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**NEBULA AI (NBAI) —  
DECENTRALIZED AI BLOCKCHAIN  
WHITEPAPER**

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Nebula AI Team

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## Abstract

The blockchain technology provides a digital trust mechanism for human beings which enhances the efficiency of value exchange and reduces costs, the genuinely credible and efficient Internet of Value is approaching. In recent years, many breakthroughs have been made in the field of artificial intelligence, and artificial intelligence has now penetrated every corner of human society and will become an essential cornerstone of change in human society.

Nebula AI is committed to building a decentralized artificial intelligence computing blockchain (NBAI) that reduces the energy costs of traditional Proof of Work by converting GPU mining machines into AI computing services. The AI transactions recorded on NBAI will be irreversible. The distributed computing network also ensures high concurrency and low latency computing power. The conversion of GPU mining machines makes it possible to provide more cost-effective artificial intelligence services.

Nebula AI will cooperate with large-scale third-party Internet data centers to provide adequate computing power for AI computing. Nebula AI has established an artificial intelligence training centre in Canada. System-based quantitative finance, image identification and other blockchain applications are also in development.

The well-developed NBAI ecosystem integrates the top-level applications such as DAI App, scientific research and application, university education, and the bottom-level of NBAI blockchain, Artificial Intelligence Mining Machine and Artificial Intelligence Data Center. The innovative economic model of NBAI ecosystem is the realization of a complete set of value-added economic systems.

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# 1 Technology and Industry Overview

## 1.1 The Internet of Value

The traditional Internet is based on historical content, instead of creating new value; the industry calls it the Internet of Information. The blockchain technology, on the other hand, has evolved the Internet into a network infrastructure for building social trust systems through the establishment of efficient and reliable value exchange system, which will enable the Internet to generate new value and realize the efficient exchange of value, the industry calls it the Internet of Value.

### 1.1.1 Blockchain Development

Blockchain technology is a comprehensive technology system based on distributed systems, computer networks, cryptography, data structures and other research results in various fields. The blockchain records and maintains data in multiple ways, assures the data transmission and access security by applying cryptography, and the data is stored in a chain structure and can only be read or written to ensure its consistency, prevent tampering and cannot be denied. Blockchain technology represented by Bitcoin and Ethereum implements peer-to-peer credit transactions between distributed nodes by adding technologies such as data encryption, consensus mechanisms, timestamps, and economic incentives. It has solved the problems of cumbersome and inefficient transaction cycles, high costs and unsafe data storage, which have become commonplace in traditional centralized systems, and became the nuclear technology of the modern digital cryptocurrency system. This technology system enables information consensus, sharing, and co-responsibility among all participants that can be entirely ported to the underlying applications of most trust-based business models and organizations.

Satoshi Nakamoto published the Bitcoin Design Paper *Bitcoins: A Peer-to-Peer Electronic Cash System* in 2008, where he indicated to create a new decentralized electronic payment system, which “based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need

for a trusted third party [?]. From then on the blockchain technology represented by bitcoin began to be known to the world.

Blockchain technology is typically divided into two generations by industry and academia

- 1.0 Bitcoin — solves the problem of encrypting ledger and decentralized payments.
- 2.0 Ethereum — enriches the application value of blockchain technology. The smart contracts used by Ethereum can use virtual machines and contract programming to provide new ideas for the development of cryptocurrencies. At the same time, a large number of DApps and ICO financial innovations came into being, opening up new territory for financial markets.

As the first application of the blockchain, Bitcoin realized the mode of decentralized cryptocurrency ledger system. Bitcoin relies on the completion of computational tasks based on a particular algorithm and does not depend on any individual or organization, thereby ensuring consistency with the distributed ledger system. Vitalik Buterin applied the concept of smart contracts in his design of Ethereum [?], giving us a common framework for blockchain with Turing completeness.

The application of blockchain technology establishes credible peer-to-peer transmission, which provides us with a new social trust mechanism, both to support common decision-making and protect individual rights and interests, both open transaction information and protect node privacy. This mechanism enhances the efficiency of the value exchange and reduces the cost, laying a new foundation for the development of the digital economy. It marks the beginning of human society to evolve from the Internet of Information and build a genuinely credible and efficient Internet of Value. At the same time, the application of blockchain innovation is thriving, showing the new direction of public service development and industrial innovation revolution.

### 1.1.2 DApp and Artificial Intelligence

DApp (Decentralized Application) is a kind of application that runs on the node of the decentralized P2P network server. It mainly consists of front-end presenta-

tion layer, background server and smart contract. With the rapid development of Ethereum, a few millions of DApps have emerged in all walks of life, and the Internet of Value ecosystem is increasingly complete.

In recent years, many breakthroughs have been made in the field of artificial intelligence, and a wave of research on its fanaticism has been set off on a global scale. The research and application of artificial intelligence have now penetrated every gap in human society. DApps also have no shortage of artificial intelligence figure. However, the research on artificial intelligence requires strong computational power, which has been promoted from the early stage of CPU computation to GPU computing. The large-scale application deployment has higher requirements on hardware performance and system concurrent processing.

Nebula AI blockchain, as a new generation of AI blockchain, is dedicated to solving the computing power needs of human beings in the process of artificial intelligence, expediting the inter-regional transfer of resources and writing integrated and decentralized AI applications more conveniently, so as to realize a seamless integration of blockchain micropayments, hyperledger, decentralized features, and AI applications and achieve the transformation from DApp + AI to DAI App.

Nebula AI is committed to building a decentralized artificial intelligence computing blockchain (NBAI) that reduces the energy costs of traditional Proof of Work (PoW) by converting GPU mining machines into AI computing services. On the Nebula AI blockchain, developers can design their own DAI Apps based on Nebula AI's generic programming interface, gaining access to NBAI Tokens revenue by publishing free or paid Apps, or by the use of paid users. The AI transactions recorded on NBAI will be irreversible. The distributed computing network also ensures high concurrency and low latency computing power. The conversion of GPU mining machines makes it possible to provide more cost-effective artificial intelligence services. Nebula AI has established an artificial intelligence training centre in Canada and is dedicated to disseminating the latest applications and knowledge in the AI industry and delivering talents to society. Also, Nebula AI will cooperate with large-scale third-party Internet data centers to provide computing power for AI computing. System-based

quantitative finance, image identification and other related blockchain applications are also in development.

NBAI blockchain will inject fresh blood into the Internet of Value and provide cost-effective basic services for global artificial intelligence development.

## 1.2 Market Prospects

The blockchain technology has achieved global application deployment; all countries are closely watching the development of the blockchain, planning the application of the blockchain. According to market research firm Gartner, blockchain-based businesses will reach 100 billion U.S. dollars by 2020. In addition to the large-scale application of the financial sector, the blockchain will create over one trillion value in the manufacturing and supply chain industries. Klaus Schwab pointed out that blockchain is the fourth industrial revolution after mechanization, electrification and digitization. It is estimated that by 2025, 10% of the global GDP will use blockchain technology for data storage [?]. MarketsandMarkets forecasts that the average annual growth of global blockchain applications and solution providers to improve business operations will reach its peak between 2016 and 2021 [?]. The market prospect of blockchain technology mainly lies in the social public services and economic models optimization:

At the level of social public service, blockchain technology is penetrating into all aspects of social security, intellectual property and public administration, and mainly focuses on four areas: identity verification, forensic authentication, information sharing, and transparent government. The British government released the report *Distributed ledger technology: Beyond Blockchain* in 2016, for the first time from the national level to explore the critical application of distributed ledger in government affairs [?]. Subsequently, the United States set up a “Congressional Blockchain Caucus” and the governments of Russia, Singapore, Dubai, Japan and China all accelerated the social application of blockchain technology [?]. Under the influence of the underlying philosophy of distributed consensus, transparent open source and social collaboration of blockchain technology, the public service realizes an overall

change from data management process optimization to management thinking, helps to increase public participation, reduce social operating costs and improve the quality and efficiency of social management, which plays an important role in promoting the level of social management and governance.

At the level of economic optimization, the core philosophy of the blockchain economy lies in the reconstruction of business logic, creating a new pattern of finance and economy in the future, not just a technological revolution [?]. As early as 2015, the blockchain has become the highest-paid sector in U.S. venture capital. The current global blockchain has more than 2,000 projects, the global value of crypto assets reaches 90 billion US dollars. Blockchain has high application value regarding finance, shared economy and Internet of Things, which has attracted the wide layout of business groups such as Goldman Sachs, Citigroup, Nasdaq, Deloitte and Airbnb. User groups in the fields of blockchain/crypto assets are also growing rapidly: from 2 million users worldwide in early 2013 to 20 million in early 2017 [?]. In the blockchain system, participants can trade without having to know each other's basic information so as to achieve "trustless trust" and change the third-party-based trust model in the traditional mode, and the economic system can be out of the current system constraints or endorsement by third parties, the two sides realize the delivery of value. This kind of economy based on blockchain solutions can improve the existing business rules, build a new industrial collaboration model and improve the efficiency of collaborative logistics. Blockchain can provide systematic support for economic and social transformation and upgrading [?]. The significant advantages are the optimization of business processes, lower operating costs and synergy, and These advantages have emerged in all areas of society, including financial services, supply chain management, smart manufacturing, education and employment.

After 60 years of ups and downs, the artificial intelligence industry is finally recovering with the rise of machine learning. Now it has formed a new round of development in the world; countries have sounded the horn to explore the mysteries of human wisdom. The scale of the global artificial intelligence market reached 168.39 billion in 2015. In 2016, the research and development of artificial intelligence in all

fields in the world have been strengthened and emphasized, the market scale of the industry increased more than 190 billion [?]. According to the market demand, the global market size of artificial intelligence is expected to reach 270 billion by 2018.

DApp will form the backbone of the value internet in the future. Artificial intelligence will cover all application areas. Blockchain, as the infrastructure of the former two, will undoubtedly become popular and will inevitably bring significant changes to the traditional Internet, human society and the natural environment.

