

# Decentralizing AI Applications With Block Chain

Shraddha Phansalkar, Pooja Kamat, Swati Ahirrao, Ambika Pawar

**Abstract:** Artificial Intelligence (AI) offers intellectual, customized and better decision-making capabilities for humans in diverse areas of applications and use-cases. All of these applications have far reaching effects on the human life and the living pattern. AI algorithms however are based on a centralized architecture, methodology and learning patterns. Although there is an advent of resource-unbounded, parallel environments in computing, the inherent centralized strategies bound the learning as well as performance of these algorithms. Decentralized AI applications are the need of time. Block chain enabled solutions for decentralization address these issues as well as important concerns of security, trust and efficiency. Although the research as well as commercial groups have put up a step forward in bringing these two technologies together, there are research challenges to its realization. The presented work puts forth the need of bringing these technologies together with discussions to various challenges. It also addresses the strategies for addressing the challenges in amalgamation of these trends with reference to numerous applications where this blend can create a greater value

## 1. Introduction

Intelligence built on the machine which can solve problems of complicated nature in a precise and efficient manner is artificial intelligence (AI). AI systems mimic human intelligence with assistance in problems of social relevance like planning, predicting, learning, describing, problem solving and prescribing. Artificial intelligence solutions apply neural networks, support vector machines, machine learning algorithms or fuzzy logic or combinations of any one to solve these problems [1]. AI systems assume a centralization model at its core. Due to large volume of data controlled by different organizations and absence of mechanisms for sharing the data, decentralization of AI is mandatory. In the centralized Artificial Intelligence [2], the problem of response time is generally faced as machine learning algorithm requires large computation. Training the

AI models in the central manner takes lot of time for tuning and improve the performance. There is also a problem of expensive hardware with the centralized approach. Typical AI solution has a massively large data set at its core with continuous and evolving stages of training model creation, regularization and optimization. AI solution is generally deployed on a centralized processing element and hence demands high computing power as well as an extensive storage. Block chain [3] is defined as a distributed ledger for immutable and secured records. Its decentralized nature favors zero down-time, reliability, trust and provenance. These characteristics are the causes of the paradigm shift in the digital era where unlike a centralized control, process is delegated to a group of benefited stakeholders. Block chain is a sequential storage of transactions where

