Blockchain based Federated Learning Platform/ Model Trading Marketplace

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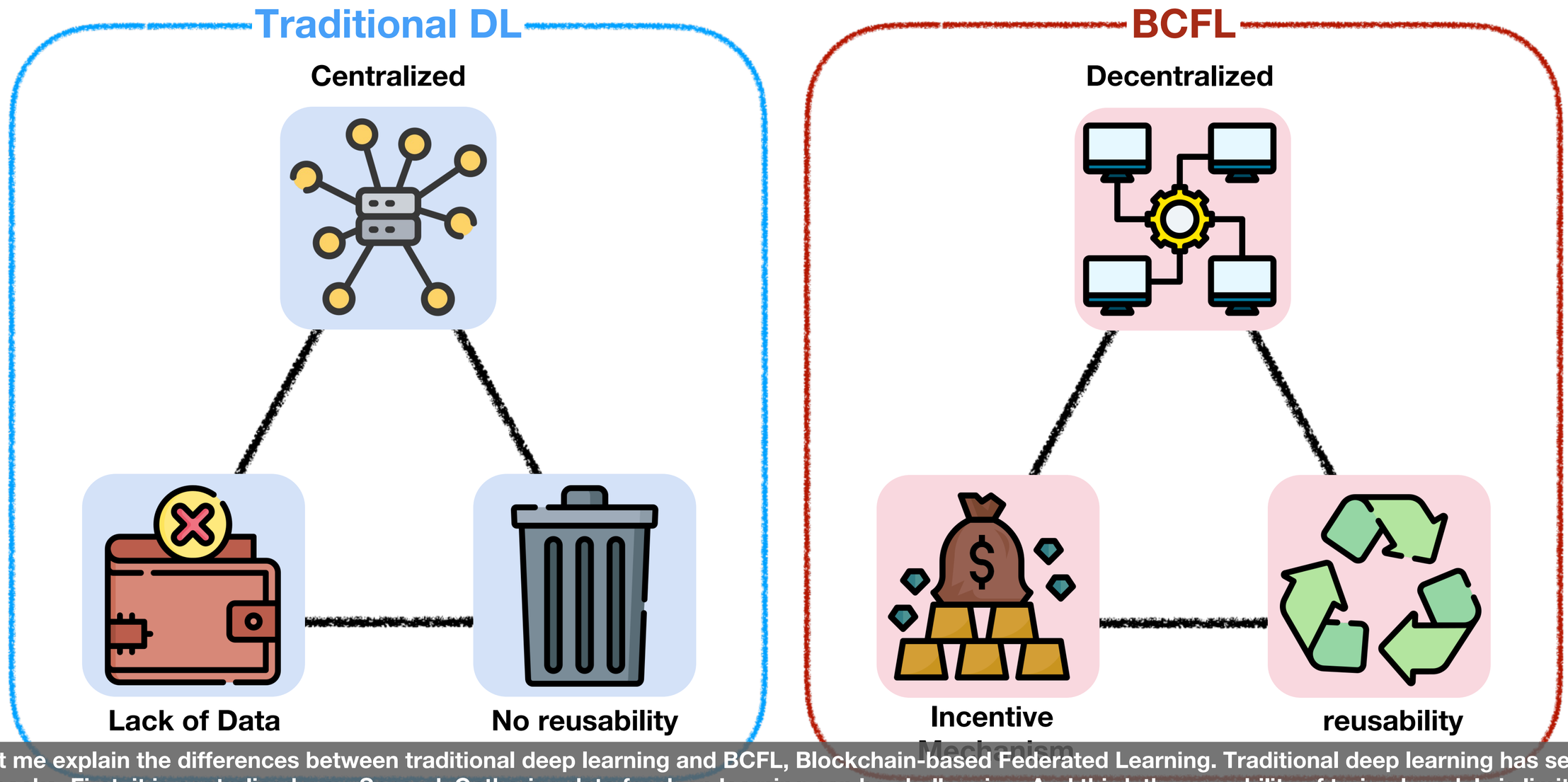
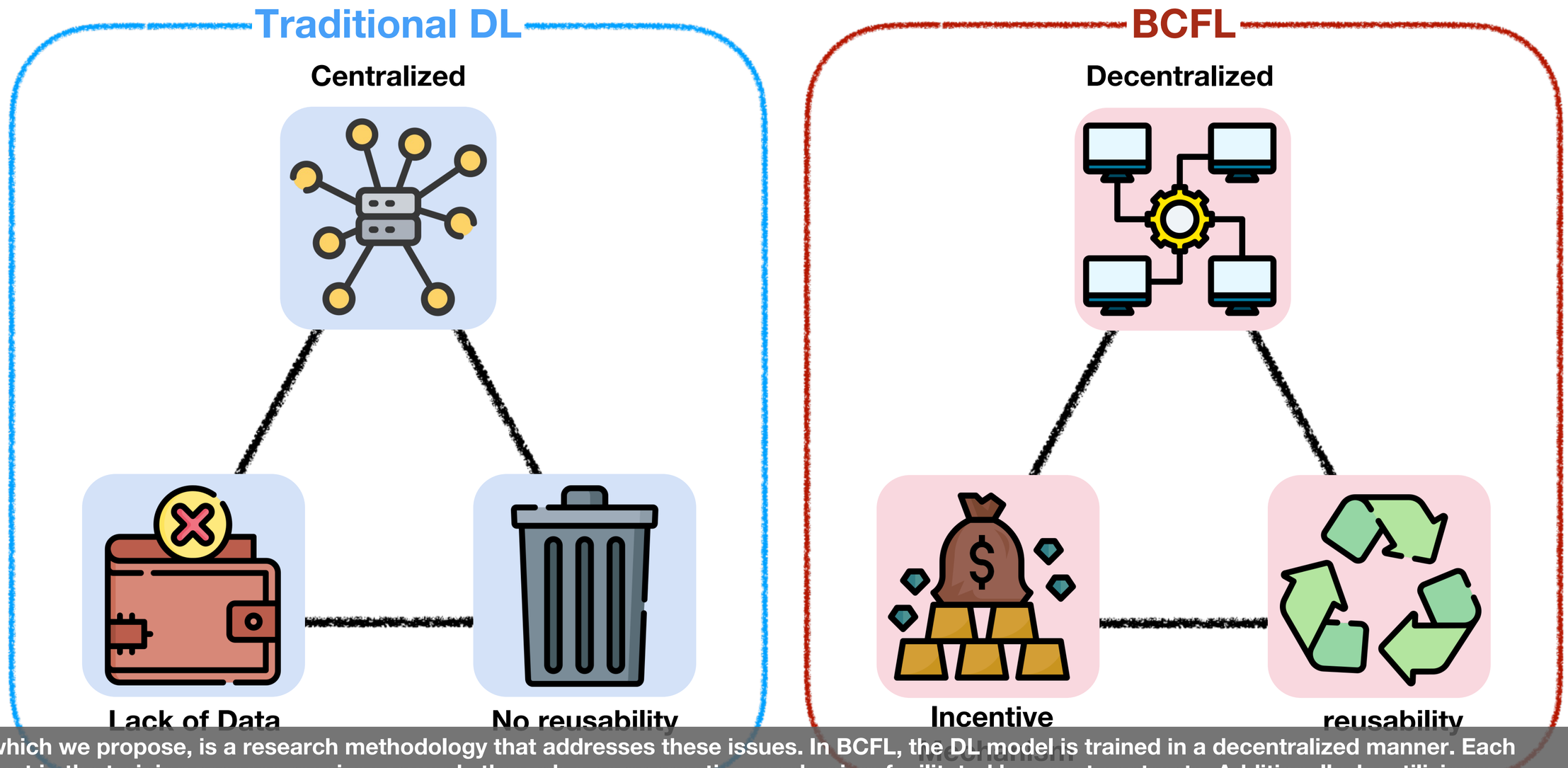
Tradition DL vs BCFL



