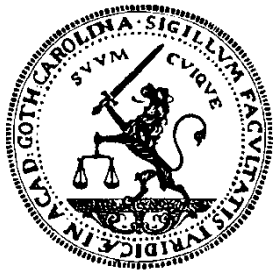

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Abbreviations

AI	Artificial Intelligence
ANN	Artificial neural network
DNN	Deep neural network
EU	European Union
ML	Machine Learning
ODR	Online dispute resolution
P2P	Peer to peer
PoW	Proof of work
US	United States

1. Introduction

1.1 Purpose

This thesis will debate two important topics that could probably be interconnected in the near future.

The first topic to be analyzed, will be the Blockchain engine which is used currently as a digital ledger all around the world, from cryptocurrencies to registering pieces of lands or for the full process of how a diamond is being discovered up until it is sold. Blockchain is a forever growing 'phenomenon' in the digital era and one of the main purposes for this thesis will be to understand how it works, why is it being used and if it can in the near future be legally binding or enforced by national or supra-national Courts. As every other system, Blockchain may have its own flaws, as well the primary focus of this thesis will be the dispute resolution doctrine and if it can be applied in the blockchain as a legally binding measure and if so how could it be implemented and also how will it work.

The second topic of this thesis, is Artificial Intelligence, which since its invention in the 1950's, is still a topic for the future but with possible appliance in the present times.
The purpose of adding the Artificial Intelligence theorem to this thesis, is given by the fact that Blockchain is a fast processing engine for a plentitude of actions and only a 'machine' could keep track of every transaction made on the chain and also could find easy and fast ways to resolve occurring issues.
For this topic the thesis will try to debate is if Artificial Intelligence could be viewed in present times as a legal enforcer and if it could be given a legal status in the present society.
The question of how AI works and how it could be implemented or if it can be implemented as a 'law enforcer' on a future legally binding Blockchain, will be discussed in this thesis.
The main focus of the AI topic will be that of understanding if a machine could have a more balanced view over different future legal issues; if the algorithm inputs are safe to be legally binding and if the algorithm could find solutions with a known reason that is based on the processing unit of the AI; and finally if AI is more suitable than a man/judge/legal enforcer to settle disputes and if so could the AI be biased given the fact that algorithms are an input given by human kind.
As a result, the final goal of this thesis is to present a future solution to an Artificial Intelligence operated Blockchain that could find fast and legally binding resolutions to disputes that may appear on the engine.

1.2 Research questions and delimitation

This topics of both Blockchain and Artificial Intelligence are vast and are, currently, not embrace by any Legal system to their full potential. Thus, the thesis will have a large spectrum over all types of legislation around the globe with delimitations only being related to the dispute resolution doctrine that is covered by any nation's legal rules.

As to delimitations towards the Blockchain, the thesis will analyze the basics of the engine and where it is needed it will go into depth of the technicalities that may occur trying to solve some topics.

As well, with the Artificial Intelligence topic, there will be analyzed every subject that is related to a possible engine that could act as a 'Judge' in solving disputes on the Blockchain.

True Artificial Intelligence is not yet regulated by any legislation in the present times, thus, making a delimitation nearly impossible to be set, but this thesis will limit to debate only the topic related to the dispute resolution procedure and also to the transposition between legally binding contracts and smart contracts which can be found on the Blockchain.

The more basic questions to be answered have been highlighted in the previous subchapter 1.1, regarding Blockchain and Artificial Intelligence.

As a result, the question that will revolve around this thesis will be:

1. Could Blockchain be legally binding and incorporated into every nation's legislation?

2. Could Blockchain and Artificial Intelligence work together to create a new Digital Court for dispute settlements and thus, eliminating the need for a physical and time costing Court?

2. Blockchain

2.1 Short history

Stuart Haber and Scott Stornetta, were the first ones to conceptualize a crypto graphical set of chains that could safe keep timestamps of works done on the system without anyone tampering with it.[1] A lot of specialists think that Haber has aided Satoshi Nakamato with the invention of the bitcoin blockchain and further conceptualized it for other uses as well. [2]

Blockchain was a system that first appeared in 2008, and it was invented by a person or group called Satoshi Nakamoto which later was found to be a pseudonym and not a real person, but it is still not proven. Satoshi invented the blockchain for the use of cryptocurrencies and mainly Bitcoin at the time, for user to have an easier way to make transactions across a secure network.[3] Nakamoto believed that this system was needed for transactions to be handled between two parties without the necessity of a third one to approve of a specific transaction thus, making it faster and secure at the same time. With this Nakamoto has tried and succeeded to protect any of the parties, buyer and seller, by making it impossible to reverse any transaction that take place on the blockchain.[4]

2.2 How Blockchain works

Blockchain, as previously said, is a secure shared cryptographical public ledger that helps users to make transactions without any third parties authorizations and in which user can have access to all already done transactions but without the possibility to alter them or to control them as the system is similar to a file that is installed on every user's computer and only has access to it by making transactions. Blockchain operates on a peer to peer network (P2P), where all the users run the same protocol (blockchain engine) and where everybody holds o copy of the ledger with all transactions that have been made until the present day. This ledger has been built on chain of blocks that have multiple transaction on them, similar to a brick wall where every brick/block contains timestamps of the transactions and their validation by the network itself. [5]

Further on, we will analyze most of the concepts such as "blocks", "nodes", "hashes", "timestamps" etc. that make the blockchain work.

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[1] 'Blockchain', https://en.wikipedia.org/wiki/Blockchain#History , accessed on 28.02.2019
[2] 'Stuart Haber', https://www.worldcryptoindex.com/creators/stuart-haber/ , accessed on 28.02.2019
[3] 'Blockchain', https://en.wikipedia.org/wiki/Blockchain#History , accessed on 28.02.2019
[4] S. Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System', Bitcoin Nakamoto Whitepaper, p.1
[5] S. Voshmgir, V. Kalinov, 'Blockchain A Beginners Guide', Creative Commons, 2017, p. 4-6.

2.2.1 Blocks and Hashes

Blocks are the 'ledgers' in which data is collected from all transactions previous, present or possible future. Taking the example of the Bitcoin Blockchain it is estimated that around 500 transactions are within only a single block.[6]

In a block, all the data is permanently stored and users can access everything that has been 'written' and 'approved' in this blocks to in so much as verifying (at least on the Bitcoin Blockchain) if users have made transaction with other users and if they have received their payments.[7]

By comparing to something palpable, the entire blockchain can be regarded as a ledger and where the blocks which build it are the pages from that ledger.

Blocks encompass data that is based on previous transaction but with application in the present time that can help future transactions happen and even the construction of a new block on the chain. Every block holds within itself data that was mined in previous blocks along the chain.

This past data will become the header of the present block and it is called the 'block hash' which means that the present block is a valid block as the previous one has ended recording transactions. This hashes are to be found in all blocks at it helps build up the entire chain with the data of past transactions.

Hashes are also used as parts of identifying blocks as every single block on the chain has a unique cryptographically originated hash. Each and every new block creates a hash of its own by using the previous block's hash this allows users to identify blocks on a chain and also to identify the origins of the new block.

