# CHAPTER 6 AI and IPR Infringement: A Case Study on Training and Using Neural Networks

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## §6.01 Introduction

This chapter examines whether and under what conditions using the data of third parties to develop artificial intelligence (AI) applications could infringe upon intellectual property rights (IP rights, IPR). It focuses on the use of machine learning technology, particularly neural networks (NN) that can be trained to carry out tasks. To develop AI applications based on neural networks trained with data, access to and authorization to use data[1] suitable for the training are required. For instance, to train a neural network to recognize different species of dog, labelled images of dogs of different species are needed. Since data may be protected by IPRs or other rights, authorization from right holders could be required if using the data would otherwise constitute infringement. At the same time, however, it is not clear if training a neural network (or subsequently using a trained neural network) falls within the scope of the exclusive rights of IP holders, such as, for instance, the right to reproduce works or the right to use patented inventions. This chapter sheds light on the question of whether the training of NNs falls within the scope of the exclusive rights of European copyright, patent, and other IP rights. Its main focus is on whether the computational processes involved in training NNs and using trained NNs could constitute direct infringement in themselves. This is an issue that raises legal questions unique to the computational processes involved in NNs; direct and indirect infringement resulting from the use of NNs to produce goods or services is not subject to such fundamental uncertainty over the applicability of exclusive rights.[2] The chapter contributes to legal scholarship by raising this

[1] In this chapter, we do not define 'data' or 'artificial intelligence' but use these terms as they are defined in, for instance, Chs 4 and 7 of this book.
[2] This chapter examines the situations in which these computational processes could constitute direct infringement, which raises novel legal issues specific to the technology. These issues arise because these processes alone could infringe upon exclusive rights, but it is unclear whether they

novel question and offering some preliminary avenues for resolving the issue in the key fields of IP law.

## §6.02 Neural Networks: Technology and the Role of Data in Their Development

Much of the current work in the field of AI, including image and voice recognition and automated vehicles, relies on NNs.[3] An advantage of neural networks is that humans need not determine specific instructions on what a computer should do: an NN can learn from data how to carry out a desired task.[4] For instance, in the field of image recognition, images of dogs could be used to train an NN to recognize whether an image fed to it contains a dog.[5] It would be extremely difficult to achieve this functionality by creating rules as there can be various kinds of dogs, represented differently in images. Similarly, images of dogs could be used to train a network to autonomously produce new pictures of dogs.[6]

An NN is a system of interconnected neurons, each of which processes information it receives from the inputs of the network or of other neurons. When data is fed into the system, it processes this data and produces outputs. Different NN designs serve different functions. For example, a deep NN is a type of neural network that has one or more hidden layers of neurons between its input and output layers. Deep NN is, in principle, capable of very complex and advanced tasks. For this reason deep NN are the basis of many of the current AI applications. However, practical

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fall within the scope of existing exclusive rights. Additionally, the subsequent use of trained neural networks could also result in direct infringement or indirect infringement, but these issues are fundamentally less unclear. For instance, manufacturing a patented product would constitute infringement, regardless of whether neural networks were used in the process, and offering a trained neural network that facilitates the infringement of a patent could undoubtedly constitute indirect infringement.

[3] *See*, for example, Ian Goodfellow, Yoshua Bengio & Aaron Courville, *Deep Learning* Ch. 12 (2016); An excellent non-technical explanation is provided in Ch. 5 of *Elements of AI*, https://course.elementsofai.com (accessed May 2019).

[4] *Id.*

[5] *See*, for example, Kirill Panarin, *Dog Breed Classification using Deep Learning: Hands-On Approach*, https://towardsdatascience.com/dog-breed-classification-hands-on-approach-b5e4f88c333e (accessed 8 May 2019).

[6] *See*, for example, Kyle Wiggers, *DeepMind AI can Generate Convincing Photos of Burgers, Dogs, and Butterflies*, https://venturebeat.com/2018/10/02/deepmind-ai-can-generate-convincing-photos-of-burgers-dogs-and-butterflies/ (accessed 9 May 2019).

uses of deep neural networks are limited by the computational resources, algorithms and training data available.[7] For instance, complicated AI applications requiring complex and vast neural networks could require so extensive computational resources that developing them may be technically or commercially impossible.

