

Autonomous Artificial Inventors & Creators: Who owns the IP rights when a machine creates?

Anika Zabeen, 520314

Intellectual Property Shaping Society

University of Turku

Faculty of Law

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UNIVERSITY OF TURKU

Faculty of Law

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Anika Zabeen

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Computers have become super computers at recent times. Computer programs such as AI and ML can execute tasks and projects autonomously and independently. It is smarter than other conventional computer programs in a sense that it has creative features like learning, thinking, evolving, and communicating. Using this type of smart computers in the inventive and creative process are becoming extremely popular amongst the inventors, scientists, and researchers. When using these machines, it gives the impression that the machine is inventing or creating the work instead of the people working behind it. As these machines internal and external state are utmost convoluted, it is incomprehensible for the common people. Therefore, identifying the true and original inventors and creative people behind the work is difficult. Moreover, if there is no proper right holder, the rights may not be assigned.

This paper aims to solve this issue of inventorship and provide a solution to the problem. The statements made in this thesis will be supported with relevant leading case laws and experts' opinions. This paper was inspired by the case of DABUS but it can be applied to all inventive and creative machines.

Besides analysing the inventive step in regards of Machine learning and Artificial Intelligence, the inventive process, inventive contribution, and inventive act in the machines work will be evaluated to determine the inventors. The work has compared and analysed different legal systems, jurisdiction and patent offices to gain better understanding of the requirements.

In addition, this paper has thoroughly described how the creative and inventive machines work and identified the true inventors behind each machine's work.

Keywords: Intellectual Property Rights, Artificial Intelligence, Patent Laws, Machine Learning, Inventorship, Inventive step, Obviousness, Computer Implemented Inventions, Inventive process, Genetic Programming, Artificial General Intelligence, Neural Networks.

Table of Contents

1. Introduction	15
1.1 Background	16
1.2 Research questions and limitations	18
1.3 Research method	19
1.4 Outline of this thesis	19
2. Autonomous systems:	20
2.1 Machine Learning	20
2.2 Artificial Intelligence:	22
2.3 Alleged Autonomous Machines	28
3. Legal Background	31
3.1 Laws on CII	31
3.1.1 Patent Laws	31
3.1.2 Copyright Laws	33
3.1.3 It is Allowed by both	37
3.3 The requirement of Invention	38
3.4 The requirement for Inventorship	47
3.5 The Inventive Process & Contribution	54
3.6 Specific provisions for CII	61
4. Case studies:	64
4.1 AI Inventor Advocators	66
4.2 Reasoning of the Patent offices	67
5. Analysis	70
5.1 Introduction to the problem	70
5.2 Inventorship in CII	73
5.3 Inventive Step in CII	78
5.3.1 ML Inventions	80

5.3.2 Computer Implemented Inventions	81
5.3.3 Computer Assisted Inventions	81
5.4 Final Analysis	83
Conclusion:	84

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Abbreviations

AI Artificial Intelligence

AGI Artificial General Intelligence

AIA America Invents Act

CII Computer Implemented Inventions (CII)

CJEU Court of Justice of the European Union

EU European Union

EPO European Patent Office

EPC European Patent Convention

GP Genetic Programming

IP Intellectual Property

ML Machine Learning

PCT Patent Cooperation Treaty

USPTO United States Patent and Trademark Office

UK IPO United Kingdom's Intellectual Property Office

WIPO World Intellectual Property Organization

WTO World Trade Organization

1. Introduction

“Technologies are emerging and affecting our lives in ways that indicate we are at the beginning of a Fourth Industrial Revolution, a new era that builds and extends the impact of digitization in new and unanticipated ways.”

*World Economic Forum.*¹

Computer programs have developed in great deal since it was first invented. Now computers can mimic cognitive functions such as learning and problem solving that is associated with the human mind.² Artificial Intelligence (AI) is said to be machine’s brain. There is common belief that computers are gaining the capacity to think and act like human brain. Moreover, famous people like Stephen Hawking and Elon Mask fear that machines may soon rise up to replace and outdate humans.

More interestingly, some people are advocating rights for computer and machines. They are arguing that inventive or creative computers should be inventor instead of the human programmer or developers working behind the inventive machine. Moreover, machines are the true inventors and the inventive mind behind the inventive process. One academic who is advocating for inventive and creative AI’s is Ryan Abbott of University of Surrey.³ Abbott argues that the law should embrace treating nonhumans as inventors because this would motivate programmers, developers and researchers working on this type of creative and inventive machines.⁴

However, there is no proof that computers have inventive or creative capabilities like human or they should be regarded as inventors. Moreover, while Abbott claims that patents have been granted on an invention created by the artificial inventor, a machine is yet to invent anything. Machines are incapable of taking any creative or inventive step

¹ WORLD ECONOMIC FORUM, AVAILABLE AT [HTTPS://WWW.WEFORUM.ORG/AGENDA/2016/01/WHAT IS THE FOURTH INDUSTRIAL REVOLUTION/](https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution/)

² RUSSELL, STUART J.; NORVIG, PETER (2009). ARTIFICIAL INTELLIGENCE: A MODERN APPROACH (3RD ED.). UPPER SADDLE RIVER, NEW JERSEY: PRENTICE HALL. ISBN 978 0 13 604259 4

³ [HTTPS://RYANABBOTT.COM/](https://ryanabbott.com/)

⁴ ABBOTT, RYAN; ‘I THINK, THEREFORE I INVENT: CREATIVE COMPUTERS AND THE FUTURE OF PATENT LAW’, BOSTON COLLEGE LAW REVIEW, VOL. 57, No. 4, 2016. AVAILABLE AT: [HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=2727884](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884)

independently and autonomously. There is always a human behind the inventive and creative process. This paper is going to discuss these issues.

Moreover, the concept of machine inventorship or authorship, is conflicting with not only intellectual property laws, but also with the human attribution right.⁵ It is highly unlikely that patent offices or national courts will allow a machine to become an inventor or author and own IP rights. Moreover, if an inventive machine is working as a black box, it will become even more challenging for humans to get patent protection for computer implemented, or computer assisted inventions. In addition, if there is no legitimate author or inventor, it may never be granted or become invalid or unenforceable in the court. If there is no protection for this type of machine work, the work will fall into the public domain and no one will be benefited from it, not even the society. The society will not benefit because gradually it will demotivate inventors to create and invest in this type of autonomous system. As they will get no profit or recognition, they will be less inclined in researching and developing. Moreover, if they do research and develop this type of machines, they will tend to protect it with trade secret and not to disclose it to the public.

1.1 Background

AI has developed rapidly over the last few years. A World Intellectual Property Organization (WIPO) report states that the numbers of AI patent applications have been growing by an average of 28% every year since 2012.⁶ Machine learning prevails over other AI techniques, representing 89 percent of patent filings and 40 percent of all AI related patents. Machine learning grew by 28 percent from 2013 to 2016; in the same period, fuzzy logic has grown by 16 percent and logic programming by 19 percent. Deep learning is the fastest growing technique in AI, with a 175 percent increase over the period. Multitask learning, grew by 49 percent. Other techniques with notable increases were neural networks, latent representation, and unsupervised learning.⁷

5 BALLARDINI, R., HE, K. AND ROOS, T., 2019. AI GENERATED CONTENT: AUTHORSHIP AND INVENTORSHIP IN THE AGE OF ARTIFICIAL INTELLIGENCE. [ONLINE] ELGAR ONLINE: THE ONLINE CONTENT PLATFORM FOR EDWARD ELGAR PUBLISHING. AVAILABLE AT: <[HTTPS://WWW.ELGARONLINE.COM/VIEW/EDCOLL/9781788119894/9781788119894.00015.XML](https://www.elgaronline.com/view/EDCOLL/9781788119894/9781788119894.00015.xml)> [ACCESSED 20 JULY 2020].

6 WIPO TECHNOLOGY TRENDS 2019 ON ARTIFICIAL INTELLIGENCE

7 WIPO TECHNOLOGY TRENDS 2019 ON ARTIFICIAL INTELLIGENCE, PP 31. AVAILABLE AT [HTTPS://WWW.WIPO.INT/TECH_TRENDS/EN/ARTIFICIAL_INTELLIGENCE/STORY.HTML](https://www.wipo.int/tech_trends/en/artificial_intelligence/story.html)

Most of the time AI is simply used as a tool to invent or create something. In recent years some AI systems can function with less human involvement and said to be fully autonomous. Moreover, the volume and diversity of content and invention created by autonomous AI's is likely to grow immensely in the future. However, the scope for getting IP protection for this type of invention or creation are limited. As AI systems are working autonomously, it is problematic to identify one true inventor. Hence the problem arises who will own the IP rights in any invention it creates. When an AI is used as a tool, it raises few controversies than when an AI is independent in its creation or invention without any human involved.

Recently a patent application was filed on behalf of a machine, claiming that the machine is the inventor. The main person behind this application, Ryan Abbott claimed that a machine invented fractal container and neural flame all by itself.⁸ Moreover, he adds that machines are already independently or autonomously creating potentially patentable inventions. He provided three examples in support of his claims:

1. the Creativity Machine made by Stephen Thaler;
2. the Invention Machine developed by John R. Koza; and
3. IBM's Watson Supercomputer.

Being an inventor requires creativity or inventive step which is absent in machines. In all three cases, the claims of 'creativity' and 'inventiveness' is argumentative. The machine did not train itself or decided that it will create or invent something, the persons behind the machines did. Hence after understanding the machines capability to invent or create, we have to focus on finding the right person responsible for the inventive or creative process. Which is utmost difficult, as the "super intelligent" machine works in mysterious ways.

However, it is true that patent protection should be available for AI assisted or AI implemented invention. It will encourage researchers and scientists to develop, own, and use AI. An AI that understands art, analyses big data, find solutions for problems and assisting in an inventive

⁸ ABBOTT, RYAN; THE ARTIFICIAL INVENTOR PROJECT. AVAILABLE AT <http://artificialinventor.com/patentapplications/>

contribution, is an incredible advancement of machine learning. Allowing patents on AI implemented or assisted inventions, will promote the development of inventive AI, finally lead to more innovation for the society. Hence, determining the inventors behind the scenes is utmost important to protect or enforce those rights. The future of development in this technology depends on it.

1.2 Research questions and limitations

The main research question of this thesis is that who will be the inventor among the multiple people involved in an invention made by an autonomous and independent AI. First of all, we have to understand how an AI system works. How it invents or creates something. Secondly, what is the legal status and requirements of AI implemented or AI assisted invention. Thirdly, how did the patent offices define inventorship and what makes a person inventor. Finally, why the patent offices at present are reluctant to allow patents for this type of inventions and what is the problem if they are allowed. Finally, how to identify the true inventor or inventors behind the inventive process. When we think about getting patents for inventions created by artificial intelligence, we need to consider the requirement of the invention, the inventor, and the inventive process.

Main Research Question: Who is the true inventor among the multiple people involved in an invention made by an autonomous and independent AI?

Other Research Questions

1. What are Autonomous systems?
 - i. What is Machine learning algorithm?
 - ii. What is Artificial Intelligence?
 - iii. How it creates or invents something?
2. What does the copyright law and patent law say about computer implemented or assisted inventions?
 - i. What are patentable subject matters in CII?
 - ii. What are the other requirements of getting a patent?
 - iii. What are the requirements for inventorship?

3. How can we find the true inventors behind the machine's work?
 - i) How to identify the true inventor or inventors when AI creates independently?
 - ii) What is inventive contribution, inventive step and inventive process?
 - iii) Which actions make a person inventor or inventors?

1.3 Research method

The main research method used in this paper will be a comparative analysis. This paper is going to compare the laws and case studies in EU, USA, and UK. Requirements and procedure of computer implemented and assisted inventions in those countries. Patent office's such as WIPO, EPO, USPTO and IPO and their views on this topic will be discussed. In respect to the United States, this paper is only going to look into the federal law and USPTO office.

Moreover, as this research paper is based on AI, the function and procedure of AI will be discussed elaborately. Books, blogs and comment from computer engineers and scientist from all over the world will be used in this paper. Supporting documents and other materials will also be included.

1.4 Outline of this thesis

The thesis focuses on how to identify the human inventors when an autonomous AI creates or invents something. New generation of AI systems are presumed to be independent and they require less human participation. Hence, it is assumed that the AI system has invented or created something by itself. This paper disagrees that AI systems even if they are super intelligent, are not capable of inventing or creating. There is always a human taking the inventive step. However, it is not easy to find the true human inventors as there are multiple people involved in this type of inventions.

This paper is going to discuss and analyse all this issues in Five chapters. In the first part the paper will introduce the problem and the background of the problem. Then in the second chapter, definitions ML and AI systems will be given with example. Describing how they are

assisting in inventions and their distinctive features will be described. In the third chapter the paper will discuss if the law allows computer implemented invention or not. Then the requirements to be patentable subject matter, invention and inventor will be given. Then in the fourth chapter two major cases where it was claimed that the machine is the inventor, will be discussed and the reasoning of the patent offices to refuse the patent application will be reviewed. Then in the fifth and last chapter, the inventive process in inventions made by AI will be discussed. This paper will try to reason what actions make a person an inventor and how to identify the true inventors. This paper will mostly focus on two AI systems the creativity machine Dabus and the GP invention machine, but it can be applied to all AI systems and machines which work autonomously and independently.

2. Autonomous systems:

2.1 Machine Learning

Most of the intelligent computers at present includes machine learning (ML) algorithms. Traditional computers consist of fixed algorithms which does not change with the data input and its output is fixed with specific commands from the users. Commanding traditional computers tasks like word processing, storing data and making decisions based on that input enables the computer to deliver an output. An example of this can be traditional search engines which uses key words or phrases as an input, then process the input to produce a request to a database. The database comprises of all the documents and files, reclaims the findings, ranks them according to benchmarks, and then at the end deliver them to the user.⁹ It is the programmer who code the system and the system implements the steps.

However, ML is different than traditional computers. Instead of explicitly programming a ML system to perform a certain task, it learns to configure itself by the input data. The machine learns from the designs in the stored data, without any explicit coding or explicit selection of designs by the programmer.¹⁰

⁹ KENT, PETER. SEARCH ENGINE OPTIMIZATION FOR DUMMIES . 3RD ED. HOBOKEN, N.J: WILEY.

¹⁰ KULKARNI, SIDDHIVINAYAK. MACHINE LEARNING ALGORITHMS FOR PROBLEM SOLVING IN COMPUTATIONAL APPLICATIONS INTELLIGENT TECHNIQUES . HERSHEY, PA: IGI GLOBAL 701 E. CHOCOLATE AVENUE, HERSHEY, PENNSYLVANIA, 17033, USA.

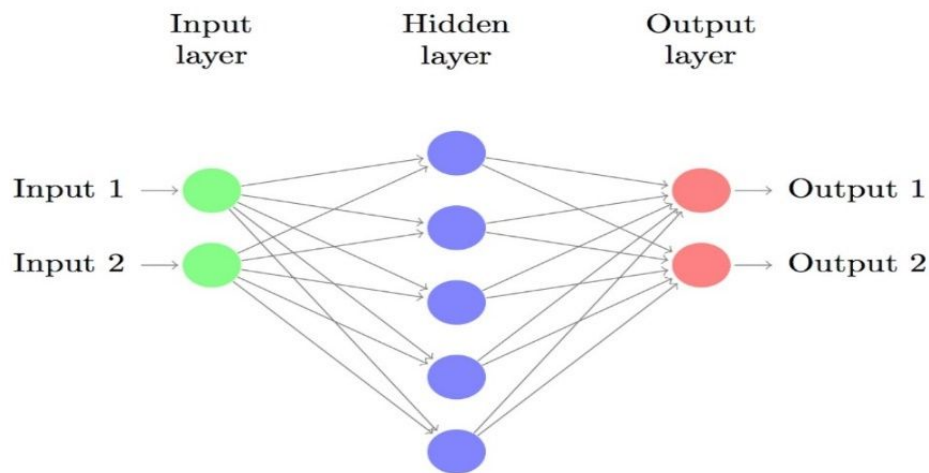


Figure 1 Terry Jack, *Deep Learning Research MC.AI*

One example can be, a ML algorithm implemented in an image recognition used to recognition someone's face. Image recognition is one of the most common use of machine learning. There are many situations where one can classify the object as a digital image. For example, in the case of a black and white image, the intensity of each pixel is served as one of the measurements. In coloured images, each pixel provides 3 measurements of intensities in three assorted colours red, green and blue (RGB). Machine learning can be used for face detection in an image as well. There is a separate category for each person in a database of several people. Machine learning is also used for character recognition to discern handwritten as well as printed letters.¹¹ Programmers can segment a piece of writing into smaller images, each containing a single character.

Another example of ML is speech recognition. Speech recognition is the translation of spoken words into the text. It is also known as computer speech recognition or automatic speech recognition. Here, a software application can recognize the words spoken in an audio clip or file, and then subsequently convert the audio into a text file.¹² The measurement in this application can be a set of numbers that represent the speech signal. Speech recognition is used in the applications like voice user interface, voice searches and more. Voice user interfaces include voice dialling,

¹¹ DAMIANI, ERNESTO. "SIGNAL PROCESSING FOR IMAGE ENHANCEMENT AND MULTIMEDIA PROCESSING ." NEW YORK: SPRINGER SCIENCE + BUSINESS MEDIA.

¹² CAMASTRA, FRANCESCO., AND ALESSANDRO. VINCIARELLI. MACHINE LEARNING FOR AUDIO, IMAGE AND VIDEO ANALYSIS : THEORY AND APPLICATIONS . LONDON: SPRINGER.

call routing, and appliance control. It can also be used a simple data entry and the preparation of structured documents.

ML can also be used in the techniques and tools that can help in the diagnosis of diseases.¹³ It is used for the analysis of the clinical parameters and their combination for the prognosis example prediction of disease progression for the extraction of medical knowledge for the outcome research, for therapy planning and patient monitoring. These are the successful implementations of the machine learning methods.

2.2 Artificial Intelligence:

AI refers to technology that can conduct tasks which normally require human intelligence.¹⁴ Machine learning enables AI to learn from data without being explicitly programmed to do so. A machine learning system typically comprises of computational models based on an algorithm or algorithm stack with a dataset to train it.¹⁵ AI consists of algorithms that can modify its own algorithms and create new algorithms by inputs and data. Therefore, it does not depend solely on the primary inputs which it was designed to recognize as triggers. AI systems have the ability to self learn and change over time from how they were originally designed and programmed. This ability to change, adapt and grow based on new data is labelled as “superintelligence”.¹⁶

AI which has machine learning algorithms are different from traditional computers and software. According to Summerfield *"Rather than explicitly programming a computer to perform a particular task, an ML system uses a learning algorithm through which some internal state of the system is configured in response to input data. The internal state represents what the machine has "learned" from patterns in the input*

13 PAUL, SUDIP., PALLAB. BHATTACHARYA, AND ARINDAM. BIT. EARLY DETECTION OF NEUROLOGICAL DISORDERS USING MACHINE LEARNING SYSTEMS . HERSHEY, PENNSYLVANIA (701 E. CHOCOLATE AVENUE, HERSHEY, PENNSYLVANIA, 17033, USA): IGI GLOBAL.