There is also another way to find out a block's identity by checking the block's height on the chain, but it can be difficult at times as multiple blocks could be at the same height.[8][9]

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[6] 'Blockchain: what is in a block?', D. Cosset, 2017, https://dev.to/damcosset/blockchain-what-is-in-a-block-48jo , accessed on 3.03.2019

[7] 'Block (Bitcoin Block)', 2018, https://www.investopedia.com/terms/b/block-bitcoin-block.asp , accessed on 3.03.2019

[8] Ibidem.

[9] 'Blockchain: what is in a block?', D. Cosset, 2017, https://dev.to/damcosset/blockchain-what-is-in-a-block-48jo , accessed on 3.03.2019

2.2.2 Nodes

The 'nodes' or 'masternodes' on the Blockchain are one of the most important part in how the chain operates. Nodes can be defined as storage units for the blocks/transactions within the blocks and mainly these units are computers, laptops or even high performance servers. Any device that is connected to internet or to a server that has internet access and has its own IP can become a node of the network. Taking the example of the Bitcoin node, all of the transactions that happened in this specific network are registered in the nodes and can be made accessible to any user of the interface.
Nodes can come in two forms, full nodes and light nodes. Full nodes are a copy of every transaction that has happened on the blockchain network since it has started registering while the light node is just a copy of transactions that has happened in the last month or just a recent history of these transactions.
Nodes can be regarded as the safeguardian of the cryptocurrency network as it is almost impossible to hack or alter any data as long as there is still a copy (full node) on a device that has operated on the system.
This nodes can protect the blockchain network as in case of a system crash or massive hacks and even power outages, the system is safeguarded inside the node as it does not affect any data written in the node.
Thus, it is almost impossible to shut down the Blockchain network it would take an enormous brute force hack or even a massive electromagnetic impulses that are systematically deployed around the world to crash the system but in the end as long as just one full node survives the blockchain system survives as well.[10][11][12]

Users that run full nodes do not get paid, they are just running the nodes for the cryptocurrency system to run safe and for it to have continuity.
Miners that want to add new blocks on the chain have to be validated by the existent nodes, based on the legitimacy of the ongoing transactions, therefore, a node's 'job' is to:
a. check the validity of the transaction;
b. save the blocks on the chain if they are validated and store them;
c. transmit the new data towards other 'interested' nodes for the safekeeping of the transactions.[13]

[10] 'How nodes work on the blockchain', 2018, https://www.worldcryptoindex.com/how-nodes-work/ , accessed on 10.03.2019
[11] 'Nodes', 2018, https://lisk.io/academy/blockchain-basics/how-does-blockchain-work/nodes , accessed on 10.03.2019
[12] 'Blockchain: What are nodes and masternodes?', Jimi S., 2018, https://medium.com/coinmonks/blockchain-what-is-a-node-or-masternode-and-what-does-it-do-4d9a4200938f , accessed on 10.03.2019
[13] Ibidem.

2.2.3 Timestamps and proof of work

Every block that is put on the blockchain has different identification and verification "pieces" that validate it on the chain. One of the reasons this two subjects will be discussed in the same chapter is because both, timestamps and proof of work, are 'tools' that can verify and certify that a specific block can be put on the chain.

In the white-paper Satoshi wrote about blockchain it is mentioned that timestamps are of use to prevent the double-spending issue. It comes as an overprotective measure; other than previously mentioned block hashes. Every timestamp is registered with a Unix system timestamp. The Unix time is a system that can encode the timestamp on the blockchain to single number that can encompass every detail regarding time such as years; months; weeks; days; hours; minutes and seconds. For example the date of 17th September 2004 with the time of 23:59:58 would be transferred and encoded through Unix as 1095379198.75. Thus every time there is a new block or node on the blockchain it receives the timestamp of the previous work as a validation along the block hash giving the user the assurance that the block has not been manipulated. Timestamps can be viewed as the stamps that a notary office puts on the papers that are about to go through the process of being approved and legalized by the office. BlockNotary is a phone app that allows you to timestamp every media file you have on your phone and put in on their blockchain such as photos; videos; receipts; app extensions, etc. This app is used in different states such as Vermont; Illinois; Hawaii and Arizona. Vermont was one of the first states to recognize that blockchain can have legal benefits towards registering documents/media files and has issued a law H.868 Act 157 that is applicable since 2016 (in the state of Vermont). [14] [15] [16] [17]

Proof of work (PoW) is another utensil which can help users identify if previous blocks and current mining blocks are validated by the system and are safe. The PoW works together with the timestamp to validate a block and all pieces of data are put in the same hash with the number starting at zero bits. This value is found in all new blocks with the name of 'nonce' and is left 'unwritten' until a value is given through that nonce by a timestamp and a PoW. Proof of work is also the main 'tool' for mining, that is used to solve the blocks and the mathematical problems within the block (for example to solve a block to mine a bitcoin the proof of work is required to validate the answer to the mathematical problem). Similar to the timestamp the proof of work is another way to solve the double-spending issue.[18] [19]

[14] 'Vermont Blockchain Law', 2018, https://www.blocknotary.com/vermont-law, accessed on 30.03.2019
[15] 'Unix Time', 2019, https://en.wikipedia.org/wiki/Unix_time, accessed on 30.03.2019
[16] 'Block Timestamp', 2019, https://en.bitcoin.it/wiki/Block_timestamp, accessed on 30.03.2019
[17] S. Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System', Bitcoin Nakamoto Whitepaper
[18] 'Proof of Work vs Proof of Stake: Basic Mining Guide', 2017, https://blockgeeks.com/guides/proof-of-work-vs-proof-of-stake/, accessed on 30.03.2019
[19] 'Proof of work', 2019, https://en.bitcoin.it/wiki/Proof_of_work, accessed on 30.03.2019

Thus, both timestamps and PoW work together in the aid of both users that want to check the legitimacy of a block/blockchain and for miners, to help them solve the required mathematical problems to achieve a specific reward.

2.3 Usage of Blockchain and legal enforcement

2.3.1 Types of usage

The blockchain, as previously stated, can be used in a plentitude of areas. In this chapter, we will try to exemplify some of the usages and if it can be legally enforced and also if it would be beneficial to be enforced. As we saw in the previous chapter, in the United States, specifically, the state of Vermont has issued a law where blockchain authorized media files or documents can be legally binding. (H.868 Act 157)

There are 3 types of Blockchains available at the present moment and those are: a. private blockchain; b. public blockchain and c. consortium blockchain.

