RECENT DEVELOPMENTS ON WHAT CAN BE PATENTED IN THE UNITED STATES- BIOTECHNOLOGY, SOFTWARE AND COMPUTERS AND BUSINESS METHODS

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This paper will discuss what subject matter is patentable under the United States patent law. It will focus primarily on recent developments relating to biotechnology, software and computers, and business methods..

I. PATENT SUBJECT MATTER IN GENERAL

In the United States, patent law is contained in federal statutes. The patent law is contained in the United States Code, Title 35. Court proceedings concerning patents interpret this law. Succeeding court cases must interpret the same statute in accordance with what is known as the common law. That is, a later court must give deference to earlier interpretation of statutes depending on the hierarchy of what court made the earlier interpretations.

The United States Supreme Court is the final authority on the meaning of the patent law. Just below that court is the Court of Appeals for the Federal Circuit. That court has exclusive jurisdiction of all appeals of trial court proceedings involving patents.

What subject matter may be the subject of a patent is set forth in 35 United States Code Section 101. This is often cited as 35 U.S.C. Sec. 101 or 35 U.S.C. 101.

A. Statutory Law

35 United States Code Section 101 provides:

"Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."

B. Common Law

The Supreme Court has held that Congress intended the statutory subject matter allowed to be patented under Section 101 to "include anything under the sun that is made by man." [1] However, the Supreme Court has cautioned that this statement is not absolute. It has recognized some exceptions as to what is patentable. It has held that "laws of nature, natural phenomena, and abstract ideas" are not patentable.[2] It explained that phenomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable as they are the basic tools of scientific and technological work. Monopolization of those tools through the grant of a patent might tend to impede innovation more than it would tend to promote it.[3]

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[1] Diamond v. Chakrabarty, 447 U.S. 303 (1980)

[2] Diamond v. Diehr, 450 U.S. 175 (1981).

[3] Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S.Ct. 1289 (2012).

The Supreme Court has provided examples of the types of things which are not patentable. For example, the Court has written that a new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, the Court said that Einstein could not patent his celebrated law that E=mc2; nor could Newton have patented the law of gravity. The Court said such discoveries are manifestations of nature, free to all men and reserved exclusively to none."[4]

The Court has recognized, however, that too broad an interpretation of this exclusionary principle could eviscerate patent law. For all inventions at some level embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas.[5] The Court has recognized that patent protection must strike a delicate balance between creating "incentives that lead to creation, invention, and discovery" and "imped[ing] the flow of information that might permit, indeed spur, invention."[6]

The United States courts have recently struggled with what is patentable subject matter in the areas of biotechnology, software and computers and business method patents. The most recent Supreme Court pronouncement concerned the patentability of DNA. Cases in each of these areas will be considered below.

II. BIOTECHNOLOGY

A. The U.S. Supreme Court Myriad Case

In June of this year, the United States Supreme Court considered whether patent claims for DNA are patentable.[7] Myriad Genetics, Inc. discovered the precise location and sequence of two human genes, BRCA1 and BRCA2. Knowledge of the location of these two genes allowed Myriad to determine their typical nucleotide sequence.[8] That information in turn enabled Myriad to develop medical tests that were useful for detecting mutations in the patient's BRCA1 and BRCA2 genes. Mutations of these genes can substantially increase the risks of breast and ovarian cancer. So such tests could assess whether the patient had an increased risk of these types of cancer.

1. THE CLAIMS

Two types of composition of matter claims were at issue before the Supreme Court. The first were claims for a naturally occurring segment of deoxyribonucleic acid (DNA) isolated from the rest of the human genome. A representative claim of this type was "[a]n isolated DNA

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4 Mayo Collarborative, *supra*.

5 Mayo Collarborative, *supra.*.

6 Mayo Collarborative, *supra.*

7 Association for Molecular Pathology et al v. Myriad Genetics, Inc., et al, Case No. 12-398, June 23, 2013.

8 The Supreme Court opinion included a lengthy description of DNA, genes and the basic steps in biotechnology. This description is included here as Exhibit A.

coding for a BRCA1polypeptide," which has "the amino acid sequence set forth in SEQ ID NO: 2." SEQ ID NO:2 sets forth a list of 1,863 amino acids that the typical BRCA1 gene encoded. Put differently, claim 1 covered the DNA code that tells a cell to produce the string of BRCA1 amino acids listed in SEQ ID NO:2.

