

Module 4

Patents and Mathematics.

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REFERENCED DOCUMENTS

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1	2020-1-UK01-KA201-078934	IPinSTEAM Proposal
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APPLICABLE DOCUMENTS

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Contents

1. Title of the Module	Σφάλμα! Δεν έχει οριστεί σελιδοδείκτης.
1.1 Learning Outcomes	4
1.2 Main Content	4
1.2.1 Terms and Definitions.....	4
1.2.2 Theory behind the IP implementation	6
1.2.3 Practical examples	7
1.2.4 Case studies.....	10
1.3 Knowledge Assessment	10
1.4 Skills Assessment.....	11
2. References	12

1. Patents and Mathematics

1.1 Learning Outcomes

In this module, we are going to learn what a trademark is and what can be its uses related to mathematics, statistics, and big data. However, before going into the concepts mentioned above, we must know what a trademark is, as well as other fundamental aspects related to this concept.

After completing this module, you will be able to:

- To know the basic principles of intellectual property, specifically, patents.
- Discover how patents work and their impact on everyday life.
- Learning about the relationship between mathematics and patents

Estimated seat time: 2 hours

1.2 Main Content

1.2.1 Terms and Definitions

To begin with, one of the most important factors we need to know is at least a small definition of what patents are. A patent is a set of exclusive rights granted by a state to the inventor of a new product or technology, which can be commercially exploited for a limited period, in exchange for the disclosure of the invention. The registration of a patent constitutes the creation of a monopoly in an artificial manner, and falls within the framework of industrial property, which in turn forms part of the intellectual property regime. The holder of a patent may be one or several national or foreign persons, natural or legal, combined in the manner specified in the application, in the percentage mentioned therein. Patent rights fall within what is known as industrial property and, like real estate, these rights can be transferred by acts between living persons or by succession, and can be rented, licensed, sold, exchanged, or inherited.

Following the original definition of the word, one of the purposes of patent law is to induce the inventor to disclose his knowledge for the advancement of society in exchange for exclusivity for a limited period.

Now that we know the definition of the word Patent, we should broaden our knowledge about the uses of the word Patent. There are different types of patents, although they mainly fall into three categories:

- Utility patents, these patents include machines, apparatus, methods, processes, products, etc.
- Design patents, this category includes the exterior lines, ornamentation, texture, and aesthetics of something.
- Plant patents, including the cloning of plants and trees.

Another thing to bear in mind is that you cannot patent absolutely everything. There are some things that cannot be patented, either for one reason or another. One of the many things that cannot be patented are mathematical methods or procedures. This is decided by the types of patent law in the world, but in this module, we will focus on two fundamental concepts: the **Berne Convention** and the **European Union** patent law system.

The **Berne Convention** is an international treaty on the protection of copyright in literary and artistic works. Its first text was signed on 9 September 1886, in Berne (Switzerland). It has been supplemented and revised several times and was last amended on 28 September 1979.

The Berne Treaty is governed by three simple concepts. The three basic principles are as follows:

1. Literary and artistic works by authors from the countries of the Union or published for the first time in one of these countries, may receive the same protection in each of the other contracting states as they grant to the works of their own nationals.
2. This protection shall not be made conditional upon the fulfilment of any formality.
3. This protection is independent of the existence of corresponding protection in the country of origin of the work. However, if a contracting state provides for a longer term than the minimum prescribed by the convention, and the work ceases to be protected in the country of origin, protection may be denied once protection in the country-of-origin ceases.

On the other hand, **EU patent** law is the one we must abide by in our territory, and the one that, at a legal level, has the greatest validity. Patents in the European Union are based on two systems: the national patent and the European patent. Neither has Community legislation behind it. National patents were the first to appear. These patents have been de facto harmonised in all EU countries: all EU members have signed the Paris Union Convention for the Protection of Intellectual Property (20 March 1983) and the TRIPS agreement.

Registering a patent gives you exclusive rights to an invention for a limited period, usually 20 years. No one can make, use, offer for sale, sell, or import a product or process based on your patented invention. Someone can be granted temporary permission to use the invention through a patent licence agreement or sell the patent to someone else. A patent cannot be renewed after its validity has expired.

Now that we know more about patents, let's evaluate the benefits and disadvantages of having a patent.

What are the **benefits** of having a patent?

To start all, patents guarantee the existence of a plan for anything useful or practical. The state gives patent owners with trade control protection for the duration of the patent's legislative life. The patent statement is exemplified by a counterfeit market limitation or deficit in the market for innovation due to the monopolistic character of the patent. Imitation market limitations allow the patent owner to raise expenses beyond the market equilibrium cost, providing the patent owner with unusual benefits.