First, let me explain the differences between traditional deep learning and BCFL, Blockchain-based Federated Learning. Traditional deep learning has several drawbacks. First, it is centralized way. Second, Gathering data for deep learning can be challenging. And third, the reusability of trained models is limited.

Tradition DL vs BCFL

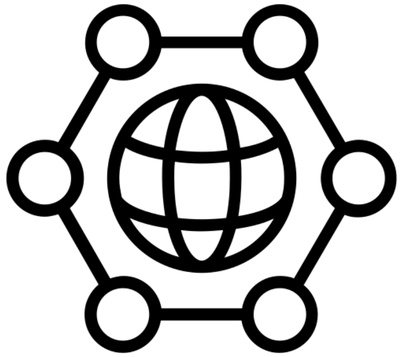


BCFL, which we propose, is a research methodology that addresses these issues. In BCFL, the DL model is trained in a decentralized manner. Each participant in the training process receives rewards through a compensation mechanism facilitated by smart contracts. Additionally, by utilizing a marketplace for DL models, Trained models can be bought and sold, thus ensuring reusability.

Benefits of BCFL

Rapid growth of the data market

The Potential of DL & BC Convergence

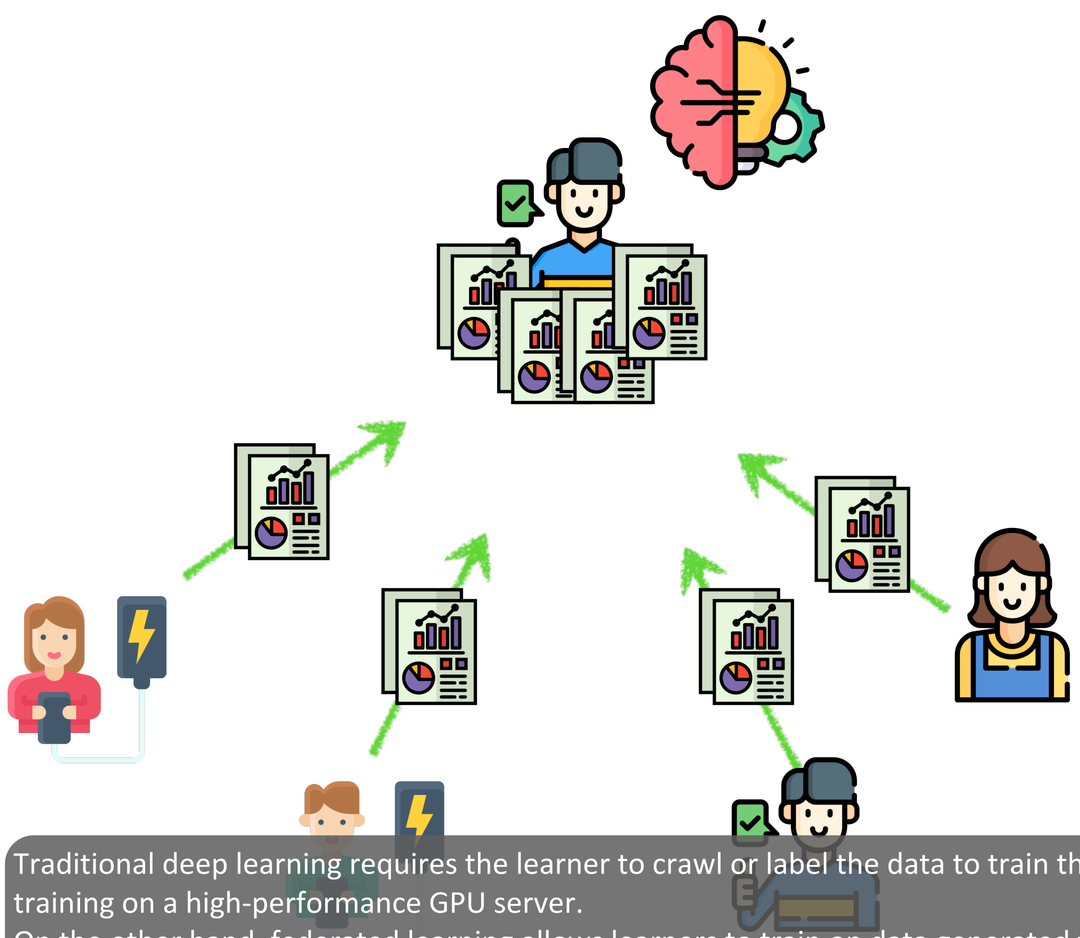


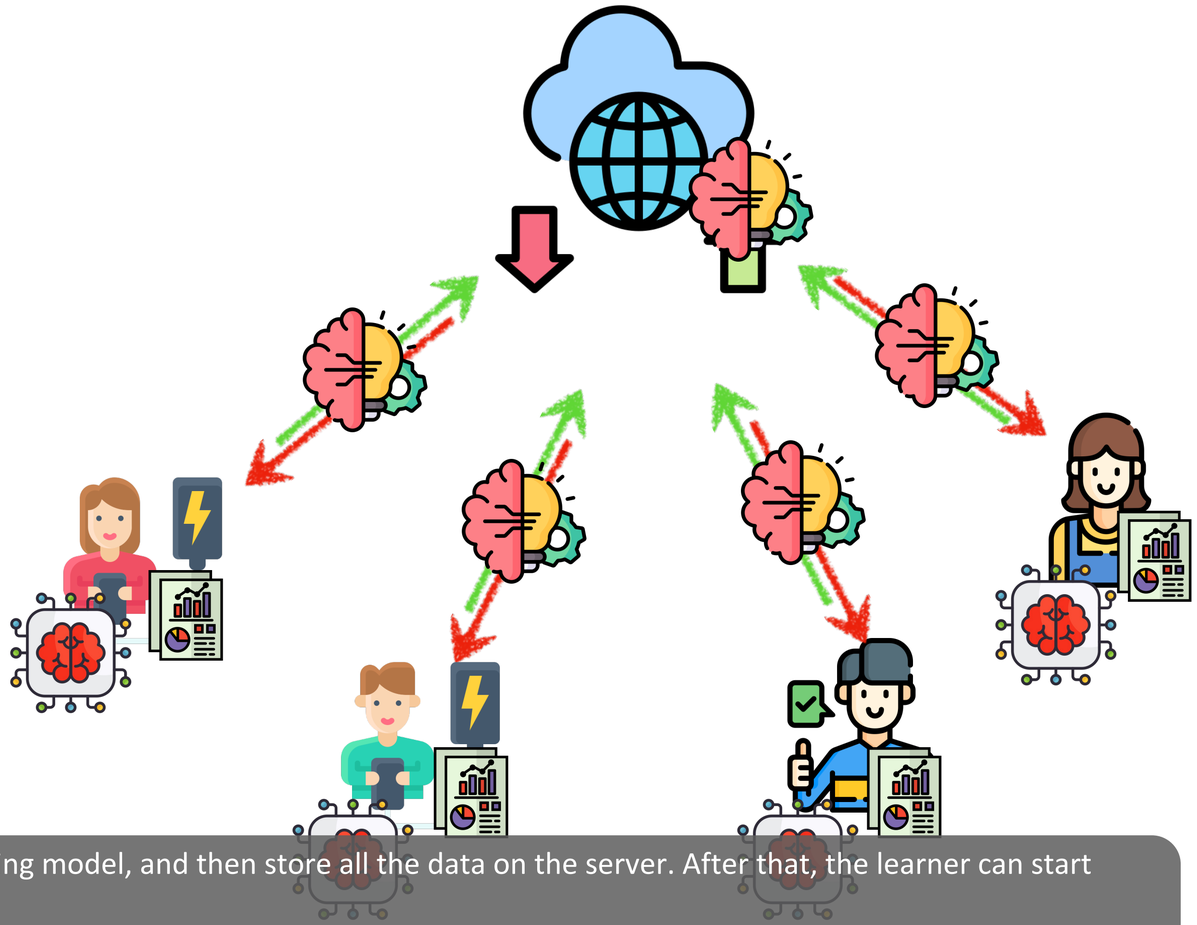
Provide Learning to selling E2E solution