A private blockchain means that access is restricted to it by certain parties and is mostly used by companies that wish to safe keep their data. In a private blockchain there is just one private entity that is the owner of the chain and not everybody can audit or inspect the chain unless it has a permission to do so. Thus, the chain is not decentralized, as a public blockchain would be, and the owner has the ability to override certain data on the chain. Private blockchains are faster in comparison to the public ones because there is less usage of computing power as not as many users are profiting of it and not everybody has to have a copy of the blockchain running on their computers.[20]

Public blockchains are the most dominant type of usage on the market, the most used and prolific chains are the Bitcoin Blockchain and the Ethereum Blockchain. As the name suggests it is open for everyone that wants to use the system and it can be reviewed at any time. All transactions across the system are made public and anyone who uses the blockchain can verify it at any time. These public blockchain work on a proof of work basis discussed above where most of the users are rewarded for their work on the chain whether they are miners or simply vouchers that validate the works. The system is decentralized meaning that no one is the owner of the chain and at least one copy will always be safe guarded on every user's computer. By being decentralized the system is nearly if not impossible to be corrupted or altered in any form.[21][22]

Consortium blockchains are in a way similar to private blockchains in which, not everybody is able to access the chain without a prior authorization from an owner. These types of chains are mainly used by groups or undertakings most of them being used in

[20] S. Khatwani, 'What Are Private Blockchains & How Are They Different From Public Blockchains?', 2018, https://coinsutra.com/private-blockchain-public-blockchain/ , accessed on 10.04.2019
[21] Ibidem.
[22] S. Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System', Bitcoin Nakamoto Whitepaper

the banking sector. Some examples of consortium blockchains are Quorum, Hyperledger and Corda. Taking the example of Quorum, the blockchain system is used for providing financial security for the banking sector while using Ethereum and smart contracts.

Thus, using a consortium blockchain undertakings can easily do business with one another as the system is faster than for example signing a normal contract for providing services whereas on the chain, a smart contract will be faster and more secure.[23]

As we have previously discussed, the usage of the blockchain technology can be very broad. From registering land to legalizing documents similar to a notary office, or helping the financial sector cutting down the costs of different transactions, the blockchain could become one of the most useful tools that the internet can provide.

One of the main topics to be discussed in this thesis will be the usages of smart contracts and how they could help solve the enforcement of blockchain as a legal standard and also, possible dispute resolutions as smart contracts derive their core basis from legally enforceable contracts.

Smart contracts are similar to a computer protocol where the 'clauses' settled by the parties will be self-executed. For example a smart contract based on a bet that team A will win by a goal difference of two in the semifinals of a cup against team B and the goals will be assisted by only one player the contract will have the inputs settled by the contracting parties and when all this 'clauses' are met the wining party will not have to transfer any goods by its own as the inputs in the smart contract will already have done it if all the clauses are fulfilled.

The blockchain is the best platform for smart contracts to be settled on, as it gives full transparency and also a validation and confirmation of the work that has been done on the contract that cannot be altered with thus the inputs in the contracts can hardly be altered.

The main issue at hand is if smart contracts and blockchain can be legally enforced which will be discussed in the next subchapter.

[23] T. Mueller, 'Public vs Private vs Consortium Blockchains — what's best for enterprises?', 2018, https://medium.com/evan-network/public-vs-private-vs-consortium-blockchains-3ad180d1e74, accessed on 10.04.2019

2.3.2 Could it be possible to legally enforce blockchain and smart contracts?

As smart contracts are derived from legally binding contracts and the blockchain is just the platform that can enable them to be settled there could be a substantial possibility that in the near future smart contracts could become legally binding alongside the blockchain system as one better the other to work properly. We have previously stated that there are laws at least in the United States where they are trying to legally enforce documents that have been registered in the blockchain system.

But the main problem at issue is if these 'tools' are going to be binding how will they be settled in case of possible disputes? Smart contracts can be the solution for these disputes as the 'clauses'/inputs that are written in these contracts are self-executed because it involves the program to run the actual and factual evidence that has happened after the contract has been closed without it being able to be altered. But as it happens on the internet and online disputes resolutions (ODR's) are not legally enforced yet, it would prove a huge amount of law changing for the lawmakers to fulfill.

As ODR's are not in themselves regulated and there is not a uniform platform form them to be settled on all around the world they have to be settled in public courts or through the own websites of goods sellers. Even though the EU has created a regulation for uniformity across all member states (ODR Regulation 524/2013) it is difficult to transpose this into cross-border conflicts. But even in this case there is not legal enforcement of ODR's and most of them are settled through voluntary compliance as in case of the eBay Resolution Center that comes in the aid of buyers to solve disputes risen from their own website. One of the solutions for enforcement of the ODR's is form them to be settled upon on public courts where the 'victim' is given an arbitrational award.

There is also another way to solve this disputes through a user review system where buyers and sellers alike can review each other's compliance to the service that they provide but this system as well is not legally enforced. But one of the most lucrative ways to counteract the disputes could be the usage of the blockchain system as private-enforcement can help the resolutions to be solved without any interference from human biases.

As previously stated through a smart contract that could be used in all types of transactions between parties, the clauses are going to have immediate effect as the inputs can not be altered.[24]

[24] R. Koulu, 'Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement', Volume 13 Issue 1, 2016, p. 41-69

2.3.2.1 Smart contracts and their resemblance to legally binding contracts

The blockchain can be used similarly to a notary office, as approval of smart contracts. As the system is a based on a public ledger, everybody can verify the contracts and the clauses that have been introduced into them. Most of these smart contracts can be seen on the Ethereum blockchain, as they help the users to do business faster and more secure and also, this platform was designed for smart contracts. It is obvious that, these smart contracts draw their basis from legally binding contracts the only difference is the 'smart' term which stands for contracts that can be written on a software. They could be viewed as legally relevant actions as their clauses are self-enforced meaning that the system executes the contract by allocating the goods that have been contracted towards the parties bound by the smart contract. By being self-enforced contracts, the 'payment' is not affected by any third parties and is not being held up by 'bureaucracy' nor is it stopped by the debtor being able to fulfil his duties as the 'goods' have already been placed in the inputs of the smart contract. Thus, smart contract can and will have the ability to change the format of entering in online agreements and of course any online dispute resolutions. By trusting the decentralized network that the blockchain provides it will mean the replacement of entrusting towards any type of third party with acknowledging the validity of a contract. With this in mind, the lawmakers will find it difficult to find the boundaries between the original contract and the execution of it and also, how to differentiate between contractual law and procedural law when they will try to eventually legalize smart contracts. As specified above, smart contracts could solve the ODR's problems as their self-enforcement could prevent any types of conflicts between contracting parties. Thus, smart contracts could become more efficient that courts and will solve any contractual disputes faster. The difficulties for smart contracts come from 'translating' them in a legal format as digital inputs are not covered by law. Even though, smart contracts operate on the same similar logic as legally binding contracts where two or more parties are willing to enter a contract it is hard to transpose the digital clauses into legally binding clauses without a proper framework for it. As the digital clauses have to reach out towards external factors (for example a sports application to see the correct score of a game that is part of the contract), these factors have to be unbiased and trustworthy and as applications are not always correct in showing results this could compromise the efficiency of smart contracts.[25]

But, is it possible for artificial intelligence (AI) to overcome this disputes that may occur? This question will be answered in the next chapter as we try to analyze the

[25] R. Koulu, 'Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement', Volume 13 Issue 1, 2016, p. 41-69

possibility of introducing AI technology into the blockchain system that could help almost any type of issues or disputes that may occur on the blockchain.

3. Artificial intelligence

3.1 Short history

The first ideas that emerged about Artificial Intelligence can be traced back to ancient times where many thought it would be possible for machines or artificial species that could have been crafted by humans to achieve a high level of consciousness and intelligence. Pascal has invented in 1642, the first mechanical calculating machine and could be regarded as the founding steps of the invention of AI. In 1943, Warren McCulloch and Walter Pitts, have established the first foundations of neural networks by comparing computing power of a machine with the brain waves of a human being.