The second group of claims was for synthetic DNA known as cDNA. Claim 2 claimed "[t]he isolated DNA of claim 1, wherein said DNA has the nucleotide sequence set forth in SEQ ID NO:1." Like SEQ ID NO:2, SEQ ID NO:1 sets forth a long list of data, in this instance the sequence of cDNA that codes for the BRCA1 amino acids listed in claim 1. SEQ ID NO:1 lists only the cDNA exons in the BRCA1 gene, rather than a full DNA sequence containing both exons and introns. As a result, claim 2 covers the cDNA nucleotide sequence listed in SEQ ID NO:1, which codes for the typical BRCA1 gene

2. THE COURT'S HOLDINGS.

The Supreme Court decided that the first type of claims for naturally-occurring, non-modified sequences of DNA cannot be patented under US law. It said that regardless of how "ground breaking, innovative, or even brilliant" such a discovery may have been, such claims "fell squarely within the law of nature exception".

On the other hand, it held that the complementary, or cDNA, of Claim 2 was patentable because it did not occur naturally. The nucleotide sequence of the second type of claim did not include all of the nucleotides present in the DNA sequence present in the body.

In finding such claims patentable, the Supreme Court rejected the argument that cDNA is not patent eligible because "[t]he nucleotide sequence of cDNA is dictated by nature, not by the lab technician." The Court said while that may be true, the lab technician unquestionably creates something new when cDNA is made. The Court explained that cDNA retains the naturally occurring exons of DNA, but it is distinct from the DNA from which it was derived because it lacks introns. Therefore, the Court said that as a result, cDNA is not a "product of nature" and is patent eligible under §101 (except insofar as very short series of DNA may have no intervening introns to remove when creating cDNA. In that situation, a short strand of cDNA may be indistinguishable from natural DNA.)

The exact holding of the Supreme Court was: "we hold that a naturally occurring DNA segment is a product of nature and not patent eligible merely because it has been isolated, but that cDNA is patent eligible because it is not naturally occurring."

3. THE COURT'S REASONING

As to the DNA claims, the Court said it was undisputed that Myriad did not create or alter any of the genetic information. What it did was identify groups of relatives with a history of breast cancer or ovarian cancer. Because these individuals were related, scientists knew that it was more likely that their diseases were the result of genetic predisposition rather than other factors. Myriad compared sections of their chromosomes looking for shared genetic abnormalities not found in the general population. This process eventually enabled Myriad to determine where in the genetic sequences the BRCA 1 and BRCA 2 genes resided. Regardless of

this effort, the Supreme Court stated "extensive effort alone is insufficient to satisfy the demands of [section] 101."

One of the judges writing the lower court opinion for the Federal Circuit Court of Appeals found isolated DNA to be patentable because the isolated DNA was in fact a new molecule. That was because the entire DNA molecule in the body is held together by chemical bonds. The covalent bonds at each end of the segment must be severed in order to isolate segments of DNA. That judge said this process technically created new molecules with unique chemical compositions. The Supreme Court rejected that reasoning saying that the claims before it were simply not expressed in terms of chemical composition. It also stated that the claims did not rely in any way on the chemical changes that result from the isolation of a particular section of DNA.

Myriad argued that the past practice of the Patent & Trademark Office in awarding gene patents is entitled to deference. The Supreme Court disagreed. The Court found there was no reason to grant deference to the Patent Office's practices. In so doing it stated that concerns about the public and patent owners relying on Patent Office determinations were better suited to action by Congress rather than the courts.

B. What The Myriad Court Did Not Decide

It is important to note what is not decided. First, there were no method claims before the Court. In dicta, the Court said that had Myriad created an innovative method of manipulating genes while searching for the BRCA1 and BRCA2 genes, it could possibly have sought a method patent on that. But it said the processes used by Myriad to isolate DNA at the time of Myriad's patents "were well understood, widely used, and fairly uniform insofar as any scientist engaged in the search for a gene would likely have utilized a similar approach".

