

# Advanced AI for scientists: the AI4EOSC platform approach

*Judith Sáinz-Pardo Díaz and Ignacio Heredia Cachá*

Advanced Computing and e-Science group  
Institute of Physics of Cantabria (IFCA) - CSIC | UC



- Evolution of the DEEP Hybrid DataCloud platform
- Runs September 1st 2022 – August 2025 (36 months)
- 7 academic + 2 SME + 1 non-profit organization

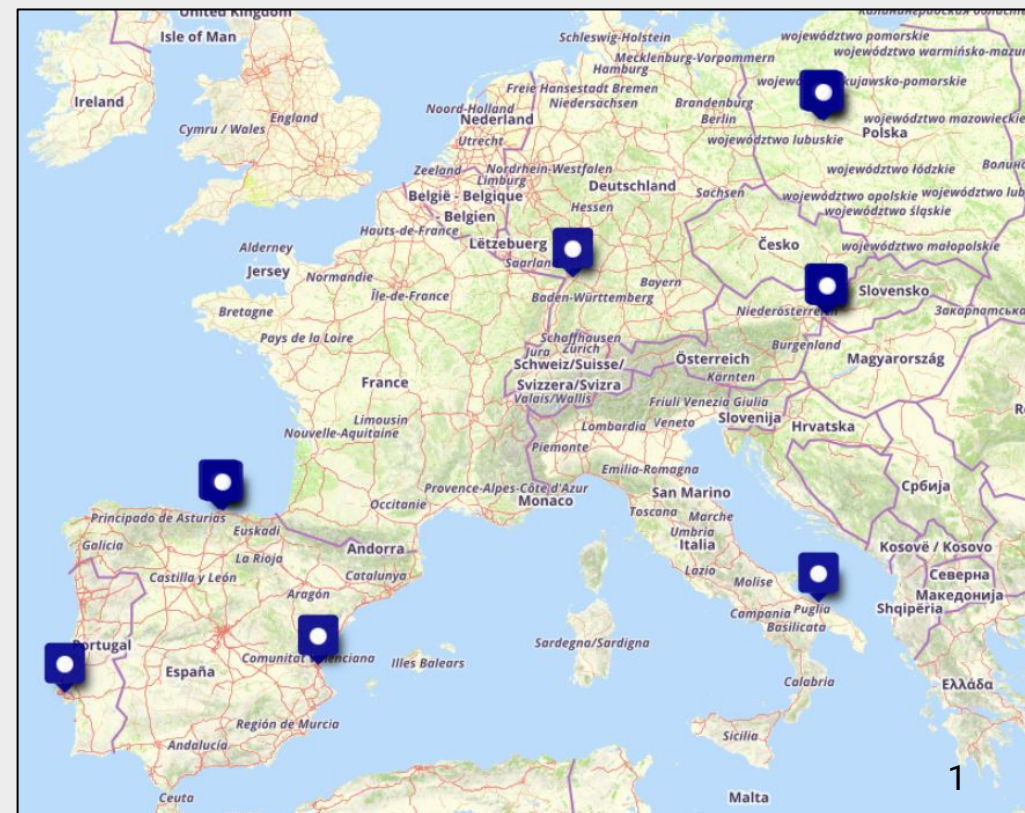
Advanced features for distributed, federated, composite learning, metadata provenance, MLOps, event-driven data processing, and provision of AI/ML/DL services

- Funding: 5M€
- 3 workshops on AI, image processing, federated learning
- 1 external users open call
- 8 peer reviewed publications in high impact journals
- 2 peer reviewed publications in high impact conferences
- Collaboration with several EU funded and INFRAEOSC projects



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## AI4EOSC main objectives

1. Feature rich **services and platform** to build and deploy **custom AI applications in the EOSC**
2. Support for **building AI systems on distributed datasets**, with a particular focus on **federated learning**
3. Services to **compose AI tool workflows**, enabling the development of complex data-driven AI applications
4. **AI Exchange Hub** in the context of the EOSC, enhancing and increasing the application offer currently available
5. **Extend** the service offer and the **capabilities** being offered through the **EOSC portal**, with focus on AI



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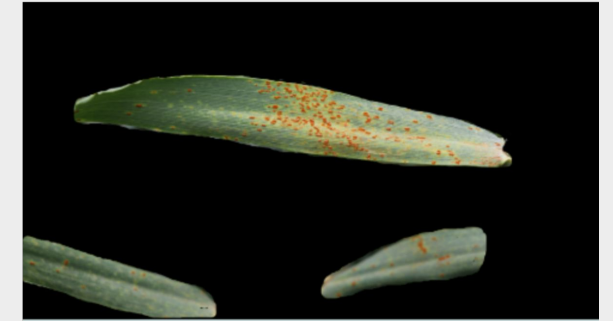
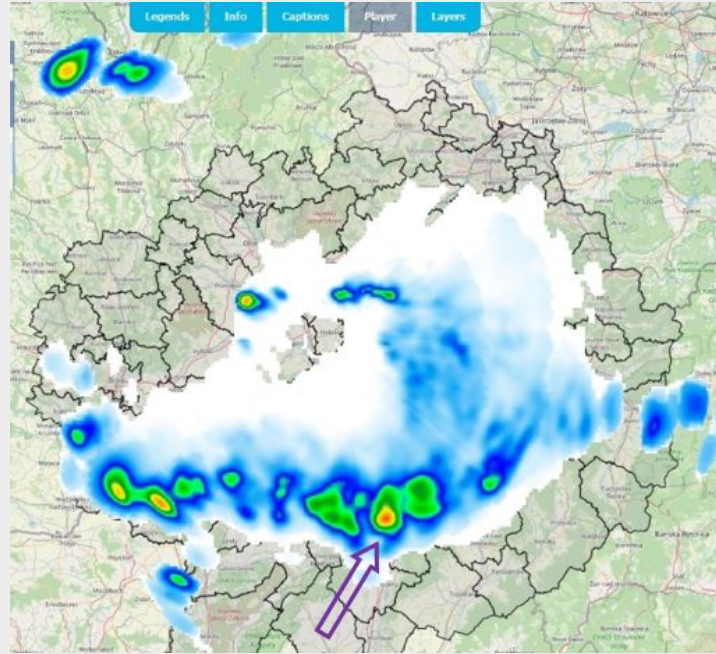


