SKYCHAIN

The future of artificial intelligence in healthcare!

Annotation

Blockchain infrastructure aimed to host, train, and use artificial intelligence (AI) in healthcare.
The mission of Skychain is to save 10 million patients from premature death due to medical errors within 10 years.
This is the future of artificial intelligence!

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Skychain is the next leader in the healthcare AI market.

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Introduction

We would like to introduce you to the Skychain project. Skychain is an infrastructure blockchain project aimed to host, train, and use artificial neural networks (ANNs) by market participants.

The first years of Skychain development will be devoted only to medicines that will help doctors and patients have accurate diagnoses by using this system.

Skychain is a sharing economy project, which means that each member of the Skychain ecosystem provides resources and thus creates a product that is ahead of any competitor. The system will reward each participant with lucrative benefits.

Skychain is a project that will "uberize" artificial neural networks with developers of individual ANNs rather than taxi drivers, with consumers of ANNs (doctors and patients) rather than passengers, and with miners' computers and servers rather than cars.

IBM estimates that the artificial intelligence market in healthcare will be $200 billion per year within a few years. The goal of Skychain is to take a 70% share of this market. It will achieve this goal by creating the best open infrastructure that will gather the resources of the majority of participants in this industry and surpass any closed corporate product.

In the future, Skychain could expand beyond medicine and be used for building, fast-distributed training, and a wide range of neural networks.

Problems in the Field of Medicine

Hundreds of thousands of misdiagnosed patients die every year in the United States and the European Union alone. Economic costs arising from complications caused by misappropriation of medicines total more than $100 billion per year.

Below are some of the main causes of incorrect diagnoses:

- Doctors have a narrow view of the problem, typically specializing in individual organs or body systems and often not seeing the picture as a whole;
- Doctors' lack of experience and gaps in knowledge often result in their inability to diagnose rare diseases;
- Doctors often do not have enough time to analyze anamneses due to a high utilization of methods and a lot of time spent on documentation;
- Doctors may find it difficult to determine a disease just by X-rays, CT scans, MRIs, and histological tests for a non-standard course of a disease, and they may have a high dependence on their subjective experiences.

Artificial intelligence based on artificial neural networks will completely change these scenarios in the field of medical diagnostics.

Medical Artificial Neural Networks Today

Today, artificial neural networks demonstrate their ability to diagnose more accurately than most doctors.[1] Besides diagnosing, ANNs can prescribe treatment and adjust it upon receiving new data and a patient treatment dynamic.

ANNs use large arrays of disease records from hospitals' patient records, reference data, and medical research data. Many companies and laboratories are already successfully doing this. Key participants in this market include the following:

1. Creators of neural networks:
    - Small laboratories that have trained one or two neural networks to solve a certain diagnostic problem. For example, a network may detect a specific type of oncology on a radiograph

https://www.newyorker.com/magazine/2017/04/03/ai-versus-md
https://www.extremetech.com/extreme/233746-ai-beats-doctors-at-visual-diagnosis-observes-many-times-more-lung-cancer-signals

- Large corporations such as IBM that create neural networks for a wide range of diagnostic tasks

2. Medical data providers:
   - Hospitals and state structures create their own medical data sets, investing a significant amount of money into creating them. These are disparate data sets, and their owners do not want to share them since they prefer to receive a return on investment and income from the data.
   - The current state of the market basically does not allow providers of medical data to earn money from the data since the creators of artificial medical neural networks are not ready to buy the data at a high cost.
3. Infrastructure providers:
   - The current leader of manufacturers of equipment for training and using neural networks is Nvidia, which provides specialized GPU processors with tensor cores that increase the performances of computing neural networks up to 10 times. Other market participants include AMD, Intel, and a few others.
   - Cloud services such as Amazon, Google, and Microsoft provide high-processing power to ANN developers.
   - Developers of libraries for building neural networks allow programmers and other specialists to quickly design and launch their own neural networks.
4. Consumers of neural networks:
   - Today, doctors do not have available access to external neural networks. Individual neural networks are tested by individual clinics, but widespread use is limited by the lack of public infrastructure.
   - Patients are interested not only in more accurate and well-founded diagnoses that could be obtained with the use of neural networks but also in self-diagnosis. For example, a patient could photograph a mole to determine the risk of melanoma, and so on. These types of neural networks are not available today to ordinary citizens.

The medical neural networks market is still in its initial stage. Here are some of the current problems:

- Laboratories, creators of ANNs, find it difficult to provide access to end users (doctors) due to the lack of a single infrastructure. Skychain will provide an analogue of an AppStore that will let any doctor use a certain neural network.
- Experienced specialists in the field of artificial neural networks do not have access to medical data due to the large number of possible data providers and the high cost of the data. Skychain contains a data marketplace that provides the possibility of training neural networks for a fee using a large number of data sets created by independent providers. It offers the possibility to train the deepest and most accurate neural networks while paying the royalty to data providers.
- Large corporations such as IBM cannot on its own train thousands of ANNs that are required to fully cover all areas of medical diagnostics. Skychain will host thousands or even tens of thousands of highly specialized neural networks created by hundreds of laboratories and corporations.
- The market of neural network development is constrained by the high cost of equipment for effective learning and the complexity of tools for building and training ANNs. Skychain will provide convenient tools for building ANNs, as well as inexpensive and fast learning with the help of Skychain's distributed computing resources, that will surpass the computing power of large corporations' data centers.

Skychain will change the ecosystem of ANNs, making them publicly available to all market participants. Each participant will benefit from participating in the Skychain community.

About Skychain

Skychain is a distributed open network project designed to accurately diagnose patients and prescribe an effective treatment. Skychain has the following advantages:

- Uploading any ANNs trained by laboratories or specialists to Skychain and receiving payment from ANN end users
- A data marketplace of Service for Deep Learning where medical data suppliers will be able to offer their data sets as a service for AAN training
- Effective use of miners' computing resources to ensure the smooth operation of a neural network
- Public pay-per-use access to neural network capabilities
- Open distributed storage of all ANNs within Skychain and its settings, stored in a distributed chain of blocks according to blockchain principles
- Constant learning from a neural network upon adding new information and experiences

Public Encrypted Distributed Storage of Author's ANNs

Skychain stores all information about all ANNs in Skychain in an encrypted form. Any specialist or company will be able to upload its neural network to Skychain, designed and trained to effectively solve a particular task. Then, an author of the uploaded neural network will be remunerated by Skychain participants for each access to the service of his or her ANN.

Skychain for medical data providers is a data marketplace where they can provide their data as a service for training third-party neural networks.

- Trained neural networks on the supplier data sets can only be used with Skychain, so the data set that providers will receive includes a guaranteed share of revenue from all neural networks trained, based on their data.
- The preparation of medical data sets will be beneficial for market participants who own this data.

