

# Flock.io



## Federated Machine Learning On the Blockchain

Litepaper v1.1

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*“Flock.io is more than a platform—it’s a call to action. We are revolutionising AI by putting control back into the hands of individuals. Join us to break down barriers, democratise innovation, and shape a future where AI serves all of humanity. Together, we can make this vision a reality.”*

— Flock.io Founding Team

# **SOLVING THE AI CENTRALISATION PROBLEM**

The rapid pace of artificial intelligence (AI) development has highlighted significant challenges in its creation and deployment, primarily due to the centralised control maintained by a few large corporations. Such a centralised approach exacerbates biases within AI models due to a lack of effective governance and oversight, limiting transparency into models' inner workings and the overall AI development pipeline.

Furthermore, this centralisation not only diminishes public engagement but also raises serious data protection concerns and issues of data monopolisation. The resulting monopolistic control over data and model outputs also poses a threat to innovation and equitable data usage, as users unknowingly contribute to data sets that only serve the interests of these corporations.

Against this backdrop, FLock aims to revolutionise model training and fine-tuning through decentralisation and community governance, promoting value alignment for AI development. Our mission is to ensure that AI objectives align with public ethics and societal goals, empower communities in decision-making processes, and prioritise the practical usefulness of AI solutions.

By dismantling barriers to participation, FLock enables developers to contribute models, data, or compute resources in a modular fashion. This approach fosters the creation of diverse, purpose-built models developed and maintained by and for communities, under their guidance and stewardship.

Our blockchain-based platform incentivizes users to democratically and permissionlessly participate in the entire AI development process, from training to fine-tuning to inferencing. It eliminates the need for user data collection and promotes the equitable, transparent distribution of rewards and inclusive governance.

## **DEMOCRATISE AI**

Flock's mission is to democratise AI through decentralised, blockchain-based systems. Specifically, Flock facilitates an open and collaborative environment where participants can contribute models, data, and computing resources, in exchange for on-chain rewards based on their traceable contributions.

In doing so, Flock:

**ENHANCES TRANSPARENCY AND PARTICIPATION**

**INTRODUCES ROBUST INCENTIVE MECHANISMS TO ENSURE FAIR CONTRIBUTIONS**

**ENABLES DIVERSE COMMUNITIES TO DEVELOP PURPOSE-BUILT AI MODELS**

Ultimately, together with unyielding commitment from the community and ecosystem, Flock is embarking on a journey to revolutionise the landscape of AI development and deployment.

## TRAINING

In the context of machine learning (ML), "training" refers to the process of teaching a ML model to make predictions or decisions based on data. The accuracy of a model is measured by the loss function, which assesses the discrepancy between the predicted and actual labels of the data. Training involves adjusting the model's internal parameters to minimise the loss function.

## VALIDATION

Validation in the context of ML is a critical process used to evaluate the performance of a model on new data during the training phase. It serves as a check to prevent overfitting, ensure the model's generalizability, and help fine-tune model parameters. The primary purpose of validation is to provide an unbiased evaluation of a model's performance during training. It helps to ensure that the model is not just memorising the training data but is also able to perform well on unseen data.