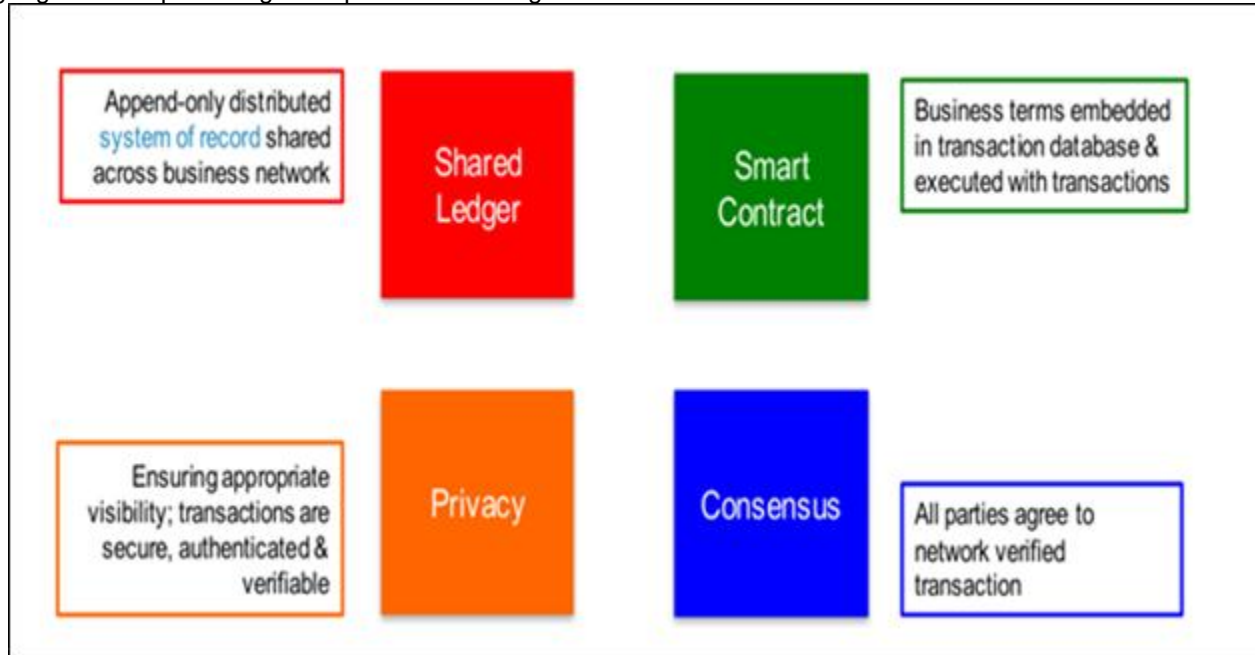


Figure 1. Features of Block chain

The data is secured with the cryptographically signed hash functions. The distributed ledger enables the creation of tamper-proof, highly robust databases which can be read and updated only by those with permission. The distributed nature of the Block chain is characterized with the features [4]. Figure 1 also depicts them in pictorial representation.

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- 1) **Timestamped:** It is a timestamped collection of information where the sequence as well as the contents of the data (blocks) is always untampered and notarized.
- 2) **Immutable:** A block of data once put on the block chain is immutable. Any accidental or deliberate change on the block can be detected and the changes can be tracked.
- 3) **Cryptographically hashed:** Every Block is uniquely identified by a cryptographically calculated unique hash function. This hash is a function of the contents, and hash of the previous block in the chain.
- 4) **Decentralized:** Block chain is based on peer-to-peer network which means that anybody can join a block chain network and get a copy of the entire block chain. Any new block that is added to the chain is actually sent to all the peers and they can verify the same with a trivial verification algorithm.
- 5) **Proof-of-Work:** A decentralized network can be truly distributed only when the decisions of creating content is taken with a consensus of all the participatory nodes. A proof-of work is a unanimous decision of accepting a new block in the system as an authenticated set of records which are untampered, sequenced and rightly hashed.
- 6) **Smart Contracts:** The data on the block chain is decentralized and can be protected from unauthorized and unauthenticated access with smart contracts which are automated program codes that govern who on the network can access what and how much data.

## 2. How AI and Block Chain are intrinsically different?

*Table 1: AI and Block chain are Different*

AI Features	Typical AI Use Cases for the features	Block Chain Features	Typical Block Chain Use Cases for the features
Probabilistic Models: It is based on the randomness and uncertainty in prediction. It depicts the real world scenarios where not everything about anything is known to a model.	A learning of the customer shopping preferences in the past can help in probabilistically determining future choices and they recommend products or services.	Deterministic Model: The facts are asserted and established. It is a process of sharing the actions that will be causing the same results irrespective of who processes it. Determinism is the heart of block chain	A block/transaction that is approved by a node will always be approved by every node.
Changing Models: AI are based on learning model which evolve with more and more experiences. They are enriched with more data sets.	Recommender system learns more with user experience. It is better enhanced with user diversity and with more and more user preferences	Permanent and non-transient Model: The data records are immutable with time. Block Chain does not allow illegitimate updating and deletion of records	A record of transaction of currency transfer will always persist in the chain and cannot be altered or removed.
Algorithms that are used try to best guess the reality	An incidence of a system is a guess to a diagnostic	Algorithms and methods are used to record the reality	A record of transfer of ownership of an object (land/currency etc.) is to be recorded as real.

Table 1 outlines the extrinsic features of these two technologies. Although both of them are incomparable, the features show how there can be typical use cases where they are applied. We analyze their differences in the core. Although they are different in nature, in literature works like [5], the authors also have discussed how these intrinsically different technologies can create wonders with their integration.