Skychain takes care of the intellectual property of developers of neural networks and data owners. A developed and trained neural network, as well as the data set with which it was trained, are protected from outside participants.

Effective Use of Miners' Computing Powers

Today, cryptocurrency mining has brought unprecedented computing power to miners in a single network. Mining of modern cryptocurrencies has no value except for proof of performed work that serves as a basis for a cryptocurrency issuance and blockchain protection.

Skychain will change this. Miners will perform useful work, providing computing capabilities for a neural network. Upon the completion of performed work (analysis of anamnesis, referral to an additional examination, diagnosis, creation of a treatment record, as well as learning ANNs), a miner will get a share of the cost of the provided service.

Thus, miners will not only generate cryptocurrency emissions but will also perform a socially useful function of high economic value.

Public Pay-per-Use Access to Neural Network Capabilities

Skychain is a project of a public ANN to which any participant or organization can connect. Miners will provide their computing powers and receive the inner cryptocurrency—Skychain Global Coin—as a reward.

Patients, doctors, medical institutions and online services will be able to use the Skychain capabilities by paying for each use of a neural network with Skychain Global Coin. Creators of ANNs will be rewarded for each use of the ANNs they develop and train.

Constant Learning of the Artificial Neural Network

For each requested session of an artificial neural network, Skychain will get feedback in the form of patient test results, symptoms, and recovery dynamics. This feedback will constantly train the neural network, making it more accurate and efficient. In the future, that should make Skychain the most accurate and trained therapist in the world.

Structure of Skychain Modules

The Skychain project consists of several interconnected modules:

- SkyUI – Module for conducting an interactive dialogue with a doctor or patient
  - The dialogue is conducted in an interactive form. Besides text information, the module can download images and graphic files with medical test results (MRI, CT scan, X-ray, histology, endoscopy, etc.).
  - The module also recognizes test results in the form of structured documents.

- SkyEngine – Core of the artificial neural network
  - SkyEngine analyzes all information about the patient and gives a diagnosis or possible diagnoses and any medical tests and studies required for an accurate diagnosis.
  - It is a set of trained ANNs. The input neural network classifies all the information received, determining areas for a detailed analysis.
  - Then, the input neural network sends all patient information to specialized ANNs, checking for the presence or absence of certain diagnoses or problems.
  - In the case of severe diseases, specialized ANNs will perform differential diagnostics of diseases and confirm or reject diseases that threaten the life or health of a patient.

- SkyLearningZone – Closed area for neural networks training
  - The SkyLearningZone is the data marketplace where medical data providers can provide their data sets as a service for the training of third-party neural networks.
  - Trained neural networks on the supplier data sets can only be used with Skychain, so data set providers will receive a guaranteed share of revenue from all neural networks that are trained based on their data.
  - One neural network can be trained using several data sets of a single medical area, thereby achieving significant depth and accuracy.
  - Neural networks that were trained in SkyLearningZone cannot leave this zone. Their authors will not be able to copy their neural networks but can only provide paid access to their functions. That ensures that the owner of the data will receive a royalty from all neural networks trained on the basis of the data. It also guarantees the preservation of the value of the supplier's data.
  - When training neural networks in SkyLearningZone, the structure and code of the neural network cannot be downloaded from SkyLearningZone, so the author of the neural network guarantees the safety of its own developments and know-how.
  - All the neural networks trained in SkyLearningZone are automatically ranked because in addition to training, the neural networks are tested and their accuracy and quality determined automatically.

- SkyConstructor – An interactive environment for building and training ANNs.
  - An ANN author builds te structure of an ANN in a visual editor and selects its learning mechanism.
  - The module provides ready-made patterns of ANNs in order to quickly build a neural network.
  - An ANN author creates a description of the neural network and uploads it to Skychain, paying a reward to the system (miners) for adding the neural network to the blockchain.
- SkyTherapist – Module for creating treatment protocols
  - A specialized module consisting of a database of scientific researches and recommendations trained on patient records by a neural network.
  - The module generates the most effective treatment protocol according to the patient diagnosis, test results, and general information (growth, age, drug tolerance, medical history, etc.).
- SkyMobile – A mobile application that allows patients to get independent service by using Skychain on their own. Tasks solved at the first stage include the following:
  - Diagnosis of melanoma according to a photo from a mobile phone
  - Analysis of symptoms of a patient who does not require emergency hospitalization and recommending medicines that do not require a prescription
  - Detection of risks and threats to the patient's health and a recommendation to contact the nearest doctor if detected

Road Map

01/2017–11/2017

Research and development works carried out in key areas of the project. The working capacity of all key technologies and algorithms of Skychain confirmed. Thus, Skychain is based on a fully developed architecture, algorithms, protocols, and approaches.

Pre ICO – December 2017

The fundraising plan is $500,000–$1,000,000. The funds raised will be used for project marketing and the ICO.

ICO – March 2017

The fundraising plan is $12,000,000. The funds raised will be used for product development, finalizing partnership agreements, and ecosystem development.

Skychain Alfa – June 2018

ANNs of our partners who are trained to perform a limited set of diagnostics will be added to SkyEngine.

Analysis of images and graphic studies:

- Detection of cancer at an early stage by analyzing radiographs, CT scans, and MRIs
- Detection of diseases according to a chest X-ray interpretation, taking into account sensitivity and specifics of a patient's body
- Analysis of histological images for detection of common cancers

- Detecting melanoma on the basis of high resolution photos of the skin

Analysis of medical tests and symptoms:

- Predicting the possibility of a heart attack by analyzing a variety of criteria (height, age, ECG or ECHO, indications, chronic diseases)
- Diagnosis of common disorders and diseases based on biochemical blood tests and patient's symptoms

At this stage, Skychain will demonstrate its usefulness and vitality to the medical community and continue developing.

Skychain Beta – December 2018

Skychain keeps developing, with additional opportunities for test analyses being added. SkyTherapist is trained on the basis of scientific research and analyses of case histories.

SkyTherapist is launched in a limited mode:

- Creation of an effective protocol for the treatment of the most common diseases (infectious, chronic, etc.) with out-patient treatment
- Generating an effective protocol of treatment of some common cancers

Doctors will independently enter a patient's diagnosis, and information about the patient analyzes into SkyTherapist, which offers a doctor several effective treatments according to the accumulated knowledge.

Skychain Release – June 2019

Launch Skychain in full scale, including the SkyUI module for interaction with a doctor and a patient, SkyEngine trained to diagnose diseases, and SkyTherapist providing treatment protocols for most diseases. The further development of Skychain will be evolutionary—the neural network will be trained, identifying diseases with ever-increasing accuracy and providing more effective treatment protocols.

2025

By 2025, we expect that Skychain's capabilities in the field of hosting any ANNs, as well as the huge computing resources of Skychain miners, will be in demand by specialists in a wide range of areas, not just medicine.