## STAKING, SLASHING AND REWARDS

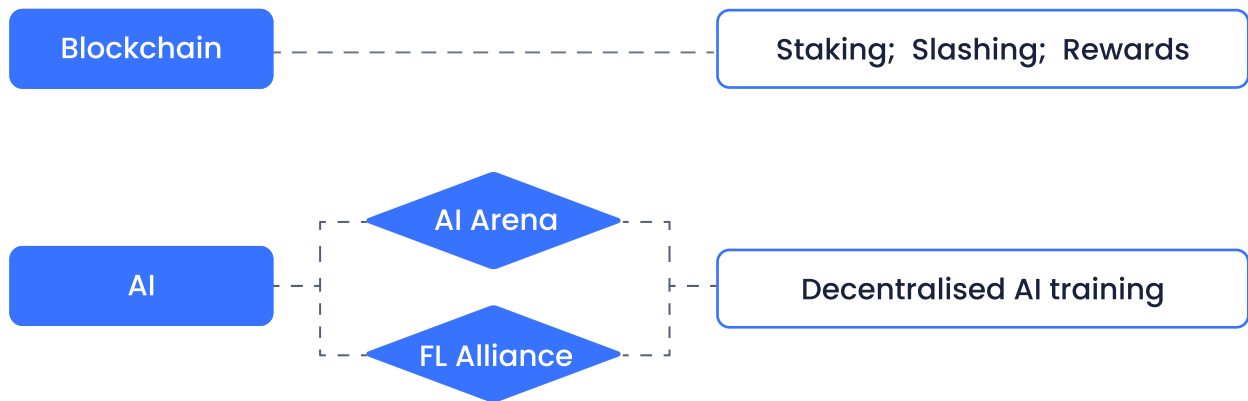
Tokenomics serves as the cornerstone of the security and sustainability of the Flock ecosystem. To participate in Flock, one first needs to stake a sufficient amount of tokens, ensuring that the user is incentivized to behave honestly in the system. In the event of abusive or dishonest behaviour, the user's staked tokens will be slashed as a punishment. Users' active participation in the system is further enhanced through various dynamic reward mechanisms. \$FLOCK, Flock's native token, helps orchestrate all staking, slashing and rewards distribution, executed on smart contracts, which would ensure transparency and fairness.

## DELEGATION\*

Flock allows participants to be supported by delegators through \$FLOCK token delegation -- delegators delegate \$FLOCK to participants; in return, delegators take a share of the rewards earned by participants. Consequently, it creates a dynamic and competitive environment where participants are incentivized to not only perform optimally but also establish and maintain appealing conditions in order to attract current and prospective delegators.

\*The delegation feature may not be accessible in some countries due to local laws and regulations.

# FLOCK: WHEN AI MEETS BLOCKCHAIN



## AI LAYER

### AI Arena

Flock’s AI layer supports a conventional ML model training paradigm, optimising models directly on users’ devices with their own data. By leveraging the power of the broader community to maximise the generalisation ability and performance of the final trained models, this layer is designed to encourage community members to contribute various public or local data for training purposes. By doing so, contributors are continually engaged and rewarded based on the quantifiable impact of their data on improving the model’s performance.

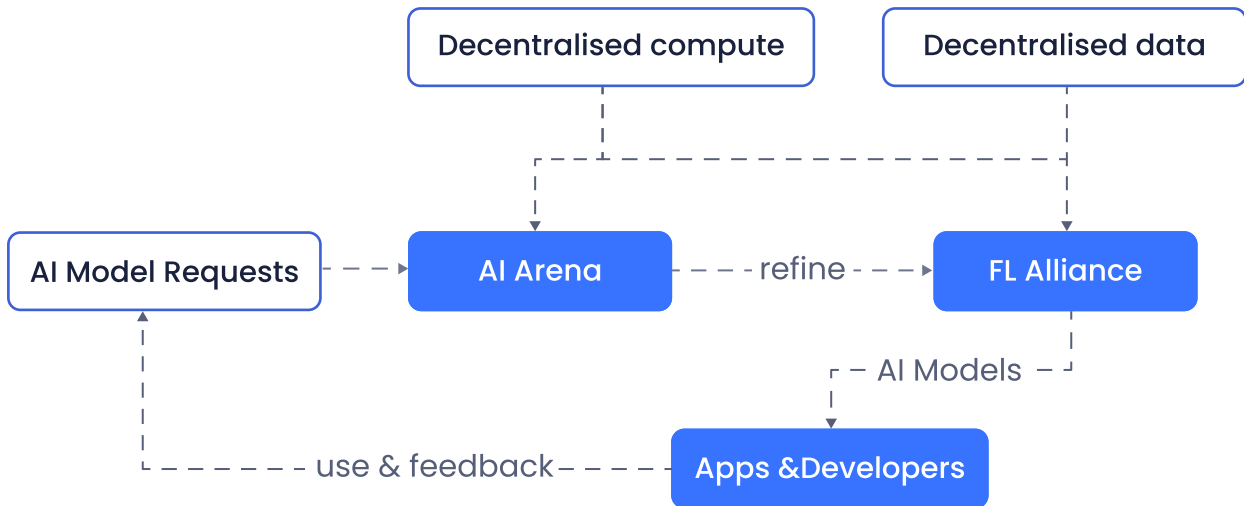
### FL Alliance

Utilising the federated learning (FL) approach, Flock’s AI layer also enables thousands of participants to collaboratively train a global model, where data sovereignty is preserved by ensuring that no local data are transmitted at any stage of the training process. Specifically, within the AI layer, a model aggregation component allows participants to upload weights from models trained on their unique local data. These weights are then aggregated to build an optimal global model, enhancing its generalisation capabilities and performance.

