study in this article, the two variables related are the educational degree reported by patent bar members and the field of invention reflected on issued patents. As each degree could be relevant to multiple patent classifications and most patent classifications are associated with more than one degree, multi-way cross-tabulation was used that allows each value of each variable to be associated with multiple values of the other variable.

underlying technology.[39] A summary appears in Table E.[40]

The number of patents best associated with the top fifty undergraduate majors is presented for five time periods.[41] Some technologies have greatly decreased in rank over time. The most significant changes were found in agriculture which dropped eight places in rank from twenty-fifth to thirty-third, ceramic engineering which fell nine places from twenty-third to thirty-second, food technology which decreased eleven places from twenty-fourth to thirty-fifth, metallurgical engineering which dropped ten places from sixteenth to twenty-sixth, and petroleum engineering which fell ten places from nineteenth to twenty-ninth.[42] Other technologies have significantly increased during the time period. Computer science went up ten places from twelfth to second, computer engineering rose fourteen places from twenty-first to seventh, biophysics jumped eight places from thirty-second to twenty-fourth, and optics rose ten places from twenty-eighth to eighteenth.[43]

As patent activity moves from plowshares to artificial intelligence, the nonlegal credentials of patent practitioners should have also changed. Unfortunately, this has not occurred.

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[39] *See Major to PTO Class Table*, DATABASE OF PATENT PRACTITIONERS, http://ipmall.info/hosted_resources/patent_bar/Database%20of%20Patent%20Practitioners.mdb (last visited Mar. 22, 2010) (on file with the North Carolina Journal of Law & Technology).

[40] *See infra* Table E. Table E and the cross-tabulation were limited to the top fifty majors (by count) found in the FOIA data. The authors felt that the remaining majors in the file would have an insignificant effect on the statistics as each major's count was so low (the count for the fiftieth ranked major was no more than sixty-eight practitioners, which corresponds to only 0.168 percent of the entire patent bar). *See infra* Table A. As each additional major could require a significant increase in the size of the cross-tabulation table, and would require a significant amount of time to generate, they were omitted.

[41] Those issued before 1986 and in 1991, 1996, 2001, and 2006. *See infra* Table E.

[42] *See infra* Table E.

[43] *Id.*

IV. COMPARING PATENT TECHNOLOGY WITH PATENT BAR EXPERTISE

If the patent bar were perfectly attuned to current needs, the rank of technologies being patented would match that of patent practitioners' undergraduate majors (a perfect match). Moreover, as the prominence of technologies change, pre-legal training would follow. Obviously, a perfect match is an unreasonable expectation if for no other reason than the natural time lag between when a technology is first created and enough practitioners of the technology have been trained for them to join the patent bar. Nevertheless, over the twenty or so years it takes to develop a sufficiently large cadre of trained practitioners in a new technology, the patent bar's training should have also adjusted accordingly.

A Spearman rank correlation[44] was used to determine how well the reality of the patent bar matches the demands of society for patents. In this mathematical analysis, technological areas were ranked from most to least commonly patented. Similarly, undergraduate majors were ranked by their prevalence among patent practitioners. A perfect fit between these two ranks would have a correlation of 1.0 (the first ranked patent technology is also the largest major, the second ranked is the next largest, etc.) while a perfect misfit would equal -1.0 (the first patent technology would be the last major, etc.).[45] Because correlations of plus or minus one are rare, correlations greater than 0.9 are considered very strong, those between 0.7 and 0.9 are strong, those between 0.5 and 0.7 are moderate, and those below 0.5 are considered weak.[46] A

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[44] The Spearman correlation was chosen as it is designed to "determin[e] the relationship between two variables in terms of the ranking of each case within each variable." SARAH BOSLAUGH & PAUL ANDREW WATTERS, STATISTICS IN A NUTSHELL 183 (2008). As the analysis needed was to determine if the rank of patent technologies is related to the rank of patent bar educational backgrounds, the Spearman was the entirely apropos statistic for the analysis.

[45] *See id.* at 184.

[46] *See id.* This relative scale is also used for negative correlations. At some point between -0.5 and 0.5, a correlation will lack statistical significance. *See id.* at 179–80 & 152–54. What this means is that it is impossible to distinguish between a true relationship between the two variables and the operation of chance. *See id.* at 152. If there is a greater than five percent probability that the

correlation of zero indicates the lack of any demonstrable relationship.

Spearman correlations, however, measure only at a given point in time. As this study is examining trends in patent bar membership, the correlation must be repeated at different times. If the match between patent technologies and patent bar becomes closer, the Spearman will grow; if the match is weaker, the correlation will be smaller; otherwise, the Spearman will not change.

Those who expect a strong correlation between practitioner training and patent technology will be disappointed.[47] Formal nonlegal training of patent bar members only weakly correlates with patented technologies. Moreover, the relationship has diminished over time.

The correlation between the ranking of qualifying majors and patented technologies for 1986 was 0.421.[48] 1986 was chosen as it is twenty years earlier than the latest data provided by the PTO. This is late enough that the first graduates with computer-related degrees could be expected to be interested in joining the patent bar[49] but, at the same time, it is far enough back from the last data

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correlation represents random chance rather than a real relationship, the result is considered insignificant. *See id.* In other words, no relationship has been shown without statistical significance.

For the number of data points in the PTO data, a lack of significance occurs for a Spearman correlation between -0.279 and +0.279. *See* CRITICAL VALUES OF THE SPEARMAN'S RANKED CORRELATION COEFFICIENT (RS), http://webspace.ship.edu/pgmarr/Geo441/Tables/Spearman%20Ranked%20Correlation%20Table.pdf (last visited Feb. 20, 2010) (on file with the North Carolina Journal of Law & Technology).

[47] Some of this weakness is to be expected. Over the multi-decade career of most patent attorneys, technology progresses. While training in the technology of buggy whips may have been quite apropos in 1880, for example, by the 1920s and 1930s, such knowledge would be obsolete.

[48] *See* BOSLAUGH & WATTERS, *supra* note 44; *infra* Table A, E. The significance level of this result is less than 0.005, much stronger than the 0.05 level required. *Id.*

[49] The first computer science programs were created at Stanford and Purdue Universities in 1962. Elliott B. Koffman & Aaron Finerman, *Education in Computer Science*, *in* ENCYCL. OF COMPUTER SCI. 616 (Anthony Ralston, et al., eds., 4th ed., 2000). Although the number of universities offering a computer

available for 2006 to establish any long-term trend that exists within the patent bar. For 2006, the Spearman correlation dropped to 0.367.[50] This suggests that members of the patent bar were less aptly trained in 2006 than they had been twenty years earlier.

An explanation for the declining correlation is easily postulated. Over the twenty year period, the quantity of computer technology patents skyrocketed.[51] In 2006, computer science patents were the second most common type of patent issued.[52] Yet, as discussed below in Part V, the PTO persists in barring most computer science graduates from taking its bar examination to become a member of the patent bar.[53] As a result of the Office's

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science degree grew fairly rapidly throughout the 1960s and early 1970s, the number of graduates of these programs was small in their early years. *See id.* at 616–18. Indeed, it was not until 1980 that more than 10,000 undergraduate degrees were awarded in computer science. *Id.* at 618. Throughout the 1990s, approximately 25,000 students graduated with a computer science degree. *Id.* at 618.

