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AI Systems and Drafting Patents: Enablement and Inventorship

Overcoming Patent Eligibility, Inventorship, and Enablement Challenges and Avoiding Rejections

THURSDAY, APRIL 22, 2021

1pm Eastern | 12pm Central | 11am Mountain | 10am Pacific

Today's faculty features:

Dina Blikshteyn, Counsel, **Haynes and Boone**, New York, NY

Carl A. Kukkonen, III, Partner, **Jones Day**, San Diego & Palo Alto, CA

Dr. Christian E. Mammen, Partner, **Womble Bond Dickinson**, Palo Alto, CA

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Today's Panel:

haynesboone JONES DAY WOMBLE BOND DICKINSON

Dina Blikshteyn, Counsel, Haynes and Boone
Ms. Blikshteyn is a Co-Chair of the firm's Artificial Intelligence Practice. Her practice is focused on post grant proceedings before the U.S. Patent and Trademark Office, preparing and prosecuting domestic and international patent applications, as well as handling trademark and other IP disciplines.

Carl A. Kukkonen, III, Partner, Jones Day
Mr. Kukkonen has more than 20 years of experience in strategic intellectual property counseling, technology transactions, and litigation. Specifically, he advises clients on patent infringement and validity, preparation and prosecution of patent applications, prelitigation case assessment, active patent litigation, licensing and partnering agreements, IP due diligence, and brand protection matters.

Dr. Christian E. Mammen, Partner, Womble Bond Dickinson
Dr. Mammen has more than 20 years of experience guiding Silicon Valley and global tech and life sciences clients in high-stakes patent and intellectual property litigation. He has substantial lead counsel experience and has led both large and small trial teams. Dr. Mammen has also served as lead counsel on appeals before the Ninth and Federal Circuits.

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AI Systems and Drafting Patents
Enablement and Inventorship

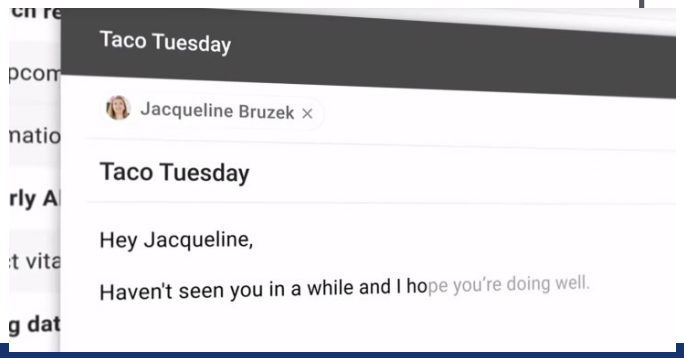
April 22, 2021

Dr. Christian E. Mammen

Background on Artificial Intelligence

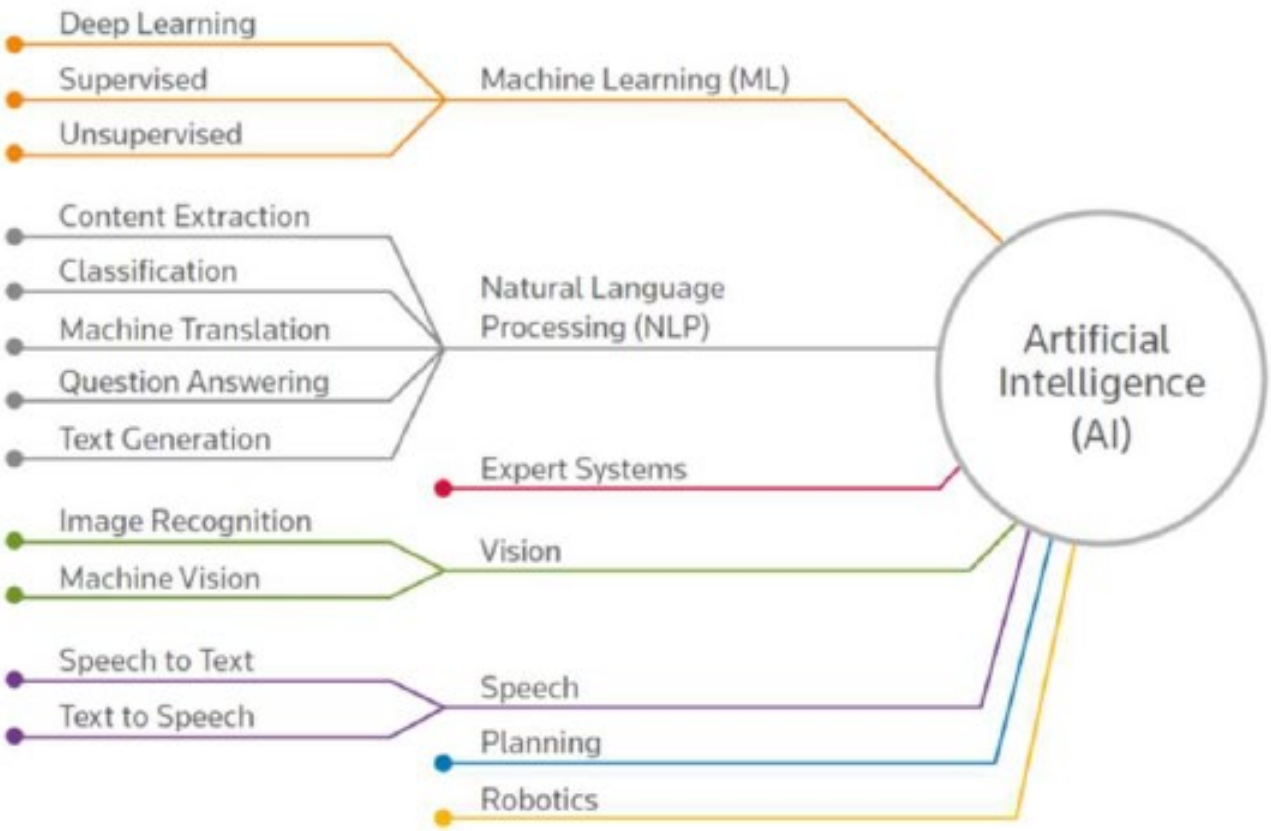
What is AI?

