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KPPB LLP
2190 S. Towne Centre Place
Suite 300
Anaheim, CA 92806

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte NICHOLAS JOHNSON, WING H. WONG,
and HUA TANG

Appeal 2018-008016
Application 13/486,982
Technology Center 1600

Before FRANCISCO C. PRATS, TAWEN CHANG, and DAVID COTTA, *Administrative Patent Judges*.

PRATS, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1 and 22–43. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as The Board of Trustees of the Leland Stanford Junior University ("Stanford"). Appeal Br. 3 (entered July 10, 2017). An oral hearing was held on September 12, 2019.

STATEMENT OF THE CASE

Appellant's invention is directed to methods of inferring (i.e., predicting) individuals' haplotypes, using genotype data obtained by sequencing the individuals' genomes. *See* Spec. ¶¶ 4–10. The Specification explains that the "term haplotype refers to the combination of alleles at multiple loci along a chromosome," i.e., the specific set of genes on a single particular chromosome inherited from one parent of an individual. *Id.* ¶ 4.

Haplotype information is useful in population and medical genetics studies. *See id.* ("In population genetics studies of evolutionary histories, haplotype data have been used to detect recombination hotspots as well as regions that have undergone recent positive selection.") (citation omitted); *see also id.* ¶ 61 ("The ability to accurately construct haplotypes from unphased genotype data plays pivotal roles in population and medical genetics studies.").

The Specification explains that, although high-throughput DNA sequencing methods provide genotype data for individuals, such methods do not directly provide haplotype information. *See id.* ¶ 4 ("[H]igh-throughput genomic or sequencing technologies . . . generate genotype data-unordered pairs of alleles.").

The Specification explains that, "[w]hile reconstructing haplotype from genotypes is straightforward in some special settings (e.g. in the presence of relatives, in sperm, or for X chromosomes in males), statistical inference of haplotype from autosomal genotype data with no known relatives is challenging." *Id.*

Nonetheless, "[n]umerous methods have been developed to infer haplotypes." *Id.* ¶ 6. One known method "begins by identifying a pool of

unambiguous (homozygous) individuals, and phases the remaining individuals based on a parsimony heuristic that seeks to minimize the total number of distinct haplotypes in the sample." *Id.*

The Specification focuses on a particular known method of inferring individuals' haplotypes, the PHASE program. *See id.* ¶¶ 7–8; *see also id.* ¶ 53 (describing "FastPHASE" as a "software package[] used to analyze large-scale high-density SNP [single nucleotide polymorphism] data").

Appellant's invention, in one embodiment, is "a modified version of the PHASE model . . . that is substantially more accurate than the FastPHASE model." *Id.* ¶ 9. The Specification refers to Appellant's inventive and more accurate haplotype modeling method as "PHASE-EM." *Id.* ¶ 8.

The Specification explains that, in one embodiment, Appellant's invention uses "a parameterization EM [Expectation-Maximization] algorithm similar to that of the FastPHASE model . . . to perform optimization on haplotypes rather than MCMC [Markov Chain Monte Carlo] sampling." *Id.*

More particularly, in one embodiment, "the imputed haplotypes themselves are used as hidden states in the HMM [Hidden Markov Model] because this is believed to be important for the PHASE model's accuracy. This increase in accuracy becomes more pronounced with increasing sample size." *Id.*

The Specification describes the calculations used in the Hidden Markov Model as follows:

> A Hidden Markov Model (HMM) is developed having a hidden state sequence H, an emitted sequence B, and jump variables J. The emitted sequence B_k is produced by taking the element of

the current imputation $A_{Hk,k}$ and changing its value with a small probability θ. The conditional probabilities of the HMM (for the jth individual's haplotypes) are

$$(1) \quad q_j(J_{k-1} = 1; \rho_k) = \rho_k = 1 - q_j(J_{k-1} = 0; \rho_k)$$

$$(2) \quad q_j(H_k = h | J_{k-1} = 1, H_{k-1} = h') = 1\{h \in \{2j, 2j-1\}\}/(2N-2)$$

$$(3) \quad q_j(H_k = h | J_{k-1} = 0, H_{k-1} = h') = 1\{h = h'\}$$

$$(4) \quad q_j(B_k = x | H_k = h; \theta_k, A^{-j}) = 1\{x \neq A_{h,k}\}(1-\theta_k) + 1\{x = A_{h,k}\}$$

Id. ¶ 34.

