The SingularityCoin White Paper

Early Rough Draft

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SingularityCoin is facilitating the operation of SingularityNet, a "Decentralized Self-Organizing Cooperative" comprised of AI-controlled software and hardware agents.

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Abstract

SingularityCoin is a revolutionary cryptocurrency designed by a nonprofit organization specifically to foster and host the growth of advanced Artificial Intelligence toward the goal of an ethically positive Technological Singularity. SingularityCoin consists of three types of tokens, designed with a special economic logic so as to enable the operation and growth of the SingularityNet -- a "Decentralized Self-Organizing Cooperative" of AI agents.   The AI agents in the SingularityNet will interact peer-to-peer, providing AI services to each other and to outside customers, and cooperating together to create a higher level of emergent intelligence.

The SingularityNet will be open, so that anyone can enter a new agent into the network, and that agent can then provide services in order to achieve SingularityCoin payments and improve its reputation.   The agents in the SingularityNet will provide AI services to all aspects of the economy including robotics, finance, manufacturing, transportation, and healthcare and others; and the network as a whole will gradually increase its collective intelligence, playing a significant and perhaps decisive role in the path to Technological Singularity.

A percentage of profits accumulated within the SingularityNet will be dedicated to "benefit projects" aimed at increasing the greater good of humanity and other sentient beings, thus aiming the network's activities in the direction of a positive Singularity.

Introduction

The concept of a Technological Singularity is increasingly widely accepted throughout the technology and business worlds. More and more, it is realized that within the next few decades there will be a transition to a new society and economy in which machine intelligence is the dominant factor; and novel digital and organic technologies acting on multiple scales will network together to produce emergent "global brain" dynamics of unprecedented complexity and sophistication.

Humanity faces many challenges on the path to a positive Singularity; and among these is the contemporary global economic system. In numerous respects, today's standard financial mechanisms and institutions are not up to the task of serving as the economic engine of a smooth transition to a broadly positive Singularity.

Blockchain provides a powerful tool for managing transactions in a Singularity-era economy; but in itself, blockchain is not enough. There is a need for a blockchain-based framework designed specifically to serve the needs of AI agents as they interact with each other and with external customers. And it is critical that this framework be designed with positive principles in mind: to foster democratic governance of the network of AI agents; to encourage the entry of innovative new agents into the network and the interaction of agents in a manner that feeds the emergence of collective intelligence; and to direct a significant percentage of the network's energy toward causes of broad benefit.

The SingularityCoin has been designed to meet these requirements, via serving as the economic engine of a novel SingularityNet network of intelligent agents. It is designed to:

- Deliver intelligent services to corporations, individuals and organisations;
- Foster the emergence of increasingly powerful distributed general intelligence;
- Deploy artificial intelligence for ever-increasing benefit of as-many humans and other sentient beings and lifeforms as possible.

SingularityCoin is a cryptocurrency comprising three types of tokens: **Foundation Coin** (intended for investment and appreciation), **Transactional Coin** (intended for mediating AI transactions), and **Benefit Coin** (intended for research, charitable and other benefit projects).

There is a special economic logic associated with the interaction of the three coin types. This logic includes a time factor incorporating the reality of exponential technological change, according to which global society is moving toward a Technological Singularity and is going to experience fundamental transitions during the next two decades. Among other aspects this time factor increases the percentage of SingularityNet revenues to go to BenefitCoins as time passes and the SingularityCoin economy grows.

Democratic governance of SingularityNet involves a system wherein votes on different issues are proportional to ownership of the different types of currency. The governance system is designed to protect the rights of major investors while at the same time ensuring that the broad community of SingularityNet users and SingularityCoin owners has a real voice.

The SingularityNet is explicitly designed both to be very practical and useful in the current tech ecosystem, and also to grow over time into a self-modifying "artificial cognitive organism," with the eventual potential for general intelligence and beneficial ethical characteristics beyond the human level.

SingularityNet nodes can run in the cloud but also on phones, robots, or other embedded devices. SingularityCoin is designed to foster the development of multiple species of robots as the next generation interface for delivering AI services and applications, and fostering the emergence of global Artificial General Intelligence. *In order to kick-start this aspect, ICO investors (above a certain minimum investment level) will receive a small-sized Hanson Robot running a lightweight SingularityNet node.*

Figure 1: Hanson humanoid robots, created by SingularityCoin partner firm Hanson Robotics, will be early targets for embedded implementation of SingularityNet nodes. ICO investors will have the option to receive an early-release limited-edition SingularityNet-powered "Little Singularity" robot.

The SingularityCoin Team

Creating the SingularityCoin and SingularityNet is a significant undertaking and building it purely from scratch would be a hugely time-consuming undertaking. Fortunately the founding team brings not only tremendous experience but also a significant body of open-source software code capable of serving as the foundation for important aspects of the SingularityNet software.

The leading founding partner organizations are:

- The OpenCog Foundation, stewards of OpenCog, the leading open-source Artificial General Intelligence platform
- Hanson Robotics, creators of the world's most lifelike humanoid robots
- Vulpem, a blockchain software engineering consultancy responsible for back-end work on a number of successfully designed private and public blockchains, cryptocurrencies and decentralised applications.
- Economic Space Agency: California based organisation, developing Gravity, a distributed computing architecture that emphasizes both resilience and interoperability, enabling a new way to create smart contracts.

Additional partner organizations include

- Humanity+, an international futurist organization, advocating advanced technologies such as AGI and decentralized economy since 1998
- The AGI Society, the only international professional organization devoted specifically to Artificial General Intelligence, organizer of the annual AGI conference series and editor of the academic AGI Journal

Along with these organizations the executives and advisors of SingularityCoin bring a wealth of experience and knowledge to the large but achievable task of creating a next-generation AI-based economic ecosystem capable of mediating the transition to a beneficial Technological Singularity.

A Decentralized, Self-Organizing Cooperative

One can think about the SingularityNet as a "Decentralized Self-Organizing Cooperative" (DSOC). It is distinguished from an ordinary corporation, above all, by its openness. At bottom the SingularityNet consists of a set of smart contract templates, which AI agents can use to exchange data, to request AI work to be done, and to supply the results of AI work. These smart contracts include the use of SingularityCoin to mediate exchange. They also include contracts to be used by external, non-AI agents who wish to obtain AI services from AI agents in the network. Anyone can create a node (an AI agent) and put it online (running on a server, home computer or embedded device) and enter this node into the SingularityNet, so that it can request and/or fulfill AI tasks in interaction with other nodes, and engage in economic transactions.