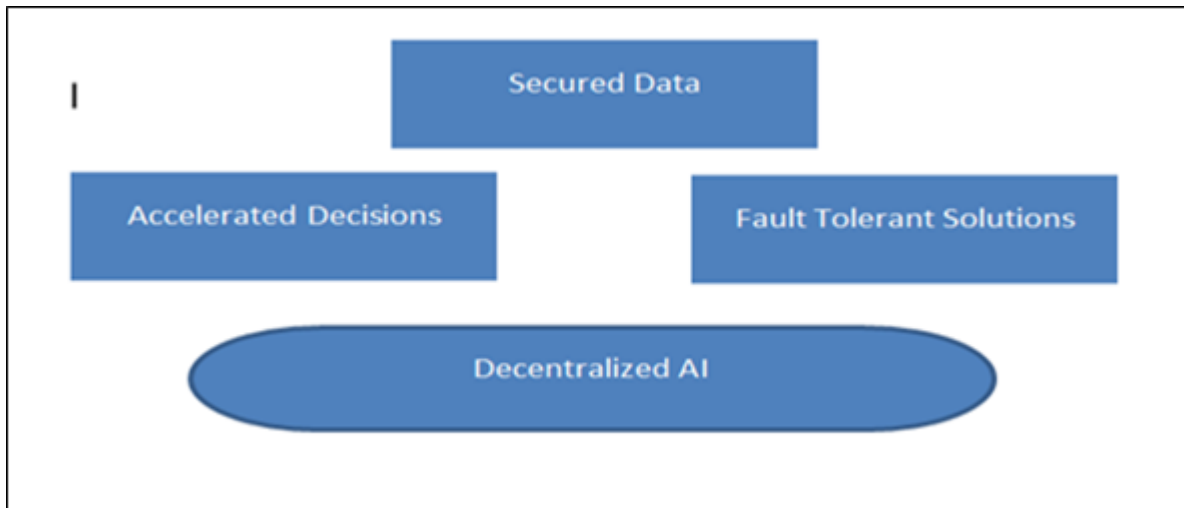
## 3. Advantages of Decentralized AI

An amalgamation of these features that actually complement each other and can add a lot of value to the

systems in the state they are now and will be in future. We now highlight the benefits of bringing AI applications on Block chain[6]. These applications are popularly called decentralized AI applications.

### a. Secured data

AI algorithms rely on the correctness, randomness and unbiased nature of data sets and learn from the experiences. An untampered record of data will always enhance the learning of the algorithms and help them to take decisions and predict the outcomes in realistic manner.



**Figure 2.** Advantages of Decentralized AI

**b. Accelerated decisions:**

Unlike a single centralized decision making AI agent, decentralizing the decision making across multiple agents will enable parallel and multi-tasking decisions for accelerated decisions.

**c. Fault tolerant solutions**

Decentralization enables distributed decision making and participative approaches. Block chains will enable AI agents work in fault tolerant systems to take decisions irrespective of few faulty or unreachable nodes.

**4. Challenges in Decentralizing AI**

There are 4 key challenges in decentralizing AI applications [5] depicted in figure 3.

1. Hesitation to sharing the data :

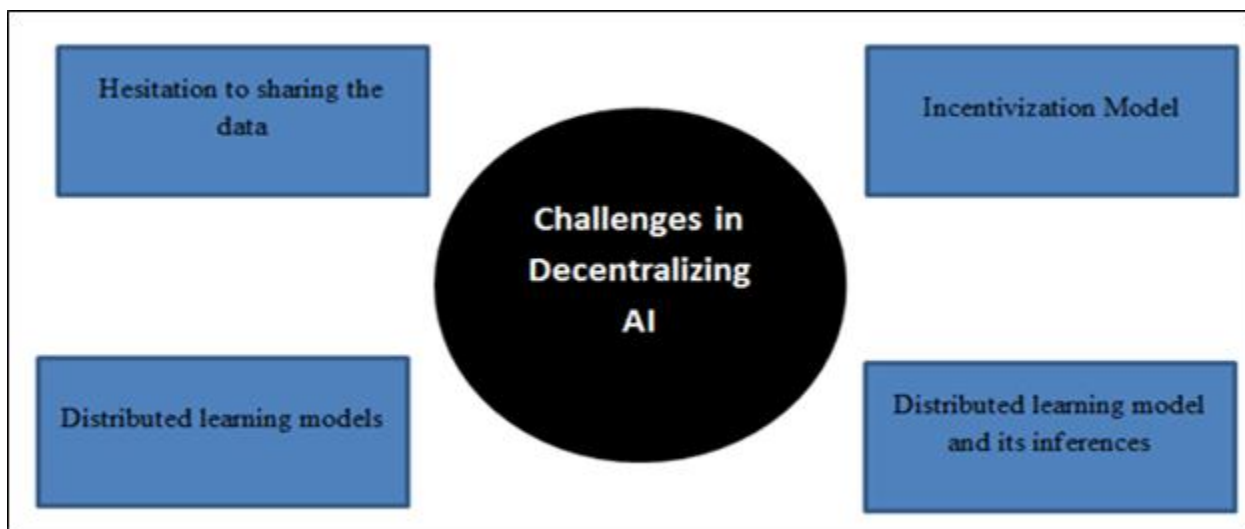
The data owners are monopolies in holding the data. So sharding and deploying data across multiple nodes is a challenge to sharing the data.