Additionally, the integration of training task automation and deployment orchestration components simplifies the process for users to join tasks, enabling them to contribute valuable knowledge extracted from their data to the task.

## AI Arena & FL Alliance Joining Hands

The AI Arena is primarily targeted at participants from the Web2 AI community, who possess the necessary computational resources to train and validate models using publicly available datasets. These trained models can be further refined through FL Alliance, which draws in participants capable of contributing their own unique data to enhance the model’s performance.



## BLOCKCHAIN LAYER

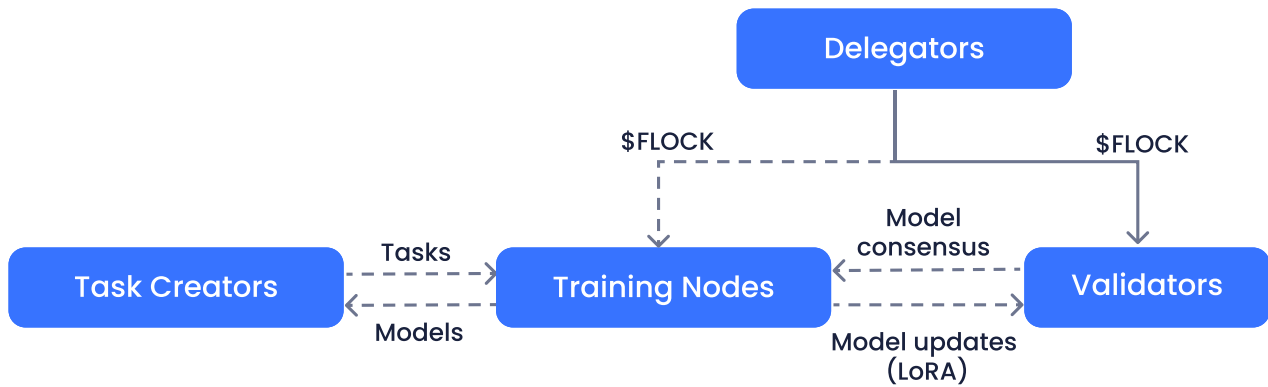
### Security

Flock employs a proof-of-stake mechanism with the goal of ensuring robust security and consensus within the network. By selecting validators based on the number of tokens they hold and are willing to stake, Flock effectively prevents Sybil attacks, as acquiring a significant influence requires substantial economic investment. Additionally, this system enhances Byzantine fault tolerance by aligning validators’ incentives with network integrity—validators who act dishonestly or fail to reach consensus risk losing their staked tokens. This economic disincentive promotes honest behaviour, ensuring the network remains secure and reliable.

### Incentives

In addition, the blockchain layer plays a pivotal role in reward distribution. It ensures that participants can securely lock in their stakes, fostering an environment of trust and transparency. The process is designed to incentivize participation by allocating rewards based on contributions, thus encouraging a more engaged and active community. Through the use of smart contracts, the system automates the rewards process, making it both efficient and fair. This automation not only reduces the potential for human error but also ensures that rewards are distributed in a timely and fair manner.

A malicious participant is subjected to slashing. This blockchain-enabled mechanism not only protects the system from immediate threats by disincentivising dishonest behaviour, but also reinforces a culture of trust and cooperation among participants.



## TASK CREATORS

Task creation is the first stage of Flock’s decentralised AI training cycle. Creators define the desired models and submit tasks to the platform. Anyone who is willing to stake a sufficient amount of tokens is eligible to participate as a task creator. Thus, the system is by design democratic, making it accessible to a broad range of stakeholders. This fosters a sense of ownership and active involvement amongst the Flock community.

## TRAINING NODES

Training nodes are responsible for training and fine-tuning the AI tasks initiated by the task creators. To become a training node, a user has to pay a registration fee and stake \$FLOCK. This mechanism ensures the integrity and health of the ecosystem, as nodes have vested interests via staking. In return, the nodes will be rewarded in proportion to their contributions.