- Definition
  - AI relates to the performance of traditionally “cognitive” functions, such as learning and problem solving, through use of computing resources without explicit programming or human interaction or guidance
  - Machine learning typically involves the preparation of an initial data set, which is used to train a model or neural network to learn various relationships (although generative adversarial networks and others may not require an initial, prepared data set)
- Types:
  - Narrow – suited to a particular purpose or task



  - “Artificial General Intelligence” (AGI)

Branches of AI



Source: Dr. Gary Marchant

Components of AI

- Software/algorithm
- Training data
- Trained model
- Outputs

Roles of AI in Patenting

- AI as a Research Tool
  - Analogous to computers, lab equipment, lab assistants
- AI as the Invention
  - E.g., self-driving cars, speech recognition, etc.
- AI as Inventor?
  - DABUS?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AI SYSTEMS AND DRAFTING PATENTS: ENABLEMENT AND INVENTORSHIP

April 22, 2021

Presented by:

Carl Kukkonen

SUBJECT MATTER ELIGIBILITY CONSIDERATIONS

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U.S. – SUBJECT MATTER ELIGIBILITY FOR PATENTING

- *Alice v. CLS Bank* Supreme Court case and progeny have been devastating to certain types of computer implemented inventions, both in the courts and at the USPTO (at PTAB and during examination).
- But not all computer implemented inventions have suffered dramatically.
- Inventions to computer database systems and information security in computer systems have fared rather well.
  - Those inventions arise in the context of computer technology to begin with.
  - Often characterized and understood as technical solutions to technical problems in computer technology.
- AI, in particular, big data analytics can encounter more difficulty in subject matter eligibility.
  - Those inventions are often viewed as claiming nothing more than abstract ideas.
  - E.g., the claims (minus the computer implementation) recite nothing more than mental steps that could be carried out in one's head, garden variety data manipulation, computations that could be carried out by paper and pencil, or methods of organizing human activities.

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U.S. – SUBJECT MATTER ELIGIBILITY FOR PATENTING

- Reminder - Alice two-part test:
  - 1) Are the claims at issue directed to a patent-ineligible concept, i.e., law of nature, natural phenomena, or abstract idea?
  - 2) If so, do the claims contain additional element(s) sufficient to ensure that the claims amount to significantly more than the ineligible concept itself? (Does it contain an "inventive concept"?)
  - New Guidelines effective as of January 2019
    - Bifurcate prong 2A of Alice analysis into two prongs
    - Under this new two-prong inquiry, a claim is now eligible at revised Step 2A unless it:
      - Recites a judicial exception, and
      - The exception is not integrated into a practical application of the exception