2. The distributed learning models are to be distributed across thousands of machines. Their synchrony and communication overhead is another challenge.

3. How can the learning model and its inferences be distributed to other nodes and how can that be validated?

4. A distributed environment to sharing data and deploying solutions can be successful only if the exchanges are properly incentivized. A proper incentivization model has to be conceptualized.

AI requires data or information to pick out trends and develop itself through deep learning. Interestingly, block chains requires power and energy to cluster computer systems and run processes quicker. This established relationship creates a dependability between both these parties which ultimately result in a technological breakthrough or a catastrophic consequence.



**Figure 3.** Challenges in Decentralizing AI

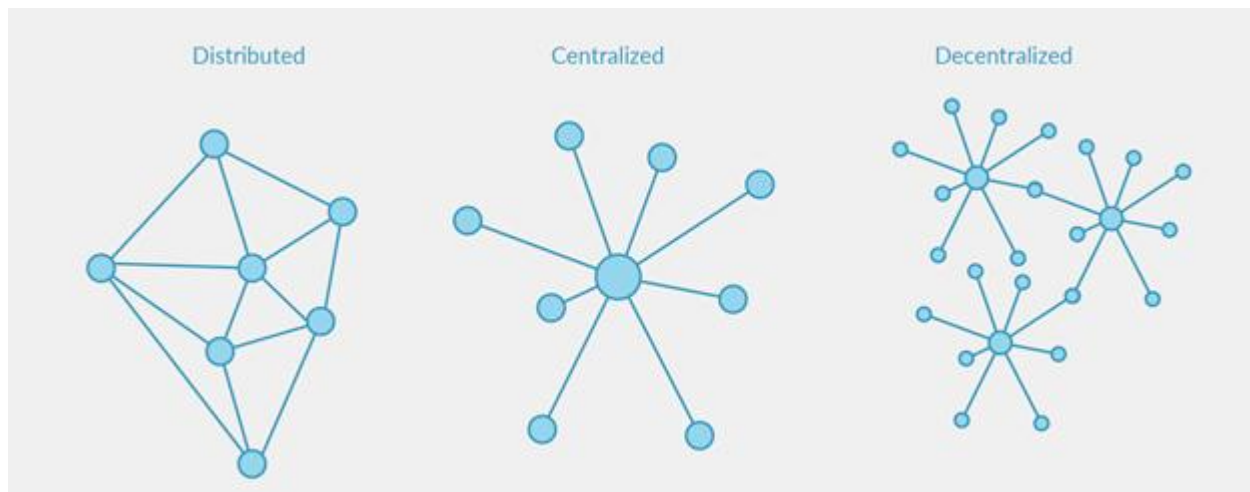
## 5. Enabling the Decentralization of AI

It is important to note the basic diversity of nature in these two technologies. This cannot be denied and there is a lot of scope of research as to how to make these two technologies work together with their incompatibilities. We now discuss the major areas of work that have to undergo a significant change when a centralized, intelligent AI solution is to be built over a decentralized but trust based block chain platforms.

### 5.1 Decentralizing Storage

In [7] an exhaustive survey of data partitioning techniques is presented for improving scalability as well as performance of a web-application. A Block chain based solution for AI applications contradicts to concentration of data at one centralized store. Figure 4 shows the different topologies of data storage as centralized, distributed and decentralized. Two of such exciting technologies that can be referred for

partitioning are sharding and swarming. Sharding involves cutting the data into several small fragments, which can be transmitted and recalled easily. Swarming is the technology used for keeping a group of shards together. While a block chain employs a network of nodes, a decentralized storage employs a collective group of nodes known as "swarms" for keeping the data. Consequently, the swarming technique lowers latency and increases performance because data is retrieved in parallel from the nearest and most convenient nodes. Since a swarm is composed of several, geographically distributed nodes in a peer-to-peer network, accessing them using a decentralized application would lead to increased reliability and scalability. The swarms for storing data would not be owned by a single company; individuals would take charge of controlling and managing the data, giving them the freedom to experience personalized and secure service.