Claim 1 is representative of the subject matter on appeal and reads as follows:

1. A computerized method for inferring haplotype phase in a collection of unrelated individuals, comprising:

receiving genotype data describing human genotypes for a plurality of individuals and storing the genotype data on a memory of a computer system;

imputing an initial haplotype phase for each individual in the plurality of individuals based on a statistical model and storing the initial haplotype phase for each individual in the plurality of individuals on a computer system comprising a processor a[nd] memory;

building a data structure describing a Hidden Markov Model, where the data structure contains:

a set of imputed haplotype phases comprising the imputed initial haplotype phases for each individual in the plurality of individuals;

a set of parameters comprising local recombination rates and mutation rates;

wherein any change to the set of imputed haplotype phases contained within the data structure automatically results in re-computation of the set of parameters comprising local recombination rates and mutation rates contained within the data structure;

> repeatedly randomly modifying at least one of the imputed initial haplotype phases in the set of imputed haplotype phases to automatically re-compute a new set of parameters comprising local recombination rates and mutation rates that are stored within the data structure;
>
> automatically replacing an imputed haplotype phase for an individual with a randomly modified haplotype phase within the data structure, when the new set of parameters indicate that the randomly modified haplotype phase is more likely than an existing imputed haplotype phase;
>
> extracting at least one final predicted haplotype phase from the data structure as a phased haplotype for an individual; and
>
> storing the at least one final predicted haplotype phase for the individual on a memory of a computer system.

Appeal Br. 19 (Supplemental Appeal Brief entered March 2, 2018, in response to Notice of Defective Brief).

The only rejection before us for review is the Examiner's rejection of claims 1 and 22–43 under 35 U.S.C. § 101 as being directed to subject matter ineligible for patenting. *See* Final Act. 2–5 (entered February 8, 2017); Ans. 3–11.

DISCUSSION

The Examiner's Rejection

The Examiner determined that, as process claims, Appellant's claims fall within one of the statutory categories of invention. *See* Final Act. 3.

The Examiner determined, however, that "[f]or the claimed method, the judicial exception is the abstract idea and mathematical manipulation of the genetic data of the step of phasing using [the Hidden Markov Model]." *Id.* at 4. The Examiner reasoned that, "[a]s such, the instant claims are drawn only to an abstract process that only manipulates data and, therefore,

are not directed to statutory subject matter" but instead "are directed towards a judicial exception, i.e. an abstract idea." *Id.*

The Examiner reasoned that, as to Appellant's claims "being directed to a process implemented on a computer system or embedded on a computer readable medium comprising instructions for carrying out the method, it is the underlying invention that is analyzed to determine subject matter eligibility, not just the use of a computer system or computer program product." *Id.*

The Examiner, having determined that Appellant's claims are directed to a judicial exception, then turned to ascertain "whether any element or combination of elements, in the claim is sufficient to ensure that the claim as a whole amounts to significantly more than the judicial exception." *Id.* at 5.

In that regard, the Examiner found that "[n]o additional steps are recited in the instantly claimed invention that would amount to significantly more than the judicial exception. Without additional limitations, a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible." *Id.*

In particular, the Examiner reasoned, if 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 non-statutory. In other words, patenting abstract ideas cannot be circumvented by attempting to limit the use [the idea] to a particular technological environment." *Id.* (brackets in original).

Moreover, the Examiner reasoned, in Appellant's claims "the computer and/or program/product amount to mere instruction to implement an abstract idea. The hardware recited by the system claims do not offer a

meaningful limitation beyond generally linking the use of the method to a particular technological environment, that is, implementation via computers." *Id.* (internal quotations omitted; citing *Alice Corp. v. CLS Bank Int'l*, 573 U.S. 208, 216 (2014)).