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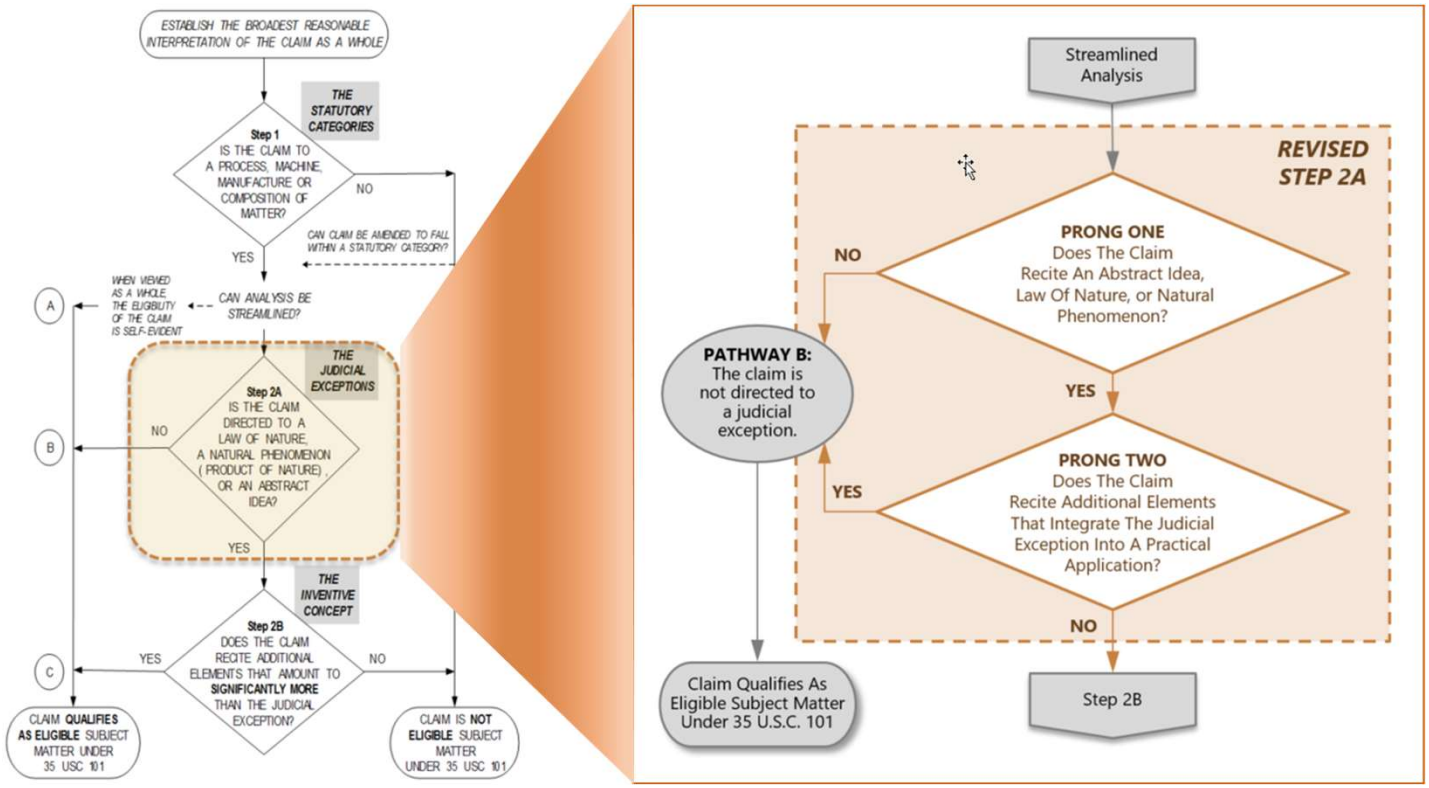
JANUARY 2019 PATENT ELIGIBILITY GUIDELINES



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PRONG ONE OF STEP 2A – GROUPING OF ABSTRACT IDEAS

Mathematical concepts

- Mathematical relationships
- Mathematical formulas or equations
- Mathematical calculations

Mental processes

- Concepts performed in the human mind (including an observation, evaluation, judgment, opinion)

NOTE: The recitation of generic computer components in a claim does not necessarily preclude that claim from reciting an abstract idea.

Certain methods of organizing human activity

- Fundamental economic principles or practices (including hedging, insurance, mitigating risk)
- Commercial or legal interactions (including agreements in the form of contracts; legal obligations; advertising, marketing or sales activities or behaviors; business relations)
- Managing personal behavior or relationships or interactions between people (including social activities, teaching, and following rules or instructions)

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PRONG TWO OF STEP 2A – INTEGRATION INTO PRACTICAL APPLICATION

Limitations that are indicative of integration into a practical application:

- Improvements to the functioning of a computer, or to any other technology or technical field - see MPEP 2106.05(a);
- Applying or using a judicial exception to effect a particular treatment or prophylaxis for a disease or medical condition – see *Vanda* Memo;
- Applying the judicial exception with, or by use of, a particular machine - see MPEP 2106.05(b);
- Effecting a transformation or reduction of a particular article to a different state or thing - see MPEP 2106.05(c); and
- Applying or using the judicial exception in some other meaningful way beyond generally linking the use of the judicial exception to a particular technological environment, such that the claim as a whole is more than a drafting effort designed to monopolize the exception - see MPEP 2106.05(e) and *Vanda* Memo.

Limitations that are **not** indicative of integration into a practical application:

- Adding the words "apply it" (or an equivalent) with the judicial exception, or mere instructions to implement an abstract idea on a computer, or merely uses a computer as a tool to perform an abstract idea - see MPEP 2106.05(f);
- Adding insignificant extra-solution activity to the judicial exception - see MPEP 2106.05(g); and
- Generally linking the use of the judicial exception to a particular technological environment or field of use – see MPEP 2106.05(h)

Whether claim elements represent only well-understood, routine, conventional activity is considered at Step 2B and is not a consideration at Step 2A.