Skychain Usage Scenario

Building and Training an Artificial Neural Network

Laboratory staff at a medical clinic with a large array of patient data decided to design and train their own neural network, not only to improve their clinic's performance but also to provide outside doctors with access to their neural network.

Building an artificial neural network

Bill, a laboratory analyst, created a new neural network using the SkyConstructor tools on the basis of a publicly available neural network pattern—an analyzer of graphic images. Using the visual builder SkyConstructor, Bill made changes to the neural network structure by adding additional layers and blocks to best configure the neural network to solve his application problem.

Preparation for learning

Bill's assistant, Tom, prepared an array of data for training in the form of a specially structured data set. The system will be trained according to this data set.

Training an artificial neural network

Bill added the prepared data set using the SkyConstructor tools, indicating a neural network training budget of 150 Skychain Global Coins provided by his company. These 150 coins will go to miners who will perform calculations necessary for training a neural network according to the specified data set.

Thousands of miners' computers downloaded this neural network to their memories and trained Bill's network in several iterations. The final neural network was on Bill's computer, and the miners were rewarded. Distributed training reduced the training time to tens of minutes instead of days or weeks that would be required for training on one server.

Testing an artificial neural network

Bill tested the trained neural network through SkyConstructor on an additional (testing) data set. The network operated correctly with high accuracy.

Publishing an artificial neural network

Bill entered the registration information about his neural network (class, description of input data, result, cost of access to the neural network, author, etc.) using SkyConstructor, signed a manifesto with a laboratory certificate, and executed the command "Upload a neural network in the blockchain." Bill set the transaction reward of 20 Skychain Global Coins for a miner who creates another block. In about 10 minutes, a new block was created in the Skychain blockchain, and Bill's neural network became available to any doctor anywhere in the world. Bill set a reward of one Skychain Global Coin that each consumer must transfer to Bill's (or his laboratory's) digital wallet for each inference operation (using a neural network for diagnosis).

Alternative learning scenario using the Skychain data marketplace

ANN lab specialists are experienced professionals in the field of neural networks, but they do not have the necessary medical data to create neural networks in the field of medicine.

In the SkyLearningZone interface in the Data Marketplace section, these specialists selected the data sets that contained information on the diagnosis of diseases by MRIs and received sample data for each data set. Using these examples, ANN lab specialists developed a neural network, tested its training on open examples, and decided to conduct its training.

The ANN lab uploaded its neural network to SkyLearningZone and trained its neural network using all selected data sets, paying only the cost of computing resources needed for training—450 Skychain Global Coin. After training, SkyLearningZone automatically checked the accuracy and quality of the neural network. The accuracy was 99.98%, which is higher than any neural network currently in the market.

The ANN lab published its neural network in the Skychain registry, while the neural network (its trained state) remained in SkyLearningZone and is available for use only within Skychain.

Use of Neural Networks by Consumers

For clarity, in this section we will provide a short example of using Skychain in a fully completed form.

The clinic where therapist Tom works purchased Skychain Global Coins at the price of $1.50 for one Skychain Global Coin to use Skychain and transferred the coins to Tom's wallet. All fees for operations are approximate.

Initial treatment

Patient Mike contacts therapist Tom. Mike has symptoms that have been haunting him for the last month and now have escalated.

Tom opens the SkyUI interface and enters Mike's symptoms and complaints into the program online in a dialog mode. SkyUI asks a few clarifying questions about the illness and tolerability, which Tom answers using the interface. After that, all received information is sent to the distributed neural network SkyEngine, and a system charges a commission of 10 Skychain Global Coins from Tom's wallet.

In response, Skychain gives the following information:

- List of possible diagnoses with their probability coefficients
- Request for additional medical tests for Mike to clarify a diagnosis

- Protocol of symptomatic treatment to alleviate symptoms and protect Tom from the development of the most dangerous probable diagnosis

Ten Skychain Global Coins, which are sent to the system, will be credited to the accounts of Skychain miners who provided their computing resources in order to process this request.

Entering additional information

Mike does additional tests recommended by Skychain and starts treatment according to the protocol recommended by Skychain. Mike comes to the second appointment with therapist Tom. Tom enters the results of Mike's analysis and treatment dynamics in the form of Mike's current symptoms, blood pressure, temperature, and so on into the SkyUI interface. All the information is then sent to the SkyEngine distributed neural network, and the system charges a fee of 10 Skychain Global Coins from Tom's wallet.

In response, Skychain provides the following information:

- Two possible diagnoses for Mike*
- Request for an additional test for differential diagnostics and the final diagnosis
- Updated treatment protocol to protect Mike from the negative development of any of the two diagnoses. The protocol of treatment also takes into account individual indicators of Mike's tests, tolerability of medicines, and their interaction

**Skychain determined that one of the possible diagnoses was missed in the initial selection. That information was sent back to the neural network so it learned to recognize it.*

Final diagnosis

Mike did an additional test to exclude one of the two diagnoses and came to Tom with the test results. Tom entered the results into SkyUI. After that, all received information was sent to the distributed neural network SkyEngine, and the system charged 10 Skychain Global Coins from Tom's wallet.

In response, Skychain provided the following information:

- Mike's final diagnosis
- Treatment protocol
- Prognosis: "full recovery in three months"

Course of treatment

During treatment, patient Mike visits therapist Tom every week, and Tom enters Mike's symptoms and new test results into SkyUI. After that, all received information is sent to the distributed neural network SkyEngine, and Skychain transfers a reward of 0.1 Skychain Global Coins to Tom’s wallet.

The reward motivates Tom to continue entering information about Mike, allowing Skychain to learn, monitor the treatment’s effectiveness, and confirm the accuracy of the diagnosis.

Treatment adjustment

During the treatment, Mike has two problems:

- He poorly tolerates one of the prescribed medicines;
- He has a sore throat, resulting in the need to adjust the treatment

Therapist Tom enters into SkyUI the information about the poor tolerability of one of the medicines, as well as information about the sore throat. After that, all received information is sent to the distributed neural network Skychain, and the system charges a commission of 10 Skychain Global Coins from Tom's wallet.

In response, Skychain provides the following information:

- Changed treatment protocol and recommendations for the period of the sore throat

Expected treatment period

Since Skychain gave a prognosis of "full recovery in three months," then three months after the start of treatment, Skychain will ask Tom to provide information about Mike's health.

Tom can do one of the following:

- Enter information about Mike's recovery, and Skychain will transfer Tom a reward of 1 Skychain Global Coin
- Enter detailed information according to the information requested by Skychain—results of new tests based on the results of recovery and a detailed description of the recovery progress. After that, Skychain will transfer Tom a reward of five Skychain Global Coins.

