

Emerging Tech Webinar Series Episode 06

Patenting Artificial Intelligence Inventions for Companies Outside the Software Industry

Today's Presenter

Greg Rabin

Greg Rabin is a senior patent attorney at Schwegman, Lundberg & Woessner. Greg's practice is focused on computer science and software inventions. Greg holds a J.D. from the University of Michigan Law School, dual Bachelor's Degrees in Computer Science and Mathematics from MIT, and a Master's Degree in Computer Science from MIT. Greg has spoken about patenting inventions in artificial intelligence and machine learning before the American Intellectual Property Law Association (AIPLA), the United States Patent & Trademark Office (USPTO), and several other organizations.



Overview

- Introduction
- Machine Learning and Non-Software Companies
- Key Players and Trends
- How to Capture and Protect AI Intellectual Property
- Patentable ML Technologies for Non-Software Companies
- ML and Current Patent Eligible Subject Matter
- Written Description and Functional Claiming with ML

The accelerating growth of enabling technologies is driving AI development:

- Powerful computing and wide availability of GPUs
- Availability of practically infinite storage and a flood of data, i.e, “Big Data”
- Development of smart algorithms
- Advancements in sensor technology (e.g., image and voice)

Increased need to identify patterns with large volumes of business data

AI Market Continues Its Upward Trend

“AI techniques . . . have the potential to create between \$3.5 trillion and \$5.8 trillion in value annually across 9 business functions in 19 industries.” - *McKinsey Global Institute*

- “AI and machine learning have the potential to create an additional \$2.6T in value by 2020 in Marketing and Sales, and up to \$2T in manufacturing and supply chain planning.” - *McKinsey Global Institute*

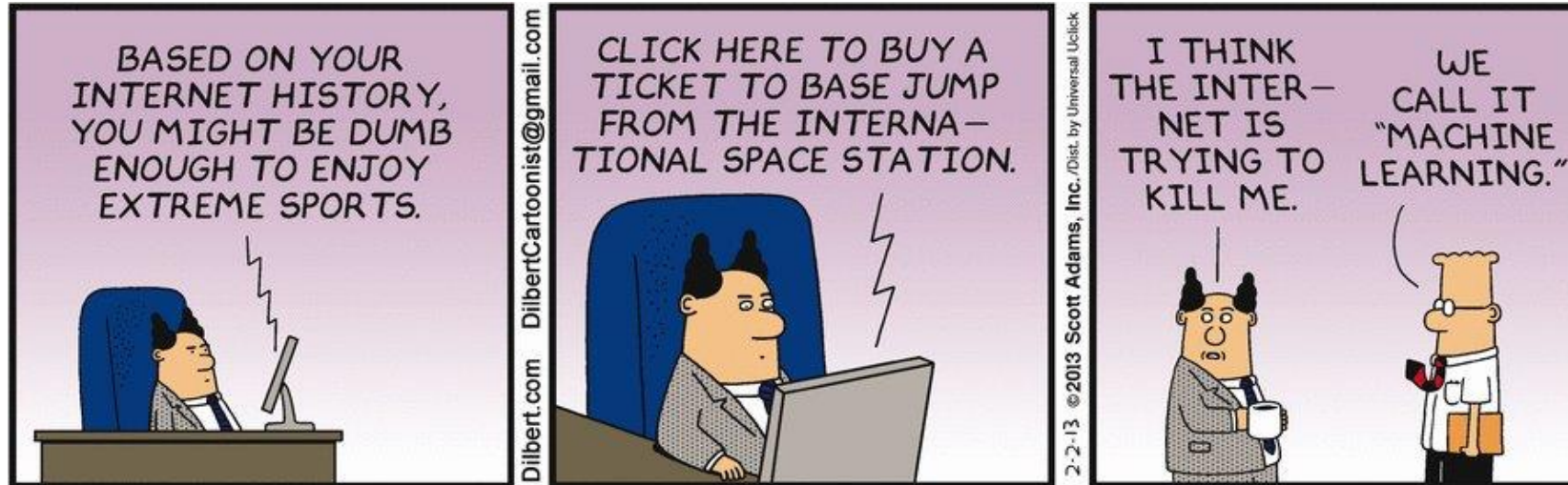
Large Government Investment:

- U.S.: DARPA will invest more than \$2 billion over the next few years to develop “third-wave” AI technology that can use “contextual adaptation” for “AI Next” campaign
- China: Goal to foster a \$1 trillion AI industry by 2030

Machine Learning and Non-Software Companies

What is Machine Learning?

Dilbert defines it best.



Seriously, what is Machine Learning?

