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A legal approach to Algorithm-driven process and Artificial Intelligence

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Abstract

This dissertation was written as part of the LLM in Transnational and European Commercial Law, Banking Law, Arbitration/Mediation at the International Hellenic University.

This dissertation approaches the concepts of Algorithms and Artificial Intelligence from a legal perspective. Software programs that are capable of learning and making their own decisions offer a multitude of applications, but also pose difficult questions in regard with their autonomous behavior

Those questions mostly refer to the fact that it is extremely difficult to find the correct formula to hold advanced algorithms and AI reliable for their actions.

This dissertation attempts to legally define the legal nature of those concepts and propose methods that can prove useful when trying to set an efficient regulatory framework

I would like to acknowledge and sincerely thank Professor Ballell, both for helping me to formulate the idea behind the dissertation and for her assistance while supervising my dissertation. (Abstract: 200-300 words)

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Preface

In a world that changes day by day, it is very difficult to keep up with everything. Technology in particular, advances at such a rate, that it forces every either science to keep up . Interdisciplinary research has become mandatory in order to analyze and explain all the amazing events that happen around. It is with great pleasure that i have made a step towards interdisciplinary research through this Dissertation. I hope that that my efforts will contribute to the better understanding of the world we live in.

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Introduction

Throughout all the years of human evolution, law science has been running behind political, cultural, societal, economical and technological changes, desperately trying to catch up and regulate them before chaos is created. It is without doubt one of Law's major weakness. It can't regulate something that does not exist, and the aforementioned changes take time to develop and produce results, that can be examined and analyzed by the Law.

In the 21st century this problem is as topical as ever, especially with the rampant growth of every feature of technology. Technological advancement penetrates and affects every other aspect of human life. In fact, some argue that technology has become the main pillar around which our lives revolve.

One of the main aspects that has made technological creations so popular is automation. Automation has made inventions incredibly practical and time consuming. The basis of automation in technology lies in the concept of Artificial Intelligence. At the heart of Artificial intelligence, are algorithms, the mechanism that make any automated process possible.

Algorithms are not a new concept in the history of mankind. They have been used for centuries but only after the creation of the first automated machine by Alan Turing have they become integral for the progress of technology. Technology and algorithms develop together. The algorithms provide the tools for technological improvement, and thus technology demands even more from there in order to further progress

The development of Algorithms has been so huge, that concepts that used to exist only in science-fiction literature such as self-learning and self-deciding machines have become part of our everyday life. The use of any computer machine, the use of the Internet, commercial transactions, automated cars, medical robots, video games, are just a few examples of how important algorithms and Artificial Intelligence has become

The use of generic algorithms is quite easy to be regulated through the specific regimes that regulate the operations they are used for. For example, internet commercial transactions are regulated by Commercial Law. There are though, algorithms so advanced that Private Law could not predict that they could exist and thus does not contain many appropriate regulations

Self-learning and self-deciding algorithms in particular pose many difficult questions to Law science. Should they be perceived as objects or as entities? Should they be awarded personality? Can they be accountable for their actions?

All these questions, and many others need to be answered. Law science must not only try to catch up to the technological evolution but also try to predict its effect on the society in order to timely analyze or even predict the results of this effect

For such a task to succeed, inter-disciplinary research is required. The first step is to understand how algorithms work, both from a scientific and a practical point of view. The second step is to analyze the nature of algorithms and find out the manner that they are affecting or may affect the real world. The last step is to try to propose viable solutions for the problems that arise from the use of advanced algorithms and also attempt to predict what kind of problems might also arise in the future.

A Brief Introduction To Algorithms

The first step towards examining the legal aspects of an algorithm, is to define its concept, its purpose of use, and its applications in practice.

Concept

An algorithm can be defined in many ways. The wide usage of algorithms in mathematics and information technology dictates the need for certain clarifications. An algorithm that solely solves a mathematical problem or is used to prove a scientific assumption or theory is not, yet, of legal interest. What is of legal interest, is the use of algorithms in computer software. An algorithm's complex structure and content can lead to dissecting it to countless subsections. The difference between a simple computer algorithm and a complex one is huge, and it represents decades of technological progress. It is only logical that a broader definition will be more useful for understanding the basic functions of an algorithm. The problem is, that generic computer algorithms are not complex enough to draw legal attention. It is the complex computer algorithms that have such impact and implications in the real world that create the need of legal characterization. This problem creates the need to not only give a broad definition, in order to understand the fundamentals of algorithm, but to also analyze in depth its more complicated aspects.

At its simplest form and definition, an algorithm is a sequence of orders designed to perform a specific task or to solve a specific problem¹. This raises the question if any set of orders or actions that lead to a specific purpose is then, an algorithm. What is important to understand about computer algorithms in particular, is the way the orders are structured by the creator of the algorithm and the way they are perceived and executed by a computer. The exact sequence of orders should always produce the exact same result with no alteration. An algorithm is thus a sequence of computational steps that transform the input into the output.(introduction to algorithms). A well-constructed and functional algorithm, or in other words a correct algorithm will always produce the correct output to the correspondent input.

The more orders and variables an algorithm contains, the more complex it becomes. The content and the scope of the orders given is also important. Certain types of orders are more difficult to translate into a programming language and to be executed by a computer. This fact makes the creation of a complex algorithm an extremely technical and delicate procedure. Even the slightest mistake or alteration can lead to a non-functional algorithm, or to an algorithm with results different than those expected. From a legal perspective this is a quite frustrating aspect of algorithms. The more complex an algorithm, the greater is the possibility that it produces unwanted results. In case the algorithm is completely dysfunctional, it causes no problem because it will not be set to use anyway. It is when the algorithm produces unexpected results along with the expected ones, that is where it becomes

¹Thomas H. Cormen Charles E. Leiserson Ronald L. Rivest Clifford Stein, Introduction to Algorithms, Third Edition, The MIT Press, page 6

tricky. One could argue that these “side effects” are not a big issue, as long as the algorithm still serves its original purpose. The truth is though that algorithms are used to an enormous extent, and execute such a big and complex array of services and operations, that any unwanted result can cause a chain reaction to the ecosystem or the sub-ecosystem in which the algorithm is used. Precision and efficiency are vital for algorithms. In an era where every aspect of the world changes in rapid fashion, algorithms do not simply aspire to solving problems, but to do so in the fastest and most practical way.