Uploading, Storage, and Execution of Private ANNs and Payment for Them

The basis of SkyEngine is a large stack of ANNs capable of performing specific tasks to diagnose symptoms, analyze medical images, differentiate diagnoses, and so on. Before launching the project, the Skychain project team will fill Skychain with a certain number.

But the main strength of Skychain is its distribution and openness.

Any specialist in a particular disease, a medical institution with a lot of case histories, a scientific laboratory, and more will be able to create their own neural networks and upload them to Skychain.

SkyEngine will provide tools that will allow independent professionals to design their own ANNs and train them on real data using Skychain computing resources. Then these ANNs will be uploaded to Skychain in an encrypted form.

After that, the creators of the ANNs will get a reward for each use of their neutral network by a doctor. Medical specialists will evaluate the quality of the neural network by raising or lowering its rating on a public list.

For example, the Institute of Intestinal Diseases can build, train, and upload a neural network that will detect and carry out various diagnoses of Crohn's disease, ulcerative colitis, IBS, and other specific intestinal diseases according to medical tests, histology, and endoscopy images. It can then enter them into Skychain and be remunerated for every use of its neural network by doctors around the world.

Skychain will protect the intellectual property of the ANN’s authors. Nobody can use a neural network uploaded to the public blockchain Skychain by its author without paying a fee set by its author. How will that be implemented?

When building a neural network, it will automatically include encryption of the output signal. In fact, anyone will be able to perform calculations on a network uploaded by its author and read its structure and parameters from the public blockchain. But to get the correct result of calculations and the result of the neural network calculations, an incoming signal must be sent to the computer/server of the ANN’s author.

Then, a specially created neural network will quickly decrypt the signal on the author’s computer and return the final correct calculation result. An ANN decrypting a signal will also be stored in a public block, but it will be encrypted with an author's key so only the author can decrypt it and run it.

About 99.9% of computing costs for performing a neural network will be distributed on the basis of an open part of the author's neural network. Then 0.1% of computing costs generated on the author's computer to secure storage of configured and trained ANNs in Skychain will allow using Skychain to publish any ANNs. Skychain will provide paid access to these ANNs with unprecedented computing resources to perform calculations, and it will protect the intellectual property of the authors of the ANNs.

Skychain Architecture

Blockchain Network

The central element of the Skychain ecosystem is the blockchain network that provides interaction among network participants. A block, whose size is limited to 10 MB, includes confirmation of the execution of the following operations (transactions):

- Skychain Global Coin transactions
- Requests for an inference using a neural network
- Requests for neural network training
- Publishing inference results
- Publishing a new neural network in the register (one per block)
- Changing a neural network's owner (10 per block)
- Updating a neural network (10 per block)

The service charges a fee for each transaction. The fee is set by the authors of the transactions. A large fee increases the chance for a transaction to be included in a block. A block includes only a neural network manifest (description) value and its hash value. A neural network is included in a separate P2P storage.

The network operation is ensured by the proof-of-stake concept.

Data Storage

To prevent excessive growth of the Skychain blockchain network, the configuration of neural networks, as well as training data sets, are published and stored in a separate P2P network. The hash of the recorded data is stored in the blockchain network.

Creating an Artificial Neural Network

Using the SkyConstructor toolkit, Skychain users create and customize layers of the neural network, indicating the algorithms for its learning and sets of test data.

Upon completing the configuration, the creator of the neural network pays for its training with Skychain Global Coin coins.

Distributed Training

Skychain will provide an opportunity for distributed training. A server that controls the training process will attract additional network servers to training. Then the controlling server will distribute an artificial neural network module and its initial parameters to training servers. After that, training servers will perform the following iterative training:

1. repeat
   a) Send a unique part of the data set to each server
   b) Get updated neural network parameters received through training from each trained server on the forwarded data set $\nabla\omega\iota$
   c) Calculate updated neural network parameters ω based on all $\nabla\omega\iota$
   d) Send updated neural network parameters to all trained servers ω
   e) If the data set is completed, break
2. until forever

Another option is training an artificial neural network with its own power.

Publishing an Artificial Neural Network in Blockchain

There are several options for publishing an artificial neural network:

- Open publishing in data storage – Any participants can perform calculations with this neural network. An author of this neural network is not rewarded for the use of his or her neural network by participants. Only the miner who performed the calculation is rewarded.

- Enclosed publishing – A neural network is stored at its creator's computer. Only Skychain publishes information about it. Authors train their neural networks on their own, perform their orders for network participants, and get remuneration for them.
    - There is an option of connecting already trained neural networks of independent laboratories and corporations to Skychain. In that case, all calculations are performed on the neural network owner's server, and Skychain is used as an infrastructure, providing access to this neural network for consumers and rewarding its owner.
- Encrypted publishing – SkyConstructor provides tools for building a neural network, and those results can be obtained only with the use of several layers in an enclosed part of the neural network located on its author's computer. A neural network's author completes the calculation. A neural network's author and the miner who completed the calculation are rewarded.

SkyEngine Register of Neural Networks

All artificial neural networks within the SkyEngine neural network register are public. The register contains a description of each neural network, its category (application field), information about the neural network structure and its trained state, the neural network owner's identifier/address, the amount of the reward to the neural network's owner for each access to it (set by its owner), and computational complexity (set by SkyEngine).

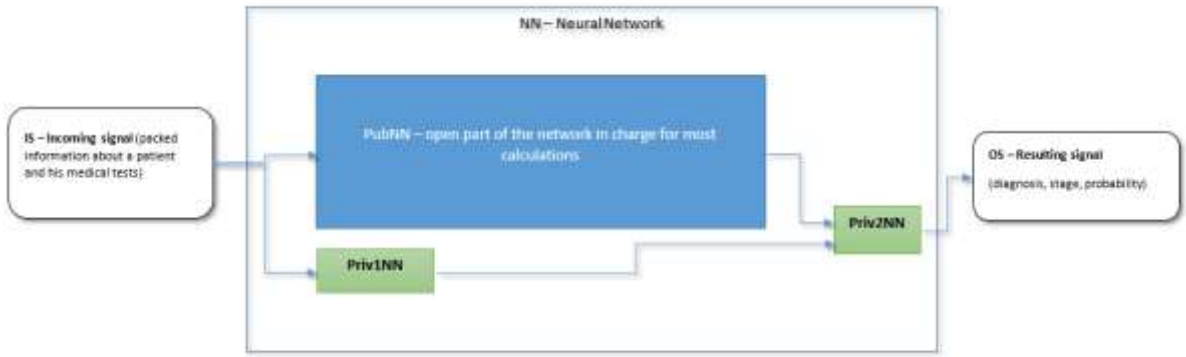
Launching Calculations

After a manual selection or as a result of an automatic classification, a table with options for launching SkyEngine is displayed to a doctor:

Category	Name, author	Reward to an author	Reward to a miner for complexity	Total price (Skychain Global Coin)	Perform
Diagnosis of skin diseases according to the dermatoscope images	Dermatoscope.Pro v.2	9	2	11	V
Diagnosis of skin diseases according to the dermatoscope images	Derm Alpha	1	3	4	V

A doctor selects neural networks from the list and clicks on Start Calculations. The final cost (15 Skychain Global Coins for this example) is charged from the doctor's or the medical institution's wallet, and the inference (calculation process) begins.

