





Federated Learning in the Alchimia Project

What is a Federated Learning ?

Federated Learning (FL) is a groundbreaking Machine Learning (ML) approach characterized by:

-  Decentralization, distributing model training across devices or nodes
-  Collaboration, allowing multiple entities to jointly train a shared global model
-  Privacy preservation, ensuring sensitive data remains on-device
-  Reduced data transfer overhead, minimizing the need for extensive data movement



Benefits

- **Streamlined communication:** Sharing model updates (weights) minimizes data exchange between devices and the server
- **Flexible storage:** Users manage storage based on their data needs
- **Enhanced privacy:** Data stays on client devices, ensuring anonymity. Additional privacy techniques can be implemented for model protection

Implementation

- **Building a strong network:** Secure and efficient infrastructure is needed to distribute and combine model updates.
- **Data balancing act:** Strategies are required to ensure a good mix of data across devices while keeping it local.
- **Privacy first:** Encryption and other techniques safeguard user data throughout the process.
- **Scaling for growth:** The system needs to handle a changing number of devices and data amounts.
- **Seamless integration:** Compatibility with existing machine learning tools simplifies deployment.

How a Federated Learning Framework Works?

1. A global model is sent from a central server to participating devices
2. Each device trains the model locally on its own data
3. Local model updates are sent back to the server
4. The server aggregates the updates to create a new global model
5. Steps 1-4 are repeated to continuously improve the model



ALCHIMIA's Federated Learning Approach

The Alchimia project leverages Federated Learning (FL) to transform steel production in Europe. Here's how:

- **Optimizing the mix of input materials for steel production:** ALCHIMIA will use Federated Learning to find the optimal mix of input materials for steel production that meets customer specifications while reducing the environmental impact and energy consumption of the process.
- **Federated Learning for AI Collaboration:** Integrates with AI4EU, GAIA-X, and common data spaces for a collaborative AI ecosystem in Europe.
- **Enabling replicability and scalability:** The project will be designed to be replicable and scalable by including a complementary use case for the manufacturing of automotive parts.
- **Prognostic optimization of furnace charges:** The system will use prognostic optimization to determine the best mix of materials to charge in the furnaces to obtain the desired product quality.
- **Smooth green transition for industries:** ALCHIMIA aims to determine the best combination of learning capacities to enable a smooth green transition for all industries through collaboration.

By using Federated Learning, ALCHIMIA aims to create a win-win situation for European steel manufacturers. They can benefit from AI-powered process optimization while safeguarding data privacy and contributing to a greener steel industry.