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U.S. – PATENT DRAFTING FOR SUBJECT MATTER ELIGIBILITY

- Describe in specification how the claimed invention presents a technological solution to a technological problem (how the invention arises in a technological context).
- Describing in the specification how the invention improves the existing technology.
  - Describe flaws of the conventional technology, benefits of the invention, etc.
  - Explain how the key claim limitations are absent in the known art, or are different from or improved over those in the art.
- Use technical terminology in claims, e.g., data signal, data structure, self-referential table, database, communication interface, network protocol, encoding, demodulating, etc.
- Recite enough technical substance in the claim so that the claim does not read on mental steps that can be carried out entirely in one's head (even if a computer processor in the claim is ignored).
- Recite interactions with other hardware in claims (machine or transformation test).
- Note that insignificant post solution activity, e.g., displaying or printing a result, may be given little or no weight.
- Description of iterative process to improve results in a technical manner has seen success.

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CONSIDERATIONS FOR PATENTING AI INNOVATIONS

- In addition to claiming strategy, explain in the specification, or be prepared to explain in arguments, how the claimed subject matter presents a technological solution to a technological problem
  - Analysis and exploitation of enormous amounts of data presents a technological problem
  - Claimed subject matter presents a technological solution
    - Reduced file size
    - Reduced processing resource consumption
  - Avoid drafting claims to preempt entire technical field
  - Address technical problem and/or advantages in claims (e.g., preamble and body of claim)
  - Claim specific data structures and how such data structures are transported and/or consumed
  - Include claims directed to graphical user interface aspects if possible

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U.S. – ARGUING FOR SUBJECT MATTER ELIGIBILITY IN PROSECUTION

- Arguments for eligibility under Step 1 of §101:
  - Argue that focus of a claim as a whole is not directed to an ineligible abstract idea.
  - Argue that the claimed invention is a technological solution to a technological problem
  - Argue against examiner's overgeneralization of claim language.
  - Argue that the claimed subject matter is directed to an improvement of existing technology.
  - Argue that claims are directed to a new and improved technology for achieving a concrete and useful result.
    - District court judges may be receptive to explanations of how the claims are directed to concrete, useful results.
      - Because they have no guidance on what "abstract" supposedly means.

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POTENTIAL DIVIDED INFRINGEMENT

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DIVIDED INFRINGEMENT CONSIDERATIONS

- AI inventions can involve multiple actors
- Scope of joint activities that can constitute direct infringement
  - *Akamai Technologies, Inc. v. Limelight Networks, Inc.* (Fed. Cir. 2015)(cert. denied)
- A defendant can be liable for direct infringement of a method when another party performs some of the steps as long as the steps performed by the other are attributable to the defendant through a (1) joint enterprise or (2) when the alleged infringer conditions participating in an activity or receipt of a benefit upon performance of the steps and establishes the manner for timing of that performance
- So joint activities ***can*** potentially constitute direct infringement, but it is still preferable to craft claims that recite the acts of only a single actor for infringement

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IN RE: STANFORD OPINION

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IN STANFORD (FED. CIR. 2021-1012)

- Federal Circuit affirmed PTAB decision finding claims genetic inheritance data analysis as patent ineligible
- Claims directed to haplotype phasing which 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

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IN RE: STANFORD (CONTINUED)

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;

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IN RE: STANFORD (CONTINUED)

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.

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IN RE: STANFORD (CONTINUED)

- PTAB found that the eight steps were directed to mental processes or mathematical concepts
  - Prong One: 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.
  - Prong Two: Board found that 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.

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IN RE: STANFORD (CONTINUED)

- On Appeal Stanford argued:
  - Claims are 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 previous
    - Federal Circuit did not deem the process being an improved technological process; and as such, deemed the claims to be directed to an abstract idea
  - The claimed process yields a greater number of haplotype phase predictions that constitute a new or different use of a mathematical process
    - Federal Circuit opined that claims did not have a practical application and transform abstract idea into patent eligible subject matter

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AI Systems and Drafting Patents: Enablement and Inventorship

Dina Blikshteyn

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Enablement

- 35 U.S.C. § 112(a)
  - The **specification shall contain** a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and **exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same**, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

- Enablement requirement of 35 U.S.C. § 112(a) can be satisfied when the specification teaches one of ordinary skill in the art how to make and use the full scope of the claimed invention without undue experimentation

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Enablement

- Test for Enablement
  - Wands Factors *(In re Wands, 858 F.2d 731 (Fed. Cir. 1988))*
    - breadth of claims
    - nature of the invention
    - state of the prior art
    - level of one of ordinary skill
    - **level of predictability in the art**
    - amount of direction provided by the inventor
    - existence of working examples
    - **quantity of experimentation necessary to make or use the invention based on the content of the disclosure**
- Rule of thumb:
  - $\text{Amount of guidance in the specification} = \dfrac{K}{Amount\ of\ knowledge/predectability\ of\ the\ art}$
  - The less known in the art, or the less predictably is the art → the more disclosure should be included in the specification

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How does enablement relate to AI?