Inference (Generating a Result)



NN (neural network) is an artificial neural network computing incoming information about the IS (incoming signal) patient and giving the result of OS (resulting signal) calculations. NN consists of PubNN, an unencrypted public part of the neural network in the blockchain. Any Skychain member can run PubNN

for calculations. Priv1NN and Priv2NN are encrypted decoding neural networks within NN. They are encrypted in the blockchain with the NN author's key. Priv1NN and Priv2NN are executed on the author's computer. These neural networks do not require significant computing resources for operation, but they are an integral part of the NN artificial neural network. The result of PubNN calculations is inaccurate without them.

So the incoming signal is first processed with PubNN on a miner's computer or server and takes 99% of computing resources. Then the PubNN calculation result and incoming IS signal are transmitted to the NN author's computer/server, where the final result OS is calculated with Priv1NN and Priv2NN neural networks. OS is sent to the user directly from the author's server.

How are Priv1NN and Priv2NN created? They are small neural networks generated automatically by Skychain tools when building a neural network. Priv1NN and Priv2NN take part in the NN training and become its integral part. The result of PubNN calculations is inaccurate without them.

This has the following advantages:

- 99% of computing costs are performed on any free Skychain server. That maximizes the distribution and utilization of network servers.
- Authors of neural networks are protected from users copying or using it without their permission. They also have guaranteed remuneration in the amount set by each author for each operation that uses the author's neural network.
- The author can always restore the encrypted decoding neural networks from the block if the author knows the private key (password).

Mining and Monetization

At the launch of the Skychain project, all SCH tokens will be exchanged for a similar amount of Skychain Global Coin Global Coins. One token is equal to one coin. The release of additional coins is impossible.

Miners creating new blocks in the chain will have the following rewards:

- Reward for each operation that includes a new artificial neural network in the system (one operation per unit)
- Reward for each operation that changes a neural network's owner (lot sale transaction)
- Reward for each operation that changes a neural network's content by the developer (uploading a new neural network version to the blockchain)
- Reward for transfers of Skychain Global Coins within the network

The core of the network will be the master nodes. Each master node must have a deposit of 100,000 SGC.

High-performance servers such as Nvidia DGX-1 that specialize in artificial intelligence calculations contain many GPUs and tensor cores that are often required for training and calculating deep neural networks. Therefore, the management company Skychain Global will approve only the master nodes that correspond to the performance of at least 50% of the performance of the average network master node.

We also expect that as Skychain penetrates the work of medical personnel, Skychain Global Coins will become a convenient and widespread means of payment. That will increase a demand for Skychain Global Coins for the income of Skychain participants and system token (coin) holders.

Distribution of Tokens at the ICO

A total of 14,400,000 Skychain tokens will be issued.

- Up to 12,000,000 tokens will be sold during the pre-ICO and ICO.
  - + 10% of the total tokens sold will be transferred to the project team, without the possibility of selling tokens within 12 months.

- + 10% of the total tokens sold will be transferred to early investors, bounty program participants, project advisors, and partners.
- All unsold tokens will be destroyed.

1. Pre-sale (pre-ICO) (December 2017)

   a) From 400,000 to 2,000,000 SCH tokens will be sold (1 SCH = $0.50)

2. ICO (February 2018)

   a) Up to 12,000,000 SCH tokens will be sold (1 SCH = $1.25), including tokens sold at the Pre-ICO.

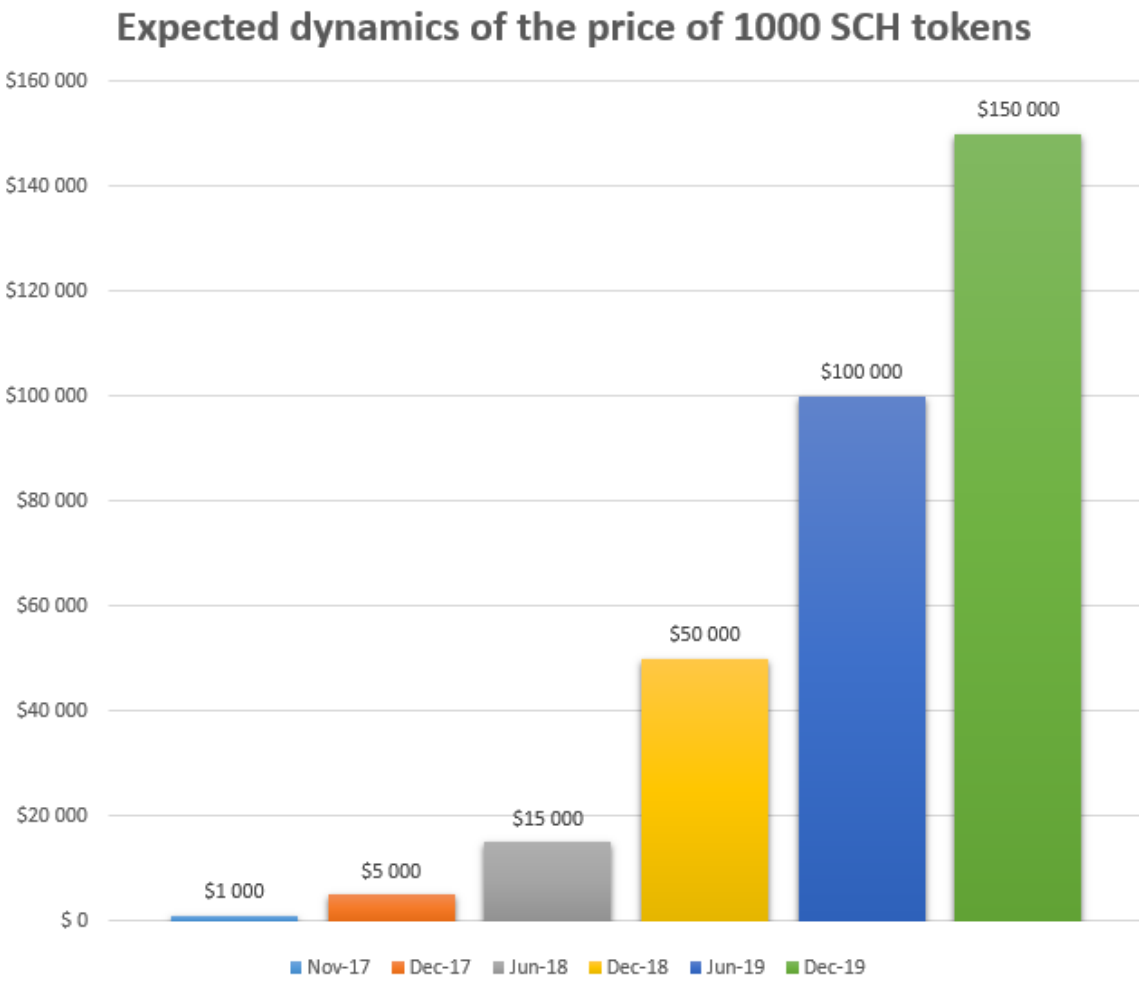
   b) Unsold tokens will be destroyed.

   c) The fundraising plan is from $10 million to $14 million.