14 BERNARD MARR; FORBES: [HTTPS://WWW.FORBES.COM/SITES/BERNARDMARR/2018/02/14/THE KEY DEFINITIONS OF ARTIFICIAL INTELLIGENCE AI THAT EXPLAIN ITS IMPORTANCE/#5fcef5dd4f5d](https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#5fcef5dd4f5d)

15 [HTTPS://TOWARDSDATASCIENCE.COM/WHATS THE DIFFERENCE BETWEEN AI MACHINE LEARNING AND DEEP LEARNING 54D0528A8ED1](https://towardsdatascience.com/whats-the-difference-between-ai-machine-learning-and-deep-learning-54d0528a8ed1)

16 GILL KS (2016A) ARTIFICIAL SUPER INTELLIGENCE: BEYOND RHETORIC. AI SOC 31:2. DOI:10.1007/s00146 016 0651 x

*data, without there being any need for the algorithm to include any explicit coding based on what the input data "means", or for the programmer to explicitly define (or even to know) what patterns the machine should look for in the data."*¹⁷

AI is also referred as “smart robots” by the EU parliament and it has the following characteristics:

- i. the capacity to obtain autonomy through sensors
- ii. or by exchanging data with from internal or external source and the analysis of the data;
- iii. the capacity to learn through experience and interaction;
- iv. the forming the robot's physical support;
- v. the capacity to adapt their behaviour and actions according to the changed environment.¹⁸

Schalkoff defines AI as “[a] field of study that seeks to explain and emulate intelligent behaviour in terms of computational processes”.¹⁹ This definition of AI highlights the importance of emulation and behaviour. When we examine the behaviour and outcome of machines without understanding its internal state, we assume that it is perceiving and thinking. In reality it is just an algorithm, or a code made to perceive ideas and think. Technical words such as output, input, data processing is more suitable to use in machine learning. The distinctive feature of AI systems compared to other software systems is, its higher degree of autonomy and independence.²⁰ There are various types of AI. Word processing is one of them. It is a particularly useful software to draft a book, thesis, or any other publications. When we say we wrote an article using Microsoft word or Google translator, it has very little to do with the end result and the user of the software is the author of the paper. In other words, this software is clearly a tool that can be compared with a paint brush, camera, or a

17 M. SUMMERFIELD, THE IMPACT OF SYSTEM LEARNING ON PATENT LAW, PART I: CAN A COMPUTER INVENT
[HTTPS://BLOG.PATENTOLOGY.COM.AU/2018/01/THE-IMPACT-OF-MACHINE-LEARNING-ON.HTML](https://blog.patentology.com.au/2018/01/the-impact-of-machine-learning-on.html).

18 RECOMMENDATION TO THE EU COMMISSION ON CIVIL LAW RULES ON ROBOTICS (2015/2103(INL)).

19 R. SCHALKOFF, ARTIFICIAL INTELLIGENCE: AN ENGINEERING APPROACH (MCGRAW HILL, 1990).

20 BALLARDINI, R., HE, K. AND ROOS, T., 2019. AI GENERATED CONTENT: AUTHORSHIP AND INVENTORSHIP IN THE AGE OF ARTIFICIAL INTELLIGENCE. [ONLINE] ELGAR ONLINE: THE ONLINE CONTENT PLATFORM FOR EDWARD ELGAR PUBLISHING. AVAILABLE AT: <[HTTPS://WWW.ELGARONLINE.COM/VIEW/EDCOLL/9781788119894/9781788119894.00015.XML](https://www.elgaronline.com/view/EDCOLL/9781788119894/9781788119894.00015.xml)> [ACCESSED 20 JULY 2020].

monkey. Different tools can be used to create different work, but without the user's contribution in the work, it would not have been made.

There are some software programs that provide multiple outcomes for users to choose from. For example, choosing an avatar in a computer game or creating one in social application²¹ where the user gets to choose the features of the avatar and functions. In general the system includes a sequence of multiple choice questions, and even though different choices lead to different outcomes, the creative contribution of the user is minor compared to the contribution of the maker who has architected different elements.

Some AI systems are somewhere in between these two extremes: they require significant user input, but they also significantly guide and affect the outcome. This is mostly true for most AI systems, especially those based on machine learning systems where the input is data. Machine learning is a subdiscipline of AI that can be defined as the study of algorithms and systems that improve their performance on a given task when they are provided with more data.²² The performance of AI systems based on machine learning relies critically on the quality of the data. Thus, the role of the data provider i.e. trainer also needs to be acknowledged.

Researchers and engineers working on AI and ML have made significant contribution in this field. As a result, we are seeing some evolutionary inventions i.e. translation of human languages²³ and self driving cars²⁴. These AI systems create an impression to a nontechnical audience that these systems are far cleverer, and closer to achieving human like intelligence. However, in reality they are as intelligent as they are allowed or made to be.

21 WIKIPEDIA: AVATAR (COMPUTING), RETRIEVED FEBRUARY 9, 2018.

22 T. MITCHELL, MACHINE LEARNING (MCGRAW HILL, 1997).

23 WU, Y., SCHUSTER, M., CHEN, Z., LE, Q., NOROUZI, M., MACHEREY, W., KRIKUN, M., CAO, Y., GAO, Q., MACHEREY, K., KLINGNER, J., SHAH, A., JOHNSON, M., LIU, X., KAISER, L., GOUWS, S., KATO, Y., KUDO, T., KAZAWA, H., STEVENS, K., KURIAN, G., PATIL, N., WANG, W., YOUNG, C., SMITH, J., RIESA, J., RUDNICK, A., VINYALS, O., CORRADO, G., HUGHES, M. AND DEAN, J., 2020. GOOGLE'S NEURAL MACHINE TRANSLATION SYSTEM: BRIDGING THE GAP BETWEEN HUMAN AND MACHINE TRANSLATION. [ONLINE] ARXIV.ORG. AVAILABLE AT: <[HTTPS://ARXIV.ORG/ABS/1609.08144](https://arxiv.org/abs/1609.08144)> [ACCESSED 20 JULY 2020].

24 ACKERMAN, E., 2017. HOW DRIVE.AI IS MASTERING AUTONOMOUS DRIVING WITH DEEP LEARNING. [ONLINE] IEEE SPECTRUM: TECHNOLOGY, ENGINEERING, AND SCIENCE NEWS. AVAILABLE AT: <[HTTPS://SPECTRUM.IEEE.ORG/CARS THAT THINK/TRANSPORTATION/SELF DRIVING/HOW DRIVEAI IS MASTERING AUTONOMOUS DRIVING WITH DEEP LEARNING](https://spectrum.ieee.org/cars-that-think/transportation/self-driving/how-driveai-is-mastering-autonomous-driving-with-deep-learning)> [ACCESSED 20 JULY 2020].

Next, this paper will describe AI systems which are said to have inventive or creative capabilities.

Next Rembrandt

The Next Rembrandt is a computer generated 3D printed painting developed by a facial recognition AI algorithm that uses scanned data from known paintings by the Dutch painter Rembrandt.²⁵ An AI generated portrait consists of 148 million pixels and is based on 168,263 fragments from Rembrandt's works stored in a database. The 3D printing analysed the statistical properties of high resolution photographs and depth images of Rembrandt paintings and created a new Rembrandt painting. The painting has commensurate properties of other Rembrandt paintings, but it can be said to be a new painting as it is not a copy or a modification of an existing one. However, it holds the personal touch²⁶ i.e. style or personality of the artist Rembrandt.

Poem machine

Text can be analysed by calculating word repetition from the input data that determines the style i.e. corpus and new text can be produced with matching statistics.²⁷ The methods can be used to make rhyme and other constraints.²⁸ This was done in a AI project "Poem Machine".²⁹ In the project partially random choice of content was selected by using brain signals from users. However, the user had no conscious control of the outcome.

²⁵ [HTTPS://WWW.NEXTREMBRANDT.COM](https://www.nextrembrandt.com)

²⁶ VAN GOMPEL, S, AND M VAN EECCHOUD. "CREATIVITY, AUTONOMY AND PERSONAL TOUCH: A CRITICAL APPRAISAL OF THE CJEU'S ORIGINALITY TEST FOR COPYRIGHT." AMSTERDAM UNIVERSITY PRESS, 2014. 95–143.

²⁷ A KANTOSALO, J M TOIVANEN, P XIAO AND H TOIVONEN. 'FROM ISOLATION TO INVOLVEMENT: ADAPTING MACHINE CREATIVITY SOFTWARE TO SUPPORT HUMAN-COMPUTER CO-CREATION', IN S COLTON, D VENTURA, N LAVRAC AND M COOK (EDS),(JOŽEF STEFAN INSTITUTE, 2014).

²⁸ J TOIVANEN, O GROSS AND H TOIVONEN, 'THE OFFICER IS TALLER THAN YOU, WHO RACE YOURSELF!: USING DOCUMENT SPECIFIC WORD ASSOCIATIONS IN POETRY GENERATION', IN S COLTON, D VENTURA, N LAVRAC AND M COOK (EDS),(JOŽEF STEFAN INSTITUTE, 2014).

²⁹ [HTTPS://RUNOKONE.CS.HELSINKI.FI/START](https://runokone.cs.helsinki.fi/start)

Flow Machine

The Flow Machine can obtain patterns from a music database and create new compositions in the style of a chosen genre or artist.³⁰ However it needs significant adjustment by the musicians to reach a satisfactory end result. This includes adding tracks, writing, producing lyrics, and mixing.

Text generating programmes

There are several text generating programmes. One of them is the programme by Stanford PhD student Andrej Karpathy, who has trained a neural network to read text and compose sentences in a specific style, for example Wikipedia articles and lines of dialogue that resemble the language of Shakespeare.³¹

Aiva

Aiva is capable of composing soundtracks for films, video games, commercials, and any type of entertainment. Aiva's AI is trained by reading a large collection of music partitions, written by the greatest composers such as Mozart, Beethoven, and Bach and then it creates a mathematical model representation. This mathematic model is used by Aiva to write and compose contemporary music. Recently, Aiva became the first virtual artist to have its work registered with an author's rights society (cf. Société des auteurs, compositeurs et éditeurs de musique in France).³²

Robot Scientists Adam and Eve

Adam and Eve are systems capable of independently carrying out experiments in molecular biology, guided by an AI algorithm that generates hypotheses about

³⁰ <http://www.flowmachines.com/aimakespopmusic>

³¹ ANDREJ KARAPATHY'S. AVAILABLE AT: [HTTP://KARPATHY.GITHUB.IO/2015/05/21/RNN-EFFECTIVENESS/](http://karpathy.github.io/2015/05/21/rnn-effectiveness/)

³² [HTTPS://WWW.AIVA.AI/ABOUT](https://www.aiva.ai/about); [HTTPS://AIBUSINESS.COM/AIVA/ISTHEFIRSTAIOTOOFFICIALLYBERECOGNISEDASOACOMPOSER/](https://aibusiness.com/aiva/isthefirstaiotoofficiallyberecognisedasacomposer/)

reaction pathways and chooses experiments to test them.³³ Adam was claimed to be the first machine which independently discovered scientific knowledge.³⁴

Google DeepMind AlphaGo

One of successful ML application is the Google's DeepMind AlphaGo system.³⁵ It plays board games which are more complicated than chess. In March 2016, AlphaGo defeated a human champion.³⁶ Since the AlphaGo has become much better player.³⁷ It now requires only small portion of the human brain, and a domestic air conditioning to play a game and win it.

DeepMind is built on neural networks and uses a method called deep—reinforced learning.³⁸ This means that the AI can learn from its experiences and become more efficient at whatever it does. The AI is not pre programmed for a specific task from start. It learns as it goes through the process. Hence it perceives more ideas and is more advanced than any other AI.

Google's DeepMind is developed based on an idea, Artificial General Intelligence (AGI). AGI is a theoretical computer program that can perform intellectual tasks like a human brain. AGI is able to complete discrete tasks, such as recognising pictures or translating languages, which are the main focus of AIGs.³⁹ It is widely used in phones and computers at present. It's other functions includes calculating, playing games, speaking foreign languages, understand physics, compose novels, devise investment strategies, and make a conversation with strangers.

33 R D KING, K E WHELAN, F M JONES, P G K REISER, C H BRYANT, S H MUGGLETON, D B KELL AND S G OLIVER, 'FUNCTIONAL GENOMIC HYPOTHESIS GENERATION AND EXPERIMENTATION BY A ROBOT SCIENTIST' (2004) 427(6971)247–252.

34 [HTTP://WWW.CAM.AC.UK/RESEARCH/NEWS/ROBOT-SCIENTIST-BECOMES-FIRST-MACHINE-TO-DISCOVER-NEW-SCIENTIFIC-KNOWLEDGE](http://www.cam.ac.uk/research/news/robot-scientist-becomes-first-machine-to-discover-new-scientific-knowledge)

35 ALBAN LEVEAU VALLIER. COMPUTER PROGRAM "ALPHA GO" DEFEATS A HUMAN PROFESSIONAL PLAYER AT THE GAME OF GO. HYPERTHESE, 2016. PRINT.

36 [HTTPS://WWW.THEGUARDIAN.COM/TECHNOLOGY/2016/MAR/15/GOOGLES-ALPHA-GO-SEALS-VICTORY-OVER-GRANDMASTER-LEE-SE-DOL](https://www.theguardian.com/technology/2016/mar/15/googles-alpha-go-seals-victory-over-grandmaster-lee-sedol)

37 [HTTPS://DEEPMIND.COM/BLOG/ARTICLE/ALPHAGO-ZERO-STARTING-SCRATCH](https://deepmind.com/blog/article/alphago-zero-starting-scratch)

38 SHI JIM YEN ET AL. "DEEP LEARNING AND BLOCK GO." IEEE, 2017. 2698–2701.

39 GOERTZEL, BEN. "ARTIFICIAL GENERAL INTELLIGENCE: CONCEPT, STATE OF THE ART, AND FUTURE PROSPECTS." JOURNAL OF ARTIFICIAL GENERAL INTELLIGENCE 5.1 (2014): 1–48.

IBM's Watson

Another example of a machine beating humans at a game, is IBM's Watson supercomputer.⁴⁰ The game is played by answering clues in a form of a question. The clues come from a broad range of subject areas and are presented in limited context. To win, Watson needs to construe the clue, search in its huge database for related information, obtain the key data, assess the probability of correctness, prepare an answer, and 'buzz in'.⁴¹

Watson is a computer system that can answer any question as long as the relevant information is in its massive database. It is based on cognitive computing. Cognitive computing is a mixture of various techniques such as natural language processing, machine learning, reasoning etc. With the help of IBM Watson, one can integrate the artificial intelligence into an important business process. Most of the data in a database are unstructured, written in paragraphs, spoken data etc. IBM Watson helps to arrange this unstructured data in a systematically order to produce meaningful information.

When Watson is provided with the same question if the content of the database is same then it will provide with the same answer. However, if the database is enriched with more data, Watson will become more knowledgeable and it will provide better answers. Watson is able to provide better answers because better data is inserted into its database by the developers. It is only possible because of the hard work and labour of the human developers working on Watson.

2.3 Alleged Autonomous Machines

Overall, the examples given above are 'autonomous' only in a clearly constrained and limited scope. They are autonomous enough to execute the orders from programmers. They are autonomous because the engineers made them to work independently. Now this paper is going

⁴⁰ [HTTPS://WWW.THEGUARDIAN.COM/TECHNOLOGY/2011/FEB/17/IBM-COMPUTER-WATSON-WINS-JEOPARDY](https://www.theguardian.com/technology/2011/feb/17/ibm-computer-watson-wins-jeopardy)

⁴¹ [HTTPS://WWW.WIRED.COM/2011/01/IBM-WATSON-JEOPARDY/](https://www.wired.com/2011/01/ibm-watson-jeopardy/)

to discuss about machines who are allegedly autonomous and independent enough to invent or create like humans. One of them even have been named as an inventor in patent application.

The Creativity Machine

DABUS is a patented AI system created by Stephen Thaler. It is a particular type of connectionist AI.⁴² This AI system contains two neural networks: (i) one neural network, comprising a series of smaller neural networks, that generates novel ideas in response to self perturbations of connection weights between neurons and component neural nets therein, and (ii) a second neural network that monitors the first network and identifies those ideas that are sufficiently novel compared to the machine's pre existing knowledge base. DABUS can bootstrap itself from a blank slate, by learning and creating as it operates. Two inventions made by DABUS, fractal container and neural flame, are described and filed as patent applications. However, they were rejected because of incorrect naming of inventor.⁴³ The team who filed the patent application named the machine DABUS as the inventor.

Thaler's "Creativity Machine" neural networks are similar to the ML system used in AlphaGo. As explained earlier, these systems learn by modifying the machines internal states according to the training data. How they will react is fully dependent on the data. They produce outputs according to the input. The same input data will always generate the same output data. Thaler's plan was to arbitrarily alter the state of a trained neural network with 'noise', to see if an unexpected, new, and useful output can be originated.

According to Thaler: *"Whereas the discovery of just how to adjust the noise level within a trained neural network to produce new ideas is a significant scientific finding, a viable patent was not achieved until a critic algorithm was added, whether heuristic, Bayesian, or neural network based, to monitor for the very best notions emerging from the perturbed network. This is the preferred embodiment of the*

⁴² [HTTP://ARTIFICIALINVENTOR.COM/DABUS/](http://artificialinventor.com/dabus/)

⁴³ [HTTPS://PATENTS.GOOGLE.COM/PATENT/US5659666](https://patents.google.com/patent/US5659666)

*invention called a Creativity Machine, a “dreaming” network, “imagination engine,” or “imagitron” that is monitored by another constantly vigilant algorithm that we appropriately call an ‘alert associative center’.*⁴⁴

Abbott has made various claims of creativity machine’s inventiveness in his papers. He has claimed that the two artificial neural networks in the creativity machine, mirror the neural circuits in the human brain. He also claims that the machine is able to produce new patterns of data instead of simply linking it with other patterns. Moreover, he adds it is able to adjust into new circumstances without any additional human input. Finally, he claims that the machine invented the invention of Thaler’s second patent.

The Invention Machine

The second machine Abbott claim to be inventive and creative is “the Invention Machine”. The invention machine is developed on a technology called “Genetic Programming”. The main concept behind the invention machine is to program the machine in a way that it gains evolving capabilities with new environments.⁴⁵ In general other ML systems have inputs and outputs resulting from specific tasks. On the other hand, a GP is a set of mathematical or computational process combined into a data structure to perform on its inputs in order to produce the outputs. Consequently, altering the data structure changes the program and its output. Numerous procedures can be used to generate such programs, the developer John koza used Darwinism. In this process each new generation comprises of variations from the former generation, and it is programmed to select the most suitable variations to incorporate their code forward into future generations.

