United States Court of Appeals for the Federal Circuit

IN RE: BOARD OF TRUSTEES OF THE LELAND STANFORD JUNIOR UNIVERSITY,
Appellant

2020-1012

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. 13/445,925.

Decided: March 11, 2021

JOEL KAUTH, KPPB LLP, Anaheim, CA, argued for appellant. Also represented by DAVID BAILEY, CHRISTIAN HANS, MARK YEH.

MAUREEN DONOVAN QUELER, Office of the Solicitor, United States Patent and Trademark Office, Alexandria, VA, argued for appellee Andrew Hirshfeld. Also represented by THOMAS W. KRAUSE, AMY J. NELSON.

Before PROST, *Chief Judge*, LOURIE and REYNA, *Circuit Judges*.

REYNA, *Circuit Judge*.

The Board of Trustees of the Leland Stanford Junior University appeals the final rejection of patent claims contained in its patent application. The patent examiner

reviewing the application rejected the claims on grounds that they involve patent ineligible subject matter. On review, the Patent Trial and Appeal Board affirmed the examiner's final rejection of the claims. As discussed below, we hold that the rejected claims are drawn to abstract mathematical calculations and statistical modeling, and similar subject matter that is not patent eligible. Accordingly, we affirm the decision of the Patent Trial and Appeal Board.

BACKGROUND

The Board of Trustees of the Leland Stanford Junior University ("Stanford") filed its Application No. 13/445,925 ("'925 application") on April 13, 2012. The '925 application is directed to methods and computing systems for determining haplotype phase. J.A. 270, 906–07. Haplotype phasing is a process for determining the parent from whom alleles—i.e., versions of a gene—are inherited. A haplotype phase acts as an indication of the parent from whom a gene has been inherited.

According to the written description of the '925 application, improved haplotype phasing techniques "promise[] to revolutionize personalized health care by tailoring risk modification, medications, and health surveillance to patients' individual genetic backgrounds." J.A. 269–70. Achieving the understanding necessary to accomplish those goals has long challenged scientists because it requires "interpretation of massive amounts of genetic data produced with each genome sequence." J.A. 270, 296. The '925 application purports to meet that challenge via a method for receiving certain types of genetic data and processing the data by performing mathematical calculations and statistical modeling to arrive at a haplotype phase determination.

The claimed methods first involve using two types of information, namely genotype data and pedigree data, to determine alleles' inheritance state using a method

published in the prior art, namely Roach et al., *Analysis of Genetic Inheritance in a Family Quartet by Whole Genome Sequencing*, 328 SCIENCE 636 (2010). The Roach reference teaches the use of a hidden Markov model ("HMM")—a statistical tool used in various applications to make probabilistic determinations of latent variables—to predict inheritance state. *See* J.A. 272–73, 282, 294–95, 319–20.

The written description also explains that, in the prior art, methods of determining haplotype phase based on inheritance state yielded an incomplete number of the alleles' haplotypes. *See, e.g.*, J.A. 297 (discussing the "trio" method that predicted haplotype phases for approximately 80 percent of heterozygous positions); *see also* J.A. 909; Appellant's Br. 7 (explaining that "the inheritance state information produced by the HMM is uninformative in some regions of the allele data"). The claimed methods allegedly increase the number of possible haplotype phase predictions. *See, e.g.*, J.A. 298–99 (explaining that the claimed methods result in "phase resolution of 97.9% of heterozygous positions"); *see also* Appellant's Br. 5 (contrasting the inventions from the "'trio'" method").

The increase in haplotype phase predictions is made possible by factoring additional data into the analysis. *See* J.A. 296–99; *see also* Appellant's Br. 7. The first type of additional data, known as "linkage disequilibrium data," could at the time be obtained from the "SNP Annotation and Proxy Search" or "SNAP" database, which launched in approximately 2008. *See* J.A. 283. The second type of additional data is referred to as "transition probability data." According to the written description, transition probabilities are set depending on "the expected number of state transitions and the total number of allele assortments in the pedigree." J.A. 273, 295. These two types of additional data allegedly enable haplotype phase to be inferred in regions where inheritance state is uninformative. *See* J.A. 273, 298–99; *see also* Appellant's Br. 3.