Business model design using FL model sales revenue

First, BCFL has high utility in the rapidly growing field of data markets.
Second, it holds significant academic value as a technological example of the integration between deep learning and blockchain.
Third, our proposed BCFL platform is a highly-utilized blockchain solution that encompasses end-to-end processes from training to selling.
Lastly, BCFL's business model holds economic potential due to its ability to generate revenue in the DL model market, which represents a new value proposition.

Traditional DL vs Federated DL



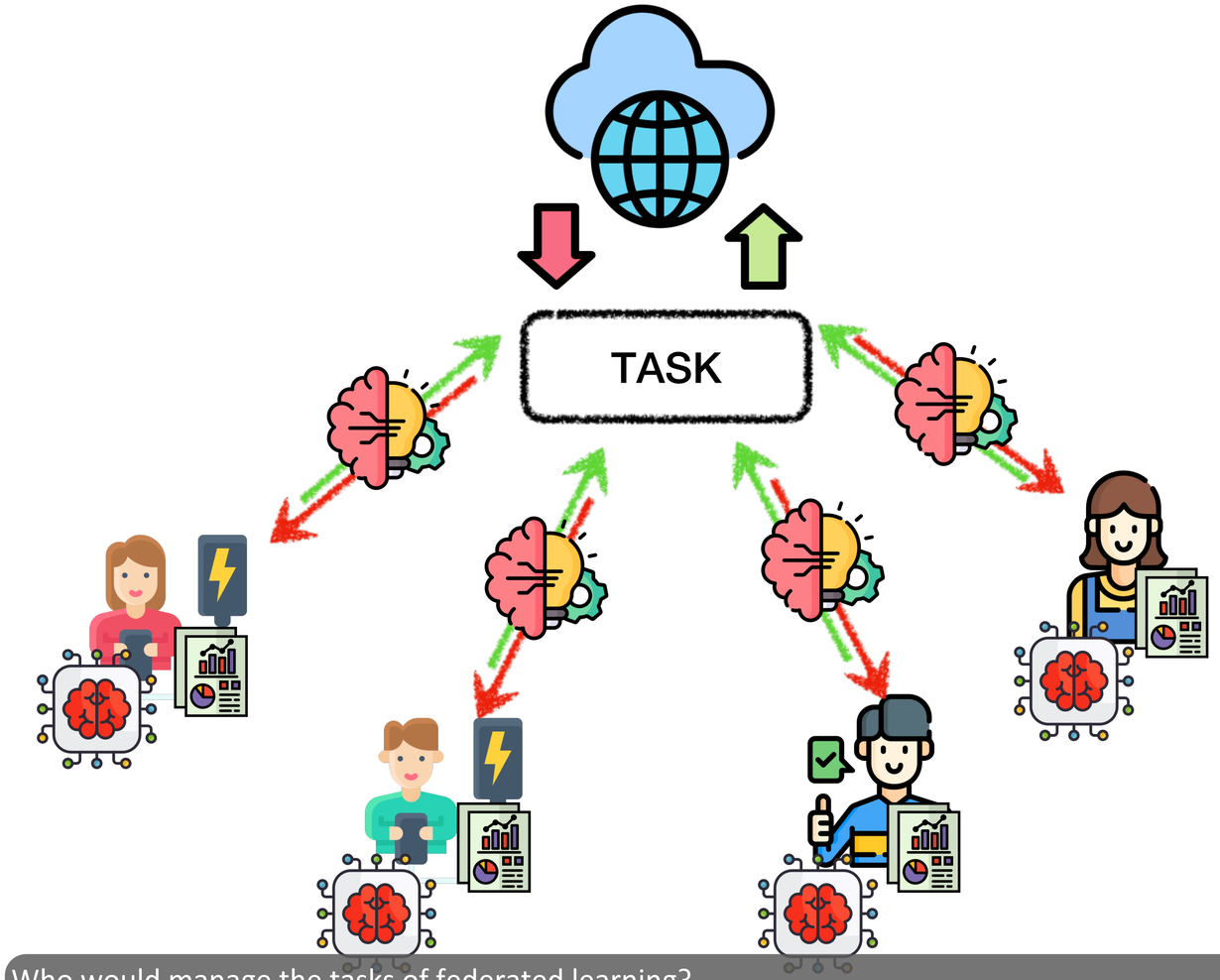


Traditional deep learning requires the learner to crawl or label the data to train the deep learning model, and then store all the data on the server. After that, the learner can start training on a high-performance GPU server.
On the other hand, federated learning allows learners to train on data generated from smart devices such as personal computers, tablets, etc., and then send the trained models to the server. The server does not have the data, but simply aggregates the trained models.