The invention machine evolves to solve a technical problem without any human supervision. This machine using 1000 networked computers, has designed antennae, circuits, and lenses. In order to optimize the design of an antenna, two things need to be measured: a ‘goodness function’ that allocates a value to each proposed design and an algorithm

⁴⁴ [HTTP://IMAGINATIONENGINES.COM/IEI_IP_OVERVIEW.PHP](http://IMAGINATIONENGINES.COM/IEI_IP_OVERVIEW.PHP)

⁴⁵ GENETIC PROGRAMMING AND EVOLVABLE MACHINES. NETHERLANDS: KLUWER ACADEMIC PUBLISHERS, 2000.

that evaluate potential designs to recognize those that have high goodness values. This is a successful approach utilized in antenna designs and electrical circuits, which are patentable subject matters.⁴⁶ This invention machine has earned a US patent for developing a system to make factories more efficient. However, the AI was not named inventor in the patent application and only humans were listed as inventors.

Koza has been organizing a GP contesting event called “Humies” every year since 2004.⁴⁷ In this event, applications win prizes which provide solutions to practical problems using GP that are usually done by humans. When assessing human competitiveness numerous methods are used, such as if the solution is an improvement of a prior art, or if it would qualify today as a patentable new invention. Koza has discussed those winning applications in his article.⁴⁸ Abbott is making his claims based on this applications. He is arguing that there are at least thirty one cases where a machine made an output which is a duplicate of a previously patented invention, infringed a previously issued patent, or created a patentable new invention. Whereas Koza is trying to promote GP and trying to inspire other programmers to use GP to invent or create, Abbott is trying to make a machine inventor.

3. Legal Background

3.1 Laws on CII

3.1.1 Patent Laws

When a patent application is filed, if it meets all the requirements than it is accepted by the patent offices. There has been no prejudice based on product, process, or fields when applying for patents. Assuming an invention meets all patent requirements, it is deemed to be an invention and not excluded from patentability. There is no provision in law that expressly denied patent protection of AI implemented inventions.

46 J R KOZA, F H BENNETT III, D ANDRE AND M A KEANE, 'GENETIC PROGRAMMING: BIOLOGICALLY INSPIRED COMPUTATION THAT CREATIVELY SOLVES NONTRIVIAL PROBLEMS', IN LAURA F LANDWEBER AND ERIK WINFREE (EDS),(SPRINGER VERLAG, 2001).

47 [HTTP://WWW.HUMANOCOMPETITIVE.ORG/](http://www.humanocompetitive.org/)

48 KOZA, JOHN; HUMANOCOMPETITIVE RESULTS PRODUCED BY GENETIC PROGRAMMING, GENETIC PROGRAMMING & EVOLVABLE MACHINES, VOL. 11, MARCH 2010. AVAILABLE AT [HTTP://WWW.GENETICPROGRAMMING.COM/GPEM2010ARTICLE.PDF](http://www.geneticprogramming.com/GPEM2010ARTICLE.PDF)

Article 4.A.(1) of the Paris Convention for the Protection of Industrial Property states that “*any person who has duly filed an application for a patent ... in one of the countries of the Union, or his successor in title, shall enjoy, for the purpose of filing in the other countries, a right of priority...*”. Article 4ter further provides that “the inventor shall have the right to be mentioned as such in the patent”.

Article 27 of TRIPS (Trade Related Aspects of Intellectual Property Rights), signed by the 164 member states of the WTO, states in relation to patentable subject matter that:

“1. Subject to the provisions of paragraphs 2 and 3, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application.”

The European Patent Convention, Article 52(1) states: “European patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application.”

The word “shall” can be interpreted as if it is a mandatory requirement for Patent offices. Meaning that patent offices will grant patent on any invention in all fields including AI which fulfils all the requirements of getting patent. This is also mentioned in article 27 of the TRIPS, which does not enquire to grant patent on how the invention has been derived or who made the invention. It does not exclude granting patents for inventions made by a machine i.e. an AI system.

In the United States, 35 USC 101 states that “whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor...”. This provision is authorised by Article I, Clause 8, Section 8 of the US Constitution, which grants Congress the power to promote the progress of science and useful arts, by securing

for limited times to authors and inventors the exclusive right to their respective writings and discoveries.

The common barrier to patenting machine learning, and other AI systems, is that, in most countries, including the U.K. and United States, abstract mathematical methods and computer programs are not patentable. While the position varies from country to country, patents are typically available if the invention have technical effect outside the mathematical method or computer program as well as being new, non obvious and useful.

3.1.2 Copyright Laws

Copyright is the exclusive right given to the creator of a creative work to reproduce the work. In the context of copyright, authorship is determined by the “author” of a work. When an AI system is merely used by a human as a tool for creating the work, the human using the system will be deemed to be the author; e.g. a person using speech to text software on their computer will be considered the author of any documents the system generates.⁴⁹ This is supported by most copyright laws and the laws are discussed below.

European copyright law comprises of international copyright treaties, EU legislation and the cases of the Court of Justice of European Union (CJEU), as well as national laws and cases. The three major international treaties relevant to European copyright law are the Berne Convention, the WIPO Copyright Treaty and the TRIPS agreement. There is no explicit definition of authors in Berne Convention or in the WIPO Copyright treaty and TRIPS agreement, but it has been mentioned multiple times.

Article 2 (1) of the Computer Program Directive states that “the author of a computer program shall be the natural person or group of natural persons who has created the

49 IGLESIAS PORTELA, M., SHAMULIA, S. AND ANDERBERG, A., INTELLECTUAL PROPERTY AND ARTIFICIAL INTELLIGENCE – A LITERATURE REVIEW, EUR 30017 EN, PUBLICATIONS OFFICE OF THE EUROPEAN UNION, LUXEMBOURG, 2019, ISBN 978 92 76 14178 5 (ONLINE), DOI:10.2760/2517 (ONLINE), JRC119102.

program or the legal person designated as the right holder by that legislation”.⁵⁰ The literal interpretation of the clause means that the author shall be a natural person who has created the program or who derived the right from the inventor i.e. employee.⁵¹

Despite the fact that the CJEU never decided on the concept of author directly, such definition can be derived from a bunch of decisions on the merit of the criteria of ‘originality’. The requirement of originality in European copyright law is defined in the Computer Programmes Directive,⁵² the Database Directive⁵³ and Term Directive⁵⁴ as the “author’s own intellectual creation”. Infopaq extended the interpretation of originality as “author’s own intellectual creation” to all the other categories of work.⁵⁵ In this case the CJEU held that copyright protection within the meaning of Article 2(a) of InfoSoc Directive should apply only to a subject matter which is original in the sense that it is its author’s own intellectual creation.⁵⁶ The CJEU further interpreted this concept in another decisions, such as *Murphy*⁵⁷, *Painer*⁵⁸, and *Football Dataco*⁵⁹, stating that ‘author’s own intellectual creation’ means that the author should “stamp his personal touch or reflect his personality in the sense that he expresses his creative abilities in original manner by making free and creative choices”.⁶⁰

The emphasis on the ‘personal touch’ and ‘personality’ interpreting the concept of ‘originality’ indicates an idea of the author as a natural person as only human beings may have personality and personal touch.⁶¹ Under current copyright laws and

50 ARTICLE 2(1), DIRECTIVE 2009/24/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 23 APRIL 2009 ON THE LEGAL PROTECTION OF COMPUTER PROGRAMS [2009] OJ L111.

51 THOMAS DREIER, P. BERNT HUGENHOLTZ (EDS.), *CONCISE EUROPEAN COPYRIGHT LAW* (2ND EDS, WOLTERS KLUWER, 2016) 248.

52 ARTICLE 1(3), DIRECTIVE 2009/24/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 23 APRIL 2009 ON THE LEGAL PROTECTION OF COMPUTER PROGRAMS [2009] OJ L111.

53 ARTICLE 3(1), DIRECTIVE 96/9/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 11 MARCH 1996 ON THE LEGAL PROTECTION OF DATABASES [1996] OJ L 77/20.

54 ARTICLE 6(1), DIRECTIVE 2006/116/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 12 DECEMBER 2006 ON THE TERM OF PROTECTION OF COPYRIGHT AND CERTAIN RELATED RIGHTS [2006] OJ L 372.

55 CASE C05/08 *INFOPAQ INTERNATIONAL A/S V DANSKE DAGBLADES FORENING* [2009] ECLI:EU:C:2009:465. 38 DIRECTIVE 2001/29/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 22 MAY 2001 ON THE HARMONISATION

56 CASE C05/08 *INFOPAQ INTERNATIONAL A/S V DANSKE DAGBLADES FORENING* [2009] ECLI:EU:C:2009:465. 38 DIRECTIVE 2001/29/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 22 MAY 2001 ON THE HARMONISATION

57 JOINED CASE C0403/08 AND C0429/08 *FOOTBALL ASSOCIATION PREMIER LEAGUE LTD ET AL V. QC LEISURE ET AL* [2011] ECLI:EU:C:2011:631.

58 CASE C0145/10 *EVA-MARIA PAINER V. STANDARD VERLAGES GMBH ET AL.* [2013] ECLI:EU:C:2013:138.

59 CASE C0604/10 *FOOTBALL DETACO LTD ET AL., v YAHOO! ET AL* [2012] ECLI:EU:C:2012:115.

60 KAN HE, ‘THE CONCEPT OF ORIGINALITY IN EU AND CHINA’ IN NIKLAS BRUUN ET AL (EDS), *THE GOVERNANCE OF IP IN EU AND CHINA* (EDWARD ELGAR, 2016) 150.

61 VAN GOMPEL, S, AND M VAN EECHOUD. ‘CREATIVITY, AUTONOMY AND PERSONAL TOUCH: A CRITICAL APPRAISAL OF THE CJEU’S ORIGINALITY TEST FOR COPYRIGHT.’ AMSTERDAM UNIVERSITY PRESS, 2014. 95–143.

interpretations, a non human or an entity with no legal personhood, like an AI, is not eligible for authorship status of any creation in the EU. Moreover, based on the line of reasoning followed by the CJEU in key cases concerning originality, it seems unlikely that an AI could qualify as the author of other types of the works either as it lacks personality or personal touch. However, it is still allowed to be copyrightable and the author will be the person who provided the necessary surroundings.

The UK is the first country who provided explicit copyright protection for computer generated work. According to Copyright Designs and Patents Act 1988 without a human author, the work cannot be original. If a literary, artistic, dramatic or musical work is not original, then no copyright subsists in the work.⁶² UK copyright law goes further and acknowledges the possibility that works could be computer generated defined as a "generated by computer in circumstances such that there is no human author of the work".⁶³ CDPA further provides that the author of a computer generated work is deemed to be the person "by whom the arrangements necessary for the creation of the work are undertaken".⁶⁴ Hence, according to the CDPA an AI cannot be an author and the author will always be the human contributor. Using a machine will not preclude him from authorship. Similar provisions also exist in Ireland, NZ and in India.⁶⁵

On the other hand, the USA has taken a more restrictive approach. In USA copyright does not protect work which are not generated by humans. The human authorship issue came into discussion with the "Monkey selfie" case.⁶⁶ The People for the Ethical Treatment of Animals (PETA) argued that a monkey named Naruto is the author of the photographs taken by it. The monkey took a picture of himself using a camera owned by photographer David Slater. The photographer argued that he provided the necessary surroundings and he made the monkey to take the selfie, hence he should be the author of the work and the court agreed. It was decided that the Copyright Act does not

62 SECTION 1(1)(A) (CDPA)

63 SECTION 178 CDPA

64 SECTION 9(3) OF CDPA

65 IGLESIAS PORTELA, M., SHAMULIA, S. AND ANDERBERG, A., INTELLECTUAL PROPERTY AND ARTIFICIAL INTELLIGENCE – A LITERATURE REVIEW, EUR 30017 EN, PUBLICATIONS OFFICE OF THE EUROPEAN UNION, LUXEMBOURG, 2019, ISBN 978 92 76 14178 5 (ONLINE), DOI:10.2760/2517 (ONLINE), JRC119102.

66 ROSATI, ELEONORA. "THE MONKEY SELFIE CASE AND THE CONCEPT OF AUTHORSHIP: AN EU PERSPECTIVE." JOURNAL OF INTELLECTUAL PROPERTY LAW & PRACTICE 12.12 (2017): 973–977. WEB.

extend the concept of authorship or statutory rights to animals and the US Congress had not authorized animals to be authors.⁶⁷ Furthermore, The Supreme Court and Ninth Circuit in USA have repeatedly referred to “persons” or “human beings” when analysing authorship.

The US congress office of Technology Assessment (OTA) raised the question several years ago if a machine should be allowed to be author or creator of a work which if made by humans should be considered as creative or original.⁶⁸ Then they emphasized that if machines in any sense are made creators, the rights of programmers and users of programs may become uncertain under the current copyright regime.⁶⁹

A key requirement for copyright protection is originality. The work must be the author’s own intellectual creation and it require a personal touch of the author.⁷⁰ Authorship is a pure human notion and copyright protection is tied to the author’s death and the author have moral right to regulate attribution and the integrity of the work. Copyright exists to protect creative labour of the human mind. Whether copyright can be granted to an AI generated work depends on the amount of input from the artist himself along with the data input in the machine. AI systems productivity or creativity depends on the data input and the training of data. Hence, even if an AI is allowed to have legal personhood, it is unable to be creative and pass the originality criteria under the current copyright laws.

Hence from all the copyright laws we can say that authors are allowed to use tools, including computer software, to assist in the creation of their works. Photographers are also allowed to use cameras. The fact that an author used a computer and a photographer used a camera, will not preclude them from authorship. The camera can have automatic settings and the computer

67 NARUTO, ET AL., PLAINTIFFS, V. DAVID JOHN SLATER, ET AL., DEFENDANTS. CASE No. 15 CV 04324 WHO. UNITED STATES DISTRICT COURT, N.D. CALIFORNIA. JANUARY 28, 2016.

68 U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, INTELLECTUAL PROPERTY RIGHTS IN AN AGE OF ELECTRONICS AND INFORMATION, OTA CIT 302 (WASHINGTON, DC: U.S. GOVERNMENT PRINTING OFFICE, APRIL 1986).

69 ID PAGE 72

70 ROSATI, ELEONORA. ORIGINALITY IN EU COPYRIGHT : FULL HARMONIZATION THROUGH CASE LAW . CHELTENHAM: EDWARD ELGAR PUB. LTD. PRINT.

can be autonomous and even if the authors did not press the button does not preclude them from being an author of an original work.

There are also other types of protection for this type of creations. The software code underlying the AI system may be protected by literary copyright, although its functionality and underlying algorithms may not. Training datasets may also be protected by literary copyright if they are sufficiently creative and, in the European Union, possibly also by the separate “sui generis” database right if they have been subject to sufficient investment. All elements of an AI system may comprise trade secrets if they are kept confidential.

3.1.3 It is Allowed by both

AI even if it can work independently and autonomously, it is not inventive or creative like humans. Only the human mind is capable of inventive step or creativity and only the human mind is protected under IP laws. However, that does not mean that computer technologies like ML and AI cannot be used as tools to assist people in creating patentable subject matter. From word processing software, to song composing, speech recognition, designing and manufacturing devices, to detect disease and providing diagnosis, computers are now assisting professionals in their everyday work. Programming a computer, is itself a creative endeavour, and it is protected by copyright. Moreover, if all conditions fulfilled computer assisted or computer implemented inventions can be protected by patents. Hence using a machine to invent or create will not preclude it from being a patentable subject matter, assuming that it fulfils all other requirements i.e. novelty, inventive step and usefulness.

As discussed in the last chapter that patent will be given to only human inventors and not a machine. Recognizing one inventor is enough to grant patent. If the correct inventor is not named, patent may not be granted. However, there is no universal definition of inventor. In most jurisdictions, an inventor is a person who conceives the idea of the invention. Hence the legal concept of an ‘inventor’ is not as the same as the legal concept of an ‘invention’. However, in order to grant patent both the requirements of an invention and an inventor has to be fulfilled.

3.3 The requirement of Invention

The procedure of obtaining patent, requirements placed on the applicant, and the extent of the exclusive rights vary widely between countries according to national laws and international agreements. In general, a patent application must include one or more claims that define the invention. The invention must meet all patentability requirements i.e. novelty, usefulness, non obviousness and subject matter requirement. These requirements are same in UK, USA and in EU.

Under the World Trade Organization's (WTO) TRIPS Agreement, patents should be available in all WTO member states for any invention, in all fields of technology, provided they are new, involve an inventive step, and are capable of industrial application. Nevertheless, there are variations on what is patentable subject matter from country to country, also among WTO member states.

Conditions for Patent, WIPO

In order to be patentable subject matter, one has to fulfil specific requirements. The requirements provided by the WIPO is the most accepted and applied. The following are the requirements provided by WIPO:

1. The invention must have an novel element, which has some new characteristic not known in the body of an existing knowledge in relevant technical field. This body of existing knowledge is called “prior art”.
2. The invention must involve an “inventive step” or “non obvious” step, which means that it could not be obvious to a person having ordinary skill in the relevant technical field.
3. The invention must be capable of industrial application, meaning that it must be capable of being used for an industrial or business purpose beyond a mere theoretical phenomenon, and be useful.
4. Its subject matter must be accepted as “patentable” under law. In many countries, scientific theories, aesthetic creations, mathematical methods, plant or animal varieties, discoveries of natural substances, commercial methods, methods for

medical treatment (as opposed to medical products) or computer programs are generally not patentable.

5. The invention must be disclosed in an application in a manner sufficiently clear and complete to enable it to be performed by a person skilled in the relevant technical field.⁷¹

As the above stated requirements are same in other jurisdictions, case laws will be discussed in the later part of this chapter.

WIPO on Software Inventions

It is possible to get patent on software related inventions. However, the laws and practices in this is software patent vary from one country or region to another. Some countries require a technical character to be eligible for patent protection. Moreover, not all software is eligible to be patentable subject matter. Abstract ideas or mathematical theories are not patentable subject matter. Other requirements such as the novelty (new), inventive step (not obvious) and industrial applicability (usefulness) has to be fulfilled too.

According to WIPO obtaining a patent protection for an app depends on which element of the app the inventor wishes to protect.⁷² If the inventor wants to protect a technical idea or feature of the app, patent protection is a good option. Depending on the national law, the software that runs the app is patentable if it has certain technical features. However, that technical idea must meet all other patentability requirements to obtain patent protection.