- Machine Learning gives “computers the ability to learn without being explicitly programmed.”
- Machine learning explores the study and construction of algorithms that can learn from and make predictions on data – such algorithms overcome following strictly static program instructions by making data-driven predictions or decisions, through building a model from sample inputs.
- Example applications include email filtering, detection of network intruders, optical character recognition (OCR), and computer vision.
- Source: https://en.wikipedia.org/wiki/Machine_learning

Machine Learning is a Huge Field with Many Subfields

- Uses
 - Computer Vision
 - Natural Language Processing
 - Speech Processing
- Algorithms
 - Deep Learning
 - Decision Tree
 - Bayesian Algorithms
 - Artificial Neural Networks
 - Decision Tree Algorithms
 - Clustering Algorithms



Considerations

- Is machine learning being used to solve a specific commercial need in your industry?
- As machine learned models become “smarter,” they can solve more and more problems. E.g. Simple chat bots become more advanced bots that can have actual conversations and generate ideas.
- How would you feel if a competitor applied for a patent on technology similar to the one you are developing?
- How valuable is the technology to your company?

Considerations (cont.)

- Can machine learning significantly supplement the use of human researchers or guide researchers, saving them significant time.
 - E.g. Assist in preselection of certain chemical compounds for further study to see if they can be used for a specific purpose?
- In the future, can any company NOT consider machine learning as part of its strategy?
 - Probably ok not to use machine learning in some cases, but it should, at least, be considered.

Why Should Non-Software Companies Care?

- Machine learning is a fast-growing field, and many forecasters expect this growth to accelerate.
- Machine learning is being used in more and more traditionally “non-software” fields – e.g. marketing and sales, manufacturing, supply chain planning, medicinal chemistry, computational chemistry.



Example: Atomwise, Inc.

- Atomwise is a biochemical discovery startup in San Francisco.
- Atomwise deployed a deep learning machine, AtomNet, to tackle key real-world issues in improving pesticides.
- Deep learning allowed Atomwise researchers to simulate millions of compounds and identify the ones that target pests without causing toxicity in humans or other friendly species.
 - Using traditional research methods, simulating millions of compounds would be impractical.
- This has allowed the company to produce less harmful products faster than competitors.

Faster Iteration

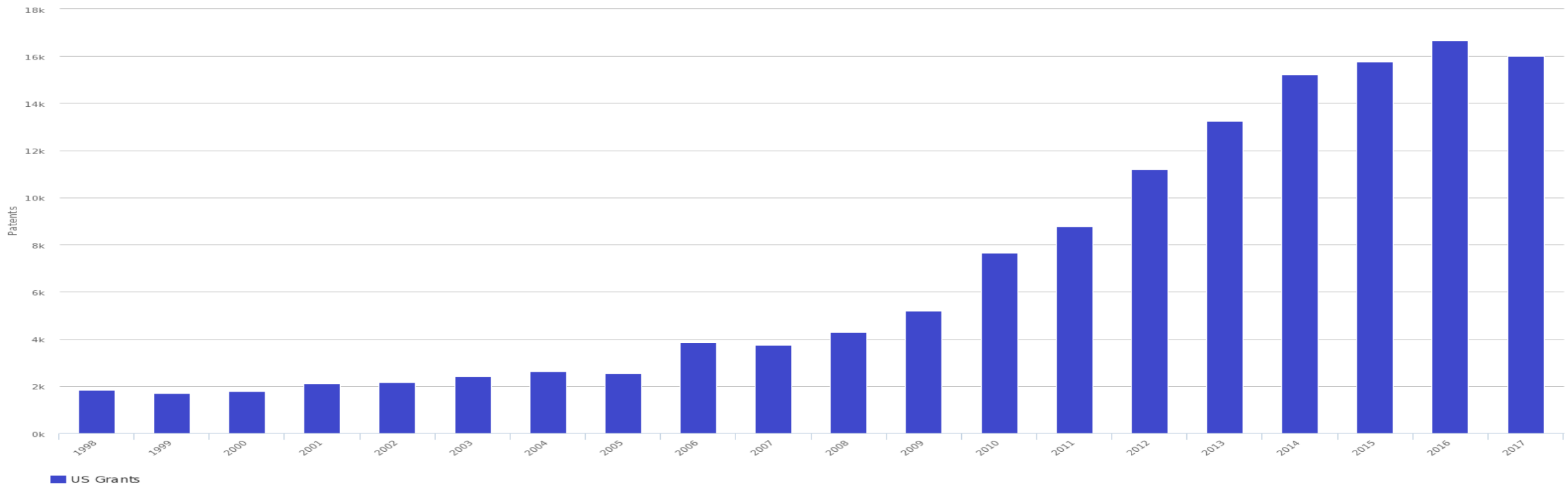
- One big benefit of machine learning technology is faster iteration.
- Samples can be generated and tested much more quickly by machines than by humans.
- Dilbert creator Scott Adams tried many different cartoons before he developed Dilbert and became successful through it. This iteration process took Adams many years. However, a machine learning algorithm that generates cartoons can do this much more quickly.
- Similarly, in the technology space, faster iteration allowed Atomwise to develop pesticides much more quickly than its competitors who used traditional schemes.