Data serves an essential role in training NNs. The process of training an NN with data essentially involves feeding data into the NN, which processes it, and adjusting the parameters of the NN based on the outputs produced. Following multiple rounds of training, the desired level of performance may be achieved. For example, a NN may through this kind of trial and error, trying to recognize images and modifying the parameters, learn to recognize if an image contains a dog. Once trained, the NN produces outputs that are based on the inputs fed into and processed by the network, such as whether a dog is represented by an image fed into the NN.[8]

## §6.03 Infringement in the Training and Use of Neural Networks

The computational processes involved in the training and use of NNs are relevant from the perspective of IP infringement. In particular, as previously mentioned, training an NN with third-party data could infringe upon IPRs. For instance, in the example mentioned above, the images of dogs could be protected by copyright that could be infringed upon in the process of training the NN when copies of the images of dogs were reproduced when collecting the images and feeding them into the NN. However, it is not clear whether and to what extent the computational processes that take place when training NNs or using trained NNs fall within the scope of the exclusive rights of IPR holders. While these computational processes do not correspond directly to any of the exclusive rights granted to IPR holders, they may still involve using, making, or reproducing protected subject matter, all actions covered by the exclusive rights granted by different IPR. In addition, these computational processes could also involve the unlawful use or acquisition of trade secrets (which are often used to protect data). This section examines whether and to what extent the training and use of NNs could involve activities that infringe on the most relevant IP rights and other rights within the European framework.[9]

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[7] For more on the construction, types, and capabilities of NNs, *see*, for example, Goodfellow, Bengjo & Courville, *supra* n. 3, Chs 6-12; *Elements of AI*, *supra* n. 3, Ch. 5.
[8] *See*, for example, *Elements of AI*, *supra* n. 3, Ch. 5.II.
[9] As mentioned above, it should be noted that if a neural network is used to, for instance, manufacture physical products that incorporate a protected design or bear a trademark, these

## [A] Copyright

### *[1] The Infringement of Exclusive Rights in Works in the EU*

Copyright protects original works of intellectual labour. Copyright gives rise to both moral and economic exclusive rights; the focus of this chapter is on the latter. In the EU, the standards for direct copyright infringement have been harmonized through various directives that require EU Member States to provide certain exclusive rights to authors, and permit or require Member States to adopt specific exceptions and limitations to those rights.[10] The EU and its Member States are also contracting parties to the Trade-Related Aspects of Intellectual Property Rights agreement (TRIPS),[11] which incorporates the Berne Convention[12] and requires that contracting parties grant a set of exclusive IP rights, to which exceptions and limitations are permitted under certain conditions.[13]

The national laws of EU Member States provide exclusive rights to authors, as required by the EU Directives and international obligations noted above. The most relevant exclusive right in the context of the training and use of NNs is the right of reproduction. While the digital copying of protected works could frequently take place in the course of the digital processes involved in training and using NNs, these processes do not require the communication or distribution of such copies to the public.

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activities can of course infringe upon third-party design or trademark rights. The focus of this chapter is entirely on the digital processes of training and using neural networks, not their later application in other contexts.

[10] Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the Harmonization of Certain Aspects of Copyright and Related Rights in the Information Society (22 June 2001), OJ L 167/10 (InfoSoc Directive), Art. 5; Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the Legal Protection of Databases (27 March 1996), OJ L 77/20 (Database Directive), Art. 6; Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the Legal Protection of Computer Programs Art. (23 Apr. 2009), OJ L111/16 (Computer Programs Directive), Art. 5.

[11] Agreement on Trade-Related Aspects of Intellectual Property Rights (15 Apr. 1994), 1869 U.N.T.S 3 (TRIPS).

[12] Berne Convention for the Protection of Literary and Artistic Works, 9 Sept. 1886, as revised at Paris on 24 Jul. 1971 and amended on 28 Sept. 1979 (28 Sept. 1979), S. Treaty Doc. No. 99-27 (1986).

[13] TRIPS, *supra* n. 11, Art. 9(1) incorporates the Berne Convention.

The right of reproduction covers the permanent and temporary reproduction of works or their parts, in any form and by any means.[14] To qualify as an infringing reproduction, a copy must be derived from the protected work, regardless of the intent of the person who copied it; the independent creation of a similar work does not qualify. A copy must also be 'substantially' similar to the protected aspects of a work (expression of the intellectual creation of the author of the work) it reproduces in order for it to count as infringing.[15]

### *[2] Direct Infringement in the Training and Use of Neural Networks*

When NNs are trained using copyright-protected works, the question arises whether the exclusive rights of authors could be infringed on by the computational processes involved in training an NN or in using it once it is trained. There is no exclusive right that covers the use of data *per se*, and works can be lawfully used as long as this does not infringe on any exclusive rights.[16] Moreover, use of a work protected by exclusive rights can only be considered infringing to the extent that it falls within the scope of protection afforded to the work. For instance, simply using information about a work (e.g., the length of a song in seconds) might not fall within the protected subject matter of, or the scope of protection afforded to, that work. As such, the use of that information to model, for instance, trends in the length of songs might not be protected by any exclusive right at all.[17]

Using copyright-protected works to develop and train NNs could, however, involve conduct that falls within the scope of the exclusive rights of copyright holders. The exclusive right most likely to be infringed by the training and use of NNs is the right of reproduction, as noted above.[18] This is because when NNs are trained using copyright-protected data, digital

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[14] An exclusive right to reproduction is required by the InfoSoc Directive, *supra* n. 10, Art. 2; the Database Directive, *supra* n. 10, Art. 5; the Computer Programs Directive, *supra* n. 10, Art. 4 and the Berne Convention, *supra* n. 12, Art. 9.