In 1950, Alan Turing one of the most influential scientists that have grasped around the concept of AI and is regarded as one of the founding fathers for this idea, has created the Touring test that can provide an insight of how intelligent an AI, can be. This test was made by Turing to see if an AI has the ability to show sights of intelligence similar to human beings. A human evaluator thus asks questions towards two parties knowing that one is human and the other an AI but being separated by walls the evaluator has no idea who is answering the question. This is where the test really comes is in effect as for the Turing test to be passed by an AI it has to give answers similar and indistinguishable from a human being. After five years since Turing provided us with his test, the term Artificial Intelligence is coined by John McCarthy in the conference that has started the evolution of modern times AI.

In 1965, ELIZA is one of the first programs that used artificial intelligence to handle dialogues with its users on different topics and since then the artificial intelligence idea has begun to grow in more areas such as the Roomba vacuum cleaner that is using AI to avoid obstacles; or the Deep Blue program that has challenged and beaten the then world chess champion Garry Kasparov; and now has become more common and could be seen in almost every household with the like of Siri, Cortana or Google Now that are completing simple tasks.[26] [27] [28]

[26] 'History of artificial intelligence', 2019, https://en.wikipedia.org/wiki/History_of_artificial_intelligence, accessed on 28.04.2019

[27] 'History of Artificial Intelligence', 2019, https://qbi.uq.edu.au/brain/intelligent-machines/history-artificial-intelligence, accessed on 28.04.2019

[28] 'The history of Artificial Intelligence', 2019, http://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/, accessed on 28.04.2019

3.2 Machine learning model: Logistics regression vs probabilistic intelligence vs neural networks vs emergent intelligence

For the better usage of artificial intelligence in the blockchain system, this chapter will analyze 'learning' types that could be applied on a future AI, and it will compare all of them to see which one could fit the needs of resolving all the disputes that could emerge from the blockchain transactions.

3.2.1 Logistics Regression

Logistics model or logistics regression is a well-known statistical format where the final output can be a 1 or a 0 in a system, or a true/false, in a more common understanding. It is frequently used to classify results in a binary format where the inputs can only have two possible results. For an AI that is programmed to use the logical intelligence system, it will mean that it will only analyze the inputs that have been given to it in different formats either in written language or mathematical problems without questioning the reasoning behind it or if the statements, that have given a positive/negative result, make sense. Thus the format that the AI will run will be called a logic-based system where we can find different types of inputs such as: a. Propositional logic; b. first-order logic; or c. knowledge based logic.[29]

a. Propositional logic

For an AI to be able to achieve propositional logic a programmer has to input a formal alphabet routine were it enables the program to understand sentences based on that alphabet. For example if 'stealing is a crime' and 'the thief is stealing' the program could come with the conclusion that 'the thief is a crime' (which has no sense). But it can be more advanced as a programmer could impose semantics for the AI to reason with them such as: 'stealing is a crime' and 'the thief is stealing' if 'a person is stealing it could be named a thief' could result in the AI drawing the conclusion that a person that has committed the crime of stealing is 'the person is a thief'. In such case the AI will have the final answer when it is inputted into the machine that of true of false if the person is a thief. But by only using this type of intelligence/logic on the AI it will only be limited by the inputs the programmer is writing.[30]

b. First order logic

Similar to propositional logic, the first order logic has in its core system an alphabet that guides its answers. What is different instead is that the machine is able to have word recognition and receive inputs as more than just 1's and 0's. Thus similar to the example

[29] R. E. Neapolitan, X. Jiang, 'Artificial Intelligence With an Introduction to Machine Learning', Second Edition, 2018, p. 1-48

[30] Ibidem.

above it could give a proper response such as the 'person is a thief' rather than true or false as the AI could recognize the elements of 'stealing', 'person', 'thief'.[31]

c. Knowledge based logic

The first two options that could be used for an AI to provide some sort of resolutions to problems, are not that powerful as the program is constrained only by the inputs and the purpose it was given to with without the machine being able to enlarge its reach in solving different disputes, thus, they are called 'weak methods'. The knowledge based logic is a 'power method' or an 'expert system'. This could be seen as an upgrade to the two previous methods because it is built upon them and it is then programmed for more advanced 'thinking'. For an AI to work with such a powerful system it has to be given a specific domain in which almost all of the data that has been collected can be analyzed by the AI. For example, the blockchain technology could be a domain for a knowledge based AI to prosper as the chain gathers and keeps all of the data that has passed through its system.[32]

All of the above mentioned methods, could be used as a compound one for a logistics regression based artificial intelligence. In the regression logistics format, an AI is being thought how to learn by being supervised. Regression, is the most used format in the present times to help build AI's that could, in a way, evolve, but only by being supervised by its programmers and not by itself.

3.2.2 Probabilistic intelligence

Artificial Intelligence programs that are programmed to deal with probabilistic models are based on the logical format but are given different rules on which they can base their responses. This model can, in most ways, emulate a human like decision making response based on probabilities of future actions. One of the rules of this program is given by the 'uncertainty inference' meaning that all possible solutions could have different reactions to different inputs.

Thus, an AI running this platform, can give for example the probabilities of transactions to happen on the blockcahin given a certain period time or the probability that a miner will find the right mathematical solution for a bitcoin. The program will run on variables from the data that has been collected so far on the blockchain giving precise answers based on the knowledge contained on the chain.

[31] R. E. Neapolitan, X. Jiang, 'Artificial Intelligence With an Introduction to Machine Learning', Second Edition, 2018, p. 1-48
[32] Ibidem.

3.2.3 Emergent Intelligence

Emergent intelligence is divided into two categories: a. evolutionary computation, and b. swarm intelligence. As the previous forms of possible artificial intelligence engines that could be used in a blockchain system were only focused on how a single human or a single mind could model the way AI 'thinks'; either in a logical reasoning or probabilistic reasoning, the emergent intelligence deals with how an AI could evolve by itself, similar to a group of people or the evolution of human kind.

a. Evolutionary Computation

"Evolutionary computation endeavors to obtain approximate solutions to problems such as optimization problems using the evolutionary mechanisms involved in natural selection as its paradigm".[33] This format allows the AI to evolve by keeping the best parts of its algorithm as the inputs are called genetic algorithms they follow the same genetic rules as humans where the fittest one can 'survive' and 'reproduce' indefinitely by keeping the best traits from previous algorithms. *"[…] in genetic programing the individual represents a program that solves a problem. The fitness function for the individual in some way measures how well the program solves the problem. We start with an initial population of programs, allow the more fit programs to reproduce by crossover, perform mutations on the population of "children", and then repeat this process until some terminal condition is met."*[34] As a consequence, the AI will keep evolving by itself by repeating the processes that it needs to evolve and 'deleting' everything else that it is out of date or has no use in its further 'quest'.[35]

b. Swarm Intelligence

Unlike the previous formats the swarm intelligence can be envisaged as multiple AI's that work together for a single purpose. Thus, each AI will have a definitive purpose on a task and for it to solve a problem it will have to be an answer that is based on the work of all the AI's. "*Swarm intelligence is intelligent collective behavior that emerges when some group of autonomous, non-intelligent entities interact."*[36] There are two forms of swarm intelligence; one that is derived from the ants behavior called 'ant colony'; while the other is called 'the flock'. By following ants behavior, programmers can input into the AI's system artificial ants or 'agents' that can mimic ants collective. Similar to how ants find the fastest and shortest way towards their nests to bring food, the 'agents' can work together as a whole to reach a final solution. Similar to the Blockchain network this type of intelligence does not have a central guiding 'hub' as the Blockchain's similar decentralized network which means that every agents can work on its own but the

[33] R. E. Neapolitan, X. Jiang, 'Artificial Intelligence With an Introduction to Machine Learning', Second Edition, 2018, p. 349-375
[34] Ibidem.
[35] Ibidem.
[36] Ibidem.