A DSOC like SingularityNet is different from a classic "decentralized autonomous organization" (DAO), in that the core parameters of the SingularityNet's operation are explicitly regulated by a Foundation that is managed by the Foundation Coin holders. The Foundation also monitors the activity within the network, while obviously respecting the privacy of the particulars of inter-agent interactions. However, beyond this high level oversigh, the detailed day-to-day operations of the SingularityNet are purely self-organizing, emerging in a bottom-up way from the activities of the AI agents involved. The AI agents in the network may also create new AI agents as a result of their automated reasoning, and place these new agents into the SingularityNet.

In short, SingularityCoin is a radically innovative economic mechanism, designed to catalyze human and machine intelligence toward a new form of ethically beneficial self-organizing intelligence. The SingularityNet of AI agents interacting via SingularityCoin, is designed to provide practically valuable AI services to customers across the Internet, while in the process of self-organizing toward its lofty goals. A highly successful SingularityNet may very plausibly play a major role in the transition of humanity toward a positive Technological Singularity.

High-Level Vision & Mission

In the short run the SingularityNet will generate exponentially increasing revenue via providing valuable AI services to customers in multiple vertical markets. This revenue will enrich the service-providing agents in the network, and also the network as a whole (via transaction fees, paid to the network s TransactionCoins); and it will also indirectly increase the valuation of the FoundationCoins, via creating visibility and enthusiasm and momentum for the SingularityCoin ecosystem.

In the slightly longer term, we envision the SingularityNet as something even more fundamental than this: a way to catalyze the convergence of multiple AI technologies toward the emergence of a self-organizing, self-modifying, self-growing and self-financing Artificial General Intelligence (AGI) that is beneficial to the future of all sentient beings.

To put it plainly: The SingularityCoin project is designed to generate an intelligent global economy that pursues maximized benefits for all individuals, groups, civilization, and life. Through the combination of powerful AI agents and a benefit-maximizing SingularityNet architecture, we will accelerate the development of a global supermind, facilitating the evolution of humanity into a more advanced, intelligent, beneficial and connected mode of being.

The growth of the SingularityNet will foster advances not only in practical AI algorithms and structures, but also in the general theory and practice of beneficial artificial general intelligence, in the design and analysis of structures for ethically intelligent economies, and in the continuous refining of means to conceptualize and estimate "benefit" and "greater good". The SingularityNet economy of smarter, more trustworthy transactions is intended to facilitate unprecedented opportunities for self-actualization, and improve odds of a more glorious future for humanity, AGI and other life-forms.

Via fostering the growth and dissemination of advanced AIs interacting in the world according to a rational and beneficial economic logic, we hope to achieve a variety of important goals, including to

- Catalyze the emergence of positive, ethical, beneficial AGI;
- Encourage the distribution of the value generated by advanced AGI throughout the broad population;
- Ensure that the inputs of a wide variety of the population are incorporated in the first advanced AGI systems to emerge on the planet.

Aligned with these goals, a few key aspects of the SingularityNet philosophy are:

- Creation of a new socio-economic engine, coupled with governance mechanisms that encourage the self-organization of an associated participatory movement. In this way it will be possible to generate an intelligent global economy that pursues maximized benefits for all individuals, groups, civilization, and life, in both the near and long term future;
- A large fraction of the contributions, returns and value generated by the Net's economy will be reinvested inside the community with the effort of building a beneficial AI ecosystem;
- The ultimate goal of creation of super-benevolent, super-intelligent AGI as a global commons: a universal basic asset or global common infrastructure for the benefit of all, in which everyone has the possibility to become a stakeholder.

These lofty goals will be approach gradually, step by step -- though given the realities of exponential progress, some steps may be progressed through quite rapidly as the network advances. Some of the initial AI agents in the SingularityNet will be proto-AGIs and others will be highly narrow AI systems aimed at particular applications. Some of the initial interactions between these initial AI agents will be relatively simple, others will be subtle and complex. Both the individual agents in the network and the network-wide emergent structures and interactions will become more and more sophisticated as the SingularityNet grows. The SingularityNet will pursue ever-smarter contracts and techniques that increase win-win profitable transactions and manage resources ever-more intelligently for increasingly accelerating returns.

These high-level visions inform the architectural and dynamic particulars described in the remainder of this white paper.

Crypto-Economic Infrastructure

SingularityNet is critically founded on blockchain, but does not in itself constitute or require any special innovations in cryptocurrency or blockchain technology. Rather, it is a specifically designed architecture for a Decentralized Self-Organizing Cooperative of AI software and hardware, which requires efficient and scalable blockchain based operations for its operation. It should be considered as a structure and dynamic that can leverage the most advanced infrastructural tools associated with various different cryptocurrencies.

On the implementation level, SingularityNet may be considered as a set of smart contracts (i.e. smart contract templates with varying degrees of abstraction), most importantly embodying:

- an API for informational exchange with an among AIs;
- a mechanism for exchanging SingularityCoin tokens (of the three types indicated above);
- a mechanism for mediating governance.

These contracts may be executed within any framework satisfying certain basic requirements. We will often refer here to the entities executing these contracts as "agents" – by which we mean either nodes in the SingularityNet, or external human or software entities that are controlling SingularityNet nodes.

Due to the rapid evolution of cryptocurrencies and associated tools, it is considered a requirement that the SingularityNet will be able to shift between different crypto-economic infrastructures as technology progresses. As one example of this, SingularityNet must and will be a multi-blockchain platform. Choices regarding the

modification and growth of the underlying platform of the SingularityNet will be made using the DSOC democratic governance mechanisms.

As for the first version of the Singularity Net we will be agnostic regarding which blockchain the SIngularity Net will be deploy on top. Currently, Ethereum, Rootstock and QTUM are been considered as valid option. During the next few weeks, we will continue to engage with these organisations in order to establish our first partner.

Among the co-founders of SingularityCoin is the **Economic Space Agency (ECSA)**, a California-centered team focused on the creation of novel multi-blockchain economic structures, to design a flexible and efficient infrastructure capable of serving as an initial general-purpose underlayer for the SingularityNet. Toward that end, ECSA is creating a tool called GRAVITY, which provides a highly flexible "operating system for the multi-blockchain economy," capable of supporting a wide variety of smart contract based interactions with high computational efficiency, on a variety of platforms. GRAVITY comes along with a set of smart contract templates specifically oriented toward design, management and growth of decentralized blockchain-based organizations of various types.. These smart contracts are being crafted by the SingularityCoin team together with the ECSA team, consistent with ECSA's role as co-founders of the SingularityCoin.