[15] *See*, for example, Case C-5/08 *Infopaq International A/S v. Danske Dagbaldes Forening* ECLI:EU:C:2009:465, 24.

[16] For a thorough analysis of the role of exclusive rights in data, *see* Ch. 7 of this book.

[17] *See*, for example, the dispute (settled between parties) that arose in relation to the alleged infringement of John Cage's song '4′33″' by Michael Batt's piece 'A One Minute Silence': Jeremy, *The Price of Silence and the Myth of the Batt Cage*, http://ipkitten.blogspot.com/2012/04/price-of-silence-and-myth-of-batt-cage.html (accessed 8 May 2019).

[18] For an overview of stages at which infringing reproduction may take place, *see* Benjamin L. W. Sobel, *Artificial Intelligence's Fair Use Crisis*, 41 Colum. J.L. & Arts 45, 61-66 (2017).

reproduction of the data is often required in the random access memory, hard drives, central processing units or specialized microprocessors designed for neural network technologies.

The reproduction can take place at various stages of training and using NNs. First, when collecting and preparing data (e.g., a dataset containing images of dogs) for the purpose of training an NN, digital copies of the data likely need to be made. For example, compiling images of dogs on a hard drive inevitably requires copies to be made of the images. There is no doubt that digital copying of entire works, in identical form, in the training data can infringe upon the right of reproduction.

Second, the computational processes that take place within an NN might also lead to the reproduction of copyright-protected aspects of training data. For example, when training an NN with the images of dogs, copyright-infringing reproductions may be produced when the works are fed into the neural network, as part of a computational process within the neural network, or by the outputs that the NN produces. For example, if a trained NN produces images of dogs that are identical or substantially similar to copyright-protected aspects of the dog images used in training the NN, infringing reproduction can take place. This is not inevitable, however; whether or not protected elements are reproduced depends on the design of the NN. An NN that simply determines whether a given image represents a dog, for example, would be unlikely to produce any infringing output, although it is possible that infringing copies could be produced within the neural network itself as part of a computational process. Evidently, analysis of whether the information reproduced by an NN is substantially similar to protected aspects of the works with which it was trained (e.g. their original expression) is required.

Clearly, reproduction could take place at various points in the training and use of NNs trained with copyright-protected material. Therefore, unless an exception or limitation applies to these activities, copyright infringement may occur if they are carried out without the consent of copyright holders. There are no exceptions or limitations in EU copyright legislation that specifically cover the commercial training or use of trained NNs. Few exceptions or limitations that EU copyright legislation allow EU Member States to adopt apply to commercial activities, except in the case of certain specific activities related to the reproduction of works in the context

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Similarly, related rights or *sui generis* rights may be infringed due to exclusive rights being infringed as the result of reproduction or similar conduct, such as the extraction of data from, or the reuse of, a protected database.

of, for instance, journalism.[19] This means that neural network development activities carried out commercially only rarely benefit from exceptions to the exclusive rights. In some situations, however, temporary copies made in the course of a technological process could meet the conditions for the mandatory exception that all EU Member States have to provide for on temporary copying.[20] Moreover, two exceptions for text and data mining has just been adopted as part of the Directive on Copyright in the Digital Single Market.[21] These exceptions could apply to neural network training to the extent that the neural network training constitutes data or text mining and, in the case of commercial activities, provided that the rightsholder has not reserved this right to itself.[22]

## [B] Patents

### *[1] Patent Infringement in the EU*

The European patent system is a complex, multilevel framework consisting of both national and regional patent bodies. One of the major European patent frameworks is based on the European Patent Convention (EPC),[23] which entered into force on 7 October 1977 and established the European Patent Organization (EPO), as well as substantively harmonizing European patent law. The main shortcoming of the EPC is that it harmonizes patent law only at the procedural, pre-

[19] *See* InfoSoc Directive, *supra* n. 10, Art. 5(3)(c), which states that Member States may provide for exceptions or limitations to the reproduction right and the right of communication to the public in the following cases: 'reproduction by the press, communication to the public or making available of published articles on current economic, political or religious topics or of broadcast works or other subject matter of the same character, in cases where such use is not expressly reserved, and as long as the source, including the author's name, is indicated, or use of works or other subject matter in connection with the reporting of current events, to the extent justified by the informatory purpose and as long as the source, including the author's name, is indicated, unless this turns out to be impossible'.

[20] InfoSoc Directive, *supra* n. 10, Art. 5(1).

[21] Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC (17 May 2019), OJ L 130/92. Article 3 of the Directive provides for an exception concerning reproductions in text and data mining for scientific purposes and Article 4 for a more limited exception on reproductions generally in text and data mining. Both exceptions are mandatory for EU Member States to adopt.

[22] Article 4(3) of the Directive, *Id.*, precludes the application of the exception in Article 4(1) where the rightholder has expressly reserved this kind of use in an appropriate manner.

[23] Convention on the Grant of European Patents (5 Oct. 1973), 13 I.L.M 268 (European Patent Convention).

grant stage, while post-grant litigation related to patent rights falls within the purview of national patent laws. Despite this state of affairs, the Convention for the European Patent for the Common Market, also known as the Community Patent Convention (CPC), though it never entered into force, succeeded in providing some concrete tools for harmonizing European patent laws. As a result, the rules on patent infringement across EU Member States very much resemble one another. More recently, harmonization efforts have contributed to the creation of a new unitary patent (UP) and unified patent court (UPC) within the EU, also known as the 'EU Unitary Patent Package', an agreement signed by twenty-five EU Member States in February 2013. Even though there are several steps remaining, as well as some important details to be finalized, before the new system can come into effect, the final agreement on this patent regime represents a highly valuable achievement.[24]

Both the CPC and UPC agreements recognise two types of patent infringement and two different kinds of liability: direct infringement, giving rise to 'strict' liability under patent law, and indirect infringement, which gives rise to what is usually called 'secondary' liability. This chapter focuses only on direct infringement and, as such, on what is often called 'absolute' liability.[25]

Direct infringement is the most basic type of patent infringement recognised by statutes and arises when someone makes, uses, sells, offers to sell, or imports a patented invention without authorization. Although the wordings of the different national patent laws in Europe are not identical, they very much resemble Article 25 of the CPC (originally Article 29)[26] and Article 25 of the UPC.[27] Generally speaking, direct infringement involves the entirety of a patented invention, including the creation of products equivalent to the patented invention. Another aspect of strict liability that is worth noting is the fact that it includes little room for subjective judgement on the nature of an infringement. Accordingly, little importance is given to who (e.g., a third party), why, and how a patented invention was replicated. Although subjective considerations such as intention might affect the type of remedy sought, an activity can be found

[24] For up-to-date information about the project, *see*: Unified Patent Court, *About the Unified Patent Court*, https://www.unified-patent-court.org/about (accessed 8 May 2019).
[25] *See*, for example, *Merrell Dow Pharmaceuticals Inc. v. H.N. Norton & Co. Ltd.*, 113 R.P.C. 76, 92 (1996).
[26] 89/695/EEC Agreement Relating to Community Patents - Done at Luxembourg on 15 December 1989 (30 Dec. 1989), OJ L 401/1.
[27] Agreement on a Unified Patent Court (20 June 2013), OJ C 175/1 (UPC Agreement).

to be infringing regardless of whether the infringer had actual or constructive knowledge of the existence of a patent.

As regards the scope of protection, patent infringement falls into two categories: literal infringement, which occurs when each element recited in a patent's claims corresponds identically to the allegedly infringing device or process, and non-literal infringement, under the doctrine of equivalents, which is when an infringing device or process is equivalent to a claimed invention (although it does not fall within the literal scope of its claims). There are differences between the standards that have been developed in different European countries in relation to the application of the doctrine of equivalents, especially between Germany[28] and the UK,[29] although various attempts at harmonization have been made[30].

The general rule is that the patent holder must prove that infringement has taken place, with the only exception being when the burden of proof is reversed.[31] The applicable standards, the burden of proof, and the tests applied when deciding patent disputes are mainly governed by national law.

## *[2] Direct Patent Infringement in the Training and Use of Neural Networks*

The digital processes that take place when training or using a trained neural network could directly infringe on product or process patents. In the context of direct patent infringement, most European jurisdictions generally distinguish between 'making' a product and 'using' a process. We first analyse the possibility that neural network training or use could involve the use of

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[28] *See*, for example, the Formstein defence; *see also* the decisions in Bundesgerichtshof Urteil vom 03.10.1989, Az.: X ZR 33/88 'Batteriekastenschnur'; Bundesgerichtshof Urteil vom 12.03.2002, X ZR 168/00 'Schneidmesser I', OLG Karlsruhe, lexetius.com/2002,244 (accessed 9 May 2019).

[29] *See Catnic Components Ltd. v. Hill & Smith Ltd.*, 99 R.P.C. 183 (1982); *Kirin-Amgen, Inc. v. Hoechst Marion Roussel Ltd.*, 122 R.P.C. 169 (2004); *Actavis UK Ltd. v. Eli Lilly and Co.*, 134 R.P.C. 957 (2017).

[30] *See* WIPO, *Text of the Basic Proposal for the Treaty and the Regulations as Submitted to the Diplomatic Conference for the Conclusion of a Treaty Supplementing the Paris Convention as far as Patents are Concerned, The Hague* (3-28 June 1991), Art. 21(2); European Patent Convention, *supra* n. 23, Art. 69. For more details about the doctrine of equivalents in Europe, *see* Marcus Norrgård, *Patentin loukkaus* (2009); Michael N. Meller (ed.), *International Patent Litigation: A Country-by-Country Analysis* (2014); Willem A. Hoyng & Frank Eijsvogels (eds), *Global Patent Litigation: Strategy and Practice* (2015).

[31] *See*, for example, Lilla Farkas & Orlagh O'Farrell, *Reversing the Burden of Proof: Practical Dilemmas at the European and National Level - Study* (2015).

patented processes and then consider the possibility that it could involve digitally making patented products.

The case law on the direct infringement of process patents within Europe is quite scarce and infringement proceedings are dealt with under national law. However, most European jurisdictions treat the direct infringement of process patents in similar ways and agree that a process patent is infringed when someone: (1) uses the protected process or offers it for use (the 'right to use' is the right to stop others from performing the patented process or offering the process for use) in the territory where the process is protected when he/she knows, or it would be obvious to a reasonable person in the circumstances, that its use without the consent of the patent holder would be an infringement of the patent; or (2) disposes of, uses, or imports any product obtained directly by means of the protected process.[32]

Training an NN with data created by using a patented method could raise questions about infringing on the protected method or process by using it.[33] For example, imagine a patented method for processing images based on an image-sharpening algorithm. In principle, it might be possible to train an NN using unprocessed images and images processed using the patented method as training data. Once trained, the NN might be able to replicate the results of the patented process such that there was little practical difference between processing an image using the patented method or using the trained NN.

As a result, the trained network might be able to imitate the patented method in a manner that for all intents and purposes provided the same results as the patented method itself. However, it could still be difficult to establish whether using the NN would fall within the scope of the patent's claims. The challenges associated with this are twofold. First, there could be fundamental uncertainty over whether the NN was carrying out operations that were either the same as or very similar to those covered by the patent claims, such that they constituted either literal or equivalent infringement. It could be argued that if the NN consistently produced the same results as, and was trained with the help of, the patented method, it could at least be

[32] *See*, for example, UK Patents Act 1977, ss 60(1) and 60 (2); German Patent Act (as amended up to Act of October 8, 2017), s. 9; Finnish Patent Act (550/1967, as amended), s. 3.

[33] In a similar manner, a product patent could be infringed on through use of the patented product. However, this would require the protected product to be used as part of the infringing conduct. For example, where the claimed product is a computer, infringing conduct could occur if a neural network was used on the computer.

capable of infringing by carrying out equivalent steps to those involved in the patented process. If the only way to achieve the results the NN produced was through the patented method, it would be difficult to deny that, fundamentally, the NN functioned in the same way as the patented method, albeit in a potentially unobservable manner.

Whether this kind of similarity is enough to fall within the scope of the patent claims is the next question. Even if literal infringement might be avoided if the NN merely approximated the patented method, it could still infringe according to the doctrine of equivalents. Replacing one or more elements of a patented method with an NN carrying out comparable functions, for instance, could arguably constitute infringement by equivalence. As a simple illustration, imagine a patented process that only contains one computational element; if the same process were carried out by replacing the computational element with an NN that produced identical results, the process could (in theory) infringe on the patent in a non-literal manner. It should be noted, however, that this issue does not yet appear to have been decided in the courts.

Second, since it can be difficult both to prove and to disprove that infringement has occurred, the evaluation of evidence and the standard of proof would raise challenges.[34] Both parties in the infringement dispute would possess information, however: the developer of the NN would have information on its design, while the patent holder might be able to test the NN's operations. The availability of this information would mean that the patent holder might be able to carry out experiments with the NN: if the NN consistently produced similar results to the patented method, this could indicate that the NN might have been specifically designed to approximate the patented method. Identical results could be considered sufficient to shift the burden of proof from the patent holder to the alleged infringer, who could then be required to establish that the same results were produced using a different method to the patent-protected one. If the alleged infringer were able to establish that the design, training, or results of the NN differed from the patented method, this could be sufficient to rebut the charge of infringement entirely. However, if it transpired that the NN was specifically designed and trained to imitate a patented method, the burden of proof for infringement could be considered met, unless the alleged infringer could establish that the NN nonetheless operated in a different manner to the patented process. This

[34] *See* UPC Agreement, *supra* n. 27, Arts 54 and 55; in the UK, *see also* UK Patents Act, *supra* n. 32, s. 60(1)(c); in Germany, *see* § 138(3) Zivilprozessordnung (ZPO) 1950 (German Code of Civil Procedure); in Finland, *see* the Finnish Code of Judicial Procedure Ch. 17, s. 2 (1734).

approach would be somewhat similar to the reversed burden of proof applicable in cases of products produced using patented processes.[35] In both situations, the relevant information is possessed by the alleged infringer and the burden of proof is shifted to the alleged infringer to address this informational imbalance. Again, though, this suggested line of reasoning does not yet appear to have been addressed by the courts.

It could be argued that the computational processes involved in the training and use of NNs could also infringe on a product patent by involving the making of the patented product. This type of infringement would require that the exclusive right to make a patented product cover products that exist only in digital form on a computer. This could be the case, at least in situations where a patent's claims specifically concern a computer (and other elements of the claims are present in the computer running the neural network). However, where a product's claims concern, for instance, a substance, it is unclear whether digital depictions of the product alone could constitute an infringing product in themselves.

Following the lines of reasoning outlined above, the training and use of neural networks could in theory infringe upon product and process patents. However, as noted above, there are unresolved legal issues over whether modelling patented processes could fall within the scope of patent claims as non-literal infringement and whether product patents could be infringed upon through depictions of a product in entirely digital form. Arguably, these possibilities are not entirely implausible, but even so, the evidentiary issues mentioned above still need to be addressed.

Whether an exception to the exclusive rights of patent holders could apply in the case of NNs is another issue that remains unclear. The exception for experimental use in particular could be relevant in this case.[36] The experimental use exception has been interpreted in various jurisdictions as allowing a broad range of uses of a protected product or process when it is the subject of research.[37] For example, a person producing training data using a patented method and using this data to train an NN could argue that this activity benefits from the experimental use

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[35] *See*, for example, TRIPS, *supra* n. 11, Art. 34.
[36] *See*, for example, UK Patents Act, *supra* n. 32, s. 60(5); German Patent Act, *supra* n. 32, s. 11(2); Finnish Patent Act, *supra* n. 32, s. 3(3)(3).
[37] In Germany, *see*, for instance, the decisions by the German Federal Court of Justice (FCJ) of 11 Jul. 1995: *Klinische Versuche* (*Clinical Trials) I (Case X ZR 99/92),* 114 R.P.C. 623 (1997) and FCJ of 17 Apr. 1997: *Klinische Versuche* (*Clinical Trials) II (Case X ZR 68/94)*, 115 R.P.C. 423 (1998); in the UK, *see Monsanto Co. v. Stauffer Chemical Co.*, 102 R.P.C. 515 (1985).

exception as it involves testing the patented process. However, the research exemption applies only if the research in question is focused on the patented subject matter *per se*; it does not cover research with a patent-protected process or product conducted to obtain information about other products or processes. This means that this exception cannot be invoked in cases where the patented product or process is merely being used as a tool for carrying out research on other products or processes. This could prevent the application of the experimental use exemption to using patented methods to train neural networks, as the objective in these cases is not merely to test the patented process, but to use the data acquired from it to develop another process.

## [C] Trade Secrets

Trade secrets are protected by the Trade Secret Directive in the EU.[38] EU Member States are allowed to provide more far-reaching protection in addition to the directive, provided that it meets certain conditions.[39] Trade secret protection is also regulated by the TRIPS Agreement.[40] Pursuant to the Trade Secret Directive, using trade secrets without the consent of the trade secret holder constitutes infringement. This applies to situations where a trade secret has been acquired unlawfully or in violation of a contractual or other kind of duty, as well as to situations where another person has acquired the trade secret unlawfully and the person using it ought to have known this to be the case.[41]

Generally speaking, legislative developments such as the new EU Trade Secrets Directive (which strengthens trade secrets as a protection mechanism), as well as recent cases like *Waymo v. Uber*[42] in the US (in respect of trade secrets relating to autonomous vehicles), highlight the importance of trade secrets in emerging fields of technology. Indeed, trade secrets are often used to provide protection for things, such as data, that might not otherwise attract IPR protection. As such, data used to train NNs may include trade secrets, that is, information that is secret, commercially valuable, and subject to safeguards to keep it secret. Where data has not been made public, it could well meet these criteria. In this case, consent might be required to use the

[38] Directive 2016/943 of the European Parliament and of the Council of 8 June 2016 on the Protection of Undisclosed Know-How and Business Information (Trade Secrets) Against Their Unlawful Acquisition, Use and Disclosure (15 June 2016), OJ L 157/1 (Trade Secret Directive).
[39] *See Id.*, Art. 1.
[40] *See* TRIPS, *supra* n. 11, Art. 39.
[41] Trade Secret Directive, *supra* n. 38, Art. 4.
[42] *Waymo LLC v. Uber Technologies Inc.*, LEXIS 175354 (N.D. Cal. 2017).

data to train an NN, as doing so in violation of a contractual duty would constitute trade secret infringement. For example, if data containing trade secrets is transferred to the developer of an NN under certain conditions and limitations, it may constitute infringement for the developer to use this data for anything other than the purposes permitted by the trade secret holder.[43] Moreover, if the NN developer using the data acquired it from another person, and knew or ought to have known that it included trade secrets acquired unlawfully or in breach of a contractual or other duty, the NN developer would also be guilty of infringing on the trade secrets contained in the data.[44] This means that even if a contractual licence is provided by the party possessing the data, the trade secret protection of other parties could still render the use of the data infringing.