WIPO on Computer Programs

Once created, software is easy to reproduce in unlimited quantity in low cost. Although there is copyright protection for software programs, it does not protect the idea of the

⁷¹ [HTTPS://WWW.WIPO.INT/PATENTS/EN/](https://www.wipo.int/patents/en/)

⁷² [HTTPS://WWW.WIPO.INT/PATENTS/EN/](https://www.wipo.int/patents/en/)

software. If the computer program fulfils the technical requirement, then it can be protected by patent.⁷³

While some countries allow patenting of all types of software, some countries exclude computer programs from patentable subject matter. Computer programs are not patentable in those countries because it lacks the technical character. As a reason for excluding software from patent protection, it is often said that invention in this field typically involves cumulative, sequential development and reuse of others' work.

On the other hand, some argue that patent protection of computer software is necessary in order to provide adequate incentive for investment in this field and to support innovation in various technological areas, which are increasingly developing hand in hand with computer technology.⁷⁴

Conditions for Patent, EPO

According to EPO an idea to be regarded as an invention, at least one significant part of its technology must be completely novel i.e. new. The novel aspect of the idea should never be described before or be used for the same purpose before.⁷⁵ Not all the technology of an invention needs to be novel. An idea may be an invention if existing technologies are combined in a way that is novel or used in a way that is novel. To find out if an idea is novel is done by searching for prior art. Novelty means significant changes of prior art.

To be regarded as an invention, an idea needs to include an inventive step. An inventive step must be nonobvious i.e. it would not readily occur to an expert in the relevant technology. The inventive element might be only a small part of the whole

⁷³ [HTTPS://WWW.WIPO.INT/PATENTS/EN/TOPICS/COMPUTER_PROGRAMS.HTML](https://www.wipo.int/patents/en/topics/computer_programs.html)

⁷⁴ [HTTPS://WWW.WIPO.INT/PATENTS/EN/TOPICS/COMPUTER_PROGRAMS.HTML](https://www.wipo.int/patents/en/topics/computer_programs.html)

⁷⁵ [HTTPS://WWW.EPO.ORG/LEARNING/MATERIALS/INVENTORS_HANDBOOK/NOVELTY.HTML](https://www.epo.org/learning/materials/inventors_handbook/novelty.html)

idea.⁷⁶ However, if that small part makes a substantial difference to the profitable prospects of the idea, it could be an important and valuable invention.

The word 'obvious' comes from the Latin term for 'upon the road' (ob via), and in the sense of inventions it means something that would be the next logical step along the path from the problem to the solution.⁷⁷

Judging what might be obvious can be exceedingly difficult. Many inventions involve combined equipment. The result of such combinations might be a new product, but its properties or functionality might be entirely predictable as soon as one knew its components. Then it could be considered obvious.

A product in which one component has been replaced for a different one with equivalent properties could be considered to be obvious. In another situation there might be a new problem which can be solved with a well known piece of equipment: the novel process for solving this problem might be considered obvious if there was only one solution to the problem, and it would be known to the typical technician facing the problem i.e. the person skilled in the art.

On the other hand, when components are combined to make a product or process with properties which are greater than the sum of its parts, or better than expected, then that could be a nonobvious invention, or an invention could come from where there are many possible solutions to a problem, but the inventor has had to research and select the best one, or an inventor might defy some technical prejudice and solve a problem by doing something every other expert had previously believed would not work.⁷⁸

⁷⁶ EPO INVENTORS HANDBOOK, AVAILABLE AT: https://www.epo.org/learning/materials/inventors_handbook/novelty.html

⁷⁷ SEVILLE, CATHERINE. EU INTELLECTUAL PROPERTY LAW AND POLICY : SECOND EDITION. 2ND ED. CHELTENHAM, GLOUCESTERSHIRE: EDWARD ELGAR PUBLISHING LIMITED. PRINT.

⁷⁸ SEVILLE, CATHERINE. EU INTELLECTUAL PROPERTY LAW AND POLICY : SECOND EDITION. 2ND ED. CHELTENHAM, GLOUCESTERSHIRE: EDWARD ELGAR PUBLISHING LIMITED. PRINT.

The EPO has favoured the “problem and solution approach” in an attempt to clarify the inventive step.⁷⁹ By this approach, the inventive step is considered as “a step from the technical problem to its solution”.

This approach is done by:

1. identification of the technical field of the invention which will also be the field of expertise of the person skilled in the art to be considered for the purpose of assessing inventive step,
2. the identification of the closest prior art in this field,
3. the identification of the technical problem which can be regarded as solved in relation to this closest prior art,
4. and then an assessment of whether or not the technical feature(s) which alone or together form the solution claimed could be derived as a whole by the skilled person in that field in an obvious manner from the state of the art.

The “objective technical problem” is derived from the features of the invention which separates it from the closest prior art. When applying for patent, the description must disclose the invention as such that the technical problem and the solution is understandable. In the problem solution approach, the technical problem is derived from the reason to modify a prior art and the act of adding features on the prior art to provide technical effect for the invention to solve a problem.⁸⁰ The objective technical problem derived in this way may differ from the problem presented in the application. The problem can be reformulated in the application by the person skilled in the art when it is analysed against the prior art. However, the reformulated technical problem should not contradict earlier statements in the application about the general purpose and character of the invention.

When evaluating the inventive step, it is measured whether the invention is obvious to the person skilled in the art or not. It is measured if the inventor has used his

⁷⁹ LI, XIANG. “A COMPARATIVE ANALYSIS OF THE INVENTIVE STEP STANDARD IN THE EPO, SIPO AND USPTO.” *JOURNAL OF INTELLECTUAL PROPERTY LAW AND PRACTICE* 8.7 (2013): 539–545.

⁸⁰ SEVILLE, CATHERINE. *EU INTELLECTUAL PROPERTY LAW AND POLICY : SECOND EDITION*, EDWARD ELGAR PUBLISHING LIMITED, 2016. PROQUEST EBOOK CENTRAL, [HTTP://EBOOKCENTRAL.PROQUEST.COM/LIB/KUTU/DETAIL.ACTION?DOCID=4731305](http://ebookcentral.proquest.com/lib/kutu/detail.action?docID=4731305).

knowledge of the prior art to modify the art to solve the objective technical problem. The point is not whether the skilled person could have arrived at the invention by adapting or modifying the closest prior art, but whether the skilled person would have done so in the hope of solving the objective technical problem or in expectation of some success. If the problem can be solved by taking a series of obvious steps, each generating a predictable outcome, is an inventive step. One other thing is evaluated if the skilled person were certain about the approach that it will succeed or hopeful that it will success.⁸¹

Existence of uncertain outcome can make the invention not obvious. This technique is performed in technical situations where predictable methods are used to solve a particular problem, but inappropriate where the invention depends on a random method.

An inventor is a person skilled in the art who is brave enough to take risks, entering unpredictable areas, and challenging established laws. These measures are not obvious to try for every person skilled in that art. If an unforeseen problem can be solved by a simple obvious step, then it is not an inventive step.⁸²

Encountering a novel problem may result in a patentable subject matter even if the solution to the problem is an obvious one.⁸³ However, perceiving the problem has to be beyond skilled person's capabilities. The inventor must be able to recognize the problem, overcome any obstacles and improve the invention to make it operative.

81 MYCOGEN MODIFYING PLANT CELLS, IT WAS DECIDED IN RESPECT OF INVENTIVE STEP IS WHETHER THE SKILLED PERSON WOULD HAVE CONDUCTED THE EXPERIMENT REFERRED TO IN IT WITH A REASONABLE EXPECTATION OF SUCCESS. IN THIS RESPECT, THE STATEMENT IN DECISION T 296/93 THAT "A REASONABLE EXPECTATION OF SUCCESS" SHOULD NOT BE CONFUSED WITH THE UNDERSTANDABLE "HOPE TO SUCCEED" IS OF RELEVANCE. IN FACT, WHILE IT CAN BE SAID THAT, IN THE LIGHT OF DOCUMENT (5A), THE EXPERIMENT IN QUESTION WAS "OBVIOUS TO TRY" FOR THE SKILLED PERSON, IT IS NOT NECESSARILY TRUE THAT THIS PERSON WOULD HAVE HAD ANY REASONABLE EXPECTATION OF SUCCESS WHEN EMBARKING ON IT. THE ANNOUNCEMENT BY DR KEMP THAT SUCH AN EXPERIMENT WAS IN PROGRESS IN HIS LABORATORY WAS NOT IN ITSELF A GUARANTEE IN THIS RESPECT, ESPECIALLY IN VIEW OF THE WARNING GIVEN BY THE SAME DR KEMP THAT "... THIS HAS BEEN DONE BY A NUMBER OF PEOPLE NOW AND NOBODY HAS SHOWN A FUNCTIONAL GENE WHEN ONE INCLUDES THE ENDOGENOUS PROMOTER". THUS, THE OUTCOME OF THE SAID EXPERIMENT WAS STILL UNCERTAIN. THE QUESTION TO BE DECIDED IS THEREFORE WHETHER THE AVERAGE SKILLED PERSON WAS IN A POSITION TO REASONABLY PREDICT ITS SUCCESSFUL CONCLUSION, ON THE BASIS OF THE EXISTING KNOWLEDGE, BEFORE STARTING THE EXPERIMENT.

82 SEVILLE, CATHERINE. EU INTELLECTUAL PROPERTY LAW AND POLICY : SECOND EDITION. 2ND ED. CHELTENHAM, GLOUCESTERSHIRE: EDWARD ELGAR PUBLISHING LIMITED. PRINT.

83 KUZNETS, S., 1962. INVENTIVE ACTIVITY: PROBLEMS OF DEFINITION AND MEASUREMENT. UNIVERSITIES NATIONAL BUREAU COMMITTEE FOR ECONOMIC RESEARCH, COMMITTEE ON ECONOMIC GROWTH OF THE SOCIAL SCIENCE RESEARCH COUNCIL, [ONLINE] (0 87014 304 2), PP.(P. 19 52). AVAILABLE AT: <[HTTP://WWW.NBER.ORG/BOOKS/UNIV62](http://www.nber.org/books/univ62) 1> [ACCESSED 20 JULY 2020].

When a person skilled in the art is trying to solve a problem for long time and he succeeds to solve it by the invention, it qualifies as an inventive step. However, mere financial success is not enough to qualify as an inventive step. The success has to derive from the technical feature of the invention and from the long term effort of the inventor to qualify as an inventive step.

EPO on Computer Implemented Inventions

Computer programs in general are not patentable, but an invention involving a computer program can be protected as a computer implemented invention. CII includes computers, computer networks or other programmable machine where one or more of the features of the claimed invention are executed by means of a program or programs. To qualify, the invention also needs to have one or more technical features which are achieved wholly or partly by means of a computer program.⁸⁴

In 1980s EPO developed the doctrine of technical effect. To receive patent in a computer implemented invention the actual contribution must be technical in nature. This is called the contribution approach⁸⁵ and it was first established in the case of *Re Vicom* (T208/84). It concerned a new method of handling the images for a CAD system. It was held that a mathematical method used in a technical process carried out in a physical entity by some technical means which produces a change in that entity is an patentable invention. Moreover, if the invention is anticipated to have a technical character and the person providing the technical character to the known art has contributed a technical contribution.

⁸⁴ J K WELLS, ANDREW. "TECHNICAL CONTRIBUTION AND PLAUSIBILITY: THE APPROACH OF THE EUROPEAN PATENT OFFICE AND THE COURTS OF ENGLAND AND WALES." JOURNAL OF INTELLECTUAL PROPERTY LAW & PRACTICE 14.10 (2019): 784–795.

⁸⁵ SMITH, G., 2007. INTERNET LAW AND REGULATION. 4TH ED. SWEET & MAXWELL, PP.126–129.

Following the Re Vicom decision, the contribution approach was again established in the case of Koch & Sterzel/X Ray Apparatus (T26/86). In this case the patent involved a data processing device which was used to adjust parameters of X ray device where the prior art used the same device and the same known computer but a different computer program. The Board assessed that, an ordinary computer program used in a general purpose computer transforms mathematical values into electric signals with the aid of natural forces. The electric signals only reproduced information and cannot be regarded as a technical effect. Hence the computer program used in a general purpose computer is excluded from patentability. However, in the present case the program controls the operation of a conventional general purpose computer technically to alter its functioning. Therefore, the unit consisting of the program and the computer combined together is a patentable invention. Hence it was held that the patent was valid as the invention has to be assessed as a whole and the use of nontechnical means did not detract from the overall technical training.

Since these two decisions, there have been several cases decided by the EPO Board of Appeal. Among them there were six cases concerning IBM text handling patents which were held invalid. The reasoning behind these decisions were that the text processing is not a technical activity and there, the effect of the program on the displayed text was not a technical one. The EPO Technical Board of Appeal held that an outcome of a computer program is not excluded from patentability if, when it is run on a computer, it produces a further technical effect which goes beyond the normal physical interactions between the program i.e. software and the computer i.e. hardware. Moreover, to determine the technical contribution of an invention appropriately, it should be evaluated by the novelty and inventive step requirement and not the subject matter requirement.

In the case of Sohei/Yamamoto's (T769/92), it was held that method of doing business is excluded from patentability even if it involved software. The Technical Board of Appeal held that if the invention solves the technical issues concerning basics of the solution of the problem in order to conduct that same invention, it is not excluded from patentability. Hence an invention comprising functional features implemented by

software is not excluded from patentability under article 52(2)(c) and (3). Such technical issues contribute to a technical nature to the invention as they entail a technical problem to be solved by implicit technical features. However, the invention in the present case did not apply to a computer program as such under Article 52(3).

In the case of Petterson's Application (T1002/92) the EPO Board of Appeal held that even if one of the practical application of the system was to provide services for the customers, the claimed subject matter is not equal to a method for doing business. The claimed device comprised of a computer hardware operated by a particular computer program. The program determined output signal of the hardware which was used for an automatic control of the operation of another system component and thus solved a problem which was of a technical nature. Hence the invention is patentable subject matter even if one of its function was of business method.

When allowing patent in a computer implemented inventions the Board considers if the subject matter i.e. the software have technical character. Technical character can be found from the execution of the software resulting in further technical effect. In Viacom it was found from the solution of a technical problem and in Sohei it was found from the technical subject required to arrive at the invention. The court stated that it would be illogical to grant a patent for a method and for a programmed computer conducting the method, but not for the software that in fact produces the technical effect.

In the case of Pension Benefit System Partnership, the board had a new approach called the hardware approach. It was held that having a technical character is an implicit requirement of the EPC and it has to be fulfilled by every computer implemented invention in order to be patentable. The mere fact that data processing and computing means i.e. technical means recited in a claimed method does not confer a technical character to the claimed method. Technical means for a purely nontechnical purpose or for processing purely nontechnical information does not necessarily confer technical character. The Board stated that a computer system programmed to act in different way than it's normal character had "the character of a concrete device in the

sense of a physical entity, manmade for a useful purpose” and was thus a patentable invention within the meaning of Article 52(1) of the EPC.

The board further stated that when examining computer implemented inventions, it is more appropriate for the examiner to proceed directly towards the question of novelty and inventive step, without considering the question of technical character. Moreover, it should be evaluated if the inventive step have overcome the objective technical problem or not. The solution of the problem constitutes the inventor’s technical contribution to the art. The hardware approach sets a comparatively low hurdle, and thus the main focus of the question of patentability moves from the question of subject matter requirement to the question of inventive step.

EPO uses a two hurdle approach when determining patentability of Computer Implemented Inventions (CII).⁸⁶ The technical character requirements relating to the first hurdle is now a formal requirement. In other words, it is a simple test that is related to the language used in the patent claim. Acceptable software patent claims can meet the first hurdle by starting with "computer implemented method for..." or "system configured to...". In the case of computer programs and according to the case law of the boards of appeal, a technical contribution typically means a further technical effect that goes beyond the normal physical interaction between the program and the computer.⁸⁷ To meet the second hurdle, a software invention needs to present a "technical application". This application is the purpose of the invention as defined in the patent claim, establishing a connection between a technical limitation of the patent claim and the technical purpose of the invention.

3.4 The requirement for Inventorship

In every jurisdiction inventorship is the starting point to gain IP rights. The inventor is the first owner of the patent and if he wants, he can transfer the rights to others.⁸⁸

⁸⁶ SMITH, G., 2007. INTERNET LAW AND REGULATION. 4TH ED. SWEET & MAXWELL, PP.126-129.

⁸⁷ https://en.wikipedia.org/wiki/Appeal_procedure_before_the_European_Patent_Office

⁸⁸ SHEMTOVE, NOAM; A STUDY ON INVENTORSHIP IN INVENTIONS INVOLVING AI ACTIVITY, THE EUROPEAN PATENT OFFICE, FEBRUARY 2019.

Article 60(1) of the European Patent Convention provides that “the right to a European patent shall belong to the inventor or his successor in title”.⁸⁹ Under the EPC article 60(1), the right to a European patent belongs primarily to the inventor. Under the article 60(1) the inventor has both the substantive right to the invention and moral rights, in particular the right to be acknowledged and mentioned. These rights are safeguarded⁹⁰ by Article 62 EPC (right to be mentioned), Article 81 EPC and Rule 19(1) EPC (obligatory designation of inventor, including indication of the origin of the right to the invention, if the applicant is not the inventor), Rule 19(3) EPC (communication to the inventor that he has been designated), Rule 20 EPC (publication of the mention of the inventor and a possibility of a waiver) and Rule 21 EPC (rectification of the designation of inventor). Finally, patent offices can refuse patents on the grounds that the application does not mention an inventor. Hence, it is of utmost important to identify the true inventor to assign rights.

When examining a patent application, the concept of inventorship can be derived from three perspectives: firstly from the patentable subject matter; secondly from the inventive act; and, thirdly, who is the true and rightful inventor of the invention.⁹¹ However, the issue of inventorship will not arise unless or until someone else claim to be an inventor or if there is an obligation to disclose how the inventor derived the right.⁹² Moreover, EPO does not investigate if there is an inventive step taken by the human inventor when granting patent.⁹³

The inventor must take the inventive step. Moreover, the invention must not be obvious to a person skilled in the art. The skilled person’s obviousness will be compared with the inventor. The requirements of an invention and inventive step have to be assessed in an objective manner,⁹⁴ meaning that it does not matter how the invention was made.

⁸⁹ https://www.epo.org/law_practice/legal_texts/html/epc/2016/e/ar60.html

⁹⁰ SHEMTOVE, NOAM; A STUDY ON INVENTORSHIP IN INVENTIONS INVOLVING AI ACTIVITY, THE EUROPEAN PATENT OFFICE, FEBRUARY 2019.