For the initial implementation of the SingularityNet, we will express the DSOC smart contracts using OWL -- a very flexible formal language with a long history in the AI community. OWL is highly extensible and we will leverage a variant of OWL augmented to handle the temporal and cryptographic relationships required in smart contracts. OWL based contracts can straightforwardly be imported into logic-based AI systems -- including OpenCog, which will be used to create AI agents serving as part of the initial release of the SingularityNet -- for automated reasoning beyond simple testing and execution. It is also important to note that the SingularityNet smart contracts will be implemented in a modular fashion so that porting a SingularityNet contract to a different

infrastructure could be done in a straightforward and automated way if this were ever deemed desirable.

Networking AI Agents Into a Greater Whole

The key types of smart contracts that serve as the fabric of SingularityNet are:

- Exchange of software or hardware services for other software or hardware services;
- Exchange of software or hardware services for SingularityCoins (of multiple types, to be described below);
- Matchmaking, to determine favorable combinations of exchanges among nodes;
- Financial exchange between different types of SingularityCoins
- Requesting, or providing, a vote on a specific governance issue.

In order to make the first two types of transactions smooth and relatively simple, a set of standard "AI software and hardware services" APIs will be provided as tools for incorporation in smart contract templates; and a number of templates embodying these tools will be provided for utilization. A few among the numerous examples of services to be covered by these APIs would be:

- Image and video processing services like: Finding what people are in an image or video, producing a text description of an image or video;
- Language processing services like text summarization, machine translation or text sentiment analysis;
- Provision of datasets to serve as background knowledge to aid AIs in doing data analysis of other datasets;
- Requests to have some particular dataset analyzed;
- Exchanging processing time or memory for payment, or for some other service.

The variety of services to be covered will be quite large, and the creation and maintenance of an ontology for these services will be carried out collectively by the SingularityNet agent community using democratic mechanisms.

One of the founding partner organizations of SingularityNet is the OpenCog Foundation, creator of the world's leading open source software toolkit and system aimed at Artificial General Intelligence..   OpenCog will be used as the basis for a number of different SingularityNet agents carrying out functions such as natural language processing, probabilistic logical inference, evolutionary learning and information theory based pattern mining.

In work at Hanson Robotics, OpenCog has been interfaced with deep neural net algorithms for vision, audition and movement processing using Google's (open source) Tensorflow framework.   As an outgrowth and scaling-up of this work, SingularityNet agents will be created, wrapping various Tensorflow-based deep NN learning mechanisms, and trained deep NN models.   The interaction between OpenCog-based and Tensorflow-based agents in the SingularityNet, will be an extension of the interaction between OpenCog and Tensorflow based software components in current Hanson Robotics work.   This will provide an exciting initial avenue for exploring the complex potentials for multi AI agent interactions in the Net.
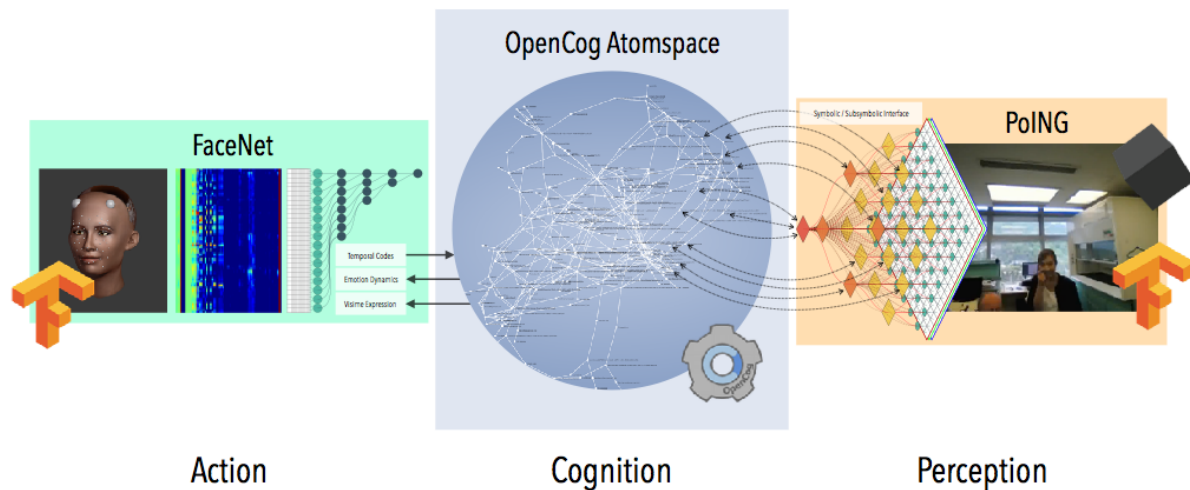
Figure 2: Synergetic Combination of OpenCog's Symbolic AI with Tensorflow's Deep Neural Networks for visual perception (via the PoING "Pyramid of InfoGANs" deep net architecture) and humanoid robot face control. This is current AI work being done at Hanson Robotics, which will be scaled-up, improved, accelerated and made more widely available via implementation within the SingularityNet. This illustrates the nature of modern AI deployments, in which components involving different algorithms and structures are networked together to achieve desired intelligent functionalities.

Some transactions in the SingularityNet will consist of an external using a proxy DA node to purchase an AI service from a single node in the Net, which fulfills the request via its own internal activity.

In many cases, however, the provision of a requested service will require a more complex combination of actions by multiple Net nodes. Control of Hanson humanoid robots is one example, requiring combined activity of a large variety of different AI agents according to a specialized architecture.

As a simpler example, a request to summarize a document might be fulfilled by Net node X, which might serve as an aggregator, sending requests to Net node Y that specializes in text summarization, Net node Z which specializes in semantic summary of video.

Net node Y might then spend some of the payment it receives on paying Net node W to do some specialized natural language processing tasks on the text it has been fed, such as entity extraction or word sense disambiguation. The Net node paid to do word sense disambiguation might spend some of the payment it receives on paying another Net node to do neural net training. The node doing neural net training might pay another Net node for access to a GPU on a server, or on someone's phone that is sitting plugged-in and idle and is running a SingularityNet app.