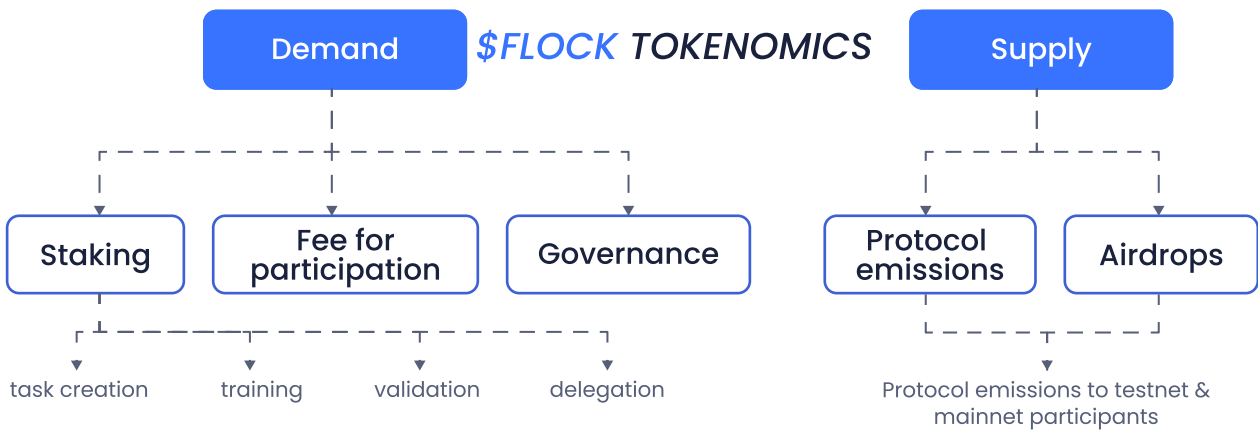
## VALIDATORS

Validators are responsible for evaluating the work submitted by the nodes. Like the nodes, validators have to stake before the evaluation tasks, and can be rewarded upon task completion. This is essential to maintaining the quality and reliability of the Flock network.

## DELEGATORS

Delegators contribute to the Flock ecosystem by supporting other participants’ staking process. To do so, delegators delegate \$FLOCK to all participants - task creators, training nodes, and validators. In return, delegators get a percentage of the total staking rewards proportionate to the amount of delegated stake. Delegators may also receive model tokens from the hosts, if applicable, for supporting the model's growth.





## TOKEN EMISSION

- \$FLOCK is Flock’s native token, which has a fixed amount of total token supply of 1,000,000,000 \$FLOCK. The daily emission of \$FLOCK tokens will decay per month.
- \$FLOCK tokens will be released as rewards to incentivise participants in creating, training, validating, and delegating tasks.
- \$FLOCK tokens are distributed across various training tasks, and the allocation is based on the cumulative staking amount contributed by participants for each task. This method ensures that rewards are proportionately shared, reflecting the level of stakeholder engagement and investment in each task.

## TOKEN DEMAND

- **Task Creator Staking**  
Users must first stake \$FLOCK in order to create a task in the Flock system.
- **Training Nodes Staking**  
Training nodes are required to stake \$FLOCK tokens to participate in the task training process.
- **Validator Staking**  
Validators must stake \$FLOCK tokens to participate in the task validation process, ensuring they have a vested interest in maintaining the integrity and success of the ecosystem’s operations.
- **Delegator Staking**  
Delegators can earn a portion of the rewards their delegated participants achieve, under a competitive environment where participants are incentivized to offer favourable conditions to attract delegators.
- **User Payment**  
Users engage directly in the ecosystem’s economy by spending \$FLOCK tokens to access models hosted on Flock.
- **Governance Participation**  
Holding \$FLOCK tokens grants Flock participants the power to influence the network’s future through participation in the DAO governance.

Flock token holders are empowered to actively engage in the system's governance through a Decentralised Autonomous Organization (DAO), a pivotal mechanism that democratizes decision-making process. This participatory model allows token holders to propose, debate and vote on various aspects of the ecosystem's development and management, ranging from technical updates and protocol modifications to treasury management and community initiatives.