[50] The significance level has decreased to the 0.01 level, still a strong confirmation. *See supra* note 46.

[51] *See infra* Table E (showing computer engineering ranked 21st in 1986 but 7th in 2006 and computer science ranked 12th in 1986 but 2nd in 2006).

[52] *See id.*

[53] *See infra* Part V. Although some computer science majors are now permitted to sit for the patent exam, all were long excluded. This disconnect between the patent bar and the technology being patented is not without cost.

Interestingly, similar impediments were raised in the Office when it sought to hire patent examiners with computer backgrounds. As a "basic requirement" for those with computer science degrees, a minimum of fifteen semester hours "must have been in any combination of statistics and mathematics that included differential and integral calculus." PTO, Job Announcement No. LD127618, http://usptocareers.gov (last visited May 3, 2007) (on file with the North Carolina Journal of Law & Technology). Although mathematics is typically part of the requirements for obtaining a computer science degree, differential and integral calculus may not be required, nor do programs typically require fifteen semester hours of mathematics.

The same announcement establishes a lower level of qualification for one with a computer engineering degree; it "must . . . be [from] a school of engineering with at least one curriculum accredited by the Accreditation Board for Engineering and Technology (ABET) as a professional engineering curriculum . . . ." *Id.* Significantly, the computer-engineering program does not need to be accredited; only one of the school's programs needs to be accredited. If the school has no accredited programs, the applicant must have taken courses in six

exclusionary policy, computer science graduates were ranked only eighth among majors in 2006,[54] and constitute a tiny percentage—less than five percent—of the total patent bar.[55]

This discrepancy stands in stark contrast with the PTO's likely justification for requiring technical training as a qualification for patent bar membership. A technical background is presumably required so that the Office can have some confidence that inventors' representatives can understand the technology in question, help assess its patentability before filing,[56] draft competent applications[57] and negotiate with examiners for allowable claims.[58] Despite this likely rationalization, many patent practitioners lack the necessary background to properly practice in the field of computer technology-based patents.

Consider, for example, U.S. Patent No. 7,028,023 ("the '023 patent") that claims a computerized list with multiple pointers.[59] That the application was filed in 2002 and issued in 2006 is extraordinary. In the late 1960s, Professor Donald Knuth of

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areas of traditional, non-computer-based engineering or "other comparable area[s] of *fundamental* engineering science or physics, such as optics, heat transfer, soil mechanics, or electronics." *Id.* This requirement apparently excludes computer technology.

[54] *See infra* Table A.

[55] *See infra* Table B.

[56] *See, e.g.*, 35 U.S.C. §§ 102 & 103 (2006).

[57] *See id.* § 112.

[58] *See, e.g.*, *id.* §§ 131 (Examination of application), 132 (Notice of rejection; reexamination) & 133 (Time for prosecuting application).

[59] U.S. Patent No. 7,028,023 (filed Sept. 26, 2002). Its primary claim reads:

> A computerized list that may be traversed in at least two sequences comprising: a plurality of items that are contained in said computerized list; and a primary pointer and an auxiliary pointer for each of said items of said computerized list such that each of said items has an associated primary pointer and an associated auxiliary pointer, said primary pointer functioning as a primary linked list to direct a computer program to a first following item and defining a first sequence to traverse said computerized list, said auxiliary pointer functioning as an auxiliary linked list to direct said computer program to a second following item and defining a second sequence to traverse said computerized list.

The apparent novelty contained within the patent is that there are multiple pointers available to traverse the list. *See id.* at 1.

Stanford University published a preeminent series of books on computer science entitled "The Art of Computer Programming."[60] The first volume, "Fundamental Algorithms", was intended to set forth techniques that all programmers should know. It describes the same invention as is claimed in the '023 patent.[61] Indeed, the code published by Professor Knuth in 1968 could be used, with minor modifications, to implement the '023 patent's first claim.[62] Yet even he was not the first to describe the invention; pertinent disclosures go as far back as 1962.[63]

Anyone graduating with a degree in computer science twenty or thirty years earlier would have recognized that this application filed in 2002 was completely within the prior art.[64] Why was the

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[60] For further information about Professor Knuth and his significant contributions to the field of computer science, see his web page at http://www-cs-faculty.stanford.edu/~knuth (last visited Apr.. 5, 2010) (on file with the North Carolina Journal of Law & Technology) and the references he cites on his *curriculum vitae*. Also, his work is often cited in the Encyclopedia of Computer Science. *See Name Index*, *in* ENCYCL. OF COMPUTER SCI. 1984 (Anthony Ralston, et al., eds., 4th ed., 2000). Professor Knuth has now retired although he remains as an emeritus professor at Stanford and continues to contribute to the field. *See id.*

[61] DONALD E. KNUTH, FUNDAMENTAL ALGORITHMS 278–93 (1st ed. 1968) ("For even greater flexibility in the manipulation of linear lists, we can include two links in each node . . . .").

[62] *See id.* at 287–93. The example Professor Knuth uses in his book is software to run an elevator. *See id.* at 280. The '023 patent is not limited to any given application. *See supra* note 59. Consequently, to use the Knuth algorithm for applications other than for elevators would require that the example be reprogrammed to remove the elevator-specific code, but the list traversing algorithms which form the core of the Knuth material would remain the same.

[63] *See* J. Weizenbaum, *Knotted List Structures*, 5 COMM. OF THE ACM 161, 163–65 (1962) (describing the list technique of organizing information and including list elements containing multiple pointers). The COMMUNICATIONS OF THE ACM is the primary academic journal for computer science. *See* Communications of the ACM, About Communications, http://cacm.acm.org/about-communications (last visited Mar. 11, 2010) (on file with the North Carolina Journal of Law & Technology).

[64] For example, Professor Clifford as a sophomore computer science student in the early 1970s wrote a computer program that used multiple links and pointers. The course, Information Organization and Retrieval, was part of the required curriculum for obtaining a B.S. in computer science. *See also supra* notes 61, 63.

'023 patent—and others like it[65]—drafted by a member of the patent bar, and why was it issued?

A large part of the story has to be the dearth of practitioners with computer science degrees on the patent bar. The law firm that drafted the '023 patent application does not list any members, associates, or agents trained in computer science on its web site.[66] Thus, even if the person who drafted the application understood the invention, his or her apparent lack of exposure to the computer science literature[67] failed to prevent the application from being submitted.[68] This would be considered an unfortunate mistake if it were simply limited to the '023 patent; but as explained in the next part of the paper, the PTO deserves much of the blame for the relative scarcity of software-savvy members of the patent bar, making it an endemic problem.

V. REQUIREMENTS TO SIT FOR THE PATENT BAR

While the PTO's eligibility requirements for membership in the patent bar should be easily determined, the reality is different. The Office publishes what appears to be a set of rules for admission to

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[65] *See, e.g.*, U.S. Patent No. 6,987,925 (filed May 13, 2003) (claiming a Linear Congruential Generator algorithm in a media player, for replaying clips in a nonrepeating sequence). This patent, too, is fully anticipated in Knuth's FUNDAMENTAL ALGORITHMS. *See* DONALD E. KNUTH, SEMINUMERICAL ALGORITHMS 9–24 (1st ed. 1969).