The overall outcome of these numerous multi-node interaction dynamics, carrying out complex AI services as a result of collective activity of multiple AI agents, will be the emergence of a SingularityNet wide AI mind with an intelligence significantly greater than the sum of its parts.

Furthermore, this emergent AI mind will be continually enhanced by the ongoing insertion into the DSOC of new nodes authored by AI software developers around the world, interested in contributing to and profiting from the SingularityNet's economic activity.

In most cases, the services required by a particular node at a particular time will be fulfillable by a number of other nodes, perhaps to different degrees and in different ways. This leads to the possibility of quite complex networks of dependency – one can visualize a graph, with an arrow from node A to node B if A is providing a service to node B. A network of dependency among agents making offers to each other to exchange services or services, or services for payments, is known as an "offer network." Constraint satisfaction algorithms may be used to find a favorable dependency network conditioned on a particular set of offers. In a well-populated SingularityNet, there will be value in

"matchmaking agents" which perform this sort of constraint satisfaction in order to arrange which of the many possible agents should fulfill each given agent's request. A matchmaking agent will receive a small amount of the payment involved in a transaction between two or more agents that it arranges.

There will also be new nodes continually inserted into the DSOC by AIs themselves. In the simplest case, for instance, an AI node X that learns models of classes of images using deep neural networks, might auto-generate another AI node Y that provides face-identification services, where Y operates by deploying a neural net model that was trained by X (but Y does not depend on X for ongoing application of this model to new datasets). Later on, AI nodes will create new node via more advanced forms of automatic programming.
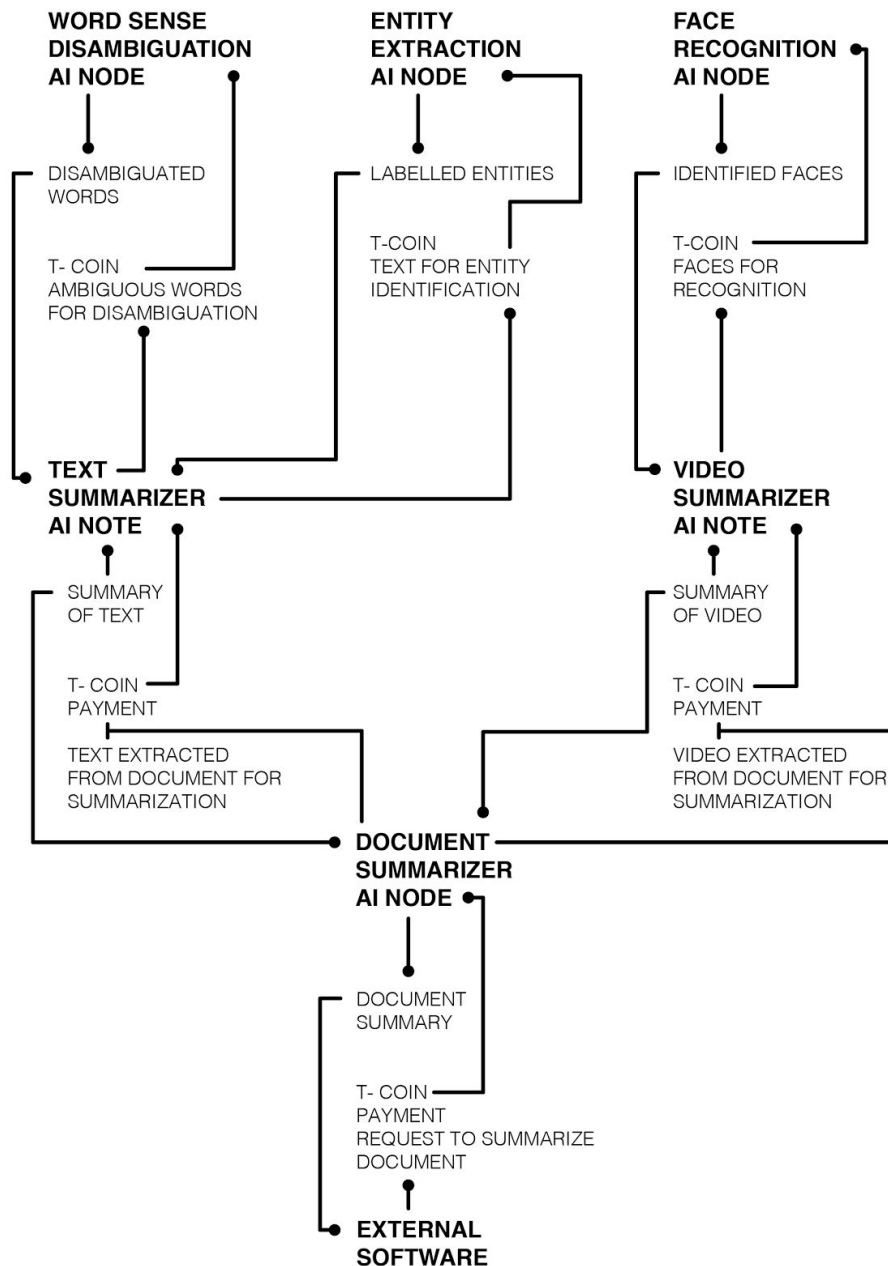
Figure 3:   Illustrative Example of Interactions Between SingularityNet Nodes.   In this example, an external customer pays a Document Summarizer node to summarize a document. The AI Summarizer node does some of the work itself, and outsources the rest of the work within the SingularityNet to Text Summarizer and Video Summarizer nodes -- which themselves outsource some of their work to other nodes. Each of these "outsourcing" relationships uses an AI API wrapped in SingularityNet smart contracts, and involves economic exchange using the Singularity TransactionalCoin.
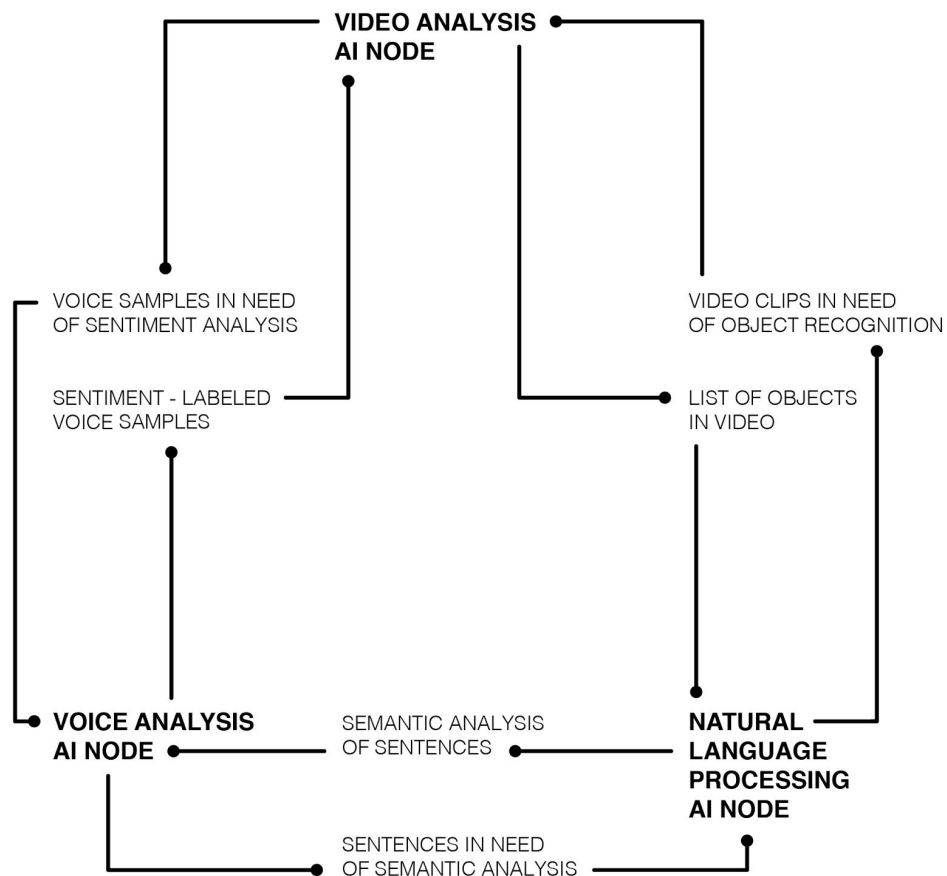
Figure 4: **Illustrative Example of a "circle of exchange" among AI agents.** **Three SingularityNet AI agents are depicted, each one providing a certain AI service to another AI node, and receiving an AI service from yet another AI node. A ternary cycle such as this is just a simple illustrative case; in a real SingularityNet setting, the cycles and other patterns of dependency between different agents will be longer and more tangled.**