By tying voting rights to token ownership, Flock aligns the interests of the voters with the long-term success and growth of the platform, as token holders are incentivized to make decisions that benefit the overall ecosystem. For instance, important parameters which govern how rewards are currently calculated can be adjusted based on the DAO's proposals. This ensures fair and democratic participation in Flock's governance which is important for the ecosystem's long-term sustainability moving forward.

Furthermore, our \$FLOCK community holders may periodically assess lists of top and trending models to adjust their future incentives. This allows for rewarding prominent model contributors while preventing issues with self-dealing and Sybil attacks.

The voting process in the Flock ecosystem is designed to be transparent, fair, and resistant to manipulation. To submit a proposal for voting, a proposer must first stake a specific number of tokens. This staking requirement acts as a barrier to frivolous or potentially scam proposals, as the proposer risks losing their staked tokens if the community deems the proposal to be invalid or malicious.

Once a proposal is submitted and the staking requirement is met, the community of token holders has the opportunity to review the proposal and flag it as a scam or frivolous if necessary. If the proposal passes this initial scrutiny, it moves to the voting stage.

For the voting process to commence, a minimum quorum of token holders must participate. This quorum requirement ensures that a significant portion of the community is involved in the decision-making process, preventing a small group from dominating the outcome. If the quorum is met and the proposal is not flagged as a scam or frivolous, a general meeting is called, and all token holders can cast their votes.

Flock's platform offers proposal rewards to incentivize users to submit high-quality, valuable proposals that contribute to the growth and development of the ecosystem.

By offering proposal rewards, Flock encourages users to actively contribute ideas and solutions that benefit the platform. This approach helps to ensure that the governance process remains focused on the long-term success and sustainability of the ecosystem.

*NOTE: The Flock team is carefully considering the specifics of DAO design, governance mechanisms, legal structure, and on-chain tooling to support DAO operations. The information above describes our initial high level vision for the DAO. It is subject to change and we will share more detailed information for Flock's implementation as we approach its launch date.*

AI Arena

FL Alliance

AI Marketplace

Flock Scripts

## AI ARENA

AI Arena is Flock's decentralised AI training platform. Through [train.flock.io](https://train.flock.io), the AI Arena gateway, users can stake \$FLOCK, Flock.io's testnet token deployed on Sepolia Base, in order to participate and earn staking rewards.

### There are four ways to participate

- **Task Creators**

Define desired models and submit tasks to the platform

- **Training Nodes**

Develop or finetune models required by task creators

- **Validators**

Evaluate the models submitted by training nodes

- **Delegators**

Delegate tokens to validators, increasing reward distribution

## FLOCK ALLIANCE

After AI Arena has optimised the model parameters, they are further refined in FL Alliance with proprietary data. By using an on-chain verifiable random function (VRF), FL nodes are randomly allocated the roles of proposers and voters with the goal of avoiding collusion and other malicious behaviours.

Developers join as FL nodes to collaboratively train a global model while using their local data and compute. They are randomly allocated the following roles:

- **Proposers**

Download the latest global model parameters, train on local data and submit the updated model

- **Voters**

Run the model with aggregated parameters and with local data, and submit scores. The scores are aggregated to a consensus which is used to reward/ slash the model proposers.

# AI MARKETPLACE

The AI Co-Creation Platform is a one-stop store for all models created on Flock's AI Arena and FL Alliance. Users can also contribute or give feedback to the datasets made available on the platform. Flock's library ranges from intelligent agents to sophisticated trading and confluence bots. One use case is BTC-GPT, which has so far reached 10k model calls.

At the core of this ecosystem lies a sophisticated chatbot, driven by state-of-the-art LLMs. The chatbot is not only empowered by the computational prowess of LLMs but is also equipped with advanced search and retrieval functionalities. This enables it to extract and leverage information from a dynamically evolving database—a repository enriched by the continuous contributions of Data Contributors. This dual capability ensures that the chatbot remains both intelligent and informed, able to deliver nuanced and contextually relevant responses.

# FLOCK SCRIPTS

Flock has developed several automated scripts so that developers can directly run in the background, no machine learning experience required. There are two scripts for participating in the AI Arena and one for FL Alliance:

- **AI Arena Training Script**

After staking on a task, this script allows you to join as a training node, automatically download the required dataset, fine-tune base models on the dataset, and submit your trained model.

