

JUNIPER NETWORKS' COMMENTS ON PATENTING ARTIFICIAL INTELLIGENCE INVENTIONS

1. Inventions that utilize AI, as well as inventions that are developed by AI, have commonly been referred to as “AI inventions.” What are elements of an AI invention? For example: The problem to be addressed (e.g., application of AI); the structure of the database on which the AI will be trained and will act; the training of the algorithm on the data; the algorithm itself; the results of the AI invention through an automated process; the policies/weights to be applied to the data that affects the outcome of the results; and/or other elements.

AI may generally be understood as any computer functionality that mimics complex cognitive functions generally associated with the human mind (such as natural-language understanding or image recognition), although the precise contours of AI are not easily defined, and perceptions of what does and does not constitute AI may change depending on the state of the art at the time. The elements of an AI invention are a subset of the elements of hardware-related and software-related inventions. Generally, many AI inventions have already issued over the last few decades as patents without explicitly being characterized as “AI inventions.”

Generally, AI encompasses (and is sometimes used synonymously with) Machine Learning (ML), in which a machine, instead of being explicitly programmed for a specific task, “learns” to perform the specific task based on training data and/or feedback by iteratively adjusting an initial model; put differently, ML is implemented by self-adaptive algorithms. ML includes, as sub-fields that currently feature prominently in ML research, Deep Learning (DL) (which involves multi-layer models) and Artificial Neural Networks, or Neural Networks (NNs) for short (collections of connected nodes that are modeled after neurons in the brain in that they process and transmit “signals” represented as real numbers); in practice, DL and NNs significantly overlap (in the field of “deep neural networks (DNN)”). Thus, a discussion of AI inventions extends to ML, which extends to DL and NNs.

ML generally involves a training phase, in which a learning algorithm adjusts the ML model based on training data and/or feedback to optimize some metric, and an inference/predictive phase, in which the (trained) model is applied to inputs to generate output. In some ML techniques, such as reinforcement learning (RL), the two phases may overlap, e.g., to refine the model (or, in RL, “policy”) based on feedback received for predicted outputs. ML inventions may relate to the training aspect and/or the inference/predictive aspect.

An AI invention may lie, for instance, in a new (or improvements to a) model (e.g., a new NN architecture, or a new RL policy), in a specific model selection or configuration of model

hyperparameters for a particular application, in the selection of data features to be used as input into the model, in a new (or improvements to a) learning algorithm or selection/configuration of a learning algorithm, in a new metric to be optimized during training or used to measure performance of the trained algorithm, or the selection of training data or feedback signals, and/or in a new practical application of a (new or existing) model and technique. Even though, by the nature of ML, the trained ML model results in part from machine operations, the hardware/software that implements the ML (or other AI) invention is, ultimately, a product of human ingenuity. For example, while parameters of an ML model (e.g., NN weights) are automatically determined during training, the model itself, as well as the algorithm used to train it, are defined by a natural person.

Whatever the specific ML or AI invention, its implementation involves storing data and instructions (e.g., training data, data structures and model parameters defining a trained model, algorithms for training or operating the model) in some form of memory and executing algorithms with some type of hardware processor. Clearly, any inventive AI configuration of the hardware and software aspects are akin to conventional hardware-related and software-related inventions. It is thus submitted that the elements of an AI invention are akin to other hardware-related and software-related inventions.

2. What are the different ways that a natural person can contribute to conception of an AI invention and be eligible to be a named inventor? For example: Designing the algorithm and/or weighting adaptations; structuring the data on which the algorithm runs; running the AI algorithm on the data and obtaining the results.

As with other software-related and hardware-related inventions, there are many different elements to an AI invention. These elements are not a closed group of elements but vary from one AI invention to another. A natural person can contribute to an AI invention by conceiving one or more new elements or selecting one or more known elements and making decisions to define their inputs, outputs and functionality. Therefore, each element of an AI invention should be considered as being open to inventive contribution.

AI elements differ depending upon whether the AI invention(s) lie in the training aspect and/or an inference/predictive aspect of the technology. For example, an inventor (natural person) may identify a unique and novel application of AI that may be deployed with software and/or hardware, may define a structure of a database on which the AI will be trained and will act, select an appropriate model and/or associated algorithm for training the model, or create a new model or algorithm (which generally involves identifying the policies/weights/parameters to be optimized during training and which, when the model is applied to input data, affect the predicted outcome). The data inputs, data

structures, and algorithms (program instructions) implementing these various elements of AI inventions are provided by a natural person in the same way as the data inputs, data structures, and algorithms for other software-related inventions. The choices or decisions by the natural person in making an AI invention may create new functionality or improve aspects of existing functionality, including its speed, accuracy, scope, and other such characteristics.

3. Do current patent laws and regulations regarding inventorship need to be revised to take into account inventions where an entity or entities other than a natural person contributed to the conception of an invention?

No. As submitted above, AI inventions are a subset of hardware-related and software-related inventions and, accordingly, it is submitted that current patent laws and regulations, including inventorship considerations, apply to AI inventions. An output of a software-related or hardware-related invention is not considered to be an invention by the software or hardware; rather, it is a product of the technology invented by a natural person.