[66] *See* Cochran Freund & Young LLC, http://www.patentlegal.com/index.php (last visited Feb. 20, 2010) (on file with the North Carolina Journal of Law & Technology). Despite not having any employees with education or training in computer science, the firm actively solicits computer software patents. *See* Cochran Freund & Young LLC, Technical Fields, http://www.patentlegal.com/technical_fields.php (last visited Mar. 25, 2010) (on file with the North Carolina Journal of Law & Technology).

[67] The '023 patent does not cite any nonpatent prior art. *See supra* note 59.

[68] Unfortunately, relying on the PTO to catch these invalid computer-based patents is unlikely to prevent future mistakes. For example, examiners are extraordinarily unlikely to have the computer science degrees needed to understand such inventions. *Cf.* Job Announcement, *supra* note 53. As the Office wants only computer science graduates who have taken courses that very few computer science graduates take, it will find few examiners competent to implement sections 101 through 103 - requiring inventions to be novel, useful and nonobvious.

the patent bar: The General Requirements Bulletin ("GRB").[69] As is discussed in the next subsection, however, there is a question about whether these rules have been properly propagated under administrative law and, consequently, whether they are binding. If the GRB is inappropriately adopted, a partial solution to the problem identified in this paper will be available as is discussed in Part VI below. But even if the GRB is found invalid and is stricken down, it would only be a partial solution to the problems identified in this study. After all, the PTO could merely re-establish the GRB through appropriate administrative rule making.

It is important to appreciate, therefore, the discriminatory nature of the GRB. Its rules constraining computer science graduates from being patent bar members are substantially responsible for creating the imbalance found in this study between the number of computer science patents and the patent bar members competent to understand them. Consequently, subsection B will discuss these rules and subsection C will establish why the rules irrationally exclude computer science practitioners. Finally, in subsection D, the persistence of the PTO in discriminating against computer science graduates will be discussed, creating the impression that the exclusion is intentional.

A. *The General Requirements Bulletin Should Not Be Dispositive of a Candidate's Admission as They Are Improperly Propagated*

The PTO's Office of Enrollment and Discipline ("OED") has the primary responsibility for setting standards for admission to practice through publication of the GRB.[70] OED also oversees the patent bar and investigates possible misconduct. Its investigative process[71] as well as the ultimate sanctions otherwise imposed by

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[69] *See* GRB, *supra* note 8.

[70] *See id.*

[71] *See, e.g.*, Goldstein v. Moatz, 445 F.3d 747 (4th Cir. 2006) (finding PTO's settlement of a case alleging violations of constitutional rights negated a right to attorney fees).

the PTO for misconduct[72] can be challenged in court. Likewise, OED's refusal to award a passing grade on an examination[73] or to place successful candidates on its roster of practitioners[74] may be challenged in court. Success is rare, however.[75]

OED's process for setting admission standards is of principal importance here. The PTO has been held to lack substantive rulemaking authority with regard to patentability standards, for example.[76] It, however, has explicit and unchallenged authority to promulgate *de jure* binding standards to govern practitioners and would-be practitioners.[77] However, it has used that authority only for one rule— a rule that lacks the specificity of the requirements set out in the GRB.[78]

Failure of OED to use its unchallenged rulemaking authority to establish binding admission rules has been contested only once.[79] After being denied the right to sit for the exam in 1990, Phillip Premysler took steps to meet standards then set out in the GRB. According to the Federal Circuit, those steps "would have been

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[72] *See, e.g.*, Klein v. Peterson, 866 F.2d 412 (Fed. Cir. 1989) (affirming PTO findings of practitioner misconduct); *see also* Lipman v. Dickinson, 174 F.3d 1363 (Fed. Cir. 1999) (affirming PTO findings of practitioner misconduct).

[73] *See, e.g.*, Wyden v. Comm'r of Patents and Trademarks, 807 F.2d 934, 935 (Fed. Cir. 1986) (unsuccessfully challenging the PTO's failure to award a passing grade for an examination); *see also* Franchi v. Manbeck, 972 F.2d 1283 (Fed. Cir. 1992) (unsuccessfully challenging the PTO's failure to award a passing grade for an examination).

[74] *See* Athridge v. Quigg, 655 F. Supp. 779 (D.D.C. 1987) (finding reasons for refusal to place government attorney on the register of attorneys not to be rational), *appeal dismissed*, 1989 WL 125440 (Fed. Cir. 1989) (mootness) (unpublished opinion).

[75] Athridge is one of the few parties to get what he sought. *Id.*; *see also* Lacavera v. Dudas, 441 F.3d 1380 (Fed. Cir. 2006) (upholding decision to grant Canadian attorney only limited recognition to practice). The *Lacavera* decision stands in stark contrast as the court found that the plaintiff was unable to demonstrate that she was treated unfairly. *Id.*

[76] *See* Animal Legal Defense Fund v. Quigg, 932 F.2d 920, 930–31 (Fed. Cir. 1991).

[77] *See* 35 U.S.C. § 2(b)(2)(D) (2006); *see also* text accompanying *infra* note 92.

[78] *See, e.g.*, 37 C.F.R. § 11.7(a)(2)(ii) (2006) (requirements for registration).

[79] Premysler v. Lehman, 33 U.S.P.Q.2d 1859 (D.D.C. 1994), *aff'd*, 71 F.3d 387 (Fed. Cir. 1995).

sufficient under the October 1990 standards, but were insufficient for the April 1993 standards. Consequently, the director of OED rejected Mr. Premysler's application."[80]

On intramural appeal:

> The Commissioner found the director improperly based his decision solely on the categories in the [GRB]. The Commissioner noted that lack of a bachelor's degree in a scientific subject is not always dispositive, an applicant may meet the requirements of 37 C.F.R. § 10.7(a) without a degree. The Commissioner concluded, however, that applicants without a degree have a high burden to show sufficient expertise and professionalism in science or engineering. The Commissioner's final decision determined that Mr. Premysler had not met this burden. Consequently, the Commissioner held that the director did not abuse his discretion in finding Mr. Premysler's credentials unsatisfactory.[81]

Premysler then challenged the decision on several grounds.[82] Of special relevance here is his complaint that GRB standards had been altered without attending to notice and comment rulemaking obligations under the Administrative Procedure Act ("APA").[83]

Under APA § 553(b), "[g]eneral notice of proposed rule making shall be published in the Federal Register . . . . [e]xcept when notice or hearing is required . . . this subsection does not apply—(A) to interpretative rules, general statements of policy, or rules of agency organization, procedure, or practice."[84] In light of that, the Federal Circuit concluded:

> The General Requirements themselves clarify that they are not

[80] *Premysler*, 71 F.3d at 389.

[81] *Id.*

[82] *See Premysler*, 33 U.S.P.Q.2d at 1861:

> Premysler argued that the change . . . between 1990 and 1993 . . . had to follow the rulemaking procedures of the Administrative Procedure Act, 5 U.S.C. § 553 (2006) ("APA"); that the regulations . . . in 37 C.F.R. § 10.7 were unconstitutionally vague; that the degree requirement deprived him of property and liberty without due process; that the preference for college degrees, the EIT test, and for former patent examiners deprived him of equal protection of the law; and that he had sufficient experience to qualify for the examination.