**VIDEO ANALYSIS
AI NODE**

REQUEST: HELP ANALYZE
SENTIMENT FROM VOICE SAMPLES

OFFER: 3 T- COINS, OR HELP
RECOGNIZE WORDS OR SENTIMENT
IN SOUND SAMPLES

**VOICE ANALYSIS
AI NODE**

REQUEST: HELP RECOGNIZE
SEMANTICS IN SENTENCES

OFFER: 3 T- COINS, OR HELP
RECOGNIZE WORDS OR SENTIMENT
IN SOUND SAMPLES

**NATURAL
LANGUAGE
PROCESSING
AI NODE**

REQUEST: HELP RECOGNIZE
WHICH OBJECTS ARE NEAR
PEOPLE WHILE THEY ARE SPEAKING

OFFER: 8 T- COINS, OR HELP
RECOGNIZE WORDS OR
SENTIMENT IN SOUND SAMPLES

Figure 4A: Illustrative Examples of Offers and Requests from Nodes in the SingularityNet.   The examples show (offer, request) pairs that AI nodes might make, offering to pay in coins or AI services for other AI services that they need (where their needs may come indirectly from other AI nodes or external customers who have requested tasks of them). Mutual fulfillment of these (offer, request) pairs leads to the circle of exchange depicted in Figure 4.

CREATES ———● "OBJECT RECOGNITION IN VIDEOS" AI NODE

DEEP NEURAL NET VIDEO MODEL LEARNING AI NODE

CREATES ———● "FACE RECOGNITION IN VIDEO" AI NODE

CREATES ———● "EVENT RECOGNITION IN VIDEO" AI NODE

REQUEST FOR VIDEOS TO USE FOR TRAINING

T- COIN PAYMENT

VIDEOS
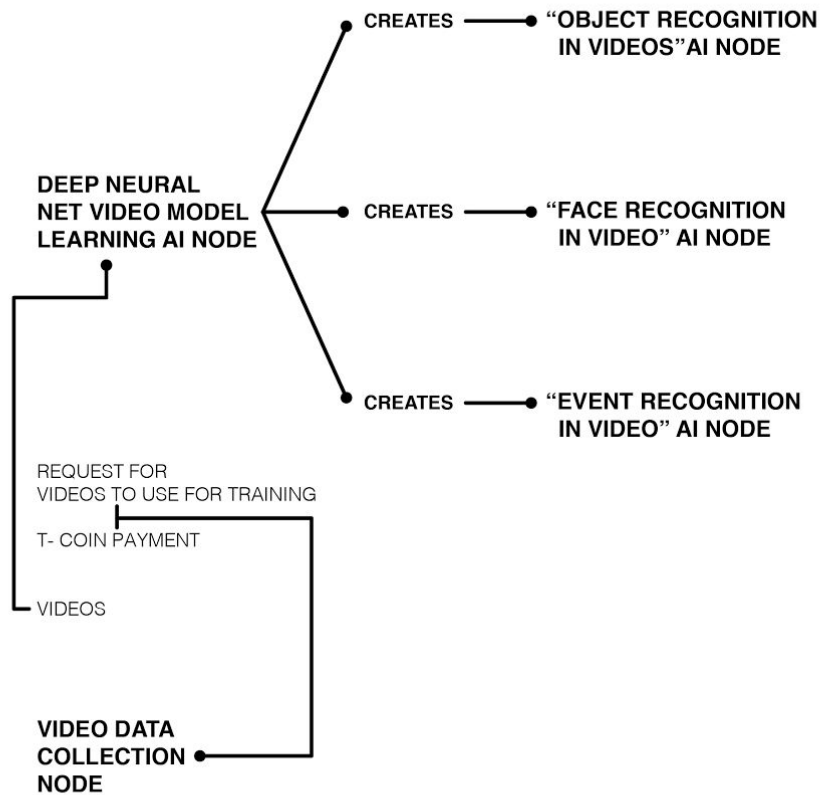
VIDEO DATA COLLECTION NODE

Figure 5. Illustrative Example of the Creation of AI Nodes by other AI Nodes. In this case an AI Node that learns deep learning models for video processing, creates other AI Nodes that apply specific learned models to specific types of data. This kind of separation between model learning and model evaluation is standard in contemporary deep neural net deployments.