Based on the above analysis, the Examiner concluded that Appellant's claims do not "recite something significantly different than a judicial exception and thereby are not directed to patent eligible subject matter." *Id.*

Principles of Law

An invention is patent-eligible if it claims a "new and useful process, machine, manufacture, or composition of matter." 35 U.S.C. § 101. The Supreme Court has long interpreted 35 U.S.C. § 101 to include implicit exceptions, however: "[l]aws of nature, natural phenomena, and abstract ideas" are not patentable. *Alice*, 573 U.S. at 216.

In determining whether a claim falls within an excluded category, we are guided by the Supreme Court's two-step framework, described in *Mayo Collaborative Services v. Prometheus Laboratories., Inc.*, 566 U.S. 66 (2012) and *Alice*, 573 U.S. at 217–18 (citing *Mayo*, 566 U.S. at 75–77). In accordance with that framework, we first determine what concept the claim is "directed to." *See Alice*, 573 U.S. at 219 ("On their face, the claims before us are drawn to the concept of intermediated settlement, *i.e.,* the use of a third party to mitigate settlement risk.").

Concepts determined to be abstract ideas, and thus patent ineligible, include certain methods of organizing human activity, such as fundamental economic practices (*Alice*, 573 U.S. at 219–20; *Bilski v. Kappos*, 561 U.S. 593, 611 (2010)); mathematical formulas (*Parker v. Flook*, 437 U.S. 584,

594–95 (1978)); and mental processes (*Gottschalk v. Benson*, 409 U.S. 63, 69 (1972)).

If the claim is "directed to" an abstract idea, we turn to the second step of the *Alice* and *Mayo* framework, where "we must examine the elements of the claim to determine whether it contains an 'inventive concept' sufficient to 'transform' the claimed abstract idea into a patent-eligible application." *Alice*, 573 U.S. at 221 (quotation marks omitted).

Early in 2019, the PTO published revised guidance on the application of § 101. USPTO, *2019 Revised Patent Subject Matter Eligibility Guidance*, 84 Fed. Reg. 50 (January 7, 2019) ("Memorandum" or "2019 Office Guidance" or "Office Guidance").[2] Following the Office Guidance, under Revised Step 2A, we first look to whether the claim recites the following:

> (1) any judicial exceptions, including certain groupings of abstract ideas (i.e., mathematical concepts, certain methods of organizing human activity such as a fundamental economic practice, or mental processes); and
>
> (2) additional elements that integrate the judicial exception into a practical application (*see* MPEP § 2106.05(a)–(c), (e)–(h)).

Only if a claim (1) recites a judicial exception and (2) does not integrate that exception into a practical application, do we then look, under Step 2B of the Office Guidance, to whether the claim:

> (3) adds specific limitations beyond the judicial exception that are not "well-understood, routine, conventional" in the field (*see* MPEP § 2106.05(d)); or

[2] Available at https://www.govinfo.gov/content/pkg/FR-2019-01-07/pdf/2018-28282.pdf.

> (4) simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception.

See Memorandum.

Analysis

Office Guidance—Revised Step 2A, Prong 1

We select Appellant's claim 1 as representative of the claims subject to this rejection. Applying Revised Step 2A, Prong 1, of the 2019 Office Guidance, we agree with the Examiner that Appellant's claim 1 recites abstract ideas in a number of instances.

Representative claim 1 recites a computerized method for inferring haplotype phase in a collection of unrelated individuals. Appeal Br. 19. After an initial step of receiving genotype data from a plurality of individuals, claim 1 recites the step of imputing an initial haplotype phase for each individual in the plurality of individuals "based on a statistical model." *Id.* Claim 1 then recites "building a data structure describing a Hidden Markov Model," the data structure including the statistically imputed haplotype phases of the individuals in the target population. *Id.*

Claim 1 then recites a step of repeatedly randomly modifying at least one imputed initial haplotype phase "to automatically re-compute a new set of parameters comprising local recombination rates and mutation rates stored within the [Hidden Markov Model] data structure." *Id.*