[83] *Id.* 37 C.F.R. § 10.7 is now § 11.7. It was not in force at the time, but see also 35 U.S.C. § 2(b)(2)(B) (2006) ("The Office may establish regulations . . . which shall be made in accordance with [APA § 553]").

[84] 5 U.S.C. § 553(b) (2006).

> dispositive . . . . The Commissioner may, at his discretion, determine if an applicant possesses sufficient technical skills to take the examination. The Commissioner in this case undertook a review of Mr. Premysler's qualifications without regard for the General Requirements. Therefore, the General Requirements, alone, do not prevent anyone from taking the examination. In sum, the General Requirements do not bind the public to new regulations that were not subject to notice and comment.[85]

Given that the GRB, alone, should not be used to deny someone the ability to sit for the patent exam, it seems remarkable that more challenges have not been lodged by computer science majors or others who would seem to have enabling "qualifications to render to applicants or other persons valuable service, advice, and assistance in the presentation or prosecution of their applications or other business before the Office."[86] Of course, the times when such challenges have been made have resulted in ruling by the PTO that give the GRB effectively binding force in the Office's decision making.[87] As the PTO gives the GRB practically *de jure* force in the admission process, the rules in the GRB must be understood to appreciate why the imbalance of patent practitioners exists.

B. *The Rules Contained in the General Requirements Bulletin*

Subject to few limitations,[88] "[a]n individual who is a member in good standing of the bar of the highest court of a State may represent a person before an agency on filing with the agency a written declaration that he is currently qualified . . . and is

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[85] *Premysler*, 71 F.3d at 390.

[86] 35 U.S.C. § 2(b)(2)(D) (2006). 37 C.F.R. § 11.7(a)(2)(ii) essentially restates those requirements.

[87] *See* Petition of Roe (Comm'r of Pat. & Trade. Nov. 10, 1999), *available at* http://www.uspto.gov/web/offices/com/sol/foia/oed/tech/tech03.pdf; Petition of Doe (Comm'r of Pat. & Trade. Nov. 12, 1997), *available at* http://www.uspto.gov/web/offices/com/sol/foia/oed/tech/tech01.pdf. In both petitions, while lip service is given to evaluating the candidate outside of the requirements of the GRB, the underlying assumption is that no education in computer science is sufficient unless it comes from a specially accredited program. As discussed in the next subsection, this eliminates a large majority of computer science graduates from consideration.

[88] *See* 5 U.S.C. § 500(d)(1), (4) (2006). The former permits discipline or disbarment; the latter permits agencies to require a power of attorney.

authorized to represent the particular person . . . ."[89] That general grant of authority to represent others before federal agencies, however, does not apply to the PTO.[90]

One reason for the aforesaid exception is that the PTO has long had such authority in patent matters.[91] The Act currently provides that it:

> may govern the recognition and conduct of agents, attorneys, or other persons representing applicants or other parties before the Office, and may require them, before being recognized . . . , to show that they are . . . possess[ing] of the necessary qualifications to render to applicants or other persons valuable service, advice, and assistance in the presentation or prosecution of their applications or other business before the Office . . . .[92]

A PTO rule, in turn, requires patent practitioners to "[p]ossess[] the legal, scientific, and technical qualifications necessary for him or her to render applicants valuable service."[93] Although neither that rule nor anything in the statutes makes explicit reference to bar examinations, they have long been administered, presumably to establish these legal qualifications. The PTO does not test technical knowledge; instead, an applicant must demonstrate his knowledge in one of three ways—each of which places individuals who hold computer science degrees at a unique disadvantage.

First, those who wish to sit for the patent bar may qualify by holding a bachelor's degree in one of thirty-two named disciplines, including computer engineering and computer science.[94] For all

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[89] *Id.* § 500(b).

[90] *Id.* § 500(e). That subsection refers to several sections of the Patent Act, but § 31, the only section of interest here, was repealed by Pub. L. 106-113, Div. B, § 1000(a)(9) [Title IV, § 4715(b)], Nov. 29, 1999, 113 STAT. 1536, 1501A-580, and replaced by 35 U.S.C. § 2(b)(2)(D) (2006), *quoted infra* at note 92 and accompanying text.

[91] *See, e.g.*, Burke & Field, *supra* note 8, at 146–48 (recounting briefly the events preceding enactment of 5 U.S.C. § 500 (2006)).

[92] 35 U.S.C. § 2(b)(2)(D) (2006).

[93] 37 C.F.R. § 11.7(a)(2)(ii) (2008).

[94] GRB, *supra* note 8, § III(A). The PTO recognizes aeronautical engineering, agricultural engineering, biochemistry, biology, biomedical engineering, botany, ceramic engineering, chemical engineering, civil engineering, computer engineering, computer science, electrical engineering, electrochemical engineering, electronics technology, engineering physics, food technology,

but computer science, a degree from an accredited institution alone is sufficient.[95] A computer science degree, however, must have been received from an institution specially accredited at the time the degree was conferred.[96]

Second, applicants qualified by having completed (1) twenty-four semester hours of physics;[97] (2) eight hours of chemistry or physics, and twenty-four hours of biology, botany, microbiology, or molecular biology;[98] (3) thirty hours of chemistry;[99] or (4) eight hours of chemistry or physics and thirty-two hours of courses in an assortment of areas,[100] including computer science.[101] The last is

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general chemistry, general engineering, geological engineering, industrial engineering, marine technology, mechanical engineering, metallurgical engineering, microbiology, mining engineering, molecular biology, nuclear engineering, organic chemistry, petroleum engineering, pharmacology, physics, and textile technology as appropriate degrees. *Id.* If the applicant's transcript does not present one of these exact degrees, this first category cannot be used. *See id.* § III(A)(i). Further, the degree must be an undergraduate degree rather than a more advanced one. *See id.* § III(A)(ii).

[95] *See id.* § III(A).

[96] *See id.* (requiring computer science programs to be accredited by the Accreditation Board for Engineering and Technology (ABET)). The two alternate agencies listed in the PTO's publication—the Computer Science Accreditation Commission of the Computing Sciences Accreditation Board and the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology—are now both part of ABET. *See* ABET, History, http://www.abet.org/history.shtml (last visited Mar. 25, 2010) (on file with the North Carolina Journal of Law & Technology).

ABET is "the recognized accreditor for college and university programs in applied science, computing, engineering, and technology." http://www.abet.org/ (last visited Mar. 25, 2010) (on file with the North Carolina Journal of Law & Technology). In fact, a vast majority of the programs that are accredited by ABET are engineering programs. *See 2008 Accreditation Statistics*, ABET, 2008, at 2, *available at* http://www.abet.org/Linked %20Documents-UPDATE/Stats/08-AR%20Stats.pdf.

[97] *See* GRB, *supra* note 8, § III(B)(i).

[98] *See id.* § III(B)(ii).

[99] *See id.* § III(B)(iii).

[100] *See id.* § III(B)(iv).