No infringement can result from information acquired through observation of an object that is lawfully possessed by the NN developer. On this basis, having obtained data lawfully, it might be possible for a developer to extract further knowledge from it. However, this would only be possible if they were not otherwise constrained by a legal duty to limit the acquisition of any trade secrets in the data they had obtained.[45] Such a duty could mean that agreements limiting the use of the data might make it unlawful to analyse it and, consequently, to use it in the training of NNs.

## [D] Other Relevant Rights

Although the rights most likely to be infringed by the training and use of NNs were examined above, other types of IPR could also potentially be infringed by these processes. It is not clear, however, whether exclusive rights cover the entirely digital processes carried out within NNs, though this is plausible in some situations, as explained below.

### *[1] Design Rights*

[43] Trade Secret Directive, *supra* n. 38, Art. 4(3).
[44] *Id.*, Art. 4(4).
[45] Id., Art. 3(1)(b), which specifies that the acquisition of trade secrets shall not be considered unlawful where it occurs through the 'observation, study, disassembly or testing of a product or object that has been made available to the public or that is lawfully in the possession of the acquirer of the information who is free from any legally valid duty to limit the acquisition of the trade secret'.

Design rights are protected in the EU by the Design Regulation[46] and national legislation that has been harmonized by the Design Directive.[47] The regulation and the directive provide for a comprehensive, exclusive right that covers, *inter alia*, making and using products in which a protected design is incorporated or to which it is applied.[48]

It could be argued that 'using' or 'making' could be involved when protected designs are fed into neural networks or when designs are produced by trained neural networks.[49] Suppose, for example, that a neural network produces an output in digital form that creates the same overall impression as a registered design. If the output were to be made into a tangible product, this would constitute infringement. It is unclear, however, whether exclusive design rights cover the computational processes involved in training and using neural networks, in which no tangible, observable products are involved. For instance, whether a design right concerning the appearance of a chair could be infringed by 'making' or 'using' digital information incorporating the design of the chair is an open question.

The first issue is whether the product in which a possibly infringing design is incorporated can be something entirely intangible, existing solely in digital form. The definition of a product in EU legislation refers to industrial and handicraft items, from the scope of which computer programs are explicitly excluded.[50] While these classes of item suggest physical objects, some of

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[46] Regulation (EC) No 6/2002 of 12 December 2001 on Community Designs (5 January 2002), OJ L 3/1, amended by Regulation No 1891/2006 of 18 December 2006 Amending Regulations (EC) No 6/2002 and (EC) No 40/94 to Give Effect to the Accession of the European Community to the Geneva Act of the Hague Agreement Concerning the International Registration of Industrial Designs (29 December 2006), OJ L 386/14 (Design Regulation).

[47] Directive 98/71/EC of the European Parliament and of the Council of 13 October 1998 on the Legal Protection of Designs (28 October 1998), OJ L 289/28 (Design Directive).

[48] Design Regulation, *supra* n. 46, Art. 19; *Id.*, Art. 12.

[49] This possibility is relevant to both registered and unregistered designs. In the case of unregistered designs, copying of the protected design is required for the infringement of unregistered designs. Design Regulation, *supra* n. 46, Art. 19(2).

[50] *See*, for example, Design Regulation, *supra* n. 46, s.1, Art. 3(b) ('"product" means any industrial or handicraft item, including inter alia parts intended to be assembled into a complex product, packaging, get-up, graphic symbols and typographic typefaces, but excluding computer programs'). The concept of "product" can be understood to refer to any two and three-dimensional designs capable of having a visual appearance. Uma Suthersanen, *Design Law: European Union and United States of America* 96-97 (2d ed. 2010); Richard Davis, Tom St Quintin & Guy Tritton, *Tritton on intellectual property in Europe* 5-049 (5th ed 2018). Often products refer to a physical item, but some examples of products that can be protected under the Design Regulation, such as ornamentations and typefaces, can be detached from concrete

the examples given, such as typographic typefaces, refer to products of an abstract and intangible nature. There is no physical object involved in a typeface – it only exists conceptually. Moreover, computer icons and designs that only appear on a computer screen can also be registered as designs.[51] Protecting such designs would necessitate that the opto-electronic incorporation of a design into a website or digital icon be covered by exclusive rights.[52]

A second challenge around design right infringement and NNs is that the computational processes involved in training and using NNs are not visible to anyone, meaning that they cannot create an impression of a design the appearance of which is protected by design rights. That is, a product in purely digital form might not be capable of producing any overall impression, whether similar or dissimilar to a protected design, on an informed user.[53] However, such concrete visibility or impression is not a requirement in the context of other types of infringement; where a tangible protected product has been made or imported, infringement could occur even in the absence of third parties who could obtain an impression of the product. For example, infringement is not avoided if a product is imported inside a cardboard box that prevents anyone observing its appearance. The test of infringement in such cases seems to be an objective assessment by a fictional informed user who is able to visually inspect the product. Hence, arguably, if, following an objective assessment, the appearance of the digital representation of a product is considered to produce a sufficiently similar overall impression to a protected design, infringement could still be possible.