**Figure 4 . Distributed vs Centralized vs Decentralized Data Storage**

### 5.2 Distributed Machine Learning

Distributed Machine Learning refers to the parallelism in computations where learning model run parallel on different data sets or subsets for space and time efficient computation. Although this adds to the communication overhead and synchronization, researchers have proposed optimized solutions to these issues. Moreover decentralized learning is essential to bring the AI models on the block chain. Distributed Machine Learning is a widely used approach to scale up machine learning model where data is large in volume. In this approach features of training samples are distributed among the different machines and can also be geographically separated. In this paper the authors have presented asynchronous stochastic gradient descent (SGD) algorithm where the features are distributed among different machines and model is learning from decentralized features. The prediction performed by joint model is better than the predictions performed by individual model and which also speeds up the training as compared

to centralized approach. In [9] Addaire put up a framework for decentralized training for neural networks and proves that decentralized training can reduce the communication overhead at the cost of model accuracy. The paper puts forth a layer framework for data parallelism and every layer shard is used to handle a subset of data parameters. It puts forth the experimental framework of layered data shard where every layered shard communicates its updates frequently to all the shards with a threshold  $t$  which makes this update sparse as well as frequent with only significantly different parameters. In [9], the author have proposed a block chain based distributed machine learning approach, where a computing node called application initiator build a learning model based on the private data set and training algorithm. This model is then set to approval on the block chain based consensus where the model is accepted by other nodes if the fusion of their model with the new one yields in better accuracy. If the model yields accuracy to

**Table 2. Multi-Agent AI and Distributed Optimization Algorithm in few typical Use cases**

Use case of Multi-agent AI	Optimization Goal	Algorithm for Distributed Constraint optimization	Block chain use case
Intelligent Transport system (ITS) Cooperative Sensing Traffic signals on road Traffic Predictive Analytics	Minimization of Global cost Minimization of computation	Dynamic algorithm which changes with time and traffic state, Total/ partial agent knowledge	Efficient use of ITS infrastructure, allowing trust-worthy and crowdsourcing ride sharing services
Precision Farming	Maximize yield Minimized effort/cost	Probabilistic DCOPs Fully cooperative learning	Accessibility Trusted data
Supply chain management	Quantity of materials or goods Time function Cost function	Graph-based optimal path Sequential or synchronous algorithms Interaction Graphs	Material traceability, provenance
Health care Electronic Health Records	Minimizing Patient treatment time, cost Patient data privacy	Pareto-optimal Dynamic DCOP.	Trust, role based access, Sharing of medical research data

many of the nodes, the model is being approved and put over the block chain. Thus the training models are verified by the participant nodes before deployment on all the nodes. Secondly the system is also secured with the privacy preserving encryption methods. In the work [10], authors have presented, different architectural design for distributed machine learning platforms are discussed. These platforms are Spark dataflow system, Parameter Server System, Tensor flow, MXNET. Experiments are carried out for all the architectures. In the experiments conducted, Spark is doing better for logistic regression but has limited scalability when the machine learning task has large volume of model parameters. Parameter server model performs better for training machine learning and deep learning model. The Tensor flow and MXNET model does not perform well in terms of speed. These architectures are not scalable because of lack of support for mutable state and speedy iterations.

### 5.3 Distributed Optimization

Optimization in AI Applications were uni-agent in nature. Decision making however demands multi-agent applications that are deployed for multiple system constraints or multiple goals. Based on the interactions in the multi-agent system, agents are of cooperative, collaborative and coordinative in nature [13]. In a decentralized system like Block chain, choosing an appropriate interaction that guarantees trust as well as ensures privacy is a concern. Table 2 shows the various multi-Agent AI and Distributed Optimization Algorithm in few typical Use cases. Decision making in optimization also depends on the achieved level of optimality, search completeness and time complexity. We present a study of typical candidate use cases with multi-agent AI [13], their optimization goals, type of algorithm used for distributed constraint optimization, type of learning and the block chain value addition to the systems [14].

## 6. AI use cases and Block chain value-addition

AI is all about learning from data. Block chain secures the data. Both technologies are mutually inclusive, and could potentially pave the way for a much more transparent, and efficient world. We discuss few applications with AI and block chain together add value together

### a) Music Streaming Industry

#### AI contribution:

From revenues to user behavior, the music streaming industry is changing the way we used to listen and enjoy music. Learning the specific tastes and preferences of every individual, streaming players are now working to build a better, more intuitive playlists. These algorithms take into consideration the music listening history of the user, analyzing genres, tonality, chord progressions, length, pitch, tempo, vocal styles, instrumentals used etc.