Stanford appeals the Patent Trial and Appeal Board's ("Board") affirmance of the examiner's rejection of claims 1, 4–11, 14–25, and 27–30 as covering patent ineligible abstract mathematical algorithms and mental processes. *See* J.A. 871–72, 1101–10. Independent claim 1 is representative and recites:

> 1. A method for resolving haplotype phase, comprising:
>
> receiving allele data describing allele information regarding genotypes for a family comprising at least a mother, a father, and at least two children of the mother and the father, where the genotypes for the family contain single nucleotide variants and storing the allele data on a computer system comprising a processor and a memory;
>
> receiving pedigree data for the family describing information regarding a pedigree for the family and storing the pedigree data on a computer system comprising a processor and a memory;
>
> determining an inheritance state for the allele information described in the allele data based on identity between single nucleotide variants contained in the genotypes for the family using a Hidden Markov Model having hidden states implemented on a computer system comprising a processor and a memory,
>
> wherein the hidden states comprise inheritance states, a compression fixed error state, and a[Mendelian inheritance error]-rich fixed error state,
>
> wherein the inheritance states are maternal identical, paternal identical, identical, and non-identical;

> receiving transition probability data describing transition probabilities for inheritance states and storing the transition probability data on a computer system comprising a processor and a memory;
>
> receiving population linkage disequilibrium data and storing the population disequilibrium data on a computer system comprising a processor and a memory;
>
> determining a haplotype phase for at least one member of the family based on the pedigree data for the family, the inheritance state for the information described in the allele data, the transition probability data, and the population linkage disequilibrium data using a computer system comprising a processor and a memory;
>
> storing the haplotype phase for at least one member of the family using a computer system comprising a processor and a memory; and
>
> providing the stored haplotype phase for at least one member of the family in response to a request using a computer system comprising a processor and a memory.

J.A. 1101–02.[1]

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[1] Claims 11 and 21, the two other independent claims in the '925 application, both recite computer hardware for carrying out the steps of claim 1. *See* J.A. 1101–10. The claims depending from claim 1 (claims 4–10 and 22–25) recite the same substantive limitations as the corresponding claims that depend from claim 11 (claims 14–20 and 27–30). J.A. 1101–10. No claims depend from claim 21.

In its analysis of the examiner's rejections, the Board applied the two-step framework established by the Supreme Court for determining patent eligibility. *See Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 573 U.S. 208 (2014); J.A. 5–18. Addressing step one of the *Alice* inquiry, the Board determined that the eight steps in claim 1 are directed to either the "mental steps of receiving, storing, or providing information" or "mathematical concepts." *See* J.A. 7–9. The Board reasoned that the claim recites steps for receiving and analyzing information, which humans could process in their minds, or by mathematical algorithms, which are mental processes within the abstract-idea category. J.A. 10. The Board concluded that the mathematical process recited in the claims is not integrated into a practical application. The Board specifically found that the claims, unlike those in *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (Fed. Cir. 2016), do not improve computer technology but rather use off-the-shelf computing equipment to perform an improved mathematical analysis. *See* J.A. 12–13. The Board explained that the claims are also unlike those covering animation of 3-D characters in *McRO, Inc. v. Bandai Namco Games America Inc.*, 837 F.3d 1299, 1315 (Fed. Cir. 2016), which improve "the computer animation process itself." J.A. 13–15. The Board concluded that claim 1 is directed to patent ineligible subject matter under § 101. J.A. 11, 15; 35 U.S.C. § 101.

Turning to step two of the *Alice* inquiry, the Board concluded that the claims did not include additional limitations that, when taken individually or as a whole, provide an inventive concept that transforms the abstract idea into patent eligible subject matter. The Board found that the steps of receiving data, performing calculations using that data, storing the results, and providing the results upon request using a computer did not go beyond the well-known, routine, and conventional. *See* J.A. 16–17 ("We find that Appellants' claims do not require anything other than the use of conventional and well-understood

techniques and equipment to gather and process data according to the recited judicial exception."). The Board explained that, although the claims may provide a valuable contribution to science, that contribution does not go beyond patent ineligible mental processes and mathematical operations. *See* J.A. 16.

The Board addressed the remaining claims and concluded that the analysis applied to claim 1 also applied to claims 7, 8, 10, 11, 17, 18, 20, and 21. J.A. 17. It separately addressed claims 9 and 19, which recite certain steps culminating in a final step of "providing the drug for treatment." The steps recited in claim 9 appear as follows and are the same as those in claim 19 in all respects material to this appeal:

> determining whether at least one genetic variant associated with disease is within the stored haplotype phase by utilizing the haplotype phase to query a disease associated-single nucleotide polymorphism database using a computer system comprising a processor and a memory;
>
> determining a drug for treatment of at least one member of the family based on information regarding drug-variant-phenotype associations from a pharmacogenomics database and the determination whether the at least one genetic variant associated with disease is within the stored haplotype phase using a computer system comprising a processor and a memory;
>
> storing the determined drug using a computer system comprising a processor and a memory; and
>
> providing the determined drug in response to a request using a computer system comprising a processor and a memory.