As discussed above, a Hidden Markov Model is a mathematical model that includes a series of calculations. *See* Spec. ¶ 34. Accordingly, claim 1 expressly recites two mathematical models in its process, the Hidden Markov Model as well as the statistical model used in the imputing step. In addition, Claim 1's "re-comput[ing]" step involves a mathematical

calculation to determine a new set of parameters comprising local recombination rates and mutation rates stored within the data structure. Appeal Br. 19. Claim 1, therefore, recites several mathematical concepts. Accordingly, we agree with the Examiner that claim 1 recites abstract ideas. *See* Office Guidance (84 Fed. Reg. at 52 (abstract ideas include "(a) Mathematical concepts—mathematical relationships, mathematical formulas or equations, mathematical calculations")).

Claim 1 also recites at least two steps that can be performed solely in the mind. Specifically, the step of "imputing an initial haplotype phase for each individual in the plurality of individuals based on a statistical model" (Appeal Br. 19) neither recites nor implies any type of computer implementation. Because the "imputing" step may therefore be performed entirely in the human mind, that step is also an abstract idea. *See* Office Guidance (84 Fed. Reg. at 52 (abstract ideas include "(c) Mental processes—concepts performed in the human mind (including an observation, evaluation, judgment, opinion") (citations omitted); *see also id.* n.14 ("If a claim, under its broadest reasonable interpretation, covers performance in the mind but for the recitation of generic computer components, then it is still in the mental processes category unless the claim cannot practically be performed in the mind.") (Citing *Intellectual Ventures I LLC v. Symantec Corp.*, 838 F.3d 1307, 1318 (Fed. Cir. 2016)).

Claim 1's step of automatically replacing an imputed haplotype phase for an individual with a randomly modified haplotype phase within the data structure is performed only "when the new set of parameters indicate that the randomly modified haplotype phase is more likely than an existing imputed haplotype phase." Appeal Br. 19. Because claim 1's automatic replacement

step is based on an evaluation of likelihood that may be performed entirely in the mind, the automatic placement step is also an abstract idea, in the form of a mental process.

Office Guidance—Revised Step 2A, Prong 2

Having determined that Appellant's representative claim 1 recites abstract ideas under Revised Step 2A, Prong 1, of the 2019 Office Guidance, we turn to Revised Step 2A, Prong 2, of the Office Guidance to determine whether claim 1 recites additional elements that integrate the judicial exceptions into a practical application. *See* Office Guidance (84 Fed. Reg. at 54–55). We agree with the Examiner that Appellant's claim 1 does not recite additional elements that integrate the judicial exceptions into a practical application.

Viewed as a whole, claim 1 is directed to a process of using abstract computational methods to obtain a specific type of information—an inferred (mathematically predicted) haplotype of an individual. Claim 1, however, does not recite any step that integrates those abstract computational methods, or the predicted haplotype information obtained therefrom, into a practical application.

Specifically, beside the abstract computational steps discussed above, claim 1 recites the steps of receiving and storing the individuals' genotype data in a computer memory, storing the individuals' imputed haplotype phases in a computer memory, extracting a predicted haplotype, and storing a predicted haplotype in a computer memory. *See* Appeal Br. 19.

Thus, rather than integrating the abstract ideas into a practical application, the non-abstract steps recited in Appellant's claim 1 merely provide a generically-recited computer-implemented methodology by which

the abstract computational methods are used to arrive at the claimed haplotype information. We, therefore, agree with the Examiner that Appellant's claim 1 does not recite additional elements that integrate the judicial exceptions into a practical application.

Appellant's arguments do not persuade us to the contrary. Appellant contends that, similar to *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (Fed. Cir. 2016), the claims under rejection "reflect a specific implementation of a solution not only in the software arts, but in the field of bioinformatics, and improve the functionality of a computer by enabling it to yield improved haplotype phasing results." Appeal Br. 7.

In *Enfish*, however, the specification of the patents at issue expressly explained how the claimed data storage and retrieval system improved computer function. *See Enfish*, 822 F.3d at 1333 (explaining that the patents at issue "teach that multiple benefits flow from this design" including "faster searching," "more effective storage of data," and "more flexibility in configuring the database"). In the present case, in contrast, Appellant does not identify any specific disclosures in the Specification asserting that improved computer function results from performing the computations recited in representative claim 1, nor does Appellant identify persuasive evidence suggesting an improvement in computer function.