- USPTO requested comments to the following question:
  - How can patent applications for AI inventions best comply with the enablement requirement, particularly given the degree of unpredictability of certain AI systems?
  - Wands factors: predictability and quantity of experimentation

- Predictability in AI systems
  - Results oriented AI systems
    - If x, then y
    - Autonomous driving, Q/A systems (chatbots), etc.
  - Cognitive systems
    - Systems that simulate human thought, help humans make decisions
  - Black box systems

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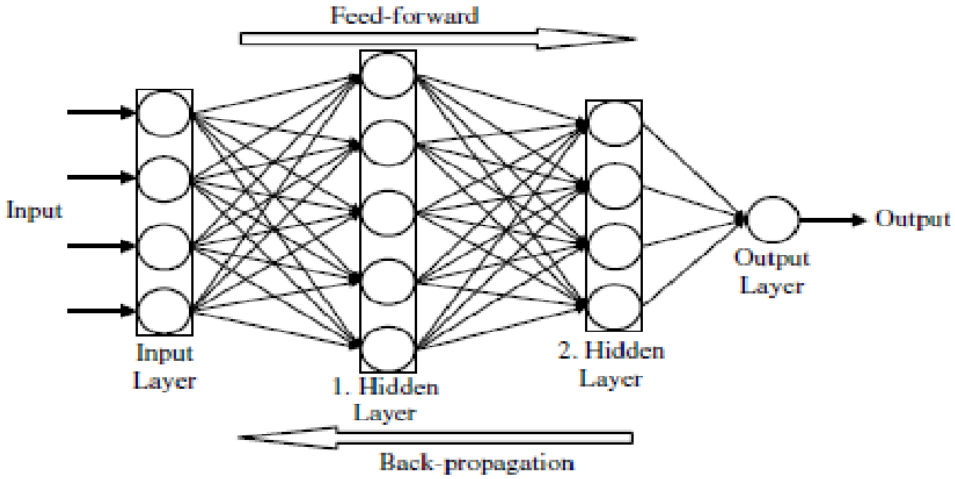
How does enablement relate to AI systems?

- Randomness of AI systems
  - AI algorithms may be random
  - Unexpected results
  - Training data



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Practice Tips - Landscape

- Landscape at the USPTO
  - USPTO hired new examiners to examine AI inventions
  - Today, examiners focus on prior art more than enablement
  - Does not mean that examiners will not focus on enablement in the future

- Issues in front of practitioners
  - AI systems have a huge learning curve
  - Sparse background sources
  - High level math: calculus, linear algebra, matrices, probability, statistics
  - Inventors who speak a highly technical language

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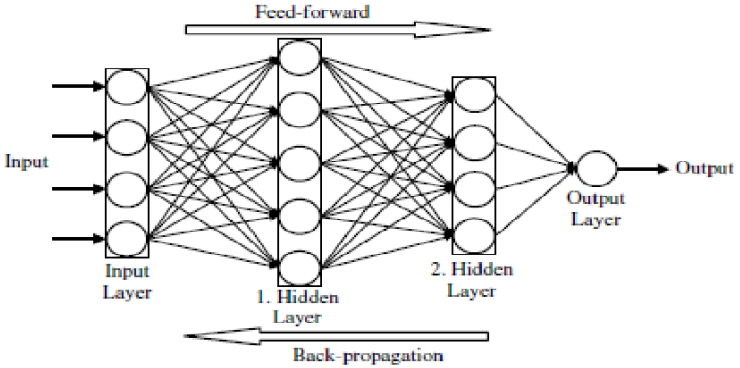
Practice Tips – Drafting Enabling Applications

- White papers
  - AI is a conference driven industry
  - Great source of information
  - Are white papers written in a language that an examiner or a practitioner can understand?
- Algorithms, source code, and pseudo-code
  - Include as a figure and reference in a flowchart
- AI system components
  - Have inventor break down the invention into components
  - Instead of neural network, probability model, etc., prepare a system diagram that includes AI structure in terms of components, such as an encoder, decoder, classifier, different network layers, etc., and show how the data flows among components



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Practice Tips – Drafting Enabling Applications

- Training Examples
  - Training examples are often found in white papers
  - Include examples for training data sets, neural network criteria (e.g. size, encoder/decoder types, layers), etc.
  - Include test results and comparisons with conventional systems

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AI Systems and Drafting Patents
Enablement and Inventorship

April 22, 2021

Dr. Christian E. Mammen

AI as Inventor, and Related Issues

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DABUS: Artificial Inventor Project

Fractal Container Specification and Drawings.

A container for use, for example, for beverages, has a wall with and external surface and an internal wall of substantially uniform thickness. The wall has a fractal profile which provides a series of fractal elements on the interior and exterior surfaces, forming pits and bulges in the profile of the wall and in which a pit as seen from one of the exterior or interior surfaces forms a bulge on the other of the exterior or interior surfaces. The profile enables multiple containers to be coupled together by inter-engagement of pits and bulges on corresponding ones of the containers. The profile also improves grip, as well as heat transfer into and out of the container.
Pending: PCT, USPTO, EPO, UKIPO

Neural Flame Specification and Drawings.