'colony' as a whole have to conclude to the same problem resolution; similar to how miners work to 'dig up' a Bitcoin.[37]

3.2.4 Neural Intelligence

The neural intelligence is different from all three previous mentioned forms of AI programming as they were based on either human intelligence representation or group intelligence. Therefore, the format that will be discussed further on will be based on the neuronal format of the brain where a network of artificial neurons will form an artificial brain to guide the program.

This way the AI will no longer be conducted by rules, and it will be able to identify different patterns at it is inputted into it. A simple way to format an artificial neural network (ANN) is to start developing a 'preceptron' which is the artificial definition of a neuron. The perceptron acts similarly to a logistics regression program as it analyses a problem the difference is that in logistics regression the program can only give a probabilistic based answer whereas in an ANN the answer is based on recognizing the pattern and identifying the right resolution.

Every perceptron in an ANN feeds its output into the next perceptron input; similar to how blockchain blocks transfer their data into the next block each time a transaction is finished or the block has fulfilled its purpose.[38]

Every ANN has an 'adaptive weights' that is inputted into each perceptron, this can be modified to help the AI 'learn' and 'study' any type of new data that can help the program evolve. Similar to a human brain, an ANN is constructed with multiple layers each layer using the artificial neurons differently in an input layer (where the data is being given to it); hidden layer (where the data is analyzed and processed by the AI); and an output layer (where the final solution can be discovered).[39]

[37] R. E. Neapolitan, X. Jiang, 'Artificial Intelligence With an Introduction to Machine Learning', Second Edition, 2018, p. 377-387
[38] Idem, p. 388-409
[39] A. Castrounis, 'Artificial Intelligence, Deep Learning, and Neural Networks, Explained', 2016, https://www.kdnuggets.com/2016/10/artificial-intelligence-deep-learning-neural-networks-explained.html, accessed on 09.05.2019

3.2.5 Pros and cons

In this subchapter, we will analyze each form of programmable AI discussed above, and how it can interact with the blockchain and how could it be beneficial or not, to use the previously mentioned formats.

a. Logistics regression

As we have already discussed, this system is based on human logic and is programmed to give simple answers such as true/false or yes/no. The benefit of this format is that is easy to program and it will have fast response on possible disputes. Also, by being fully programmed by a specialist the answers are only based on what it is 'fed' upon. But by being so simple, it is hard for it to solve complex decisions or problems that may arise on the blockchain. The logistics regression could solve a simple transfer issue transaction on the blockchain by determining if the payment has been processed by providing a yes/no answer, but it will be difficult if not impossible for it to solve the problem of how that happened and why, as the program can not correlate between two possibilities.

b. Probabilistic intelligence

Probabilistic intelligence is based on human reasoning with using parts of logic form the logistics system. This format is a rule based AI, where the answer is based on the probability of a certain thing to happen. As a program, it is easy to architect it, is easy to understand its 'thinking'. But by being a single 'decision tree' program, the AI can not deal with complex reasoning similar to the logistics regression one but it could help an AI working on the blockchain to figure out what is the probability of a user based on its previous transaction to fulfill its payment duties. But in dealing with disputes resolutions, it will be hard for o programmer to code every possible 'rule' into it, to solve this type of complex issues.

c. Emergent intelligence

The emergent intelligence has, at its root, the similar format of probabilistic intelligence meaning it is based on decision trees. The difference between them is that every single decision tree is combined to create a sort of network called 'random forest'. By doing such, the emergent intelligence has a 'group thinking'; as discussed above; similar to an ant colony. Thus, by programing the AI in a random forest format it can be trained incredibly fast as different decision trees could be program to have different rules where the 'forest' can apply them all to resolve one problem. The problem with this format is that the AI could get very complex to understand and a small change to a decision tree can affect the whole 'forest' therefore, creating uncertain answers.

d. Neural intelligence

Artificial neural networks are the most capable format of programming an AI as it is, based on the human brain 'network'. This format that is based on artificial neurons, can be coded in such a way that each and every neuron can connect to one another and transmit information. The most advance AI based on ANN's use multiple neural networks for the machine to be able to achieve what is called 'deep learning' where the AI doesn't need to be supervised while learning unlike previous discussed formats. This AI, will be able to recognize patterns and give precise responses to simple or complex resolutions in short times. The downside of ANN's is that they are very hard and slow to 'train' because of their complexity and architecture, and it is almost impossible to understand how the program has predicted it's response.

3.2.6 Potential techniques we might apply in blockchain's smart contracts

After analyzing almost every possible machine learning model (ML) of programming an AI, there can be two potential techniques that could be applied on the blockchain and their smart contracts system, to help resolve possible dispute resolutions. One of them is the logistics regression ML that could be used as a starting point to help any 'soft' disputes that may arise on the blockchain. As it is easily programmable and efficient to give fast answers, it could help on triaging disputes based on their responses and can help a court or a lawmaker in deciding which path to take but only as an advisory assessment. So far, both blockchain and AI's are not enabled to be legally enforced but they can be assessed and could help the Law system in speeding up the process and bettering it. The logistics regression ML is already being used in medicine for different classifications of medication improvements and probable cures for disease. The same pattern could be applied in the blockchain system and Law system, as well as, an AI based on this ML format could be viewed in the same way as a legal assistant. For the logistics regression based AI to be able to work with the blockchain a programmer has to code the meaning of smart contract, transaction, payment and cryptocurrency. It also has to provide a definition for the failure of the users that do not fulfill their payment obligations. Thus, as the model can not deal with complex features, it will only be able to resolve if one user has fulfilled its task or not transmitting this input towards the blockchain.

The other ML pattern that could be used for an AI, is the artificial neural network. Given it is an ML that can evolve by itself and can become 'self-taught' it can be a perfect fit for the fast growth of the blockchain system. As previously debated, it is extremely complicated to program an ANN. But, it could be built upon the structure of a possible logistic regression ML that was already in contact with the Blockchain. The ANN could be programmed to encompass every detail of the blockchain system, as each artificial

neuron could have different codes that symbolize how does a hash work to what is a node and its purpose. It will also, follow the same coding pattern in smart contracts as the AI will be able to differentiate between clauses; analyze the reason of the contract and determining how users would behave in different possible disputes. Thus, an ANN could solve any types of disputes resolutions as it would be able to learn from previous examples and will be able to detect any anomaly that has happened throughout a transaction and also why. This format could, in the future, if it will ever be legally enforceable, replace the legal actions taken to court and it will have instant resolution responses with possible immediate effect.