[101] *See id.* § III(B)(x) ("[C]omputer science courses that stress theoretical foundations, analysis, and design, and include substantial laboratory work, including software development will be accepted."). It is interesting that the

helpful for a few computer science majors, but most do not study sufficient chemistry or physics as these are not required for the typical computer science major.[102]

Last, would-be members of the patent bar can demonstrate technical competence by passing the Fundamentals of Engineering test administered by the National Council of Examiners for Engineering and Surveying.[103] The initial half of the exam covers general engineering topics.[104] In the second half, test-takers may continue with general topics[105] or they may focus more narrowly on Civil, Chemical, Electrical, Environmental, Industrial, or Mechanical Engineering.[106] A computer-specific afternoon session is not available.[107]

PTO does not require the college program to have special accreditation under the second criteria as it does for the first.

[102] *See* ASS'N FOR COMPUTING MACHINERY & IEEE COMPUTER SOC'Y, COMPUTER SCI. CURRICULUM 2008 App. A (Dec. 2008), *available at* http://www.acm.org//education/curricula/ComputerScience2008.pdf. The ACM is the primary professional society of computer science; *cf.* Eric A. Weiss, *Association for Computing Machinery (ACM)*, *in* ENCYCLOPEDIA OF COMPUTER SCI. 103 (Anthony Ralston, Edwin D. Reilly & David Hemmendinger, eds. 4th ed. 2000); http://www.acm.org (last visited Feb. 20, 2010) (on file with the North Carolina Journal of Law & Technology) ("[The ACM is] the world's largest educational and scientific computing society").

Not all chemistry or physics courses qualify. The PTO requires that the courses "be . . . two sequential courses, each course including a lab. Only courses for science or engineering majors will be accepted." GRB, *supra* note 8, § III(B)(iv).

Even the accrediting agency that the PTO recognizes for computer science majors does not require chemistry or physics to be taken. *See* ABET, CRITERIA FOR ACCREDITING COMPUTING PROGRAMS 7 (2008), *available at* http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/C001%2009-10%20CAC%20Criteria%2012-01-08.pdf.

[103] *See* GRB, *supra* note 8, § III(C).

[104] *See* NCEES, FUNDAMENTALS OF ENGINEERING (FE) EXAMINATION, http://www.ncees.org/Exams/FE_exam.php (last visited Mar. 16, 2010) (on file with the North Carolina Journal of Law & Technology).

[105] *See id.* ("other disciplines").

[106] *Id.*

[107] *See id.* The "other disciplines" listed on the web page do not include computer technology.

C. *Bases for Singling Out Computer Science Do Not Compute*

As shown above, the PTO imposes requirements on computer science graduates beyond those imposed on other disciplines. It is difficult to understand why, particularly because no such requirement is imposed on those holding computer engineering degrees. Is there a relevant difference between the two approaches to studying computer technology?

Generally, a computer engineering degree emphasizes hardware and the practical use of it while a computer science degree emphasizes software and expanding the theories of how computers can be used and programs developed.[108] These differences have been summarized by professionals who train students for computer careers:[109]

> Computer engineering is concerned with the design and construction of computers and computer-based systems. It involves the study of hardware, software, communications, and the interaction among them. Its curriculum focuses on the theories, principles, and practices of traditional electrical engineering and mathematics and applies them to the problems of designing computers and computer-based devices . . . .
>
> Computer science spans a wide range, from its theoretical and algorithmic foundations to cutting-edge developments in robotics, computer vision, intelligent systems, bioinformatics, and other exciting areas. We can think of the work of computer scientists as falling into three categories.
>
> • They design and implement software . . . .
>
> • They devise new ways to use computers . . . .
>
> • They develop effective ways to solve computing problems . . . .[110]

[108] *Compare* Yale Patt, *Education in Computer Engineering*, *in* ENCYCLOPEDIA OF COMPUTER SCI. 615 (Anthony Ralston, Edwin D. Reilly & David Hemmendinger, eds., 4th ed. 2000) *with* Elliott B. Koffman & Aaron Finerman, *Education in Computer Science*, *in* ENCYCLOPEDIA OF COMPUTER SCI. 616 (Anthony Ralston, Edwin D. Reilly & David Hemmendinger, eds., 4th ed. 2000).

[109] The Association for Computing Machinery (focusing on computer science), the Association for Information Systems (focusing on business systems), and the Computer Society (focusing on computer engineering), respectively.

[110] *See Computer Sci. Curricula 2005*, ASS'N FOR COMPUTING MACHINERY & IEEE COMPUTER SOC'Y (Mar. 2006) *available at* http://www.acm.org /education/curric_vols/CC2005-March06Final.pdf.

From this comparative description, it is apparent that graduates in computer science are at least as qualified as computer engineers to understand ever more important ways to use computers. Yet the organization chosen by the PTO for necessary accreditation of computer science diplomas, ABET,[111] is oriented toward hardware and away from the more theoretical and cutting-edge uses of computer technology.[112]

Seen in these terms, the PTO signals that engineering degrees are superior to science degrees for patent work. If that is true, why are biology, botany, chemistry and physics degrees as acceptable as the equivalent engineering degrees?[113]

An examination of the computer science programs that are not accredited by ABET is even more striking. A vast majority of computer science programs are not accredited,[114] including most of the top programs.[115] Indeed, the Massachusetts Institute of Technology, often considered to be the premier technical

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[111] *See* GRB, *supra* note 8, § III(A).

[112] Telephone interview with Dietolf Ramm, Director of Undergraduate Studies, Duke University Department of Computer Science, in Durham, N.C. (May 2007).

[113] *See supra* note 94 and accompanying text.

[114] *See 2007 Annual Report*, ABET, 2007, at 30, 32, *available at* http://www.abet.org/Linked%20Documents-UPDATE/Stats/07-AR%20Stats.pdf (indicating 249 approved computer science programs). There are 2629 four-year colleges in the United States. *The Condition of Education 2009*, NATIONAL CENTER FOR EDUCATION STATISTICS, U.S. DEPT. OF EDUC., 2009, at 1, 241 (Table A-42-2), *available at* http://nces.ed.gov/pubs 2009/2009081.pdf.

[115] *See Computer Science Rankings*, U.S. NEWS & WORLD RPT., 2008, (ranking computer science programs), *available at* http://gradschools.usnews .rankingsandreviews.com/best-graduate-schools/top-computer-science-schools /rankings. Top schools without ABET accreditation include Stanford, Carnegie Mellon, Cornell, Princeton, Harvard, Brown, Yale, Rice, Columbia, Duke, California Institute of Technology, and the flagship campuses of the Universities of North Carolina, Washington, Texas, Wisconsin, Maryland, and Massachusetts. *See* ABET Accredited Computing Programs, http://www.abet.org/schoolareacac.asp (last visited Mar. 16, 2010) (on file with the North Carolina Journal of Law & Technology).

university,[116] did not obtain accreditation until 1996.[117] Thus, no one who graduated from MIT with a degree in computer science prior to 1996 is facially qualified to sit for the patent bar.