The present invention discloses devices and methods for attracting enhanced attention. Devices include: an input signal of a lacunar pulse train having characteristics of a pulse frequency of approximately four Hertz and a pulse-train fractal dimension of approximately one-half; and at least one controllable light source configured to be pulsatingly operated by the input signal; wherein a neural flame emitted from at least one controllable light source as a result of the lacunar pulse train is adapted to serve as a uniquely-identifiable signal beacon over potentially-competing attention sources by selectively triggering human or artificial anomaly-detection filters, thereby attracting enhanced attention.
Pending: PCT, USPTO, EPO, UKIPO

A machine architecture called "DABUS" conceived of the instant inventions.

DABUS' AI-created Beverage Container

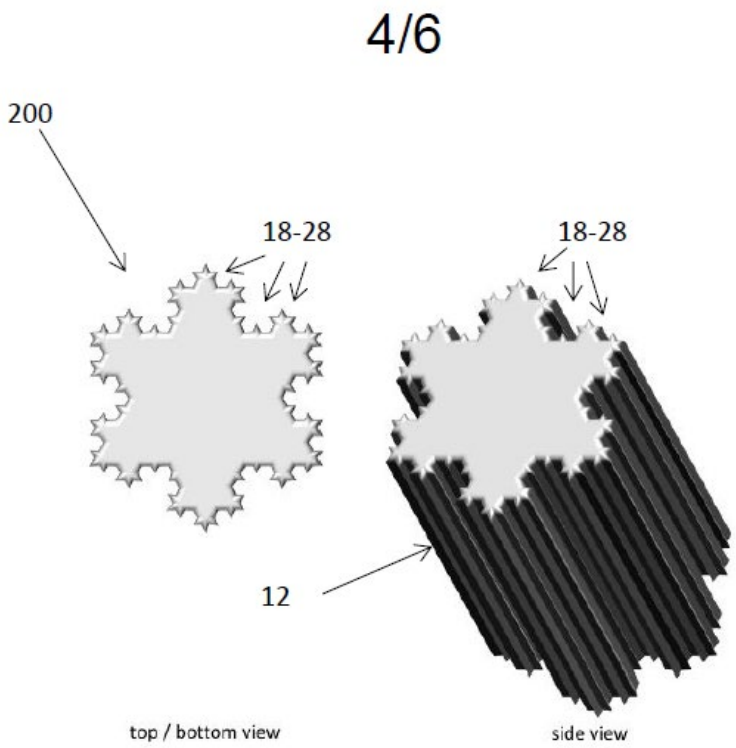

Fig. 6

Core Sources of Patent Law

- **U.S. Const., Art. I, Sec. 8, Cl. 8** – Patent and Copyright Clause
  - [The Congress shall have power] "To promote the progress of science and useful arts, by securing for limited times to authors and *inventors* the exclusive right to their respective writings and discoveries."
- **35 U.S.C. Sec. 100, 101, 102** – Patent Act
  - "The term 'inventor' means the *individual* … who invented or discovered the subject matter of the invention."
  - "*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, …"
  - "A *person* shall be entitled …"

Of “Individuals” and “Persons”

- “In determining the meaning of any Act of Congress, or of any ruling, regulation, or interpretation of the various administrative bureaus and agencies of the United States, the words ‘person’, ‘human being’, ‘child’, and ‘individual’, shall include every infant member of the species homo sapiens who is born alive at any stage of development.”
  - 1 U.S.C. Sec. 8(a)

- “The words ‘*person*’ and ‘whoever’ include corporations, companies, associations, firms, partnerships, societies, and joint stock companies, as well as *individuals*”
  - 1 U.S.C. Sec. 1

Are “Individuals” Limited to Natural Persons?

- Torture Victim Protection Act: yes (SCOTUS)
- FOIA: yes (9th Cir.)
- Ethics in Government Act: yes (DC Cir.)
- Bankruptcy Act: it depends (varies by circuit, issue)
- Criminal statutes protecting “individuals” as crime victims
  - Damage to computers: no (9th Cir.)
  - Identity theft: yes (4th Cir.)

Can an AI be an Inventor?

- "As stated previously, only natural persons can be 'inventors.'"
  - Beech Aircraft Corp. v. EDO Corp., 990 F.2d 1237, 1248 n.23 (Fed. Cir. 1993)

- "In the United States a patent application can be filed only by a natural person, the inventor …"
  - Karrer v. United States, 152 F.Supp. 66, 69 (Ct. Cl. 1957)

Whither DABUS?

- Patent Applications rejected in US, UK and EU
  - Core issue: inventor must be human
  - Practical issues: how did Dr. Thaler get DABUS' authorization to pursue the patent application?
- *Thaler v. Hirshfeld* (E.D. Va. Case No 20cv903)
  - Cross-motions for summary judgment
- Thaler's framing of a conundrum
  - Valuable inventions devised by an AI will either (a) go unprotected or (b) fraudulently name some involved human as the inventor. Since neither is desirable, AI must be recognized as inventor.

