IPO/AIPLA Category Definitions for AI-Related Inventions
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INTRODUCTION

This document provides **proposed category definitions for inventions relating to Artificial Intelligence (*i.e.*, AI-related inventions)** as well as corresponding examples for each category.

To ensure a better understanding of the category definitions and promote coherent conversations, we have provided a high-level, non-controversial description of AI technologies below. We have taken pains to avoid taking a position on an explicit definition for AI due to the term's inherent amorphousness and many interpretations. Instead, we believe defining categories of inventions relating to AI will provide a sufficient framework to facilitate continued work on AI policy issues.

For most contexts, AI in contemporary parlance is essentially synonymous with automation. From a theoretical standpoint, AI comes in three flavors: narrow AI (or weak AI), general AI (or strong AI), and super AI. Of these categories, it is only narrow AI that exists today and, by most accounts, is the only type of AI that will exist for the foreseeable future.[1]

Narrow AI involves only inductive inferences, whereas general and super AI involve deductive and abductive inferences—skills which are presently only possessed by humans. Narrow AI describes a computer program that is good at performing a defined set of tasks (*e.g.*, tasks associated with playing chess or Go or making purchase suggestions, sales predictions, or weather forecasts).

In the broadest sense, today's AI includes non-learning systems that automate traditional human tasks (*e.g.*, rule-based expert system). Machine learning is a subset of current AI where hard coded algorithms are replaced by models trained on example input-output pairs to predict outputs for previously unseen inputs. Deep learning is a subset of machine learning that employs vast networks of artificial neurons. General AI is a *purely hypothetical* computer program that can understand and reason its environment as a human would. Also *purely hypothetical*, super AI describes a computer program that is much smarter than the sum of all human intelligence in practically every field.

[1] *See, e.g.,* Dilmegani, Cem (2021) "Will AI reach singularity by 2060? 995 experts' opinions on AGI," AIMultiple. Available at: https://research.aimultiple.com/artificial-general-intelligence-singularity-timing/.

PROPOSED CATEGORY DEFINITIONS FOR AI-RELATED INVENTIONS

Preamble: The following category definitions are based on what is claimed, evaluated on a claim-by-claim basis, but not intended to preclude a claim from falling into multiple categories (*i.e.*, one claim can fall within the scope of multiple definitions).

#1 **Inventions on Core AI Technology ("Core AI Technology")**: Products, designs, processes, computer programs, or other types of material artifacts that have general applicability (*i.e.*, are not limited to specific problem domains) and are the building blocks for application-specific tools. Examples include:

(a) Software-based AI technology such as AI training, architectures, and methodologies; or
(b) Hardware-based AI technology such as AI accelerator chips, neuromorphic chips, and improvements in graphics processing units (GPUs).

#2 **Inventions on Specific Applications of Core AI Technology ("Applications of Core AI Technology")**: Products, designs, processes, computer programs, or other types of material artifacts employing Core AI Technologies as one component in a larger context to perform tasks more intelligently. In other words, this type of AI-related invention applies one or more Core AI Technologies to a specific problem or task domain. Application Specific AI inventions typically integrate the Core AI Technologies with domain specific systems that provide input data (*e.g.*, sensors) or use the outputs of the Core AI Technology for a specific end goal (*e.g.*, to control the path of a robot).

#3 **Inventions Generated By or Using AI:** Products, designs, processes, computer programs, or other types of material artifacts that are:

(a) Conceived of or devised by a human with the assistance of an AI technology (AI is a tool of innovation);
(b) Conceived of or devised by a human in collaboration with AI where the activity of the AI, if done by human, would be considered co-inventorship (AI is co-inventor with a human inventor); or
(c) Conceived of or devised by an AI system under circumstances in which no person traditionally qualifies as an inventor (AI is only inventor; no human inventors).

With inventions generated by or using AI, the resulting material artifacts may or may not relate to AI technology.