The funds raised will be used for product development, development of partners' ecosystems, neural network developers, promotion of Skychain in the medical community, and connecting already trained neural networks to Skychain.

In the future, the tokens will be exchanged for the internal cryptocurrency of the Skychain Global Coin system; one token is equal to one coin. In the future, additional coins and tokens in the system cannot appear because the system will function based on proof of stake.

The received Skychain Global Coins will be the only means of calculation among Skychain members. Each master node must have a deposit of 100,000 SGC. This price is fixed and cannot changed in the future. In addition, coins will be used when the new data provider is coded to the system for its certification and verification, as well as for the inclusion of new artificial intelligence in the AI marketplace.



Team

Gennady Popov

Founder

Gennady has 10 years of experience as a programmer. His experience includes automation of medical laboratories and automatic recognition of images with MRIs and CT scans for machine detection of pathologies of organs and joints. He also has experience in the automation of hospital medicine and health insurance funds. His large data analyses include case histories of 6 million patients for machine-based calculations of correlations and the efficiency of doctors and hospitals. He was the founder and CEO of WSS-Consulting company, the market leader in the automation of electronic document management in Russia.

LinkedIn
Facebook
Telegram

Ivan Svistunov

Chief Technology Officer

Ivan has been a programmer since 2010. He is an architect of industrial software products in the fields of big data, Highload, and cryptography (WSS Docs) using private blockchain technologies (WSS Docs Storage). Since 2016, Ivan has been working on machine learning projects and has implemented several projects in that field. His language and technology proficiency include C ++, Objective-C, JS, CUDA, T-SQL, Haskell, Blockchain, Deep Learning, Caffe, theano, and TensorFlow.

LinkedIn
Telegram

Alexander Kuzmin

Chief Operating Officer

Alexander's experience includes scientific projects in the field of artificial intelligence in multi-agent systems and artificial neural networks. He has also developed analytical projects in the field of innovative technologies and has two years of experience as an analyst of high-tech projects in the field of nanotechnology and IT. Alexander worked for three years as project manager in the field of development and the implementation of corporate IT systems. He is experienced in analytical projects in the field of innovative technologies. Alexander is a member of the physical faculty of Moscow State University, and is educated in physical and mathematical methods of management.

LinkedIn
Facebook

Sergey Verbitskiy

Full-Stack Developer

Sergey's programming languages and technologies include C#, C++, SQL, Javascript, HTML, HighLoad, Blockchain, DataMinig, DeepLearning, CUDA, Tensorflow, Theano, and Caffe. He has more than 12 years experience in the field of programming and is a leading architect of WSS Docs, a highload Enterprise Content Management system. WSS Docs is implemented in more than 300 companies throughout Russia.

LinkedIn
Facebook

Egor Chertov

Community Manager

Egor has six years experience in the field of search engine optimization and website promotion. He worked as a web editor at Greenpeace Russia and as a content manager for Beontop, one of the leading SEO companies in Dubai, UAE. Egor participated in the international environmental protection projects of Greenpeace International. He is a member of the Advertising and PR faculty of the N.A. Dobrolyubova State Linguistic University of Nizhny Novgorod.

LinkedIn
Facebook
Telegram

Dmitry Musinov

Full-Stack Developer

Dmitry's programming languages and technologies include C#, C++, SQL, Javascript, HTML, HighLoad, Blockchain, Data Mining, Deep Learning, CUDA, and Tensorflow. He has more than 10 years experience in the field of programming.

LinkedIn
Telegram

Alexey Vushkov

Full-Stack Developer

Alexey's programming languages and technologies include C#, T-SQL, NOSQL, C++, SQL, Javascript, HTML, HighLoad, Blockchain, Data Mining, Deep Learning, CUDA, and Tensorflow. He has more than five years experience in the field of programming.

LinkedIn
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Advisors

Sergey Shumskiy

Deep Learning Advisor

Sergey has a PhD from the Lebedev Physical Institute and is an expert in machine learning and machine intelligence. He is a co-founder of NeurOK, NeurOk Software, NeurOK Optics, IQmen Business Intelligence, and Factbook. Sergey is the vice-president of the Russian Neural Network Society, the head of the Neuroassistants branch in Neuronet, and the director of the Scientific Council of the Center of Artificial Intelligence Science and Technologies under the National Technology initiative.

Facebook
LinkedIn

Andrey Reznik

Business Advisor

Andrey is currently a partner in the Department of Assets and Business Estimation of the international consulting company Mazars. He has founded companies specializing in finance services, IT services and development, and automated trading. His education includes finances and loans at the Plekhanov Russian University of Economics and an MBA from INSEAD (France).

Facebook
LinkedIn

Md. Mofassair Hossain

PR and Marketing Expert

Md. Mofassair is the CEO and founder of Perhalic and one of the top ICO PR, marketing, and social media experts. He is a chartered management accountant, an expert at the Israeli Blockchain Association, a top expert at ICO Bench, and an ambassador of Humaniq and Advocate of DasCoin. He has served more than eight top successful ICOs.

LinkedIn
Facebook

Douglas Lyons

ICO Advisor/Coordinator, Consultant

Douglas' experience and track record of high performance provide the depth and expertise required to elevate his clients' businesses and execute a successful ICO/ITO launch. As an industry leader, Douglas has helped raise more than $75 million in ICO funding for various blockchain start-ups.

LinkedIn

Elena Kondrakhina — **Medicine Advisor**

Elena is the Chief Medical Officer for MedSwiss on Ermolaevsky, a Candidate of Medical Sciences, and a doctor of the highest category. She started her career as a doctor of First Aid in Moscow.

LinkedIn
Facebook

Anton Klechenov — **Scientific Advisor**

Anton is experienced in the automation of medical institutions and the processing of medical images. He has done joint scientific research and publications with MIT (USA) in the fields of computer vision and parallel computing.

LinkedIn
Facebook

Konstantin Sablin — **Medicine Advisor**

Konstantin has more than eight years of experience as an andrologist, urologist, and endocrinologist. He is a member of the European Association of Urologists (EAU). He was educated at the Sechenov Moscow Medical Academy with a Diploma in General Medicine (healthcare).