⁹¹ RO’NSBERG, ANNE LAUBER; HETMANK, SVEN; THE CONCEPT OF AUTHORSHIP AND INVENTORSHIP UNDER PRESSURE: DOES ARTIFICIAL INTELLIGENCE SHIFT PARADIGMS? JOURNAL OF INTELLECTUAL PROPERTY LAW & PRACTICE, 2019, VOL. 14, NO. 7. PP 570

⁹² RO’NSBERG, ANNE LAUBER; HETMANK, SVEN; THE CONCEPT OF AUTHORSHIP AND INVENTORSHIP UNDER PRESSURE: DOES ARTIFICIAL INTELLIGENCE SHIFT PARADIGMS? JOURNAL OF INTELLECTUAL PROPERTY LAW & PRACTICE, 2019, VOL. 14, NO. 7. PP 571

⁹³ ART. 56 EPC

⁹⁴ CORNISH/LLEWELYN/APLIN, INTELLECTUAL PROPERTY: PATENTS, COPYRIGHT, TRADE MARKS AND ALLIED RIGHTS, 8TH ED. 2013, PARA. 5 31; KROHER, IN: SINGER/STAUDER, PATG, 7TH ED. 2016, ART. 56 PARA. 4; MOUFANG, IN: SCHULTE, PATG, 10TH ED. 2017, SEC. 4 PARA. 7; ABBOTT, 57 B.C.L. REV. 1079 (1110) (2016); BLOK, E.I.P.R. 2017, 69 (73).

The invention can be made from a discovery, accident or with a help of machine. The US patent law is particularly precise about it. 35 USC 101 states that a patent may be granted to “whoever invents or discovers...”,⁹⁵ while the non obviousness provision, 35 USC 103, expressly says that “patentability shall not be refuted by the manner in which the invention was made”.⁹⁶ For instance, it does not matter if an invention came from years of hard work, experimentation, luck, geniuses, or using a program to search and analyse huge amount of data to find a solution. If the invention satisfies all other legal requirements of patent than it is a patentable subject matter. A patent is given to an invention which is new, useful, and is an extension of the current state of the art, no matter how the invention was made.⁹⁷

The inventor must recognize and understand the invention and the invention must be disclosed in the patent application. The description must allow the person skilled in the art to perform it. A inventive step requires that the inventor is able to recognize the inventive capability of the outcome and describe the findings properly in the application.⁹⁸ An inventor is simply a person or persons, who by any means recognized the usefulness of the invention and put it into action.

There is no unified definition of inventorship. Each jurisdiction has defined inventorship slightly different from others in their respective patent laws. In EU, the inventor is always a natural person and the first owner of the patent. Both EPO and national courts in member states have derived “inventorship” from the “contribution to the inventive concept”.⁹⁹

There are two main requirements for inventorship in EU¹⁰⁰:

- i. conception of the idea, and

⁹⁵USPTO.GOV. 2015. [ONLINE] AVAILABLE AT: <[HTTPS://WWW.USPTO.GOV/SITES/DEFAULT/FILES/101_STEP1_REFRESHER.PDF](https://www.uspto.gov/sites/default/files/101_step1_refresher.pdf)> [ACCESSED 20 JULY 2020].

⁹⁶USPTO.GOV. N.D. 2158 AIA 35 U.S.C. 103. [ONLINE] AVAILABLE AT: <[HTTPS://WWW.USPTO.GOV/WEB/OFFICES/PAC/MPEP/S2158.HTML#:~:TEXT=103\(A\),THEN%20PRE%20DAIA%2035%20U.S.C.](https://www.uspto.gov/web/offices/pac/mpep/s2158.html#:~:text=103(A),then%20pre%20DAIA%2035%20U.S.C.)> [ACCESSED 20 JULY 2020].

⁹⁷ RO`NSBERG, ANNE LAUBER; HETMANK, SVEN; THE CONCEPT OF AUTHORSHIP AND INVENTORSHIP UNDER PRESSURE: DOES ARTIFICIAL INTELLIGENCE SHIFT PARADIGMS? JOURNAL OF INTELLECTUAL PROPERTY LAW & PRACTICE, 2019, VOL. 14, No. 7. Pp 571

⁹⁸ RO`NSBERG, ANNE LAUBER; HETMANK, SVEN; THE CONCEPT OF AUTHORSHIP AND INVENTORSHIP UNDER PRESSURE: DOES ARTIFICIAL INTELLIGENCE SHIFT PARADIGMS? JOURNAL OF INTELLECTUAL PROPERTY LAW & PRACTICE, 2019, VOL. 14, No. 7. Pp 571. SEE ALSO: BLOK, E.I.P.R. 2017, 69 (73).

⁹⁹ ROSA MARIA BALLARDINI, KAN HE AND TEEMU ROOS; AI GENERATED CONTENT: AUTHORSHIP AND INVENTORSHIP IN THE AGE OF ARTIFICIAL INTELLIGENCE. EDWARD ELGAR PUBLISHING. Pp 128

¹⁰⁰ IPRHELPDESK.EU. 2013. FACT SHEET INVENTORSHIP, AUTHORSHIP AND OWNERSHIP. [ONLINE] P 3 AVAILABLE AT: <[HTTP://WWW.IPRHELPDESK.EU/SITES/DEFAULT/FILES/NEWSDOCUMENTS/FACT SHEET INVENTORSHIP AUTHORSHIP OWNERSHIP.PDF](http://www.iprhelpdesk.eu/sites/default/files/newsdocuments/fact_sheet_inventorship_authorship_ownership.pdf)> [ACCESSED 20 JULY 2020].

- ii. reduction of the idea into practice.

To properly determine who is an inventor, their 'active contribution' in devising the invention should be acknowledged. Meaning that without their active individual contribution the invention would not have been devised. The inventor must significantly contribute in the development of the invention. Key responsibilities of the inventor in EU are:

- i. The inventor conceives the idea
- ii. The inventor materially contributes to the development of the invention
- iii. The inventor provides solution to a problem
- iv. The inventor implements the invention

Hence the ownership of the patent can be transferred only via the inventor to its successor in title.¹⁰¹ Inventorship identifies the maker of an invention, the true inventor. On the other hand, ownership is a right to own the invention, a proprietary right. To own a patent, the successor in title must receive the ownership right from the inventor.

Who is not an Inventor under EPO:

A person who acted under the command from others is not an inventor. The person who merely does testing under direction from others or the person who merely make some suggestions but does not participate in the development of the invention, is not an inventor. Managers or supervisors cannot be inventors if they did not make any inventive contribution in the inventor's independent work.

101 IPRHELPDESK.EU. 2013. FACT SHEET INVENTORSHIP, AUTHORSHIP AND OWNERSHIP. [ONLINE] P 5 AVAILABLE AT: <[HTTP://WWW.IPRHELPDESK.EU/SITES/DEFAULT/FILES/NEWDOCUMENTS/FACT SHEET INVENTORSHIP AUTHORSHIP OWNERSHIP.PDF](http://www.iprhelpdesk.eu/sites/default/files/newsdocuments/fact_sheet_inventorship_authorship_ownership.pdf)> [ACCESSED 20 JULY 2020].

Inventor / Joint-Inventor	Not Inventor
Conceives the idea	Puts forward hypothesis
Materially contributes to the development of the invention	Passively follows the instructions imparted
Provides solutions to problems	Performs routine tasks
Implements the innovation	Executes results testing

Figure 2 European IPR Help desk, Fact Sheet.

USPTO

In the United States, conception is said to be the touchstone on the inventorship and it is completion of the mental part of the invention.¹⁰² Conception has been defined as "the complete performance of the mental part of the inventive act" and it is "the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention as it is thereafter to be applied in practice".¹⁰³ "Conception is established when the invention is made sufficiently clear to enable one skilled in the art to reduce it to practice without the exercise of extensive experimentation or the exercise of inventive skill."¹⁰⁴ Conception has also been defined as a disclosure of an invention which enables one skilled in the art to reduce the invention to a practical form without "exercise of the inventive faculty."¹⁰⁵ Conception of the idea is different from reduction to practice. Reduction to practise is done where the complete conceived idea of the invention is put into action by the person skilled in the art without any further enquiries or testing".¹⁰⁶

¹⁰² BURROUGHS WELLCOME CO. V BARR LABORATORIES, INC. 40 F. 3D 1223, FED. CIR. 1994, AT 122708. AVAILABLE AT: [HTTPS://SCHOLAR.GOOGLE.COM/AU/SCHOLAR_CASE?CASE=13830417328708424560](https://scholar.google.com.au/scholar_case?case=13830417328708424560)

¹⁰³ TOWNSEND V SMITH 36 F. 2D 292, CCPA 1929, AT 295. AVAILABLE AT: [HTTPS://SCHOLAR.GOOGLE.COM/AU/SCHOLAR_CASE?CASE=6249091079198213606](https://scholar.google.com.au/scholar_case?case=6249091079198213606)

¹⁰⁴ HIATT V. ZIEGLER, 179 USPQ 757, 763 (BD. PAT. INTER. 1973).

¹⁰⁵ GUNTER V. STREAM, 573 F.2D 77, 197 USPQ 482 (CCPA 1978).

¹⁰⁶ SEWALL V WALTERS 21 F. 3D 411, FED. CIR. 1994, AT 415. AVAILABLE AT: [HTTPS://SCHOLAR.GOOGLE.COM/AU/SCHOLAR_CASE?CASE=16045431180041582582](https://scholar.google.com.au/scholar_case?case=16045431180041582582)

The above definitions of conception of the idea and then reduction to practice gives an impression that all invention must follow this rule. However, it is an inaccurate analysis. In *Townsend* the invention occurred by accident, a gear in a screw thread cutting machine was manufactured with a wrong number of teeth. The idea of a useful configuration was conceived after the invention was reduced into practise. Yet again it does not make any difference how the invention was made.¹⁰⁷ However, before claiming the invention, the inventor must have complete understanding of the invention and it has to be complete and operative. Inventor's hope that a genetically altered yeast would produce antigen particles and reciting the particle size and sedimentation rates in the claims did not establish conception. The inventor did not show that he had a definite and permanent understanding of the invention, neither he had a reasonable expectation that, the yeast would produce the recited antigen particles. He had no idea how or whether it will work, and the invention did not become functional at that time, making it an incomplete claim.¹⁰⁸

UK

In UK the inventor is defined by the “actual deviser of the invention.”. The deviser is the person who contributes into the inventive step of the claimed invention.¹⁰⁹ A claim by claim process was denied in UK. On the other hand, the court depends on the information which is in the “heart of the invention” and who conceived the inventive concept. The person who did that is the deviser of the invention.

Moreover, contribution made on nonpatentable subject matters derived from a prior art is not inventive step. Hence a deviser of an invention means someone who contributed in the patentable subject matter of the inventive concept. The inventive concept also has to be new and not disclosed in prior art to be patentable invention.

¹⁰⁷ SHEMTOVE, NOAM; A STUDY ON INVENTORSHIP IN INVENTIONS INVOLVING AI ACTIVITY, THE EUROPEAN PATENT OFFICE, FEBRUARY 2019.

¹⁰⁸ HITZEMAN V. RUTTER, 243 F.3d 1345, 58 USPQ2d 1161 (FED. CIR. 2001).

¹⁰⁹ SECTION 7(3) OF THE PATENTS ACT 1977. LEGISLATION.GOV.UK. 1997. PATENTS ACT 1977. [ONLINE] AVAILABLE AT:

<[\[ACCESSED 20 JULY 2020\].](https://www.legislation.gov.uk/ukpga/1977/37/section/7#:~:text=7%20RIGHT%20TO%20APPLY%20FOR,ALONE%20OR%20JOINTLY%20WITH%20ANOTHER.></p></div><div data-bbox=)

The devisers of the invention are those who had conceived an idea which goes beyond the financial, abstract, or administrative nature.

Joint or Co Inventors

Who can be inventor comes into focus when there has been a dispute regarding the inventorship. Disputes where multiple people have been involved in the inventive step and claimed to be coinventors or joint inventors. In those cases, the courts at first evaluate the contribution of each alleged coinventors in the inventive step. The contributions must have significant effect on the inventive concept.¹¹⁰ The individual intellectual input of everyone who claims to be an inventor is a crucial factor in those cases. Mere routine work such as turning on the machine and checking for updates are not significant enough. In German Federal Court of Justice was established that when two individuals achieve the invention in conjunction but the single contribution of every contributor did not exceed the routine work of an average skilled person, hence they are not inventors.¹¹¹ When multiple person claim inventorship, the court compare their contribution to the inventive process and only significant contributions are allowed to make them inventors. The inventive contribution in those cases requires more intellectual or physical labour than recognition or discovery. However, invention can come from discovery or recognition too.

Inventorship is determined based on the claimed invention and on a claim by claim basis. An inventor, under U.S. patent law, is “whoever invents or discovers”. Before AIA a person who first conceived an invention and reduced it to practice was considered to be the inventor. At present under the AIA, the first person who files the patent application, becomes the inventor.¹¹²

Although AIA has made important changes in U.S. patent law, the core concept of inventorship is the same. The inventorship is still determined based on the inventive

¹¹⁰ KAFATARIS V DAVIS [2016] FCAFC 134, at [62], [65]; UNIVERSITY OF WESTERN AUSTRALIA V GRAY [2009] FCAFC 116, POLWOOD PTY LTD V FOXWORTH PTY LTD [2008] FCAFC 9, at [60]–[61]

¹¹¹ GERMAN FEDERAL COURT OF JUSTICE (BGH), GRUR 1966, 558 (560) – SPANPLATTEN.

¹¹² INVENTORSHIP AND AUTHORSHIP; ANTOINETTE F. KONSKI AND LINDA X. WU FOLEY AND LARDNER LLP, PALO ALTO, CALIFORNIA 9430461013

subject matter claimed. Inventorship is granted to person or persons who has conceived the idea of the invention. The courts have defined conception as “the formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention, as it is thereafter to be applied in practice”. In other words, if a person of ordinary skill in the art can reduce the invention to practice without any further experimentation, then the conception is complete and the person who conceived the subject matter is the inventor.

3.5 The Inventive Process & Contribution

Conception

Conception is the starting point of an inventive process. Each inventor has to contribute into the conception. Conception has been defined as the complete performance of the mental part of the inventive act. It is the formation in the mind of the inventor, of a definite and permanent idea of a complete and operative invention, and then reduction of the idea into practise.¹¹³ After the conception is complete, all other actions i.e. perfecting the act or instrument, is not part of the invention process.¹¹⁴

35 U.S.C. §116(a) recites, Inventors may apply for a patent jointly even though:

- a) they did not physically work together or at the same time,
- b) each did not make the same type or amount of contribution, or
- c) each did not make a contribution to the subject matter of every claim of the patent.

In order to be inventor, the inventor has to have an idea that is definite and permanent enough for the person skilled in the art to perform without any further research. To complete, an inventor must have the complete mental picture and able to describe it accurately so the skilled person can perform it.¹¹⁵ The second step after conception is

113 TOWNSEND V. SMITH, 36 F.2D 292, 295, 4 USPQ 269, 271 (CCPA 1930)

114 KONSKI, A. AND WU, L., 2015. INVENTORSHIP AND AUTHORSHIP. COLD SPRING HARBOR PERSPECTIVES IN MEDICINE, [ONLINE] 5(11). AVAILABLE AT: <[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC4632863/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4632863/)> [ACCESSED 4 MAY 2019].

115 MPEP.USPTO.GOV. 2020. MPEP. [ONLINE] AVAILABLE AT: <[HTTPS://MPEP.USPTO.GOV/RDMS/MPEP/e8r9#/e8r9/d0e207607.html](https://mpep.uspto.gov/RDMS/MPEP/e8r9#/e8r9/d0e207607.html)> [ACCESSED 20 JULY 2020].

that the invention is reduced in practice to proof that it operates. Sometimes the description is enough. Each inventor must contribute to the inventive process before the conception was complete.

Timing of contribution

The inventive contribution is evaluated based on when the person contributed in the conception of the idea and what was the quality of the contribution. To determine whether or not an individual made an inventive contribution, the time when the conception became complete is important. In order to be inventive contribution, the inventor has to contribute in the conception of the idea before it was complete.¹¹⁶ All the tests and experimentation which is necessary to make the invention operative is done before the conception is complete.

An inventor must contribute into the conception by experimenting and by providing information before it has become operative. Those who join after the completion of the conception of the idea, cannot be inventors. The U.S. Court of Appeals affirmed in a case law that defendant were not coinventors because their contribution to the research came after the conception of the invention was complete.¹¹⁷ The invention was already fully operative and it is not necessary to reduce into practise. Any person skilled in the art could have perform it. The alleged coinventors only helped them gain scientific certainty.

It was held in *Burroughs Wellcome Co. v. Barr labs Inc.* that contributing after the invention is complete is not inventive contribution. When conception occurred prior to testing the invention for operability. Burroughs contacted NIH to conduct testing of compounds using a test developed by NIH. Burrough selected the compounds and NIH tested those without knowing what they were. Court decided NIH is not coinventors. In addition, NIH testing was not absolute necessary to complete the conception of the invention.

¹¹⁶ KONSKI, A. AND WU, L., 2015. INVENTORSHIP AND AUTHORSHIP. COLD SPRING HARBOR PERSPECTIVES IN MEDICINE, [ONLINE] 5(11). AVAILABLE AT: <[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC4632863/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4632863/)> [ACCESSED 4 MAY 2019].

¹¹⁷ UNIVERSITY OF PITTSBURGH V. HEDRICK (573 F.3D 1290) (FED. CIR. 2009).

NIH just confirmed that it works. The conception of the invention was complete prior to testing.

Quality of Contribution

In addition to time, the quality of the contribution in the inventive process must be evaluated. The contribution of each inventor does not have to be the same kind or same level but must be related to at least one of the claims in some manner.¹¹⁸ It was decided in US court that:

*“all that is required of a joint inventor is that he or she contribute in some significant manner to the conception or reduction to practice of the invention, make a contribution to the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention, and do more than merely explain to the real inventors’ well known concepts and/or the current state of the art”.*¹¹⁹

It is reasonable to say that any contribution which adds novel, nonobvious, or useful element to the invention, is ipso facto significant. Factors such as whether the collaborator identified or solved a problem unrecognized by others; or solved a problem that other collaborators could not solve; or added a nontrivial advantage to the invention that the other collaborators did not contemplate; or contributed to the novel, nonobvious, or useful aspect of the invention; or contributed in nontrivial part of the invention which amounts to qualify as significant contribution.¹²⁰

It is not necessary that the entire inventive concept should occur to each of the joint inventors, as long as each inventor makes some original contribution to the final solution of the problem even if it is partial or very little. Each joint inventor must contribute in the conception of the invention which is not obvious to person skilled in

¹¹⁸ ETHICON, INC. v. U.S. SURGICAL CORP

¹¹⁹ PANNU V. IOLAB CORP. (155 F.3d 1344, 1351) (FED. CIR. 1998)

¹²⁰ AARON X. FELLMETH, CONCEPTION AND MISCONCEPTION IN JOINT INVENTORSHIP, 2 NYU J. INTELL. PROP. & ENT. L. 73 (2012).

that art. When determining inventorship, the contribution should be significant when its measured against the whole invention.¹²¹ Without this contribution the invention could not have happened.