#### Block chain Value add:

The amount paid to an artist for playing an album on the streaming apps is meagre and is distributed amongst the stakeholders like producers, record labels, songwriters, and artists. Singapore-based nonprofit organization Music Life Foundation and the Japan-based MusicLife Company have developed MusicLife[15], combines the technologies of block chain and artificial intelligence (AI) to create a platform that connects the music lovers with the creators of the music and the recording company. Its pricing model is based on the trends and dynamically influenced by demands (AI), however block chain enabled solution also enables the listeners to earn the shares of the profits of a music piece.



## b) Search Engine Optimization in Social Networking Sites

### AI contribution:

Social media networking sites are in constant need of user information to customize the communication for their users [16]. They commonly use technologies of Artificial Intelligence and Machine learning to better understand and predict their user behavior, browsing interests, trends in their buying patterns, etc. A very popular example of this is Google's search engine which via its Search Engine Optimization (SEO) tool indexes its web pages in such a way that the user gets the interested information effortlessly and in record time. Google in return uses the technology giants of AI and ML to record and observe patterns in the browsing history of the user which he or she shares happily. Though via this marketing organizations have been benefited immensely, however it is very concerning for the users to realize that their likes, dislikes, preferences and opinions are stalked for some purpose and without their knowledge.

### Block Chain Value add:

With the inclusion of Block chain in social media networking gives its users a control to decide whether he or she is willing to share their data and up to what extent, whether he gets paid for his data or what else could be the determinant factors. Block chain can enable secure and fast social communication and at the same time ensure privacy is not compromised at any stage. Recently a highly secure messenger was built on the technology of block chain by the name of Obsidian Secure Messenger which assures its users end-to-end encryption of their files, messages and pictures that can be seen and received only by the intended recipient [17].

## c) Smart Energy Management:

### AI contribution:

Artificial Intelligence and Block chain together can solve numerous energy management problems such as theft of energy, incorrect billing of energy consumption, credits management for efficient usage of energy, etc. AI-enable smart meters record of electricity produced and consumed by each user in the grid can be kept with credits / currency allocated to the user for excess power supply and electricity consumption credits. This helps the authorities to accurately charge the consumers according to their energy usage.

### Block Chain Value add:

Further if this energy data is maintained on a block chain framework, no one can tamper with the historical records and the block chain makes the AI driven system more transparent. The need for energy intermediaries will also be eliminated and thus the transaction costs would be reduced which further reduces energy prices. Exergy is a permissioned block chain platform developed by LO3 Energy that creates efficient energy markets which are local in nature and can be used for energy transactions across current grid frameworks [18].

## d) Financial services

### AI contribution:

Artificial Intelligence has numerous usecases in financial sector. Financial trading and investments can be informed and automated using machine learning algorithms that can be trained to monitor market sentiments. In the banking usecase, AI can be used to monitor the customer's cash account, credit account and investment account which will further help track the customer's financial health. Using predictive analysis, the customer can take smart decisions looking at his current finances.

### Block Chain Value add:

Among the first industries to adopt block chain, the financial services industry is leading the block chain revolution. The transactions can be enabled using block chain to ensure quick trades and the money can be transferred in real-time. This automated, secure and transparent process can revolutionize financial services and banking, by completely eliminating human intervention in the financial markets. ABRA is a leading private financial services and technology Company that runs an all-in-one BITCOIN cryptocurrency wallet and currency exchange application which uses block chain technology to store and encrypt digital money on user's mobile device. Barclays, UK's second largest bank patented two ideas on Block chain in 2018- a) Secure Digital Data Operations which will use block chain to validate and record transactions using both a digital currency ledger and cryptography and b) Data Validation and Storage where they to propose the development of their own data authentication system [19].

## e) Government

### AI contribution:

One of the major beneficiaries to gain from the blend of AI and Block chain technology are the Government organizations. Government systems with the help of AI can automate and further customize their processes and Block chain can provide the necessary security and transparency. Most of the e-governance services such as license renewal, tax collection, land ownership transfer, generation and collection of utility bills can be automated using AI technology.

### Block Chain Value add:

Once Block chain is incorporated in government processes, all the payment related services can be made faster with total transparency, eliminating any mistake or foul play from all ends. The Democracy Earth Foundation, a California based project is developing free open source tool for decision making based on trustworthy block chain, which can be utilized both in huge and littler foundations. Recently even the Dubai government in partnership with IBM is planning to have paperless government processes by the end of 2021 and apply block chain for all applicable government documents by 2020.