- **AI Arena Validation Script**

After staking on a task, the script monitors model submissions and run model inferences to score the submissions. The more you stake, the more models you'd be able to submit

- **FL Alliance Script**

This script enables you to participate in our FL Alliance - you are randomly assigned either as a proposer to train a model, or a voter to evaluate aggregated model parameters proposed by the proposer. Based on your performance, you are rewarded/ slashed after each round of training

## ON-CHAIN SMART AGENT

Flock is forming a strategic collaboration with a pioneer in a peer-to-peer network of open-source Smart Agents, with the goal to advance Decentralised AI Capabilities in Web3. Specifically, Flock is working to optimise our partner's workflow automation for data generation and Smart Agent models, to power its local function calls, opening up crypto trading to everyone. This partnership addresses the current limitations of open-source LLMs, providing an intuitive interface, chatbox, API for developers, cloud solution, and data management for users.

The initiative targets a reduced reliance on external function calls to OpenAI, and Flock plans to make its incentivized community fine-tuning platform available through the client interface, broadening its impact. We are actively developing additional Smart Agents to aid in trading strategies and empower users in token bridging and querying token prices using natural language. Flock has already fine-tuned a model on Mistral 7B based on the CrewAI framework, which can power a multi-agent on-chain assistant, facilitating fund transfers and token swaps.

## DEAI X DEPIN

Flock is proud to partner with a global leader in decentralised compute platforms. This collaboration bolsters Flock's access to permissionless, decentralised compute, powering AI training and fine-tuning on our decentralised training platform. Flock users on its decentralised training platform earn rewards by staking tokens to help train and fine-tune models, participating as training nodes, validators, or delegators.

Through this collaboration, Flock is expanding its users' access to permissionless compute resources, enabling the Flock community to access computational resources at competitive prices. Users can now rent GPUs and run the lightweight Flock validator script as one of the natively hosted templates.

On the other hand, miners can be onboarded to become Flock.io validators with little friction. Flock.io validators evaluate models submitted by the training nodes, providing validation scores and ensuring fair task distribution. Users can easily run the Flock.io validation script, which only requires CPU as hardware requirement.

# BLOCKCHAIN-ENABLED FL IN HEALTHCARE

Beyond our work in the Web3 ecosystem, Flock is equally relevant in the Web2 world, and our flagship collaboration with a leading British hospital affiliated with a Top UK university is an excellent testimony to this. One of the biggest challenges of building AI models in the healthcare sector is data sharing. Since healthcare data is private, sensitive, and heterogeneous, collecting sufficient data for modelling is exhausted, costly, and sometimes impossible.

Flock's groundbreaking approach in leveraging blockchain-enabled FL has proven to be effective in preserving data privacy while significantly improving prediction accuracy compared to traditional methods. This approach facilitates global collaboration, allowing healthcare institutions to contribute to model training without sharing sensitive healthcare data directly. Our work has been tested in blood glucose prediction as a pilot but can be readily extended to model other chronic diseases or address broader healthcare challenges.

And more...

## Q2 2023

- Testnet built
- Feature launched: LLM Finetuning

## Q3 2023

- LLM finetuning engineering optimisation
- FLock incubated use cases
- Hackathons
- ZKP research completion

## Q4 2023

- Feature launch: LLMs interactions
- Online competitions/tournaments for LLMs
- Hackathons (more technical) and hacker house
- Partnerships with ML projects

## Q1 2024

- Community grants for new feature support
- Ongoing dev relations

## Q2 2024

- AI Arena closed beta and open beta
- Model merging Models used for AI companions, web3 search, cryptotransactions automation

## Q3 2024 - Feature complete

- Open beta for AI Arena
- Closed and open beta for FL Alliance
- Closed beta for decentralised task creation

## Q4 2024 - Scaling participation

- Ecosystem outreach and support for task creation
- Scale number of participants and model calls

## Q1 2025 - Edge network

- Decentralised inference on edge devices
- Decentralised training and FL on edge devices



# JOIN AS **FLOCKIE** AND START BUILDING

## To learn more about Flock

- <https://www.flock.io>
- <https://docs.flock.io>

## To start building with Flock

- <https://train.flock.io>
- <https://models.flock.io/>

## To stay connected