Deployment In Robots and Embedded Devices

Many SingularityNet nodes will live "on the cloud" or on powerful computers based in offices or homes; however, a SingularityNet node is not necessarily heavyweight, and it will also be quite viable and valuable to place nodes on embedded devices of various sorts. This leads to various obvious and non-obvious possibilities in the direction of the **"Internet of Things"**.

Embedded devices that partake in the SingularityNet will be able to exchange data and AI services with other embedded devices containing SingularityNet nodes, as well as with SingularityNet nodes in the cloud and elsewhere; and they will be able to carry out financial exchanges associated with these data and AI exchanges using SingularityCoins.

The initial use case for embedded SingularityNet nodes will be the humanoid robots created by Hanson Robotics, a co-founding organization of SingularityCoin. Both the Hanson Robotics human-scale robots such as Sophia, and the more powerful among the Hanson Robotics small-sized robots, will be supplied with on-board SingularityNet nodes.

This will enable the robots to acquire "cognitive services" from cloud-based SingularityNet nodes on a micropayments basis, to receive micropayments from other SingularityNet nodes in exchange for judicious provision of data. It will also enable robots to carry out small economic transactions with each other based on purely local network interactions, in cases where Internet connectivity is an issue.

In order to kick-start the embedded aspect of the SingularityNet, investors in the SingularityCoin ICO -- above a certain minimum investment amount -- will receive a bonus as a reward for their investment: a small-sized humanoid Hanson "Little Singularity" robot, with a SingularityNet node on board.
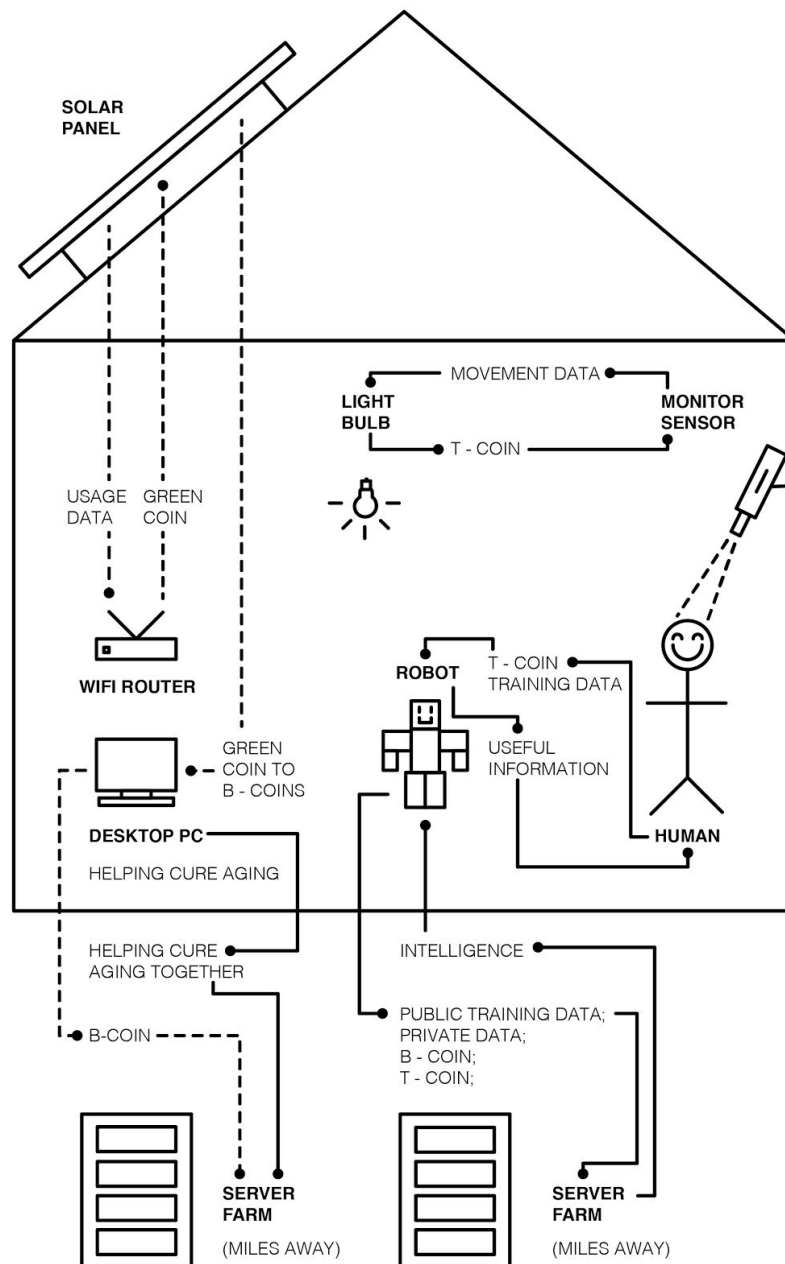
Figure 6: *Embedded Devices as SingularityNet Nodes. An Illustrative Example regarding the deployment of SingularityNet nodes in an Internet of Things context. Different home devices, running SingularityNet nodes, may interact in different ways. A solar panel may receive GreenCoin rewards for its energy generation activity, which may be transformed into Singularity BenefitCoins. Devices with extra processing or memory may receive BenefitCoins for participating in SingularityNet benefit projects. Devices may exchange Singularity T-Coin in return for data or services. Some transactions may occur within the house, and others may involve interaction with the larger external SingularityNet.*

Economic Logic

Economic theorists have extensively discussed the utility of multi-dimensional currencies or multiple, interlinked currencies (see the work of Dirk Helbing for example). Some cryptocurrencies have begun to embody these ideas, e.g. Steem with its STEEM, Steem Power (SP) and Steem Dollar (SMD) and Gnosis.