Question 4. Should an entity or entities other than a natural person, or company to which a natural person assigns an invention, be able to own a patent on the AI invention? For example: Should a company who trains the artificial intelligence process that creates the invention be able to be an owner?

No, nothing, other than a natural person, or a company via assignment, should be able to own a patent or an invention. As mentioned above, AI inventions can be training-related and, during training, an ML algorithm (defined and/or configured by a natural person) uses training data or feedback (e.g., provided by a natural person) to determine adjustable parameters of an ML model (defined by a natural person).

To the extent an AI process or tool is used to create a new product, such a product is an invention separate from the AI process or tool to the extent the particular way in which the AI tool is used is new and nonobvious (e.g., dependent on a nonobvious configuration of the model or a nonobvious application to new type of data).

Question 5. Are there any patent eligibility considerations unique to AI inventions?

No, the current patent eligibility considerations apply to AI inventions. As AI inventions are a subset of hardware-related and software-related inventions, the current patent eligibility considerations similarly apply to AI inventions. To the extent that an AI invention relates to an algorithm, the law as applied to algorithms in the software-related arts should apply.

Question 6. Are there any disclosure-related considerations unique to AI inventions? For example, under current practice, written description support for computer-implemented inventions generally require sufficient disclosure of an algorithm to perform a claimed function, such that a person of ordinary skill in the art can reasonably conclude that the inventor had possession of the claimed invention. Does there need to be a change in the level of detail an applicant must provide in order to comply with the written description requirement, particularly for deep-learning systems that may have a large number of hidden layers with weights that evolve during the learning/training process without human intervention or knowledge?

In view of AI inventions being a subset of hardware-related and software-related inventions, the same 35 U.S.C 112(a) considerations apply to AI inventions. Thus, the detailed description should describe any claimed features in the same way as in other hardware-related or software-related inventions, e.g., in the form of new or referenced algorithms and/or structures sufficient to demonstrate possession.

To the extent the AI invention utilizes known elements, the description can simply reference these elements. For example, the description of a ML invention may state what ML model and/or training algorithm is being used (e.g., a Bayes classifier). However, for any elements that are unique (or perhaps inventive), the specification should provide further detail in the form of algorithms and/or structures, for instance. For example, where an invention lies in a unique NN, the NN structure should be described (e.g., by specifying the number and types of layers and connections between them, and referencing, as applicable, any known NNs that form parts of the larger structure). Or, where an invention lies in a new or modified training algorithm, essential features of the algorithm or modification should be described. Where the invention is a DNN with a large number of hidden layers with weights that evolve during the learning/training process without human intervention or knowledge, the detailed description should demonstrate possession of the inventive DNN by description of the structure of the DNN, the method of training the DNN, and/or other identifying characteristics that distinguish the inventive DNN from other NNs in order to demonstrate possession..

Accordingly, whatever is claimed in an AI invention (e.g., the training data, the model, the training algorithm) should be adequately described in the detailed description.

Question 7. How can patent applications for AI inventions best comply with the enablement requirement, particularly given the degree of unpredictability of certain AI systems?

AI inventions/tools should be treated in the same manner as any other invention, namely the invention must be described in enough detail to allow the person skilled in the art to practice the

invention without undue experimentation. For example, where a claim in some manner recites a level of effectiveness, the description must include sufficient detail of the AI invention for (1) the AI algorithm, (2) the training data, and (3) the training process, to enable the skilled person to recreate a trained AI model operating in inference mode to operate at the effectiveness level claimed, without undue experimentation.

Question 8. Does AI impact the level of a person of ordinary skill in the art? If so, how? For example: Should assessment of the level of ordinary skill in the art reflect the capability possessed by AI?

No, like other hardware-related and software-related inventions which vary in complexity, AI inventions do not require any changes to the current legal requirements of the level of a person of ordinary skill in the art. As there are different requirements for persons skilled in the art in the areas of semiconductor manufacturing, software development, hardware development, database design, network communications, and so forth, there will be requirements for the person skilled in the AI arts.

The person of ordinary skill in the AI art has at least some general understanding of AI or ML, although the level of skill considered “ordinary” may be higher, depending on the particular invention. For instance, simple machine learning inventions (e.g., using a simple linear regression model) may require a lower level of understanding than deep learning inventions. In certain circumstances, the person of ordinary skill may include a person with a high level of understanding in mathematics (e.g., probability, statistics, calculus, and the like).

Question 9. Are there any prior art considerations unique to AI inventions?

With the growth of AI technology in research institutions/academia, and more complex AI patent applications yet to publish, non-patent literature may be of more significance when assessing the novelty of AI inventions relative to other fields. Thus, the AI-related patent/publication database may be underdeveloped relative to outside databases, particularly academic databases. While examiners have been examining AI inventions for decades, Examiner training to identify relevant prior art would be beneficial.

AI inventions will be within a wide diversity of technology areas (e.g., AI inventions applied to life sciences, processing image data, natural language processing). Accordingly, Examiner training across most of the art units is encouraged.

Question 10. Are there any new forms of intellectual property protections that are needed for AI inventions, such as data protection?

No Comment.

Question 11. Are there any other issues pertinent to patenting AI inventions that we should examine?

No Comment.

Question 12. Are there any relevant policies or practices from other major patent agencies that may help inform USPTO's policies and practices regarding patenting of AI inventions?

No Comment.