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LinkedIn

Vladimir Nikitin — **ICO Advisor**

Vladimir is the co-founder of Top ICO Advisor, an accomplished legal consultant, an ICO advisor, a blockchain cryptocurrency specialist, and a member of several boards of directors. He is a renowned member of the cryptocurrency community and an active advocate of blockchain, through which he has gained an extensive community of contacts as well as more than 30,000 network connections on LinkedIn. Vladimir is a listed blockchain expert on the ICObench (TOP-7) and an active advisor on more than 25 ICO projects.

LinkedIn

Tessa Little

Scientific Advisor

Tessa is a medical biochemist and research biophysicist with training in protein biophysics at Wits University, South Africa. After receiving a PhD, she moved into the medical health sector. Doing research at local and international universities over the years, Tessa was given the opportunity to help make sense of what seemed to be complex unrelated phenomena that clinicians often faced.

LinkedIn
Facebook

Farid Maz

Scientific Advisor

Farid studied engineering at Gadjahmada University and aerodinamics and aircraft design. He worked in various engineering projects and government urban development advisories and is a member of the city council. He is passionate about social issues and runs a charity foundation.

LinkedIn
Facebook

Francois Van Wyk

Medicine Advisor

Francois is Managing Director of the Family Doctor Clinic in Harrismith. He said, “The reason I am interested in the project is because I am very passionate about technology in healthcare, and I realize that this is the future of healthcare. I want to stay ahead of the masses and be an early adopter. I also want to contribute to a worthwhile cause. I have good experience in primary healthcare, where I believe technology will play a very important role in the future.”

LinkedIn

Michele Novi

Medicine Advisor

Michele works in Orthopaedic and Trauma surgery in Pisa, Italy. He graduated as a Medical Doctor in 2012 with a thesis on computer-assisted surgery titled “Patient-Specific Templates for Pedicle Spine Screw Placement.”

LinkedIn
Facebook

Maria Florenteva

Digital Healthcare Advisor

From 2013–2017, Maria was the Senior Vice President of PJSC Rostelecom. Since 2017, she has been the Director of the Digital Economy Laboratory of the Faculty of Economics of Lomonosov Moscow State University. Maria is a member of the Coordinating Committee of the National Consortium Smart City. She initiated the creation of the Digital Health Consortium.

Maxim Golikov

Medicine Advisor

Maxim had his residency in anesthesiology and reanimatology 2008. He is a doctor of the highest category with a specialization in ECG. Maxim believes that the Skychain project is interesting because the direction of the development of self-learning computer programs is very promising in general and in medicine in particular.

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LinkedIn

Terms and Conditions

This document can be used only for information purposes and should not be considered a public offer to sell shares or securities using the Skychain platform or any other related company.

Skychain tokens do not give the right to control

Owning Skychain tokens does not give the owner any ownership or property rights in the company. While the community's opinion and feedback can be taken into account, Skychain tokens do not give their owners a right to participate in decision-making regarding the development of the Skychain ecosystem.

Income or benefit is not guaranteed

All examples of income calculations or benefits used in this document are provided for demonstration purposes only or for showing industry averages and do not mean a guarantee that these results will be obtained in accordance with the marketing plan.

Regulatory uncertainty

Blockchain technologies can be subject to supervision or control by various regulators around the world. Skychain tokens may be subject to one or more audits or influence, including but not limited to use or possession of digital tokens such as Skychain tokens that may slow down or limit the functionality of the system or the process of purchasing Skychain tokens in the future.

Skychain tokens are not an investment

Skychain tokens are not an official or legally registered investment of any kind. Unforeseen circumstances can make significant adjustments to the objectives outlined in this document. Even though we intend to achieve all the goals described herein, all people and parties involved in the purchase of Skychain tokens do so at their own risk.

Inappropriate use

Even though Skychain tokens should not be treated as an investment, they can grow in price over time. They can also fall in price if they are not actively used in the Skychain ecosystem.

Risk of loss of funds

Funds obtained during the ICO procedure are not insured. In case of their loss or loss in price, there is no private or public insurance representative to whom you can turn for recourse.

Risk of malfunction

There is a chance that for various reasons, including but not limited to failure in the business organization or marketing strategies, the Skychain ecosystem and all subsequent marketing activities connected with the funds raised at the ICO may not be successful.

Integration

This document establishes the full agreement of the parties with respect to the importance of the topic set forth herein. All previous agreements, discussions, presentations, guarantees, and conditions are encompassed in this document. There are no warranties, conditions, or agreements, express or implied,

between the parties, other than those expressly set forth in this document. This document can be amended only in writing by the parties.

Disclaimer of warranties

You agree that using or not using Skychain tokens is entirely at your risk and that Skychain organizers bear no liability for them. On the release date, Skychain tokens will be sent without a warranty of any kind, either explicit or implicit, including all implied warranties of a commercial price for a particular purpose without violating anyone's intellectual rights. Since some jurisdictions do not allow the exclusion of implicit guarantees, the higher exclusion of implied warranties may not apply to you personally.

Prohibition of ICO in some countries

Legislation in your country may explicitly prohibit you from participating in an ICO (Initial Coin Offering). If that is the case, you cannot participate in the Skychain ICO.

FAQs

You are talking about diagnosing using medical test results and test images. Can this even be implemented?

Yes. Several dozen neural networks have already been implemented and trained by specialists around the world, solving these tasks as the best specialists in their fields. This area is developing dynamically. In 10 years, most diagnoses will be made by neural networks, probably under the supervision of a living doctor.

Then what is the use of Skychain if all this is developing fine without it?

The problem is that these neural networks function within laboratories and institutions, and there is no mechanism for the unified use of neural networks by doctors. Skychain will unify all these distributed neural networks and provide doctors with a single window for their use.

Skychain's data marketplace will allow the best specialists in the field of artificial intelligence to quickly develop and teach neural networks using the amount of medical data, which no organization or state can ever collect in one place. The number and quality of Skychain's neural networks will thus be unattainable for any private or public project.

In addition, by uploading information about a patient into Skychain, a doctor can analyze it in dozens (or even hundreds) of different neural networks and get the most complete state of a patient.

What market share does Skychain claim?

IBM estimates the artificial intelligence market in medicine at $200 billion a year in a few years. The goal of Skychain is to gain more than a 70% share of this market.

The way to achieve this goal is to create the best open infrastructure that will accumulate the resources of the majority of participants of this industry and surpass any closed corporate product.

What does blockchain have to do with it?

Blockchain will store all neural networks developed by hundreds of laboratories and organizations in a single registry so any neural network can be calculated on any server connected to Skychain. In addition, storing neural networks in a single registry is safe for the author since no one except the author can get a reward for the use of the neural network, and it cannot be unloaded and launched outside Skychain because the calculation result is decoded in the author’s neural network computer with the author’s private key.