We acknowledge the Specification's assertion of improved computational accuracy of haplotype phase using the Hidden Markov Model. *See* Appeal Br. 14 (citing Spec. ¶ 9); Reply Br. 6 (citing Spec. ¶¶ 56, 61). However, the fact that Appellant's abstract computational methods might be better than other abstract computational methods does not demonstrate that the claimed steps are integrated into a practical application.

See Parker v. Flook, 437 at 594–95 (holding alarm limit calculation ineligible for patenting despite acknowledgment that claimed computational method "provides a new and presumably better method for calculating alarm limit values").

Appellant argues:

> [T]he field of haplotype phasing (*i.e.* identifying groups of genes on chromosomes inherited together from a single parent in the absence of knowledge of the parent's genetic sequence) is a computer implemented field, and . . . under *McRO*[, I*nc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1229 (Fed. Cir. 2016)], improvements to computer implemented fields are considered technological improvements. Appellant's claims in fact represent an improvement to the computer implemented field of haplotype phasing by reciting a set of rules which, when implemented, yield improved haplotype phasing results previously unobtainable in the field.

Appeal Br. 8; *see also* Reply Br. 2–5 (arguing that, as in *McRO*, the claimed process provides improvement to computer-implemented fields of haplotype phasing and bioinformatics).

We find the present case distinguishable from *McRO*. As the court explained in *McRO*, "[t]he claimed process uses a combined order of specific rules that renders information into a specific format ***that is then used and applied to create desired results: a sequence of synchronized, animated characters***." *McRO*, 837 F.3d at 1315 (emphasis added). In contrast, in the present case, representative claim 1 merely recites a series of abstract computational steps to produce mathematically predicted haplotype information, but does not include any steps that apply that information in a practical way. *See* Appeal Br. 19. And, as discussed above, the non-abstract steps in claim 1 involve generic computer-related steps for performing the

abstract computational steps (receiving and storing genotype data in a computer memory, storing imputed haplotype phases in a computer memory, extracting a predicted haplotype, and storing a predicted haplotype in a computer memory). *See id.*

We acknowledge, as noted above, that the inferred haplotype information computed by the process of claim 1 may be useful in medical or population genetics studies. *See* Spec. ¶¶ 4, 61. Nonetheless, given the absence in representative claim 1 of any specific step that applies that information in a useful way, such as a therapeutic medical treatment based on the predicted haplotype, we are not persuaded that claim 1 integrates the abstract ideas into a practical application. *See* Office Guidance (84 Fed. Reg. at 55) (example of additional element that integrates a judicial exception into a practical application includes "an additional element that applies or uses a judicial exception to effect a particular treatment or prophylaxis for a disease or medical condition") (citing *Classen Immunotherapies, Inc. v. Biogen IDEC,* 659 F.3d 1057, 1066–68 (Fed. Cir. 2011); *Vanda Pharm. Inc. v. West-Ward Pharm. Int'l Ltd.,* 887 F.3d 1117, 1135 (Fed. Cir. 2018).

We are not persuaded, moreover, that the process recited in representative claim 1 is rendered patent-eligible by the claimed generic computer-related steps used in performing the recited abstract computations. *See* Office Guidance (84 Fed. Reg. at 55) (example of a situation in which a judicial exception has *not* been integrated into a practical is where claim "merely uses a computer as a tool to perform an abstract idea") (citing *Alice*, 573 U.S. at 222–26; *Gottschalk* v. *Benson*, 409 U.S. 63 (1972); *Credit Acceptance Corp. v. Westlake Services*, 859 F.3d 1044 (Fed. Cir. 2017)).

We acknowledge Appellant's contentions that inferring haplotype phase can only be performed practically using a computer. *See* Appeal Br. 9 ("[T]he currently pending claims . . . are not directed to an abstract idea, but rather to a concrete improvement in the computer-related field of biotechnology by reciting with particularity processes enabling the extraction of improved long range haplotype phases."); Reply Br. 5 ("Looking to only one of the subsets of data discussed in the specification– 13,976 SNPs were analyzed from only the parents in the trios-a single person would require 4.5 months to analyze this small subset of data. (See specification, ¶¶ [0047] & [0055].").)