Purpose

There are two main facets that explain the purpose of an Algorithms. Problem solving, and efficiency. These two characteristics have helped algorithms evolved from simple instructions in a cookbook to nearly sentient machines capable of great features. The purpose though, of an algorithm is set by the developer. The developer defines both the problem that he wants to be solved and they way that he wants to do it. From a developers point of view the purpose of an algorithm expresses his own will . From an abstract and philosophical point of view an advanced algorithm can redefine its purpose. Self-learning and automated decision making(which will be thoroughly explained later) can make an algorithms “behavior” unpredictable. The more advanced an algorithm becomes the closer he reaches to human-like sentience. Could an algorithm that “smart” alter, or even defy its developer’s orders. As disappointing and as anticlimactic as it may sound, it cannot. An algorithms purpose, however sentient the algorithm may be, is bound the its code. Despite that, there are ways for an algorithm to serve a purpose different than intended, but in its current state, it is still attributed to false or incomplete programming. One of course could argue, that self-learning algorithms have displayed divergent behaviours due to them processing huge amounts of data in an unpredictable manner. Again, though, had the software developer correctly foreseen how self-learning algorithms would work they could have modified the original code to avoid the from deviating. Albeit, there is one way that an algorithm can somewhat defy its developer’s orders. It has to do with the second important characteristic, the efficiency. An advanced algorithm with huge self-learning capabilities could make the decision to reach the purpose set by the developer in a different way than the developer designed, as long as the way was more efficient and did not directly violate the original set of orders, but rather bypassed them

Applications

Usually, one sole algorithm is not enough to support a complex act through a computer. It is the combination of multiple algorithms that provide the software of an electronic machine with enough information to complete the task that it is asked to do. Therefore, when discussing algorithms, one could refer either to multiple algorithms working together or to an integral part of an algorithmic system which characterizes it and provides it with that special piece of data, that is crucial to the completion of the task in hand.

The exponential growth of technology in the 21st century particularly in the sectors of information and web technology, has brought algorithms in almost every aspect of everyday life. The average person uses countless algorithms every day, even if she does not realize it. The moment someone opens her smartphone, or laptop or

proceeds to complete any action through electronic means it is almost certain that she reaches her goal with the use of countless algorithms.

The use of algorithms in everyday life is strongly connected to the use of the internet. Whether it is used for listening to music, reading the news, or completing commercial transactions, the internet provides countless services that are completed via algorithms. Sometimes algorithms are just the tools that are used in order to create the user interface of a website. But there are also more complex algorithms that are created to carry out security checks, to provide automated help or even to negotiate prices, terms and condition for some commercial transaction. The more impactful the “actions” of an algorithm are to the real world, the more important it is to legally characterize it and regulate it.

The most common application of algorithms in everyday life is data manipulation. Every second, a near uncountable amount of data, is being transferred or traded. The Internet, and high-speed connections are the catalysts for the spread and “globalization” of any kind of data. The most popular way to gain access to data are metasearch engines (for example Google). Metasearch engines retrieve information from third parties connected to the internet and present it to the user, in accordance with what the user has asked. Metasearch engines are extremely interesting from a law perspective. The amount of the data used and transferred, the way that they are processed the succession or priority in which they are presented to the user pose serious questions. Should all kinds of data be accessible? Is there a way in which search results should be presented? In what extent should search engines have a self-learning ability in order to customize their services to the users needs. Several branches of Law, such as Competition and Civil Law, have already answered some of those questions. The difficulty of their task though, is that with the rampant growth of technology, many of the solutions that used to work in the past, become obsolete, and they constantly have to be updated, in order to avoid data being processed and transferred in conditions of unregulated chaos.

Algorithms are also frequently used in any kind of commercial transaction through the internet. In fact, they are the catalytic element for it, and e-commerce would probably be dysfunctional or even non-existent without them. Electronic commerce resembles traditional commerce very much, only it is way faster. E-commerce has transcended the way commercial transactions are perceived, negotiated and concluded. First of all, algorithms provide the tools for the swift search of any product or service. Secondly they provide the tools for the swift negotiation and conclusion of commercial deals. Finally, they protect and monitor the transactions to protect the users from theft or fraud. They also allow a more efficient allocation of resources or information. The use of algorithms in commerce is so efficient, that algorithms that make their own decisions have been set to use. It is common nowadays, for an algorithm to be utilized as a negotiator, and to accept or decline offers, expressing their user’s will. Self-learning plays a vital role in such algorithms and poses many questions and concerns about the way and the extent those kind of algorithms should be used for.

Last but definitely not least, are algorithmic contracts, a truly state of the art product designed to negotiate, form and apply contractual obligations. The so called *“Smart contracts are computer protocols that facilitate, verify, execute and enforce the*

*terms of a commercial agreement*²". Current proto-examples include some digital financial instruments used on electronic securities exchanges. Smart property is property whose ownership is). The code of the algorithm, is the most integral part of the contract. In fact the contract and the algorithm can be perceived as one. The contract cannot exist without the algorithm because the algorithm defines the parameters of the contract and the algorithm is completely useless if it is not part of the contract it adheres to. One of the greatest advantages that smart contracts provide, is the ability to change the terms of the contract if a condition described in the contract changes. The same way that an algorithm gives different outputs depending on the input, an algorithmic contract enforces different obligations should a condition or circumstances change. Smart contracts can prove extremely useful in commercial transactions or in financial exchanges where the variables affecting contracts can drastically change in the blink of an eye. Smart contracts can decrease or even eradicate the risk in contractual agreements that deal with many, fast-changing variables.