## f) Healthcare

### AI contribution:

The fusion of AI and Block chain powered systems can serve the medical fraternity to a great extent. AI can be used to personalize medical treatment and nutrition plans thus helping the medical practitioner immensely. AI can track individual health data to provide improved diagnostics, and can also provide analytical insights by studying a vast population of patients.

### Block Chain Value add:

The industry-wide adoption of block chain in healthcare can enable seamless sharing of patient data, in a secure, anonymized manner to healthcare providers. The seamless data sharing enables patients to access healthcare facilities

from anywhere, which can be especially useful in case of emergencies. The Gem Healthcare Network, an Ethereum block chain, improves security in healthcare domain in the form of a permissioned block chain. Here the patients have full access over their health data and every modification is recorded on the distributed ledger [20]. GemOS, will permit patients and medical practitioners to safely access a patient's health records in real-time, thus providing the right judgement and transparency while claiming health insurances.. Gem has further collaborated with Philips to study how block chain can be used to secure the integration of data from sources such as employee wellness programs and wearable health sensors. Vytalyx, a Texas-based health tech company is creating personalized AI-enabled block chains for a variety of medical treatments such as hormone replacement etc.

**Table 3. AI Applications with Blockchain: A bird's eye view**

Industry Use Case	AI Enabled solution	Block chain Leveraged solution
<b>Music Streaming Industry</b>	Creation of intuitive playlists based on history of the user, analyzing genres, tonality, chord progressions, length, pitch, tempo, vocal styles, instrumentals	Disintermediation and trust based platform to connect the music lovers with the creators of the music and the recording company. Innovative pricing model where a music listener invests in the music art and also earns a share of profit
<b>Search Engine Optimization in Social Networking Sites</b>	AI empowers SEO tools making it effective to reach out to the users of the social networking sites with tailor made products based on the likes, dislikes and the interests of the users	Block chain empowers the user to have control over the data he would like to share with these sites and if need further pricing the shared data.
<b>Smart Energy Management:</b>	AI- enabled smart meters can maintain a record of the grid energy consumption and charge its consumers for more consumption. Also these AI-enabled intelligent meters, can now predict the optimal energy requirements needed to power every section of the grid.	Maintaining energy records on block chain will eliminate the need of intermediaries and make the entire billing process transparent.
<b>Financial services</b>	Financial investors and traders would be better equipped at making intelligent decisions in investments and trading based on market sentiments.	Block chain based smart contracts will make ensure quick trading and transfer in real time and completely eliminating the need for human intervention.
<b>Government</b>	Government customer service processes can be automated using intelligent chatbots. Machine Learning can analyze behaviors to identify emerging trends in fraud and abuse so that government agencies can act before they cause significant damage.	Blockchain will assist in identity management of customers which will further reduce the cases of fraudulent middlemen.
<b>Healthcare</b>	AI enabled systems can be created to process data – notes and reports from a patient's file, external research, and clinical expertise – to help select the correct, personalized treatment path. Further with the help of AI, x-ray scans can identify cancer and vascular diseases early and foresee the medical problems individuals may face dependent on their hereditary qualities.	Blockchain can further value add by providing necessary security in drug traceability. Whenever a drug is manufactured, a hash value of it can be maintained on the blockchain containing all the relevant information. Whenever the drug moves across the chain i.e. from manufacturer to wholesaler and further to pharmacist and finally to patient, it would be easier to track the drug. This will help maintain the integrity of the drug.
<b>Aviation</b>	Artificial intelligence can be used to improve operational efficiency, avoid costly mistakes, and increase customer satisfaction. Airlines and flight operators can significantly reduce their operational costs and overhead by optimizing their fleets and operations with AI-powered systems.	Blockchain can be used to store flight records, maintenance status and other critical airline related information. Blockchain can also be used for identity management of airline travelers that would result in eliminating the use of paper passports and human-errors in the process of checking.
<b>Legal</b>	Artificial intelligence tools can assist these legal support professionals to conduct their due diligence more efficiently	Blockchain can record events for a long duration at optimum security which will help to solve cases involving irrefutable

	and with better precision since this work is often tedious for humans	intellectual property claims or even criminal charges relating to a certain case or criminal procedure
<b>Manufacturing</b>	AI can be used to predict and forecast machine failures and equipment breakdown. AI-enabled visual inspections can be used for testing and quality optimization.	Blockchain can further strengthen AI in inventory management, supply chain management and to combat counterfeit trade.