Furthermore, when intentional violation occurs, patents provide predominant rights. Clearly, the economic consequences of such a proposal are self-evident. If the court determines that a competitor

knowingly copied and that the infringement caused injury, the patent holder may claim restitution from the competitor.

On the other hand, a patent can also trigger some negative consequences. To begin with, patents are pricey to get, typically costing a large sum to apply and get to law. Expenditures incorporate direct charges for legal services as well as soft costs (for example, an author's time) to present the invention to the patent lawyer and patent administrative offices. These expenses skyrocket if the petition includes international jurisdiction.

Furthermore, as compared to other types of intellectual property, patents have a relatively limited family's finance. A patent has a legal life of 20 years from the date of completion and submission of the patent filing. Because the most recent big recording date is the starting point for the legislative clock, patents are unique among IP kinds in that the 'award process' procedure consumes a significant portion of the patent filing personal finances. This has both legitimate and substantial ramifications.

On the now repetitive topic of applied mathematics in intellectual property and vice versa, we find on the web various opinions of many experts on the subject about this event. To summarise, in a way, within the scientific field of mathematics, and specifically among mathematicians, there is no sense of ownership as such among their creations.

1.2.2 Theory behind the IP implementation

As we have discussed in previous modules, an implementation of intellectual property in the field of mathematics is almost impossible, also in the field of patents. However, we can take as an example some countries which, according to their legislation different from that of the EU, have been able to patent certain methods, applications, or aspects of mathematics.

First, we rely on the fact that, at least beyond our borders, it has been possible to patent certain cases. The most common and recent cases we find are about patents related to algorithms. But first, we must ask ourselves, can an algorithm be patented?

Currently, there is no industrial or intellectual property law that expressly refers to the protection of algorithms, and there is great legal uncertainty about their protection. Moreover, they are not protected in the same way in all countries, which contributes to making companies' protection strategies more difficult.

In Europe, the European Patent Office (EPO) has refused most patent applications for algorithm-based methods. In contrast, in the United States, there has been a progressive trend towards acceptance of such patents.

In this context, many companies resort to trade secret protection. An algorithm, moreover, can be considered know-how (i.e., the key to their competitive advantage), and as such could be protected under the Unfair Competition Act (for the exploitation of industrial or business secrets) and the Criminal Code (for the misappropriation or improper dissemination of industrial secrets). The European Commission has recently presented a proposal for a Directive to strengthen the protection of know-how and trade secrets.

To concentrate on a specific case, we are going to focus on PageRank, which is Google's search algorithm. It was developed by the founders of Google, Larry Page (after whom the algorithm is named) at Stanford University while he was a graduate student in computer science. An Internet search algorithm is a set of instructions describing the procedure to follow to find a specific and concrete result on the Internet, within a larger data structure.

PageRank relies on the democratic nature of the web by using its vast link structure as an indicator of the value of a particular page. Google interprets a link from page A to page B as a vote, from page A, for page B. But Google looks beyond the volume of votes, or links a page receives; it also analyses the page that casts the vote. Votes cast by pages considered "important", i.e., with a high PageRank, are worth more, and help make other pages "important". The PageRank of a page therefore reflects its importance on the Internet.

Due to the commercial importance of appearing among the first results of the search engine, methods have been designed to artificially manipulate the PageRank of a page. These methods include spamming, which consists of adding links to a certain web page in places such as blogs, guest books, Internet forums, etc. with the intention of increasing the number of links pointing to the page.

In 2019, the PageRank patent expired. But the fact that from that year onwards anyone can use it freely is no longer too relevant: many, many people have devised similar algorithms to assign and calculate the "importance" or "relevance" of link nodes in large databases and hypertext documents, such as the World Wide Web.

In short, PageRank has been one of Google's best-kept secrets. However, many other similar algorithms have been appearing and, of course, they have satisfied our needs when searching the Internet, whether using Google or any other search engine or browser.