² Tim Swanson, Great Chain of Numbers: A Guide to Smart Contracts, Smart Property and Trustless Asset Management, page 6

Legal implications of algorithm-driven decision-making

Algorithm-driven decision making translates the actions of advanced algorithms into the real world, a fact that poses a series of questions regarding the autonomy of algorithmic actions.

Attribution of Legal Effects

Decision making in nature is strongly connected to cognitive ability and is considered the opposite of acting when driven by instincts. As most animals are mostly driven by their instincts of survival and reproduction, decision making is considered to be an ability connected exclusively to humans. This presumption ascends algorithm-driven decision making to something much more important than a mere computational model. The ability of a software program or a machine to not only carry orders but to proceed into making its own decisions seriously tests the limits between human intelligence and artificial intelligence.

In science fiction literature there are countless examples of sentient machines who are as intelligent as humans and even develop their own consciousness. The crucial factor that separates humans from all other creatures on earth is their ability to think and act beyond their instincts or even against them. What happens when algorithms, things that human intelligence created, start to present attributes that are considered man's privilege? Should they be banned or not? Should they be regulated? Are there certain boundaries that should not be trespassed?

It is important to note that we are not referring to decisions taken by humans after consulting information generated from an algorithm.. True algorithmic decision making means that the algorithm itself makes the decision based on the data available to it. The algorithm is programmed to judge itself according to the orders that it contains and the data and the variables that it processes. The fact that the algorithm "follows orders" does not take anything away from its decision making the same way that a human is not deprived of his decision making when forced to complete a task.

Consequently, a new series of questions arises. How should algorithms that make decisions on their own be treated? How should they reach decisions? Should their decisions be fulfilled? Should their actions have legal effects? Which variables should they take into account? In what extent should they replace human decision making? It is obvious that the use of algorithms in decision making raises many questions that need to be approached- among others- by a legal perspective. The reason is simple. Legal regimes all over the world regulate the actions and interactions of people that live into organized societies. The moment a new entity starts affecting the real world with its actions ,in the same way that people do, a need for the explanation and possibly the regulation of this entity appears. It is important to say though that, as of now, algorithmic decision making has not passed the threshold to sentient intelligence. Therefore it is only logical that the explanations and regulations pertain to the construction and function of the algorithms rather the tackling of their behavior after they are created.

Big Data

Big data is the main reason that algorithms can complete so many different tasks, with such speed and accuracy. Algorithm-driven decision making in particular, is, for the time being completely dependant on the use of Big data. A widely accepted definition of what Big Data is would be the following: Big data is *“high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation.”*³In other words big data is enormous amount of information that is easily accessible and processable. Without big data, it would be very difficult for algorithms to complete the extremely complicated tasks which they are used for today, and it would be near impossible to reach algorithm-driven decision making.

The main tool for a person to reach a decision is critical thinking. When a person wants to achieve a goal or just act in general, he calculates the variables, tries to predict the possible outcomes that would result from each of his possible different actions, and then proceeds to take action in the fashion which he deems will have the optimal result in accordance with the original goal. Should the original goal or some variable change, it is possible, but not certain, that his action will change as well. It is also uncertain that the person will reach the optimal decision as he may have missed some variables or miscalculated them

Decision making for algorithms is more or less the same. Algorithms try to achieve a goal by completing a set of orders. When the goal is complicated, and is not based on a strictly linear approach, the algorithm must make a decision. What is the value of each variable and how should they affect its final decision. Without big data it would be impossible for algorithms to take such decisions when faced with complex problems. Or, more accurately, it would be highly probable that an algorithm would make a wrong decision because it would not have processed crucial variables. The vast volume of information that big data provides, remedies the variable insufficiency and significantly reduces the probability of the algorithm reaching a wrong decision. Both the quality and the quantity and relevance of the data provided are of particular importance in the algorithmic decision making process.

When discussing big data the first question that comes to mind is “where is all this data coming from”? Databases that serve the purpose of storing thematically compact information do not possess enough data to be considered “big data. The answer is “from everyone” however simplistic it may sound. Every user of the internet has been freely giving away his personal data for decades. Personal data is currently the most important and useful kind of data on the internet. Search engines, social networking platforms, marketing, commerce, policy making are all extremely reliant on enormous amount of personal information to achieve their goals. The problem is that most people do not understand how much of their personal information they have signed away to the internet, who processes it and how it is used. Regulatory initiatives have been taken all over the world, with the most recent , the GDPR(general data protection regulation) taking effect in Europe.

The GDPR as well as any regulation that intents to protect personal data, splits the use of personal data into two categories. The collection of the data and the

³ Gartner IT glossary Big data. <http://www.gartner.com/it-glossary/big-data> Accessed 7 February 2019

processing of the data. Moreover it organizes the protection of data around the concept of consent. The concept of consent in data protection goes as follows: In order for a person party, program or entity in general to use another individual's personal information, the individual has to consent. The consent must be present, topical and include both the collecting and the processing of the data. In other words the personal data given cannot be used for any kind of processing but only for the process for which consent was given. Some argue that data protection regulations, hinder or impale the use of big data and the amazing benefits that it brings⁴. In reality, it is quite the opposite. Data regulations are not against the use of big data. They just set the appropriate framework upon which big data can be used. As with all regulations that aim to protect fundamental human rights such as personal data and privacy, data protection regulation provides a much-needed sense of security to society- the security that, although the people themselves lack the scientific knowledge to understand how their personal data are being used, a regulatory framework secures that their data will be used in respectful and beneficiary way.

Risk assessment

Risk assessment is one of the most common instruments that combines the use of big data and algorithms. While it is definitely not something new, big data and computer algorithms have increased its effectiveness by a large margin. The more data a predictive algorithm collects, the higher the chance that it correctly assesses the risk and the rewards of the action in question. Such algorithms are extremely popular in medical science, insurance, and banking.