### 1.3 Existing Challenges

#### 1. Highly Centralized

Google and Amazon have started to provide cloud services of artificial intelligence computing. However, as single-commerce companies, they could cut off the service at any time, given special circumstances, which are based on their own interests and the pressure of governments and other organizations. For example, Google was banned by the Chinese government, leaving Chinese users unable to utilize their services.

The blockchain is a new decentralized protocol that securely stores data information through a distributed ledger (a type of database distributed across multiple addresses, multiple regions, or multiple participants) [?]. The blockchain is based on the architecture of "decentralization", and the rights and obligations of any nodes are equal; the data blocks in the system are jointly maintained by all nodes, and each node shares rights and obligations; verified by node distribution in the world, to ensure that the information cannot be forged and tampered with; and technically guarantee the transaction, without the need for a third-party structure to provide a trust mechanism. Corporations use decentralized distributed ledger technology to process, verify transactions, or other types of data exchange, and the records are stored in the ledger. Once most participants agree, each record is given a time stamp and a unique encrypted signature. The distributed ledger provides verifiable and auditable information history, and all participants can view suspicious records [?]. This technique guarantees that it is impossible to shut down the entire network as long as more than one node is in operation. This makes it possible to design a decentralized

AI cloud service which cannot be blocked.

## 2. Data Privacy Security

Although centralized companies have various security agreements, it is still difficult for companies to ensure data privacy when faced with internal leaks. Also, when the government requests data, the centralized company is limited to geographical restrictions of the host country, leaving the only option to cooperate with the government and transfer ownership of the data. As a result, the user's data security cannot be 100% guaranteed.

Based on the cryptography technology, blockchain is a kind of low cost, high security, customizable and encapsulation decentralized trust solution tool based on encryption technology, which relies on the encryption algorithm, peer-to-peer transaction and information stored in each node without trusting a single center [?]. Each node is involved in maintaining the security and accuracy of the information by keeping a copy of a complete set of historical databases. The peer-to-peer blockchain encryption technology can be used to ensure that only the owner of the private key can access specific information, while other users cannot decrypt data. This is of great significance for a variety of high-value training data and models. The advantages of blockchain in terms of data security are:

- Use highly redundant databases to ensure the integrity of the information.
- Verify data using cryptography-related principles to ensure that the data cannot be tampered with.
- Use multiple private keys for access control.

## 3. Maintenance Costs

The maintenance of centralized computing center will cost heavily on workforce. The use of blockchain micropayments makes it easier to pay for maintenance and allows anyone to lend their computing power. The shared economy model dramatically reduces maintenance workforce costs as well as reducing the computing costs.

## 4. Hash Calculation Efficiency

Currently Ethereum, Zcash and other GPU Proof of Work (PoW) consume a lot of power and hash computing, the computing power of these GPUs can be used for AI calculations, rather than simply being used as POW. A recent study shows that Bitcoin mining has consumed more electricity than the average annual electricity consumption of 159 countries this year. Such a high level of power consumption has become a urgent problem to be solved. Digiconomist estimates that Bitcoin mining consumes about 30.14 TWh annually, which is much higher than the average annual electricity consumption of 25 TWh in Ireland [?]. In fact, a recent ING study by ABN AMRO shows that a Bitcoin transaction consumes enough power for a full month of household use. Digiconomist also found that the second most expensive cryptocurrency, Ethereum, consumes more power than that of most countries [?].

## 5. Blockchain Application Development Environment

With the rapid growth of various applications (DApps) on the blockchain, a good state of the ecosystem is at the heart of the user experience. This includes how users can retrieve their expected DApps in massive blockchain applications, how to motivate developers to provide more DApps to users, and how to help developers develop better DApps faster. Take Ethereum as an example, there are tens of thousands of DApps based on Ethereum. Imagine if the scale of DApps in the blockchain world is close to that of the Apple App Store, how to discover and find user's expected DApps would be a serious problem. With the popularity of blockchain technology, more and more application scenarios of blockchain technology have been excavated. Blockchain technology scenarios have been gradually expanded from the original cryptocurrency to more scenarios and user groups. For example, the community represented by Ethereum introduced the concept of smart contracts in blockchain technology, and Ripple used the blockchain technology to implement the real-time gross settlement system. With the increasing diversity of application scenarios, user demand for blockchain is also increasing, and we expect to face more challenges.

## 1.4 Project Objectives

In order to improve the status quo of the current centralized cloud computing, we utilize the decentralization of blockchain technology to rent and distribute the computing power of artificial intelligence machines globally. Blockchain encryption technology efficiently avoids the problem of internal leakage and the maintenance of distributed AI calculation units is handed over to the owners of various AI calculation units, which considerably reduces the workload of maintenance. We split this overall goal into the following sub-goals:

### 1. Shared AI Computing Platform

The shared AI computing device platform will address the unbalanced demand between consumers and suppliers of AI devices. Suppliers of AI computing devices cannot use 100% of their computing power, which leads to some computing resources being idle. On the other hand, a large number of users who need the computing power of artificial intelligence cannot obtain the economical and efficient AI computing resources. Peer-to-peer payment in blockchain technology, as well as blockchain ledger technology, enable shared AI computing to be paid and shared in the most convenient way.

### 2. AI Physical Computing Units

A large number of GPU computing mining machines can be converted into AI computing units, from simple hash calculation into more meaningful AI task calculation. Due to the particularity of AI calculation, it is necessary to pre-install the specified system and regularly update the client, including the ledger system, in order to play hardware performance better and share AI computing power.

### 3. Decentralized AI Applications

Decentralized AI Applications system requires a corresponding interface for DAI App programmers to invoke conveniently and use the platform's computing power. It includes the payment API, computing capacity estimation API and work estimation API, etc., in order to speed up the development of AI applications.

#### 4. Integrated IPFS Distributed Storage

Decentralized applications require distributed file storage systems to store data. An option is the IPFS storage system to replace the traditional centralized cloud storage or local file storage, in order to achieve better distributed storage.

InterPlanetary File System (IPFS) is a protocol and eponymous network designed to create a content-addressable, peer-to-peer method of storing and sharing hypermedia in a distributed file system. The nodes in the IPFS network will form a distributed file system [?]. Most of the future IPFS will use cross-chain service. Please read the section of Cross-chain Service Usage to know more about cross-chain technology.

#### 5. AI Engineer Training Center

Nebula AI will establish a systematic artificial intelligence training center to provide practical knowledge in the field of artificial intelligence. Engineers gradually create and train artificial intelligence models in product design through system learning and project operations. We are dedicated to disseminating the latest applications and knowledge in the AI industry and developing and delivering outstanding AI talents. Our mission is to fill the talent gap, give full play to the power of artificial intelligence in business.

## 2 NBAI Ecosystem

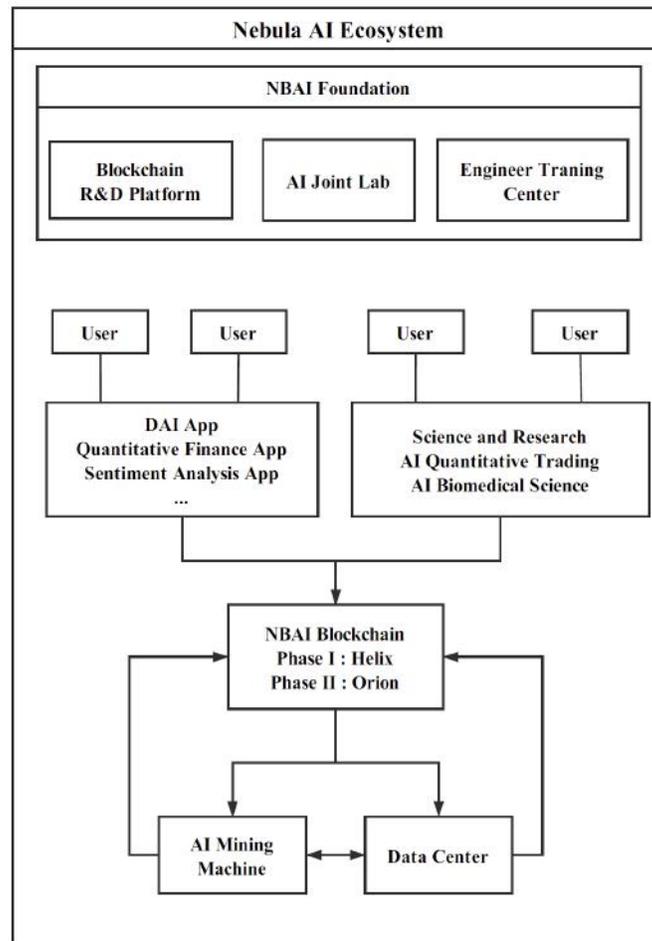


Figure 1: NBAI Ecosystem

The NBAI ecosystem consists of two major components, the NBAI foundation and the NBAI system. The NBAI foundation supports the development, operation, and management of blockchain development platforms, AI joint labs, and engineer training centers. NBAI system integrates the top-level applications such as DAI App, scientific research and application, university education, and the bottom-level of NBAI blockchain, Artificial Intelligence Mining Machine and Artificial Intelligence Data Center.

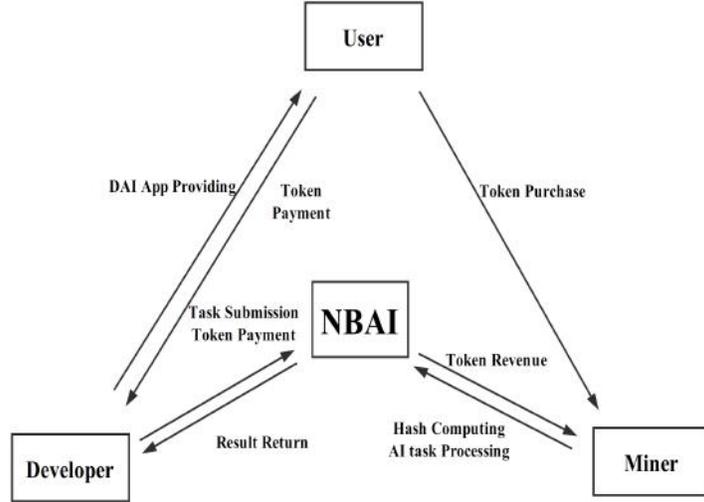


Figure 2: NBAI Economic Model

Figure 2 indicates the economic model of NBAI ecosystem. Developers provide users with DAI Apps, users pay for NBAI tokens or use Apps for free based on rules set by the developers. Developers submit artificial intelligence tasks to NBAI and pay for NBAI tokens based on NBAI’s estimated costs. Then NBAI will open the tasks and miners are free to receive and handle the tasks from NBAI, they will get the corresponding NBAI token as a reward after completing the tasks. Clients and miners can trade NBAI tokens through the exchange, so as to achieve a complete set of value-added economic systems.

## 2.1 NBAI

In NBAI system, there are a lot of deep training model (such as RNN, CNN and LSTM) to be trained, requiring a large number of GPU computing to complete. In order to solve this problem, we have to change the way of blockchain mining. Instead of simply using Proof of Work (PoW) as the solution, we issue the token by PoW at early stages and Proof of Group (PoG) in late period. Existing miners can perform artificial intelligence algorithms calculation to obtain token rewards. In the early days, Ethash was still used as a POW to ensure the stability of the block. However, in the medium term, PoG will be enabled.

### 2.1.1 Helix (PoW)

At the same time as the white paper is released, an artificial intelligence public blockchain loaded with smart contracts will be released. Therefore, the first phase of the project will be implemented using an independent ether chain. The independent ether chain has the following advantages:

- Less Traffic Delay.
- Customized Gas.

It helps to motivate miners to get profits through smart contracts instead of relying on gas profits from smart contracts.

- Customized Difficulty.

It can increase the speed of generating the block, as well as adjust the speed of token production.

According to varying computing abilities, each artificial intelligence node can obtain the tasks in the task pool through smart contracts. Then, they calculate the task, and obtain the token rewards after submitting the results. The hash of a smart contract is recorded in the block to identify the address of the task. The contract will set the task address, workload and work costs.

However, bitcoin has attracted most of the world's computing power nowadays, and other blockchain applications using the PoW consensus mechanism have found it hard to get enough hash power to protect their own safety. Mining caused a lot of waste of resources, which will inevitably lead to environmental destruction and energy shortage, resulting in all human beings need to pay for it. It is difficult to shorten the confirmation time of the block, and the cycle of reaching a consensus is longer, which is no longer suitable for the popular business applications. Also, The PoW consensus mechanism has no solution to the 51% attack yet [?]. Therefore, We think the NBAI ecosystem needs to apply a new set of consensus mechanisms to address the potential loopholes in PoW and the consensus mechanism to optimize NBAI.

### 2.1.2 Orion (PoG)

Due to the large training data of artificial intelligence, the time taken to acquire data in the system becomes very crucial. The characteristic of cloud computing is the closer the distance between nodes, the lower the cost of communication, and the higher the corresponding computational efficiency. Based on this feature and the existing issues of the PoW consensus mechanism, we will use a new consensus mechanism — Proof of Group (PoG). In PoG we will use consensus systems and NBAI credit mechanisms to ensure efficiency and security. The definitions are as follows:

#### 1. Work Node and Ledger

A work node is a main artificial intelligence computing task execution node; its main role is to perform artificial intelligence computing tasks.

In addition to the normal calculation, the ledger can also be responsible for managing other nodes and performing ledger functions. When an AI task needs to be executed distributedly, the ledger is responsible for allocating subtasks to all work nodes in the area. The task results are then written into the IPFS. The completed contract is finally submitted through the Byzantine consensus to the ledger for verification.

When a new work node joins the system, it will first broadcast the information and search for nearby nodes.

- If it finds existing nodes within the response time ( $t$ ), then it choose to join the network of designated nodes to become one of the worker.
- If there is no nodes response with time ( $t$ ), then it elects itself as a ledger.

#### 2. How to Become a Ledger

Within a network, there are two ways for a work node to become a ledger:

- After the disappearance of the original ledger in the network , the node with the highest credit automatically becomes the ledger.

- Assume there are  $n$  work nodes in the network, denoted as  $P$ . The survival time of each node is denoted as  $t$ . If  $\exists p_i$ , The product of the sum of its response time to all the other nodes in the network  $\sum_{i=1}^{n-1} T$  and its survival time is the smallest, then this node becomes the ledger.

### 3. Virtual Working Group

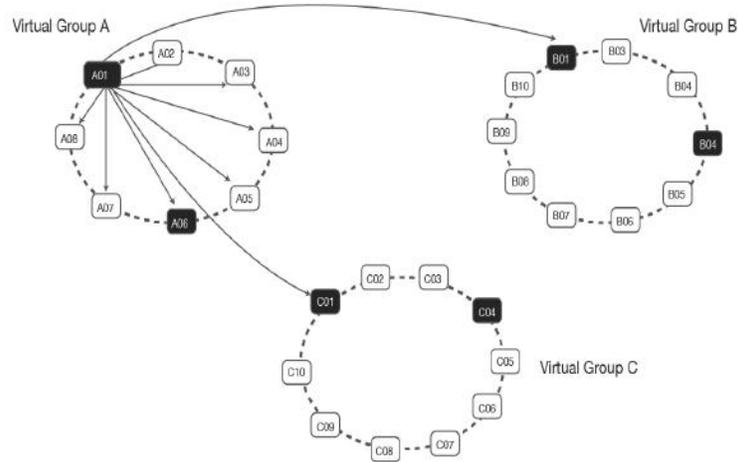


Figure 3: Virtual Working Group

Several work nodes will be combined into a working group. The backup factor in a working group is defined as the number of nodes that can simultaneously process the ledger. Assuming a total sum of  $n$  nodes, the backup factor can be  $1 < k < n + 1$ ; when  $k = n$ , it will convert into a Helix system. A backup system is a way of keeping ledger within a group. However, miners may try to increase the backup factor  $k$  by artificially in order to obtain the revenue from mining. For this reason, the system is mainly based on AI calculations and the mining output should be lower.

### 4. Communication Among Groups

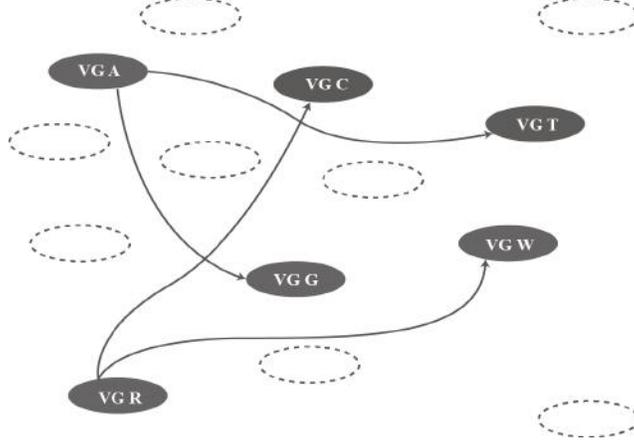


Figure 4: Communication Among Groups

The working groups compose a ledger network. The network uses the Byzantine consensus system for joint ledger, which fully guarantee the balance between preventing 51% attacks and ledger efficiency.

In Nebula AI's Proof of Group (PoG), each participant is denoted as  $P_i$ , needs to know other people they think are important in the blockchain network, denoted as  $Pk_j$ . A transaction settlement, denoted as  $TS$ , requires waiting for the vast majority of other people in the group to agree on any previous trade.

Assume  $P_i, Pk_j \in \text{group } G$ , consensus algorithm  $Consensus(A, B)$ , consensus verify algorithm  $Verify(V, NL)$ , then consensus for each node is calculated as

$$\forall i \quad TS(P_i) = \prod_{j=1}^n Consensus(Pk_j, P_i) \quad (1)$$

Furthermore, those who are considered important are confirmed only if they are confirmed by their important participants. Thus, In the working group, the final consensus is calculated as:

$$TSA = Verify\left(\frac{\prod_{i=1}^n TS(P_i)}{Consensus(G)}, [P_i, Pk_j]\right), \quad P_i \in G \cap Pk_j \in G \quad (2)$$

Eventually, when there are enough network nodes, the system will accept the transaction, and this series of hierarchical group consensus will make it impossible for an attacker to have complete consensus information and thus be unable to attack. The

PoG Consensus ensures the completeness of AI tasks and transactional information.

### 2.1.3 Task Implementation

Task pool contains two kinds of tasks:

- Generating tasks. Such as Ethash and protein sequencing.
- User tasks. Users submit tasks to solve certain problems, and the users will set the task revenues. Either task comes with a small smart contract system for submitting contracts and calculations. Mining will receive task revenues and ledger revenues at the same time.

A standard training task includes the following:

- Training data used by tasks. The dataset can come from the foundation or be customized.
- Training script used by tasks. Training methods come from standard RNN, CNN, LSTM and other customized deep learning methods.
- Training revenues. Training tasks will be completed by the AI mining Machine, the user must specify the amount of revenues, the higher the cost, the higher the training priority.

The task system is stored on the integrated IPFS, which is stores the arithmetic encryption algorithm and task code. When the miner receives the computational task, it returns its own hardware parameters, downloads the computational task unit remotely, and trains the dataset. After packaging the standard distributed TensorFlow, the appropriate redundancy calculation is added to ensure the reliability of the calculation results.

### 2.1.4 Cross-Chain Service Usage

As a decentralized artificial intelligence system, many components will be decentralized. However, designing all these components on their own is very inefficient and the system should be interoperable with other decentralized services and be used

cross-chain. There are two types of cross-chain: Value Cross-Chain and Technology Cross-Chain.

Value cross-chain is a cross-chain transaction regarding decentralized exchanges such as the exchange in the EtherDelta through smart contracts to obtain the required service tokens. The token is then used to drive the appropriate services. This kind of technology is simple, yet it has a low performance. If tokens can be redeemed in advance in the system, then latency will be reduced. Under the current conditions, USDT and Bitcoin will all be typical value cross-chain media.

Examples of technology cross-chain include cross-chain transactions between Bitcoin and Litecoin, which uses Segwit isolation in order to realize the cross-chain transactions between different currencies, as well as ongoing zero-knowledge verification transactions between Zcash and Ethereum. Zero-knowledge proofs make Zcash Tokens to be untraceable by creating private transactions on the public Zcash blockchain. A bottom chain needs to be designed for cross-chain transactions. Currently, a large number of ICO projects have attempted cross-chain.

For example, the Polkadot project of Ethcore in the field of cross-chain communications has been designed with the core philosophy of addressing two main problems of blockchain technology diffusion and acceptance: immediate scalability and extensibility. The project is currently based on Ethereum to achieve its interconnection with the private chain, and treat other public chain network as the upgrade target. After its technology is mature, the integration will dramatically enhance the scope and performance of the project [?].

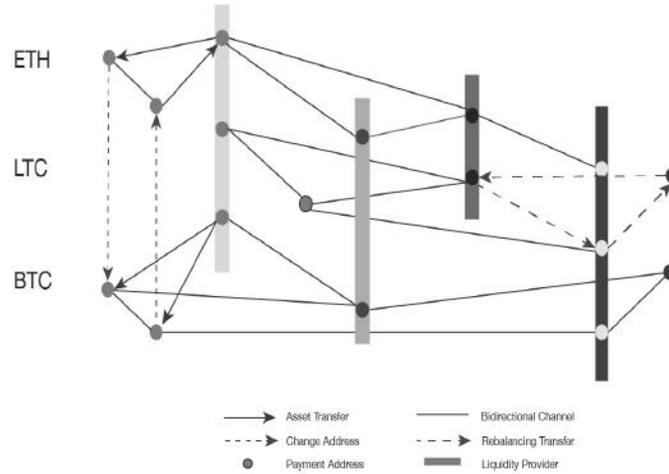


Figure 5: Cross-Chain Service Usage

## 2.2 AI Data Center and Mining Machine

### 2.2.1 AI Data Center

To guarantee adequate AI power supply before large-scale users join, we will cooperate with large-scale third-party Internet data centers in Quebec. Quebec has a very competitive global electricity bill, a cold climate, abundant resources and 34 data centers. In addition, the world's leading companies including IBM, Nokia, Amazon and Microsoft's data center are built in Quebec.

The advantage of choosing Quebec as an artificial intelligence data center are as follows:

- Adequate Water and Low Electricity Rates

TABLE 1: *Quebec electricity rates*

Province	375 kWh	750 kWh	1,000 kWh	2,000 kWh	5,000 kWh
Quebec	32.48	52.77	68.66	146.46	379.86
Manitoba	34.03	60.96	78.92	150.75	366.24
British Columbia	32.05	61.92	89.07	197.63	523.34
New Brunswick	52.88	88.32	111.94	206.44	489.94
Alberta	57.775	96.175	121.78	224.195	531.44
Saskatchewan	61.955	103.685	131.505	242.79	576.65
Ontario	64.7	110.64	141.69	267.34	674.38
Nova Scotia	64.69	118.55	154.46	298.09	728.98

According to Ontario Hydro and Hydro Québec statistics in 2013, Canada has the world’s lowest electricity rates. And among all provinces in Canada, Quebec has the lowest electricity rates [?], and more than 90% of the electricity use hydropower energy.

- Lower Temperature

Quebec has a winter of up to nine months and its average temperature in winter is below minus 10 degrees Celsius, even below 20 degrees Celsius in summer. Low temperature optimize the heat dissipation of the equipment room.

- Adequate AI Talents Pool

Google, Facebook and Microsoft have set up artificial intelligence centres in Montreal, which brought together a large number of talents in the field of artificial intelligence. For example, Yoshua Bengio, professor of computer science and operations research at the University of Montreal, is the world’s top researcher of artificial intelligence. He is the head of the Montreal Institute of Learning Algorithms and one of the three founders of advanced machine learning in the field of artificial intelligence. In addition, the Canadian government also fully supports the research and development of artificial intelligence. The federal government has given a funds of 213 million Canadian dollars to the Uni-

versity of Montreal, while the provincial government plans to add 100 million Canadian dollars in the next five years of investment.

- University Research

Nebula AI has partnered with McGill University School of Medicine, to collaborate in joint research and development for the innovative use of artificial intelligence in surgery.

### 2.2.2 AI Mining Machine

A 1080Ti graphics card computing power is 7514 GFLOP/s. Using the Caffe framework to train the GoogLeNet model of 1.3 million image data on the GTX 1080Ti, the computation time of epoch 30 times is 19 hours and 43 minutes. The calculation time of six cards can be shortened to 3.5 hours.

Any mining machine that supports CUDA operations (mainly Nvidia series graphics cards) can be installed in the AI mining system. AI mining machines pre-installed common AI algorithms, such as CNN, RNN, DNN, etc., as well as a large number of other commonly used libraries, such as TensorFlow, etc. The upgraded client included with the system, can automatically update the AI pre-installed support library. The first batch of computing miners will be preloaded with python 3.6 support libraries. The ledger client that supports Ethash is also integrated into the system.

There are three types of revenue available on AI mining machines:

- Ledger Revenue.

The Equahash-based algorithm supports ledger revenue. However, this part of the income is generally less than AI calculation income.

- AI Calculation Revenue.

The calculation revenue of AI is the most important source of revenue for miners.

- IPFS Revenue.

Mining machines can be turned duo-mining mode, support Sia and storj mining. IFPS can also be used to pay for the data storage in AI calculations.

## 2.3 DAI App Development

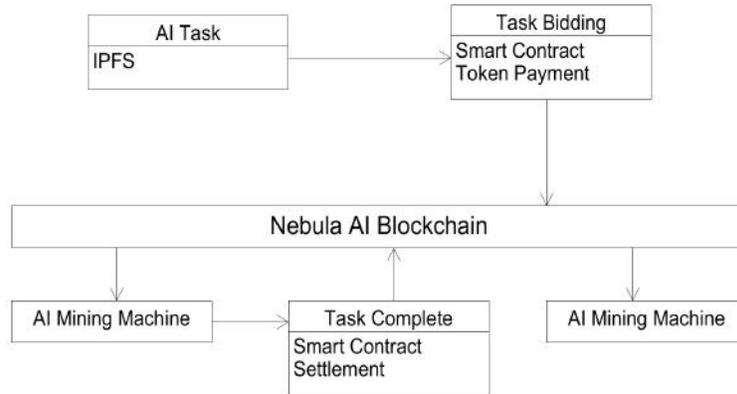


Figure 6: AI DAI App

The Ethereum community calls smart-contract based applications as Decentralized Applications. The goal of DApp is to create a friendlier interface for the smart contract, and to add additional features such as IPFS. DApp can run on a centralized server that interacts with Ethereum nodes. Examples include the famous EtherDelta, Ethercat, etc.

However, the current smart contracts are not enough for decentralized AI applications. The reasons are the following:

- Ethereum smart contracts do not come with AI calculations.  
EVM is a Turing complete contract virtual machine, but its consensus computing system can only perform simple tasks, and it is unable to perform complex artificial intelligence calculations.
- Ethereum mining clients do not support the computational libraries required for AI calculations.

The operation of artificial intelligence depends largely on the support of various development kits, and the distributed computing is main task. The supporting libraries required for the relevant computing tasks can be implemented with separate computing clients.

However, as a commercially AI application, the blockchain hyperledger and payment

function remain at the core of the system. Due to the scarcity of artificial intelligence computing resources, shared computing power will become a very useful function. Each user can link to the chain, and use blockchain to rent or lend computing power to complete the calculation tasks. DAI App users can also write standard, compliant smart contracts, according to their own needs.

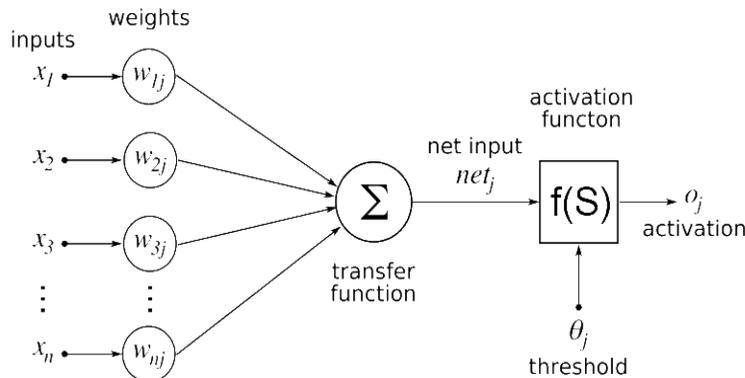


Figure 7: Deep Learning

When training a deep learning model, two major operations are performed: forward propagation and backward propagation. In forward propagation, the input is passed through the neural network, and after processing the input, an output is generated. Whereas in backward propagation, the weights of neural network are updated based on error got in forward propagation. One of the most critical problems in neural network training is the training speed, especially for deep learning, which will consume lots of time. The computationally intensive part of a neural network consists of multiple matrix algorithms, and the GPU has unique advantages regarding matrix operations and numerical calculations. In particular, floating point and parallel computations can outperform the CPU by tens to hundreds of times. While using GPU to train deep learning models, it is also easier to classify and predict on the cloud, enabling far more data and throughput with less power consumption and less infrastructure occupation. Therefore, getting enough computing power through smart contracts to for artificial intelligence calculations is an effective method.

Let's take a typical style transfer learning model (Gatys et al.) As an example to compare the time that a GTX 1080 Ti GPU, K80 GPU (AWS P2), i5 7500 CPU,

and CPU (AWS P2) use the TensorFlow framework to calculate.

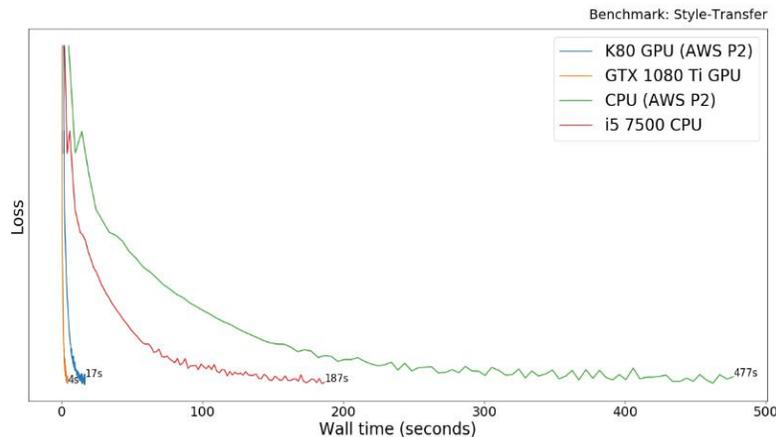


Figure 8: GPU vs CPU

The GTX 1080 Ti GPU performs nearly 50 times better than the i5 7500 CPU.

Nebula AI provides very competitive computing power. Nebula AI artificial intelligence mining machine using Nvidia 1080 Ti, let's take Amazon P2.xlarge (Nvidia Tesla K80) as an example, we do the following calculations: Nvidia 1080 Ti costs 1,000 Canadian dollars, electricity costs 0.1 Canadian dollars per hour, assuming a 1080 Ti has a life span of two years and its unit computing price per hour is  $1000/(36 \times 2 \times 24) + 0.1 = 0.157$  CAD/hour.

The official test data shows that the Nvidia 1080 Ti's Tensorflow GPU performance is four times that of Amazon P2.xlarge instance [?]. The price of P2.xlarge is 0.9 Canadian dollars/hour, which is 23 times the unit price of computing power provided by Nebula AI. Users need to upload data to Amazon servers for calculation, which can not guarantee the data privacy, but decentralized NBAI can solve this problem.

## 2.4 Higher Education

NBAI provides rich interfaces for scientific research in major universities around the world, which can significantly improve the work efficiency of researchers and reduce R&D costs, and break the barriers between high-level programming needs

and low-level configurations. The Platform as a Service (PaaS) provided by the NBAI ecosystem enables university students to focus on research instead of bottom configuration.

## **2.5 Nebula AI Foundation**

The Nebula AI ecosystem is expected to become a partner community using NBAI cryptocurrency. The Nebula Foundation aims to be an independent, nonprofit, and democratic governing body for this ecosystem.

A blockchain AI Foundation will be established for the promotion and education of foundational artificial intelligence and fund venture activities. We encourage everyone in the community to join in and participate in all the of the DAI APP R&D interactive activities which are willing to integrate the system into the Nebula AI platform.

Based on the principle of independence, the Foundation s' wallet takes three quarters multiple signatures. Increasing the signature should be reviewed by the Finance and Management Committee. Large amount of tokens use cold storage, while small amount of tokens use multiple signatures.

### **2.5.1 AI Joint Laboratory**

Nebula AI Foundation will extend broad cooperation in the AI, Blockchain, Distributed Computing with Universities of Montreal, University of Toronto and McGill University. Canada is going to create a new centre of super-artificial intelligence in Toronto, Waterloo, Montreal, and Edmonton, in order to establish a sound financial, business and human resources-ecological chain. In 2017, the federal government 's annual budget also indicated that government will focus on grants to the artificial intelligence industry in the above regions and will put artificial intelligence at the top of the national development level.

The research conducted by Professor Yoshua Bengio and his team at the University of Montreal over the past 10 years has laid the groundwork and put Montreal at the forefront of artificial intelligence. Bengio also conducts academic research at the

Institute of Algorithms (MILA) at the University of Montreal. MILA is supported by The Institute for Data Valorisation (IVADO). Nebula AI is actively communicating with MILA to promote collaborative research.

The Surgical Innovation program, Department of Surgery, McGill University School of Medicine (North America's top medical school) and Nebula AI embarked on a research project about AI medical imaging supported supported by Mitacs. The Mitacs Project is a collaborative project initiated by the Canadian Information Technology and Integrated Systems Mathematics Organization and has been in operation for more than ten years. Jake Barralet is the leader of the program.

In February 2018, R & D laboratories are set up in Silicon Valley, and conduct extensive cooperation with local universities and industry on the application of artificial intelligence and the research on blockchain.

### **2.5.2 AI Engineer Training Center**

Every successful project is inseparable from a large number of engineers. The current market is in a shortage of AI talents. Nebula AI collaborates with educational institutions such as the local ECV learning on funding and project platforms. AI scientists at Nebula AI will also serve as project trainers and recruit a large number of AI intern trainees, continuing to provide high-caliber talents for the AI industry. On January 27, 2018, the first group of students took an AI Engineer training class led by Dr. Tengke Xiong. They will become a solid R&D team reserve force for Nebula AI in the future. Blockchain training has also been scheduled in the program, which will take place in mid-February.

### 3 NBAI Architecture Design

#### 3.1 NBAI Logical architecture

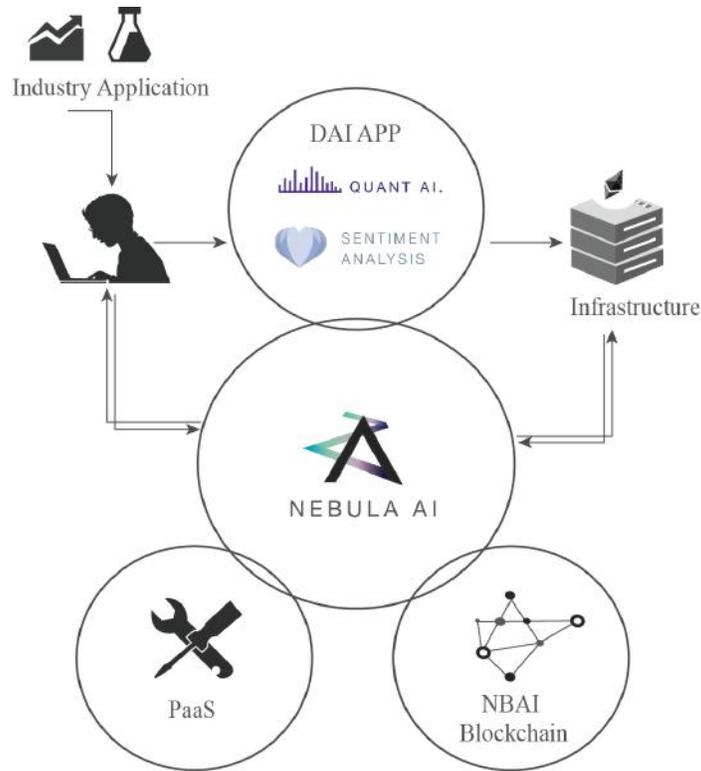


Figure 9: System Logic Diagram

The logical structure of NBAI is mainly composed of industry application requirements, developers, DAI App, infrastructure and Nebula AI. Nebula AI provides PaaS (Platform as a Service) and NBAI blockchain. A large number of artificial intelligence development needs in industries such as finance, healthcare and biology have prompted developers to develop DAI Apps for different industry applications, provide solutions by deploying applications and join the Nebula AI ecosystem to generate revenue. Nebula AI will provide a wealth of interfaces and applications for developers. The decentralized blockchain provided by NBAI, in conjunction with the Nebula AI credit mechanism, will address the issue of P2P trust and big data processing for sensitive data and models.

### 3.2 NBAI System Architecture

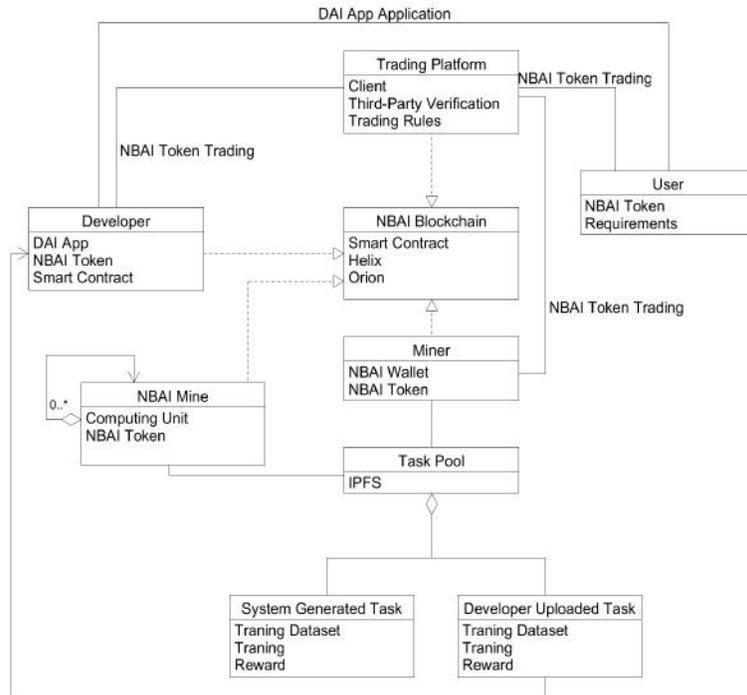


Figure 10: System Architecture

The system architecture of NBAI is mainly composed of NBAI, developers, users, trading centers, miners and task pools. Nebula AI not only provides a decentralized NBAI blockchain, it also offers the NBAI token exchange center to improve the value exchange in the NBAI ecosystem.

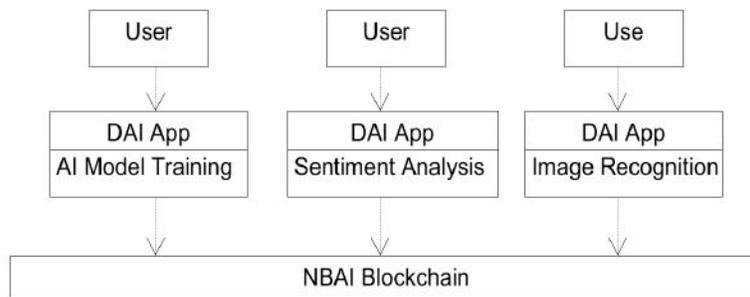


Figure 11: Shared AI Cloud Computing Platform

Nebula AI provides a shared AI cloud computing platform, PaaS (Platform as a Service) enables non-IT sector practitioners to achieve rapid development and de-

ployment, and reduce the dependence on the system environment and computing power.

### 3.3 API/SDK Support

Some common prepaid, up-charged smart contracts can be generated programmatically using the SDK, and the APIs provide interfaces in a centralized service. The first batch of supported SDKs uses python as the main programming language, followed by java and .net. With the support of the SDK, users can programmatically drive AI calculations more conveniently and become an interface point with the centralized system.

## 4 NBAI Optimized Design

### 4.1 Data Security Encryption

Data will be saved using Homomorphic Encryption. The idea of homomorphic encryption refers to the operation of encrypting several data and then deciphering the result, which is consistent with the result of performing an operation when these data are not encrypted. The current homomorphic encryption schemes can be divided into three types: partially homomorphism, somewhat homomorphism and fully homomorphism. Partially homomorphism can only realize a certain kind of algebra (or, multiply, add); The somewhat homomorphism can realize a finite number of additions and multiplications simultaneously; fully homomorphism realizes any number of additions and multiplications. Homomorphic encryption scheme can not only realize the encryption function, but also can be used for ciphertext data calculation.

Let  $\langle G, * \rangle$   $\langle H, o \rangle$  be two algebraic systems,  $f : G \rightarrow H$  is a mapping. If  $\forall a, b \in G, f(a * b) = f(a)of(b)$ , then  $f$  is a homomorphic mapping from  $G$  to  $H$ . Encryption is a mapping from plaintext to ciphertext space. If the crypto map is a homomorphic map, we say that it is a homomorphic encryption scheme. We give the following definitions:

Let  $E(K, x)$  denotes the encryption of  $x$  using the encryption algorithm  $E$  and the encryption key  $K$ .  $F$  represents an operation. For  $E$  and  $F$ , There exists an efficient algorithm  $G$ :

$$E = (K, F(x_1, \dots, x_n)) = G(K, F, (E(x_1, \dots, x_n))) \quad (3)$$

Then the encryption algorithm  $E$  is said to be homomorphic for  $F$ .

If the definition of the equation only holds for  $F(x_1, \dots, x_n) = \sum_{i=1}^n x_i$ , then the encryption scheme Is an additive homomorphic encryption scheme.

If the definition of the equation only holds for  $F(x_1, \dots, x_n) = \prod_{i=1}^n x_i$ , then the encryption scheme Is an multiplication homomorphic encryption scheme.

An encryption scheme is a fully homomorphic encryption scheme if the equality in the definition holds for  $F(x_1, \dots, x_n)$ , which contains a mixture of addition and multiplication operations.

The homomorphic encryption scheme that only holds for one kind of operation is called the partially homomorphic encryption scheme.

The homomorphic encryption scheme  $\varepsilon$  of the public key system consists of 3 random algorithms  $KeyGen_\varepsilon$ ,  $Encrypt_\varepsilon$  and  $Decrypt_\varepsilon$ .

- $KeyGen_\varepsilon$ : Receive the safety factor  $\lambda$  as input, output the private key  $sk$  and the public key  $pk$ ,  $pk$  defines the plaintext space  $P$  and ciphertext space  $X\tilde{a}$
- $Encrypt_\varepsilon$ : Receive input  $pk$  and plaintext  $\pi \in P$ , and output ciphertext  $\psi \in X$  encrypted with plaintext  $\pi$  with public key  $pk$ , denoted as  $\psi = Encrypt_\varepsilon(pk, \pi)\tilde{a}$
- $Decrypt_\varepsilon$ : Receive the input  $sk$  and  $\psi$ , output the plaintext  $\pi\tilde{a}$

The computational complexity of the above three random algorithms is determined by the polynomial of  $\lambda$ , and the encryption system should satisfy the correctness condition: if  $(sk, pk) \stackrel{R}{\leftarrow} KeyGen_\varepsilon(\lambda)$  and  $\pi \in P$ ,  $\psi \stackrel{R}{\leftarrow} Encrypt_\varepsilon(pk, \pi)$ , then  $Decrypt_\varepsilon(sk, \psi) = \pi$ .

In addition, the  $Evaluate_\varepsilon$  algorithm is interpreted as: Entering a public key  $pk$ , a circuit  $C$  from the circuit set  $C_\varepsilon$  and a set of ciphertext  $Y = \langle \psi_1, \dots, \psi_t \rangle$ , output the ciphertext  $\psi \in C$ . If

$$\psi_i = Evaluate_\varepsilon(pk, \pi_i), i = 1, \dots, t,$$

then

$$Evaluate_\varepsilon(pk, Y, C) = Evaluate_\varepsilon(pk, C(\pi_1, \dots, \pi(t))) \quad (4)$$

Once the algorithm is preserved, the data structure is preserved. Therefore, in the process of machine learning, we only need the data structure, we can decrypt the encrypted information and machine learning.

## 4.2 Distributed System Optimization

Data transmission can be speeded up by the equal segmentation of big data processing. The worker node on NBAI receives the task for concurrent processing, after which each node returns the result to the selected aggregation node for the task's consolidation, and finally returns the task owner. In these transmissions and processing, we optimize NBAI by node election, data access, load balancing, network security and and the research of redundancy mechanisms.

When NBAI receives AI tasks with large datasets from developers, single miners can not handle the tasks on their own, we need to split the tasks and deliver them to multiple miners for calculation, and eventually return the aggregated task results to the developer. This series of operations needs to rely on a complete and optimized distributed system. NBAI will also be optimized to meet the performance demands of high throughput, low latency and high concurrency.

Although the traditional distributed system structure has only three layers, but according to the business demands, it will often designed to more levels. A multi-tier structure often has a wide range of proxy processing and routing. Most of these proxy processes are connected via TCP to both ends. However, in order to avoid the high failure rate and high maintenance cost of TCP, NBAI will apply message queuing mechanism to realize inter-process communication.

NBAI uses NoSQL to provide a solution to the distribution of data storage tiers, In addition to the advantages of high-volume and high-speed access, NoSQL can only retrieve and write using an index. This constraint brings the advantages of distributed

implementation, the system can press this main index to define the data stored in the process. Such a big data-level task, can be safely sent to different nodes.

```
future<int> get();
future<> put(int);

void function(){
    get().then(then[] (int i)){
        put(i + 1).then([] {
            std::cout << "an integer has been put";
        });
    });
}
```

Figure 12: Future/Promise Model

Because distributed systems involve a great deal of network communication and the system relies on asynchronous, non-blocking programming models, developers generate a large number of callback functions in the programming of distributed systems. Task instructions will be distributed to multiple processes, and completed through a combination of network communications. However, this asynchronous programming model callback is very detrimental to code maintenance. In order to solve this problem, NBAI uses the Future/Promise model to optimize the callback function.

## 5 NBAI Token NBAI

### 5.1 Token Plan

#### 5.1.1 Use Value of Tokens

The system's token is used to purchase computing power. When the training data is relatively small, the token consumed is less, and when the training data is large, the token consumed increases accordingly. The costs paid depends on the training costs and the value of the current token which is the hash power of each 1080Ti graphics card within one minute, that is,  $7514 \text{ GFLOP/s} \times 60$ .

#### 5.1.2 Token application

Tokens will be used in the following three cases:

- Developers Test

Developers in the test will consume some tokens for model training. Depending on how many tokens are paid, the training time required to train the model will be reduced by 50% to 90%.

- Use of DAI APPs

DAI APPs may be set as paid apps by developers; users must pay tokens to use these AI services, such as the trend prediction of cryptocurrencies app in this Whitepaper.

- Purchase of DAI training services

When users utilize training services to obtain finer models, they are required to pay for retraining the models.

### **5.1.3 User scenarios**

#### **1. Quantitative Trading**

Quantitative trading has been using computers for assistance since many years ago. Analysts use a variety of quantitative models to design metrics and observe data distribution, using the computer as an operator. Until the rise of machine learning in recent years, the data can be rapidly and quantitatively analyzed, fitted, and predicted, so that analysts can predict the market trend of future financial products more accurately. However, the calculations of these models still require a lot of artificial intelligence computing power. With the traditional approach, each trading section needs to set up a data center on its own. However, sharing computing power can eliminate the need for expensive maintenance, and allow financial trading firms to focus more on predicting itself.

#### **2. AI Learners Program**

Colleges and universities gradually set up artificial intelligence courses, which will be more popular in the next few years. Students usually choose small tasks to run on their computers, and run time-consuming tasks in the school computer labs. However, these fragmented tasks can be solved with blockchain computing cloud. Low-cost AI

computing services are ideal for students to complete a variety of computing tasks, and quickly modify their models.

### 3. Biomedical Artificial Intelligence

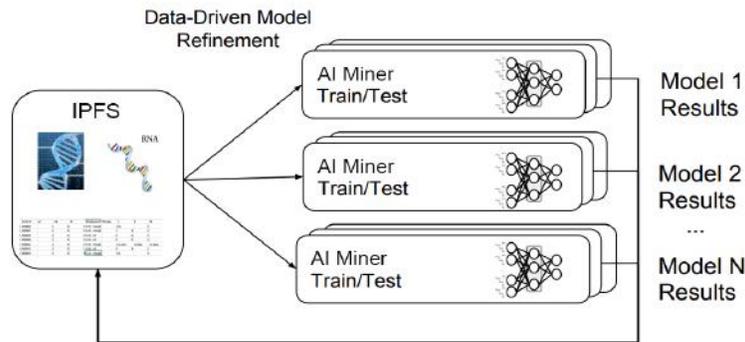


Figure 13: AI for Cancer Research

Early detection of tumor onset is of great significance. However, because of the small area of early cancer lesions, the traditional method is difficult to judge benign and malignant, which makes it difficult for clinical diagnosis. Doctors often need to test by biopsy method, which not only increases the medical cost but also brings patients great pain. The application of artificial intelligence in medical image recognition and multidisciplinary collaborative diagnosis can effectively overcome this difficult point, enhance the ability of doctors to diagnose, help to make quick decisions and promote the medical services transform to individuation and precision.

## 5.2 DAI App Developer Profit model

### 1. DAI App Task Types

- Class I — Require training model.

App users have to pay for tokens to drive calculations that consume a lot of resources. The training time may take hours or even hundreds of hours.

- Class II — No need to train models or use existing models.

The Apps do not need to consume computing power, users only need to pay a certain fee for smart contract costs. It is also possible to invoke the computing

results of Class I DAI Apps to generate the application. This type of DAI Apps is less expensive.

## 2. Task Calculation

A standard computing contract contains the following basic elements:

- AI task data address
- AI task program script
- AI task execution result output address
- AI task revenue

## 3. Task Release

When the task is posted on the chain, all AI miners can accept tasks from the system. The task is identified as “in progress ”when it is executed by the mining machine. The user can set several different levels of redundancy calculations to ensure a more accurate result. Nounce can be set to different levels such as 1, 2, 3 to correspond to different redundancy calculations. Larger numbers mean more calculations are needed to ensure the accuracy of the results. The corresponding cost will be higher.

## 4. Cost Calculation

AI calculation is generally divided into training phase and using phase. The training phase will consume a lot of training resources, most of the computational power will be used here. In the using phase, due to the end of the training, it will consume less power. At the start of the task, the smart contracts will pre-charge a portion of the upfront expenses and, at the end of the calculation, will re-calculate the total costs and require the customer to pay the balance again to obtain the data.

The users need a certain amount of margin to start booking service, multi-signature automatic contracts will lock the funds to ensure the transaction being operated normally.

## 5. Task Execution

The mining machine clients read the task plans from the chain and parse them

into executable AI code. Artificial intelligence and training data can be stored in external links when tasks start executing. The code will be executed in the following steps:

- Parse the encryption task.
- Download data remotely.
- Set the task to execute state.
- Write the progress and result of the operation.
- Mining machine binds address for rewards.

#### 6. Calculation Ends

DApp users download the results of the implementation, which can be used directly for the web demo or offline use. Execution results can be obtained by API method, and be used after decrypting.

### 5.3 NBAI AI Application Case

Hedge funds, banks and large international companies like Goldman Sachs are benefiting from smart-technology-based foreign exchange and stock trading. These companies predict the short-term and long-term effects of various financial markets through “deep learning” — mathematically-based predictive and probabilistic models which evolve continuously. cryptocurrencies players such as Pantera Capital, and financial institutions including Santander and Citibank, are also looking for making money from cryptocurrencies. Designing an artificial intelligence model requires a large amount of computing power. Each user must compute the model each time when the parameters are adjusted. At this point, getting enough computing power through smart contracts for artificial intelligence computing is an effective method. The standard system goes through the following steps:

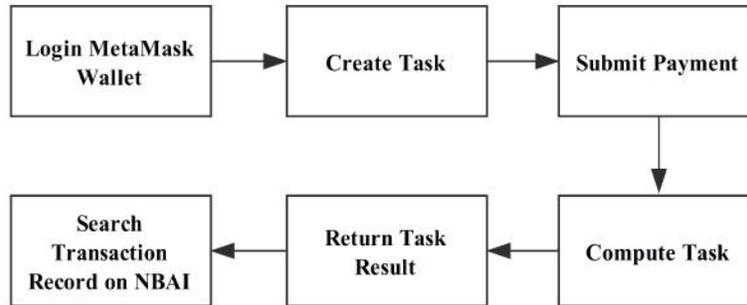


Figure 14: NBAI AI Application Case

## 6 Roadmap

- Q1 2017 Began to design concept, research, and explore the hyperledger
- Q3 2017 Developed the AI DAI APP and conceptual prototype.
- Q1 2018 Started to sell tokens; Helix test chain went live.
- Q3 2018 Helix public chain will go live, integrate the first DAI APP; start to develop the Orion and Orion prototype chain.
- Q1 2019 Orion test chain will go live.
- Q3 2019 Orion public chain will go live and integrate 10 DAI APPs..
- Q1 2020 Orion will integrate 50 DAI APPs.
- Q3 2020 Orion will integrate 500 DAI APPs.

## 7 Collaboration Plan

### 1. Cooperation Projects

- Distributed System Optimization and Cloud Computing Project
  - Concordia University
- Surgical Innovation Program
  - Department of Surgery - McGill University & Mitacs
- Canada Summer Jobs (CSJ)
  - Government of Canada

## 2. Cooperation Partners

- YES Montreal
- Scientific Research and Experimental Development (SR&ED) Canada
- McGill University
- Concordia University
- Timechain
- Beepay
- Express Mining
- ECV Learning
- JTech Soft
- The IT Professionals Association of Greater Montreal (APIGM)

## 8 ICO Plan

The initial release is 6.7 billion tokens. Each year a certain amount of tokens are produced, the amount decreases from 2% per year to 0.2% in six years. Tokens are consumed when users use customized predictive features of artificial intelligence, and the amount of tokens consumed depends on the amount of computation. As the system's accuracy increases, the demand for tokens will increase.

Miners get tokens through mining, and AI mining machines are the main sources of mining returns. Any application based on the NBAI's blockchain (such as quantitative trading, Biomedical AI) can only be paid by NBAI tokens.

Tokens are ERC 20 tokens, and will be replaced by Nebula AI main chain tokens 1:1 in the future.

Public offering is 1 Ethereum = 100,000 NBAI.

ICO softcap: 5,000 Ethereum.

Private placement starts from January 22, 2018, and ends on March 30, 2018. The private placement hardcap: 18,000 Ethereum.

Public offering starts within one month after the end of private placement. The

public offering hardcap: 12,000 Ethereum.

Unsold tokens from private placement will be merged into public offering.

Unsold tokens of public offering will be completely destroyed.

45% Sold by the private placement and public offering

25% Held by the foundation & community

15% Held by the core team

10% Held by the early-stage investors

5% Held by the marketing & Partner supporters

For token investors from private placement and public offering, there will be no token lockup period.

The tokens held by the foundation will be frozen after crowdfunding ends and are thawed in 18 stages (about 3 years), every 60 days for a cycle, and thaw 1/18 of foundation holdings each time.

After the public offering, NBAI tokens will gradually go live on top international platforms.

Token sale contact email: [tokensale@nebula-ai.com](mailto:tokensale@nebula-ai.com).

## 9 Core Team

### 9.1 R&D Team

The NBAI project has been receiving validation since early 2017. After several technical modifications and evolutions, the initial use of Hyperledger Fabric evolved into Bitcoin, and finally decided to use Ethereum technology as the main chain, which lasted one year. During this period, we have received assistance from multinational investors from the United States, China, Singapore and Canada.

Charles CAO CEO & Co Founder

Charles graduated from Fudan University in 2007 where he majored in Electronic Engineering. He afterwards worked at Shanghai Academy of Spaceflight Technology and IBM Shanghai. He obtained his master's degree in Electronic and Computer

Engineering at Concordia University in 2010. During his study, he received funding from NSERC (The Natural Sciences and Engineering Research Council of Canada) for engaging in Video Transcoding Studies.

After graduating, Charles worked at SAP, Autodesk, Expedia and Paysafe (acquired by Blackstone Group for \$ 3.9 billion) until the core project leader.

In 2013, Charles set up Service ECVictor where he focused on building the electronic platform for software technology and he has successively invested in multiple start-ups such as O2O, medicine, education, e-commerce, and logistics. He has been actively following the progress of the Bitcoin blockchain since 2013 and has been widely publicized in the community.

In 2014, Charles founded the Montreal IT Association with more than 700 members, and held more than 100 events, as well as many popularization and research seminars on cutting-edge technologies such as blockchain, artificial intelligence and big data.

Charles founded Express Computing Inc. (Ethereum mining company) in July 2017 in Quebec, Canada, the hash power sales website went live and operated over the same period and completed thousands of dollars in hash power sales three hours after the website going live. The company integrated operated regarding mining machine design, mining and sales.

Charles is active throughout the North American blockchain community and analyzes multiple ICO products. He is devoted to the education popularization and deep research of North American blockchain.

Qinhui LIN Project Manager

Qinhui has over 13 years consulting and developing experience in startup and banking industry. He was a former CTO in a startup of residential social platform and led a team to build solid, high-concurrency and scalable social portal who has 3 million registered users. In particular, he has over 7 years experience providing consulting and development service for Banking institutions such as Wellsfargo, GE Capital and Laurentian Bank in Montreal and Worked closely with stakeholders to

provide technical solutions upon request. At NBAI, he is dedicated to blockchain programming, mining and integrating with the AI to build an efficient win-win AI and blockchain ecosystem.

Tengke XIONG AI Architect

Dr. Xiong has acquired a Ph.D. and postdoctoral degree in Computer Science at Sherbrooke University. In addition to this, he has more than ten years of experience in AI development. He was a visiting scholar at Shenzhen Institutes of Advanced Technology, the Chinese Academy of Sciences and has published 6 papers in top international journals, regarding the topic of data mining. Before joining Nebula AI, he worked as the chief scientist at multiple AI companies. He has also founded his own AI research company and is now responsible for the project architecture.

YanYan LI CFO

Yanyan held a master's degree in Finance and bachelor's degree in MIS from Fudan University. She had three years of work experience in a leading securities company in China and over two years' experience in the investment in the Canadian market. She is also a Canadian CFA candidate and a CPA candidate.

Yanping Lu AI Architect

Yanping Lu obtained her Ph.D. degree in Computer Science at Sherbrooke University. She has many years of experience in intelligence model optimization, high dimensional data feature selection/classification and application in medical image processing. She was an assistant professor in Xiamen University and has publications in top AI journals such as Machine Learning, IEEE Transactions on Biomedical Engineering etc. Dr Lu joined Nebula AI as AI Solution Architect and is responsible for development environment for deep learning, big data analytics etc.