Key Players

Growth of Patent Protection for AI and ML in the U.S.

U.S. Patent Grants for AI and ML (20 Years)

Patents per Source per Publication Year



AI and ML Patents – Keyword Clustering



U.S. Patents Grants for AI and ML Past 10 Yrs

How to Capture and Protect AI Intellectual Property

Capturing ML Inventions at the Source

- Rules
- Training Data Sets
- Hardware/Software Platform Independence
- Sufficiently Enabling Description
- Best Mode
- Trade Secret Features
- Components from Open Innovation Sources
- Components from Third Parties

US Patent Inventorship

- Current US patent law awards patents to “individual(s)”:
 - 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. U.S. Constitution, Art. 1, Section 8, Clause 8
 - Under 35 U.S.C. § 100(f) “inventor” means “the ***individual*** or, if a joint invention, the ***individuals*** collectively who invented or discovered the subject matter of the invention.”
 - The Committee Reports accompanying the 1952 Patent Act indicate that Congress intended statutory subject matter to “include anything under the sun that is made by ***man***.” S. Rep. No. 1979, 82d Cong., 2d Sess., 5 (1952); H. R. Rep. No. 1923, 82d Cong., 2d Sess., 6 (1952) (emphasis added).
 - 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. § 8(a).
 - “Invention”: conception + reduction to practice. “Conception”: each inventor must contribute to the conception of the invention. Conception is defined as the formation ***in the mind of the inventor***, of a definite and permanent idea of the complete and operative invention, as it is hereafter to be applied in practice. *Stern v. Trustees of University of Columbia*, (Fed. Cir. 2006)

Capturing ML Inventions at the Source

- Joint inventors must be **“aware”** of each other’s work on the invention
 - 35 U.S.C. § 116(a) “neither states nor implies that two inventors can be ‘joint inventors’ if they have had no contact whatsoever and are completely unaware of each other’s work.” *Kimberly-Clark Corp. v. Procter & Gamble Distr. Co.*, 973 F.2d 911, 916 (Fed. Cir. 1992).
- “Because conception is the touchstone of inventorship, **each joint inventor must generally contribute to the conception of the invention.**” *Bard Peripheral Vascular, Inc. v. W.L. Gore & Assoc., Inc.*, 776 F.3d 837 (Fed. Cir. 2015).
- Merely adding **routine** knowledge or skill is **not** an inventive contribution
 - Simply providing “well-known principles” or techniques, or “reduc[ing] the inventor’s idea to practice” does not qualify. *Ethicon, Inc. v. United States Surgical Corp.*, 135 F.3d 1456, 1460 (Fed. Cir. 1998).

Patentable Machine Learning Technologies for Non-Software Companies

Patentable Machine Learning Technologies for Non-Software Companies



1. New approaches, using machine learning technology, to solving problems in the company's line of business.
2. New machine learning technologies themselves.

Note: There may be overlap between (1) and (2).

1. New Approaches to Problem Solving

- Grandfather of 101 cases is *Diamond v. Diehr*, 450 U.S. 175 (1981).
- Issue was validity of U.S. Patent 4,344,142, “Direct digital control of rubber molding presses,” to James R. Diehr, II, of Troy, Michigan.
- The Supreme Court held that controlling the execution of a physical process, by running a computer program did not preclude patentability of the invention as a whole.
- Novelty could lie in the computer program or in the physical process.