Risk assessment though, does not come without disadvantages. Its main disadvantage has to do with its very nature. It tries to predict a result, based on the calculation of countless data and variables. But, however well designed a predictive algorithm may be, even if it processes enormous amount of information, it is still prone to reaching a wrong conclusion. Algorithms of course, cannot be vessels of perfection that defy logic and always produce perfect results. The point is that the sensitive nature of the data that risk assessment algorithms process (personal data, medical history, economic power etc) and the significance of the results they produce, calls for a strictly regulated environment, both from an ethical and from a legal point of view. Predictive algorithms are used to replace human work, because a person's computational and data processing ability can never match that of a computer's. On the other hand, algorithms, especially those designed to improve while processing data through self learning, lack the critical ability, the experience and the perception of the world that a person has. Therefore it has to be ensured that risk assessment algorithms will not sacrifice civil rights in exchange for time consumption and efficiency. In order for that to happen the concepts of indiscrimination, efficiency and even ethics have to be imbued into the algorithm. This is an extremely difficult task for two reasons. First of all there is no universal definition or agreement of what the aforementioned concepts are and second they are by far too complicated to be sufficiently expressed through an algorithm. Nevertheless, certain boundaries can

⁴Nicholas Diakopoulos, Sorelle Friedler, How to hold Algorithms Accountable, MIT technology review, 17-11-2006, accessed 20-11-2019

already be set, mainly by restricting the extent of the decision making the algorithm can perform. Another obvious solution is human monitoring but it is a solution that is axiomatically against the true purpose of algorithm driven-processes. If a human is indeed needed in the end, why not have him making the decisions in the first place?

Ethics

ethics are an integral part of regulatory regimes and policy making. Although ethics are not directly part of the law, and are not defined in it, they have an impact on almost every legal rule, serving as the backbone of any legal regime. In every democratic state, no rule can be deemed “unethical”. This axiom can be the source of ambiguity because ethics are not defined by law, but rather by the common belief of each society. Different societies have different beliefs resulting in different ethics. The law cannot be sure to what extent a rule is unethical or if the society itself has the correct perception about what is ethical and what not. Nevertheless common sense implies that most people hold up to a similar array of ethical standards and only differ in specific cases.

Algorithms that can act on their own fall under this category of special cases..Should they be allowed to act on their own and in which circumstances? Should somebody control them? Do their abilities create problems in competition and labor law? Do they violate human rights? Ethics have played a great role in the formation of law in human history. For this reason any new, groundbreaking discovery has to be filtered through the entwined disciplines of ethics and law. For that reason, it comes as no surprise that that innovators often consider ethics as obstacles towards the goals.

In this specific case, ethics and laws do not raise serious opposition towards automated algorithm driven process. Even if private law has implemented only a few, specific rules, concerning algorithms, it is adaptable enough to regulate them without ground-breaking changes⁵. There are however disagreements, that are not exclusively about algorithms but rather about the advancement and exploitation of technology in general.

The main point of dispute is boundaries. Should they exist in the exploitation of technology or not? In extremis the dispute goes like this: On the one side there is the argument that technology should be used to serve mankind and needs to be constantly moderated in order to avoid the danger of slowly transforming the world into a technological dystopia where only a few have access to the highest technology and use it to control the rest. The other side, attempts to counter that argument by claiming that such fears are unreasonable and that in any case, mankind should learn to adapt to technological advancement. Based on those arguments should competition and labor law try to halt and regulate the use of algorithms on self-driven processes or should it let it run unchecked and try to adapt to it? The answer is not as easy as it looks, as it is difficult to find common ground among those arguments. For example, should algorithms and technologically advanced machines take completely over of the service sector, which has traditionally been person-related? Is the efficiency of the services provided more important from the uncertainty that will be created regarding

⁵ Scholz, Lauren, Algorithmic Contracts (October 1, 2016). Stanford Technology Law Review, Vol. 20, 2017. Page 50

unemployment? Are we ever going to reach a point where human employees become obsolete, resulting in the creation of a technology Aristocracy or is it a step towards the future, where people will be freed from labor boundaries, becoming free to pursue other endeavors. As it is very difficult to predict the outcome of the rampant advance of technology, the law tries to focus in the present. It regulates technology based on the axioms and morals that have survived and functioned so far. All in all, ethics do play an important role in the regulation of algorithms, and are expected to play an even greater role, the more complex and intelligent algorithms become.

Self-Learning Algorithmic processes

Self learning Algorithms are a part of Artificial Intelligence. Artificial Intelligence is the main concept upon which any type of machine-type decision making is based.

Artificial Intelligence

Artificial Intelligence(abbrev.AI) can be interpreted in two ways. From a narrow point of view, Artificial Intelligence applies advanced analysis and logic-based techniques to machines. From a wider point of view Artificial Intelligence is the opposite of natural intelligence as demonstrated by humans. According to the first interpretation Artificial Intelligence is the tool to achieve automated decisions by machine. According to the second interpretation Artificial Intelligence is not perceived merely as a tool of computer science, but rather as a living organism, constantly evolving, with an eventual goal of mimicking natural intelligence and potentially conquer the same cognitive ability that the human brain displays.

In any case, one fact is true for both interpretations. Artificial Intelligence is constantly evolving, and rapidly so. The gap between algorithm-driven decision making, self-learning, and human-like cognitive ability might be huge at the moment, but it is getting narrower every year. The fact that artificial intelligence is still, almost exclusively, controlled by man, does not mean that it will perpetually continue to be so. It is very difficult to define the point at which Artificial Intelligence will act, freely enough in order to be compared to human intelligence because human intelligence is so complicated that it is extremely difficult to categorize and set a standard cognitive plateau that needs to be met.

This debate is of vital importance from a legal perspective. The same way that it is difficult to define at what point AI is “smart enough”, it is equally difficult to define whether it should be considered as property(res) or as an entity. There is already the example of AI controlling LLC companies but the question goes far beyond that. If AI at some point in the future, were to be considered as an autonomous entity, how should it be treated? Should it be treated as a natural or legal person? Should it have rights? Should it be held accountable? Should those legal definitions apply to AI the same way that they apply to existing entities or should a completely new legal entity be created, specifically designed to regulate and define AI?