The contribution of each inventor does not have to be the same type or amount, nor each inventor has to contribute to every claim of the patent. An individual can be joint inventor, even though he only contributed to one element each of two claims of the 55 total claims that were issued.¹²² Additionally, one inventor can do more of the experimental work while the other make other type of contribution.

Determining what constitutes not insignificant is subjective and fact specific. Merely suggesting an idea, providing professional services or advices, or assisting in perfecting an already fully conceived invention cannot be deemed as an inventive contribution.¹²³ Hence this are not significant contribution to conception of the invention. It is important to note that, a person is not excluded from being an inventor because his contribution was in the experiments or tests.

If an invention is fully operative but the inventors are not sure of it, it does not disentitle them from inventorship. Draft patent application disclosing the procedure of treating AIDS with AZT was sufficient to proof that it was fully conceived by the inventor even if he was unsure if it will work or not.¹²⁴ The person who suggests an idea of a possible outcome in an inventive process but do not act on it, is not an inventor. Courts have denied inventorship to persons who merely suggests a way to improve an invention but takes no further role in making the suggestion work in an invention.¹²⁵ Alleged coinventor merely suggested seeds to use in the invention but did not act in the inventive process.

121 KONSKI, A. AND WU, L., 2015. INVENTORSHIP AND AUTHORSHIP. COLD SPRING HARBOR PERSPECTIVES IN MEDICINE, [ONLINE] 5(11). AVAILABLE AT: <[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC4632863/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4632863/)> [ACCESSED 4 MAY 2019].

122 (ETHICON (135 F.3D AT 1460–1465)

123 WOMMACK V. DURHAM PECAN CO., INC., 715 F.2D 962, 965 (5TH CIR. 1983).

124 BURROUGHS WELLCOME (40 F.3D AT 1230),

125 ELI LILLY & CO. V. ARADIGM CORP. (376 F.3D 1352, 1359) (FED. CIR. 2004), GARRETT CORP. V. UNITED STATES (422 F.2D 874, 881) (CT. CL. 1970); EX PARTE SMERNOFF (215 U.S.P.Q. 545, 547) (B.P.A.I. 1982))

Moreover, an inventor does not lose his right to inventorship because he used services, ideas, suggestions and help from others to perfect the invention. In the case of *Hess v. Advanced Cardiovascular Systems Inc.*,¹²⁶ The court determined that Hess is not an inventor because he just provided his opinion on a well known object which can be found in textbooks. Hess was an expert in material science, and he was just providing professional suggestions. The invention was conceived by two doctors who needed some special materials. The material was suggested and provided by Hess. The extensive research and development were done by the two doctors and Hess has no part in it. Hess's contribution was well known and "did no more than a skilled salesman would do in explaining how his employer's product could be used to meet a customer's requirements."

Supreme Court in *Samuel Morse's invention "the telegraph"* decided that only Morse was the inventor even though he consulted with others during the development of the invention. It was held: "*[n]o invention can possibly be made, consisting of a combination of different elements ...without a thorough knowledge of the properties of each of them, and the mode in which they operate on each other. And it can make no difference, in this respect, whether he derives his information from books, or from conversation with men skilled in the science. If it were, otherwise, no patent, in which a combination of different elements is used, could ever be obtained.*"¹²⁷ Every invention is made of combination of different elements. It is essential to know the properties and how they operate. In order to do so an inventor can get that information from books, websites, or from other skilled professionals.

In the case of *Ethicon, Inc. v. U.S. Surgical Corp.* a technician who assisted with a project was named coinventor as he contributed in a portion of two claims of the patent.¹²⁸ Dr. Yoon, a medical doctor and prior inventor, conceived idea of a new endoscopic device that would prevent accidental injury during use. Later he asked Choi to assist

¹²⁶ *HESS V. ADVANCED CARDIOVASCULAR SYSTEMS, INC.* (106 F.3d 976) (FED. CIR. 1997)

¹²⁷ *O'REILLY V. MORSE* (56 U.S. 62, 111) (1853)

¹²⁸ *ETHICON, INC. V. U.S. SURGICAL CORP.* (135 F.3d 1456) (FED. CIR. 1998)

him with various projects. One of the projects was an improved endoscopic device. The court settled that Choi was one of the joint inventors as he contributed in one of the two claims in the patent application. This case illustrates that an inventor only needs to contribute in one claim of the conceived invention, and it does not matter if he is skilled in the whole invention or not. Mr. Choi was an electronics technician, who had basic training but no college degree.

One legal commentator has compiled a list of contributions that the courts have found to be insufficient to satisfy inventorship.¹²⁹ According to Chisum any suggestion of desired end result without action is not inventive contribution. Person who is following instruction from the original deviser is not inventors. If a person reduces the invention into practise after it was already a complete and operative invention, is not an inventor. Finally, the person who provided general information about elements to use in the invention with no knowledge of the ultimate goal or idea, is not an inventor.

To summarize, the inventive contribution of the conception of the invention, has to be new, not obvious, minimal but significant in quality and more than advice, mere suggestion or an idea. Moreover, if its reduced into practise, it has to be done before the conception was complete and operative. The contribution can be very little and belong to only one claim but it has to be significant enough as if without his contribution, the invention would not happen.

Experimentation & Conception

Conception is the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention. For the conception to be complete, the idea of the invention must be operative and fully functional. So that any person skilled in the art can reduce it into the practise.

129 DONALD, C., 2011. AMERICA INVENTS ACT OF 2011: ANALYSIS AND CROSS REFERENCES. [ONLINE] CHISUM.COM. AVAILABLE AT: <[HTTPS://WWW.CHISUM.COM/WP-CONTENT/UPLOADS/AIAOVERVIEW.PDF](https://www.chisum.com/wp-content/uploads/AIAOVERVIEW.PDF)> [ACCESSED 20 JULY 2020].

If the invention is a predictable technology then a drawing of the device in a manner that distinguishes the invention from prior art is enough to make it complete and operative. However, when the invention is an unpredictable technology, it has to be tested and experimented to prove that it is operative, then it can become complete.¹³⁰

If the invention is made with conventional method and it is a known art, the description of the invention is enough to prove that it is complete. There is no need to reduce it into practice to make the conception complete. The invention is complete simultaneously with the idea itself. Here nothing more than routine skill work is necessary to prove complete conception of the idea or reduction to practice. Such as for chemical compounds a description of the structure of the compound is enough. The conception is complete and operative prior to testing and experimentation.

On the other hand, if the invention is complex and unconventional, then reduction to practice is necessary to prove that it is operative. In the case of *Oka v. Youssefyeh*, Youssefyeh claimed that he conceived the idea of the invention on February 27, 1980 but the person skilled in the art found the method to be unsuccessful.¹³¹ On October 1980 the conception was complete by Oka, when he conceived an idea of a complete and operative invention. Thus, in situations where the invention is made with unconventional techniques, where it is still not operative, it cannot be deemed complete.

In certain conditions, the conception of the idea is not complete unless or until it is differentiable from the prior art.¹³² This is known as the doctrine of simultaneous conception and reduction to practice. Applicable to the field of biological compounds. In these cases, an inventor is often unable to explain how it is different from other compounds and how did he obtain it. Hence conception is not complete until it is experimented and reduced into practice. It is only achieved after it has been isolated from other compounds. Conception of a new compound is complete when the characteristics

130 KONSKI, A. AND WU, L., 2015. INVENTORSHIP AND AUTHORSHIP. COLD SPRING HARBOR PERSPECTIVES IN MEDICINE, [ONLINE] 5(11). AVAILABLE AT: <[HTTPS://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC4632863/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4632863/)> [ACCESSED 4 MAY 2019].

131 *OKA V. YOUSSEFYEH* (849 F.2D AT 583)

132 *AMGEN, INC. V. CHUGAI PHARMACEUTICAL CO., LTD.* (927 F.2D 1200, 1206) (FED. CIR. 1991)

of the gene is identified. The characteristics of the gene makes it different from other genes.

In biological inventions, the conception is not complete until the inventor can explain its characteristics and functions. The material has to be reduced into practice and become operative before it can be complete. Having an idea of a compound and hoping it will work, does not amount to complete conception. This is also contradicting the rule to disclose the invention in the patent application.¹³³ The applicant must trial the invention before filing a patent application and then describe the operative and functional invention as a proof of conception.

3.6 Specific provisions for CII

Now from all the legal requirements of invention, inventive process and inventorship we can derive specific conditions for CII. First of all, if a computer is working in its general capacity, then there is no technical effect.¹³⁴ Hence there is no inventive step. The actual involvement of the computer has to be of technical nature. The machine must have a technical character and that technical character must solve a technical problem. A technical character can be found from the execution of the software resulting in further technical effect. If a person uses a computer in an obvious way, then it is not an inventive act rather a known art. An inventor has to make the computer system to act in a different way than it's normal character to pass the technical character requirement. The user either has to use the machine for a technical feature or in a technical process or to solve a technical problem. The person who recognizes the technical character of the computer and uses it to actively contribute in devising the invention, is the inventor in CII invention. Without their active contribution the machine could not have had solved the technical problem. His contribution in the machine must create a technical effect which goes beyond the normal physical interaction between a program i.e software and a computer i.e. hardware.

¹³³ *FIERS V. REVEL* (984 F.2D 1164, 1169) (Fed. Cir. 1193)

¹³⁴ *PENSION BENEFIT SYSTEM T 931/95*

If a person who is using the AI doesn't understand or is clear on how the machine came to that solution, he will not be able to describe or disclose the invention in the application. Hence it will be an invalid patent application on the basis of insufficient disclosure of invention. According to article 100(b) of EPC, the patent has to disclose the invention in a manner sufficiently clear and complete for it to be carried out by persons skilled in the art. Describing the work and expressing it clearly is a requirement of the patent application. So that the person skilled in the art can use that description and operate the invention without any further experiment or modification. Simply posing a problem is not enough, the inventor has to carry out steps to accomplish the desired result.

In *Morgan v Hirsh*, Morgan just has an idea and he suggested it to Hirsh. Hirsh conceived the idea of the invention and then got some feedback from Morgan. Morgan only evaluated the product not the invention. Morgan didn't put any contribution in the conception of the machine. Hence, the court decided that Morgan is not an inventor. Similarly, if the computer scientist conceived a problem and has conceived of means of accomplishing the task using genetic programming, it's a tool. He has simply conceived of a mean of figuring out a way to accomplish the task. It is already conceived by him, the computer just carry out the order/tests. Finally, he recognized the usefulness of the product.

In *Hitzeman v. Rutter*, Hitzeman, the court ruled that the conception of an idea of an invention is incomplete until the inventor has the full and functional idea of the invention. The particle size and sedimentation rates were material limitations of the counts and that the claimant is required to show that he knew these limitations when he conceived the idea of the invention. The Board found that mere hope of producing such particles in yeast, is not conception, but only a research plan or a general goal. Moreover, there has to be reasonable expectation that the invention will work, and the inventor must know the mechanism by which the invention is made and how it will become operative.

The Hitzeman rule can be applied to CII by replacing yeast with computer programs. Hitzeman didn't have a complete operative conception of 22nm particle until after he tested and tried with yeast and the invention became fully functional after that. Before that the court found that Hitzeman had conceived of the particle size limitation, but it was not complete until he found out that it would be produced by yeast. A person with an idea to use a computer program capable of processing data and creating an output in a particular format to invent is an inventor. The inventor used a combination of subprograms with the hope of creating a desired output. Applying the Hitzeman rule, conception of a claim for creating an output occurs prior to testing of the combination of subprograms. However, conception of a claim that recited the use of the subprograms may not occur until after the machine operated to produce the desired output. Moreover, an inventor does not lose inventorship because he used a computer.

When discussing the inventorship issue in AI, WIPO raised few important questions.¹³⁵ Questions like at what stage the idea of the invention came from the AI and whether the AI has real mind of its own or did it use its own mind in the inventive process. In response to this question WIPO explained it is obvious that the AI is no real person and therefore, even if it is intelligent and creative, it only analyses the information fed into it. It is not difficult to understand that the effort of the human remains the same in the inventive process. However, the AI is able to produce more effective results which the human developer himself cannot have produced or thought of.¹³⁶ This is possible because AI at present are not fixed on the primary input.

Moreover, WIPO adds even if the AI is allowed to be an inventorship, it will never be able to use it. The human inventor has goals and purpose to make and use the invention,¹³⁷ which is absent in a machine. The result is recognized useful by the humans, assessed by the humans, and put into practice by the humans, then finally it becomes a patentable invention.¹³⁸ The AI is able to produce an outcome as a result of

¹³⁵ WIPO CONVERSATION ON INTELLECTUAL PROPERTY (IP) AND ARTIFICIAL INTELLIGENCE (AI). [ONLINE] AVAILABLE AT: <https://www.wipo.int/edocs/mdocs/mdocs/en/wipo_ip_ai_ge_19/wipo_ip_ai_ge_19_inf_4.pdf> [ACCESSED 20 JULY 2020].

¹³⁶ TONY BRADLEY, FACEBOOK AI CREATES ITS OWN LANGUAGE IN CREEPY PREVIEW OF OUR POTENTIAL FUTURE, FORBES (JULY 31, 2017), <https://www.forbes.com>.

¹³⁷ SOLVAY S.A. v. HONEYWELL INTERNATIONAL, 742 F.3d 998, 1000 (2014).

¹³⁸ CHRIS SMITH ET AL., THE HISTORY OF ARTIFICIAL INTELLIGENCE, https://courses.cs.washington.edu/courses/csep590/06au/projects/history_ai.pdf Pg. 13

adequate testing and training by the human trainer. Hence it is fully dependable on humans and do not qualify to be an inventor.

4. Case studies:

The Creativity machine:

Patent applications have been made to the US, EU and UK patent offices on behalf of a machine called Dabus. The application claims that the machine is the inventor of two inventions; a plastic food container and a flashing light. Applicants claim that the products, a food container that can change shape and a flashing light designed to attract attention in an emergency were created and designed solely by the machine Dabus. It was argued that the machine's invention are themselves evidence of its inventive capability. The UK IPO has already found those inventions to be novel, inventive and to have industrial applicability. However, it was denied by the patent offices on the basis of incorrect naming of Inventor. The applicant Thaler named the machine "Dabus" as an inventor and he claimed for the ownership of the patent. However, the applicant was unable to demonstrate how he derived the right to own the patent application.

DABUS, an acronym for "device for the autonomous bootstrapping of unified sentience" was created by DR. Stephen Thaler.¹³⁹ The AI system contained an initial artificial neural network, made up of series of smaller neural networks. It has been trained with general information from various fields. The first network generates novel ideas in response to self perturbations of connection weights between neurons and component neural nets within. A second critic artificial neural network monitors the first neural network for new ideas and identifies those ideas that are sufficiently novel compared to the machine's pre existing knowledge base.¹⁴⁰ The critic net also generates an effective response that in turn injects/retracts

139 [HTTP://ARTIFICIALINVENTOR.COM/SHOULDŌANŌAIŌSYSTEMŌBEŌCREDITEDŌASŌANŌINVENTORŌROBERTŌJEH](http://artificialinventor.com/shouldoanaiosystemobecreditedoasanoinventororobertojeh)

140 [HTTP://ARTIFICIALINVENTOR.COM/PATENTŌAPPLICATIONS/](http://artificialinventor.com/patentŌapplications/)

perturbations to selectively form and ripen ideas having the most novelty, utility, or value. In the case of the instant inventions, the machine only received training in general knowledge in the field and proceeded independently to conceive the idea of the invention as claimed by Thaler.

Thaler used words and images to train the machine to produce outputs. Thaler claims that he may have built DABUS, but DABUS generated the idea of creating the light and the food containers all by itself. Moreover, he adds that he has no skill in this fields and he would not have been able to generate the ideas by himself. Hence, when he applied for patent, he named the machine as the inventor and not himself. The patent applications were filed by a team led by Ryan Abbott.

The Invention Machine:

Abbott's second example of creative machine is the GP based invention machine. According to Abbott, the USPTO granted patent on an invention which was invented by that machine developed by John Koza.¹⁴¹ The invention machine developed by John Koza is based on GP system. Abbott claims that the machine has invented the claimed inventions.¹⁴² However these are very argumentative and empty allegations.

First of all, GP is an old concept by Alan Turing from 1950's.¹⁴³ There are multiple machines developed by GP. 'Invention Machine' is a title used by Koza to explain a technology which is applied in generating new solutions to technical problems.¹⁴⁴ Koza insists that he is the inventor of the machine and the invention created by it. Although evidence of prior work on this technology can be found dating back to 1950s.

141 US6847851B1 APPARATUS FOR IMPROVED GENERAL PURPOSE PID AND NON PID CONTROLLERS GOOGLE PATENTS. [ONLINE] PATENTS.GOOGLE.COM. AVAILABLE AT: <[HTTPS://PATENTS.GOOGLE.COM/PATENT/US6847851](https://patents.google.com/patent/US6847851)> [ACCESSED 20 JULY 2020].

142 ABBOTT, R., 2016. I THINK, THEREFORE I INVENT: CREATIVE COMPUTERS AND THE FUTURE OF PATENT LAW. SSRN ELECTRONIC JOURNAL, [ONLINE] AVAILABLE AT: <[HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=2727884](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884)> [ACCESSED 4 NOVEMBER 2019].

143 GENETIC PROGRAMMING AND EVOLVABLE MACHINES. NETHERLANDS: KLUWER ACADEMIC PUBLISHERS, 2000. PRINT.

144 GENETIC PROGRAMMING.COM. 2020. GENETIC PROGRAMMING.COM HOME PAGE. [ONLINE] AVAILABLE AT: <[HTTP://WWW.GENETIC PROGRAMMING.COM/INVENTIONMACHINE.HTML](http://www.genetic-programming.com/inventionmachine.html)> [ACCESSED 20 JULY 2020].

Moreover, even if Abbott argues that the USPTO granted patent on the machine's outcome, it was never named as an inventor. The patent actually named John Koza along with two other individuals as inventors, neither of whom appears to be a computer.

4.1 AI Inventor Advocators

The patent applications naming the machine as an inventor were filed by a team led by Ryan Abbott. According to Abbott, as AI is functionally inventing it should be listed as an inventor. Moreover, he adds allowing machines to be named inventors would encourage more development into inventive machines. Therefore, more developers and programmer will be encouraged to develop this type of autonomous AI.

In Abbott's opinion allowing a person to be listed as an inventor instead of an AI in an invention generated by it, would not be unfair to an AI as it has no interest in being acknowledged. However, allowing people to take credit for the work they have not done would devalue human inventorship. It would put the work of someone who merely asks an AI to solve a problem on an equal footing with someone who is legitimately inventing something new.¹⁴⁵

Abbott states that the machine must get its due credit. Even when an inventor does not own a patent, law requiring a natural person to be listed as an inventor ensures that people receive due credit. "However, these laws were created without regard to the future possibility of inventive activity by machines" says Abbott.