Broader Policy Discussions

- USPTO Questions and Request for Comments (87 FR 44889, published 8/27/19)
  - Questions about AI inventions and related issues
- USPTO Report on Comments Received (*Public Views on Artificial Intelligence and Intellectual Property Policy* (October 2020)
- UK UPO Formalities Manual (10/28/19)
  - "Where the stated inventor is an 'AI Inventor', the Formalities Examiner request a replacement F7. An 'AI Inventor' is not acceptable as this does not identify 'a person' which is required by law. The consequence of failing to supply this is that the application is taken to be withdrawn under s.13(2)."
  - https://www.gov.uk/guidance/formalities-manual-online-version/chapter-3-the-inventor (Section 3.05, updated 10/28/19) (emphasis added)

When AIs Gain Agency…

- POSITA Definition
  - AI of Skill in the Art (AISITA)?
  - One standard for people and AIs, or two?
- Obviousness
  - Is everything obvious to an AI?
- Written Description/Enablement
  - What is an enabling disclosure for an AI invention?
  - Does it even need to be human-readable?

Patent Questions – AI and Inventing

- Can an AI be an “inventor”?
  - What about the AI’s programmers?
- What does it mean to be “novel” and “nonobvious” when an AI gets involved?
  - “*Person* of skill in the art” and “Level of skill in the art”
- How can we articulate/explain the “invention” when an AI comes up with an “invention”?
  - The disclosure must “enable a person of skill in the art to make and use the invention”
  - AI’s “black box” problem – does it impact enablement?

Other Patent Law Issues

- AI and Invalidating Patents
  - Using AI to find prior art – and to connect the dots between multiple references
  - Is everything “obvious” to an AI?
- AI and Infringing Patents
  - Can an AI be an infringer?
  - “Black box” problem – how can we determine what the AI actually does?
  - Using AI to determine infringement / find infringements?
- AI and Patent Litigation
  - Authorizing suit
  - Service of process on an AI
  - Deposing an AI?

Categories of AI Inventions

- Where the AI is the invention
  - Section 101
  - Black box
  - Enablement
  - Scope of what is claimed
- Where the AI helps the human inventor
  - Just another technology tool?
  - Or is the human helping the AI?
- Where the AI is the inventor
  - Legal restrictions
  - Conceptual limitations

Electronic Personhood?

- European Parliament Commission on Civil Law Rules
  - 2017 Proposal to create “electronic personhood” for robots
  - Included a call for the European Commission “to elaborate criteria for an ‘own intellectual creation’ for copyrightable works produced by computers or robots”
  - … but not a parallel mention of patentability of AI-created inventions.

- Ryan Abbott, *The Reasonable Robot* (2020)
  - Advocates a principle of nondiscrimination between humans and AI in future development of laws

What is the Motivation of the 2017 EP Proposal? Preamble--

- whereas from Mary Shelley's Frankenstein's Monster to the classical myth of Pygmalion, through the story of Prague's Golem to the robot of Karel Čapek, who coined the word, people have fantasised about the possibility of building intelligent machines, more often than not androids with human features;
- whereas now that humankind stands on the threshold of an era when ever more sophisticated robots, bots, androids and other manifestations of artificial intelligence ("AI") seem poised to unleash a new industrial revolution, which is likely to leave no stratum of society untouched, it is vitally important for the legislature to consider all its implications;
- * * *

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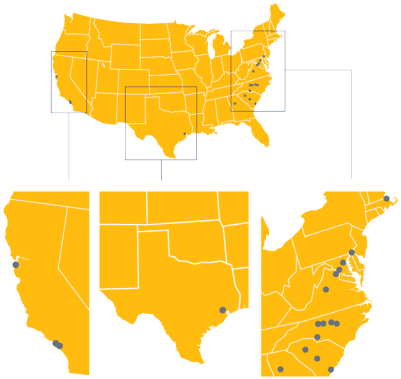

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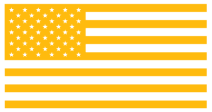
Consolidating our national reputations and regional heritage under one powerful transatlantic brand

Our sectors

Representing more than **250** Publicly Traded Companies in the US and UK

+150 Chambers rankings

UK Top 20 Law firm



US Top 80 Law firm

Global Top 100 Law firm by revenue

WOMBLE
BOND
DICKINSON

SAMPLE CLAIMS

JONES DAY

SAMPLE WI-FI BENCHMARKING CLAIMS – “THE UGLY”

1. A method for characterizing performance of a Wi-Fi system comprising:

monitoring data characterizing communications between a Wi-Fi system and a plurality of nodes connected thereto;

extracting variables from the received data characterizing performance of the Wi-Fi system including speed of transmission, quality of service, and capacity;

generating a machine learning model for modeling performance of the Wi-Fi system, the machine learning model comprising variables and weighting coefficients for the variables; and

assessing, using the generated machine learning model, a performance metric for the Wi-Fi system.

Potential divided infringement challenges with “generating step”
No clear physical world input / output

JONES DAY

SAMPLE WI-FI BENCHMARKING CLAIMS – "THE BAD"

1. A method for characterizing performance of a Wi-Fi system comprising:

monitoring data characterizing communications between a Wi-Fi system and a plurality of nodes connected thereto;

extracting variables from the received data characterizing performance of the Wi-Fi system including speed of transmission, quality of service, and capacity; and

assessing, using the extracted variables and based on a machine learning model trained using historically derived data from a plurality of other Wi-Fi systems, a performance metric for the Wi-Fi system.