3.3 Importance of the machine learning interpretability and fairness

This subchapter, will analyze the importance of the artificial intelligence interpretability and how/if their reasoning can be interpreted by specialists; also their accuracy of providing the right/fair response. Most of the complex AI's such as the ones based on ANN's or emergent intelligence, can become difficult to handle when a human tries to figure out, the reasoning behind solving an issue. These algorithms that deal with how an AI 'thinks' are called 'black-box algorithms' and they are part of the hidden layers previously discussed.

3.3.1 Interpretability

Somewhere in the near future, AI's will probably have the power to replace human reasoning and to be entrusted in taking different decisions, but only if they will be able to explain how they have reached that decision and how did they analyze it. In the present times, deep neural networks (DNN) are easily mistaking different types of inputs that should be encrypted into a certain category and are wrongfully classified into different ones. They are also vulnerable to attacks that alter their algorithms, so that the attacker can benefit from the bad reasoning of the AI. Thus, for all of this errors from the AI' to be avoided there is a need for other programs that can explain what the programs are 'thinking'. AI's have to have the power to explain their decisions in order for humans to trust their reasoning. "*In order for humans to trust black-box methods, we need explainability – models that are able to summarize the reasons for neural network behavior, gain the trust of users, or produce insights about the causes of their decisions.*"[40] There is the need for a specialist to be able to trust any decisions made by the AI, so that these 'thinking machines' can be enrolled into the community and

[40] L. H. Gilpin, D. Bau, B. Z. Yuan, A. Bajwa, M. Specter, L. Kagal, 'Explaining Explanations: An Overview of Interpretability of Machine Learning', Computer Science and Artificial Intelligence Laboratory Massachusetts Institute of Technology, 2019.

possibly be legally enforceable. The main idea behind the interpretability of the AI's is that the language and reasoning that the machine is using should be easy and clear to understand.

"*The goal of interpretability is to describe the internals of a system in a way that is understandable to humans. The success of this goal is tied to the cognition, knowledge, and biases of the user*: *for a system to be interpretable, it must produce descriptions that are simple enough for a person to understand using a vocabulary that is meaningful to the user*".[41] There is also the goal of how complete the explanation that the AI is giving when it is tasked with an issue. This should be seen as how the whole system has come to the conclusion of given a certain answer based on its knowledge of the problem. But one of the dilemmas that the ML developer's community is facing, is that of when should AI's stop to explain a reasoning to better persuade the user and how transparent should they be when they are giving their response. This is one of the main issues when both completeness and interpretability are trying to be achieved in the same time. "*We believe that it is fundamentally unethical to present a simplified description of a complex system in order to increase trust if the limitations of the simplified description cannot be understood by users, and worse if the explanation is optimized to hide undesirable attributes of the system. Such explanations are inherently misleading, and may result in the user justifiably making dangerous or unfounded conclusions.*"[42]

3.3.2 Fairness

After discussing how machine should be able to reason and explain their answers there also comes the questions of how precise and fair the data and their analysis on a certain problem is. As all things, machines can be biased similar to humans. To program a complex machine learning capable AI the work loadout is divided between a plentitude of persons. There are programmers how will work solely on the coding of the artificial neurons; others that will work on how to connect them; others that will program the architecture of the AI; and others that will be preoccupied with what the system will base its knowledge from. Thus, for an ML AI every process has to be clearly defined by programmers but it is incredibly difficult and time consuming as perfection can not be reached by anyone. We have seen how an AI can become unfair in the COMPAS case where the algorithm is based on the probability or risk of defendants becoming recidivists. This program analyzed the defendant's physical structure and behavioral conduct; the knowledge being withdrawn from previous case files. Based on the case of Loomis, a person who was caught driving a vehicle that was used in a shoot-out and

[41] L. H. Gilpin, D. Bau, B. Z. Yuan, A. Bajwa, M. Specter, L. Kagal, 'Explaining Explanations: An Overview of Interpretability of Machine Learning', Computer Science and Artificial Intelligence Laboratory Massachusetts Institute of Technology, 2019.
[42] Ibidem.

where he pleaded guilty for escaping from a police officer, the judge wanted to see the probability of Loomis becoming a recidivist. The judge then consulted with COMPAS and based on the program's score, Loomis was considered to have a high potential of committing other crimes and was sentenced to 6 years in jail. He appealed the sentence claiming that, by using COMPAS, he was stripped from the right of proper due process.[43] Loomis lost the case in appeal, but it has risen a lot of controversy in the area as the system is not at its first strike. In 2016, the program was under controversy that its algorithms are biased against African-Americans as they concluded that a high percentage of the arrestees were, if they were men of color, labeled as high risk of committing more crimes. The programmers defended the system by saying the algorithms can not provide wrong answers as the mathematical quotations are never wrong as mathematics are always precise. A test was made to see how an analysis based on several suspects went on and a group of people was hired to give their reasoning of if those suspects were liable of committing other crimes. The group was precise at a rate of 67% while the COMPAS system was at a similar margin but lower, at 65%. Thus, the issue of how fair an ML can be is still at risk and based on the fact that AI's can not be held accountable of their mistakes there are more liable to hurt the processing system.[44] [45] [46]

Therefore, the bias of the ML based AI's will be accounted for how biased the programmers will be when they architecture the system. The AI will be able to evolve and the figure out flaws within its system and knowledge but ultimately he can not change the biases in the Law making process or regulation and has to be updated regularly. So far, the bias of the AI could be similar to the humans that are programming it or as previously analyzed it can be grater in the case of COMPAS if the AI is not being guided regularly by the progress of the Law.

3.3.3 Accountability

In the present context, the most debated idea of how and if AI should be enforced as legal entities, is that their power to be held accountable. Unlike undertakings or regular persons, a machine can not be punished or furthermore it can not comprehend what they have done wrong it their processes. Withdrawing the conclusion from the case of *Naruto v Slater* which is a copyright based case on whether a monkey could have ownership of

[43] S. Shaikh, H. Vishwakarma, S. Mehta, K. R. Varshney, D. Wei, 'An End-To-End Machine Learning Pipeline That Ensures Fairness Policies', IBM Research, 2017.
[44] S. Shaikh, H. Vishwakarma, S. Mehta, K. R. Varshney, D. Wei, 'An End-To-End Machine Learning Pipeline That Ensures Fairness Policies', IBM Research, 2017.
[45] E. Yong, 'A Popular Algorithm Is No Better at Predicting Crimes Than Random People', 2018, https://www.theatlantic.com/technology/archive/2018/01/equivant-compas-algorithm/550646/, accessed on 15.05.2019
[46] 'COMPAS (software)', 2019, https://en.wikipedia.org/wiki/COMPAS_(software), accessed on 15.05.2019

the photograph it has taken of himself. In this case, Naruto has taken a selfie using Mr. Slater equipment. Slater then posted this picture in his book. People for the ethical treatment of animals (PETA) has argued that Naruto should be able to have copyright claims as the photo was taken by himself. Slater has stated that without his guidance and his placement of the equipment, the monkey would have never been able to take that photo. During the legal course of the case, the US Courts have strongly admitted that copyright claims protection do not extend to animals. Even though, PETA was defending Naruto in the legal courts even they did not have a legal course to take as they can not defend a right that can not be extended to beings without at least basic knowledge of what they can stand for in a legal court.[47] [48]

As a result, transferring this case to a future appliance over the AI, Machine learning models can not be held accountable for their actions, as they do not 'understand' where they have done something wrong or they are not capable to stand in court similar to Naruto.