Send data to Server. And train with high-end GPU server.

Send trained model to server. Just use own device.

(Who/How) Federated Learning



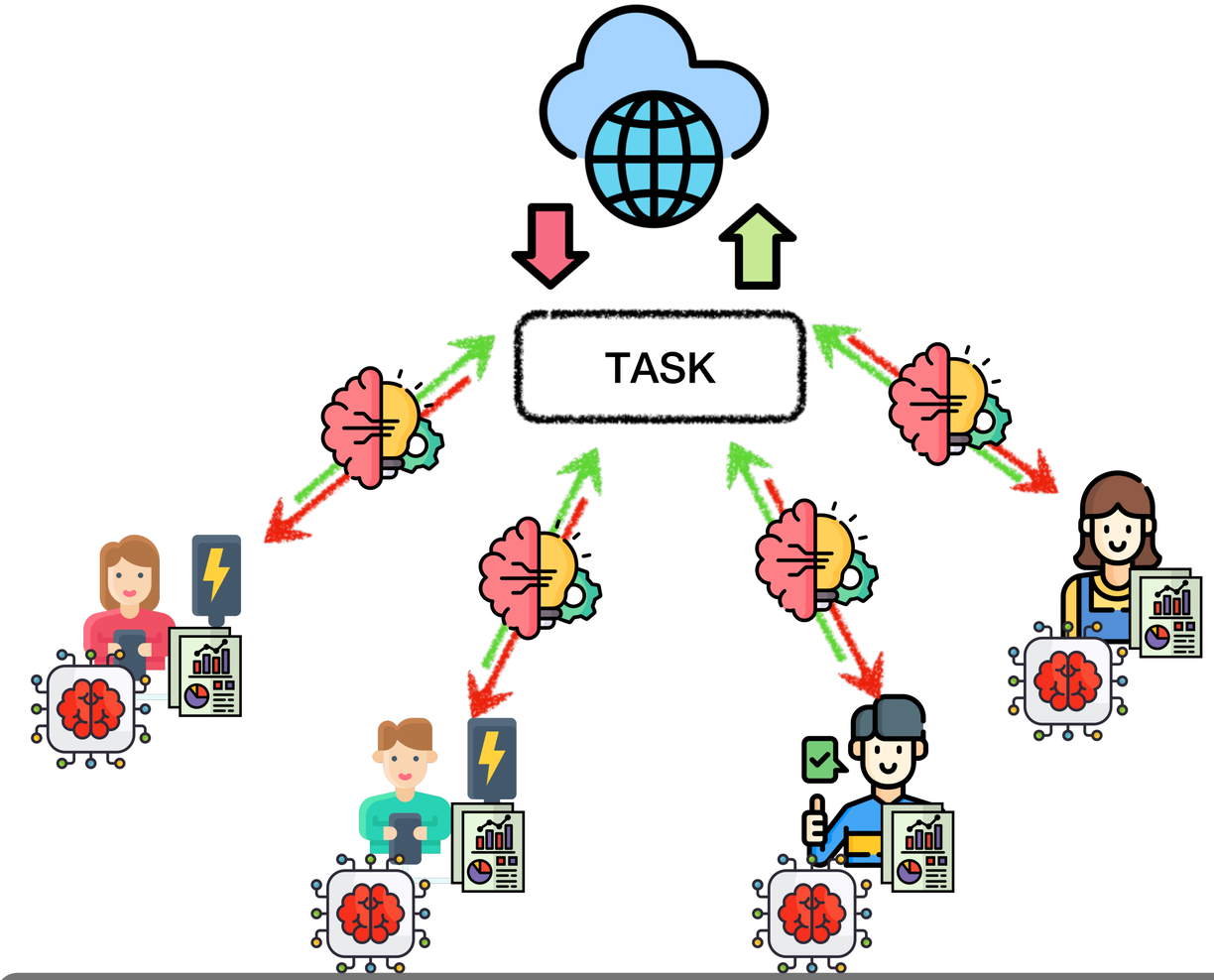
Who manage FL task?

Why should people participate?

Is this system safe from malicious participants?

Who would manage the tasks of federated learning?
Why should people participate in the learning?
Finally, is the system safe from participants who provide malicious data?