J.A. 1103–04, 1106–07. The Board determined that claims 9 and 19 are drawn to patent ineligible subject matter

because they "are not directed to a specific method of treatment, do not identify specific patients, do not recite a specific compound, do not prescribe particular doses, and do not identify the resulting outcome." J.A. 18. The Board distinguished claims 9 and 19 from the patent eligible claims discussed in *Vanda Pharmaceuticals Inc. v. West-Ward Pharmaceuticals International Ltd.*, 887 F.3d 1117 (Fed. Cir. 2018), because the claims in *Vanda* were directed to a "specific method of treatment for specific patients using a specific compound at specific doses to achieve a specific outcome." J.A. 17–18. For these reasons, the Board affirmed the examiner's rejection of claims 1, 4–11, 14–25, and 27–30 under § 101. Stanford appeals. We have jurisdiction pursuant to 35 U.S.C. § 141(a) and 28 U.S.C. § 1295(a)(4)(A).

STANDARD OF REVIEW

We review Board decisions in accordance with the Administrative Procedure Act ("APA"), 5 U.S.C. § 706(2). *Dickinson v. Zurko*, 527 U.S. 150, 152 (1999). Under the APA, we review the Board's legal conclusions de novo and its factual findings for substantial evidence. *ACCO Brands Corp. v. Fellowes, Inc.*, 813 F.3d 1361, 1365 (Fed. Cir. 2016). Substantial evidence is "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *In re Gartside*, 203 F.3d 1305, 1312 (Fed. Cir. 2000) (quoting *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938)).

DISCUSSION

The Supreme Court has articulated a two-step analysis to determine patent eligibility under 35 U.S.C. § 101. *Alice*, 573 U.S. at 217–18. In the first step, we examine whether a claim is directed to patent ineligible subject matter, such as an abstract idea. *Id.* If so, we turn to the second step and examine whether the claims contain an inventive concept sufficient to transform the abstract idea into patent eligible subject matter. *Id.* at 221. In this

second step we consider the claim elements individually and as an ordered combination to determine whether any additional limitations amount to significantly more than the ineligible concept. *Id.* at 217–18, 221. A patent eligible claim must do more than simply recite the abstract idea "while adding the words 'apply it.'" *Id.* at 221.

We conclude that all the reviewed claims of the '925 application are directed to patent ineligible abstract ideas. Courts have long held that mathematical algorithms for performing calculations, without more, are patent ineligible under § 101. *See, e.g.*, *Parker v. Flook*, 437 U.S. 584, 595 (1978) ("[I]f a claim is directed essentially to a method of calculating, using a mathematical formula, even if the solution is for a specific purpose, the claimed method is nonstatutory." (internal citation and quotation marks omitted)); *Gottschalk v. Benson*, 409 U.S. 63, 72 (1972) (finding claims patent ineligible because they "would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself"); *SAP Am., Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1167 (Fed. Cir. 2018) (explaining that the focus of the claims, namely selecting certain information, analyzing it using mathematical techniques, and reporting or displaying the results of the analysis, "is all abstract"); *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344, 1351 (Fed. Cir. 2014) ("Without additional limitations, a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible."); *In re Schrader*, 22 F.3d 290, 294 (Fed. Cir. 1994) (holding that a data gathering step of entering bids was "insufficient to impart patentability to a claim involving the solving of a mathematical algorithm").

On its face, representative claim 1 is drawn to a "method for resolving haplotype phase." J.A. 1101. The method first involves "receiving" allele data and pedigree data and "determining an inheritance state" based on the received data "using [an HMM]." *Id.* The method then

involves "receiving" transition probability data and population linkage disequilibrium data and "determining a haplotype phase" based on that received data as well as the earlier-calculated inheritance state "using a computer system comprising a processor and a memory." *Id.* Lastly, the method involves "storing the haplotype phase" and "providing" it "in response to a request using a computer system comprising a processor and a memory." *Id.* at 1101–02. Claim 1 recites no concrete application for the haplotype phase beyond storing it and providing it upon request.

Stanford argues that claim 1 is not directed to an abstract idea because the specific application of the steps is novel and enables scientists to ascertain more haplotype information than was previously possible. *See, e.g.*, Appellant's Br. 5 ("While the 'trio' method may be able to provide long-range haplotype phasing for approximately 80% of heterozygous positions, the method of the present invention provides accurate, long-range phasing at 97.9% of all heterozygous positions." (citing the '925 application at ¶¶ 91–92)). Even accepting the argument that the claimed process results in improved data, we are not persuaded that claim 1 is not directed to an abstract mathematical calculation. *Synopsys, Inc. v. Mentor Graphics Corp.*, 839 F.3d 1138, 1151 (Fed. Cir. 2016) ("[A] claim for a new abstract idea is still an abstract idea."); *SAP*, 898 F.3d at 1170 ("[P]atent law does not protect such claims, without more, no matter how groundbreaking the advance.").