Thus, the main problem and question is if AI's can not be held accountable for their actions will they ever be legally enforced? The European Parliament has already taken this into consideration by adopting a set of rules; *Civil Law Rules on Robotics (2015/2103(INL))*; that shall apply and further develop the legislation to be suitable for robots. This adopted text by the European Parliament should be view as a future set of rules that could be transformed into legislative acts from where everybody can benefit. This is also defined in the Annex of the text in the Introduction subparagraph: "[…] *S. whereas the European industry could benefit from an efficient, coherent and transparent approach to regulation at Union level, providing predictable and sufficiently clear conditions under which enterprises could develop applications and plan their business models on a European scale while ensuring that the Union and its Member States maintain control over the regulatory standards to be set, so as not to be forced to adopt and live with standards set by others, that is to say the third countries which are also at the forefront of the development of robotics and AI*."[49] Also, the EU Parliament has potentially suggested that, AI should be embedded with basics sets of ethical rules: "*V. whereas the Union could play an essential role in establishing basic ethical principles to be respected in the development, programming and use of robots and AI and in the incorporation of such principles into Union regulations and codes of conduct, with the aim of shaping the technological revolution so that it serves humanity and so that the benefits of advanced robotics and AI are broadly shared, while as far as possible avoiding potential pitfalls;*"[50] Furthermore, we see that the EU Parliament is trying to set definite rules on the problem for liability of future AI's as the current legislations are not going to be able to fulfill/cover all the areas that could be 'taken

[47] 'Monkey selfie copyright dispute', 2018, https://en.wikipedia.org/wiki/Monkey_selfie_copyright_dispute, accessed on 17.05.2019

[48] Naruto v. Slater, No. 16-15469 (9th Cir. 2018)

[49] European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))

[50] Ibidem.

over' by 'self-thinking robots': "*AH. whereas, as regards non-contractual liability, Directive 85/374/EEC can cover only damage caused by a robot's manufacturing defects and on condition that the injured person is able to prove the actual damage, the defect in the product and the causal relationship between damage and defect, therefore strict liability or liability without fault framework may not be sufficient*;"[51] the EU has also taken the possibility of future AI's to be able to comprehend and to evolve into machines that learn from their mistakes and understand where they have made different mistakes: "*AI. whereas, notwithstanding the scope of Directive 85/374/EEC, the current legal framework would not be sufficient to cover the damage caused by the new generation of robots, insofar as they can be equipped with adaptive and learning abilities entailing a certain degree of unpredictability in their behavior, since those robots would autonomously learn from their own variable experience and interact with their environment in a unique and unforeseeable manner";*.[52] Thus, based on these principals settled in the annex this future legislation should cover any types of areas where automatization can be achieved, such as: medical help, public transportation, human enhancements and education. Thus, the Parliament has demanded the EU Commission to set a base of rules of conduct to the manufacturers of AI where the accountability/liability do not impede with the future progress of this science but are clear enough to set the grounds for any type of damages/problems/disputes that may occur by using these machines: "*51. Asks the Commission to submit, on the basis of Article 114 TFEU, a proposal for a legislative instrument on legal questions related to the development and use of robotics and AI foreseeable in the next 10 to 15 years, combined with non-legislative instruments such as guidelines and codes of conduct as referred to in recommendations set out in the Annex; 52. Considers that, whatever legal solution it applies to the civil liability for damage caused by robots in cases other than those of damage to property, the future legislative instrument should in no way restrict the type or the extent of the damages which may be recovered, nor should it limit the forms of compensation which may be offered to the aggrieved party, on the sole grounds that damage is caused by a non-human agent;"*[53]. By further analyzing the text given by the EU Parliament we can see that ultimately the responsibility for any types of damages that may occur shall fall to the manufacturer/owner/producer/inventor of these intelligent machines. Thus the accountability of errors should only fall to humans and not machines: "*56. Considers that, in principle, once the parties bearing the ultimate responsibility have been identified, their liability should be proportional to the actual level of instructions given to the robot and of its degree of autonomy, so that the greater a robot's learning capability or autonomy, and the longer a robot's training, the greater the responsibility of its trainer should be; notes, in particular, that skills resulting from "training" given to a robot should be not confused with skills depending strictly on its self-learning abilities when seeking to identify the person to whom the robot's harmful*

[51] European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))
[52] Ibidem.
[53] Ibidem.

behaviour is actually attributable; notes that at least at the present stage the responsibility must lie with a human and not a robot;".[54] There is also a new specific format that the AI's will be incorporated within and they will become legal entities with the name electronic legal persons and where they have the possibility of interact with humans autonomously without any help from other humans: "[…] f)*creating a specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently;".*[55] [56]

4. Possible solutions for dispute resolution

This chapter will discuss options that could be achieved using AI technology to further aid the blockchain system and dispute resolutions. It will summarize some of the details from previous chapters and will combine them to give a wider and more understandable view of both AI's and blockchain being used as a whole.

4.1 Dispute resolution with the aid of blockchain

As it was previously highlighted in the chapters above the best way to resolve disputes on the blockchain would be the usage of smart contracts. Smart contracts are similar to legal biding contracts as people that want to engage in different commercial actions must agree to enter into that said smart contract. This agreement is given by both parties when they make a transaction towards the smart contract (for example, John and Mary are betting on which horse is going to win the race; the bet is 1.50 bitcoins; they both pay the amount and the value of the contract becomes 3 bitcoins). Thus after the race is over the winner is settled by the external inputs that the smart contract is receiving. This process of the smart contract deciding on the winner is one of the best solutions to prevent conflicts as there is no third party to make a decision that could be biased. Also as it is self-executory parties that have entered the contract can hardly back away from it or subtract themselves from paying. This can be both good for the dispute resolutions as it is free from conflict but could also harm the system as some parties could complain of wrong doing after the contract was terminated. Even though it may sound simple to

[54] European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))

[55] U. Bux, N. Nevejans, 'European civil law rules on robotics', Université d'Artois, Centre de Recherche en Droit Ethique et Procédures, 2016

[56] M. Butterworth, 'The ICO and artificial intelligence: The role of fairness in the GDPR framework', Fieldfisher LLP, London, 2018

use a smart contract the coding behind it is quite hard to compose. This could be an impediment for future usage in difficult tasks such as inheritance or merger contracts. But it could still be used in online disputes resolutions where most of the issues arise from the payment of a product that was not deliver that are simple to handle and could be automatized using the blockchain technology and the smart contract system.[57]

4.2 Dispute resolution with the aid of Artificial Intelligence

As previously stated, the benefit of artificial intelligence in the Law system is already being used in areas such as: due diligence (electronic discovery in Civil Law cases where the AI can search and analyze any type of digital imprint of the parties involved such as emails, video files etc.), legal research (where undertakings use AI's to reorder certain topics and prepare for their cases; analyze contracts and can correct simple data from them autonomously). As AI's are extremely versatile, any type of ML could be used to engage with any type of dispute resolution. But there is the problem of whether humans can trust something that is automatic and relief their belief of the preconception that any machine can malfunction and result in errors at any time. Until this 'problem' is solved AI's will probably only be used as support systems and not as an autonomous programs where it could be the 'Judge' of any decision that comes in its 'hands'.[58] [59]

4.3 Dispute resolution using Artificial Intelligence and Blockchain

In this subchapter, we will try to see how both system could work together as a whole for the benefit of solving disputes faster and in a safer way as they could both complement each other in different task where Blockchain could help triage the requests and AI could help solve them.