(Block Chain based) FL



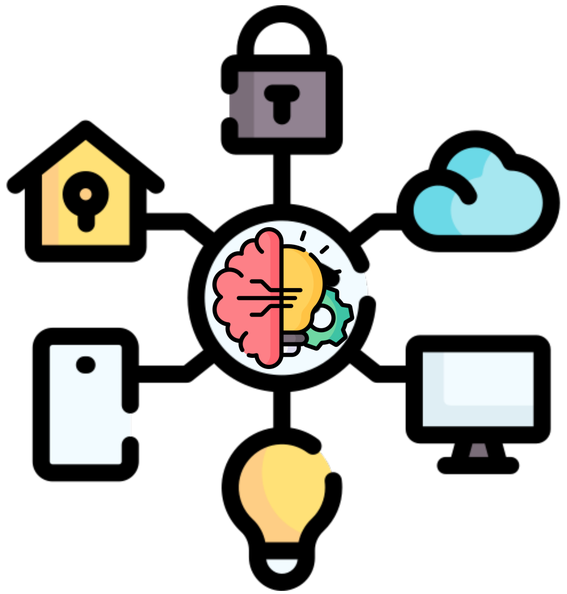
Who manage FL task?
-> Mange Task using Smart Contract

Why should people participate?
-> They will get rewards

Is this system safe from malicious participants?
->Yes, It is. Evaluate algorithm will give penalty

Blockchain can solve all of these problems. The task can be managed by smart contracts that control the learning. Participants can receive rewards based on their contribution to the learning. Is this system safe from malicious participants? Malicious participants will be penalized according to our platform's evaluation mechanism. They will be blacklisted and will not be allowed to participate in future learning.

BCFL on zkEVM



Massive device(10^{10}) participate in Federated Learning

Massive number of transaction (more than 10^{10}) occur in the learning process

Our bcfl platform runs on zkEVM.
Federated learning in the real world operates on massive devices, which can generate massive numbers of transactions.
zkEVM batches transactions together, which can reduce gas costs, making it a suitable environment for federated learning solutions.

How BCFL work?

1. Task Generate : Task Generator register Task in the blockchain

Task Generator

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How does our BCFL work?
First, the task creator creates a task on the blockchain by defining the desired DL model type and the required parameters.

How BCFL work?

2. Recruitment of participants:

incentives for providing data and learning deep learning models

Who want to Join Cat Dog
Classification model training Task?

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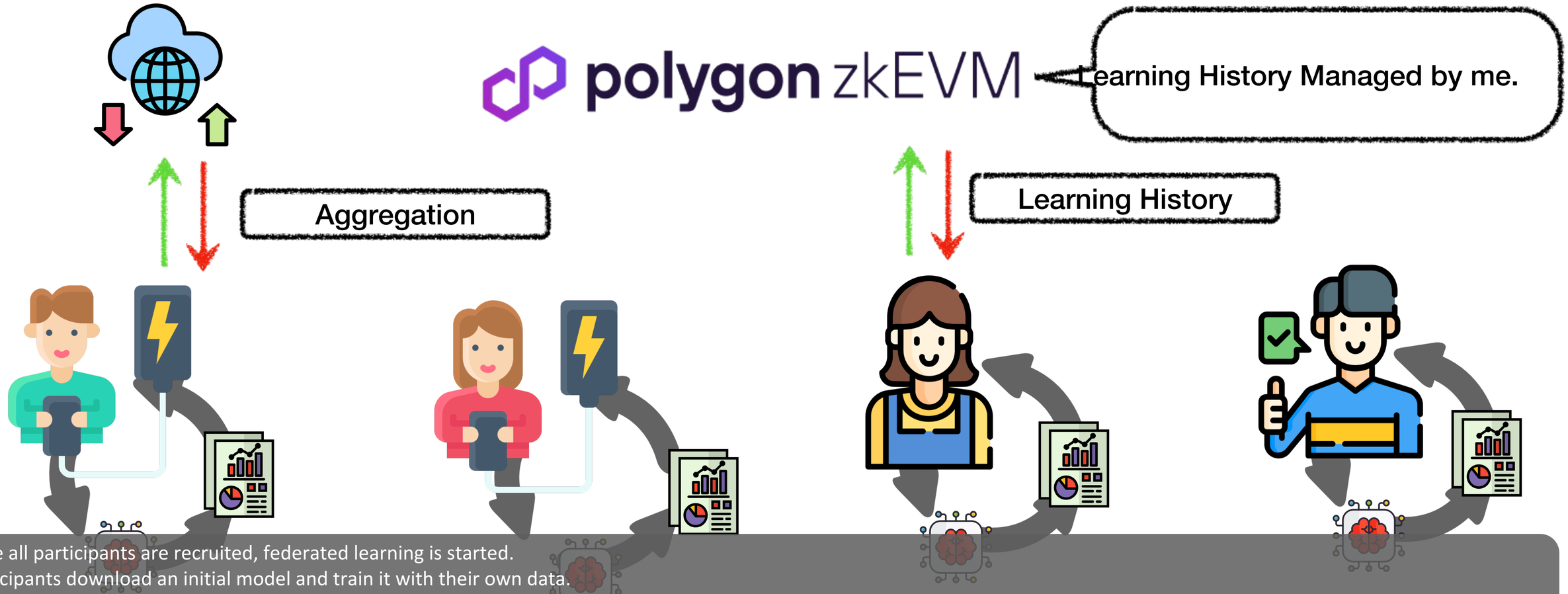
Is there any Incentive?
I have enough data!

Second, once the task is registered, our platform recruits participants.
Users who have data that is suitable for this task will participate in the task in the expectation of appropriate rewards.

How BCFL work?