Representative claim 1, however, only requires performing the claimed abstract computation using "genotype data describing human genotypes for a plurality of individuals." Appeal Br. 19. Claim 1, therefore, does not require any particular amount or content of genotype data to be analyzed, and encompasses much smaller data sets than the 13,976 SNPs described in ¶ 47 of the Specification. *See In re Trans Texas Holdings Corp.*, 498 F.3d 1290, 1299 (Fed. Cir. 2007) ("[W]hile 'the specification [should be used] to interpret the meaning of a claim,' courts must not 'import[ ] limitations from the specification into the claim.' . . . [I]t is improper to 'confin[e] the claims to th[e] embodiments' found in the specification . . . .") (Quoting *Phillips v. AWH Corp.,* 415 F.3d 1303, 1323 (Fed. Cir. 2005) (citations omitted, bracketed text in internal quotes in original). Moreover, the fact that non-computer methods might take a single individual several months does not persuade us that performing computations encompassed by claim 1 cannot practically be performed solely in the human mind.

In sum, for the reasons discussed, under Revised Step 2A, Prong 2, of the 2019 Office Guidance we agree with the Examiner that Appellant's claim 1 does not recite additional elements that integrate the judicial exceptions into a practical application.

Office Guidance—Step 2B

For the reasons discussed above, we are persuaded that Appellant's representative claim 1 recites judicial exceptions (abstract ideas in the form of mathematical concepts and mental processes) under Revised Step 2A, Prong 1, of the 2019 Office Guidance, and does not integrate those judicial exceptions into a practical application under Revised Step 2A, Prong 2. Accordingly, we turn to Step 2B of the Office Guidance to determine whether (a) claim 1 recites specific limitations beyond the judicial exceptions that are not well-understood, routine, or conventional in the field, or (b) whether claim 1 simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception. *See* Office Guidance (84 Fed. Reg. at 56).

As discussed above, the non-abstract steps in claim 1 involve generic computer-related steps for performing the abstract computation (receiving and storing genotype data in a computer memory, storing imputed haplotype phases in a computer memory, extracting a predicted haplotype, and storing a predicted haplotype in a computer memory). *See* Appeal Br. 19. The Examiner finds that these are "necessary and conventional steps in computer use, and more specifically in genetic analysis of obtaining starting data and providing/storing the data analysis results, in this case when using a computer for the HMM modelling." Ans. 5–6.

Appellant contends that it is the abstract computational steps that provide the inventive concept to claim 1:

> With respect to the claims at issue, it is the clauses that the Office action fails to consider including (but not limited to) the processes of "building a data structure" containing "a set of imputed haplotype phases" and "repeatedly randomly modifying[]. . . of the imputed initial haplotype phases[]. . ." and, "automatically replacing an imputed haplotype phase of an individual with a randomly modified haplotype phase ... when ... the randomly modified haplotype phase is more likely than an existing imputed haplotype phase" in order to obtain the "final predicted haplotype phase from the data structure" as recited in claim 1 that constitute something more.

Appeal Br. 13.

As explained in the 2019 Office Guidance, however, it is the "***additional elements*** recited in the claims" beyond the judicial exceptions in the claim that must provide significantly more than the recited judicial exception. *See* Office Guidance (84 Fed. Reg. at 56) (emphasis added). Thus, the fact that the abstract computational steps recited in Appellant's claim 1 might be a highly significant discovery in the field of haplotype prediction is insufficient to establish eligibility for patenting. *See In re BRCA1- and BRCA2-Based Hereditary Cancer Test Patent Litigation,* 774 F.3d 755, 759 (Fed. Cir. 2014) (Even if Appellants "made a '[g]roundbreaking, innovative, or even brilliant discovery,' . . . that is not enough" to establish patent eligibility.) (Citing *Association for Molecular Pathology v. Myriad*, 133 S. Ct. 2107, 2117 (2013)).