The Court also was clear that the case did not involve patents on new applications of knowledge about the BRCA1 and BRCA2 genes. The Supreme Court quoted with approval a statement in the lower court Federal Circuit opinion that "[a]s the first party with knowledge of the [BRCA1 and BRCA2] sequences, Myriad was in an excellent position to claim applications of that knowledge", although such patent claims were not before the Court. So, for example, claims to the use of the BRCA1 and BRCA2 genes in diagnostics were not precluded as to patentability.

Also, the Court did not consider the patentability of DNA in which the order of the naturally occurring nucleotides had been altered. The Court noted that scientific alteration of the genetic code presented a different inquiry. It expressed no opinion about the application of §101 to such endeavors.

Furthermore, is unclear whether a claim written differently to claim a new molecule (e.g. to claim the molecule of naturally occurring DNA without the introns) with possibly unique chemical compositions would be patentable. As noted, one of the judges at the Federal Circuit Court of Appeals found such a claim would be patentable. The Supreme Court rejected that reasoning because the claim was not expressed in terms of a chemical composition. It did not, however, expressly say that such a new chemical composition would not be patentable subject

matter. So, it is unclear as to how many modifications and the type thereof would qualify as something which was not naturally occurring and therefore patentable. Commentators have suggested that when drafting new claims certain terms, such as "discovered," "found," "identified," "located," "isolated," and "purified" should be avoided. The patent specification was written in terms of the many "discoveries" Myriad had made. The use of terms such as these were specifically mentioned as raising issues of patentability by the Court. They are more related to unpatentable laws of nature than to patentable inventions. Conversely, it has been suggested that terms, such as "created," "synthetic," and "derived" should be used. These terms were used favorably the Court when discussing why cDNA is patentable.

Some commentators have commented that it is unclear whether this decision precludes patentability of all other naturally found biological molecules. Specifically, antisense DNA, microDNA, siRNA, viruses, proteins, antibodies and stem cells have been mentioned as molecules as to which the applicability of this decision is unclear.

C. Impacts of the Myriad Decision

The U.S Patent & Trademark Office issued preliminary guidance to patent examiners after the Myriad decision. This guidance states that the Supreme Court's decision "significantly changes the Office's examination policy regarding nucleic-acid related technology". It states that "examiners should now reject product claims drawn solely to naturally occurring nucleic acids or fragments thereof, whether isolated or not, as being ineligible subject matter under 35 U.S.C. § 101." The Patent Office said it would issue more comprehensive guidance later.

Some commentators have raised concerns that the Supreme Court's decision might adversely affect commercial activities in biotechnology research and development. It should be noted, however, that the Court expressly stated that "the rule against patents on naturally occurring things [contained in 35 USC § 101] has limits" and that "too broad an interpretation of this exclusionary principle could eviscerate patent law".

Indeed, the patentee Myriad has started new infringement proceedings against two companies, Ambry Genetics and Gene by Gene, which companies announced, on the very day that the Supreme Court issued its decision, that they would provide genetic diagnostic testing for the BRCA1 and BRCA2 genes. Myriad claims that Ambry will offer its tests for $2,280, while Myriad's tests run to $4,040. Furthermore, Myrad asserts that "[w]hile Ambry's tests do not offer the accuracy, quality and reliability of Myriad Genetics' integrated BRAC*Analysis*® test, they present a significant competitive threat as third-party payors, rather than patients and their health-care providers, frequently decide where testing will be performed and such payors are often not well-informed about the competitive quality of such tests."

In these new litigations, Myriad claims it has many DNA-related patent claims of a type which were not before the Supreme Court and are not affected by that decision. Myriad claims it has 515 distinct method and product claims in 24 patents which are not adversely affected by the finding that Myriad's five DNA claims were invalid. Myriad asserts that the Supreme Court "found that, unlike isolated human genes, synthetic DNA is man-made and is not a product of nature. Plaintiffs' remaining patent claims covering BRCA1 and BRCA2 gene

testing, including those at issue here, pertain to synthetic DNA or methods-of-use, which were not affected by the Court's decision, and remain valid and enforceable."

Myriad explains that all of the claims it is now asserting in these new litigations "either require the use of inventive DNA synthesized in a laboratory based upon knowledge about the BRCA1 and BRCA2 genes (*e.g.*, gene-specific probes, primers and arrays) or pertain to such synthetic DNA compositions themselves, and these compositions are patent-eligible under the Court's Myriad decision."

Myriad further explains that the Supreme Court decision did not "involve patents on new *applications* of knowledge about the BRCA1 and BRCA2 genes. Judge Bryson [of the Federal Circuit] aptly noted that, "[a]s the first party with knowledge of the [BRCA1 and BRCA2] sequences, Myriad was in an excellent position to claim applications of that knowledge. *Many of its unchallenged claims are limited to such applications."* (Emphasis in original).

Myriad states that its claims to probes and primers are not barred by the Supreme Court decision because they are "synthetically created complementary DNA molecules". So it says they are patentable because "they are not naturally occurring." That is "they are synthetic, laboratory-created DNA carefully designed by man to achieve specific performance metrics." Myriad further states that "[c]reating synthetic DNA sharing sequence similarity with any particular gene requires an application of detailed knowledge from the discovery of that gene's structure".9

As evidence of the patentability of its existing claims, Myriad notes that in the litigation culminating in the Supreme Court decision there was no challenge to the genetic diagnostic method claims. Therefore, it argues that this supports patentability and the statutory presumption of validity. Indeed, Myriad notes that the Federal Circuit found a claim relating to drug screening methods (Claim 20 of Myriad's '282 patent) patentable. This claim was not appealed to the Supreme Court.

Myriad further says that the Supreme Court decision does not in any way adversely affect the claims now in litigation because "there was nothing untoward about Myriad having sought and obtained patent protection over these newly discovered and isolated genes." Furthermore, it analogized the Federal Circuit's finding of method claim 20 being patentable to the patentability of the primers and probes in its asserted claims. This is because of the reasoning in the Federal Circuit opinion that the non-naturally occurring nature of the cells recited in that method claim was important to patentability.

Ambry's response to the patent infringement claims was a denial of infringement and an assertion that all of the patent claims are invalid. It also asked the Court to find that Myriad violated the United States antitrust law and committed patent misuse, rendering the patents unenforceable.

III. SOFTWARE AND COMPUTERS

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9 Note that the Supreme Court's distinction was between DNA found in nature vs. the claimed cDNA which was not. The Court's specific reason for differentiating between non-patentable DNA and patentable cDNA was not on the basis of synthetic DNA versus naturally occurring DNA.

The status of patentability of software and computer-implemented inventions in the United States is very difficult to determine at the present time. The Supreme Court is currently considering whether to decide two cases which may give a definitive answer to this question. These are the CLS Bank case decided by all of the active judges on the Federal Circuit Court of Appeals (CLS Bank International v. Alice Corp., 717 F.3d 1269 (2013.) and Ultramercial, LLC et al v. Hulu, LLC, #2060-1544, 2013 U.S. App. LEXIS 12715 (Fed. Cir., June 21, 2013), now known at the Supreme Court level as WildTangent, Inc. v. Ultramercial, LLC et al. This is a very important area of the patent law since a recent government study showed that of the patents being issued by the U.S. Patent & Trademark Office over 50% of them are software patents.

Two of the leading Supreme Court cases on this issue at the present time are Diamond v. Diehr, 450 U.S. 175 (1981) and Bilski v. Kappos, 130 S.Ct. 3218 (2010).

The Diehr case involved a patent on a method of curing rubber using a mold. Respondents characterized their contribution to the art to reside in the process of constantly measuring the actual temperature inside the mold. These temperature measurements are then automatically fed into a computer which repeatedly recalculated the cure time using a recognized mathematical equation. When the recalculated time equaled the actual time that elapsed since the press was closed, the computer signaled a device to open the press. According to the respondents, the continuous measuring of the temperature inside the mold cavity, the feeding of this information to a digital computer which constantly recalculateed the cure time, and the signaling by the computer to open the press, were all new in the art.

The Court found that the transformation of raw synthetic rubber into a different state or thing was the type of industrial process which historically waas eligible to receive the protection of the United States patent laws. It stated that such protection was not altered by the fact that, in several steps of the process, a mathematical equation and a programmed digital computer were used. The Supreme Court stated that "`a process is not unpatentable simply because it contains a law of nature or a mathematical algorithm" and that "an application of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection."

It further explained that while the mathematical equation would not be patentable in isolation, when a process for curing rubber was devised which incorporated into it a more efficient solution of the equation, then that process is not barred from being patented.

The patent application in Bilski sought patent protection for a claimed invention that explains how buyers and sellers of commodities in the energy market can protect, or hedge, against the risk of price changes. The key claims were claims 1 and 4. Claim 1 described a series of steps instructing how to hedge risk. Claim 4 put the concept articulated in claim 1 into a simple mathematical formula. Claim 1 consisted of the following steps:
"(a) initiating a series of transactions between said commodity provider and consumers of said commodity wherein said consumers purchase said commodity at a fixed rate based upon historical averages, said fixed rate corresponding to a risk position of said consumers;
(b) identifying market participants for said commodity having a counter-risk position to said consumers; and

(c) initiating a series of transactions between said commodity provider and said market participants at a second fixed rate such that said series of market participant transactions balances the risk position of said series of consumer transactions."

The Bilski court first noted that 35 USC Section 100 (b) defines "process" as: "process, art or method, and includes a new use of a known process, machine, manufacture, or composition of matter, or material." The Supreme Court first rejected the Federal Circuit Court of Appeals formulation that to be a patentable process the process had to be tied to a particular machine or apparatus or transform a particular article into a different state or thing. The court said that such a machine or transformation test could be a useful or important clue, an investigative tool, for determining whether a claimed invention is a patentable process, but it could not be the sole test for determining whether an invention is a patent eligible process.

While rejecting any specific test as the sole test, the Supreme Court found that claims 1 and 4 were unpatentable because they merely explain the basic concept of hedging which is a fundamental economic practice long prevalent in the system of commerce. Furthermore, while the Supreme Court specifically rejected the machine or transformation test of the Federal Circuit Court of Appeals, it made clear that it was not intending to foreclose the Federal Circuit court's development of limiting criteria on assessing the patentability of a process claim which might further the purposes of the Patent Act and are not inconsistent with its text.

After the Bilski Supreme Court decision, the Federal Circuit attempted to formulate such a test for computer-enabled inventions. This was in the CLS Bank case. There the patents on appeal involved a computerized trading platform for exchanging obligations in which a trusted third party settled obligations between a first and second party so as to eliminate "settlement risk". A representative method claim is claim 33, which the Supreme Court quoted as follows:

"33. A method of exchanging obligations as between parties, each party holding a credit record
and a debit record with an exchange institution, the credit records and debit records for exchange
of predetermined obligations, the method comprising the steps of:
(a) creating a shadow credit record and a shadow debit record for each stakeholder party to be
held independently by a supervisory institution from the exchange institutions;
(b) obtaining from each exchange institution a start-of-day balance for each shadow credit
record and shadow debit record;
(c) for every transaction resulting in an exchange obligation, the supervisory institution adjusting
each respective party's shadow credit record or shadow debit record, allowing only these transactions that do not result in the value of the shadow debit record being less than the value of the shadow credit record at any time, each said adjustment taking place in chronological order; and

(d) at the end-of-day, the supervisory institution instructing ones of the exchange institutions
to exchange credits or debits to the credit record and debit record of the respective parties
in accordance with the adjustments of the said permitted transactions, the credits and debits
being irrevocable, time invariant obligations placed on the exchange institutions."

The Federal Circuit decided to hear the appeal in that case by the entire court (a so-called en banc consideration). Normally appeals are heard by a three-judge panel. There were ten active judges who heard the CLS Bank appeal . The Court posed two questions for briefing: (1) what test should the court adopt for determining if a computer-implemented invention is a patent ineligible "abstract idea," and when does a computer lend patent eligibility to an otherwise ineligible idea; and (2) should it matter whether the invention is claimed as a method, system, or storage medium, and should such claims be considered equivalent for purposes of Section 101.

A majority of the 10 judges were unable to agree on the answers to the two questions. Instead, the Court affirmed by a majority vote the patent ineligibility of method and computer-readable media claims, such as Claim 33 above, and affirmed by a 5-5 tie vote the patent ineligibility of the system claims before the court.

The en banc Court issued the following order: "Upon consideration en banc, a majority of the court affirms the district court's holding that the asserted method and computer-readable media claims are not directed to eligible subject matter under 35 U.S.C. § 101. An equally divided court affirms the district court's holding that the asserted system claims are not directed to eligible subject matter under that statute." Six separate opinions (totaling 127 pages) were issued by judges stating their agreement or disagreement with the result in the appeal and proposing certain tests in answer to the questions presented.

The Supreme Court has been petitioned to review this case (a so-called Petition for Certiorari). The Supreme Court has the discretion to accept the case for review or not to. The question presented to the Court for possible decision is: "whether claims to computer-implemented inventions-including claims to systems and machines, processes, and items of manufacture-are directed to patent-eligible subject matter within the meaning of 35 U.S.C. Section 101 as interpreted by this Court?"

The WildTangent case is also currently before the Supreme Court on a different Petition for Certiorari relating to patentability of computer related inventions. The question presented to the Supreme Court in the Petition for Certiorari in that case is: "When is a patent's reference to a computer, or computer-implemented service like the Internet, sufficient to make an unpatentable abstract concept patent eligible under 35 U.S.C. § 101?".

The WildTangent case involves a patent claiming a method for advertising which can be used as a form of currency. The Federal Circuit opinion recognized that the claims related to an idea, but held that they were not impermissibly abstract and were therefore patentable. This was because the court said they included several steps that must be performed with computers,

on the Internet, and in a cyber market environment. The court noted that the claims required implementation by several computer systems operating in tandem over a communications network.

IV. BUSINESS METHODS

The appellants in the Bilski case above argued that the patent claims there for commodity trading were unpatentable because they were merely a method of doing business. The Supreme Court rejected a broad prohibition on patentability of all methods of doing business. So at least some business method patents are patentable.

But drawing the line between what is a patentable method of doing business and an unpatentable method of doing business is extremely difficult. Since the Bilski opinion, here are some examples of what the courts have decided when presented with the question of patentability of business method patents.

The Supreme Court itself considered a method claim of helping doctors to treat patients with autoimmune diseases by determining whether a given dosage of a drug was too high or too low. See Mayo Collaborative Servs. case, supra. A representative claim in that case read:

"A method of optimizing therapeutic efficacy fortreatment of an immune-mediated gastrointestinal disorder, comprising:
(a) administering a drug providing 6-thioguanine to a subject having said immune-mediated gastrointestinal disorder; and
(b) determining the level of 6-thioguanine in said subject having said immune-mediated gastrointestinal disorder,
wherein the level of 6-thioguanine less than about 230 pmol per $8x10^8$ red blood cells indicates a need to increase the amount of said drug subsequently administered to said subject and
wherein the level of 6-thioguanine greater than about 400 pmol per $8x10^8$ red blood cells indicates a need to decrease the amount of said drug subsequently administered to said subject."

The Supreme Court found this claim unpatentable because the claim merely informed a relevant audience about certain laws of nature i.e., the natural laws describing the relationships between the concentration in the blood of certain thiopurine metabolites and the likelihood that the drug dosage will be ineffective or induce harmful side-effects. The Court held that any additional steps consist of well understood, routine, conventional activity already engaged in by the scientific community. Those steps, when viewed as a whole, were found to add nothing significant beyond the sum of their parts taken separately.

The Court held that such a claim merely tells doctors interested in the subject about the correlations that the researchers discovered. The additional steps of "administering", "determining", and "wherein" were not themselves natural laws but neither were they sufficient to transform the nature of the claim from merely a law of nature.

Additionally, the WildTangent and CLS Bank cases now before the Supreme Court involve patents claiming business methods. The Ultramercial case involves the idea of using advertising as a form of currency and the CLS Bank case involves a computerized trading method of doing business. Claim 33 in the CLS Bank case, reproduced above, was found unpatentable as "abstract" despite having some steps that might seem to not to be, e.g., the creation of shadow debit and credit records.

Some other business method cases decided by the Federal Circuit Court of Appeals after the Supreme Court Bilski case include *Bancorp Servs., LLC v. Sun Life Assur. Co. of Canada*, 687 F. 3d 1266 (Fed. Cir. 2012) (unpatentable life insurance policy management system claims); *DealerTrack, Inc. v. Huber*, 674 F.3d 1315 (Fed. Cir. 2012) (unpatentable method of managing a credit application); and *Fort Props., Inc. v. Am. Master Lease LLC*, 671 F.3d 1317 (Fed. Cir. 2012) (unpatentable claims for enabling property sales without incurring tax liability).

EXHIBIT A

Genes form the basis for hereditary traits in living organisms. See generally *Association for Molecular Pathology* v. *United States Patent and Trademark Office*, 702 F. Supp. 2d 181, 192–211 (SDNY 2010). The human genome consists of approximately 22,000 genes packed into23 pairs of chromosomes. Each gene is encoded as DNA,which takes the shape of the familiar "double helix" that Doctors James Watson and Francis Crick first described in 1953. Each "cross-bar" in the DNA helix consists of two chemically joined nucleotides. The possible nucleotides are adenine (A), thymine (T), cytosine (C), and guanine (G), each of which binds naturally with another nucleotide: A pairs with T; C pairs with G. The nucleotide cross-bars are chemically connected to a sugar-phosphate backbone that forms the outside framework of the DNA helix. Sequences of DNA nucleotides contain the information necessary to create strings of amino acids, which in turn are used in the body to build proteins. Only some DNA nucleotides, however, code for amino acids; these nucleotides are known as "exons." Nucleotides that do not code for amino acids, in contrast, are known as "introns."

Creation of proteins from DNA involves two principal steps, known as transcription and translation. In transcription, the bonds between DNA nucleotides separate,and the DNA helix unwinds into two single strands. A single strand is used as a template to create a complementary ribonucleic acid (RNA) strand. The nucleotides on the DNA strand pair naturally with their counterparts, with the exception that RNA uses the nucleotide base uracil (U) instead of thymine (T). Transcription results in a single strand RNA molecule, known as pre-RNA, whose nucleotides form an inverse image of the DNA strand from which it was created. Pre-RNA still contains nucleotides corresponding to both the exons and introns in the DNA molecule. The pre-RNA is then naturally "spliced" by the physical removal of the introns. The resulting product is a strand of RNA that contains nucleotides corresponding only to the exons from the original DNA strand. The exons-only strand is known as messenger RNA (mRNA),which creates amino acids through translation. In translation, cellular structures known as ribosomes read each set of three nucleotides, known as codons, in the mRNA. Each codon either tells the ribosomes which of the 20 possible amino acids to synthesize or provides a stop signal that ends amino acid production.

DNA's informational sequences and the processes that create mRNA, amino acids, and proteins occur naturally within cells. Scientists can, however, extract DNA from cells using well known laboratory methods. These methods allow scientists to isolate specific segments of DNA —for instance, a particular gene or part of a gene—which can then be further studied, manipulated, or used. It is also possible to create DNA synthetically through processes similarly well known in the field of genetics. One such method begins with an mRNA molecule and uses the natural bonding properties of nucleotides to create a new,synthetic DNA molecule. The result is the inverse of the mRNA's inverse image of the original DNA, with one important distinction: Because the natural creation of mRNA involves splicing that removes introns, the synthetic DNA created from mRNA also contains only the exon sequences. This synthetic DNA created in the laboratory from mRNA is known as complementary DNA (cDNA).

Changes in the genetic sequence are called mutations. Mutations can be as small as the alteration of a single nucleotide—a change affecting only one letter in the genetic code. Such small-scale changes can produce an entirely different amino acid or can end protein production altogether. Large changes, involving the deletion, rearrangement, or duplication of hundreds or even millions of nucleotides, can result in the elimination, misplacement, or duplication of entire genes. Some mutations are harmless, but others can cause disease or increase the risk of disease. As a result, the study of genetics can lead to valuable medical breakthroughs.

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