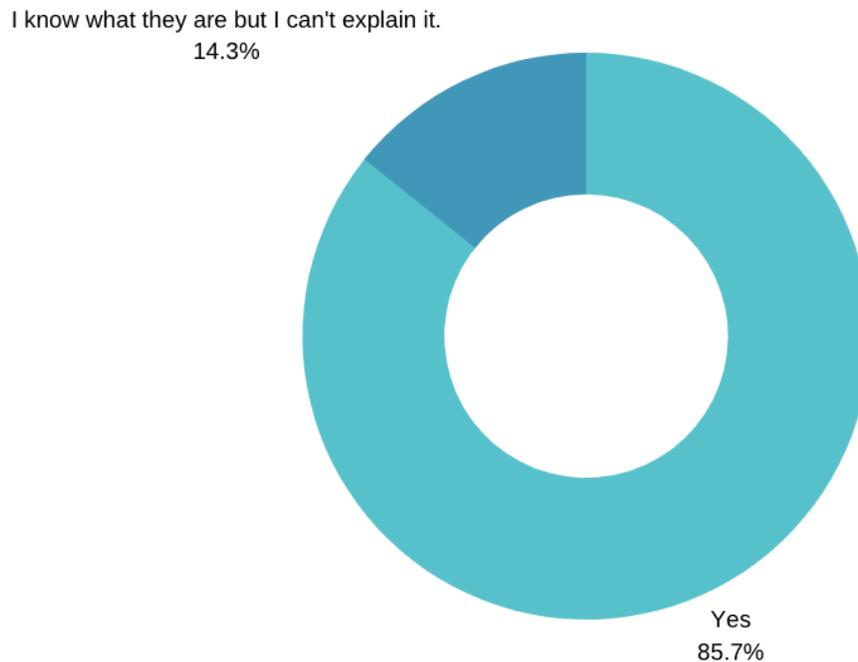
1.2.3 Practical examples

In the practical examples section, a survey has been conducted to have a better understanding of direction of this subject.

In the first question, it asked a simple question but important for the continuation of the survey, which was whether they knew what a patent is. The majority knows what a patent is, only a 14.3% doesn't know.

What we can observe in this question is that at least, in general terms, the experts know what a patent is, although in some exceptional cases, they did not know how to explain it. Nevertheless, we consider this point of view to be very interesting, as it is key to the development of the rest of the questions.

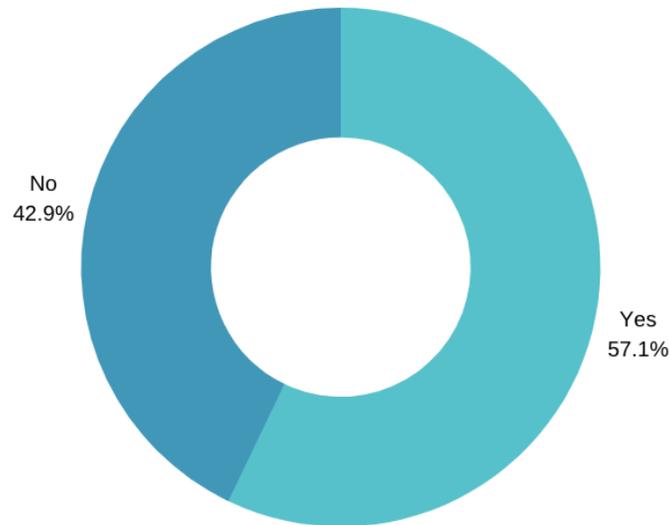
Do you know what patents are?



Then it was asked if they think that an algorithm should be patented such as that of the google search engine. More than half agreed that the algorithm should be patented, while the rest disagreed.

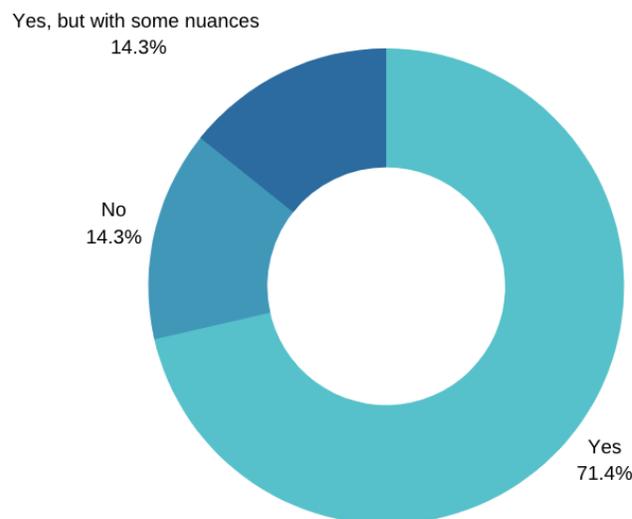
The experts were then asked whether they considered it appropriate that an algorithm such as google search could be patented. In this case, there was more disparity of opinion. Some, on the one hand, consider that patenting this type of algorithm is the right thing to do, specifically 57.1% of the experts. The rest are of the opposite opinion. In this question, there is a slight majority who can inform us about the reasons for patenting and others who oppose this decision and prefer to keep everything as it is today. In the Case Studies section, we will look at the reasons for these answers.

Do you consider it appropriate that a search algorithm, such as that of the google search engine, can be patented?



And last, it was asked if the algorithms for social media much access to personal data have too to perform their searches. Here the majority agreed that they do have too much access to personal data, while only 14.3% disagreed.

Do you think that social media search algorithms access too much personal data to perform their searches?