Appellant contends that no evidence supports the Examiner's determination that the non-abstract computer-related steps recited in claim 1 (receiving and storing genotype and haplotype data, extracting a predicted

haplotype phase) are well-understood, routine, conventional activities previously known in the field of haplotype prediction. Reply Br. 13–15.

As noted above, however, Appellant repeatedly contends that haplotype prediction is a computer-implemented field. *See* Appeal Br. 8–9; Reply Br. 3–5. Consistent with the Examiner's determination, therefore (*see* Ans. 5–6), the claimed steps of receiving and storing genotype and haplotype data in computer memory, and extracting a predicted haplotype phase therefrom, would not only be necessary in that computer-implemented field, but would also necessarily be routine and conventional in haplotype prediction.

Indeed, in describing the state of the art, Appellant's Specification cites two known software packages as a basis for comparison to the inventive method of representative claim 1. *See* Spec. ¶ 53 ("Two software packages are used to analyze large-scale high-density SNP data: FastPHASE . . . and Beagle . . . .") (citations omitted). On the current record, these undisputedly art-recognized software packages would appear to necessarily involve the steps of receiving and storing genotype and haplotype data in computer memory, and extracting a predicted haplotype phase therefrom. Appellant does not persuade us, therefore, that the preponderance of the evidence fails to support a finding that the claimed steps of receiving and storing genotype and haplotype data in computer memory, and extracting a predicted haplotype phase therefrom, are well-understood, routine, conventional activities previously known in the field of haplotype prediction.

In sum, for the reasons discussed, we agree with the Examiner that, in reciting the non-abstract steps of receiving and storing genotype and

haplotype data in computer memory, and extracting a predicted haplotype phase therefrom, representative claim 1 simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exceptions recited in the claim.

Eligibility for Patenting—Conclusion

As discussed above, we are persuaded that Appellant's representative claim 1 recites judicial exceptions (abstract ideas in the form of mathematical concepts and mental processes) under Revised Step 2A, Prong 1, of the 2019 Office Guidance, and does not integrate those judicial exceptions into a practical application under Revised Step 2A, Prong 2. As also discussed above, we are persuaded that, as to the additional elements beyond the judicial exceptions recited in the claim, claim 1 simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exceptions. Accordingly, applying the principles set forth in the 2019 Office Guidance, we find that the preponderance of the evidence supports the Examiner's determination that Appellant's claim 1 is directed to subject matter that is ineligible for patenting.

We acknowledge, but are unpersuaded by, Appellant's contention that the process recited in claim 1 does not preempt any and all uses of the Hidden Markov Model recited in the claims. *See* Appeal Br. 10–11; Reply Br. 10–11. Our reviewing court has explained that, "[w]hile preemption may signal patent ineligible subject matter, the absence of complete preemption does not demonstrate patent eligibility. . . . Where a patent's claims are deemed only to disclose patent ineligible subject matter under the *Mayo* framework . . . preemption concerns are fully addressed and made

moot." *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1379 (Fed. Cir. 2015).

In the present case, as discussed above, under the *Mayo* framework as implemented by the 2019 Office Guidance, we are persuaded that the preponderance of the evidence supports the Examiner's determination that Appellant's claim 1 is directed to subject matter that is ineligible for patenting. Accordingly, the fact that Appellant's claim 1 might not preempt any and all uses of the Hidden Markov Model does not demonstrate patent eligibility. *See Ariosa*, 788 F.3d at 1379.

In sum, for the reasons discussed, Appellant does not persuade us that the Examiner erred in determining that Appellant's claim 1 is directed to subject matter that is ineligible for patenting. We, therefore, affirm the Examiner's rejection of claim 1 as being ineligible for patenting. Claims 22–43 fall with claim 1. *See* 37 C.F.R. § 41.37(c)(1)(iv).

CONCLUSION

In summary:

Claims Rejected	**Basis**	**Affirmed**	**Reversed**
1, 22– 43	§ 101, ineligibility for patenting	1, 22– 43	
Overall Outcome		1, 22– 43	

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED