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BACKGROUND DOCUMENT ON PATENTS AND EMERGING TECHNOLOGIES (UPDATE OF SCP/30/5)

Document prepared by the Secretariat

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I. INTRODUCTION

1. At the twenty-ninth session of the Standing Committee on the Law of Patents (SCP), held in Geneva from December 3 to 6, 2018, the Committee agreed that the Secretariat would prepare a background document on patents and emerging technologies and submit it to the thirtieth session of the SCP. Consequently, the Secretariat submitted document SCP/30/5 to the thirtieth session of the SCP for discussion.

2. From the discussions at the twenty-ninth session of the Committee that had led to the above decision, many delegations who had taken the floor had referred to artificial intelligence (AI) as an issue to be discussed by the Committee. Therefore, while the term "emerging technologies" might have a broad meaning, covering various new technologies, including artificial intelligence (AI) and machine learning, blockchain, synthetic biology and gene editing, document SCP/30/5 covered background information on patents and AI.

3. At the thirty-fifth session of the SCP, the Committee agreed that the Secretariat would update document SCP/30/5 by compiling current laws and practices relating to the patentability of AI-related inventions, based on the information received from Member States and regional patent offices, which will be submitted to the thirty-sixth session of the SCP. Pursuant to that decision, this document updates Part III, Sections A to E of document SCP/30/5.

4. In addition, to maintain the integrity and readability of the document, the Secretariat added, in Part II of document SCP/30/5, an overview of Generative AI. Furthermore, Parts III, Section F and IV of document SCP/30/5 are updated on the basis of the activities of the SCP related to the topic of patents and AI since its thirtieth session.

5. This document maintains the structure of document SCP/30/5, which consists of three parts. The first part of the document provides background information about AI technology. The first part of the document illustrates the basic technological concept of AI, particularly on machine learning technology, which is the core of the current AI development, and Generative AI. Such an introductory description of the technology is considered necessary, since implication of a particular technology to the patent system requires at least the basic understanding of the technology itself.

6. The second and third parts of the document describe the intersection between patent systems and AI. They address two distinct issues: the second part looks at the AI technology (or AI-related inventions) as the subject of patent protection, and the third part discusses use of the AI technology as a tool for the authorities and users of the patent systems.

7. As to the term "quality of patents", although no single definition is identifiable, two main concepts arose from the earlier activities of the SCP. They are: (i) the quality of a patent itself as in the invention for which the patent is granted meeting the substantive criteria; and (ii) the quality of patent procedures before patent offices and beyond (document SCP/27/4 Rev.). From this viewpoint, it could be said that the issues relating to the patent protection of AI-related inventions touch upon the first aspect of patent quality, while the issues about the improvement of patent procedures using AI technology relate to the second aspect of patent quality.

8. In addition, the document contains an Annex, which lists webpages of the World Intellectual Property Organization (WIPO) and IP Offices, dedicated to AI and patents.

II INTRODUCTION TO AI TECHNOLOGY: NEURAL NETWORK, DEEP LEARNING AND GENERATIVE AI

9. While there is no single definition of AI, AI systems can be viewed primarily as learning systems. The first part of the document introduces the most important technical concepts around Neural Network (NN), Deep Learning (DL) and Generative AI, which are today the

paramount technologies in AI.[1] It provides an understanding of how these emerging technologies work in an accessible manner for non-computer specialists in order to assist better understanding about the intersection between AI technology and patents.

A. Machine Learning

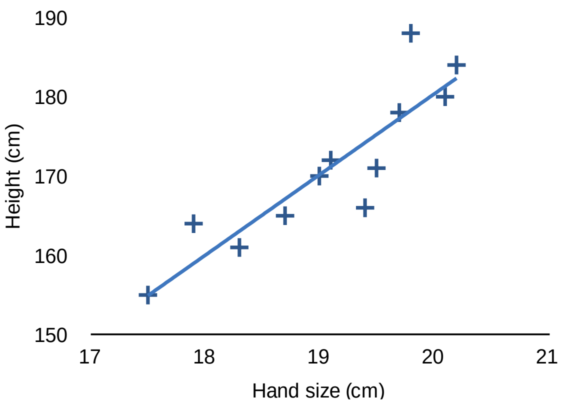
10. Historically, the first approaches to AI were to *program* a machine. Program here means that a human provides step-by-step instructions to the machine for completing a certain task. In the 80s for example, the dominant AI approach was the *Expert Systems*, using rules written by specialists of their domain to reproduce human expertise. Costly and limited, these approaches led to the so-called second AI winter between years 1987 and 1993.

11. In contrast, the Machine Learning (ML) approaches explore how a machine can learn to solve a task from examples of input and expected output, without being explicitly programmed how to do so in a step-by-step sequence of instructions. This approach is closer to actual biological cognition: a child learns to recognize objects (such as cups) from examples of the same objects (such as various kinds of cups). It is today by far the dominant and most successful approach in AI.

12. Generally speaking, a Machine Learning method takes in an input of observations, and uses them to predict an output. Given a dataset of input and output pairs, the learning method will try to build a mathematical model that minimizes the difference between its predictions and expected outputs. By doing this, it tries to learn the associations/patterns between given inputs and outputs that can be generalized to new inputs not seen before.

13. To illustrate this learning process, let us consider the simplest approach to machine learning, a linear regression. Suppose that we want to learn how to correlate the height of the person with the size of her/his hand. We have a certain number of observations of height and hand size pairs (left table), represented as crosses in the figure below:

height (cm)	**hand size (cm)**
170	19.0
155	17.5
184	20.2
188	19.8
178	19.7
172	19.1
165	18.7
180	20.1
161	18.3
171	19.5
164	17.9
166	19.4



hand size =
0.098 * height + 2.23

if height = 180 cm,
hand size =
0.098 * 180 + 2.23
hand size = 19.9 cm

14. Linear regression is a technique for finding a straight line between these points with the least possible error. The process for minimizing the error is the training. A mathematical method realizes this training by finding the straight line with highest proximity to the data points. Once this line with minimal error is found, the hand size of a person based on her/his height can be predicted. For instance, if the height of a person is 180 cm, the model will predict that her or his hand size is 19.9 cm (see the right box).

[1] WIPO Technology Trends 2019 – Artificial Intelligence, page 31. Machine learning represents 89% of AI-related patent filing and 40% of all AI-related patents. Within the machine learning technique, deep learning showed the annual growth rate of 175%, and neural networks grew at the rate of 46%, from 2013 to 2016.

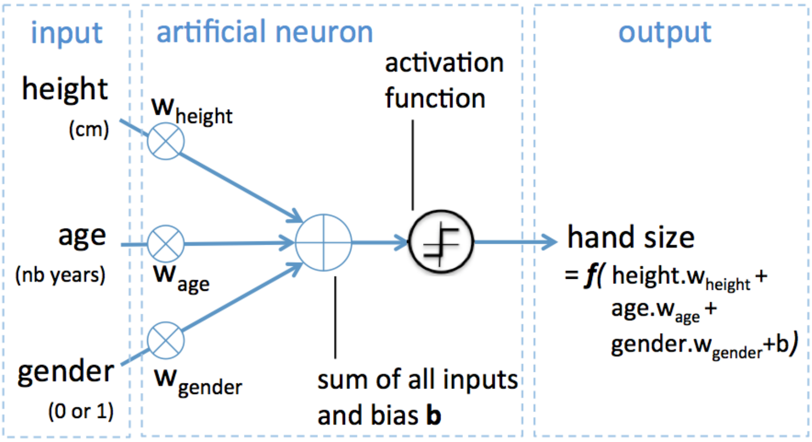
15. Such a simple method is of course too restricted for learning more complex problems, involving for instance, more than two numerical variables. In the example above, it appears that age and gender should be added to the person height for more reliable hand size predictions. More sophisticated mathematical models are also used, in particular non-linear models that are not limited to straight lines.

16. Among those more advanced methods, Neural Networks (NN) offer a universal predictor, able to accept any kind of input. NN excel more particularly for solving tasks involving unstructured data as input, such as image or speech. As an advanced type of NN, Deep Learning continues to be the core technique in AI patent applications.

B. Neural Networks

17. The fundamental building block of a NN is the artificial neuron, also called *perceptron* or *node*. It was developed by Frank Rosenblatt in the 1950s and 1960s. A neuron takes *n* inputs, known as *features*, which are numerical representations of the data to be processed (pixels, words, signal, etc.). Each input is multiplied by a weight and sum-up (see the diagram, below). A bias *b* is added to this weighted summed combination. Finally, this value is passed to an activation function *f*.

18. For example, coming back to the example of predicting hand size, if the data on height, age and gender of a person are available, the artificial neuron will be as follows:



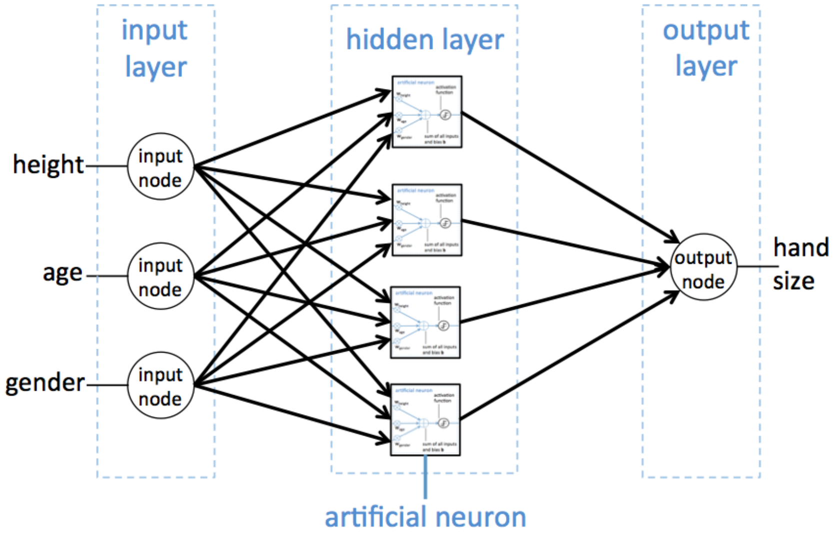
19. The weights capture the strength of the corresponding input features, in other words how much a particular feature influences the final results on its own.

20. The activation function models the “firing rate” of a biological neuron – propagating either a final signal or no signal. It takes the weighted sum of input and performs a certain fixed simple mathematical operation on it. One of the most commonly used activation function is called ReLU (Rectified Linear Unit).[2]

21. An artificial neuron is a relatively simple function. It can be programmed in less than 25 lines of code. A full neural network is then composed of at least three layers: an input layer, one or more hidden layers and an output layer. Input and output layers contain nodes performing no computation. They simply pass the numerical information to hidden layer for the input nodes, or transfer information from the network to the outside world for the output layer.

[2] The ReLU takes a number as input and returns the maximum of 0 or that number. For example, if the input is “1”, the output will be “1”, and if the input is “-1”, the output will be “0”.

Hidden layers contain artificial neurons as presented above. Nodes from adjacent layers have connections (or edges), shown in the arrows, between them.



22. The input layer is filled with numerically encoded information, and then propagated forward through the hidden layers. The initial numerical values are modified by the neurons of the hidden layer and then propagated to the output layer corresponding to the final output. The number of output nodes matches the number of answers expected from the NN. For instance, in this example, a single value, the hand size, is expected. The flow of data is here always forward through the layers.

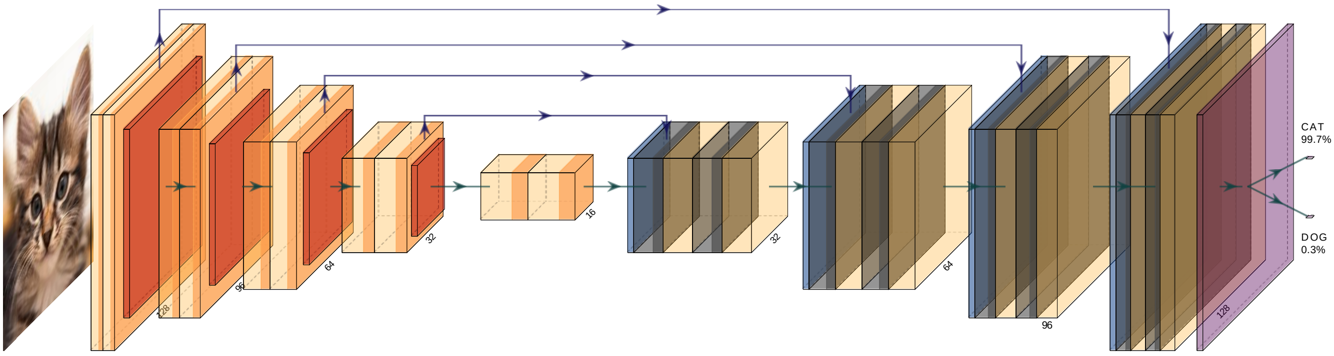
23. Training a neural network consists of setting the parameters *weights* and the *bias* of all the neurons of the hidden layers to minimize the error observed on a set of examples, similarly as for the linear regression presented in section A, above. The mechanism for training a NN is basically "learning from mistakes". The training data consists of a number of input/output pairs. When a neural network is presented with an input, it makes a random "guess" as to what the corresponding output might be. It then sees how far its answer was from the actual output, and makes an appropriate adjustment back to its weights and bias. The process continues repeatedly with all input/output pairs until we reach optimum weights and bias.

24. It should be noted that the artificial neurons are only very loosely inspired from the mammalian biological neuronal structure and on a much lower scale. Biological neurons are considerably more complex and diverse than artificial neurons. A large number of factors (synaptic structure and geometry, type of neurotransmitter, etc.) have an effect on the signal propagation. A synapse for instance is composed of more than 2000 different proteins, presenting a large variety of physicochemical properties.[3]

[3] "The differences between Artificial and Biological Neural Networks", Nagyfi Richárd, Blog entry at Toward Data Science, September 2018. https://towardsdatascience.com/the-differences-between-artificial-and-biological-neural-networks-a8b46db828b7.

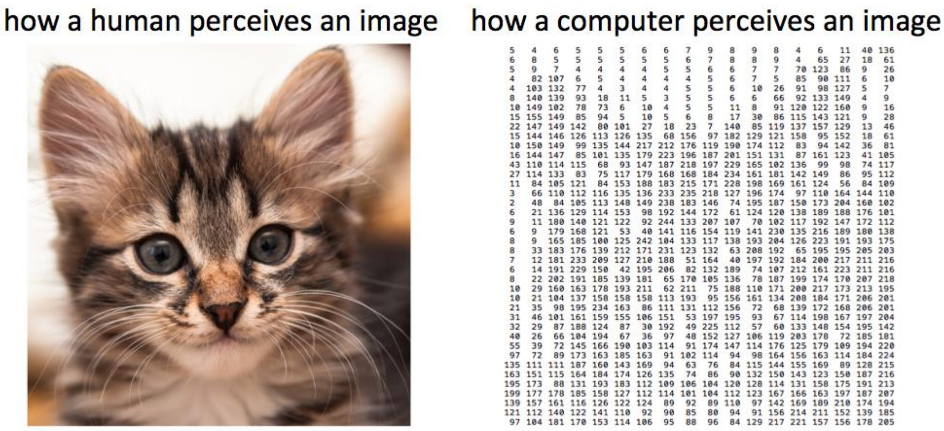
C. Deep Learning

25. Although neural networks are known since the fifties, the usual number of hidden layers remained in practice only *one* until the years 2000s. The improvement of computational power has made possible in the last decade to increase (so "deepen") the number of layers of neural networks. For example, considering a cat or dog image classification problem (do we have a cat or dog on an image?), a deep neural network today looks as follows:



26. In the above example, we see a major shift in term of scale as compared to the simple NN previously described:

(i) The number of input nodes is very high; each input node receives the information of one pixel of an image. In the example below, the image of a cat is transformed into a matrix of size 18*40, with each pixel defined by its level of grey, expressed as an integer between 0 (white) and 256 (black). For a realistic cat and dog image classification, we use typically images of size 128*128 pixels, with each pixel defined by three values for red, green, blue levels, i.e., 49,152 input nodes, and consequently 49,152 input features for *each* following neurons.



(ii) Multiple layers of neurons are introduced to process successively the input information. More than ten layers are not rare for image processing, each layer possibly containing hundreds of neurons, usually organized differently to provide particular advantages.

(iii) A typical deep neural network like this one can have several ten million of weights and bias parameters to be set during the training, requiring ten thousand of labeled images.

27. Surprisingly, with an existing Open Source framework, such as Keras,[4] a trained data scientist can implement this Deep NN in less than 100 lines. With an online open dataset of dog and cat images, the network will achieve more than 93% accuracy of classification with commodity hardware: a level that is not far from the human performance (estimated around 95% for such a task).

28. The multiplication of layers introduces the notion of hierarchy for the representations and the process involved in the global prediction task. The first layers usually capture low level patterns in the input data (like lines, colored areas, etc. when processing an image), intermediary layers identify higher-level structures (like prototypical ears or muzzle of cats for the cat and dog classification) and finally the last layers self-specialize for performing the final prediction tasks based on identified structures.

29. Deep neural networks present several key properties, as compared to traditional neural networks, which explain their current success.

Discovery of features representations

30. Traditional machine learning uses features handcrafted by an engineer for solving a problem. For instance, for the prediction of the hand size, the ML engineer will select some features based on their own intuition and experiments, for instance the height, gender and age of the person. This step is called *features engineering*. A feature is an aspect of the data to be used by the ML algorithm to predict an output. This step is in general highly time-consuming, and when processing unstructured data (images, text, voice, videos), it is relatively inefficient.

31. For the first time in machine learning, Deep Neural Networks show a practical ability to automatically discover such features from raw data. By deepening the number of layers, neural networks both learn the useful features and how to use them to solve tasks. For example, for predicting the hand size, one would simply feed in a deep neural network the largest possible set of biometric measures, and let the network automatically identify the ones to exploit for the final selection. Similarly for image classification, raw pixel data are sent to the network, which will identify patterns, like shapes of ears, tongues or teeth that are discriminant to decide if the input is a picture of a dog or a cat.

Data scale and deep learning performance

32. With traditional machine learning techniques, the performance quickly reaches a plateau as the amount of training data increases. It means that adding more training data is useless, after a while, the training algorithm somehow “saturates”. One of the key properties of deep learning is that the performance continuously increases with an increase in the training data. This property explains why the largest networks existing today in machine vision could use as many as 15 million images for training.

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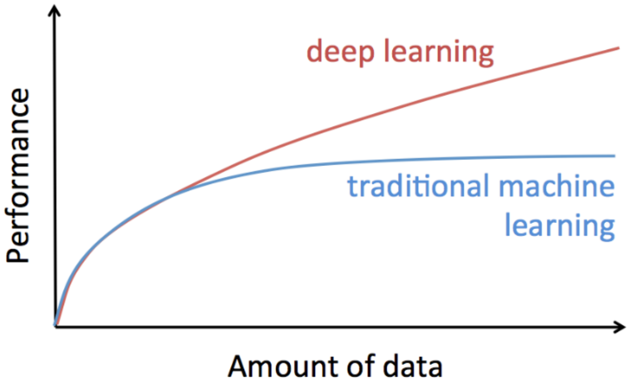
4 Keras: The Python Deep Learning library, François Chollet and others, 2015-2024. https://keras.io/.



33. Mathematically, artificial neural network models can be understood as just a set of matrix operations and finding derivatives.[5] With the increase of computational power, deep learning can surpass any other ML approaches, as long as a massive amount of training data is available.

34. How far can we scale such neural networks and continue to improve performance and capacities of Deep Learning models? The experiments that took place to explore and improve this scaling capacity led to the current Generative AI outstanding success.

D. Generative AI

35. Generative AI can be defined as a technology that can create new, meaningful and human-like content, including text, images, audio, or video, when prompted by a user. "Prompts" here correspond to textual instructions in natural language, usually produced by the human users.

36. The next section describes the main concepts of Generative AI:

- the distinction between discriminative and generative tasks and models;
- the transformer architecture and the attention mechanism, which are the foundation behind the modern rise of Generative AI; and
- the main characteristics of Large Language Models.

Discriminative versus generative tasks

37. Deep neural networks can usually be adapted to two different kinds of tasks:

- *Discriminative* tasks are tasks involving a decision on the input data, such as classification, identifying names in texts or segmenting an image. *Discriminative* models are models adapted and trained to separate input data into these different classes.
- *Generative* tasks are tasks involving the creation of new data given some input data. *Generative* models are models adapted and trained to create such new data. They are typically used to translate text, generate images, summarize text or answer questions.

38. The two following diagrams illustrate these fundamental types of machine learning tasks.

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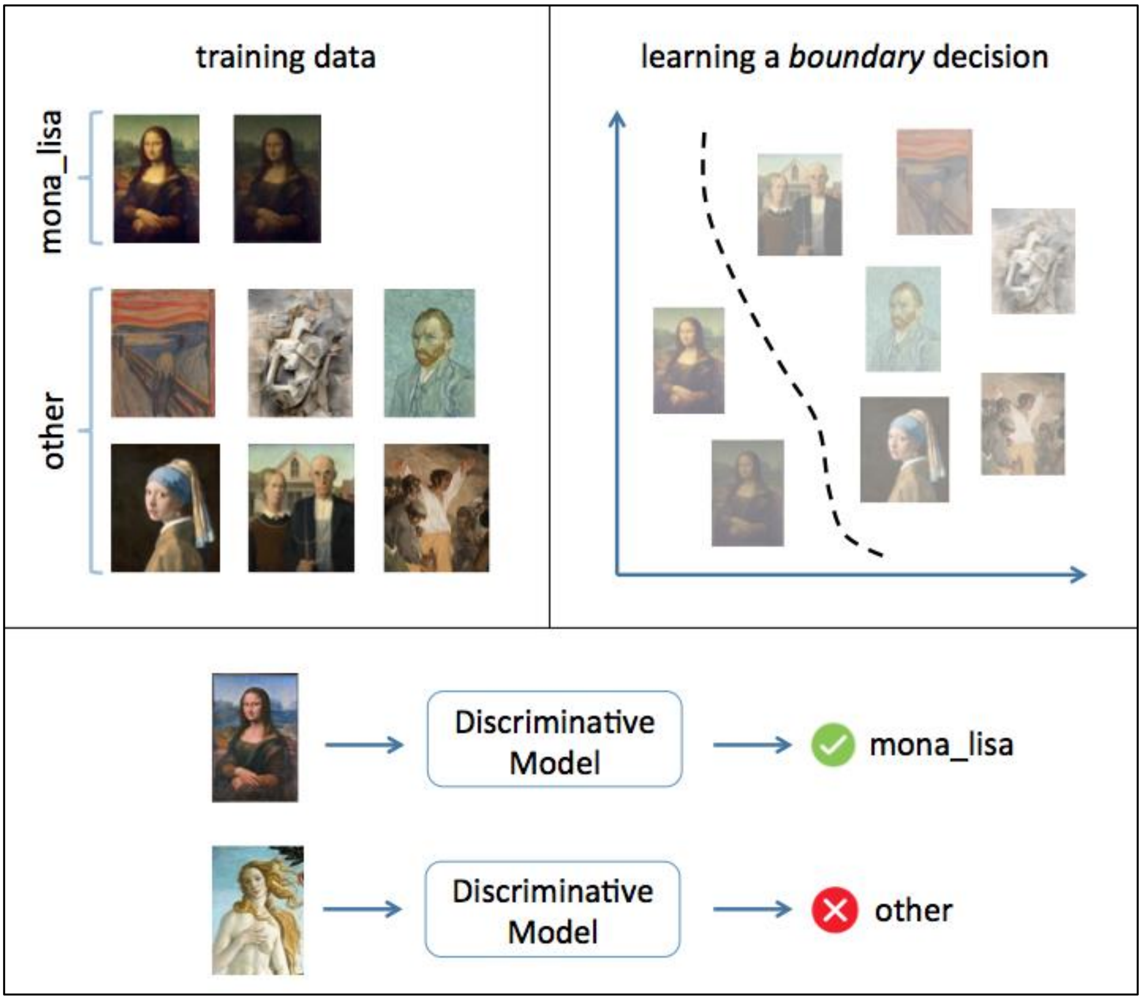
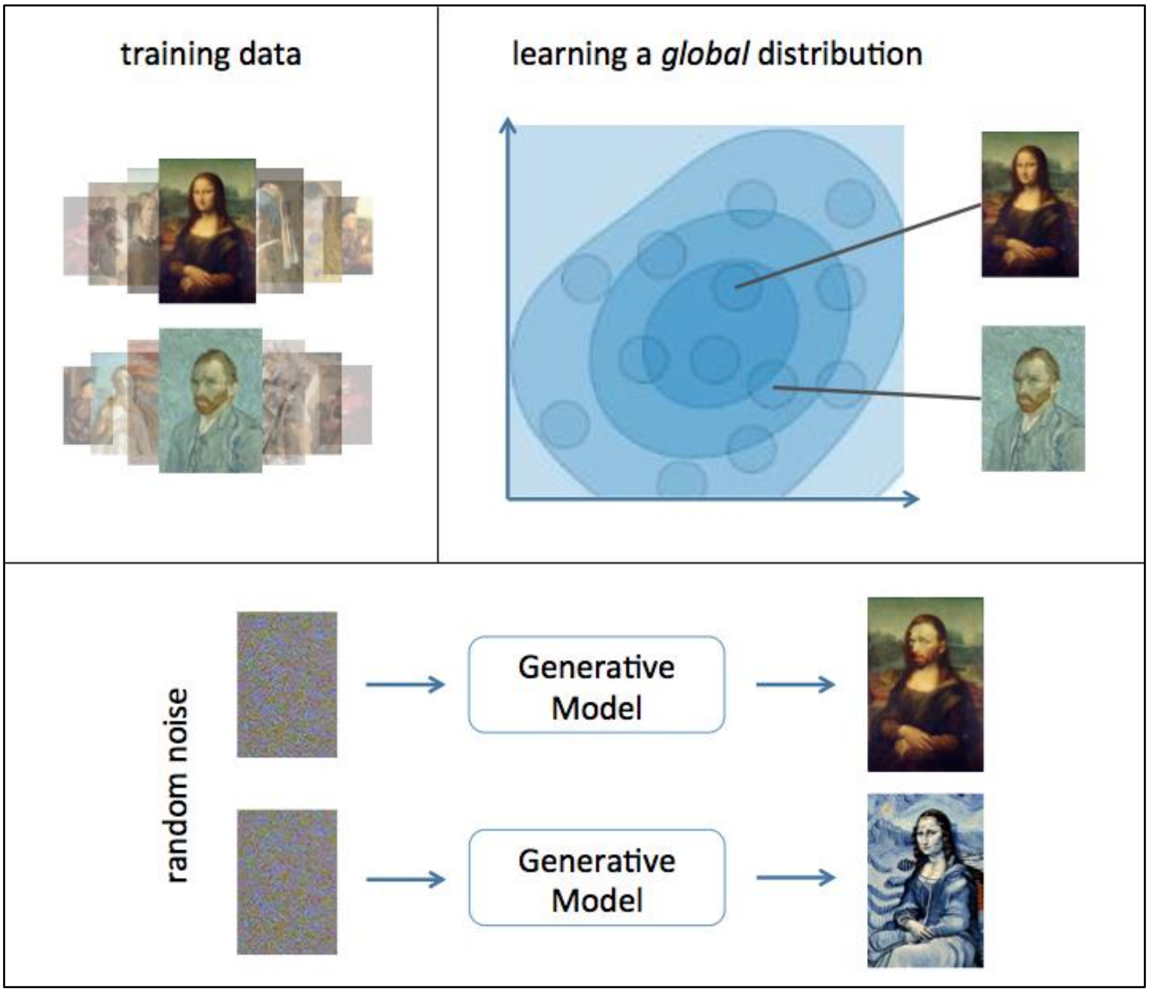
5 Running such mathematical calculations can be highly optimized for vector processors (doing the very same calculations on large amounts of data points over and over again) and speed up by magnitudes using GPUs (Graphical Processing Unit, the same used for speeding-up video games) or new dedicated hardware.



Source: Painting visuals from Wikimedia Commons under public domain, originally from WIPO Patent Landscape Report on *Generative Artificial Intelligence*, 2024. https://doi.org/10.34667/tind.49740

39. Above: A discriminative task for classifying whether an image is the Mona Lisa painting or not. The model must learn how to distinguish two classes: the painting *Mona Lisa* and *other* paintings. For this sort of models, the learning process focuses on the criteria to distinguish the classes. So, expressed as a space of painting characteristics, the model concentrates on representing the boundary between the two classes of paintings.



Source: Painting visuals from Wikimedia Commons under public domain, originally from WIPO Patent Landscape Report on *Generative Artificial Intelligence*, 2024. https://doi.org/10.34667/tind.49740

40. Above: **A generative task for producing new painting samples**. For the generative task, the model must learn the global aspect of every painting to be able to generate coherent new paintings. For this sort of models, the learning focuses on representing the global distribution of the characteristics of the painting. The two generated images were produced using the original Stable Diffusion[6] model.

41. Discriminative models excel in classification but cannot generate new data. In contrast, generative models can also address discriminative tasks, but usually with lower accuracy than discriminative models. Generative models have more parameters, are computationally more expensive and require more training data than discriminative models. For this reason, discriminative tasks have received initially more interest. As computing power increased, and more training data became available, generative tasks became more feasible and attracted more development effort in the last years.

The Transformer architecture

42. Transformer is a type of Deep Neural Network designed specifically for natural language processing (NLP) tasks. It was introduced first in 2017[7] and has been developed to better scale

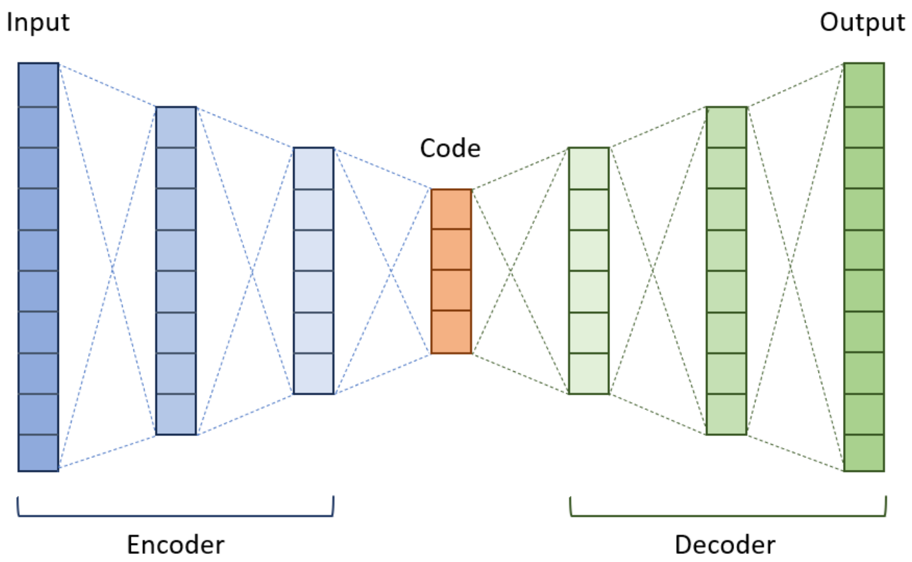
6 Rombach R., Andreas Blattmann A., Dominik Lorenz D., Patrick Esser P., Björn Ommer B. (2021). "High-Resolution Image Synthesis with Latent Diffusion Models". arXiv:2112.10752, https://arxiv.org/abs/2112.10752.

7 Vaswani A., Shazeer N., Parmar N., Uszkoreit J., Jones L., Gomez A., Kaiser L., Polosukhin I. (2017). "Attention Is All You Need". Advances in neural information processing systems 30.

during training than other traditional Deep Learning methods. Transformers are based on two important concepts: encoder-decoder and self-attention,

43. An **encoder-decoder** model is based on three parts: encoder, code and decoder. The encoder is a neural network that learns how to encode and compress input data into an intermediary representation, the code, which is basically a sequence of numbers. The code is then used by the decoder, another neural network, which has learnt how to decompress and reconstruct data into the expected input format. Beyond data compression, the objective of the encoder-decoder is to learn how to represent the nature of some data, so that modifications of this internal representation can still be re-constructed into a new meaningful output.

44. This approach was in particular developed to address machine translation, where an input in a source language is encoded into a compressed numerical representation, which is then decoded into a target language, based on a large volume of translation input/output examples.



45. Above: Encoder-decoder Neural Network architecture. An input, such as text or image, is encoded into vectors through several layers of neural networks. The *code* is an intermediary compressed numerical representation, which can be then used by the decoder to generate an output in a desired target language or image representation. Note that the number of layers in modern models can be much higher than represented here.

46. For a system dedicated to discriminative tasks, the Decoder part is usually removed, because the output is normally just a classification, not newly created data. This is the case for the BERT (Bidirectional Encoder Representations from Transformers) model family, which was the center of interest of the Machine Learning field between 2018 and 2022. For a system dedicated to generative tasks, the Encoder might be removed, because the output should be newly generated data, and the encoder might not be helpful. This is the case for the OpenAI GPT (Generative Pre-trained transformers) models.

47. **Attention** is a neural network mechanism that makes it possible for the learning to focus on different parts of the text simultaneously. It allows to capture long-range dependencies in text, which is important for understanding and phrasing complex language. In practice, *attention* assigns weights to input tokens based on importance so that the model gives more emphasis to relevant tokens. However, how are these important tokens selected? Depending on this selection criteria, different types of attention mechanisms exist.

48. The original transformer architecture uses *self-attention*: following this approach, the correlations between every possible pair of words in all the inputs of the training data is

evaluated. To give a quick insight into this process: if two tokens appear together more frequently in the training data than by random chance, they will be assigned stronger weights than non-correlated tokens.

49. In conclusion, the **Transformer** is an encoder-decoder deep neural network that takes advantage of attention to maintain faster training time than previous deep neural network as its number of layers increases. The capacity to scale is directly related to this number of layers. Stacking more layers means multiplying the global number of neurons and thus the capacity to store more learned parameters. In Transformers, each layer uses attention. As a result, the learning process does not loop over the input multiple times, which is expensive in term of computation. Instead, the Transformer passes the input through multiple attention layers.

50. As visible in the table below, the number of layers of Transformers has continuously increased over time, allowing to train on larger datasets and to learn more parameter information.

Model Name	Developer	Year	Number of layers	Number of parameters	Training data size (estimates)
Transformer (original)	Google	2017	6	110 millions	800 million words
BERT	Google	2018	12	110 millions	3.3 billion words
GPT	OpenAI	2018	12	110 millions	600 billion words (40GB)
GPT-2	OpenAI	2019	48	1.5 billions	8 millions web pages
GPT-3	OpenAI	2020	96	175 billion	570 GB of text data
GPT-4	OpenAI	2023	120	1.8 trillions(est.)	13 trillion tokens

51. We mentioned previously that the generative capacity of a model increases as the size of the model and the training increase. We understand here why the transformer architecture made possible the rise of Generative AI, while discriminative tasks were before the most successful AI systems.

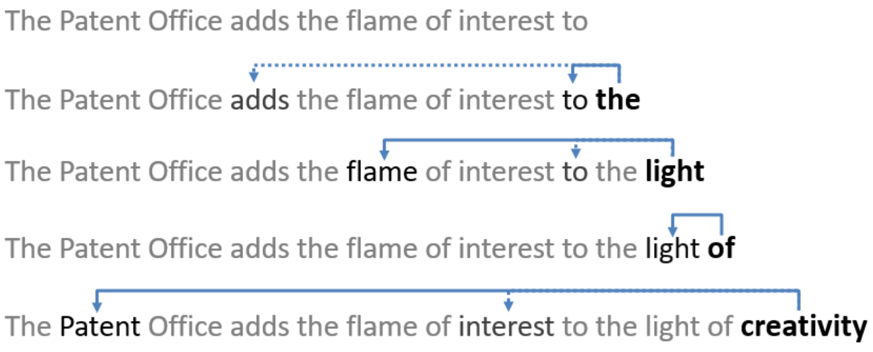
From Large Language Models to ChatGPT

52. As illustrate by the previous table, Large Language Models (LLM) are very large models trained with a massive amount of training data. Their development requires large and modern computing infrastructure. Even with a large computing center of hundred thousand processors, the training of such LLM take typically between two weeks and three months. These models are the basis of modern assistants such as the well-known OpenAI ChatGPT, Microsoft Copilot or Google Gemini. They share a particular generation mechanism called *autoregression*.

53. Instead of generating a complete text or image in once, **autoregressive models** generate data one element at a time, based on previously generated elements. For example, with text, the generation becomes the result of an iterative process where the next word is predicted considering the previously generated words, until the end of a text is predicted. This can be viewed as an auto-completion function, which mimics human language. This is also similar to the well-known next word prediction feature of smartphone keyboards. However, models considered here are considerably larger than next word prediction of a phone application, typically by a factor 1000 or more.

54. One key advantage of this approach is that the prediction of a next token or word can be learned just with ordinary text. As the text is scanned during training to set the internal parameters of the model, these models have the capacity, given a text context, to predict the most likely next word. Such training does not require manually labeled data. The computer can learn to identify patterns without a human to provide guidance along the way, a type of learning

called *unsupervised* learning. However, a massive amount of text is required to reach the current performance of these models.



55. Above, an example of text generated via autoregression, illustrating the attention mechanism. As the model generates the text word by word (in bold), it can focus on previous words that are relevant to each newly generated word via the attention mechanism (blue arrows). In practice, the window size of words that can be reached is very large, up to 100,000 tokens for the most recent models.

56. Two interesting properties emerge in such models:

- they not only learn the general language, but also how to generate text about a variety of facts concerning entities and events in the world, when seen in the training data,
- they are able to memorize so much text content that the completion becomes surprisingly precise and relevant if enough initial context is provided.

57. These two properties make possible versatile assistants like ChatGPT, which can go beyond the generation of grammatically correct text. These assistants can further answer questions and realize various tasks such as summarization, classification, rephrasing, translating, creation of stories, etc. However, given that these models are designed to predict one next word at the time for completing an input text, how can they achieve such sophisticated tasks?

58. This capacity to assist and dialogue with users is provided by tuning these models with thousands of examples of **instructions and expected results**. The instructions correspond to the “prompts” that would be entered by users to express their request. The model will learn to generate text to match the expected results, as a completion of these instructions. While the base LLM captures the competence of generating a huge variety of human language texts, this additional tunning teaches the model how to use this competence for performing tasks following instructions, enabling fluent and versatile dialogues.

59. The previous traditional "supervised" machine learning models require a large amount of task-specific annotated training data. In contrast, these LLM can generate new content just by writing natural language "prompts." Therefore, using these Generative AI tools does not require technical skills anymore. Modern cutting-edge AI becomes directly accessible to the general public, who just need to prompt the models with natural language instructions.

60. Considerable research work has been conducted for addressing various tasks and assistance in multiple business areas, as well as generating other form of language, such as programming code or structures describing proteins. A reference is made to the recent WIPO

Patent Landscape Report on Generative AI[8] for a comprehensive description of applications and examples.

LLM customized for generating invention

61. One of the most relevant applications for the SCP is **AI-generated inventions**. To enable this capacity, LLM are typically fine-tuned with different or additional instructions and expected results relative to invention. They can also be further pre-trained with patent documents, scientific texts or other technical content, possibly combined with a search engine indexing such literature (a technique called *Retrieval Augmented Generation*).

62. Such customized models can be used in different ways:

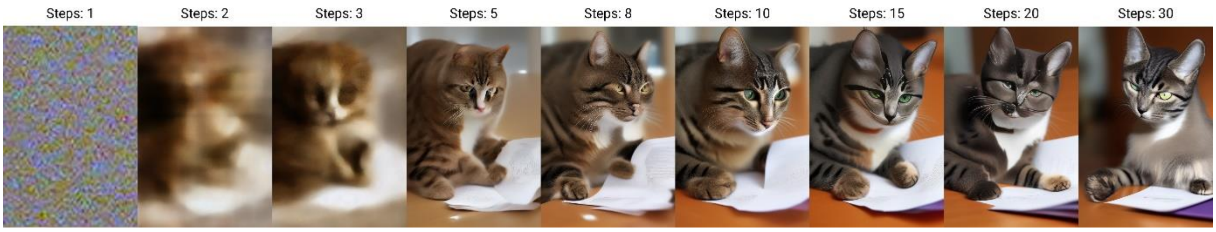
(i) A model is used to help the drafting of a patent application, based on the outline of a human-based invention, including suggestion of the relevant prior art.
(ii) A human identifies inventions and uses the model to identify other possible problems that may be solved by these inventions.
(iii) A human identifies a problem and uses the model to generate possible solutions.
(iv) A human uses the model to identify potentially valuable problems and to generate possible solutions to these problems.

63. These different usages of customized LLM can be viewed as gradually higher levels of inventorship, from assistance and insights to human inventor, to more significant generations of novel ideas. However, other factors determine the nature and extent of human effort involved in the generation of inventive LLM outputs:

(i) the creation of the prompts for querying the model,
(ii) the technical principles and features provided for guiding of the model,
(iii) the choice of model parameters,
(iv) the number of iterations involved in prompting the LLM.

LLM for images and other modalities

64. We have focused in this document on text generation. However, mature models for image generation appeared before LLM, using different type of models. Novel and meaningful images are constructed based on models trained similarly on hundred thousand images, controlled by additional machine learning mechanisms. Textual descriptions of the training images make possible to combine text and image modalities. For example, diffusion models can produce high-resolution images from short textual description, as illustrated by the famous Stable Diffusion model, released in 2022.



Source: Stable Diffusion model with the prompt "a cat reading a patent, originally from WIPO Patent Landscape Report on *Generative Artificial Intelligence*, 2024. https://doi.org/10.34667/tind.49740

65. Above, the image generation is using the original Stable Diffusion model with the prompt "a cat reading a patent". The generation process corresponds to: (i) supplying an image with

[8] World Intellectual Property Organization (WIPO) (2024). *Generative Artificial Intelligence*. Patent Landscape Report. Geneva: WIPO. https://doi.org/10.34667/tind.49740.

random noise (random pixels) and (ii) iteratively use the neural network to remove noise. The supplied textual prompt is used to drive the generation. As the noise is progressively removed, a novel and meaningful image is constructed, using figurative elements statistically related to the prompt, as learned with a large amount of training data. Other modalities successfully covered by such models include video (an image being successively translated to another image), speech, music, and 3D scenes built from one or several 2D pictures.

E. Current Limits of Deep Neural Networks and Generative AI

Deep neural networks are black box

66. Contrary to more classical algorithms, the decision process captured by a neural network during the learning process cannot be explicitly expressed in a comprehensible form for a human. As mentioned earlier, a Deep Neural Network could learn itself useful features in data. For instance, for the dog and cat classification task, the network could identify prototypical ears or muzzle of a cat. But in practice, most of the time, these features are not interpretable by a human. These patterns emerge from the numerical optimization process in the hidden layers, and are not accessible to our interpretation.

67. In addition, it is not possible to exhibit an equation or the coefficients defining a relation between an input and an output in term of standard mathematics. The network is the final equation of the relation, possibly involving hundred billion parameters. Such a complex decision process cannot be illustrated with a flowchart or any kind of traditional methods to represent algorithms. This explains why it is often said that the deep neural networks are "ultimate" black box and lack transparency. The training itself is realized by the NN *on its own* and the resulting network is enormously complex.

Deep learning requires a lot of data

68. A surprising observation is that neural networks and deep learning are amongst the simplest machine learning models in terms of involved mathematical modeling. It is often said that the underlying mathematics is accessible to a good high school student. Still, they provide today by far the best results. The reason is that they are the most adapted to take advantage of very large training dataset. The success of deep learning and generative AI is today much less related to theoretical progress than pure increase of computational power and availability of massive human behavioral data: something often called *brute force*.

69. The immediate limits of DL are related to the cases where brute force is not possible. This covers in particular tasks with no or limited data (e.g., processing rare human languages, drug discovery for rare diseases, etc.) or domains with legal restrictions.

Real world data is biased

70. The success of Deep Learning depends on the availability of a large volume of data, but this dependency on massive datasets also creates several issues:

– *Data bias*: Data collection at scale is often not neutral, some groups in relation to age, gender, and ethnic origins being under or over-represented.[9] Bias can come from the data collection technique, from existing social bias, or from the fact that people who create datasets and the models were not a diverse group.

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9 Amazon scraps secret AI recruiting tool that showed bias against women, Jeffrey Dastin. Reuters Business News, Oct. 2018 (https://www.reuters.com/article/us-amazon-com-jobs-automation-insight/amazon-scraps-secret-ai-recruiting-tool-that-showed-bias-against-women-idUSKCN1MK08G).

– *Bias amplification*: By nature, the machine learning training methods tend to identify discriminant patterns in data for quickly increasing the quality of prediction or generation. Consequently, they not only learn our actual bias, but oftentimes, they also amplify our bias.

– *Lack of reproducibility*: As a model depends on a unique composition of training data, reproducing some claimed results is only possible in the very rare case of open data.

Trustworthiness

71. It is not uncommon for LLM to generate inaccurate content expressed in a convincing manner. Such untruthful outputs are referred to as *hallucinations*. Although a lot of work has been dedicated recently to reduce the frequency of such factual errors, they remain significant, especially in specialized domains.

72. A recent study estimated that the frequency of hallucinations per output in GPT-4.0 is around 28.6% on simple task[10], which is likely higher than usually perceived by users. When applied to the legal domain for example, a study from Stanford researchers[11] measured that the frequency of hallucinations per response of GPT-4.0 is at least 58%. Even with customized LLM such as the ones commercialized by LexisNexis and Thomson Reuters, specifically pre-trained with legal texts and using legal databases to enrich and control the prompts (a technique known as Retrieval Augmented Generation or RAG), the rate of hallucinations per generated response was still estimated between 17% and 33%, according to a study from the same researchers[12].

73. The evaluation of LLM over time appears difficult. In classical Machine Learning evaluation, systems should not be tested and evaluated on the data they were trained on. This principle ensures that different systems can be benchmarked and compared over time in a fair manner using open-access datasets. LLM are trained on large portions of the Internet, which means LLM might be trained with these existing evaluation datasets commonly published online, possibly multiple times. This phenomenon is called *data contamination*. The evaluation of a LLM model is then not anymore measuring its capacity to answer correctly unseen questions, but to simply memorize published solutions.

74. Some researchers are also describing a future gradual loss of performance related to the quality of available training data, called *Model Collapse*. As the output of Generative AI systems is flooding the internet, future models might themselves be trained on online content that earlier models have created, including all their biases and errors, resulting in a progressive decrease of accuracy and capacity.

Offensive and sensitive content

75. The Generative AI models are trained with a massive amount of data, text and images. It is not possible to filter out in a perfect manner all inappropriate, morally and ethically challenging content from the pre-training data. The consequence is that these models can reproduce and recompose similar offensive content in the generated output.

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10 Chelli M, Descamps J, Lavoué V, Trojani C, Azar M, Deckert M, Raynier JL, Clowez G, Boileau P, Ruetsch-Chelli C. Hallucination Rates and Reference Accuracy of ChatGPT and Bard for Systematic Reviews: Comparative Analysis. J Med Internet Res. 2024 May 22;26:e53164. doi: 10.2196/53164.

11 Matthew Dahl, Varun Magesh, Mirac Suzgun, Daniel E Ho, Large Legal Fictions: Profiling Legal Hallucinations in Large Language Models, *Journal of Legal Analysis*, Volume 16, Issue 1, 2024, Pages 64–93, https://doi.org/10.1093/jla/laae003.

12 Varun Magesh, Faiz Surani, Matthew Dahl, Mirac Suzgun, Christopher D. Manning, & Daniel E. Ho, Hallucination-Free? Assessing the Reliability of Leading AI Legal Research Tools, Stanford University, *forthcoming 2024.*

76. Various techniques try to prevent this. For example, the predicted words or phrases are continuously filtered through what are known as *guardrails* to remove offensive content (guardrails can be blacklisted words for examples). However, there is today no guarantee to fully neutralize such generated output, especially when toxic prompts are used.

AI resources and infrastructure

77. LLM pre-training is expensive, and the exploitation of LLM at scale requires similarly large computing centers and electrical power. Generative AI relies also on data at internet scale. Combined with the investment capacity and the availability of local digital skills, concerns about a gap between high income nations and low- and medium-income countries have been addressed in various fora.[13] At the same time, AI technologies have also been deployed to improve, for example, education, healthcare and financial inclusion in developing countries.[14]

III PATENT PROTECTION OF AI-RELATED INVENTIONS

78. This Part of the document looks at patent protection of AI-related inventions. The "AI-related inventions" may take different forms. Innovation may occur in the improvement of AI techniques, while they may take place through integration of the AI technology in existing devices in order to improve its functionality or add a new feature. In addition, the AI technology can be used as a tool for R&D to create a new invention. Implication of the AI technology to patent law may not necessarily be the same among those different forms of the AI-related inventions.

A. General Considerations

79. It is widely recognized that the patent system should contribute to the promotion of technological innovation as well as to the transfer and dissemination of technology, for the benefit of the society at large, through balanced rights and obligations of technology producers and users of technological knowledge. To this end, each country provides a legal framework and enacts laws and regulations, which are interpreted by courts and supplemented by practical guidance developed by the administrative body.

80. As the patent system is technology neutral, whenever a new technology emerges, a question is often raised as to whether the purposes of the patent system could continue to be served. It has been the case for semiconductor technology, computer software, information technology and biotechnology: the debates continue as technology develops. It is therefore not surprising that the emergence of AI has raised similar questions and debates, scrutinizing the readiness of the current patent system to accommodate the AI technology.

81. For decades, computer technology, covering both hardware and software, has been utilized to assist the invention creation process of humans in many fields of technology. For example, developments in the mechanics and electronics have been assisted by computer-aided designs (CAD), bioinformatics has facilitated researchers to analyze and interpret biological data, and computational chemistry has helped chemists to find new chemical

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13 See, for example, United Nations and International Labour Organization report: "Mind the AI Divide: Shaping a Global Perspective on the Future of Work", July 26th, 2024, ISBN: 9789211066524, https://www.ilo.org/media/581631/download. A research paper notes that the income level, share of youth population, digital infrastructure, specialization in high-skill tradable services, English proficiency, and human capital are strongly correlated with higher uptake of generative AI. See "Who on Earth is Using Generative AI?", Policy Research Working Paper 10870, World Bank Group at: https://documents1.worldbank.org/curated/en/099720008192430535/pdf/IDU15f321eb5148701472d1a88813ab677be07b0.pdf.

14 See for example, "Tipping the scales: AI's dual impact on developing nations", World Bank Blogs at: https://blogs.worldbank.org/en/digital-development/tipping-the-scales--ai-s-dual-impact-on-developing-nations.

substances. Computers have also been integrated into devices and apparatus, to perform a specific function.

82. In the case of computer technology, new inventions relating to that technology may be categorized into three types:

(i) new inventions that improve the computing functions of computers as such;

(ii) new inventions (a device, an apparatus etc.) that incorporate computers to carry out a specific function; and

(iii) new inventions created through the assistance of computers, which can be in any field of technology.

83. A similar kind of categorization may be possible for AI technology:

(i) new inventions on the core AI technology itself;

(ii) new inventions that incorporate the AI technology (for example, a translation device incorporating AI deep learning, and a medical device for diagnosing a specific disease); and

(iii) new inventions created with the assistance of the AI technology (for example, a new material found with the assistance of the AI technology).

84. At the current stage of the technological development of AI, instructions and interventions by humans are still an important part in the creation process of those inventions. However, as the AI technology develops, the nature of human intervention in the creation process might change relative to increased autonomous performance of an AI system.

85. Therefore, the AI-related inventions may be understood from another angle, focusing on the creation of a core inventive concept. From that perspective, AI-related inventions may be categorized as follows:

(i) identification of a problem and conception of a solution are made by humans, while the AI technology is used for mere verification, automation, adaptation or generalization of the human solution;

(ii) identification of a problem is made by humans and conception of a solution is assisted, guided or led by the AI technology;

(iii) identification of a problem and conception of a solution are made together by humans and the AI technology; and

(iv) identification of a problem and conception of a solution are made by the AI technology without any human intervention.

In the second scenario, the relevance of the AI technology in the invention creation process may be from minimum to determinative. The fourth scenario, i.e., artificial general intelligence or superintelligence,[15] is not something that the current technology permits.[16] Nevertheless, the possibility of such development marks a significant difference from the conventional computer

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[15] It means that AI systems are able to successfully perform any intellectual tasks that could be undertaken by the human brain, or the hypothetical ability of a machine far surpasses the human brain.

[16] WIPO Technology Trends 2019 − Artificial Intelligence, p.19.

technology. Such a difference leads to new questions of a different nature when it comes to AI patenting.

86. Since the emergence of the AI technology, innovators and researchers have filed patent applications, and patents have been granted, on those inventions. As illustrated in the "WIPO Technology Trends 2019 − Artificial Intelligence", they cover various AI techniques[17] for numerous AI functional applications[18] in a variety of AI application fields[19]. Open source (or open innovation) approaches are also popular among AI developers.[20] For the detailed patent landscape data on AI-related inventions, reference is made to the said WIPO publication. In conjunction with its rising public prominence and the growth in attention in the scientific literature, recent years have also shown an exponential rise in patents relating to generative artificial intelligence.[21] In terms of the number of patents filed, the most important generative artificial intelligence models are (i) generative adversarial networks (GANs); (ii) variational autoencoders (VAEs); and (iii) decoder-based large language models (LLMs). These patents are not concentrated in a specific field or industry and have been filed in a vast array of key applications areas.[22]

87. How the AI technology affects patent laws has not been determined yet. Many states have not established a special procedure for examining AI-related applications.[23] However, certain characteristics of the AI technology seems to hint the areas in the patent laws that might be impacted by this emerging technology in the future, if not immediately. Thoughts may be given to the points, such as:

(i) Since the AI technology is primarily implemented by software, current patent law issues surrounding the computer implemented inventions and inventions using software may continue to be relevant to the AI technology;

(ii) The cognitive characteristics of the AI technology call for further thoughts on how this technology might be integrated into the human innovation processes, and on its implication to the assumption of "human-made" inventions under the patent system and patent law;

(iii) The inherent technical limitations in fully reproducing and describing the processes carried out in the deep learning neural network draws our attention to their potential impact on one of the fundamental principles of the patent system, that is, dissemination of new technological knowledge.

88. So long as the rationale of the patent system is to contribute to the promotion of technological innovation as well as to the transfer and dissemination of technology, patent system needs to continue providing incentives for innovation and mechanisms for sharing new knowledge in the field of AI as well (unless there are other legal/social/economic tools that sufficiently address these matters). At the policy level, the main considerations could be: with a view to the objective of the patent system, would the development of AI technology distort the balance sought by the patent system? If so, how that could be restored? Is it useful to update patent laws and practices in light of the development of AI technology? Are there, or will there

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17 For example, machine learning, fuzzy logic and logic programming.
18 For example, computer vision, natural language processing and speech processing.
19 For example, transportation, telecommunication and life and medical science.
20 WIPO Technology Trends 2019 − Artificial Intelligence, p.109.
21 World Intellectual Property Organization (WIPO) (2024). *Generative Artificial Intelligence*. Patent Landscape Report. Geneva: WIPO. https://doi.org/10.34667/tind.49740
22 For example, software, life sciences, publishing, business solutions, industry, transportation, security, and telecommunications.
23 For example, the Russian Federation, see comments received from the Russian Federation in response to C.9199.

be, any gaps between the existing legal concepts of the patent system and the emergence of the AI?

89. In order to answer those questions, there is a need to understand the technical specificity of AI compared with the conventional computer technology, and to evaluate how the current law and practice might possibly be applied to the AI technology today, and beyond. This background document does not attempt to describe the full set of issues in a comprehensive manner. However, the following paragraphs provide a sample of patent law issues that may be relevant, where patent protection is sought, and patents are granted, on the AI-related inventions. The term "AI-related inventions" refers to various kinds of inventions as described in paragraphs 83 and 85, above. At this point, there are very few official guidance that specifically address patent law questions applied to AI-related inventions. As AI is a new technology, case law has not been fully developed, and a few patent offices have issued guidance, clarifying its practices in this field. Enforcement and licensing of AI patents against the backdrop of claim interpretation, might also be part of the future discussion items, along with more commercialization of AI-integrated products in the market. In general, negotiating licensing agreements and solving patent disputes require complex and multi-faceted considerations. It still needs to be seen whether AI-related inventions *per se* would bring additional complication to such already complex questions.

90. The current patent system is built on the assumption that certain incentive mechanisms would promote creative activities by humans. From the high-level policy perspective, potentials shown by the development of the AI technology pose a legal philosophical question on the incentive theory of the patent system. Although it is still a science fiction, this may be particularly so once an AI-machine is capable of comprehensively processing various data (not only scientific and technological data but also personal and behavioral data as well as social and legal data), identifying a problem, solving the problem with a new invention and producing new products to the market to satisfy humans, all being done autonomously. While it may be an intellectually interesting question, it is well beyond the scope of this document.

91. Recent advancements in AI, particularly in areas like deep learning and generative models, have led to increasingly sophisticated AI systems capable of performing complex tasks with minimal human intervention. These developments have sparked significant discussions regarding the implications of AI-generated inventions on the current patent system.[24] The debate over whether AI can be considered an inventor under existing patent laws has risen in prominence, with some jurisdictions issuing guidance on this matter.

92. Moreover, the rapid integration of AI into various sectors has underscored the need for clearer guidelines and standards concerning the patentability of AI-related inventions for legal certainty, consistency and fairness in the patenting process. The unique nature of AI, characterized by its ability to learn and evolve autonomously, challenges traditional patentability requirements, such as novelty, inventive step, and sufficient disclosure. The black-box nature of some AI models, especially in deep learning, complicates the requirement for a clear and reproducible description of the invention.

B. Patentable Subject Matter

93. In general, patents shall be available for any inventions, whether they are products or processes, in all fields of technology, provided that they meet all the legal requirements, including the requirement that the inventions do not fall under the excluded subject matter. There is no international mandatory definition of the term "invention" and national laws define the scope of the excluded subject matter, in line with the international treaties to which the country is a party. Consequently, there are differences in the scope of patentable subject

[24] For example, see comments received from Australia and Brazil in response to C.9199.

matter from one country to another.[25] Many countries exclude from the patentable subject matter mathematical methods, schemes, rules and methods for performing mental acts, business rules and methods and programs for computers. Some of them clarify that those subjects are excluded from the patentable subject only to the extent that a patent application relates to such subject matter as such. In one jurisdiction,[26] the case law establishes that claims directed to law of nature, natural phenomena and abstract ideas are excluded from patent protection. In another jurisdiction, its patent law[27] defines the term "invention" as "the highly advanced creation of technical ideas utilizing the laws of nature" and the category of a product invention includes a computer program and any other information that is to be processed by an electronic computer equivalent to a computer program.[28]

94. Beyond the improvements on hardware components that run the AI functions, inventions relating to AI techniques and AI functional applications are mostly directed to software. As such, many Member States consider AI-related inventions to be a subset of computer implemented inventions.[29] As in the case of conventional computer technology, AI applications can also be used in non-technology areas, such as finance, insurance, e-commerce etc. In addition, machine learning is based on computation models and algorithms for classification, clustering, regression and dimensionality reduction, which may be considered mathematical techniques. Furthermore, while the importance of training data for the performance of machine learning cannot be denied, data *per se*, which is mere information, is not a patentable invention.

95. Patent eligibility of computer-implemented inventions or software-implemented inventions has already been one of the areas where it has been difficult to draw a clear-cut line between eligible and non-eligible subject matter. For example, in many countries, the "technicality" of the claimed invention is considered important for the determination of patent eligibility. In those countries, case law and office practices have been developed to clarify the concepts such as the "technical problem", "technical means", "technical effects" and "technical purpose". As to the patent eligibility requirement applied to AI-related inventions, some patent offices have issued guidance pertaining to AI-related inventions which is described below.

96. In Australia, IP Australia considers that AI-related inventions are generally a subset of computer implemented inventions for the purpose of subject matter eligibility. Australian courts have yet to consider an invention including or using AI, but patentability is generally found where there is some technical solution provided to a technical problem. Under these principles, where AI is improved in a material or technical manner or AI is used to address a technical problem, patentability may be found.[30]

97. In Brazil, the National Institute of Industrial Property (INPI) updated their Computer Implemented Inventions (CII) Guidelines in 2020 to address AI-related patent applications.[31] Patent eligibility is determined by whether the claimed subject matter falls within one of the exclusions from patentability in INPI's examination guidelines. The revised guidelines also emphasize that artificial intelligence techniques, including machine learning and deep learning tools, when applied to solving technical problems, may be considered inventions.[32] Here, AI models or algorithms, when taken detached from applications in a specific technical field, are considered to be a mathematical method or algorithm and thus not patent eligible. In contrast,

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[25] See "Certain Aspects of National/Regional Patent Laws – Exclusions from patentable subject matter" at: https://www.wipo.int/scp/en/annex_ii.html.
[26] The United States of America.
[27] Section 2(1) and (4) of the Japan Patent Act.
[28] For more information about exclusions from patentable subject matter and patent eligibility of computer-implemented inventions, see SCP/13/3 and SCP/15/3 (as regards computer programs as excluded patentable subject matter, see, in particular, Annex II of SCP/15/3).
[29] For example, see comments received from Chile, Lithuania, and Portugal in response to C.9199
[30] See comments received from Australia in response to C.9199.
[31] Resolution INPI/PR No. 411, of 2020.
[32] See comments received from Brazil in response to C.9199.

eligible subject matter includes inventions related to changes in the AI core techniques, such as alterations to the training process or the development of a new neural network architecture, when such changes are justified considering the specific technical issue being addressed, in addition to being incorporated into a technical field and generating a technical effect. In Brazil, neural network architectures, when viewed alone, are considered mathematical methods. In regard to hardware based artificial intelligence systems, to ensure patent eligibility, it is essential to present the specific characteristics and details on how the hardware implementation is carried out, it is insufficient to merely mention a possible hardware interpretation.[33]

98. In China, revised patent examination guidelines, which modified the examination criteria relating to AI inventions, came into effect in 2024.[34] In general, under the new criteria, AI related inventions can be subject matter eligible if the algorithm has a specific technical relationship with the internal structure of the computer system, and can solve the technical problem of how to improve hardware computing efficiency or execution results.[35] To constitute eligible subject matter, the claim must contain technical features in addition to algorithmic features of rules and methods for business. The updated examination guidelines also include examples of the evaluation for subject matter in a variety of AI related fields, including big data processing, deep neural networks, and others.

99. To date, there is no established case law in Germany specific to the patentability of AI-related inventions. However, as these inventions are conceptually similar to computer-implemented inventions, eligibility is thus generally addressed by applying the three-stage examination approach for program-related inventions which was established by the German Federal Court of Justice (BGH) on the basis of Sections 1, 3, and 4 of the Patent Act of Germany.[36]

100. Examples relating to AI inventions are also included in the Examination Handbook for Patent and Utility Model, issued by the Japan Patent Office (JPO).[37] These examples illustrate the criteria for determining whether AI inventions have a technical nature, which is essential for patent eligibility. The JPO emphasizes that AI-related inventions must produce a specific technical effect or contribute to solving a technical problem in order to be patentable, and mere algorithms or abstract ideas without such technical contributions are not eligible for patents.

101. In the Republic of Korea, the Korean Intellectual Property Office (KIPO) has prepared a detailed examination guide in the artificial intelligence field.[38] Similar to other offices, this guide states that the criteria on patent eligibility for AI-related inventions are in principle the same as those for computer software-related inventions. In general, AI inventions will be patent eligible when: (i) information processing is performed by a "combination of software and hardware"; and (ii) the claims do not involve a "human mental activity or offline activities". The examination guide prepared by KIPO also includes examples relating to AI inventions.

102. Singapore similarly provides specific guidance for determining the patent eligibility of AI-related inventions.[39] According to the Examination Guidelines, AI and machine learning

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33 *Ibid.*

34 The Fourth Interpretation of the Revisions to the Patent Examination Guidelines (2023) – Examination of Patent Applications for Invention Involving Computer Programs, available at: https://www.cnipa.gov.cn/art/2024/1/18/art_2199_189877.html.

35 *Ibid.*

36 See comments received from Germany in response to C.9199.

37 Annex A of the Examination Handbook for Patent and Utility Model. As regards the patent eligibility, the examples discussed are: claims directed to data that is mere presentation of information; a data structure that enables information processing, which can be performed in voice interactive systems; a trained model for analyzing reputation of accommodations.

38 Examination Guide in the Artificial Intelligence Field, Korean Intellectual Property Office, available at: https://www.kipo.go.kr/upload/en/download/Examination%20Guide.pdf.

39 Examination Guidelines for Patent Applications at IPOS, paras 8.22-8.27.

methods, such as neural networks, support vector machines, discriminant analysis, decision trees, and k-means are considered mathematical methods and are not regarded as inventions on their own.[40] Merely implementing an AI method using conventional computer hardware is unlikely to meet the eligibility criteria unless the actual contribution goes beyond the underlying mathematical method. However, AI-related inventions that apply AI to solve specific problems, like recognizing human speech or images, may be considered patent-eligible. The claim should be functionally limited to solving the specific problem, either explicitly or implicitly, by establishing a sufficient link between the problem and the steps of the mathematical method.[41] For instance, specifying how the input and output of the sequence of mathematical steps relate to the problem ensures that the method is causally linked to solving it. Furthermore, AI methods claimed with reference to their implementation on a computer or using computer hardware must demonstrate that they solve a specific problem. If the application involves merely using conventional hardware to implement a machine learning method, it is unlikely to be patent-eligible, unless the hardware interaction addresses a specific problem to a material extent.

103. In the United Kingdom, the Court of Appeal has recently addressed the subject matter eligibility of artificial neural networks (ANNs).[42] The invention in this case generated music track recommendations to a user by passing music tracks through a trained ANN. Here, the Court determined that a computer is defined as "a machine which processes information" and that a computer program consists of "a set of instructions for a computer to do something," specifically to process information in a particular manner.[43] It further concluded that an ANN, regardless of whether it is implemented in hardware or software, qualifies as a computer, and its weights and biases are considered a computer program.[44] The Court ruled that improvements in recommendations made by ANNs do not constitute a technical effect because “what makes the recommended file worth recommending are its semantic qualities” which are subjective and cognitive in nature and do not turn the system into one which produces a technical effect outside the excluded subject matter.[45] As a result, the ANN invention in this case was excluded from patentability as a computer program as such. In response to this ruling, the Intellectual Property Office of the United Kingdom (UKIPO) has indicated that going forward, it will treat ANN-implemented inventions like any other computer implemented inventions for the purpose of subject matter eligibility.[46]

104. In the United States of America, the 2019 Revised Patent Subject Matter Eligibility Guidance issued by the United States Patent and Trademark Office (USPTO) includes one example that specifically discuss patent eligibility of a computer implemented method of training a neural network for facial detection comprising a series of steps for such training.[47] The USPTO subsequently updated its eligibility guidance for AI inventions in 2024. Central to the updated guidance is the application of the framework from the Supreme Court’s decision in *Mayo*, *Myriad*, and *Alice*.

105. Step one of the USPTO’s subject matter eligibility analysis addresses whether the claimed invention is a new and useful process, machine, manufacture, composition of matter or improvement thereto (i.e., statutory subject matter). If an invention is not a process, machine, manufacture, or composition of matter, the invention is statutorily not patentable. Step 2A prong one involves determining whether a claim is directed to a judicial exception to patentability such

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40 *Ibid.*
41 *Ibid.*
42 Comptroller – General of Patents, Designs and Trade Marks v Emotional Perception AI Limited [2024] EWCA Civ 825.
43 *Ibid* at para 61.
44 *Ibid* at para 68.
45 *Ibid* at para 79.
46 Statutory guidance, Examining patent applications involving artificial neural networks, available at: https://www.gov.uk/government/publications/examining-patent-applications-involving-artificial-neural-networks/examining-patent-applications-involving-artificial-neural-networks.
47 2019 Revised Patent Subject Matter Eligibility Guidance, Example 39.

as an abstract idea, law of nature, or natural phenomenon. If the claim does not recite a judicial exception, it is considered eligible, and the eligibility analysis ends. If a judicial exception is identified, step 2A prong two assesses whether the claim elements, individually, or in combination, add significantly more to the judicial exception, thus transforming it into a patent-eligible application. If instead, the claim is “directed to” the judicial exception, the analysis will proceed to step 2B to evaluate whether the claimed additional elements amount to significantly more than the recited judicial exception itself. Step 2B includes a consideration of whether the additional element is a well-understood, routine, conventional activity. A claim may be found to lack significantly more (and thus be ineligible) based on one or more of these judicial considerations (e.g., a conclusion that the additional limitation(s) are insignificant extra-solution activity or more instructions to apply an exception). In contrast, if USPTO personnel determine in Step 2B that the additional elements do amount to significantly more than the judicial exception, the claim is patent eligible.

106. In relation to AI inventions, the updated guidelines provide additional clarity in particular to two areas of the above-mentioned test: (1) the evaluation of whether a claim recites an abstract idea in Step 2A prong one; and (2) the evaluation of the improvement consideration in step 2A prong two. The updated guidelines provide considerable commentary and hypothetical examples of how these steps in the test are applied to AI related technologies.[48] While the new guidelines emphasize that the *Alice/Mayo test* for analyzing the subject matter eligibility has not changed, the new guidance introduce three new examples that either pass or fail the test. These examples are related to “AI for Anomaly Detection Using Neural Networks”, “AI for Analyzing Speech Signals”, and “AI for Personalized Medicine”.[49]

107. In the November 2018 edition of the Guidelines for Examination in the European Patent Office (EPO), under the sections in respect of the patentability of mathematical methods and schemes, rules and methods for performing mental acts, playing games or doing business, new sub-sections relating to, *inter alia*, artificial intelligence and machine learning have been created in order to define the relevant patentability criteria more precisely.[50]

108. Regarding the inventions created with the assistance of AI technology, the consideration of the patentable subject matter obviously depends on the nature of the final invention and how it is claimed. For example, in countries where plants are excluded from patentable subject matter, patent claims defining a new and innovative plant, created by the assistance of an AI tool, would not be patentable.

C. Novelty and Inventive Step

109. It is said that inventive step analysis is the most difficult requirement in the patentability criteria to assess.[51] Among the rejected patent applications, many of them are rejected on the ground of lack of inventive step. When the validity of patents is challenged by third parties, they often base their arguments on non-compliance with the inventive step requirement. Patent

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[48] 2024 Guidance Update on Patent Subject Matter Eligibility, Including on Artificial Intelligence, available at: https://www.federalregister.gov/documents/2024/07/17/2024-15377/2024-guidance-update-on-patent-subject-matter-eligibility-including-on-artificial-intelligence.

[49] July 2024 Subject Matter Eligibility Examples: https://www.uspto.gov/sites/default/files/documents/2024-AI-SMEUpdateExamples47-49.pdf.

[50] Guidelines for Examination in the European Patent Office (EPO), Part G, Chapter II, 3.3.1. In essence, the Guidelines state that artificial intelligence and machine learning are based on computational models and algorithms for classification, clustering, regression and dimensionality reduction, which are *per se* of an abstract mathematical nature, irrespective of whether they can be "trained" based on training data. However, if artificial intelligence and machine learning find applications in various fields of technology, making a technical contribution and supporting the achievement of a technical purpose, such invention may be considered patentable subject matter.

[51] For more information about how the inventive step requirement is implemented in different countries, see SCP/22/3, SCP/28//4, SCP/29/4 and SCP/30/4.

applications and patents in the field of AI appear to be the same. Questions have emerged regarding how to analyze the inventive step and define the concept of a person skilled in the art for inventions involving the use of AI.[52] Although the available data is limited, among the oppositions filed by third parties in relation to AI-related applications/patents, many of them are on the grounds of lack of inventive step (obviousness).[53]

110. Oftentimes, when new technology emerges, assessment of inventive step faces a particular challenge. This is because prior art references are scarce, and the determination of the exact scopes of the hypothetical person skilled in the art, and of the general common knowledge in that particular art, have not fully been established. Lack of case law and official guidance makes it difficult to assess inventive step in a consistent manner. However, as the technology manures, common interpretations and standard practices have gradually emerged in many technology areas.

111. Since the assessment of inventive step is made by a person skilled in the art, the determination of the level of knowledge and skill possessed by this hypothetical person is one of the cornerstones of the inventive step assessment.[54] The exact level of such knowledge and skill needs to be defined for each concrete individual case. It also changes with the technological development. In general, the capacity and knowledge of a hypothetical person skilled in the art can, where appropriate, correspond to those of a team of persons working in various relevant fields.[55] Therefore, it is expected that the more an AI tool is used in the relevant art, the less innovative such use would become, since a person skilled in the art, i.e., an interdisciplinary team able to use the AI tool, would turn to the usage of such a tool in its research. The similar consideration applies to the notion of the “common general knowledge”.[56]

112. In China, when conducting a novelty examination of an invention patent application that involves the algorithmic features or business rules and methods, all the features described in the claims should be considered. These features include both the technical features and algorithmic features or business rules and methods features.[57] Furthermore, if an algorithm, which has a specific technical relationship with the internal structure of a computer system, enhances the system’s internal performance, then it should be considered when evaluating inventiveness. Similarly, if a solution improves user experience through technical features, or through the interaction of technical features, algorithmic features, and business rules or methods, this enhancement in user experience should be taken into account when assessing inventiveness.[58] For example, if the algorithm in the claim is applied to a specific technical field, and can solve a specific technical problem, then it can be considered that the algorithmic features and the technical features functionally support each other and have an interactive relationship, and the algorithmic features become part of the technical means adopted.[59]

113. Annex A of the Examination Handbook for Patent and Utility Model, issued by the JPO, contains several examples relating to assessment of inventive step for AI-related invention.[60] For example:

– lack of inventive step, because the invention merely systematized human operations in an AI system (Example 33);

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[52] See comments received from Chile in response to C.9199.
[53] WIPO Technology Trends 2019 − Artificial Intelligence, p.115 to 117.
[54] See document SCP/22/3.
[55] Document SCP/22/3, paragraphs 34 and 35.
[56] See document SCP/28/4.
[57] CNIPA Guidelines for Examination Section 2, Chapter 9, Article 6.1.3
[58] The Fourth Interpretation of the Revisions to the Patent Examination Guidelines (2023) – Examination of Patent Applications for Invention Involving Computer Programs.
[59] JPO - CNIPA Comparative Study on AI-Related Inventions.
[60] Annex A of the Examination Handbook for Patent and Utility Model, Examples 31 to 40, JPO.

– lack of inventive step because of a mere modification of a method for estimating output data from input data (Example 34);

– involvement of inventive step, because adding certain training data presents a significant effect (Example 34);

– lack of inventive step, because a modification of training data for machine learning is a mere combination of known data, without any significant effect (Example 35);

– involvement of inventive step due to certain pre-processing of training data (Example 36);

– lack of inventive step, because it is a simple systematization of human tasks using generative AI (Example 37);

– involvement of an inventive step based on features in the application of generative AI (Example 38);

– involvement of an inventive step based on a difference in the learning method of a trained model that estimates output data from input data (Example 39); and

114. Involvement of an inventive step based on new features added to a simple systematization of human tasks using artificial intelligence (Example 40).At the EPO, in regard to inventive step, AI-related inventions are assessed in a similar way to other computer implemented inventions. Here, it is made sure that only features contributing to the technical character of the invention are considered for the assessment of inventive step. In particular, "non-technical" features, understood in this context as features which, on their own, would fall within a field excluded from patentability, can only be considered for assessment if they contribute to solving a technical problem. Even technical features may be ignored with regard to assessment of inventive step if they do not contribute towards solving a technical problem. There have been several EPO Board of Appeal Decisions that pertain to the assessment of inventive step in relation to inventions pertaining to AI and machine learning.[61]

115. In relation to inventions "invented" by AI machines, concerns about massive creation of "new inventions" by AI machines have been raised, with a fear that it would lead to the situation where everything would be invented by the machine and patented. Somewhat mirroring the above, there are projects to generate "prior art" using the AI technology by publishing the outputs of AI machines, so that any of such output would no longer be patentable by others.[62]

116. As to the new inventions, the enabling disclosure requirement and industrial applicability (utility) requirement would prevent patenting of, for example, a mere combination of known chemical elements without any description of how such a compound can be produced and how it can be used. Similarly, information described in a published reference can only be regarded as having been made available to the public, and thus an eligible prior art reference, if the information is described in sufficient detail to enable a person skilled in the art to practice the teaching. A chemical structure disclosed merely in the form of a chemical formula, for example, is most likely not considered as an eligible prior art reference to deny the novelty/inventive step of the corresponding chemical compound.

117. The rationale of the inventive step (non-obviousness) requirement is that patent protection should not be given to an invention that could be deduced as an obvious consequence of what

[61] Artificial Intelligence and Machine Learning Case Law, available at: https://www.epo.org/en/legal/case-law/2022/clr_i_d_9_2_11_e.html.

[62] All Prior Art project (https://allpriorart.com/about/).

is already known to the public, since it would contribute very little to the society.[63] Such a policy objective may guide the determination of the inventive step for each case, including the AI-related inventions.

D. Sufficiency of Disclosure and Claims[64]

118. Similar to the inventive step assessment, new technologies pose particular challenges to disclose inventions in a clear and complete manner, and to draft clear and concise claims that adequately cover the scope of legitimate protection. Lack of case law and official guidance makes it also difficult for the IP offices and users of the patent system to assess the compliance with the disclosure requirements.

119. Regarding the description of the claimed invention, in general, national/regional patent laws require that an applicant for a patent shall disclose the invention in a manner sufficiently clear and complete for the claimed invention to be carried out by a person skilled in the art (enabling disclosure requirement).[65] It is through this requirement that the patent system facilitates the dissemination of information and access to technological knowledge contained in patent applications and patents. This results in the expansion of public stocks of technological knowledge and an increase in the overall social benefits, for example, inducing the technology transfer and avoiding a duplicative R&D.

120. In relation to the AI technology, a question may be to what extent an AI algorithm, a training model, a neural network architecture, a learning process, training data, hardware components etc. should be disclosed in a patent application in order to meet the enabling disclosure requirement.[66] The assessment of sufficiency of disclosure of AI-inventions is thus a new challenge for which many countries have yet to develop case law on this point.[67] One of the challenges may come from the fact that, under the current deep-learning technology, it is problematic for humans to identify each process step taken in a deep learning neural network and to explain exactly how the neural network arrives at the final result. When a system has several ten millions of weights that contribute to a classification, it is too complex to express it in a human comprehensible form. In certain cases, it may be more difficult to rationalize the AI output (i.e., to provide reasoning in a credible way) without having a real-world experimental data.

121. At the same time, the extent of the disclosure of the claimed invention in the description part of a patent application obviously depends on what is claimed in the claims part of the application. For example, in case where an invention relates to the application of the AI technology to solve a problem by training a deep learning algorithm with a specific dataset, if the claimed invention encompasses broader application, not one type of dataset but all dataset types that are necessary for a person skilled in the art to carry out the broad scope of the claimed invention may be required in the description.

122. In this regard, the notion of a person skilled in the art is also important for the assessment of the enabling disclosure. For example, if an AI technology is applied to an invention in a specific field (for example, an image recognition neural network applied to an invention in the field of security and surveillance), a team of persons skilled in the art in the AI technology and in the surveillance area may constitute a hypothetical person skilled in the art for the assessment of such invention.

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63 Document SCP/22/3, paragraph 3.
64 See also document SCP/34/5 (Further Study on the Sufficiency of Disclosure (PART I)), Part IV, AI-related inventions.
65 See document SCP/22/4. See also "Certain Aspects of National/Regional Patent Laws – Sufficiency of Disclosure" at: https://www.wipo.int/scp/en/annex_ii.html.
66 See comments received from Chile and Germany in response to C.9199.
67 For example, see comments received from Germany in response to C.9199.

123. Another issue might arise from the fact that deep learning technologies are non-deterministic: they involve some randomized initialization. Therefore, even the same training data and the same neural network architecture might lead to slightly different performance of machine learning. The training of a model with the same training data and same neural network architecture will result in two slightly different training behavior. Similar to the cases of biological materials where biological variability is unavoidable, a consideration might be given to the so-called reproducibility or plausibility of the claimed inventions based on the disclosure in a patent application.

124. In relation to the training data, solving a problem with one particular AI-technique might require a particular dataset. The important role that a training dataset plays in the performance of the deep machine learning might raise questions as to the extent of its disclosure in a patent application and to the availability of such a dataset with a view to verify the claimed invention by third parties (i.e., whether the claimed invention actually works or not).

125. As regards the claims, many national laws stipulate that the claims shall be clear and concise. In addition, the claims shall be supported by the description (support requirement).[68] In general, the rationale of this requirement is that the claimed invention should not exceed the scope of the invention disclosed publicly in the description. Similarly, the essential policy goals of the written description requirement provided under the law of the United States of America[69] is "to clearly convey the information that an applicant has invented the claimed subject matter and to put the public in possession of what the applicant claims as the invention".[70] Accordingly, those requirements point to the fundamental principle that patent protection shall not be accorded to what has not been invented by the applicant as of the filing date and what has not been shared with the public through the disclosure in the patent application as of the filing date. Since the AI-related inventions are mostly computer-implemented inventions, as to the techniques of claiming AI-related inventions, applicants may face similar challenges in properly covering their inventions in the claims.

126. Regarding the application of the disclosure requirements to AI-related inventions, Annex A of the Examination Handbook for Patent and Utility Model, issued by the JPO, contains several concrete examples.[71] The examples primarily illustrate the cases where the AI technology is applied to inventions in various fields of technology, and thus the machine learning generally requires multiple types of training data. They discuss the importance of showing a certain relationship (such as a correlation) among those data in order to fulfill the disclosure requirements. In addition, one example discusses the case where the AI technology is presumed to provide a certain function to a product invention claimed. The claimed invention does not meet the disclosure requirement, since the description only provide the AI inference data (no experimental data of the product) in the description, and neither prior art nor the general common knowledge suggest that the AI inference data be able to substitute the experimental data.

127. In the Republic of Korea, the description should thoroughly explain the specific means, technical problems addressed, and solutions provided by the AI-related invention, ensuring that a skilled person can easily understand and reproduce it. An invention is considered inadequately disclosed if it does not specifically provide for a correlation between input data and output data of a trained model as a certain means for implementing an AI-related invention. Correlation between input data and output data of a trained model means: (i) training data is specified; (ii) a correlation for solving a technical problem of the claimed invention between characteristics exists; (iii) a learning model to train by using training data or a training method is specifically described; and (iv) a trained model is generated for solving a technical problem of

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68 See document SCP/22/4.
69 Section 112(a) of Title 35 of the United States Code. See document SCP/22/4.
70 *Ibid.*
71 Annex A of the Examination Handbook for Patent and Utility Model, Examples 46 to 51, JPO.

the claimed invention by means of such training data and training method. However, if a person skilled in the art presumes or understands such a correlation on the basis of the model(s) described in the description of the invention, as taking common general knowledge at the time of the filing of the application into account, the enablement requirement is deemed to be met. Additionally, merely using functional block diagrams or general flow charts without providing specific implementation details is generally insufficient. The application must describe how the hardware or software implements the invention's functions in a manner that is understandable and reproducible by someone skilled in the art. This detailed disclosure ensures that the invention can be reproduced and utilized effectively, satisfying the enablement requirement, and supporting the innovation's practical applicability.[72]

128. In March 2024, the Guidelines for Examination at the EPO were updated and included substantive changes relating to the sufficiency of disclosure requirement for AI-related inventions.[73] One of the significant revisions in the updated Guidelines is that inclusion of detailed information about the training data for a claimed AI model in a patent application may be necessary to meet the sufficiency of disclosure requirement. It aims to ensure sufficient disclosure and serves as evidence of technical effect. Specifically, the updated guidelines state that a patent disclosure is insufficient when "*the mathematical methods and the training datasets are disclosed in insufficient detail to reproduce the technical effect over the whole range claimed. Such a lack of detail may result in a disclosure that is more like an invitation to a research programme.*"[74] The new guidelines also state that "*the technical effect that a machine learning algorithm achieves may be readily apparent or established by explanations, mathematical proof, experimental data or the like […] If the technical effect is dependent on particular characteristics of the training dataset used, those characteristics that are required to reproduce the technical effect must be disclosed unless the skilled person can determine them without undue burden using common general knowledge. However, in general, there is no need to disclose the specific training dataset itself*."[75] While the Guidelines currently state that full disclosure of the underlying training dataset is not generally required, instances where it is necessary have not yet been fully defined.

129. There have been two decisions at the EPO pertaining to sufficiency of disclosure and AI. In T 0161/18, the EPO Board of Appeal determined that a patent application pertaining to an artificial neural network under the case failed to meet the sufficiency of disclosure requirement. It noted that the application did not disclose which input data are suitable for training the artificial neural network or at least one dataset suitable for solving the technical problem.[76] Similarly, in T 1191/19, a patent application was found not to be in compliance with the sufficiency of disclosure requirement. In reaching this conclusion, the Board noted that the application did not provide any example of training data or even the amount of training data required to enable the invention to provide a meaningful prediction.[77] These cases stress the importance for applicants to ensure that their disclosures are enabling, potentially including detailed training data and other pertinent information to comply with the EPO's requirements.

130. As a new technological area, the application of the sufficiency of disclosure requirement to AI-related inventions is still evolving and has not yet been clearly set. Various jurisdictions are in the process of developing reports and rules to address these unique challenges.[78] Continued development of legislation, guidelines, and court rulings in this area will help to establish more precise standards and practices. In a general sense, the black box phenomenon inherent to

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[72] Examination Guide in the Artificial Intelligence Field, Korean Intellectual Property Office.
[73] Guidelines for Examination in the European Patent Office (EPO), Part G, Chapter II, 3.3.1.
[74] Guidelines for Examination in the European Patent Office (EPO), Part F, Chapter III, Insufficient Disclosure.
[75] Guidelines for Examination in the European Patent Office (EPO), Part G, Chapter II, 3.3.1.
[76] EPO Board of Appeal Decision T0161/18.
[77] EPO Board of Appeal Decision T1191/19.
[78] See comments received from Brazil in response to C.9199.

many AI algorithms may not pose a problem regarding the sufficient disclosure of the invention as long as sufficient details are given about which AI algorithm to use and how to train it.[79]

E. Industrial Applicability

131. In relation to the reproducibility and plausibility of the claimed inventions, in some countries, the compliance with the industrial applicability requirement may also necessitate the claimed invention to be reproducible with the same characteristics, whenever necessary.[80]

132. A key aspect of industrial applicability is the reproducibility and consistency of the claimed invention. For AI systems, especially those employing deep learning and neural networks, demonstrating consistent performance can be challenging due to their inherent complexity and the often opaque nature of their decision-making processes.

133. As an example, an AI system used for predictive maintenance in industrial machinery may be considered to be industrially applicable only if it can consistently predict failures accurately. This may require detailed documentation of the AI model, including its training data, algorithms, and validation results, to ensure that it can be reliably implemented and produce consistent results in an industrial setting.

F. Inventorship and Ownership

134. As AI becomes increasingly integrated into the invention process, important questions arise regarding the ownership of AI created inventions and the criteria that make a natural person the inventor when assisted by AI.[81] In 2023, document SCP/35/7 was created to address the evolving topic of inventorship and ownership in the context of AI-related inventions. That document presents an in-depth overview of the interaction between humans and AI in the invention process and offers a thorough analysis of current legal frameworks and policy questions surrounding AI inventorship.[82] Therefore, this Section only provides an overview of the inventorship/ownership issues regarding the AI-related inventions.

Inventorship and Ownership under Patent Law

135. Article 4*ter* of the Paris Convention states that the inventor shall have the right to be mentioned as such in the patent. This provision refers to what is commonly called the "moral right" of the inventor to be named as such in the patent granted for his invention in all countries of the Paris Union. It is generally understood that the inventor can waive such right, unless national legislation prescribed otherwise. As the Paris Convention does not define the term "inventor", the identification of an inventor/inventors as well as the procedure for the exercise of such moral right is regulated by each Member State in its applicable law.[83] If more than one inventor jointly create an invention, they are joint inventors.

136. Although the patentability requirements (such as the patentable subject matter, novelty, inventive step (obviousness), industrial applicability (utility) and disclosure requirements) are independent from the question of inventorship, inaccurate indication of inventors may have

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79 See comments received from Germany and Portugal in response to C.9199.

80 SCP/5 Informal Paper (The Practical Application of Industrial Applicability/Utility Requirements under National and Regional Laws). See also the Case Law of the Boards of Appeal of the European Patent Office, Part I.E.2.

81 See comments received from Chile in response to C.9199.

82 At the thirty-fifth session of the SCP, the Committee agreed that the Secretariat would update Sections V and VI of document SCP/35/7, and would submit it to the thirty-seventh session of the SCP.

83 Guide to the Application of the Paris Convention for the Protection of Industrial Property, G. H. C. Bodenhausen (WIPO Publication No. 611).

serious legal consequences. Incorrect designation of inventors can lead to various legal consequences, with different jurisdictions offering remedies for such inaccuracies.

137. While not all national legislations define the term "inventor", considering the rationale of the patent system and the moral right being one of the fundamental rights associated to patent rights, there might have been a general presumption that an inventor(s) under patent law is presumed to be a person(s).[84] If this presumption is valid, the logical consequence might be that regardless of the level of contribution by the AI machine to the conception of the invention, the machine is not an inventor.

138. Where the invention creation process involves the use of an AI system, as long as a person (or persons) in that process qualifies as an "inventor" under the applicable law – broadly speaking, contributing to the conception of the claimed invention – that person (or persons) would be an inventor (or inventors) of that invention, be it an AI programmer, an AI developer, an AI user or otherwise. A question, theoretical at this point, is if no person would qualify as an inventor under the applicable law, who has the right to a patent?

139. While it is expected that AI machines would possess higher cognitive abilities with the technological advancement, the evolution of technology is often incremental. In addition, the AI technology might play a different role in the invention creation process, depending on each case, i.e., any role within the range from a mere assisting tool to a means that is instrumental for the perception of the inventive concept. Therefore, setting "inventions by humans" against "inventions by a machine" appears to be too simplistic for the complex discussion on inventorship issues.

140. In general, the right to a patent belongs to an inventor (or inventors) at the first place, while the inventor(s) can assign the right to another natural or legal person. Therefore, the concepts of inventorship (i.e., a person who invented the invention) and ownership (i.e., a person who has the right to file a patent application or obtain a patent) are separate but related. In many countries, where an invention is made under employment, the right to a patent, in principle, belongs to an employer, often under certain conditions.[85] Therefore, the inventorship/ownership issues may be part of the essential policy questions for the designing of a patent system.

AI Inventorship and the DABUS Case

141. Two patent applications, which indicated the AI system "Device for the Autonomous Bootstrapping of Unified Science" (DABUS) as the name of the inventor, were filed by Stephen Thaler. The applications were initially filed with the EPO and the UKIPO and reportedly, were subsequently filed in 15 additional jurisdictions. The International Bureau of WIPO received an international application under the Patent Cooperation Treaty (PCT) that indicated DABUS as the inventor (PCT/IB2019/057809).

142. Various IP Offices received one or more of these DABUS applications either via the PCT application entering in the national phase or by direct filing. The IP Offices that already processed the applications predominantly rejected them, on the grounds that the name of a natural person was not indicated as the name of the inventor. In many instances, the applicant appealed these decisions to courts, which denied an AI machine to be an inventor under patent law.

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84 According to 35 U.S.C. §100(f), an "inventor" is "the individual or, if a joint invention, the individuals collectively who invented or discovered the subject matter of the invention". In the United States of America, the inventor, or each individual who is a joint inventor, of a claimed invention must, in principle, execute oath or declaration directed to the application.

85 For the sake of completeness, it should be also added that the right to a patent may also be transferred to another person through inheritance.

143. Document SCP/35/7 outlined the decisions of IP Offices and courts (if available) from Australia, Brazil, Canada, Germany, India, New Zealand, the Republic of Korea, South Africa, the United Kingdom, the United States of America and the EPO.

IV. AI TECHNOLOGY AS A TOOL IN THE PROSECUTION AND ADMINISTRATION OF PATENT SYSTEMS

144. The AI technology solutions may be used in patent proceedings and beyond, i.e., as a tool to file patent applications by applicants, to process patent applications by patent offices, to enforce patents by patentees, to invalidate patents by third parties, or to resolve disputed by judiciaries etc.

A. Tools for the IP Authorities

145. IP offices have already started to use AI technology to facilitate IP administration and delivery of their service. The WIPO Index of AI Initiatives in IP Offices[86] is an on-line portal on which such use of the AI technology is listed by country/territory and by business application of AI. The categories of business applications in the Index, which are the major business areas of IP Offices' work facilitated by the AI technology, are: (i) digitization and process automation; (ii) patent examination management; (iii) helpdesk services; (iv) image search; (v) machine translation; (vi) patent classification; (vii) patent prior art search; (viii) trademark classification; (ix) copyright registration; and (x) data analysis.

146. During the WIPO Meeting of Intellectual Property Offices (IPOs) on ICT Strategies and Artificial Intelligence (AI) for IP Administration, held in Geneva, from May 23 to 25, 2019, one of the main themes was how the applications of AI and other advanced technologies had been, and could be, used by IP Offices.[87] The discussions at the Meeting indicated the progress that had been made in various offices to harness the potential of AI in the IP administrative systems, and demonstrated the desire from offices for an ongoing exchange of information and experience in AI, which would also avoid, *inter alia*, a duplication of efforts.[88] As a follow-up to the Meeting, WIPO established a dedicated web page on AI[89] and an electronic forum for the discussion of ICT strategies and AI for IP Administration, which is restricted to the experts nominated by IP Offices. Furthermore, the Committee on WIPO Standards (CWS) established a Task Force on ICT Strategy and Standards, which, *inter alia*, reviews the Recommendations presented at the Meeting.[90]

147. In addition, since February 2019, the WIPO Conversation on Intellectual Property and Artificial Intelligence (later renamed to the WIPO Conversation on IP and Frontier Technologies) provides an open, inclusive forum to engage with, and facilitate discussion and knowledge building among, the widest possible set of stakeholders on the impact on IP of frontier technologies, including artificial intelligence (AI).[91] Most recently, the sixth session in 2022 focused on AI inventions and how IP Offices worldwide are supporting AI, and the eighth session in 2023 covered impact of Generative AI on creation of contents and a multitude of IP questions related to it.

148. In the field of patent administration, national and regional patent offices have developed (or have been developing) the AI application tools for: classification of patent applications; formality check; prior art search; machine translation of relevant documents; assistance to

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86 https://www.wipo.int/about-ip/en/artificial_intelligence/search.jsp.
87 Documents and presentations of the meeting are available at: https://www.wipo.int/meetings/en/details.jsp?meeting_id=46586.
88 Document WIPO/IP/ITAI/GE/18/5 (Summary by the Facilitator).
89 https://www.wipo.int/about-ip/en/artificial_intelligence/.
90 Document CWS/6/3.
91 https://www.wipo.int/about-ip/en/frontier_technologies/frontier_conversation.html.

substantive examination (for example, automatic annotation of patent literature and automatic detection of exclusions from patentable subject matter); and more generally, data conversion and document management.[92]

149. The International Bureau of WIPO has also used AI for its work in order to enhance functions and processes at the Organization. It also develops and provides a range of AI-powered services and tools to assist users and stakeholders. WIPO currently uses AI in a number of areas, including speech-to-text, image search within the Global Brand Database, automatic patent classification, Nice and Vienna classification assistance, and machine translation (WIPO Translate).[93]

150. During the sharing sessions held at thirty-first, thirty-third and thirty-fifth sessions of the SCP, IP offices and the International Bureau of WIPO presented their use of AI in patent administration and patent examination.[94]

B. Tools for Applicants, Third Parties and IP Professionals

151. Considering the ever-increasing amount of publicly available information generated through the patent system, AI technology may also assist applicants, third parties and IP professionals for achieving higher quality and efficiency in their respective activities.

152. The International Association for the protection of Intellectual Property (AIPPI), the American Intellectual Property Law Association (AIPLA) and the International Federation of Intellectual Property Attorneys (FICPI) consider that the applications of AI in IP practices can be grouped into three categories: (i) document automation; (ii) process automation; and (iii) AI-enabled insights.[95] They predict that AI-document automation would be able to look at language in context, and assist, for example, application drafting and proofreading. AI-based process automation would leverage patent data for search purposes, and would be used for docketing, generating office action shells and creating and managing information disclosure statements. AI-enabled insights would provide users of the patent system with insights and predictions, which they may use to make better-informed decisions.

[Annex follows]

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92 WIPO Index of AI Initiatives in IP Offices. See also documents SCP/32/4,and 4 Corr. as well as SCP/34/4.

93 For detailed information, please visit the WIPO website at: https://www.wipo.int/en/web/ai-tools-services/.

94 Presentations are made available on the respective SCP meetings webpages. Documents SCP/32/4 and 4 Corr. as well as SCP/34/4 contain reports of the sharing sessions held during SCP/31 and SCP/33, respectively. A similar sharing session will also be held during the thirty-sixth session of the SCP.

95 The AIPLA/AIPPI/FICPI AI Colloquium Primer, available at: AIPPI/AIPLA/FICPI Joint Colloquium on Artificial Intelligence, March 28 and 29, 2019 https://ficpi.org/colloquium.

WEBPAGES AND PUBLICATIONS HOSTED BY WIPO AND IP OFFICES DEDICATED TO AI

Artificial Intelligence (AI) and Inventorship (document SCP/35/7)
https://www.wipo.int/meetings/en/doc_details.jsp?doc_id=620584

Further Study on the Sufficiency of Disclosure (Part I) (document SCP/34/5)
https://www.wipo.int/meetings/en/doc_details.jsp?doc_id=582853

"Intellectual Property and Frontier Technologies" webpage
https://www.wipo.int/about-ip/en/frontier_technologies/

- Getting the Innovation Ecosystem Ready for AI - An IP policy toolkit

WIPO Technology Trends 2019 − Artificial Intelligence
https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf

Generative Artificial Intelligence. Patent Landscape Report (2024)
https://www.wipo.int/web-publications/patent-landscape-report-generative-artificial-intelligence-genai/assets/62504/Generative%20AI%20-%20PLR%20EN_WEB2.pdf

Australia

"Generative AI and the IP System" webpage
https://www.ipaustralia.gov.au/temp/Generative-AI-and-the-IP-System.html

Brazil

Final Report IP BRICS Offices, IP BRICS-INPI
http://www.ipbrics.net/secondpage/project/Patent%20Processes%20and%20Procedure%20-%20AI%20Study%20Report.pdf

China

Examination of Patent Applications for Inventions Involving Computer Programs
https://www.cnipa.gov.cn/art/2024/1/18/art_2199_189877.html

Japan

"AI-related Inventions" webpage
https://www.jpo.go.jp/e/system/patent/gaiyo/ai/index.html

JPO - CNIPA Comparative Study on AI-Related Inventions (2023)
https://www.jpo.go.jp/e/news/kokusai/cn/document/ai_report_2023_e/cn_ai_report_en.pdf

Comparative Study on Computer Implemented Invention/Software Related Inventions between JPO and EPO (2021)
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