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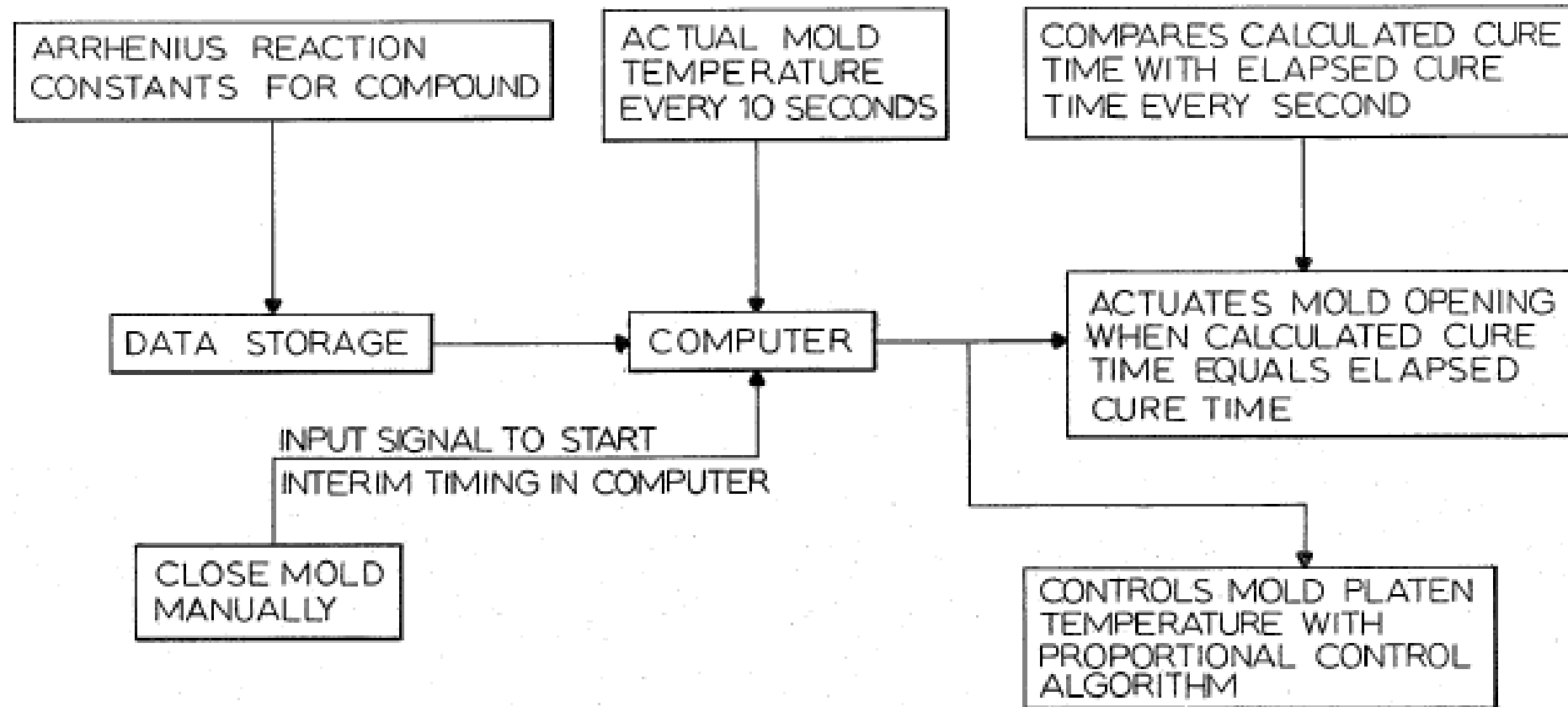


FIG. 1

Diehr Patent

- Filed in 1975 and issued in 1982.
- This is NOT machine learning. This is a 1970s computer preprogrammed with instructions.
- However, the computer gathers data from the data storage and the environment (mold temperature) and makes decisions based on this data using preprogrammed rules.

Diehr Patent is Far From Modern Machine Learning



Diehr Patent – Modernized

- In the Diehr patent, the computer gathers data from the data storage and the environment (mold temperature) and makes decisions based on this data using preprogrammed rules.
- Replace preprogrammed rules with a trained neural network (and a description of the training process), and you have a machine learning invention that is clearly patentable under the rules expressed by the Supreme Court in *Diehr*.

Diehr Patent – Modernized

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Machine Learning Technologies Likely Patentable Under *Diehr*



- Using a trained neural network to control fabrication of a chemical.
 - Chemical may be rubber, glass, a detergent.
- Using a trained neural network to control development of a biological or biomedical compound.
 - Biological or biomedical compound may be a drug, a vaccine, an artificial limb, an artificial organ, a lab-grown meat, and the like.

Some of the Easiest 101 Hurdles

- Software companies WISH it was this easy for them!



Toronto, ON



Silicon Valley

Modern Example of This Approach

- US Patent No. 8,478,535, issued to Nebojsa Jojic of Redmond, WA, and originally assigned to Microsoft Corporation.
- Filed on December 30, 2005, and issued on July 2, 2013.
- Title: Systems and Methods That Utilize Machine Learning Algorithms to Facilitate Assembly of AIDS Vaccine Cocktails
- Brief description: Machine learning techniques are used “to generate vaccine cocktails for species of pathogens that evolve quickly under immune pressure of the host.”