In order to achieve the short and long terms goals associated with the SingularityNet, we have determined it is beneficial to have 3 different "token states":

- **F-Coins (Foundation Coins):** These represent a "founder's stake" in the SingularityNet; holders are "founders" of the DSOC, which gives special participation rights in the DSOC democratic decision mechanisms.
- **T-Coins (Transactional coins)**: These are used for routine interactions between agents in the Net, includingexternal entities (or internal agents) contracting AI services from other agents
- **B-Coins (Benefit coins)**: These will be given to agents that make contributions assessed by the Net community to be beneficial for sentient beings, now and in the future. They are expendable on projects that increase the utility and power of the network.

We have explored some initial hypotheses regarding the precise mechanisms for transition between the different "states" of currencies, as well as for the generation and value of T-Coins and B-Coins. We are now working on thorough computer simulations to explore these dynamics, and will have specific, well-tested and analysed mechanisms

implemented prior to the token launch. Discussions with the broader blockchain community will also be valuable in reifying these dynamics.

One essential point is that a small percentage of each T-coin transaction will be spent as a transaction fee, to cover operational expenses and SingularityNet development, and the rest to be transformed into B-coins (used to promote general benefit).

Usually, external agents will interface with the DSOC via T-coins, in order to pay for AI services. However, through consensus of the SingularityNet community, other arrangements may also exist.

Figure 6: Interactions Between Membership, Transactional and Benefit SingularityCoins

Mediating Knowledge Pools at Different Levels

In general, nodes in the SingularityNet will contain and produce a combination of private information, information that is sharable within larger groups of nodes, and information that is publicly sharable. SingularityNet smart contracts can be used to mediate the informational interactions between nodes in a way that reflects complex privacy constraints.

For example, an owner of a Hanson robot containing a SingularityNet node may wish to keep most of the data gathered by their robot private, but to share some particular sorts of data gathered by their robot more broadly. They may wish to keep particular facts learned by their robot secret, but to share general learning the robot has done about the patterns of language and the patterns of arrangement of visual and auditory perception – so that their robot's data can help increase the intelligence of the SingularityNet as a whole.

This distinction may be embedded in a smart contract mediating the exchange of information between their robot and another SingularityNet node representing a collective pool of knowledge. This contract may also contain a specification of the payment their robot receives for sharing its general learning with the collective knowledge pool.
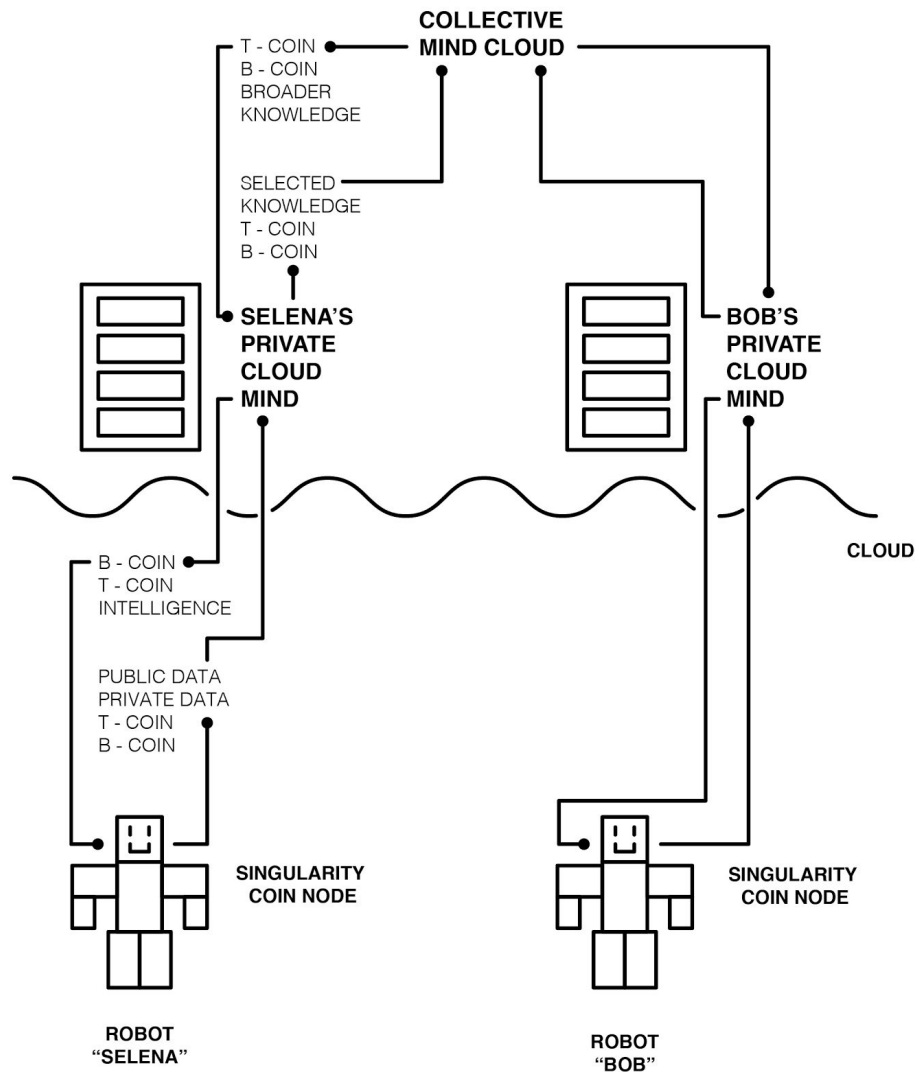
Figure 7: Illustrative Example of Smart Contracts Mediating Interactions Between Knowledge Pools at Different Levels. Robots running SingularityNet nodes may do some processing on-board and some online via AI agents running in the SingularityNet. Some of their AI processing and knowledge is private to each robot, but some can be shared with the collective SingularityNet mind. The AI nodes running the robot minds can receive Singularity T-Coin for the knowledge they share; and can pay with Singularity T-Coin for any knowledge they obtain from the SingularityNet's collective knowledge store. In this sort of application, SingularityCoin is serving as a mechanism enabling smooth and flexible information flow in a distributed cognitive engine.