On one hand it is truly difficult to decide what should be done, especially when examining a hypothesis that will probably not come true in the near future. On the other hand, one of the main disadvantages of the legal science is that it always comes late to the rescue. In order to provide the rules that will create a peaceful and organized society, the legal science has to first examine any aspect of human behavior that needs to be regulated. This takes time and as history has shown great regulatory reforms usually follow great societal, economic or technological changes. And although legal expertise has reached unparalleled improvement, it is still not enough to follow the extreme speed at which technology advances. That is why it is important to attempt to make as many logical assumptions as possible on order to react faster when circumstances demand

However much progress the human race has already made, human behavior still presents many flaws. We live in organized societies, yet most people still don't understand the importance of acting as a concise unit, rather than as individuals. The same manner in which human rights and laws are trespassed on a daily basis could apply to public reactions towards AI. It is highly possible that people would like to control it, even if it showed signs of true intelligence, and ultimately feel threatened by it. How should the law react to these implications? The more we pose potential scenarios that stem from the evolution of AI the more we discover the need to create new legal concepts and tools that will smoothen the transition into increasingly intelligent technology. Such concepts, however, cannot be created if we don't accurately define the current state of AI or the state which we expect it to reach in the near future.

Self-learning Algorithms

Self learning algorithms are, at the moment, the state of the art tool, as far as automated processes go. Self-learning is of great importance in the evolution of algorithm. It is not simply a feature that improves the decision-making ability of algorithms. It is one of the necessary steps that is needed to bridge the gap between algorithms and sentient intelligence. The ability to learn and to adapt accordingly is one of the main functions of the brain of the homo sapiens and of advanced mammals in general. If an algorithm can break the boundaries set by the original code and set of commands, surely step by step it can learn to change its function or even disagree with the orders given, should they oppose the adaptations that the algorithm has made itself.

Self-learning in Algorithms though, is not without boundaries itself. Algorithms do not magically evolve the ability to learn. It is a feature, embedded in their code. This means that the self-learning procedure is still defined by the programmer who writes the code thus binding the self-learning ability of the algorithm to his intentions. Algorithms are still unable to ask their own question or choose the aspect they want to improve upon. If they were able to accomplish such features we would probably characterize them as truly intelligent machines. The ability of algorithms to learn for themselves is a derivative from the processing of huge amounts of data. The more data a self-learning algorithm collects, the better it learns to process them. It can learn to categorize them, and separate the important from the non-important, thus reaching faster and better decisions. The algorithm can develop its own tendencies and even

produce a new, albeit similar, way to solve the task that it is used for. In other words the algorithm learns in order to make itself more efficient. Instead of the programmer having to make modifications to the algorithm to keep it updated, the algorithm itself improves at a rate faster than a human could improve it, as it is able to quickly calculate and assess insurmountable volumes of data.

Machine learning, although instructed in a specific way by the creator of the algorithm, can produce unexpected results. As algorithms and machines cannot, yet, truly act on their own account they can be driven to wrong decisions, if the data is not processed correctly or if the data is faulty. In fact even if everything is working as intended, algorithms can reach to a wrong decision the same exact way a human can do. A common example which also involves risk assessment are bank loans. Self-learning algorithms were designed to approve or decline loan applications. Through risk assessment the algorithm calculated the possibility of the debtor repaying the loan based on variables that the applicant provided to the bank. Then the algorithm decided whether the application should be accepted and under which conditions. The self-learning algorithm after processing thousands of data and applications, started to develop tendencies itself. Those tendencies lead the algorithm to misinterpreting the data and displaying discriminating behavior. In a few words the algorithm started linking the economic strength of each applicant with her residence or origin thus converting them to factors crucial for its final decision. This resulted in algorithms massively rejecting applications based on discriminatory factors. Self-learning algorithms cannot yet grasp the concept of causality and lack the ability of critically assessing the connection of the data they are provided with. Those kinds of behaviors cannot yet be solved by evolving the self-learning process of algorithms but rather, by ensuring that the code and the self-learning mechanism are strictly and clearly defined in order to set the algorithm in the intended path of learning. Regulatory intervention is also mandatory in order to protect the rights that are in danger by unaccepted algorithmic-driven decisions.

Liability

Liability is common and widely used notion in Private Law. In fact, if liability did not exist it would be impossible for a wide array of laws to function, as the connecting link between an illegal action and the entity that committed it would not exist. One would rarely be able to take legal actions for damages and compensation, as the law would not recognize who should be the one responsible for reimbursing them. Algorithmic-driven processes and self-learning decision making raise the question of whether the algorithm itself should be held accountable for its actions. Before diving into the specifics we should distinguish three different agents that could possibly bear liability. The first one is the creator of the algorithm. The second is the user of the algorithm. The third is the algorithm itself.

Liable Algorithms

It is quite safe to argue that algorithms, and AI agents in general, cannot, at their present state be held liable, in the same way that the other legal entities are. They do not make decisions out of their own sentient and critical thinking, they do not have knowledge of the law and the way it is interpreted, and most importantly they have

neither rights, nor obligations. As impressive as their functions may be, they are still *res*. Holding them liable would be impractical as it would not serve the purpose that liability is used for in legal frameworks.

Liabe Developers

The second option is to hold the developer of the software accountable for its actions. As he is the one that created the software, he should bear the responsibility for its actions. The problem is that since the AI itself lacks the intent that would justify its course of actions any action of the AI which could not predicted could falsely express the intent of the developer. Also, from a technological and economic point of view, such an argument would greatly discourage developers from improving the state of AI intelligence as the legal implications of their actions would be too heavy to take the risk.

Liabe Users

The third option is to hold the user of the software liable. This option is easy to apply if the user of the algorithm uses it in a way different than intended or against the instructions of the manufacturer. It seems unfair though to hold the user liable for any malfunction of the algorithm which is the result of unsuccessful or careless developing.