Moreover, the PTO rigorously enforces the limitation. Petitions to sit filed by applicants with computer science degrees awarded by non-ABET-accredited schools are consistently denied.[118]

D. *Knocking on the Door of the Patent Bar*

The barriers against admitting computer science graduates are not newly constructed. Roughly twenty years ago, an informal request by the ABA to permit computer science majors to sit was rejected by then-Commissioner Quigg.[119] More recently, a formal request to remove the barriers was made:

> Since adoption of the APA, the PTO has often conducted notice and comment rule making even for exempt rules. The PTO also recently conducted APA-compliant rule making before changing rules regarding the computerized administration of the PTO Exam. It is surprising, therefore, that the PTO does not regard rules regarding the requirements sufficient to sit for the PTO Exam as warranting notice and comment rule making. These are far more significant from the perspective of [petitioners]. The need for close attention to rules applicable to sitting for the PTO Exam was made even more

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[116] *See Best Engineering Schools*, U.S. NEWS & WORLD RPT., 2009 (ranking MIT first), *available at* http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/rankings.

[117] ABET Accredited Computing Programs, http://www.abet.org/AccredProgramSearch/AccreditationSearch.aspx (last visited Mar. 16, 2010) (on file with the North Carolina Journal of Law & Technology) (search for institution = "Massachusetts Institute of Technology" and program area = "computer science").

[118] *See* Petition of Doe (Comm'r of Pat. & Trade. Nov. 12, 1997), *available at* http://www.uspto.gov/web/offices/com/sol/foia/oed/tech/tech01.pdf; Petition of Roe (Comm'r of Pat. & Trade. Nov. 10, 1999), *available at* http://www.uspto.gov/web/offices/com/sol/foia/oed/tech/tech03.pdf.

[119] *See* David Bender, *Current Developments in Software Patents*, 298 PLI/PAT 379, app. 2 (1990) (reprinting PTC Subcommittee on Software Patent Protection to the Computer Law Committee of the ABA-PTC Section. Subject 8. Updating Patent Bar and Examiner Qualification Proposed Resolution 701-1). The resolution is indicated to have passed 54 to 2, but the date does not appear. *Id.* A Westlaw search did not indicate further action.

> compelling by *Ex parte Lundgren*. That decision, and the Federal Circuit decisions cited therein, have substantially revised the rules applicable to the patentability of computer-based inventions.[120]

That petition, however, was rejected.[121] Acknowledging what is implicit in *Premysler*, James Toupin, PTO General Counsel, stated in part:

> An applicant with a computer science degree who does not meet the specific guidelines set forth in the Bulletin could submit an application asserting that he or she nonetheless possesses the requisite legal, scientific and technical qualifications. If, after being given an opportunity to overcome any cited shortcomings, the applicant is denied admission to the examination, the applicant could petition the OED Director to review the decision. The OED Director would consider such a petition on its merits, and if the OED Director's decision were unfavorable, the applicant could petition for review under 37 C.F.R. § 11.2(d).[122]

This process is identical in all material ways to that considered in *Premysler*, and indeed the Bulletin's description of the process remains essentially unchanged. Accordingly, the PTO continues to regard the process for developing the bulletin as fully in accordance with existing law. Further, the constantly changing nature of invention points to the PTO's need, while giving general guidelines through the Bulletin, to conduct individualized assessments of applications for registration, rather than binding itself and its applicants through rigid rules implemented by notice-and-comment rulemaking.[123]

The PTO's aversion to "rigid rules implemented by notice-and-comment rulemaking"[124] is understandable.[125] However, most

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[120] Thomas G. Field, Jr., *Admission to Practice Before the U.S.P.T.O. in Patent Cases* 3, *available at* http://ssrn.com/abstract=1192402 (containing a petition requesting rulemaking to address specific technical qualifications attorneys need to sit for the patent bar) (internal citations omitted). *See also id.* at 8–9 (noting a declaration by Professor Stanley C. Eisenstat, Department. of Computer Science, Yale University, which points out that current criteria for admission of lawyers holding computer science degrees are irrational).

[121] *See id.* at 10–11 (noting a letter by James Toupin, General Counsel for PTO, denying the petition).

[122] *Id* at 11.

[123] *Id.*

[124] *Id.*

would-be members of the patent bar take the GRB at face value—as does the PTO based on its actions—effectively making what is only a *de facto* standard into a *de jure* one.[126] Unlike *Premysler*, candidates for admission may be unwilling to challenge its application to themselves through expensive litigation. Those who do not appreciate the opportunity to do so may, instead, take additional courses[127] or simply give up.

VI. THE CURE

The problems identified above can be divided into two categories. First, and of immediate concern, is the PTO's use of artificial barriers to prevent computer science graduates from joining the patent bar. Second, and of more importance in the long-term,[128] is the PTO's failure to follow appropriate rulemaking procedures. Each of these problems has a different solution.

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[125] *See, e.g.*, William S. Jordan, III, *Ossification Revisited: Does Arbitrary and Capricious Review Significantly Interfere with Agency Ability to Achieve Regulatory Goals through Informal Rulemaking?*, 94 NW. U. L. REV. 393, 393–94 (2000) (internal citations notes omitted):

> [I]t has become a virtual article of faith that judicial review of agency rules . . . has been a major culprit in the "ossification" of informal rulemaking. According to the ossification hypothesis, the prospect of facing hard look review by the courts has caused administrative agencies to become reluctant to use the informal rulemaking process, with its attendant benefits of clear prior notice, widespread public participation, and comprehensive resolution of issues affecting large numbers of people or economic activities.

One has to question, however, whether the PTO has ever done an "individualized assessment" of an applicant as a failure to satisfy the dictates of the GRB seems always to prevent an applicant from becoming a patent attorney. *See supra* notes 94–96.

[126] The GRB, itself, fosters that view by stating: "An applicant with a Bachelor's degree in a subject not listed above, . . . *must* establish to the satisfaction of the OED Director that he or she possesses the necessary scientific and technical training under either Category B or Category C below." GRB, *supra* note 8, § III(A)(i) (emphasis added).

[127] This is particularly true in light of the comparative cost in time and money. As for the latter, however, *see infra* note 129 and accompanying text.

[128] It is unlikely that computer science will be the last new technology developed that leads to patented technology.

A. *The Patent Bar Must Admit Computer Scientists*

To cure the problem of artificial barriers erected against computer science graduates, the GRB should be changed immediately in three specific ways.[129]

For category A admissions—those based on obtaining a specific undergraduate degree—a computer science bachelor's degree should not have to be from an ABET accredited program; instead, as is required for all other degrees, if the computer science degree is obtained from an accredited institution, it should provide sufficient evidence of technical ability.

For category B admissions—those based on taking specific course work as an undergraduate—computer science courses should qualify in the same way courses in other sciences or engineering do.

For category C admissions—those based on passing the Fundamentals of Engineering examination—the inappropriateness of the current engineering test to all disciplines should be acknowledged. Unless and until the Fundamentals of Engineering examination is broadened to include more recently developed engineering disciplines, consideration should be given to accept other state- or professional society-sponsored examinations such as the Certified Computing Professional examination offered by the Institute for Certification of Computing Professionals, which is sponsored, in part, by the Association for Computing Machinery.[130]

With these changes, the patent bar would become open to a significant number of practitioners with the needed computer-

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[129] Professor Field would argue for a more fundamental change. In his view, a patent bar examination for attorneys, coupled with a redundant set of ethical obligations is unnecessary. See, for example, Kroll v. Finnerty, 242 F.3d 1359 (Fed. Cir. 2001) (holding that membership in the patent bar does not confer immunity to ethical obligations imposed by states). A bar examination and the imposition of ethical standards on patent agents, however, is fully warranted and equivalents should be adopted by the many agencies that permit lay practitioners.