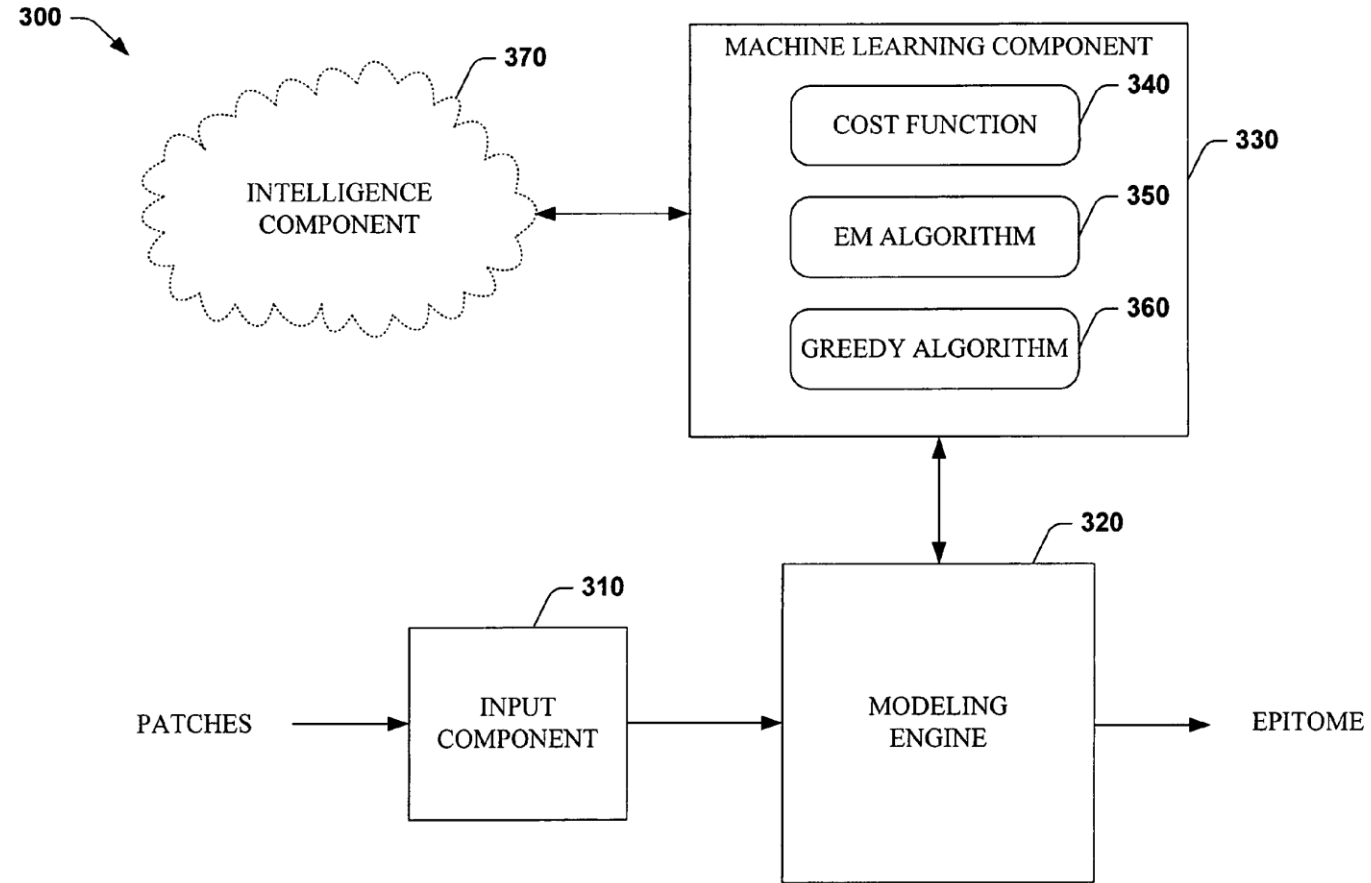


FIG. 3



2. New Machine Learning Technologies

- Very different problems may require very different machine learning technologies.
- Typically, when faced with a new machine learning problem, software companies attempt to recycle preexisting technologies to solve them.
- E.g. Problem: recognize faces of cats.
Solution: Re-train human facial recognition model on cat faces.



New Machine Learning Technologies

- This might not always apply.
- Human → Cat facial recognition may work.
- But human facial recognition → complex chemical recognition might be much more difficult.
- What might be changed:
 - New feature vector/ data studied by the neural network to draw conclusion.
 - New training dataset(s).
 - New neural network structure.

New Machine Learning Technologies

- Here, you are looking at advances in the field of computer science itself, rather than the use of a computer to solve a problem in another field.
- E.g. a new neural network vs. using a neural network to control a process of curing rubber.

Machine Learning and Current Patent Eligible Subject Matter

Patent Eligible Subject Matter in the US

To be eligible for a patent, the subject matter of the claim must be directed to a **process, machine, manufacture, or composition of matter**. See 35 U.S.C. §101.