Lu YAO AI Engineer

Lu worked at HK Financial Invest. PLC as a Quantitative Trading Specialist, and as a Statistical Modelling Analyst at AXA (HK). She was the leader of Risk Warning and Machine Learning Research funded by SCUT. She is a master of Economics and

is proficient in Python and R. She focuses on the application of deep learning and Neural network algorithms in finance.

Tong PANG Blockchain Developer

Tong majored in Computer Science in Concordia University. As a full stack developer, he is proficient in blockchain algorithm such as Ethash and DPOS. He is responsible for the design and implementation of blockchain products.

Kaichen ZHANG AI Engineer

Master of Computer Science in Concordia University. Proficient in Java, Python and JavaScript, engaged in work and research in the direction of combining artificial intelligence, blockchain and business intelligence. “Internet Marketing” textbook contributor, former financial education company regional manager. He focuses on the field of semantic analysis and deep learning.

Ming YUE AI Developer

Ming graduated from Civil Aviation University of China. He has ten years of experience in machine learning and software development. As an expertise in computer vision and machine learning algorithms, he had developed many video inspection software systems for iron/steel and railway industry in China. Currently Ming focuses on Image Recognition and Computer Vision in Nebula AI.

Richard YAN Senior Full Stack Developer

Richard graduated from Fuzhou University and has more than ten years of experience in software development in South America, Europe and North America. He participated in developing a number of large software platforms and he is proficient in python, Node.js, and performance optimization.

Alberto Lacerda Front End Developer

Alberto majored in Computer Science at Laureate International Universities. With over 10 years of experience in IT field. Has worked for Accenture as Software Developer, and collaborated with FIFA World Cup projects. Currently working as Front End Developer for Nebula AI.

Chi ZHANG Blockchain Developer

Chi obtained a master degree in Computer Science at Concordia University. He is familiar with technologies and frameworks related to Python, Js and Java. He takes the responsibility of developing and maintaining backend services. Currently Chi focuses on developing blockchain related applications.

Yue LI Blockchain Developer

Yue graduated from Beijing University of Posts and Telecommunications and has experience in software development in both China and North America. He participated in developing multiple software platforms. Yue is proficient in Java, Spring and code performance optimization. He works as blockchain developer in Nebula AI.

Hong PANG Python Developer

Hong graduated from Tianjin University and obtained master degree in Applied Science at Concordia University. He is familiar with python, PHP, Javascript as well as related frameworks. He has been working as a backend software developer and currently he is taking part in R&D of blockchain technology at Nebula AI.

Pin ZHOU Software Developer

Pin obtained master degree in computer science at Harbin University of Science and Technology. She has over 8 year experience in IT development. Currently, she works as a software developer at Nebula AI.

Yi Cao AI Developer

Yi obtained master degree from McGill University. With 3 years' experience in project management, she is passionate in feature engineering, data mining and application of deep learning in medical diagnostics. Yi works as machine learning engineer at Nebula AI.

Xiaojun WEN Front End Developer

Xiaojun graduated from Software Applications Specialist program in Vanier college. He has two years' experience in front-end development, creates over 20 websites for different clients. Familiar with front end developing techniques like HTML/CSS,

JavaScript, xiaojun currently works as front end developer for Nebula AI.

Sidi SHEN UI Designer

Sidi majored in Graphic Design at Lehigh University in the USA, and worked as Freelancer for 3M Company in Shanghai. She is an experienced UI/VI designer with many awards in design field. She is responsible for the design of all the company's products, website promotional materials, and marketing activities.

Alecsa Tabisaura UI Designer

Alecsa majored in graphic design at Cégep Marie-Victorin, in Montreal, Canada. She has worked as a freelance graphic designer for various projects and companies. She is experienced in branding design and UX design. Currently a part of the design team, working as graphic designer for Nebula AI.

Mable XU Executive Assistant & Marketing Coordinator

Mable majored in Acting and Broadcasting at Communication University of China. With over five years of experience in sales and marketing field. Currently working as assistant and marketing coordinator for Nebula AI.

Jessica Boxerman Marketing Coordinator

Jessica has years of marketing experience, active in many European North American communities. She is responsible for European and American community building, brand building and marketing public relations.

Yan XU Front End Developer

Yan obtained his bachelor degree at Peking University, followed by a master s degree of Ecolé Polytechnique de Montreal. He has worked as a Web Developer in SAP, and currently is the leader of the Web Developer team at Nebula AI.

Zan WANG AI Engineer

Zan majored in Electronic Engineering at Concordia University. He has over ten years of work experience in data analysis, and has previously worked in LG and SK, where he was responsible for data processing and NLP research.

Carlos Gonzalez Oliver Blockchain Developer

Carlos is a Computer Science Ph.D. student at McGill University, and co-founder of Delphi Crypto blockchain consulting. He has expertise in machine learning, algorithmic solutions to biological problems, and a passion for scientific applications to blockchain technology.

## 9.2 Advisory Team

Yan LIU Cloud Computing and Distributed Professor

As Concordia University cloud computing and distributed system expert, Dr. Liu published hundreds of articles, she has more than nine years experience in defence system development. She worked in America at Department of Energy Pacific Northwest National Laboratory (PNNL) and National ICT Australia (NICTA) as senior engineer.

Thomas Fevens Medical Imaging and Computer Vision Advisor

Associate Chair in Department of Computer Science and Software Engineering at Concordia University. Dr Fevens leads Computational mathematics and Visualization lab, and he is also the director of Surgical Innovation Centre. Dr Fevens has extraordinary publications in computer-aided medical diagnosis and 3D graphics. In 2018, Nebula AI has established and promoted an artificial intelligence collaboration with Dr Fevens' laboratory, in the field of medical imaging.

Zhenhua LIN AI Advisor

Dr. Lin is a postdoc at University of California, Davis, engaging in mathematical statistics. He graduated from Fudan Computer and Information Technology Department in 2008 with a major in Information Security. In 2011 and 2013, he received a master's degree in computational science and a master's degree in statistics from Simon Fraser University in Canada, and graduated with a Ph.D. in Statistics from the University of Toronto in 2017, focusing on functional data analysis and differential geometry statistics. His research interests include non-Euclidean statistics, statistical machine learning, and implantation of distributed machine learning in blockchain.

Xun SHI Blockchain Advisor

Dr. Shi works for the video processing technology company Harmonic Inc., located at Silicon Valley. He completed his Ph.D. studies at York University in Toronto, Canada in 2012 and focuses on computer vision and artificial intelligence. He received a bachelor's degree in computer graphic from Beijing University of Computer Science in 2006. He is currently a video compression algorithm design engineer. He focuses on the theory and industrialization of computer hardware and software algorithms, especially on blockchain, cryptography, encrypted networks, and decentralized video broadcasts.

Louis Cleroux Blockchain Expert

Louis works with early-stage entrepreneurs looking to improve/disrupt blockchain technologies such as Ethereum and Bitcoin. His latest tech investment is around Smart Wallets&Smart Apps.

Yu GUAN Blockchain Advisor

Yu is a . NET / C# / Azure Cloud/DevOps/Microsoft technology expert. He started his career at Microsoft and have been focusing on software architect/design/development for almost 20 years. He is conferred Microsoft Most Valuable Professional (MVP) award by Microsoft CEO Satya Nadella. Currently he is CTO of a hi-tech real estate management platform company in Canada.

Bin ZHU Cloud Computing Advisor

Bin is a Data Science Expert who has worked in Huawei and MindGeek, where he built and led a 30-person Big Data R&D team. He has more than 15 years of experience in database and big data, as well as having dealt with PT level data. He is also expert in team communication, coordination and management.

Douglas Leahey Business Development Consultant

Dr. Leahey graduated with a Ph.D. in Environment, and currently he is a Montreal Youth Employment Adviser. He provides legal, financial, and government-related innovative support project advisory services. He also assists in the devel-

opment of company strategic directions and marketing strategies.

Jake Barralet Advisor of Internship Mitac

Dr. Barralet is a Materials Science graduate who specialized in Biomaterials during his Ph.D. at the Interdisciplinary Research Centre in Biomedical Materials, QMW, and the University of London. After a postdoctoral position at Tokyo Medical and Dental University he worked at Smith and Nephew Group Research Centre, York, UK developing bone graft and casting materials. At the University of Birmingham in the UK, he progressed research themes regarding tissue engineering and bone grafts in collaboration with biologist and clinical co-workers. Currently, he co-operates with Nebula AI in the AI biomedical field.

## 10 Conclusion

As the world's first AI blockchain system, Nebula AI is dedicated to driving the advancement of artificial intelligence technologies, building a credible trust-based blockchain, creating social value and serving all of humanity. NBAI builds the next generation of AI blockchain infrastructure platform that enables developers in many industries to truly develop, compute and deploy artificial intelligence with high efficiency, low cost, safe and reliable, without worrying about the underlying development, system configuration and environment setup.

NBAI can be considered as a consensus system for decentralized data. As the value carrier, NBAI Tokens realize the value flow of artificial intelligence in NBAI ecosystem. Traditional Internet connection can solve the problem of data communication, while NBAI further solves the problem of data consensus on the basis of traditional Internet. Compared with a large, centralized platform, NBAI can avoid data being stored or stolen by service providers and realize the public processing tasks while ensuring data privacy.

The rapid development of blockchain technology has made it possible to realize the digital credit society. NBAI will inject more fresh and vibrant blood into the development of global blockchain technology and look forward to pushing artificial

intelligence, an important area where human society can change, to new heights.

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## A Revision History

- 27/02/2018      Change the private placement hardcap from 25,000 ETH to 18,000 ETH.  
Change the public placement hardcap from 24,000 ETH to 12,000 ETH.  
Cancel the plan to build 10MW AI computing center.  
Change to cooperate with large-scale third-party Internet data centers.  
Adjust Collaboration Plan.  
Adjust the proportion of tokens.  
Add Advisory Team members.
- 07/03/2018      Add R&D Team members.
- 16/03/2018      Change the private sale date.
- 19/03/2018      Adjust the softcap.
- 09/04/2018      Add R&D Team members.  
Merge unsold tokens from private sale into public offering.