We have also examined, consistent with our precedent, whether the claimed advance demonstrates an improvement on a technological process or merely enhances an ineligible concept. *See, e.g.*, *Athena Diagnostics, Inc. v. Mayo Collaborative Servs., LLC*, 915 F.3d 743, 750 (Fed. Cir. 2019). The claimed advance proffered by Stanford, that the process yields a greater number of haplotype phase predictions, may constitute a new or different use of a mathematical process, but we are not persuaded that the process is an improved technological process. We therefore conclude

that claim 1 is directed to the abstract idea of mathematically calculating alleles' haplotype phase.

Because claim 1 is directed to a patent ineligible mathematical algorithm, we turn next to *Alice* step two. We conclude that claim 1 is not transformed at step two into patent eligible subject matter. Claim 1 recites no steps that practically apply the claimed mathematical algorithm; instead, claim 1 ends at storing the haplotype phase and "providing" it "in response to a request." Simply storing information and providing it upon request does not alone transform the abstract idea into patent eligible subject matter. *See, e.g.*, *In re Greenstein*, 774 F. App'x 661, 664 (Fed. Cir. 2019) (explaining that the claims at issue only invoked a computer as a generic tool to store information and record transactions).

Notably, claim 1 neither requires, nor results in, a specialized computer or a computer with a specialized memory or processor. Indeed, it is hard to imagine a patent claim that recites hardware limitations in more generic terms than the terms employed by claim 1. *See* J.A. 1101–02 (reciting method steps carried out by a "computer" with a "processor" and a "memory"); *see also Alice*, 573 U.S. at 226 (explaining that the hardware-related terms "data processing system," "communications controller," and "data storage unit" are "purely functional and generic"); *In re TLI Commc'ns LLC Pat. Litig.*, 823 F.3d 607, 614 (Fed. Cir. 2016) (holding generic computer components insufficient to add an inventive concept to an otherwise abstract idea). The written description makes clear that the mathematical steps performed, and the types of data received, as claimed, are conventional and well understood in the prior art. *See, e.g.*, J.A. 272–73, 282–83, 294–99, 319–20. Thus, taken individually, the limitations of claim 1 fail to transform the claims into a patent eligible application.

Although Stanford faults the Board for failing to assess the elements of claim 1 as an ordered combination,

Stanford fails to explain how that combination of elements moves the claimed subject matter beyond the abstract and into the practical. *See* Appellant's Br. 41–43; *see also Affinity Labs of Tex., LLC v. DIRECTV, LLC*, 838 F.3d 1253, 1263 (Fed. Cir. 2016) (explaining that novelty does not necessarily avoid abstractness). That a specific or different combination of mathematical steps yields a greater number of haplotype predictions than previously achievable under the prior art is not enough to transform claim 1 into a patent eligible application. *See SAP*, 898 F.3d at 1170 (holding an advance in financial mathematical techniques does not constitute an inventive concept). The alleged innovation accomplished in claim 1 is in the mathematical analysis itself, namely, in the receipt of data, executing mathematical calculations, and storing the resulting data. The alleged innovation therefore subsists in "the basic tools of scientific and technological work." *See Alice*, 573 U.S. at 216.

The remaining claims contain no limitations that, when considered individually or as an ordered combination, transform them into patent eligible applications. Independent claims 11 and 21 recite generic computer hardware for performing the calculations covered in claim 1. Such hardware by itself is insufficient to provide an inventive concept. *See, e.g.*, *Alice*, 573 U.S. at 222–24; *SAP*, 898 F.3d at 1168–70. Dependent claims 4–7, 14–17, 22–25, and 27–30 recite additional calculation steps and specify certain aspects of the haplotype phase algorithm covered by claim 1. But none of these additional steps move the claims beyond patent ineligible abstract mathematical algorithms. *See SAP*, 898 F.3d at 1169 (holding dependent claims patent ineligible where they add features that "simply provide further narrowing of what are still mathematical operations")).

Dependent claims 8–10 and 18–20 contain limitations drawn to making non-specific determinations of a "diagnosis," "drug treatment," and "prognosis" based on the

haplotype phase calculation. Without further limitations, these claims do nothing more than recite the haplotype phase algorithm and instruct, "apply it," as the Supreme Court has prohibited. *See Alice*, 573 U.S. at 221. These claims are devoid of an inventive concept that transforms the claims into a patent eligible application.

CONCLUSION

We have considered Stanford's remaining arguments and find them unpersuasive. For the above reasons, the Board's conclusion that claims 1, 4–11, 14–25, and 27–30 are drawn to patent ineligible subject matter under § 101 is affirmed.

AFFIRMED