EXAMPLES:

Because of the significant differences among these categories of AI-related inventions, there is no one set of elements common to all AI-related inventions. Due to the diversity of implementation and application, identifying the range of possible elements in each category of AI-related inventions would require a lengthy and detailed treatment that is not likely to be valuable in the context of this question. Further, an attempt to distill common elements of all AI-related inventions would necessitate creating broad general features that are not beneficial to understanding the differences between AI-related inventions for considering issues such as inventorship, enablement, eligibility, non-obviousness, and so forth.

Nevertheless, we discuss and provide examples regarding elements of the above categories of AI-related inventions for clarity. The elements depend on the subtype of AI being used and the application domain in which the AI is deployed.

#1 Core AI Technology: Elements depend on the subtype of AI technology being considered. Thus, the elements of a new type of artificial neural network (NN) architecture will be different from the elements of a new type of expert system, evolutionary algorithm, or AI accelerator chip.

Given the current interest in neural networks (NN) and machine learning (ML), the following features may be part of a Core AI invention for a new NN architecture:

- General objective, such as classification, prediction, translation, content generation;
- Data representation and pre-processing;
- Node ("neuron") definition (internal structure, activation function, output function);
- Layer definitions, including layer function (*e.g.*, input, convolution, normalization, pooling, hidden layer, output layer, connections, weighting, etc.), layer shape and interconnectivity, organization and sequencing of layers; and
- Hyperparameters, optimization, regularization, loss function, training algorithm.

This list is illustrative and not meant to suggest that every feature must be expressly discussed in a patent application for a NN architecture. Rather, the list identifies various aspects of a NN architecture that may be part of a Core AI invention.

> Example: A training technique that vastly reduces the training time of ML models for very- high-dimensionality data sets, such as population-wide medical studies, by using a new loss function and training algorithm. The ability to train or retrain ML models rapidly may be extremely important, such as where conventional training models require significant amounts of time to complete even on the fastest supercomputers, and where the new training process may complete the same training within several hours. This training technique is an improvement in the functionality of the ML model. The elements

of the AI-related invention here would be the loss function and the steps of the training algorithm and the selection of the relevant hyperparameters.

#2 **Applications of Core AI Technology**: Elements can be similar to those of Core AI Technologies but applied for a particular application domain.

Example: A factory assembly line including a machine vision system that visually inspects a manufactured part for defects. The system is configured to inspect the part for potential defects using infrared and ultraviolet light at a point in the manufacturing process during which the part is not visible to humans, such as within a mold, where early detection may permit an adjustment of the manufacturing process that compensates for the defect and salvages the part. In this example, the machine vision system includes a conventional convolutional NN that is trained in a typical manner to detect a simple feature, such as color, shape, orientation, or alignment of the part. The training data is specific to infrared and ultraviolet images of the part being manufactured under various conditions, and the output layer is configured to provide a classification signal as to the type of defect. Thus, the ML component is integrated into a specific application using domain specific data to provide domain specific outputs.

#3 **Inventions Generated By or Using AI**: Elements depend on what is invented. For instance, if the invention is a beverage container, the elements will be associated with the beverage container (*e.g.*, shape, material, etc.). If the invention relates to an improvement in AI, the elements will be associated with Core AI Technologies described above. There are no elements specific to the fact that the invention was generated by AI as opposed to a human.

Example: A synthetic protein that binds to a receptor to provoke an immune system response. The selection of the protein may involve the simultaneous consideration of many properties, such as the shape and physical chemistry of the amino acid sequence that exclusively binds to this receptor; the synthesis pathway to produce this protein from a DNA sequence, including how it is assembled and folds into an active conformation; and compatibility with other co-factors or pharmaceuticals. The protein may be primarily or even solely designed by a conventional ML algorithm; however, the elements of the claimed invention would be directed to the structure of the protein itself, such as the nucleic acid or amino acid sequences that encode it, without regard to the manner in which it was identified by the ML system.