Accountability

It is obvious that it is difficult to find a working formula in order to hold algorithms liable for their actions . The gap that this difficulty creates can be bridged by Algorithmic Accountability. Although liability and accountability are nearly synonyms, liability refers more to the legal nature of responsibility whereas accountability is closer to the responsibility as a citizen. In algorithmic context, accountability tries to prevent the problems that advanced algorithms can cause by establishing a set of accountability mechanisms. A dual approach of the subject could prove very efficient. An ex-ante approach would provide the mechanisms that guarantee that the algorithm should work as planned and a post-ante approach would provide the mechanisms required for the surveillance and monitoring of the results the algorithm produces. Both the ex-ante and post-ante mechanisms should be filtered through the following principles. Accuracy, Explainability, Responsibility and Auditability⁶

Accuracy⁷

It is quite common for advanced Algorithms to present results different than expected or to display unpredictable behavior. The accuracy principle finds direct application to both the ex-ante and post ante mechanisms. Ex ante accuracy means that advanced algorithms must be developed following the highest standards and spend a sufficient time in alpha and beta phase before they are released into the

⁶ Nicholas Diakopoulos, Sorelle Friedler, How to hold Algorithms Accountable, MIT technology review, 17-11-2006, accessed 20-11-2019

⁷ Id

market. Post ante accuracy means that the algorithms need to be constantly checked even for the slightest errors. Those errors when found, should be categorized and analyzed in order to improve the ex ante accuracy mechanisms

Explainability⁸

The way an algorithm works and the results that they produce should be easily accessible to the people that are being affected by it. As the function of any algorithm is fairly technical, the explainability principle, supports that the technical information regarding an algorithm should be “translated” to the subject that uses the algorithm or is affected by it in words and notions that it can understand. Concepts like big data, machine learning or risk-assessment are not easily understandable by most people. Risk assessment algorithms in particular should be explained in depth, as they play a vital role in in wide array of applications that are easily and frequently accessible by a large number of people.

Responsibility

Responsibility⁹

Responsibility is probably the easiest principle to explain. Responsibility in algorithmic accountability means that a person should always be in charge of monitoring the various effects that an algorithm can have on the society. The following clarification should be made. The person in charge is not liable for the “actions” of the algorithm rather than responsible for the overview of both the ex-ante and post-ante mechanisms. The responsibility principle encompasses the difference between liability and accountability in the context of algorithm-driven process.

Auditability¹⁰

The principle of Auditability in algorithmic accountability does not present major differences with the notion of auditability in policy enforcement. It supplements the concept of responsibility by adding a third, independent party in the monitoring of the algorithm’s effects and results. It is used as both as a safeguard towards the correct application of the principle of responsibility and as an extra tool that can ensure that the ex-ante accountability mechanisms are working as intended.

Fairness¹¹

As algorithms try to reach automated decision through self-learning it is quite possible for them to reach unfair or illegal decisions. Sometimes they can express discriminatory or biased behavior because the data that they process display themselves discriminatory or biased values. Stereotypes, discrimination and all kinds of bias, are products of human behavior. For that reason it is unavoidable that Algorithms, when processing such data, will reach to the same, faulty conclusions. This fact dictates for

⁸ Nicholas Diakopoulos, Sorelle Friedler, How to hold Algorithms Accountable, MIT technology review, 17-11-2006, accessed 20-11-2019

⁹ Id.

¹⁰ id.

¹¹ id

constant evaluation both on the results of the algorithms and of the data that were used. The evaluation should also be available for public dialogue in order to increase the understanding of the society in regard to algorithms and even promote a sense of security about the way that algorithms are used.

Possible Legal Solutions

As accountability is the only useful tool we are forced to enter a field of legal assumptions that could potentially deal with the problem of AI liability.

Allocation of Personality

The most important step into trying to hold someone or something liable is to perceive it as an entity. In the beginning of law making there used to be only natural person. After the emergence of organized commercial transactions through the coordinated use of resources and entrepreneurship, legal regimes created legal entities. Unions of people who worked together towards achieving the same goal, could now use their union as independent entity, upon which personality was allocated. Personality is the central idea around rights and obligation unfold. It is only logical to try to tackle the algorithmic liability issue through the allocation of personality.

I have identified four ways to try to allocate personality to algorithms. The first two and most obvious ones would be to consider advanced algorithms either as legal entities or natural persons. The third would be to try to connect the algorithms personality to the personality of its developer or its user. The fourth one would be to create a completely new way to allocate personality, specially designed to fit Artificial Intelligence. Each method has advantages and disadvantages.

A legal-entity model

A legal entity is a lawful or legally standing association, corporation, partnership, proprietorship, trust, or individual¹² that is allocated with personality by the law, has the legal capacity and can be held liable for illegal actions. Legal entities have worked wonders for people associations as they provide them with the tools to act as one. On first sight, characterising advanced AI agents as legal entities would automatically solve a lot of issues. They would be recognised by the law, have the capacity to perform complex, legal-binding transactions and be held liable should the produce illegal results. The disadvantage in this case though is quite obvious. Legal entities are created according to strict prerequisites set by the law. If those prerequisites were to be enforced onto the developing procedure of Artificial Intelligence, it would hinder significantly its developing time and decision-making abilities. Additionally, legal entities are, governed and represented by natural persons. In that case it would be extremely difficult to set rules of governance and representation for an algorithmic legal entity. In addition, although legal entities are bound to their statute, they are free to amend it according to the rules that the

¹² The Law dictionary, Black's Law Dictionary Free Online Legal Dictionary 2nd Ed, accessed 7-2-2019

statute sets. All in all, legal entities are fully capable to reach decisions on their own, therefore the principles and measures regulating them would be really difficult to become adaptable with the needs and the very nature of advanced AI agents.