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products and thus be of abstract nature. Gordian N. Hasselblatt, *Community design regulation: (EC) No 6/2002: article-by-article commentary* 34, 46-51 (2d ed 2018).

[51] *See*, for example, EUIPO, *Guidelines for Examination of Applications for Registered Community Designs Design*, https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/contentPdfs/law_and_practice/designs_practice_manual/WP_2_2016/examination_of_applications_for_registered_community_designs_en.pdf, Section 4.1.3 (accessed 9 May 2019).

[52] Two-dimensional representation, including on a website, of a design can constitute reproduction. Joined Cases C‑24/16 and C‑25/16 *Nintendo Co. Ltd v BigBen Interactive GmbH and BigBen Interactive SA* ECLI:EU:C:2017:724, 69. Reproduction of a design in two-dimensional form (images of trains in a catalogue) has also been considered as infringing under the Design Directive by the German Federal Supreme Court. Hasselblatt, *supra* n. 50, 217.

[53] This assessment of the overall impression of a design determines the scope of protection, and hence whether infringement has occurred. Design Regulation, *supra* n. 46, Art. 10; Design Directive, *supra* n. 47, Art. 9.

Accordingly, if the concept of a product as an industrial or handicraft item covers designs made or used entirely in digital form, such as the features of a chair represented digitally, it is possible that a protected design made or used in computational processes alone could infringe on design rights. Consequently, using a dataset of registered designs to train an NN could constitute infringement where the digitally produced designs create the same overall impression. It is not clear, however, whether products in which protected designs are incorporated can be created in solely digital form in such a way as to constitute making, using, or other kinds of infringing activity in the context of design rights.

### *[2] Trademarks*

Trademarks are protected in the EU by the Trademark Regulation[54] and national legislation harmonized by the Trademark Directive,[55] which provide an exclusive right to trademark holders to use trademarks in the course of trade.[56]

It is doubtful whether trademarks could be infringed on through the computational processes involved in training using NNs. This is because exclusive trademark rights only apply to the use of trademarks in the course of trade in relation to goods or services.[57] Even if data containing trademarks were used to train an NN, or used in a trained NN, such use would not count as being in the course of trade if no one could observe the trademarks and they were not used in relation to the trade of any goods or services.

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[54] Regulation (EU) 2017/1001 of the European Parliament and of the Council of 14 June 2017 on the European Union Trade Mark (16 June 2017), OJ L 154/1 (Trade Mark Regulation).
[55] Directive (EU) 2015/2436 of the European Parliament and of the Council of 16 December 2015 to Approximate the Laws of the Member States Relating to Trade Marks (23 December 2015), OJ L 336/1 (Trade Mark Directive).
[56] Trade Mark Regulation, *supra* n. 54, Art. 9; *Id.*, Art. 10.
[57] In particular, infringing use requires using the trade mark in the alleged infringer's own commercial communication. Joined Cases C-236/08 to C-238/08 *Google France SARL and Google Inc. v. Louis Vuitton Malletier SA* ECLI:EU:C:2010:159, paras 50, 55-57; Case C-324/09 *L'Oréal SA v. eBay International AG* ECLI:EU:C:2011:474, paras 101-102. By contrast, merely providing a technical framework for others to sell products, a subcontractor filling trademarked cans with beverages for another company, or stocking trademarked goods in a warehouse has been deemed not to involve infringing use of trade marks. *See* for an overview of the concepts Davis, St Quintin & Tritton, *supra* n. 50, 3-459-3-467, 3-477-3-485; Gordian N. Hasselblatt, *supra* n. 50, 337-341.

## §6.04 Conclusions

Training and using trained NNs could infringe upon the IPRs of third parties, as the processes involved in training and using neural networks could include activities that fall within the scope of the exclusive rights of IP right holders. Infringement could occur even if no good or service were provided on the market, since the digital processes themselves might infringe on IPRs when the data used to train an NN is protected by IPRs or other rights. This fact notwithstanding, it is not clear whether or to what extent the computational processes involved in training and using NNs do fall within the scope of exclusive rights. In particular, the processes that take place in NNs are not comfortably covered by existing legal definitions of making, using, or other such concepts. Although it seems that using and training NNs could infringe upon copyright and trade secret rights under certain conditions, whether patent or design rights protect the type of use seen in NNs is uncertain, and it is likewise doubtful whether trademarks can be infringed on when a trademark is only processed within an NN, without any link to its use as a symbol for products sold in the course of trade.

Leaving aside the conceptual ambiguity of whether the processing that takes place in NNs can fall within the scope of exclusive rights or not, another fundamental challenge specific to NNs is that the workings of neural networks are difficult even to explain and understand. It is, therefore, hard to determine whether or not reproduction or use takes place within an NN in any particular case.