3. Federated Learning : The trainer proceeds with learning using its own resources, and the server proceeds with aggregation using the learned model.
Polygon manages learning records.



Once all participants are recruited, federated learning is started.
Participants download an initial model and train it with their own data.
The models trained by each individual are uploaded to IPFS and the CIDs are recorded on the blockchain.
These models are aggregated on the server and then redistributed to the clients, and this process is repeated until the DL model achieves satisfactory performance.

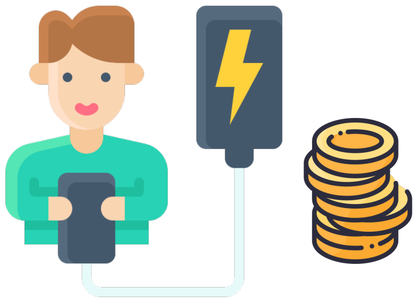
How BCFL work?

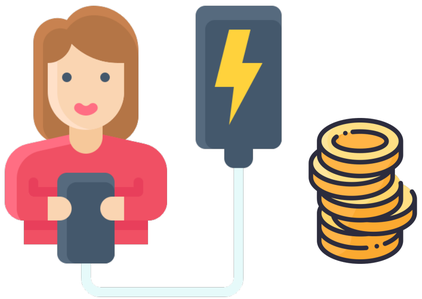
4. Incentive mechanism :

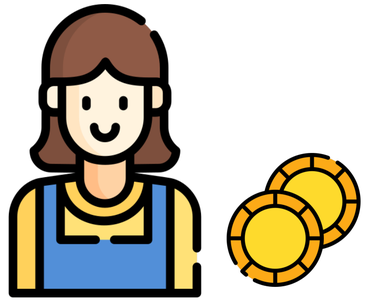
Distribution of token(stake in the final model)s according to contribution to the final mo

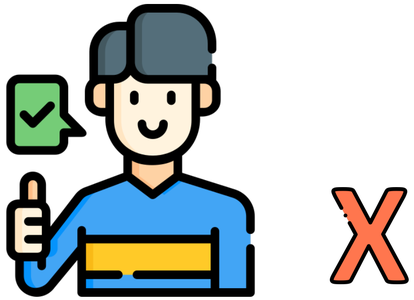
polygon zkEVM

I will distribute incentives according to the amount of contribution.





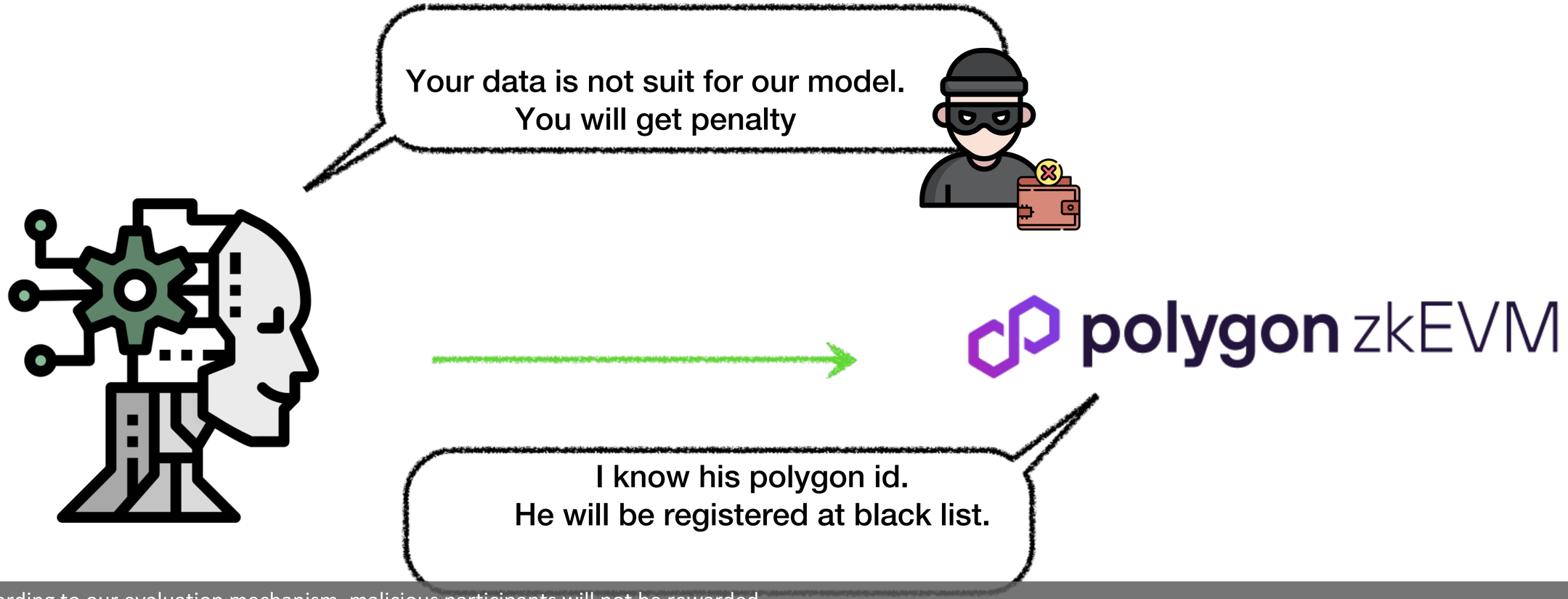




Once training is complete, participants are rewarded with tokens based on their contribution to the training of the final model.