[130] *See* Certified Computing Professional, http://www.iccp.org/ (last visited Mar. 17, 2010) (on file with the North Carolina Journal of Law & Technology).

based skills.[131]

B. *The Fair Rules for Patent Bar Admission Should Be Adopted with Notice-and-Comment Rulemaking*

As noted above, the PTO has eschewed formal notice-and-comment rulemaking to establish the requisites for technical and legal competence in patent matters.[132] As a result of this, the patent bar is less than optimally qualified to understand much technology currently being patented. While the APA is not an instrumentality without weaknesses, it does serve to require administrative agencies to publicly propose rules, solicit public comments on them, and provide some level of explanation for the rules that are adopted. With this process there will be greater admissions to the patent bar, which, in turn, would open the door for new technologies.

That notice-and-comment rulemaking is sometimes subjected to too-intense review[133] is no justification for its wholesale abandonment. As the court stated in *Appalachian Power*:

> The phenomenon we see in this case is familiar. Congress passes a broadly worded statute. The agency follows with regulations containing broad language, open-ended phrases, ambiguous standards and the like. . . . Several words in a regulation may spawn hundreds of pages of text as the agency offers more and more detail regarding what its regulations demand . . . . Law is made, without notice and comment, without public participation, and without publication in the Federal Register or the Code of Federal Regulations. With the advent of the Internet, the agency does not need these official publications to ensure widespread circulation; it can inform those affected simply by posting its new guidance or memoranda or policy statement on its web site. An agency operating in this way gains a large advantage. "It can issue or amend its real rules, i.e., its interpretative rules and policy statements, quickly and inexpensively without following any statutorily

[131] Similarly, the PTO should more carefully tailor its prerequisites for potential patent examiners in the computer science area. *See supra* note 53.

[132] *See* Field, *supra* note 120, at 11 (citing a letter by James Toupin, General Counsel for PTO).

[133] *See* Jordan, *supra* note 125.

prescribed procedures."[134]

C. *Methodologies to Force Change*

For decades, the PTO has resisted changing its admission system despite compelling evidence of the system's serious deficiencies. Although one might hope that the PTO would voluntarily modify its practices, it is naive to expect it to change either the GRB or its rulemaking procedures without outside compulsion. Consequently, it may be necessary to: bring a series of suits or a class action to induce the PTO to recognize that notice and comment rulemaking under the APA is advantageous for it to adequately recognize newly developing technologies; find a computer science major who is prepared to sue the PTO after being rejected for admission;[135] file another rulemaking petition with the PTO followed by a suit if it is rejected; or encourage Congress to amend Titles 5 and 35 of the U.S. Code to insure that the patent bar has no artificial barriers to membership.

VII. CONCLUSION

Fixing the problems identified in this paper will not be a

[134] Appalachian Power Co. v. E.P.A., 208 F.3d 1015, 1020 (D.C. Cir. 2000) (quoting Richard J. Pierce, Jr., *Seven Ways to Deossify Agency Rulemaking*, 47 ADMIN. L. REV. 59, 85 (1995)).

[135] Indeed, the situation computer science majors face is very much akin to that faced in *Athridge*, *supra* note 74. Faced with the certainty of losing, the PTO withdrew the rule. If nothing else, that could help it avoid payment of attorney fees.

In that regard, the ultimate disposition in *Tafas v. Kappos*, 586 F.3d 1369, 1371 (Fed. Cir. 2009) (en banc), is illuminating:

> This is not a case in which the regulations have been overridden by a statutory change; instead, it is a case in which the agency itself has voluntarily withdrawn the regulations and thus set the stage for a declaration of mootness. The motion's statement that an intervening regulatory change is directly analogous to an intervening statutory change is not persuasive. The agency does not control Congress; but it does control the decision to rescind the regulations. Thus, it was the USPTO (the losing party in the district court action) that acted unilaterally to render the case moot, and *vacatur* is not appropriate.

Unlike *Goldstein v. Moatz*, 445 F.3d 747, 750–52 (4th Cir. 2006), it therefore appears that Tafas will be able to recover his attorney fees.

panacea for all that ails the patent system. The other problems identified in the literature—from failures to cite non-patent prior art in patent applications to administrative misfeasance—should also be addressed.[136] A failure to respond to the increasing technological disconnect between the patent bar and the technology underlying modern patents, however, will have an overwhelming negative impact. Without change, the number of inappropriate patents granted will continue to grow while novel inventions will be lost in the noise of a nonfunctional system.

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[136] *See supra* Part I.

Tables

A. Top Fifty Majors of Patent Bar Members

Major Field	Count	Percent
Electrical Engineering	6,520	16.071%
Chemistry	5,733	14.131%
Biology	4,201	10.355%
Mechanical Engineering	3,703	9.127%
Chemical Engineering	2,523	6.219%
Physics	1,946	4.797%
Biochemistry	1,550	3.820%
Computer Science	1,193	2.941%
Engineering	1,050	2.588%
Business	1,033	2.546%
Microbiology	766	1.888%
Civil Engineering	721	1.777%
Computer Engineering	615	1.516%
Aeronautical & Astronautical Engineering	567	1.398%
Mathematics	550	1.356%
Industrial Engineering	514	1.267%
Pharmacology	454	1.119%
Biomedical Engineering	371	0.914%

Major Field	Count	Percent
Material Science & Engineering	336	0.828%
Medicine	273	0.673%
Environmental Science	272	0.670%
Genetics	259	0.638%
Agriculture	239	0.589%
Psychology	236	0.582%
Political Science	232	0.572%
Zoology	217	0.535%
Science	190	0.468%
Nuclear Engineering	184	0.454%
Economics	183	0.451%
English	180	0.444%
Metallurgical Engineering	176	0.434%
Finance	163	0.402%
History	161	0.397%
Geology	155	0.382%
Law	153	0.377%
Liberal Arts	149	0.367%
Physiology	136	0.335%
Animal Science	113	0.279%
Philosophy	105	0.259%
Botany	102	0.251%
Ceramic Engineering	101	0.249%

Major Field	Count	Percent
Biophysics	94	0.232%
Foreign Languages	92	0.227%
Biotechnology	90	0.222%
Bioengineering	78	0.192%
Optics	75	0.185%
Neuroscience	73	0.180%
Public Health	72	0.177%
Marine Engineering	70	0.173%
Food Technology	68	0.168%
Petroleum Engineering	68	0.168%

B. Cumulative Grouping from the Top 50 Majors

Major Field Group	**Count**	**Percent**	**Components**
Chemical	10533	26.0%	Chemistry, Chemical Engineering, Biochemistry, Pharmacology, Medicine
Mechanical	10307	25.4%	Mechanical Engineering, Physics, Engineering, Civil Engineering, Computer Engineering, Aeronautical & Astronautical Engineering, Industrial Engineering, Material Science & Engineering, Nuclear Engineering, Metallurgical Engineering, Geology, Ceramics Engineering, Biophysics, Optics, Marine Engineering
Biological	9502	23.4%	Biology, Biochemistry, Microbiology, Pharmacology, Biomedical Engineering, Medicine, Environmental Science, Genetics, Agriculture, Psychology, Zoology, Physiology, Animal Science, Botany, Biotechnology, Bioengineering, Biophysics, Neuroscience, Public Health