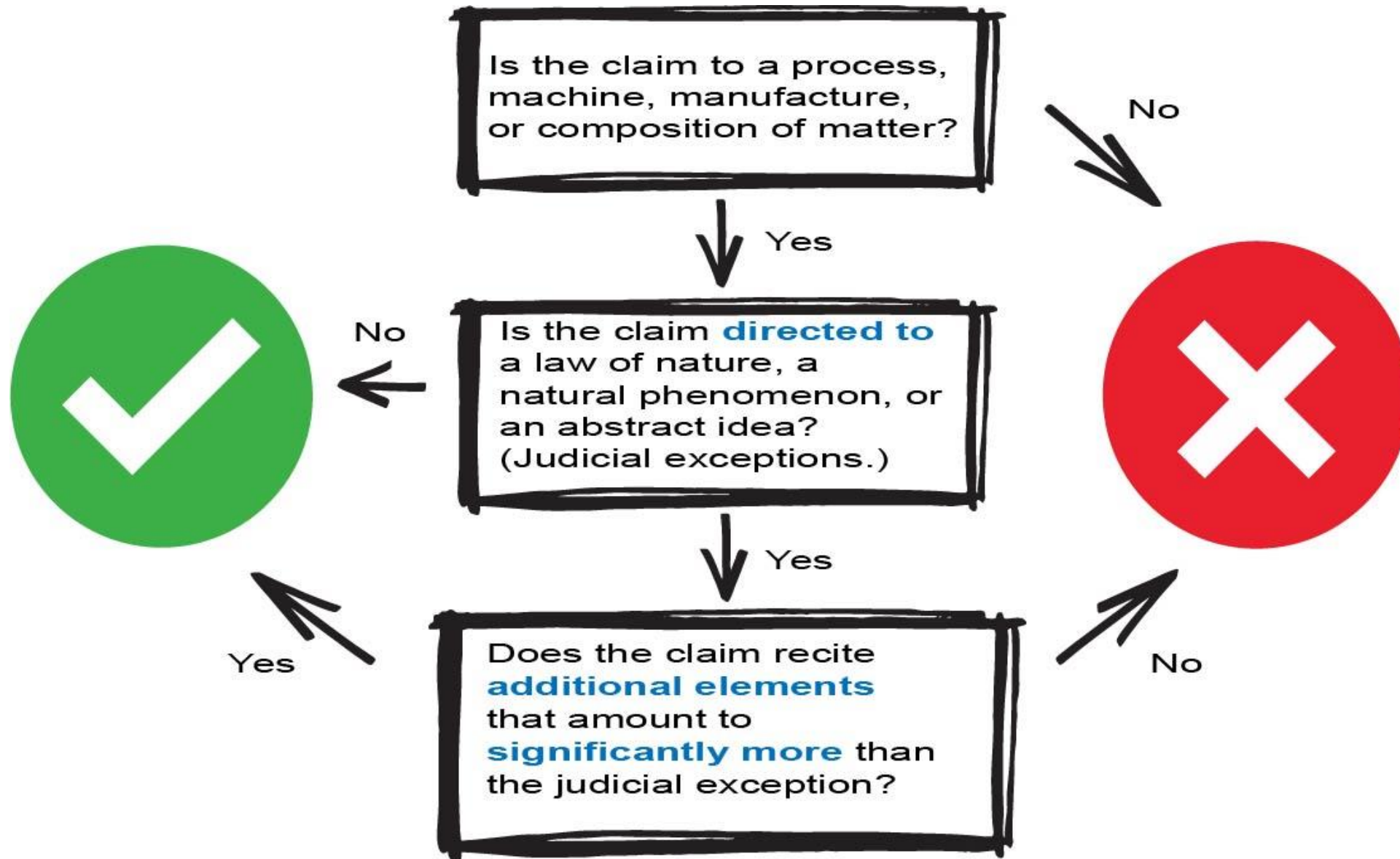
Judicial Exceptions to Patent Eligibility

Abstract ideas (e.g., mathematical algorithms)

Laws of nature

Natural phenomena

Alice Test



1. Draft ML Claims to Recite a Specific Improvement

- *Enfish, LLC v. Microsoft Corp.* (Fed. Cir. 2016)
 - U.S. Patent Nos. 6,151,604 and 6,163,775
 - The claims recited a self-referential table, a specific type of data structure designed to improve the way a computer stores and retrieves data in memory.
 - “means for configuring”
 - Specification included a 4 step algorithm for configuring a self-referential table
 - A self-referential table for a computer database
 - **Patent eligible because the claims are directed to an improvement of the functioning of the computer.**
 - **Claims a specific improvement to computer technology**

2. Claim the Application or Use

- *Thales Visionix, Inc. v. United States* (Fed. Cir. 2017)
 - U.S. Patent No. 6,474,159
 - The claims disclose an inertial tracking system for tracking the motion of an object relative to a moving reference frame.
 - Sensors that automatically calculated the position, orientation, and velocity of an object in 3-D space
 - **Patent eligible because the claims are directed to systems and methods that use inertial sensors in a non-conventional manner to reduce errors in measuring the relative position and orientation of a moving object on a moving reference frame.**
 - **Claims application or use of data, not just generation**

U.S. Patent No. 6,474,159 – Claim 1

1. A system for tracking the motion of an object relative to a moving reference frame, comprising:

a first inertial sensor mounted on the tracked object;

a second inertial sensor mounted on the moving reference frame; and

an element adapted to receive signals from said first and second inertial sensors and configured to determine an orientation of the object relative to the moving reference frame based on the signals received from the first and second inertial sensors.