## g) Legal

### AI contribution:

The advent of AI and block chain wave in the legal industry is helping the legal system become faster at closing cases and may prevent the need for a trial on most occasions. Machine learning and AI can help lawyers and paralegals perform research while preparing for cases, which not only saves time but also delivers evidence and information that may have been missed by human eyes. Legal system software can further be strengthened by AI for effective legal document analysis. AI algorithms can review case documents and mark them as relevant to a particular case.

Block Chain Value add:

Block chain, which can execute smart contracts automatically when certain conditions are met, will eliminate most.

## h) Aviation

As drones become more and more numerous with time, they would require more than just a smart AI to stay out of each other's courses and avoid collisions and delays. One company has used the combination of AI and block chain to control drone traffic, which will enable any number of drones to function without obstructing each other. This will not only help the drone industry but can also eventually be adapted to the aviation industry, which can lead to an increased prevalence of aerial transport. Block chain can further value add by facilitating the tracing the status and location of valuables such as commuters luggage, goods and aircraft spare parts in a very safe and unalterable manner as these assets change custody [23].

## i) Manufacturing

The manufacturing industry is utilizing innovations, such as Industrial Internet of Things (IIoT), Artificial Intelligence (AI) and Block chain to accomplish high operational efficiencies, better business knowledge, and more profound client engagements.

### AI contribution:

AI is used to analyze patterns and inconsistencies present in the data collected from the sensors enabled at the factory floor. Predictive maintenance provided by AI helps the manufacturers to make the necessary repairs and damage management and avoid production downtime. AI algorithms can be used to optimize the generative design of the products before it goes into manufacturing [24].

### Block Chain Value add:

Block chain technology furthers empowers the manufacturing sector in numerous ways such as audit trails, tracking inventory, counterfeit trade and automation. Manufacturing businesses could rely on block chain to track defective products or manage the list of product inventory instead of shuffling through hundreds of papers,

bills, receipts, files and data. Block chain can help automate the manufacturing processes by displacing unnecessary middlemen and intermediaries. This will also help combat counterfeit trade wherein fraudsters try to clone the barcodes and QR codes of manufactured products. US block chain company Skuchain's Popcodes application allows for tracking and tracing goods at every point of the supply chain. Enabling all of this technology together reduces stock wastage, increases efficiency and allows companies to have greater control over their supply chains [25].

## 7. Platforms that are Decentralizing AI Today

Although blockchain based AI solutions are promising but challenging, few commercial platforms which offer the scalable AI applications are introduced. We present an overview of few platforms that offer Decentralized AI services:

### a) SingularityNet[26]:

It is one of the most popular open stack market-place for AI services which are now available to all the users. It is decentralized in nature and allows any user to create, modify and learn from the global network of AI services. It allows user to create a service in AI using common programming languages, wrapping a service as an executable as well as integrating AI services together.

### b) Ocean[27]:

It is also one of the most popular protocols that does a decentralized arrangements of services that are deployed on a truly decentralized system. It also provides an incentivization model for the sharing of data and services in the system. It allows sharing the data at no cost to data privacy. It brings compute to the data and thus sensitive data will never leave its secured premises. Ocean is known to be the first system that explicitly incentivizes people to share their data and services where the people bet for the popular services.

### c) Algorithmia[28]:

It allows to run multiple models at once on the same infrastructure and dataset, comparing results, errors, drift, and performance side by side. This allows comparing the models with their accuracy. It helps deploy AI model as API that any application can call, connect any data source and training platforms, scale the compute to peak efficiency and low latency, as well as manage the AI lifecycle.

## CONCLUSION

Artificial intelligence has brought technological reforms in the way of executing business. But decentralized AI with block chain is the need of time. There are several areas where AI and Block chain can bring a significant value-addition to the use case. Data protection, enhanced security, trustworthiness, efficient use of infrastructural



resources are some of them. Block chain pave way to decentralized AI, flexible AI as well as explainable AI which are need of time. The applications and use cases which were traditionally run with traditional AI can be leveraged with decentralization and distributed techniques. There are several challenges with the learning methods, optimization goals as well as with data storage and computation which needs to be addressed. But the study of several applications show that the integration of both the technologies will lead to smoother data management, trusted transactions and efficient use of resources.

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