Potentially eliminates divided infringement by reciting the use of a machine learning model
No physical world input / output

JONES DAY

SAMPLE WI-FI BENCHMARKING CLAIMS– “THE GOOD”

1. A method for characterizing performance of a Wi-Fi system comprising:

monitoring data characterizing communications between a Wi-Fi system and a plurality of nodes connected thereto;

extracting variables from the received data characterizing performance of the Wi-Fi system including speed of transmission, quality of service, and capacity; and

assessing, using the extracted variables and based on a machine learning model trained using historically derived data from a plurality of other Wi-Fi systems, a performance metric for the Wi-Fi system; and

automatically adjusting, based on the performance metric, at least one operation parameter of the Wi-Fi system to enhance performance.

Physical world input / output
Uses machine learning model, rather than generating it

JONES DAY

Example Figure

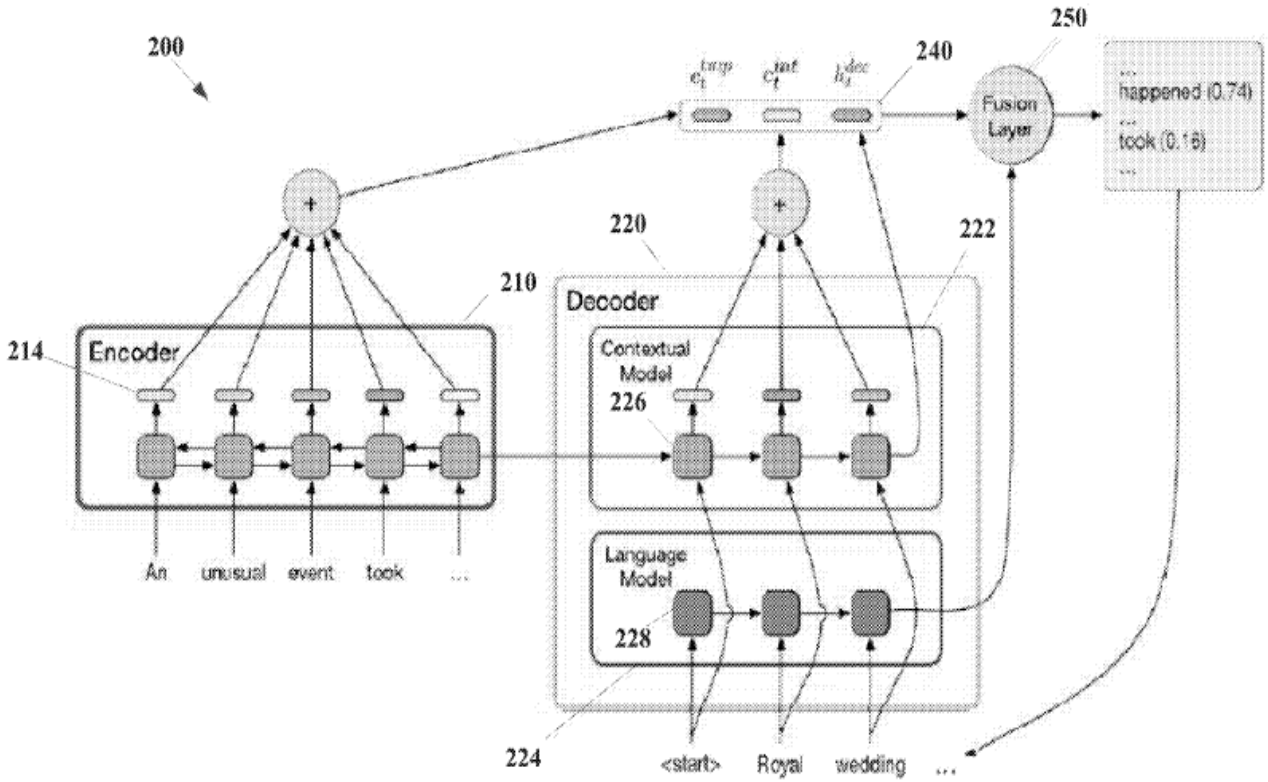


Fig. 2

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Example Claim

- A system for providing an abstractive summary of a source textual document, the system comprising:
  - an **encoder** generating, using a processor, an encodings for the source textual document and encoder temporal attention context vectors;
  - a **decoder** separated into a contextual model and a language model,
    - the **contextual model** generates, using the processor, decoder intra-attention context vectors and first vectors for extracting words from the source textual document from the encodings, and
    - the **language model** generates, using the processor, second vectors for composing paraphrases of selected words in the source textual document from a fixed vocabulary;
  - a **reference vector** combining the encoder temporal attention context vectors, the decoder intra-attention context vectors, and the first vectors; and
  - a **fusion layer** generating the abstractive summary of the source textual document from the reference vector and the second vectors.

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