3. Include Implementation Details in Claims

- *McRO, Inc. v. Bandai Namco Games America Inc.* (Fed. Cir. 2016)
 - U.S. Patent Nos. 6,307,576 and 6,611,278
 - A patent claiming a method for automating part of a preexisting 3-D animation
 - Automating the facial expressions of animated characters through rule sets
 - **The court found that the process recites a combined order of specific rules that renders information into a specific format and was patent eligible.**

U.S. Patent No. 6,307,576, Claim 1

1. A method for automatically animating lip synchronization and facial expression of three-dimensional characters comprising:

obtaining a first set of rules that define output morph weight set stream as a function of phoneme sequence and time of said phoneme sequence;

obtaining a timed data file of phonemes having a plurality of sub-sequences;

generating an intermediate stream of output morph weight sets and a plurality of transition parameters between two adjacent morph weight sets by evaluating said plurality of sub-sequences against said first set of rules;

generating a final stream of output morph weight sets at a desired frame rate from said intermediate stream of output morph weight sets and said plurality of transition parameters; and

applying said final stream of output morph weight sets to a sequence of animated characters to produce lip synchronization and facial expression control of said animated characters.

**Implementation
details**

4. Avoid Black Box Terminology

- *Vehicle Intelligence and Safety LLC v. Mercedes-Benz USA, LLC*, (Fed. Cir. 2015)
 - US Patent No. 7,394,392
 - Claims methods and systems that screen equipment operators for impairment, selectively test those operators, and control the equipment if an impairment is detected.
 - An “expert system” that detects potential impairment in an operator and controls the operation of equipment if an impairment is detected.
 - **Patent invalid for being drawn to a patent-ineligible concept, specifically the abstract idea of testing operators of any kind of physical or mental impairment.**

U.S. Patent No. 7,394,392 – Claim 8

8. A method to screen an equipment operator for impairment, comprising:

screening an equipment operator by one or more expert systems to detect potential impairment of said equipment operator;

selectively testing said equipment operator when said screening of said equipment operator detects potential impairment of said equipment operator; and

controlling operation of said equipment if said selective testing of said equipment operator indicates said impairment of said equipment operator, wherein said screening of said equipment operator includes a time-sharing allocation of at least one processor executing at least one expert system.

Written Description and Functional Claiming with Machine Learning

- 35 USC 112: Written Description and Means + Function
 - (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.
 - (f) An ***element in a claim for a combination may be expressed as a means*** or step for performing a specified function ***without the recital of structure,*** material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

Functional Claiming Pre-*Williamson*: The Presumption



- A claim element that explicitly recites a “**means for**” performing a function is presumed to invoke the statutory construction of § 112(f) / Pre-AIA ¶6
- A claim element that lacks the word “means” is presumed not to invoke the statutory construction
 - Previously, the presumption flowing from the absence of the term “means” was characterized as “**a strong one that is not readily overcome.**”
 - The statutory construction was not applied unless the limitation was “essentially ... **devoid** of anything that can be construed as structure.”

Post-Williamson

- Abandons characterizing as “strong” the presumption that a limitation lacking “means” is not subject to § 112 (6)
- Overrules the strict requirement of a showing that the limitation essentially is **devoid** of anything that can be construed as structure
- Standard is instead: “...*whether the words of the claim are understood by persons of ordinary skill in the art to have a **sufficiently definite** meaning as the name for structure.*”

“Nonce” Words

[Nonce] [transition] [function]

Courts have held the following to invoke § 112(f)/¶ 6:

- Module for
- Unit for
- Device for
- Mechanism for
- Element for
- System for
- Component for
- Member for
- Apparatus for
- Machine for



Courts have held the following not to invoke § 112(f)/¶ 6:

- Circuitry / circuit for
- Processor
- Computing unit
- Detent mechanism
- Digital detector for
- Reciprocating member
- Connector assembly
- Hanger member

MPEP 2181: §112(f) Claims Must Satisfy §112(b)

- “If one employs means plus function language in a claim, ***one must set forth in the specification an adequate disclosure showing what is meant by that language.*** If an applicant fails to set forth an adequate disclosure, the applicant has in effect failed to particularly point out and distinctly claim the invention as required by the second paragraph of section 112.”
- **Test:** Is the corresponding structure of a means-plus function claim disclosed in the specification in a way that one skilled in the art will understand what structure will perform the recited function?
- If not, claim is indefinite and, therefore, invalid

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- Need disclosure of structure that corresponds to the claimed function
- Disclosure of a general purpose computer not enough when element must be implemented in special purpose computer
- Requires an algorithm for performing the function expressed as: a formula, prose, flow charts, ...
- Expert declaration that a person of ordinary skill in the art would know what structure is needed is not enough:
 - Patentee's expert testified: "as one of ordinary skill in the art, reading the specification, I would know exactly how to program a computer to program a computer to perform the recited functions...[and the structure could be either hardware or software]"
- Illustrations in the specification of the function being performed (e.g., displays) is not a substitute for disclosure of an algorithm