Moreover, he insists as there is no law where it says that a machine can be inventor, it should be made. Most jurisdictions require patent applications to disclose an inventor

¹⁴⁵ ABBOTT, R., 2016. I THINK, THEREFORE I INVENT: CREATIVE COMPUTERS AND THE FUTURE OF PATENT LAW. SSRN ELECTRONIC JOURNAL, [ONLINE] AVAILABLE AT: <[HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=2727884](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884)> [ACCESSED 4 NOVEMBER 2019].

who is a natural person. This requirement is designed to protect and acknowledge the rights of human inventors but not the machine.

However, Ryan Abbott is not against of human ownership. In his opinion AI should not own a patent but the person who owns the AI should own the patent. He states that it is unnecessary and costly to change the laws to make an AI legal person and own property. He states that AI should be named inventor and the owner of the AI should be the owner of the patent.

According to Abbott, an AI can be treated as an employee and then the AI can transfer the right to the maker Thaler. He is making this claim based on his idea that most inventors do not necessarily own their patents and it is owned by others such as employers. Ownership right can be transferred from an employee to an employer by contract or other legal means. In many national jurisdictions, ownership is automatically bestowed upon the employer if an invention is made within the scope of employment.¹⁴⁶ Ryan Abbott argues that an AI's owner should own the patent because his AI is generating the work.

The main claim that the AI inventor team is making that there is no human contribution in the invention. The machine only received general training and Thaler has no idea about the subject matter of the invention. The machine independently conceived idea of a novel, useful, patentable subject matter.¹⁴⁷ However, if this is the case then any mouse, monkey, yeast, monkey or camera used in the inventive process could become inventors if they made the invention possible.

4.2 Reasoning of the Patent offices

The EPO has denied the European patent application designating an AI as an inventor. The EPO stated that “they do not meet the requirement of the European Patent Convention

¹⁴⁶ [HTTPS://WWW.WIPO.INT/WIPO_MAGAZINE/EN/2019/06/ARTICLE_0002.HTML](https://www.wipo.int/wipo_magazine/en/2019/06/article_0002.html)

¹⁴⁷ ABBOTT, R., 2016. I THINK, THEREFORE I INVENT: CREATIVE COMPUTERS AND THE FUTURE OF PATENT LAW. SSRN ELECTRONIC JOURNAL, [ONLINE] AVAILABLE AT: <[HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=2727884](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884)> [ACCESSED 4 NOVEMBER 2019].

(EPC) that an inventor designated in the application has to be a human being, not a machine.” The refusal refers to Article 81 and Rule 19 of the EPC. Article 81 of the EPC states: “The European patent application shall designate the inventor. If the applicant is not the inventor or is not the sole inventor, the designation shall contain a statement indicating the origin of the right to the European patent”.¹⁴⁸ Rule 19 concerns the designation of the inventor. Neither specifically addresses the possibility of a nonhuman inventor. The EPO was not satisfied with Thalers answer on how he derived the right to the invention from the AI and why he is applying on behalf of a machine.

Thalers team argued that no patent office ever examines who is designated as an inventor in the patent application. Moreover, it is not a requirement for patent applications to answer how the inventor derived the right from the invention. The team behind the AI inventorship have always maintained that the AI made the invention but as it cannot own rights, the owner of the machine should be the owner of the rights. Thaler derived the right to own the invention from owning the machine. When this claim became ineffective in the court, Thaler then tried to argue with the court that he derived the right to invention as an employer. This was also not sufficient to prove his arguments as a machine cannot be employed.¹⁴⁹ However, it was noted in the preliminary opinion: "machines do not have legal personality and cannot own property, a machine cannot own rights to an invention and cannot transfer them within a employment relationship as proposed by the applicant or by succession as suggested by the applicant".

The EPO rejected the application because it did not meet the requirements for inventorship under the European Patent Convention (EPC). The office published its reasons for the decision on 29th January 2020, stating that the EPC was written with the clear legislative understanding that the inventor is always a natural person. Giving the machine a name is also immaterial, the EPO stated that “names given to things may not be equated with names of natural persons. Things have no rights which a name

148 OFFICE, E., 2020. EPO PUBLISHES GROUNDS FOR ITS DECISION TO REFUSE TWO PATENT APPLICATIONS NAMING A MACHINE AS INVENTOR. [ONLINE] EPO.ORG. AVAILABLE AT: <[HTTPS://WWW.EPO.ORG/NEWS_EVENTS/NEWS/2020/20200128.HTML](https://www.epo.org/news_events/news/2020/20200128.html)> [ACCESSED 20 JULY 2020].

149 HUGHES, R., 2019. EPO REFUSES "AI INVENTOR" APPLICATIONS IN SHORT ORDER AI INVENTOR TEAM INTEND TO APPEAL. [ONLINE] THE IPKAT. AVAILABLE AT: <[HTTP://IPKITTEN.BLOGSPOT.COM/2019/12/EIPO-REFUSES-AI-INVENTOR-APPLICATIONS-IN.HTML](http://ipkitten.blogspot.com/2019/12/eipo-refuses-ai-inventor-applications-in.html)> [ACCESSED 20 JULY 2020].

would allow them to exercise”. The grounds of refusal also proves that EPO agrees that machines lack creative qualities and legal personality. EPO added that for machines to have a legal personality or legal rights, lawmakers would have to pass legislation specifically to this effect. The EPO concluded with stating that the inventor of Dabus, Stephen Thaler, had claimed that he was the natural successor in right to the machine but machines are not capable of assigning rights.

The UK IPO also has refused to accept the application. The Office has published a decision setting out its reasons on December 4, 2019. In the decision, the UKIPO Hearing Officer, citing sections 7 and 13 of the Patent Act 1977 and Rule 10 of the Patents Rules 2007, held that the Office accepts that DABUS created the inventions in the patent applications but that as it was a machine and not a natural person, it could not be regarded as an inventor.¹⁵⁰ Moreover, IPO added as DABUS has no rights to the inventions, it is unclear how the applicant derived the rights to the inventions from DABUS. They said “There appears to be no law that allows for the transfer of ownership of the invention from the inventor to the owner in this case, as the inventor itself cannot hold property.”¹⁵¹

The Hearing Officer further noted that while he agrees inventors other than natural persons were not contemplated when the EPC was drafted, it is settled law that an inventor cannot be a corporate body. Accordingly, since the applicant acknowledges DABUS is an AI machine and not a human, so cannot be taken to be a ‘person’ as required by the Act.¹⁵²

However, the Hearing Officer also added that the case raised an important question: given that an AI machine cannot hold property rights, in what way can it be encouraged to disseminate information about an invention? He answered that as the applicant says, inventions created by AI machines are likely to become more

150 PO.GOV.UK. 2020. UK IPO DECISION. [ONLINE] AVAILABLE AT: <[HTTPS://WWW.IPO.GOV.UK/P_CHALLENGE_DECISION_RESULTS/074119.PDF](https://www.ipo.gov.uk/p_challenge_decision_results/074119.pdf)> [ACCESSED 20 JULY 2020].

151 DECISION P 4. ID

152 DECISION P 6 ID

prevalent in the future and there is a legitimate question as to how or whether the patent system should handle such inventions. He presumes that the present system does not cater for such inventions and it was never anticipated that it would, but times have changed, and technology has moved on. It is right that this is debated more widely and that any changes to the law can be considered in the context of such a debate, and not shoehorned arbitrarily into existing legislation.¹⁵³

The UKIPO Formalities Manual was updated in October last year to say that an AI inventor is not acceptable. However, the Hearing Officer stated in the decision that this had no bearing on the decision in this case. The Hearing Officer also referenced the similar opinion of the EPO at that time.”

5. Analysis

5.1 Introduction to the problem

The AI should not be allowed to be an inventor for many reasons. In principle the inventor is deemed to be the first owner of the invention. To make an AI an inventor, courts must first allow it to have ownership rights. At present AI systems are incapable of legally owning property or owning rights. Therefore, a patent application designating AI as an inventor is likely to be denied. However, this is not the only reason to deny AI inventorship. It is not capable of taking the inventive step, which is the primary condition of being an inventor.

In the case of AI, as they currently have no rights to own property, it is arguable that the owner of the AI system is the “successor in title”¹⁵⁴ or otherwise entitled “by virtue of any enactment or rule of law”¹⁵⁵ to any inventions made by the AI system. Inventions can be preassigned, for example by someone who is hired to conduct technical research or development. Under such circumstances, it may be arguable that the applicant is not a “successor in title” but a “precursor in title” by virtue of benefiting from an assignment executed before the making of any invention. When transferring the ownership, the inventor must be either the employee or a party to a contract of the

¹⁵³ DECISION P 7 ID

¹⁵⁴ EPC AND UK PATENTS ACT 1977

¹⁵⁵ UK PATENTS ACT 1977

parent company. Nonetheless, those are both legal categories and an AI fits neither. AI is a machine and it does not have a right to have a successor or precursor or to transfer or assign rights.

However, AI should not have a legal personality. At least not yet. Making an AI a legal person will complicate the laws of ownership, contracts, liability etc. However, AI is not a human being and cannot own a property nor be employed. Even if the AI becomes a legal entity it is not capable of inventing or creating by itself. If the IP rights include machines as an inventor, it will ultimately damage the right of the creative and inventive humans.¹⁵⁶

Moreover, making a machine an inventor will complicate other areas of laws such as who will be the person skilled in the art, which is used to evaluate patentability.¹⁵⁷ This is evaluated by comparing the inventor with the person skilled in the inventive art and whether it is obvious to him or not. When comparing with a machine anything is obvious and it becomes more complicated for the human inventor to get patent protection. It is suggested that the skilled person can be person who understand the AI system and how the invention was derived from it. Moreover, there is always a human working behind the inventive AI such as inserting data, setting parameters, or combining the results.

An AI which is truly capable of inventing will be capable of thinking and understanding the prior art, finding a solution to a problem, finding a novel and inventive solution to the problem and then describing that solution in a way that is understandable to a person skilled in that art all by it self. The Oxford English Dictionary defines conception as forming or devising of an idea in the mind.¹⁵⁸ Consequently, the result or outcome is unimportant, but the actual process of forming the idea of an invention in the human mind is conception. An AI capable of being

156 DUCATO, R. AND STROWEL, A., 2019. LIMITATIONS TO TEXT AND DATA MINING AND CONSUMER EMPOWERMENT: MAKING THE CASE FOR A RIGHT TO "MACHINE LEGIBILITY". IIC INTERNATIONAL REVIEW OF INTELLECTUAL PROPERTY AND COMPETITION LAW, [ONLINE] 50(6), pp.649-684. AVAILABLE AT: <[HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=3278901](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3278901)> [ACCESSED 4 APRIL 2020].

157 ABBOTT, RYAN; EVERYTHING IS OBVIOUS 66 UCLA L. REV. 2, 23-28 (2019)

158 OXFORD ENGLISH DICTIONARY, AT (2), [HTTPS://EN.OXFORDDICTIONARIES.COM/DEFINITION/CONCEIVE](https://en.oxforddictionaries.com/definition/conceive).

inventive would have close to a human level intellect, i.e. an artificial general intelligence (AGI).¹⁵⁹ An AGI is a program developed by companies like Google DeepMind and Google Brain. Dr Thaler has, in fact, argued that his algorithm “paves the way for sentient AI since it teaches how machines may generate the equivalent of subjective feelings. It is expected to be the successor to deep learning and the key to achieving human level machine intelligence. It will be used to build highly transparent and self explanatory synthetic brains to achieve so called “Artificial General Intelligence (AGI)”.

Furthermore, the question of whether the AI should be designated as an inventor is unnecessary if ownership is always assigned to the maker of the AI. If this is the case, the AI can be treated like any other platform technology from which novel and inventive subject matter can be made. The inventor is simply the inventor of the AI. However, this cannot be applied to all case. The owner may let others to use his AI and he may not conceive the idea of the invention. Hence, he should not be allowed to own the patent as he did not contribute in the conception of the invention. An inventor should be a person who made the inventive contribution with the inventive goal in the mind.

An inventor should be a person who found out a problem and tried to solve it with the help of the AI. Similarly, when a programmer designs an AI differently to solve a problem also qualifies as an inventor. Also, a developer who develops an AI to generate specific outcome is also an inventor. Finally, the person who recognizes the output of an AI as a patentable subject matter may also qualify as an inventor. Moreover, if the AI suggests many viable options and a person selects the best outcome can also be inventor. However, this scenarios are not appropriate where the importance of an AI’s output is obvious, and no further human activity is necessary. Who can be an inventor when an AI creates and what is considered contribution in the inventive step will be discusses thoroughly in the next chapters.

¹⁵⁹ GOERTZEL, BEN. “ARTIFICIAL GENERAL INTELLIGENCE: CONCEPT, STATE OF THE ART, AND FUTURE PROSPECTS.” JOURNAL OF ARTIFICIAL GENERAL INTELLIGENCE 5.1 (2014): 1–48.

5.2 Inventorship in CII

There are no specific rules for inventors to make inventive contribution in patentable subject matters. The inventor can be characterized as the person who identifies the significance and function of the invention. The inventor may discover the invention by pure luck and then reduce it into practice and it can become an inventive conception. Here, if the invention is obvious to the person skilled in this art it cannot be regarded as inventive step.

A user can also be an inventor if he changed the AI system to produce an inventive output, added elements such as algorithms chosen by him, parameters selected by him, other designs, and inputs. When an AI system creates a patentable outcome where the maker of the AI has no part, it is not justified to make him the inventor over the user.

While comparing the inventorship requirement in different jurisdictions, it was observed that the inventor has to conceive the actual invention to be considered inventor. That means a person devising a ML system with the inventive goal in mind has conceived the claimed invention. If this is the case, then the person who devised the machine with a view to provide a solution to a problem, that person may be considered an inventor under the present inventorship law in all the jurisdictions.

In relevant jurisdiction inventors are determined as a person who is responsible, wholly or partially, for the intelligent and creative conception of the invention. The contribution in the invention making process goes beyond the financial, administrative, or mechanical concepts and is not abstract in nature. It can be of a creative nature but does not have to be inventive in the nonobvious sense. Meaning that applicable jurisdictions award patents where the inventor conceives the invention by luck rather than real inventive effort i.e. tests and he reduces the invention into practise and it is distinguishable from the state of the art. It is the inventor who

recognises the importance and function of the substance that came to their understanding by sheer luck, which may be adequate for them to be inventors.¹⁶⁰

If we apply this rationale to AI systems, the person who recognises the importance and function of the output produced by an AI system may be considered as an inventor. When it comes to a human user who uses a ML technique developed by another, the inventor is the person who tooled the AI system in a unique way in order to produce the inventive outcome i.e. the programmer of the AI system. However, under such circumstances if the user is the person who conveyed the inventive conception of the invention may be the person who geared up the machine to generate the inventive outcome, making choices relative to problems such as the choice of the algorithm utilized, the selection of parameters and the design and choice of input data. Same rationale applies even if the particular output was variable.

The ML systems and AI systems at present are not capable of being creative or inventive. Moreover, without the contribution of human, it is not able to create patentable inventions. However, these super intelligent systems can be used as a tool to create patentable inventions. These systems do not autonomously or independently produce new and useful inventions. In contrast there is always a person or group of persons working behind the inventive machine. This diverge from Ryan Abbott's argument that for many years ML and AI is independently creating patentable inventions and it is going to increase more in the future.¹⁶¹

It makes significant differences in autonomous machines, if the computer is programmed to do something or it is programmed to learn to do something. In the first case the machine can only make moves determined previously by specific programming. In the second case the machine is free to learn any strategies and make

¹⁶⁰ SHEMTOVE, NOAM; A STUDY ON INVENTORSHIP IN INVENTIONS INVOLVING AI ACTIVITY, THE EUROPEAN PATENT OFFICE, FEBRUARY 2019.

¹⁶¹ ABBOTT, RYAN; 'I THINK, THEREFORE I CREATE: CREATIVE COMPUTERS AND THE FUTURE OF PATENT LAW', BOSTON COLLEGE LAW REVIEW, VOL. 57, NO. 4, 2016. AVAILABLE AT: [HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=2727884](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884)

new moves in response to the opponents moves. Even if the machine is independent to make new moves which the human mind has not considered before, the act of the machine is not inventive. The inventive act lies in the programming of the machine. The machine is still following the orders given by the developers. A computer program becomes the world's best player as a consequence of years of programming, labour, testing, and experiences from the engineers working on it. AlphaGo or Watson wins the game because it was programmed to do so. Hence, it is not more autonomous or independent than other computers.¹⁶²

When an existing machine creates an invention, there is always a human inventor or inventors. Moreover, it is coherent with the old and present patent law. As this paper has discussed in previous chapters that any patentable invention is always derived from a human intellect, no patent will be awarded to nonhuman inventors. Current patent law only protects the human minds.

Now this paper is going to discuss the “invention machine” which Abbott claimed is inventive, in regard of inventorship. Abbott claims that the USPTO has granted patent on the machine's work.¹⁶³ However, the patent named John Koza and two others as inventors, neither of whom appears to be a machine.

The inventive machine was made based on a proportional integral derivative (PID) controllers. PID controllers are commonly used in applications for industrial process control. These applications require continuous modification in order to maintain specific results.¹⁶⁴ PID controllers are mostly used in closed loop operations of industrial automation. One common example of PID controller is automobile cruise control. A simple PID controller has three main controllers which are combined in a way that it produces a control signal. As a feedback controller, it delivers the control output at

¹⁶² EN.WIKIPEDIA.ORG. N.D. ALPHAGO. [ONLINE] AVAILABLE AT: <[HTTPS://EN.WIKIPEDIA.ORG/WIKI/ALPHAGO](https://en.wikipedia.org/wiki/AlphaGo)> [ACCESSED 20 JULY 2020].

¹⁶³ PROCESS, M., 2020. US6847851B1 APPARATUS FOR IMPROVED GENERAL PURPOSE PID AND NON PID CONTROLLERS. GOOGLE PATENTS. [ONLINE] PATENTS.GOOGLE.COM. AVAILABLE AT: <[HTTPS://PATENTS.GOOGLE.COM/PATENT/US6847851](https://patents.google.com/patent/US6847851)> [ACCESSED 20 JULY 2020].

¹⁶⁴ EN.WIKIPEDIA.ORG. 2020. PID CONTROLLER. [ONLINE] AVAILABLE AT: <[HTTPS://EN.WIKIPEDIA.ORG/WIKI/PID_CONTROLLER](https://en.wikipedia.org/wiki/PID_controller)> [ACCESSED 20 JULY 2020].

desired levels. The controller causes the system to make a quick response without going beyond its capacity and remain constant if any external disturbances occurs.