How BCFL work?

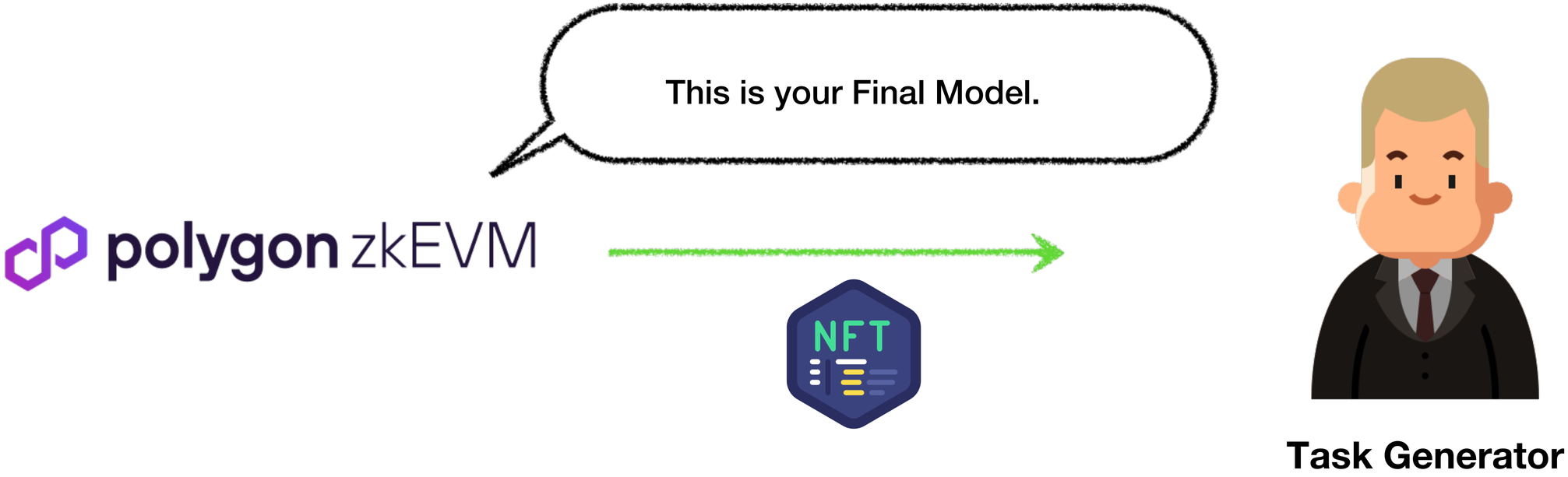
4-1. Polygon Id’s role



According to our evaluation mechanism, malicious participants will not be rewarded.
We have the idea of using Polygon IDs for participant management.
The BCFL system blacklists the Polygon IDs of malicious participants so that they cannot participate in other tasks.

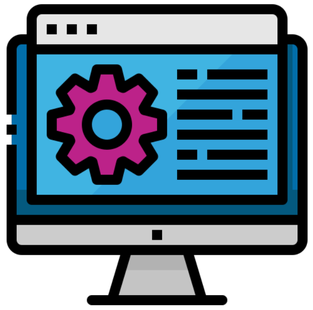
How BCFL

5. Final Model NFT :Issuance final model nft



When training is complete, the task generator will get an NFT of the trained model.

How to use Final NFT



It can be applied for Deep Learning Application.

It can be sold on a model nft marketplace.

=> Participants share profits according to their stake.

zkEVM Demo

```
dy@kangaroo:/media/hdd1/es_workspace/D-DES/server$ node app.js
Example app listening on port 3000
finsih158
0x68F825dB6b9b39fa95910C3c35f9BF83f161e0Df
{
  taskId: 158,
  taskContractAddress: '0x68F825dB6b9b39fa95910C3c35f9BF83f161e0Df',
  taskStatusCode: 1,
  taskPort: 8083
}
{
  data: OkPacket {
    fieldCount: 0,
    affectedRows: 1,
    insertId: 0,
    serverStatus: 2,
    warningCount: 0,
    message: '(Rows matched: 1  Changed: 1  Warnings: 0',
    protocol41: true,
    changedRows: 1
  },
  type: true
}
get error
WARNING flwr 2023-05-20 20:50:35,539 | app.py:203 | Both server and strategy were provided, ignoring strategy

get error
INFO flwr 2023-05-20 20:50:35,539 | app.py:148 | Starting Flower server, config: ServerConfig(num_rounds=1, round_timeout=None)

get error
INFO flwr 2023-05-20 20:50:35,552 | app.py:168 | Flower ECE: gRPC server running (1 rounds), SSL is disabled

get error
INFO flwr 2023-05-20 20:50:35,553 | server.py:303 | FL starting
```

Q&A

APPENDIX

Block Chain based Federated Learning