- Programmed computer functions require a computer programmed with an “algorithm” to perform the function
 - Specialized functions: functions other than those commonly known in the art, often described by courts as requiring “special programming” for a general purpose computer.
 - Ex. “Event detection system that communicates network event information”
 - ***Requires disclosure of an algorithm***
 - Non-specialized functions: functions known by those of ordinary skill in the art as being commonly performed by a general purpose computer or computer component
 - Ex. means for storing data

Avoid Indefiniteness When Claiming ML



- *Gradient Enters. v. Skype Techs. S.A.*, 2015 U.S. Dist. LEXIS 126790 (W.D.N.Y. Sept. 22, 2015)
 - U.S. Patent No. 7,669,207; Claim 27
 - Skype successfully argued the system claims, Claim 27 and its dependent claims, are invalid under § 112(f) because the patent fails to disclose adequate structure corresponding to the claimed function.

U.S. Patent No. 7,669,207 – Claim 27

27. A system for detecting, reporting and responding to network node-level occurrences on a network-wide level, the system comprising:

a plurality of mobile agents, each of the mobile agents is hosted by one of a plurality of nodes in a network which each detect for one or more events;

a designation system that designates one of the mobile agents hosted at one of the nodes as a controlling mobile agent and designates another one of the mobile agents hosted at another one of the nodes as the controlling mobile agent when the one of the mobile agents previously designated as the controlling mobile agent is unavailable;

an event detection system that communicates network event information associated with an event detected at one or more of the nodes in the network to the controlling mobile agent; and

“Designation System”

28. The system as set forth in claim 27 wherein the **designation system** determines which one of the nodes is best suited to host the controlling mobile agent and selects the one of the nodes to host the controlling mobile agent based on the determination.

29. The system as set forth in claim 28 wherein the **designation system** utilizes at least one of a voting and an artificial intelligence algorithm to determine which one or more of the nodes is best suited to host the controlling mobile agent.

32. The system as set forth in claim 27 wherein the **designation system** determines when the one of the mobile agents previously designated as the controlling mobile agent is unavailable.

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Computer-Readable Medium (CRM) Claim

- The CRM claim is a hybrid of the apparatus and the method claim, having properties of both.
- The CRM claim takes the form of a computer-readable medium storing instructions that, when executed by a computer, cause it to perform a specified method.
- CRM claims remain viable options today—even after *Alice Corp. v. CLS Bank Int'l.*
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Example CRM Claim: US 9,600,929 – Claim 4

4. A non-transitory computer-readable storage medium including computer-executable instructions which, when loaded to a computing system, execute a routine comprising:
- (i) aligning a first set of 3D voxel data of an object and a second set of 3D voxel data by matching a level of detail (LOD) of the first set and an LOD of the second set;
 - (ii) making a one-to-one comparison between each voxel in the first set of 3D voxel data and a corresponding voxel in the second set of 3D voxel data simultaneously to create a diff model that records differences found between the first and second sets of 3D voxel data, the differences including additions in which an empty voxel in the first set is changed to an occupied voxel in the second set and deletions in which an occupied voxel in the second set is changed to an empty voxel in the second set; and
 - (iii) displaying the content of the diff model on a display including displaying the additions and deletions in a manner visually distinguishable from each other.

Machine Learning Technologies to Avoid Patenting

- Primarily mathematical algorithms or non-technological business algorithms that don't impact anything outside the computer.
- E.g. techniques for hedging investment risk, computations done inside a computer that do not have a real-world impact and are not tied to the functionality of the computer (e.g. graphics processing unit (GPU), memory structure, data structures).
- For these technologies, consider a defensive publication to prevent competitors from getting patents in the law changes.

Claims

- Recite specific elements and/or ordered combination; focus on technological solution or aspects
 - Avoid terminology that reads on mental thoughts

OK	Better
<i>“determining a crash occurrence”</i>	<i>“analyzing sensor data to determine if received sensor value exceeds a deceleration threshold ”</i>

Claims

- Recite more than conventional computer processing steps or functions
- Claim application or use of data, not just generation
- Include implementation details in claims
- Consider means-plus-function claiming if novelty is in the algorithm
- Consider drafting claims as a computer-readable medium
- Consider using different types of claims, e.g., CRM claims, method claims, functional claims

Specification

- Focus specification on technical aspects of invention
- Identify problems in the art and explain the invention's specific improvements over the prior art
- Avoid characterizing any claim elements as conventional, routine, or commercially available
- Avoid using overly abstract language to describe invention
- If the individual steps are “well known,” then emphasize that the combination of these steps (i.e., the claimed process) is far from routine and conventional

**Thank You For Your Interest.
Questions?**

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