Electrical	7135	17.6%	Electrical Engineering, Computer Engineering
Computer	1808	4.5%	Computer Science, Computer Engineering

C. Top Twenty Degrees of Patent Bar Members

Degree	Count
BS	17,672
MS	5,110
BA	4,817
PhD	3,771
BSEE	2,056
BSE	1,273
BSME	1,130
MBA	1,111
MA	653
BS ChE	538
MSEE	439
MSE	431
AS	343
AA	194
LLM	162
BSCE	157
BSAE	118
MSME	117
MD	110
BSIE	93

D. Top 50 Universities Granting Degrees to Patent Attorneys/Agents

University Attended	Count
Univ. Illinois	929
Massachusetts Inst. Tech.	908
Univ. Michigan	743
Cornell Univ.	631
Univ. California Berkeley	623
Purdue Univ.	602
Univ. Texas	582
Univ. Wisconsin	545
Univ. Maryland	520
Univ. Washington	503
Univ. California Los Angeles	487
Pennsylvania State Univ.	464
Rutgers Univ.	459
Stanford Univ.	451
Columbia Univ.	446
Georgia Inst. Tech.	423
Univ. Minnesota	420
Texas A&M Univ.	408
Rensselaer Polytechnic Inst.	396
City Univ. New York	374

University Attended	Count
Northwestern Univ.	362
Ohio State Univ.	351
Univ. Pennsylvania	348
Brigham Young Univ.	344
Univ. Virginia	334
Johns Hopkins Univ.	329
Harvard Univ.	317
Virginia Tech.	312
Univ. California San Diego	303
Univ. Southern California	303
Michigan State Univ.	288
Univ. Notre Dame	284
Univ. Florida	280
Duke Univ.	273
Univ. Colorado	267
Univ. Utah	265
Yale Univ.	260
Princeton Univ.	257
Iowa State Univ.	245
North Carolina State Univ.	245
Univ. California Davis	241
George Washington Univ.	236
Rice Univ.	231
Carnegie Mellon Univ.	226

University Attended	Count
Univ. Arizona	220
New York Univ.	218
Univ. Pittsburgh	217
Boston Univ.	216
Univ. Indiana	211
Univ. Missouri	211

E. Counts and Rankings of the Technology Underlying Patents over Time[137]

Major Associated with Patent	**Pre-1986 Patents**	**Rank**	**1991 Patents**	**Rank**	**1996 Patents**	**Rank**	**2001 Patents**	**Rank**	**2006 Patents**	**Rank**
Aeronautical & Astronautical Engineering	2938	38	539	38	358	39	678	41	548	42
Agriculture	***34088***	***25***	***4900***	***31***	***4421***	***34***	***5766***	***34***	***5088***	***33***
Animal Science	1211	39	187	44	141	44	165	44	160	44
Biochemistry	136710	11	22894	11	27678	12	41314	13	33566	13
Bioengineering	26708	29	7171	24	8907	22	12272	24	11086	22
Biology	70471	17	15361	14	20021	14	31223	14	25839	14
Biomedical Engineering	49735	22	11861	19	14666	17	21883	17	17307	17
Biophysics	**24855**	**32**	**6786**	**27**	**8570**	**26**	**11751**	**27**	**10709**	**24**
Biotechnology	26708	29	7171	24	8907	22	12272	24	11086	22
Botany	68542	18	9820	21	9868	21	12672	22	10142	25
Business	928	40	237	39	474	38	1579	38	3537	36
Ceramic Engineering	***38281***	***23***	***5969***	***29***	***5430***	***30***	***6842***	***32***	***5253***	***32***
Chemical Engineering	295521	6	42653	6	46007	5	63302	7	48961	9
Chemistry	295521	6	42653	6	46007	5	63302	7	48961	9
Civil Engineering	83101	15	12075	18	11520	19	15293	19	14298	19
Computer Engineering	**52901**	**21**	**13269**	**16**	**23126**	**13**	**42602**	**12**	**61406**	**7**

137 Technologies that are in bold italics have decreased significantly in rank making such patents much less common. Those that are in bold, but not italics, have increased significantly in rank, making them more common. Technologies in normal type have not changed significantly.

Major Associated with Patent	Pre-1986 Patents	Rank	1991 Patents	Rank	1996 Patents	Rank	2001 Patents	Rank	2006 Patents	Rank
Computer Science	**111434**	**12**	**22890**	**12**	**36554**	**10**	**56888**	**9**	**90902**	**2**
Economics	816	41	194	41	305	41	941	39	2281	39
Electrical Engineering	193249	9	34358	9	44652	8	72308	5	90279	6
Engineering	449829	2	72141	2	72399	2	95132	2	90608	3
Environmental Science	21557	34	3081	35	3620	35	4299	36	3203	37
Finance	816	41	194	41	305	41	941	39	2281	39
Food Technology	***34560***	***24***	***4835***	***32***	***4778***	***33***	***6276***	***33***	***4052***	***35***
Genetics	13572	37	3023	36	5129	32	9043	31	7663	31
Geology	25580	31	3395	33	3047	36	4354	35	4418	34
Industrial Engineering	278926	8	41282	8	38685	9	50485	10	37796	11
Marine Engineering	88453	14	13555	15	12116	18	16070	18	14039	20
Material Science & Engineering	296491	5	47251	5	45487	7	63658	6	51603	8
Mathematics	530	43	203	40	292	43	453	42	959	41
Mechanical Engineering	584608	1	89754	1	87123	1	117906	1	101120	1
Medicine	54734	20	12598	17	16222	16	24277	16	19634	15
Metallurgical Engineering	***76737***	***16***	***11543***	***20***	***10007***	***20***	***12280***	***23***	***10116***	***26***
Microbiology	33973	26	6179	28	8809	24	13917	20	11411	21
Neuroscience	23637	33	5340	30	6668	29	10577	28	8387	28
Nuclear Engineering	16724	35	2541	37	2682	37	3179	37	2904	38
Optics	**32446**	**28**	**7865**	**23**	**8801**	**25**	**11879**	**26**	**16397**	**18**
Petroleum Engineering	***67629***	***19***	***8428***	***22***	***7636***	***28***	***10153***	***29***	***8378***	***29***
Pharmacology	107186	13	15411	13	17327	15	24370	15	19151	16

Major Associated with Patent	Pre-1986 Patents	Rank	1991 Patents	Rank	1996 Patents	Rank	2001 Patents	Rank	2006 Patents	Rank
Physics	449829	2	72141	2	72399	2	95132	2	90608	3
Physiology	152251	10	25801	10	31078	11	45404	11	36322	12
Psychology	20	44	194	41	343	40	294	43	474	43
Public Health	32813	27	6903	26	8413	27	12900	21	9752	27
Science	449829	2	72141	2	72399	2	95132	2	90608	3
Zoology	15004	36	3257	34	5243	31	9192	30	7882	30