A natural person model

So, if legal entities seem incompatible with the concepts of AI, would the legal principles concerning natural person be more appropriate? Natural persons in law is a much easier concept to perceive. A natural person is simply “*A human being, naturally born*,”¹³. If we should interchange the terms of human and naturally with the term artificial could we apply to AI the same principles that we apply for natural persons. First of all it would be quite easy to allocate personality from a numeric point of view. An artificial being is easier to be perceived the same way a sole person is perceived, rather like an association of person. It will also possess legal capacity and be liable for its illegal actions. One could also argue that since a AI has become so sentient that there is a need for it to be held liable for its action, that it should be treated the same way as humans are, on grounds of equality. The problem in this notion is that until AI reaches such an ascended level of intelligence and cognitive ability, this kind of allocation of personality would be completely useless. Moreover, one just cant' replace the notion of a human, natural-born being with the notion of a human-developed sentient machine. Legal, ethical and philosophical questions arise regarding the connection of human intelligence with sentiments in comparison to an entity, that although sentient, cannot feel emotions.

Pseudo-allocation

Instead of directly allocating personality onto Artificial intelligence, there could be a possibility to legally bind the actions of AI on a person. This kind of pseudo-allocation would resemble the responsibility that people have over their pets actions, or the scheme with which some kinds of algorithms are protected by Intellectual Property rights, when their function is critically connected with a particular kind of machine. It also seems fair that the person that created the AI or the person that benefits from it, should also bear liability for its actions. By latching the liability of an AI to another person we could instantly solve all legal implications that can occur from its actions by transferring them to the person that the AI is “attached to”. This solution however does not differ much from the way that Law treats AI today. AI is treated like property, and the ones that can possibly held reliable for its actions are those who ask property rights on it. The developer or the user of the AI. This kind o arrangement has already been deemed insufficient. Since the level of AI will definitely increase in the future, the current arrangement will soon become obsolete, reducing the chances to reinstate it to solve liability issues caused by more sophisticated AI. The concept though, of latching an AI to a person should not be lightly rejected as it offers two great advantages. A sentient yet emotionless AI could be a threat for humans, since it could find difficult to understand laws and morals due to the lack of empathy. Connecting it to a person would not only solve this problem but also give a sense of

¹³ The Law dictionary, Black's Law Dictionary Free Online Legal Dictionary 2nd Ed, accessed 7-2-2019

security to the society. On the other hand moral and philosophical concerns rise again. Should an autonomous, sentient machine be connected to a natural person the same way property or pets are? Should human rights also apply for AI?

A model designed specifically for AI

Having discussed the use of the pre-existing legal tools of personality allocation we can easily deduce that all of them have significant drawbacks. The legal classification of the concepts that exist in the world is the following: Persons, legal entities, objects, ideas, living creatures, natural environment and Space. A self-deciding AI whether in its current or in a future advanced state, is neither of these things but it contains characteristics from many of them. For example AI is created the same way objects are created, but it has the ability of decision-making which cannot be found in any other kind of objects, but only in persons, legal entities and living creatures. That is why, in my opinion, the best way to allocate personality to AI would be to create a new type of entity, that would match the features that AI can accomplish. This legal “invention” should either be a new type of entity that would operate under the same rules that are connected to personality allocation on persons and legal entities, or a completely new type to perceive personality from a legal standpoint. A combination of both could also be possible. Such a creation would solve so many problems that could occur from the use of the previous models. First of all, the creation of new legislation give the legislative authority the opportunity to customize it to the exact needs and unique characteristics of AI. The legislative authority will already have years of experience with AI in order to spot exactly the problems that exist with the personality allocation of AI. Private Law has not accounted for the new realities of Artificial Intelligence. It is nimble and well constructed enough though, to be supplemented with new legislation without the need of fundamental reforms¹⁴. The main features of such a legislative initiative should be a legal definition of the newly created AI entity, the classification of AI and the clarification of which types of AI fall under the legislation and of course the main characteristics of the new entity(name, place etc). With those clearly defined and set, legislators can then move onto allocating personality to AI in a way that is both fair from a legal perspective and functional in reality.

Alternative Liability Approaches

Another way to try to hold semi-autonomous algorithms or advanced Artificial Intelligence accountable for their actions would be to change the way that we perceive liability or create new liability rules. This way we could skip, the arduous task of trying to allocate personality to AI. The general legal trend at the moment is to hold the developer liable for any obvious and foreseeable malfunction of the AI or the user for incorrect use or for misuse of the AI. As those trends hardly tackle the problems of AI liability there, a need appears for an alternative approach of liability

¹⁴ Scholz, Lauren, Algorithmic Contracts (October 1, 2016). Stanford Technology Law Review, Vol. 20, 2017. Page 50

Artificial Intelligence Negligence

Negligence is the most common ground on allocating liability to a person. Negligence means that the person responsible for the unwanted result, did not take all the precautionary measures to prevent it from taking place although he could predict the possibility of it happening. The general standard which applies for all persons is how an average and reasonable person would react. In the case of algorithms, negligence so far is allocated either on the developer who neglected to predict the possible outcome, or the owner/user who neglected to monitor the AI correctly. The scenario in which neither of them showed negligence but the AI still caused damages through its actions still remains unregulated. The concept of Artificial Intelligence Negligence tries to hold AI responsible for its actions without directly tampering with the concept of liability.

Artificial Negligence should work the same way that human negligence works. The Advanced AI agent did not take all precautionary measures to ensure that a possible risk that happened, was averted. The general standard which applies for persons should apply for AI, with just a little twist. When talking about person, it is quite difficult to define, how the average person reacts and thinks. That is why private law describes who is not considered an average person(for example kids at a very young age, or people with cognitive disabilities). With AI it is much easier to clearly define its capabilities. Therefore the general standard could be categorized or even individualized depending on the cognitive power and distinctive features of each AI. For example if an AI was designed to complete a very particular task, and someone used it to complete a slightly different task, the argument could be made that , under the general standard, that particular AI, however advanced, could not predict the undesirable outcome. This argument becomes really crucial in cases that the AI would indeed showed negligent behavior for its own standards, but even if it did not, the undesirable outcome would still happen. The rule of causality should still connect the negligence shown with the outcome.