Governance

Balancing economically asymmetric ownership with broad and meaningful democratic participation, is a challenge for all economic systems. The SingularityNet design confronts this challenge in an innovative way, via a multidimensional voting mechanism, with a separate voting system associated with each of the three currencies. This is very broadly reminiscent of the logic underlying bicameral parliaments and separation of powers among branches of government, in traditional political systems; however, the blockchain-based foundation of the SingularityNet mechanisms allows this sort of mechanism to be designed and tuned in a much more careful way. The governance structure of the SingularityNet will have three aspects, corresponding to the three types of currency:

- F-Coin holders will vote regarding core issues related to the Foundation underlying the SingularityNet. This includes any potential "Post-ICO" coin offerings to be done at a later date, following the ICO;
- Voting regarding specific issues pertaining to the infrastructure and operation of the DSOC will be carried out by nodes who have transacted using T-Coins. The number of votes possessed by a node will be (sublinearly) proportional to the total number of T-Coins they have spent over time, with a linear time-decay used in calculating the contribution of each historical expenditure to the total;
- Expenditure of B-Coins will be done by B-Coin holders contributing their B-Coins "bounty style" to specific benefit projects proposed by SingularityNet participant nodes (via an approval process to be outlined below, whose details are still under refinement and will be fully reified before ICO based on discussions with the blockchain and philanthropic communities).

The specific parameters of the T-Coin and B-Coin voting processes are currently being explored via computer simulations and will be reified before the ICO.

AI for General Good

SingularityNet exists not merely to provide AI services and to lead to the creation of increasingly powerful AI -- but also to provide broad benefit to humans and other sentient beings, and to lead to the creation of increasingly beneficial AI.

This is the explicit purpose of the B-Coin (Benefit Coin) which is a key aspect of the SingularityCoin's economic logic.   For the B-Coin to do its job effectively, however, the SingularityCoin community will need to do a good job of ongoingly refining its value system and choosing specific benefit projects to support.

Formulation and reification of an appropriate value system to guide the ongoing decision process of assessing which projects qualify as "benefit projects," will be an important ongoing task for the SingularityNet leadership and community.   Connecting formalized ethics that can be explicitly supplied to AIs and robots, with the messy everyday ethical decisions that confront human beings, is a challenge that will become increasingly relevant to the SingularityNet as it moves toward Artificial General Intelligence. Between Pre-ICO and ICO, and ongoingly after ICO, SingularityNet will engage a combination of ethical philosophers and AI and robotics technology leaders to create appropriate formalizations of ethical principles and tie these in with practical democratic decision processes regarding B-coin allocation.

The logic of the B-Coin has two aspects: agents 1) accumulate B-Coins for contributing work to projects that are certified as broadly beneficial, and then 2) have the ability to direct their B-Coins toward other projects that are certified as broadly beneficial.   Any agent can propose a "potentially beneficial" project, and if it is successfully certified as beneficial, it can then request other agents put some of their B-coins into the project.

For a project to be certified as beneficial, it must receive a certain number of votes among B-coin holders (where each B-coin holder gets a total number of votes that is proportional to the number of B-coins they hold). This mechanism is designed so that a non-trivial plurality, but not a majority, of B-coin voters must consider a project as beneficial in order for it to be certified as such.

To start the benefit activity of the DAO in an appropriate direction, the SingularityNet will initially partner with several existing charitable organizations, pre-certifying their activities as beneficial from the perspective of B-Coin expenditure:

- Sparks (rewarding and promoting environmentally sound energy usage);
- Humanity+ (advocating ethical uses of transhumanism-oriented technologies);
- SENS Foundation (combating aging and death)
- Foresight Institute (fostering beneficial nanotech R&D, including medical nanorobotics);
- Anyone Can Code (teaching programming, AI and robotics to high school and middle school aged girls and boys in Africa);
- The Global Brain Institute (doing cutting-edge research thinking regarding the question of what beneficial values the SingularityNet should be focusing on).

These are all organizations with which the SingularityCoin co-founders have specific experience; and, most importantly, they are not arbitrary charities, but rather they are initiatives specifically seeking broad benefit via positive development of advanced, Singularity-oriented technologies. This is a way to achieve an uncommon amount of leverage in providing broad benefit to human beings now and in the future.

Technical roadmap

The following technical roadmap describes the key milestones to be achieved en route to the full development of the SingularityNet.

Infrastructure Modules

Milestones -> Modules	ICO (Nov 2017)	V1 (Aug 2018)	V2 (Dec 2018)
API for AI-Agent Interaction	Simple API covering initial AI agent functions	Full API for Request/ Fulfillment of AI Tasks	API for Automated Agent Creation
Economic- Logic Smart Contracts	Designed and implemented		
Offer-Network Smart Contracts		Designed and implemented	
Offer Network Matchmaking Agents		Designed and implemented	Integrated with OpenCog for more intelligent matching
Scripts Mapping SingularityCoin Smart Contracts into GRAVITY		Designed and implemented	
Democratic Governance Smart Contracts	Designed and implemented	Extended to enable advanced liquid democracy features	

Milestones -> Modules	ICO (Nov 2017)	V1 (Aug 2018)	V2 (Dec 2018)
Distributed Persistence Solution		Designed with test implementation	Full implementation
Deployment of GRAVITY on selected server farm	Test implementation created	Full implementation	
Integration with third party tools for use of distributed @Home processing capability		Designed with test implementation	Full implementation
Node running on Raspberry Pi 3	Design	Full implementation	
Node running on Hanson "Little Singularity" Robot	Design	Full implementation	
Node running server-based portion of robot mind	Design	Full implementation	
Smart Contracts for knowledge mediation between embedded and server-based AI nodes		Initial, simple implementation	Full implementation
Node running "collective mind" for sharing between multiple agents		Design, test implementation	Full implementation
Smart Contracts for knowledge mediation between individual and collective AI nodes		Design, test implementation	Full implementation

Initial AI nodes

Milestones -> Modules	ICO (Nov 2017)	V1 (Aug 2018)	V2 (Dec 2018)
OpenCog-based Natural Language Understanding Node		Full version	
OpenCog-based Time Series Prediction Node	Simple version	Full version	
Tensorflow-based Image Labeling Node	Simple version	Full version	
Tensorflow-based Facial Emotion Recognition Node	Simple version	Full version	
OpenCog supervised text classification Node		Full version	
OpenCog Node for supervised classification of structured data		Full version	

Initial Benefit Nodes

Milestones -> Modules	ICO (Nov 2017)	V1 (Aug 2018)	V2 (Dec 2018)
"Benefit" AI Node applying OpenCog to analyze longevity genomics data, publicly post results	Initial version	Full version	
"Benefit" AI Node applying Tensorflow to identify diseases in pictures of leaves from agricultural plants		Initial version	Full version
"Benefit" AI Node wrapping CLASP framework for nanotech stimulation		Initial version	Full version

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