1.2.4 Case studies

As for the case studies, let's evaluate the assumptions or hypothetical events that could occur. Firstly, we all know that algorithms access a lot of personal data about us, the users. Sometimes, this use of data through the well-known Cookies, implies an excessive abuse of data collection. A large part of those surveyed agree that we are handing over this data free of charge to companies such as Google, and this can sometimes be dangerous. Let's not forget that these companies often sell our data to third parties to profit both informatively and financially. According to experts, this should be strictly forbidden, as it is not moral.

On the other hand, they were also asked whether they considered that algorithms should be in the public domain. On this question, there was a great disparity of opinions, as although they focused on a yes or no question, the arguments provided were completely different from each other.

To begin with, one of our experts believes that the creation and dissemination of these algorithms should be private. In his view, he means that all the information collected by the algorithms is personal, and therefore, as a personal data collection entity, the algorithms should not be in the public domain.

However, among the arguments in favor of no, it is considered that each company has its own procedures behind it. Private companies should not provide such a large amount (and quality) of information, more than anything else, to guarantee the security and privacy of this data.

On the other hand, there is another group of respondents who prefer not to get fully involved in this controversy. They consider the use of our data to be excessive, but they do not know to what extent it may or may not be beneficial whether the search algorithms that access our data should be in the public domain or not.

All the other experts we have asked to agree that such algorithms should be in the public domain. Firstly, because these algorithms access a large amount of data, we, the consumers, need to know what possible consequences we are exposing ourselves to. Cybersecurity is an indispensable component of today's society, and we cannot leave our data in the wrong hands.

Similarly, other experts agree that both the code and the algorithm itself should be in either case. In addition, this should also serve at the legal level to regulate, to a certain extent, how and in what way an algorithm can access our personal data.

1.3 Knowledge Assessment

Quiz-like assessment based on the main content. Please mark the correct answer with bold when required. Include 10 questions for your module. Increase gradually the level of difficulty.

Question 1: Mathematics are patentable.

[False] [True]

Question 2: PageRank is the search algorithm used by Google.

[Yes] [No] [It was, but now google uses another]

Question 3: Patents in the European Union are based on two systems
[True] [False]

Question 4: Check the two **CORRECT** options about types of patents
[Utility patents] **[Design patents]** [Mobility patents] [Useful patents]

Question 5: What are the **benefits** of having a patent? There are 2 correct options.
[Protecting valuable ideas]
[There are no personal benefits]
[The idea is patented forever, and no one can copy it]
[If your idea is copied intentionally, the guilty party takes the consequences.]

Question 6: Mathematics can only be patented in the United States. There are 2 correct options.
[Mathematics cannot be patented in the United States.]
[Only algorithms can be patented, but mathematical procedures can be patented in the EU.]
[There are algorithms that have been patented, but only depending on the legislation of the country or region, they are accepted or not.]
[In the United States it is possible, at least it is allowed within the legal framework.]

Question 7: The use of algorithms is closely related to the personal use of our data. There are 2 correct options.
[No, data usage is related to cookies.]
[No, but sometimes they access our information.]
[Yes, and sometimes there are problems with data traffic.]
[Yes, and many other browsers have found ways to create algorithms like PageRank.]

Question 8: Match the terms with their definitions.

Utility patents: Machines, apparatus, methods, processes, products

Design patents: Exterior lines, ornamentation, texture, and aesthetics of something

Plant patents: Cloning of plants and trees

Question 9: Match the concepts with their explanations.

Algorithm: is a finite sequence of well-defined instructions, typically used to solve a class of specific problems or to perform a computation.

Patent: is a type of intellectual property that gives its owner the legal right to exclude others from making, using, or selling an invention for a limited period of years

Berne Convention: is an international agreement governing copyright

Data protection: legal control over access to and use of data stored in computers

Mathematics: the abstract science of number, quantity, and space, either as abstract concepts, or as applied to other disciplines such as physics and engineering

1.4 Skills Assessment

A good exercise to apply all the content of the mathematics and patents modules would be to ask moral or even philosophical questions when implementing all the information presented.

Throughout the module we have been able to see how mathematics, or rather, the attempt to patent mathematical elements, is subject to many different opinions, sociological concepts, and a great deal of agreement in the mathematical community in general about the free use and consumption of mathematical elements.

Therefore, the following questions could be raised to carry out a critical and objective reasoning about patents.

Patents indicate, among many other things, ownership. We have seen, both in this module and in the previous ones, that the mathematical community exempts this sense of ownership from its most fundamentals, so we ask ourselves, is it necessary to patent certain elements if not even their creators themselves are interested in owning them? Should one protect certain things related to the field of mathematics, whether to protect them in case of copying, fraud, or swindling?

These questions would be a clear example of implementing critical thinking about mathematics and patents. A good reflection on these issues is an improvement of skills in this area.

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