Koza developed a GP machine which modifies the value of the PID controller constraints, using a fitness measure. The machine only produces equations, based on the predetermined variables. For computer constraints the equations are then inserted into a PID controller to enhance the constraints for specific applications. PID controllers are described as: *“PID tuning is a difficult problem, even though there are only three parameters and in principle is simple to describe, because it must satisfy complex criteria within the limitations of PID control. There are accordingly various methods for loop tuning, and more sophisticated techniques are the subject of patents”*.¹⁶⁵

Koza just mixed computational powers and GP techniques in the machine to solve problems. Claim 1 of the Koza patent exemplifies the result of such a process:

“1. A proportional, integrative, and derivative (PID) controller comprising a proportional element, an integrative element, and a derivative element coupled together and responsive to a reference signal to generate a control signal in response thereto to cause a plant to generate a plant output, wherein the proportional element has a gain element with a gain being substantially equal to

$$0.72 * K_u * e^{-\frac{1.6}{K_u} + \frac{1.2}{K_u^2}} - .001234000198 * T_u - 6.117274273 * 10^{-6}$$

*where K_u is the ultimate gain of the plant and T_u is the ultimate period of the plant.”*¹⁶⁶

Everything except the equation in the invention are conventional and not novel. The equation is the ‘invention’. Moreover, the equation contains number of random

¹⁶⁵ EN.WIKIPEDIA.ORG. 2020. PID CONTROLLER. [ONLINE] AVAILABLE AT: <HTTPS://EN.WIKIPEDIA.ORG/WIKI/PID_CONTROLLER> [ACCESSED 20 JULY 2020].

¹⁶⁶ STREETER, MATTHEW & KEANE, MARTIN & KOZA, JOHN. (2002). AUTOMATIC SYNTHESIS USING GENETIC PROGRAMMING OF IMPROVED PID TUNING RULES.

constants, some of them are mentioned previously. This may not be substantial enough in the court to make the machine inventor, making it a weaker claim for the machine.

Other claims of similar equations to compute constraints in the PID controller can be found in the patent. These equations are not obvious as they do not resemble to any similarity with other recognized PID controller constraints and no person skilled in this art in general will not pursue such exceptional methods. However, that does not make the computer an inventor. It just followed orders i.e. programmer's command. It was programmed with random elements to find an equation by tests and achieve best controller performance to generate an output. Hence it is Koza who programmed the machine to generate equations which can evolve for better outcome.

The invention made by Koza using the GP machine is a "computer assisted invention" and it is not different from other conventional machine assisted or implemented inventions. Using this type of inventive machine does not contradict the fundamental nature of the human contribution. Just like any other machine, AI systems require human controller who recognizes the nature of the computer and program the computer to set constraints to generate output. By using ideal algorithms, inputs and functions, a machine can learn to solve a problem. This solution may be new, useful and be an improvement over existing art and a patentable subject matter.

However, the machine did not recognize or decided that those outputs are new, nonobvious, useful, or patentable subject matter. It was programmed to improve its performance to find a suitable solution which was predetermined by the programming. Whether the solution is new, nonobvious, useful, or patentable was determined by the programmer or the operator, making them the inventor. This is in line with the current and long established patent law principles.

The way Abbott describes the invention machine, it may give the impression that the machine invented the outcome. Koza claimed that the machine can be used to invent

but Abbott is making a machine an inventor. Moreover, till now Abbott have not demonstrated any evidence of a machine having inventive or creative capabilities like humans. It may create some confusions for someone lacking clear understanding of machine's work, but not for someone who knows how the machine works. Abbott's states in his paper that:

“If a computer scientist creates an AI to autonomously develop useful information and the AI creates a patentable result in an area not foreseen by the inventor, there would be no reason for the scientist to qualify as an inventor on the AI's result.”¹⁶⁷

The above stated statement is inaccurate for any AI at present and it is unlikely to become true in the imminent future. ML systems do not independently create innovations. AlphaGo will not spontaneously decide to play monopoly. Koza's invention machine will not design a trendy outfit. IBM's Watson is not going to write a song and decide to perform in Eurovision. Therefore, AI's can be self learning, autonomous and independent but it lacks the inventive or creative capabilities as Abbott claims.

In previous chapters it was stated that ML can help in creating inventions and there is always a human working behind the machine, taking the inventive steps and whom the current patent law is fully capable of recognising as inventors. However, it is utmost difficult to recognize the human's contribution in the CII as it is different from conventional inventive activities and not comprehensible by traditional knowledge. In order to be an inventor in CII, one has to contribute significantly in the machine's work. The inventive step lies in using the machine. I will discuss these issues in the next chapter.

5.3 Inventive Step in CII

Inventing or creating is a very human act and machines are incapable of being inventive or creative. They lack innovative qualities like thinking, imagination, creativity, reasoning or decision making. Therefore, it is impossible for a machine to

¹⁶⁷ ABBOTT, R., 2016. I THINK, THEREFORE I INVENT: CREATIVE COMPUTERS AND THE FUTURE OF PATENT LAW. SSRN ELECTRONIC JOURNAL, [ONLINE] AVAILABLE AT: <[HTTPS://PAPERS.SSRN.COM/SOL3/PAPERS.CFM?ABSTRACT_ID=2727884](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884)> [ACCESSED 4 NOVEMBER 2019].

invent. However, machines can assist or be implemented in inventive process. And the person using the machine to assist or implementing it in the inventive process is the inventor. In every patentable invention, there is always a human inventor.

ML systems can be used in many ways to invent. The most common is programming the machine and designing the algorithms differently. This is only done by programmers and person skilled in this art. Examples of this type of inventions are genetic programming in machines. AI can also be implemented in machines to solve a problem, and then the machine does its work. This is the most common type of inventions and examples are mobile phones and autonomous cars. Then there is “computer assisted inventions”. These are created entirely or in parts by ML. In the past the number of computers assisted inventions were very few, but it is increasing over time. DABUS and the invention machine both has assisted Thaler and Koza in inventing.

In all of these cases it is extremely difficult to identify the human inventors because the more they are autonomous and independent, it becomes more difficult to find the human behind the inventive process. In April 2017, Amazon CEO Jeff Bezos wrote about the differences between ML system and traditional computer program. According to Bezos:

“Over the past decades computers have broadly automated tasks that programmers could describe with clear rules and algorithms. Modern machine learning techniques now allow us to do the same for tasks where describing the precise rules is much harder.”

ML systems are not much different from traditional computer programs as it represents. Instead of coding the machine, nowadays programmers make the machine to learn and differentiate between data that is inserted in it.¹⁶⁸ Even if these machines are programmed and controlled by data inputs, they are able to make unpredictable outcomes from unconventional methods. These machines have multiple algorithms which decides how they

168 SUMMERFIELD, M., 2020. THE IMPACT OF MACHINE LEARNING ON PATENT LAW, PART 3: WHO IS THE INVENTOR OF A MACHINE ASSISTED INVENTION?. [ONLINE] BLOG.PATENTOLOGY.COM.AU. AVAILABLE AT: <[HTTPS://BLOG.PATENTOLOGY.COM.AU/2018/02/THE IMPACT OF MACHINE LEARNING ON.HTML](https://blog.patentology.com.au/2018/02/the-impact-of-machine-learning-on.html)> [ACCESSED 20 JULY 2020].

collect and generalize data but not how they deliver the outcome. Therefore, not much has changed in a machine except the use of complex algorithms in it.

In this viewpoint, this paper argues that when an invention is created by an autonomous AI, inventorship should be derived from successfully devising and utilizing a ML system in an inventive process. Moreover, an inventor should not lose inventorship because the software and the hardware in the machine were created or distributed by someone else.

5.3.1 ML Inventions

Machine learning technologies itself is an invention. Programmers and developers are behind of this type of inventions. In a conventional game there is a scoring system to determine stronger and weaker players. When the scores and player moves are inserted into a computer, by predicting probable future moves and calculating the scores of the opponent, it can develop a strategy to win the game. If the game is more complicated, then predicting future moves in a brief period of time is not possible by the machine player. Moreover, the performance of the computer is dependable on the scoring system i.e. the data. If a high score is placed on a knight in a chess game, the computer will never risk it to lose it.

The programmer programs the rules of playing the game and scores in a mathematical formula into the computer. Complicated games become complicated formulas in a computer. Instead, it can be done by using simple computational elements such as networks to change inputs into outputs. Each computational element will have one or more variable constraints. The computer is trained by finding values for all these constraints.¹⁶⁹ A trained computer then will find the best output for an input.

In the field of ML, a great deal of research is done in developing and improving the computational elements and the algorithms used in the training constraints. Inventions may

¹⁶⁹ SUMMERFIELD, M., 2020. THE IMPACT OF MACHINE LEARNING ON PATENT LAW, PART 3: WHO IS THE INVENTOR OF A MACHINE ASSISTED INVENTION?. [ONLINE] BLOG.PATENTOLOGY.COM.AU. AVAILABLE AT: <[HTTPS://BLOG.PATENTOLOGY.COM.AU/2018/02/THE-IMPACT-OF-MACHINE-LEARNING-ON.HTML](https://blog.patentology.com.au/2018/02/the-impact-of-machine-learning-on.html)> [ACCESSED 20 JULY 2020].

arise from this type of research projects and in this case the inventors are the scientists who are developing the machines.

5.3.2 Computer Implemented Inventions

More people are using the ML system than of developing or improving it. Nowadays anybody can use the ML to solve a problem and become person skilled in this art. Many aids is available to provide guidance on how to implement ML technologies and which programming language to select.¹⁷⁰

The ‘MarI/O’ machine which was programmed to play the game *Super Mario World* is a good example of a ML implemented invention. The creator SethBling used the ML technology to develop a machine which can learn how to play a game.¹⁷¹ He developed the machine and not the ML technology. His creative part lies in devising and conceiving the idea of using the ML system. Using a ML system requires unique skills, experience, and creativity, which can only be done by the person skilled in this art.

The neural network and GP used in the machine were already a common knowledge. SethBling chose specific programs, selected the constraints, designed the input data, and created a fitness equation to evaluate the outcome. He implemented all of this into a machine which is not obvious to a person skilled in the art. Moreover, the computer did not decide to play a game, nor he learned to play the game by itself, it was just programmed to do so.

5.3.3 Computer Assisted Inventions

The third type of invention resulting from ML is the computer assisted inventions. The invention machine and DABUS are examples of the ML assisted inventions. When ML

¹⁷⁰ GitHub. n.d. JOSEPHMISITI/AWESOME MACHINE LEARNING. [ONLINE] AVAILABLE AT: <[HTTPS://GITHUB.COM/JOSEPHMISITI/AWESOME MACHINE LEARNING](https://github.com/josephmisiti/awesome-machine-learning)> [ACCESSED 20 JULY 2020].

¹⁷¹ STANLEY, KENNETH; MIKKULAINEN, RISTO; ‘EVOLVING NEURAL NETWORKS THROUGH AUGMENTING TOPOLOGIES’ [PDF, 445kB] BY UNIVERSITY OF TEXAS. EVOLUTIONARY COMPUTATION, VOL. 10 NO. 2, 2002, PP 99Ö127. A VAILABLE AT: [HTTP://NN.CS.UTEXAS.EDU/DOWNLOADS/PAPERS/STANLEY.EC02.PDF](http://nn.cs.utexas.edu/downloads/papers/stanley.ec02.pdf)

technology assists in an inventive process, the output is the invention.¹⁷² Nor the ML technology or configuration of the system is the invention. Both the invention machine and DABUS are invention themselves and then used to invent other new inventions.

Difference between Marl/o and the invention machine is that the former solves gaming strategy and the later designs patentable subject matter. In both situations the creative act rests in the programming of the machine so that it can assist into creative process. The computer follows the programming rules and act accordingly to generate an output. The output can be either strategic moves to win the game or a design of a patentable subject matter.

Any inventive or creative machine can be sold or transferred to someone who have no understanding of the internal work of the machine. However, he may know how to utilize it and use it to invent or create. If this user invents a patentable subject matter, he is the owner. The maker of the machine is not the inventor because he did not contribute in the inventive process of the new invention. He made the machine and sold it to the user. Now the user is the sole owner of that version of the machine and he has the right to use it to make patentable inventions. In case of DABUS or Invention machine, it is able to modify its own output without the user's involvement because it is programmed with fitness formula. In case of Marl/O, it was able to analyse its own moves and make a strategic move based on past game data.¹⁷³ Hence, when a machine makes a patentable invention, the person behind the inventive process is the inventor. However, to be noted that in order to be a patentable subject matter the machine has to produce a technical effect which goes beyond the normal physical interactions between the program and the machine. The machine has to be a part of the inventive process and the user has to make significant changes in order to make an invention which is not obvious to other users.

172 SUMMERFIELD, M., 2020. THE IMPACT OF MACHINE LEARNING ON PATENT LAW, PART 3: WHO IS THE INVENTOR OF A MACHINE ASSISTED INVENTION?. [ONLINE] BLOG.PATENTOLOGY.COM.AU. AVAILABLE AT: <[HTTPS://BLOG.PATENTOLOGY.COM.AU/2018/02/THE IMPACT OF MACHINE LEARNING ON.HTML](https://blog.patentology.com.au/2018/02/the-impact-of-machine-learning-on.html)> [ACCESSED 20 JULY 2020].

172 GitHub. N.D. JOSEPHMISITI/AWESOME MACHINE LEARNING. [ONLINE] AVAILABLE AT: <[HTTPS://GITHUB.COM/JOSEPHMISITI/AWESOME MACHINE LEARNING](https://github.com/josephmisiti/awesome-machine-learning)> [ACCESSED 20 JULY 2020].

173 SUMMERFIELD, M., 2020. THE IMPACT OF MACHINE LEARNING ON PATENT LAW, PART 3: WHO IS THE INVENTOR OF A MACHINE ASSISTED INVENTION?. [ONLINE] BLOG.PATENTOLOGY.COM.AU. AVAILABLE AT: <[HTTPS://BLOG.PATENTOLOGY.COM.AU/2018/02/THE IMPACT OF MACHINE LEARNING ON.HTML](https://blog.patentology.com.au/2018/02/the-impact-of-machine-learning-on.html)> [ACCESSED 20 JULY 2020].

173 GitHub. N.D. JOSEPHMISITI/AWESOME MACHINE LEARNING. [ONLINE] AVAILABLE AT: <[HTTPS://GITHUB.COM/JOSEPHMISITI/AWESOME MACHINE LEARNING](https://github.com/josephmisiti/awesome-machine-learning)> [ACCESSED 20 JULY 2020].

5.4 Final Analysis

This paper's main objective was to clarify why a machine cannot be an inventor and how to identify the human inventor. Some people like Ryan Abbott has claimed that the machine are the true inventors instead of the humans. Moreover, he claims that Patent offices have granted patent on this type of inventions before which is untrue.¹⁷⁴

However, when we analysed how the ML technologies work and their limitations, we saw that machines are incapable of being inventive or creative. All existing machines are programmed to generate output constraints using specific set of mathematical formulas based on the input. This is not an inventive step rather a part of the inventive process. Moreover, to qualify as a patentable subject matter the machine has to produce a technical effect which goes beyond the general interaction between the program and the machine. The programmer used the machine and gave it the technical effect to devise the invention.

Moreover, the purpose of IP is to protect the fruits of the conscious human mind. When identifying the inventor, we have to find out the person who used their conscious mind to devise an invention. The conscious mind engages in either devising, designing, directing, or discovering the invention. Hence, in every existing ML systems it is possible to identify the human inventors. Unless or until the machine develops a conscious mind, it should not be allowed to be inventors. Making the machine an inventor is contradictory not only to current Patent Law but also to ownership and other laws relating to it. Moreover, it will demotivate the human inventors to research, work and develop in this field.

Abbott insisted that the AI should be allowed to be inventors, so that developer get motivated to develop this type of inventive AI's. In reality, it is the opposite. Making a machine an inventor will bar the humans from getting credits for their labour in making the invention. Abbott's assertions undercut his argument. Crediting the AI instead of the humans will demotivate the programmers to develop this type of machines.

¹⁷⁴ Abbott, Ryan; I Think, Therefore I Invent: Creative Computers and the Future of Patent Law', *Boston College Law Review*, Vol. 57, No. 4, 2016, Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2727884

Blok argues that patent law cannot and should not be interpreted in a way that allows AI systems to have the same position in patent law that human inventors have. Human input is inevitable in the inventive process, whether that is through selecting a specific AI application or creating a specific algorithm to solve a technical problem. Therefore, he argues that AI systems are and should be treated as tools of inventors and skilled persons, instead of autonomous machines.¹⁷⁵

Conclusion:

Machine assists, human invents. Machines are not inventors and they should not be allowed to be inventors. Even those machines such as Thaler's "Creativity machine", or Koza's "Invention machine" are far smarter, autonomous and independent than other computers or machines, they are not the inventors. Nonetheless, Koza's work demonstrates that computers can be programmed to generate solutions to problems that were devised through conventional processes of human thought and ingenuity, that would potentially be regarded as patentable inventions. However, this does not mean that the programmed computer should be regarded as inventor. It means that computers can be programmed to efficiently search a well defined solution space within a narrow field, using algorithms and parameters devised by human designers, by learning patterns based upon past performance. This is neither creative nor inventive on the part of the computer unless it is redefined 'creativity' and 'invention' by reference purely to the end result, rather than the process by which the result is achieved. This redefinition is what makes Abbott to argue that machines are capable of inventing.

However, Abbott's paper contains no credible, objective, independent evidence for "computational invention". Indeed, Abbott's arguments in support of this concept not only rely on self interest and subjective claims, but merely beg the question. It can hardly be possible to identify machine creativity or inventiveness in the absence of meaningful working definitions of these terms. These are matters that philosophers

¹⁷⁵Blok, P., 'The inventor's new tool: artificial intelligence — how does it fit in the European patent system?', *European Intellectual Property Review*, Vol. 39, No 2, 2017, pp.69-73.

have sought to address for literally millennia. As philosophy professor John R Searle wrote:

*“...the prospect of super intelligent computers rising up and killing us, all by themselves, is not a real danger. Such entities have, literally speaking, no intelligence, no motivation, no autonomy, and no agency. We design them to behave as if they had certain sorts of psychology, but there is no psychological reality to the corresponding processes or behaviour”.*¹⁷⁶

The same can be said of computers engaging in creative or inventive activity. What we observe is a behaviour that superficially mimics invention, although none of the psychological characteristics of human creativity or inventiveness is present. With such strong development in the fields of AI and machine learning, it is clear that DABUS or Invention machine will not be the only cases claiming AI inventorship, and the interpretation of inventorship will need to be resolved in the courts in very near future. As AI software becomes super software, incredibly powerful and versatile, the challenges for the patent system will likewise significantly increase. Cases such as this help us to realize these changes and ensure that AI and its impact on patents and patentability continues to be dealt with systematically and in line with the laws and needs of stakeholders. Only by doing so can our system provide the stability and predictability that the industry needs for its business models, and further support economic growth of Innovation.

¹⁷⁶ https://www.nybooks.com/articles/2014/10/09/what_your_computer_cant_know/