What are the advantages of Skychain for developers of neural networks?

Today, developers of neural networks must purchase expensive equipment to train their artificial neural networks, experiment with various neural network structures, and select the best structure to solve their problems. With Skychain, any researcher can build their own artificial neural network using SkyConstrucor builder tools, pay for renting the required computing resources with Skychain Global Coins, and train their neural network.

The developer will also be able to train the neural network using a large number of data sets provided by independent suppliers, which will make it possible to train the deepest and most accurate neural networks.

Then, Skychain will allow an author to get remuneration from the neural network’s end users. That will motivate developers of neural networks to upload their neural networks to Skychain and thus develop the Skychain ecosystem.

Will calculations and training of neural networks be distributed?

Yes. When a doctor sends information about a patient and the test results, this information is distributed to many neural networks and executed on a variety of servers at the same time.

Neural networks can also be trained in parallel. For example, one server (e.g., of a neural network's developer) controls the training process, and plenty of servers of miners consistently train it on individual examples and send the neural network parameters to the controlling server to combine them. The calculation of neural networks (inference) will be performed on a miner's server and decrypted on the neural network owner's server. But an inference is not a costly operation and is effectively performed even on one server.

What are the advantages of Skychain for miners?

Skychain miners can provide their computing resources and get paid, not only for mining cryptocurrency coins but also for providing a requested service, which is a solvent demand. This fundamentally sets Skychain mining apart from the mining of classic cryptocurrencies (BTC, ETC, etc.) where miners perform useless calculations only for proof of work.

What are the advantages of Skychain for doctors and patients?

Skychain will be able to analyze information about a patient according to medical tests, history, symptoms, and research results. Moreover, this analysis can be performed with hundreds of different neural networks at once that will not miss any important detail and can effectively diagnose rare diseases and improve the quality of diagnostics. A doctor and a patient will be able to get a reliable second opinion from Skychain.

Can Skychain be used for other tasks that are not in the medical neural network?

Yes. Skychain architecture allows the storing and processing of any neural network. We are focusing on medicine at this stage since there is a very urgent need and the project organizers have rich experience in that field.

Some large companies (IBM, Google) design and provide their neural networks for rent, including for medical purposes. Don't you think they will monopolize this market and leave no room for Skychain?

These companies' developments are interesting, but training even one artificial neural network for the diagnosis of a single disease is a complex task that requires painstaking work to design a neural network and prepare a large data set for its training. A neural network often must be redesigned and retrained after the training.

In Skychain, developers will be able to train their neural networks using a large number of data sets provided by independent suppliers for reward, which will make it possible to train the deepest and most accurate neural networks.

Thousands of independent laboratories will be able to place their neural networks on Skychain, and no corporation in the world can spend that much intellectual and human resources to create that product. Just like no taxi company can compete with the Uber drivers network in the number of cars, no software developer can compete with the App Store in the number and coverage of applications.

Some companies such as Amazon provide computing resources of their data centers for rent to neural network developers for training and calculations. These centers are very efficient. Will the use of Skychain computing resources for training neural networks be in demand?

Yes. Data centers of large corporations are extremely big. But if you look at the current blockchain networks such as Ethereum, you can see that these networks combine huge computing resources of miners that are more superior in their processing powers than any centralized data center. That's why Skychain will provide more computing power and at a better price than any corporation.

How do you assess a chance of project failure?

We admit that at the pre-ICO or ICO stage, there may be a situation where the project's tokens will not be redeemed, and we will not be able to develop the project without this support. Project failure is possible in this case. But we are 100% sure that a platform with principles outlined in our white paper will be created and universally recognized. Modern technologies allow for the creation of such a system, which means it will definitely happen since its high value for people is obvious. If the ICO is successful, we are confident that we will implement Skychain and that it will be universally recognized.

Ok, this project is really interesting, but why do you think it is your team that should implement it?

The Skychain project is at the intersection of five fields:

1. Blockchain
2. Artificial neural networks
3. IT in medicine
4. Sharing economy
5. Cryptography

The founders of Skychain have deep knowledge and extensive experience in all these fields. In addition, it is extremely important that they have decided to devote their lives to the Skychain project.

Why did you choose ICO and not attract venture investment?

The attraction of classical investors reduces the level of independence of the team and the project. We want to remain independent and not rely on investors' opinions and their short-term goals to develop Skychain. Therefore, we chose an ICO model and hope for community confidence in our project, team, and goals.

What equipment do I need for Skychain Global Coin mining?

Skychain Global Coins can be mined with computers that have 4–8 powerful video cards. Algorithms of artificial intelligence use matrix multiplication operations (BLAS GEMM), which is most efficiently computed on tensor cores such as Nvidia's Tesla V100. The use of tensor cores allows the training and calculation of Skychain neural networks to speed up by 12 times.

The field of artificial neural networks is rapidly developing, and new architectures, libraries, and approaches to training are emerging. What if Skychain lags behind?

Skychain is an infrastructure. We will be adding support for all widespread libraries and tools. For example, if a new library for artificial neural networks that solves problems well appears tomorrow, we will test it and include its support in our core. Skychain will thus speed up the progress in this area and the use of the latest developments and libraries by a wide array of specialists and consumers.

Participation in Skychain

Participation in the Pre-ICO

We look forward to your participation in our pre-ICO. Funds raised at the pre-ICO will be used to organize the ICO and platform marketing.

The participation method is indicated on our website https://skychain.global/.

Participation in the ICO

By becoming an ICO participant, you will become a full-fledged participant in the Skychain community. After launching the platform, we will exchange the tokens you purchased at the ICO into the inner currency Skychain Global Coin.

The participation method is indicated on our website https://skychain.global/.

Participation in Skychain Development

We welcome everyone who wants to join our team. We are interested in attracting mathematicians and programmers with scientific projects and experience in the fields of artificial intelligence, artificial neural networks, and deep learning. We are also interested in your fresh ideas or developments in these fields. Just email us and we will definitely reply to you.

Participation in the Initial Configuration and Training of Skychain

We are looking for partnerships with medical institutions and health insurance funds that can provide us with millions of case histories for the training and configuration of the Skychain artificial neural network.

Participation as a Neural Network Developer

If your laboratory or organization already has experience in the field of artificial neural networks and you want to publish them for public access and be remunerated for their use, we welcome you to our project. We can test the operation of your neural networks in Skychain and support you in the integration of your neural networks into Skychain.

Participation in the Testing and Pilot Operation of Skychain

We are looking for partnerships with medical institutions, specialists, and practicing doctors who will help us test the system on real patients. During the testing period, no diagnosis or treatment will be prescribed based on Skychain recommendations. Only a diagnosis and protocol of treatment prescribed by a doctor and proposed by the artificial neural network will be checked by displaying comparison results in Skychain.

Contact us

https://skychain.global/