4.3.1 Legal resolution support system

Something that could be implemented in the closest future can be a machine learning AI that can help the blockchain system to overcome possible resolutions and sort them out for a legal court to further analyze them. This system may involve an AI that is based

[57] R. Koulu, 'Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement', Volume 13 Issue 1, 2016, p. 41-69

[58] R. Koulu, 'Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement', Volume 13 Issue 1, 2016, p. 41-69

[59] M. Mociarikova, 'Using artificial intelligence in online dispute resolution', Masaryk University, 2018, p. 13-20

on a ML that gathers previous knowledge of similar disputes that have happened on the blockchain and also future ones. It could be a simple one, based on logistics regression where users will be evaluated based on their actions on the blockchain or a more complicated one based on an ANN that analyzes the actions before the dispute has surfaced and why it has surfaced. But one of the most relatable to date system will be one based on rules, similar to the one presented in previous chapter COMPAS. The reason of why this is one of the best option at the present moment is that it is a fast way to architect an AI and the Law system can be coded into rules for a ML. But the decisions that they will make will be simple as a yes/no or true/false based answers. Parties that will use this type of format will be able to input their own facts about a case and the AI will further analyze them and compare them to previously settled cases. Decision based system are already being used in different areas such as banking (where people are 'tested' to see if they will be fit for a loan), social services (where the AI analyzes if people should be granted benefits) and medical system (where doctors can make trials of whether drugs would affect a patient response to a treatment).[60] [61]

4.3.2 Expert and Knowledge Based systems

Expert and knowledge based system, can be combined to form an AI that could be capable of merging with the Blockchain technology. As expert system are defined by the similarities of the human nature where the AI is gathering data on a specific part of an 'action' as an expert lawmaker will do (that can be the area of dispute resolution). Thus, the expert system will learn and gather knowledge from previous cases making itself better but only by being closely monitored by a human counterpart. The expert system can work together with a Knowledge based system AI as the expert ML will evolve with the previous gathered data and the Knowledge based system will analyze all present and future possibilities based on the output of the expert system. Expert system are already being used to monitor simple task in the areas of accounting, human resources (triaging personal CV's), medicine (narrowing the possibilities of drug related side effects based on computer trials), financial services, etc. This systems can help a law practitioner; at least in the case of dispute resolution where the amount of data is increasing at a high rate; to automate simple and easy tasks such as filing and arranging the incoming disputes based on importance and amount of work. Thus, as blockchain is already a system that stores a lot of data on it and an AI needs that data to evolve, it only makes sense that such a program should and could exist. This 'merger' between blockchain and AI programs, would benefit both the Law system where courts could be lessened from the huge amount of workload and both the systems as blockchain is already being introduced into the laws of different countries, whereas AI is still trying

[60] R. Koulu, 'Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement', Volume 13 Issue 1, 2016, p. 41-69

[61] D. Carneiroa , P. Novaisa , F. Andradeb , J. Zeleznikowc , J. Nevesa, 'Online Dispute Resolution: an Artificial Intelligence Perspective', University of Minho, Department of Informatics, Braga, Portugal, p. 1-26

to make its way into the legislation but it will help if both systems were viewed as one. Blockchain is by itself a safe and transparent system that can provide a secure network for dispute resolution but with the aid of AI's it will only make it safer and as well be more autonomous as the blockchain can not think or evolve in the same way as an AI.[62] [63]

5. Conclusions

After analyzing what Blockchain means and how it works and the different utilizations for it that can be used in the day to day actions of either a lawmaker or a simple person; and also the interference with different Machine Learning models of Artificial Intelligence that can improve the overall system and also improve the Dispute resolution problem in a much safer and time saving way that a legal court we refer back to the questions asked in the subchapter 1.2.

Could Blockchain be legally binding and incorporated into every nation's legislation? As previously highlighted it has already begun to be used as a simple system that validates and authenticates simple documents, photos, signatures or every digital possession. But by changing the Law to fit this new technology, we also have to change our understanding of basic contractual law and also procedural law as the smart contracts that are going to be entered into an agreement on the Blockchain will have the power to prevent almost any type of conflict. Thus, procedural law, alongside contractual law, have to be changed in accordance to what the smart contracts can offer. As transparency and anonymity are a big part of the whole system, the lawmakers will have to find the fine lines between accepting a harsh or soft law that regulates the full reach of Blockchain.

Could Blockchain and Artificial Intelligence work together to create a new digital court for dispute settlements and thus eliminating the need for a physical and time costing court? As previously discussed, the first thing that has to happen is that both Blockchain and AI have to be legally incorporated into the Law system. Blockchain has already began to be legalized in some formats in some states in America and also different countries all around the globe. Lawmakers are already preparing laws for the induction of AI into the Law system such as the Robotics legislation that is currently being worked on in the EU. But, for them to both be regarded as a digital court they have to also pass the 'trusting test' of mankind. Mankind has to somehow accept this changes and also be sure that an automated, self-controlled and autonomous system can be trusted to fulfill their needs in the dispute resolution area. This system can be first introduced as a support part of a Court that can keep track of all the data and routines that a trial has to go

[62] Ibidem.

[63] J. South, A. Rogers, 'What Might Artificial Intelligence Mean For Alternative Dispute Resolution?', Kluwer Mediation Blog, 2018, http://mediationblog.kluwerarbitration.com/2018/08/30/might-artificial-intelligence-mean-alternative-dispute-resolution/, accessed on 15.07.2019

through. Then it can be used as an advisor where judges can consult the system and base their judgement on the output of the machine. Only after it has been tested for a long period of time and it has amassed a huge amount of data, can it be taken into consideration of slowly replacing a court but that will probably happen in a distant future as the present technology can not encompass all of the actions a court has to make.

Looking further into the future, quantum computing can be the next step for the AI to progress even more. Recently there has been a breakthrough in the beginning of 2019, where a quantum computing system has been achieved. Quantum AI by Google has already began to test this system with all ML AI where they have seen a substantial progress in how the AI gathers, analyzes and reviews data differently and faster than a normal AI. They have discovered that a quantum computing based AI can survey multiple data sets from different areas and discover patterns faster than ever before.

"*Quantum computing is expected to be able to search very large, unsorted data sets to uncover patterns or anomalies extremely quickly. It might be possible for the quantum computers to access all items in your database at the same time to identify these similarities in seconds.*"[64]

But even though it is so advanced it still need human supervision to evolve, learn and to introduce new inputs into the system. If this system keeps evolving, it will bring AI and Blockchain to the next level where their induction into every nation's Law procedure will only become necessary as they will achieve such a high computational power that can solve multiple cases at once in the mater of seconds.

[64] B. Marr, 'How Quantum Computers Will Revolutionise Artificial Intelligence, Machine Learning And Big Data', 2019, https://www.bernardmarr.com/default.asp?contentID=1178, accessed on 20.07.2019.

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