Although AI negligence though does not come without drawbacks. Even if AI negligence was applied and legislated the problem the remedial satisfaction of the one that was damaged would still be impossible as AI would not possess property or assets. In fact the position of the one damaged would be worse than before as the negligence and liability for the damaging act would be bound to an entity which cannot actually remedy the damage that it has cause. A possible solution to this problem would be to create¹⁵ compensation funds, specifically designed for AI systems. Those funds would serve the same role that auxiliary insurance funds do. In Greece for example, an auxiliary compensation fund exists in case a person is damaged by someone else who is not covered by insurance. Every Greek citizen that is covered by insurance, apart from the premium, also pays a small fee dedicated to this cause. Quite so the developer or the user of AI could pay a small fee in case the AI has to compensate for damages that it has caused.

¹⁵ Mak, V., Tjong Tjin Tai, E., & Berlee, A. (Eds.) (2018). *Research handbook on data science and law*. Edward Elgar Publishing, page 79

Non-human liability

A concept that is particularly popular among scholars¹⁶ is to allocate liability to AI the same way that it is applied for movable objects and animals. This means that the liability for the actions of the AI will be transferred to the owner. The justification for the application of such strictu-sensu liability is that since he acknowledges the risk, however minimal, that the AI can potentially cause damage, he accepts it the moment he turn the AI into operation. On the one hand such an approach would easily bypass the problems that exist with the pseudo-allocation of personality on AI, as liability would be the only aspect of personality that would be allocated to the person. On the other hand such allocation of liability would only temporary solve liabilities issues as it will eventually become obsolete as AI progresses and develops. There will definitely come a point in time when the actions of AI will be really difficult to be compared to those of animals, or strongly dependent on the person operating them. It is important to note though, that for the time being, this is the solution that is most widely used in Europe with the likes of Germany and France adopting and evolving it. Albeit not quite concise and complete in terms of legal theory, this solution bridges the gap in practice and every day life, until more suitable and elegant solutions are designed and applied.

Limitation of Liability

Since liability causes so many problems to the functions, development and monitoring of AI intelligence, one could probably support that maybe AI should not be liable at all. As simplistic as this notion may sound it is not without a foundation in the history of legislation. Complete erosion of liability may sound axiomatically incorrect and definitely poses significant dangers, but the limitation of liability is a concept that has existed in the past and is currently in effect in Europe via the GDPR. The adoption of immunity rules for semi-autonomous software and AI can prove extremely useful in creating a smooth transition period until the liability issues of AI are more efficiently dealt with. During the limitation period, legislators can experiment on which solution or framework is the appropriate one to resolve the AI liability issues. The example of ISP's is a perfect match for this case. Initially ISP's were exempt from liability rules. As time passed by, both legal theory and courts around the world started to better understand how ISPs work and how they should be regulate. ISPs used to bear 0 liability for illegal actions made by their clients(the users of the internet. Piracy and illegally downloaded material had become a huge issue. With the implementation of the GDPR the ISPs can be held liable if the have knowledge of the illegal actions of their clients and they take no measure to stop them. Limitation of Liability has proven to be effective and could in-fact find immediate effect for some uses of AI that are directly beneficiary to the public such as medical algorithms and autonomous vehicles. The gains of a limited liability policy on such AI that greatly benefits the society outscale the risks of an AI causing damages. In other words while strict application can work as a deterrent for the creation and development of beneficiary AI, limited liability can serve the exact opposite purpose by giving the correct incentives.

¹⁶ Mak, V., Tjong Tjin Tai, E., & Berlee, A. (Eds.) (2018). *Research handbook on data science and law*. Edward Elgar Publishing. page 69

Governmental Monitoring

As with any problem that may occur in an organised state, governmental monitoring can offer provide the tools to solve it. In the case of algorithmic liability governmental monitoring can help ensure that a common way to resolve the problem is agreed. Policy makers can make use of the algorithms itself to promote monitoring. The most integral target that has to be achieved through governmental monitoring is the clarification of the liability ambiguity that exists in algorithm. Although computer scientists can build algorithms to permit after-the-fact assessment and accountability, it would be much more convenient to attack the source of the problem and enforce ex-ante controlling and monitoring mechanisms. Such a task should be carried, though, with extreme caution, not only to avoid violating civil rights of the developers but to ensure that developer will not meet excessive or illogical hurdles that could discourage them from keeping developing software

Conclusion

Artificial Intelligence has become an integral part of everyday life. Whether it is through the use of a cell phone or through the completion of a commercial transactions algorithms are almost everywhere. Some kinds of algorithms are so developed that have the ability to reach their own decisions and modify their behavior through self-learning

As long as AI is working as intended, everything's fine. The moment though, an algorithm makes a mistake or produces unpredictable results, problems become to emerge. The three pillars around which those problems revolve are the following. Automated, algorithm driven process, machine learning, and liability.

The evolution of big data has made the decision-making and self-learning process of algorithms extremely complex and unpredictable. Automated decision making and self-learning make it extremely difficult to categorize and perceive algorithms as objects. The problem is that it is equally difficult to perceive them as natural persons or entities. On the one hand if we cannot perceive them in any legally efficient way it is very difficult to hold them accountable for their actions. On the other hand, if hold their developers or their users accountable for every mistake that the algorithms make, then they will correspondingly stop developing and using them. Technological miracles that took years to develop will have gone to waste.

Another approach to the liability issue is the promotion of accountability of algorithms. Accountability focuses more on the prerequisites that an algorithm must meet in order to avoid to producing illegal or unwanted results. Although the accountability concept can seriously reduce the amount of unwanted, algorithm-produced results, it serves only as a prevention measure and cannot deal with a real case where an algorithm or an Artificial Intelligence agent has caused damages

For those reasons the main issues that have to be tackled are the allocation of personality and liability. Those issues, unfortunately, cannot be handled in a traditional way because private law does not provide the tools to do so. New creative and innovative way must be found in order to fill the gaps that currently exist in private law without having to fundamentally reform it. In the meantime, it would be extremely

useful to create practical and easy to perceive, however incomplete tools, in order to bridge the gap until Law Science after serious research and experimentation can find the exact correct tools to regulate the captivating, yet extremely complex and difficult to deal with, concept of Artificial Intelligence.

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Appendix