## AI4EOSC use cases:

Agrometeorology

Integrated plant protection

Automated thermography

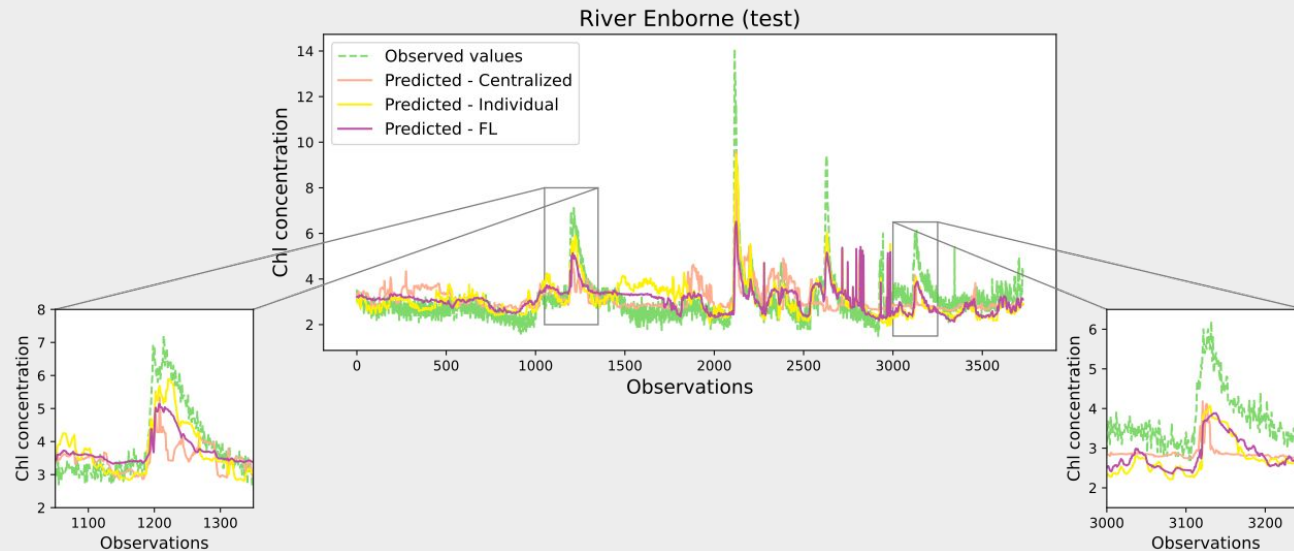


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Water quality: predicting Chl concentration

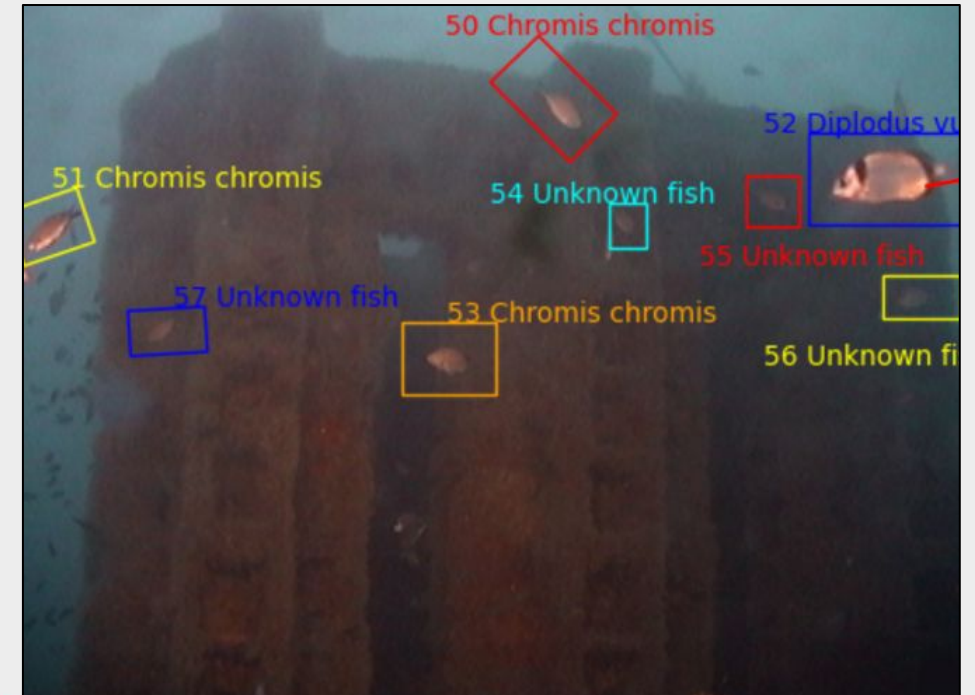
Fish detection and classification



Sáinz-Pardo Díaz, Judith, Castrillo, María and López García, Álvaro. "Deep learning based soft-sensor for continuous chlorophyll estimation on decentralized data." Water Research 246 (2023): 120726.  
<https://doi.org/10.1016/j.watres.2023.120726>



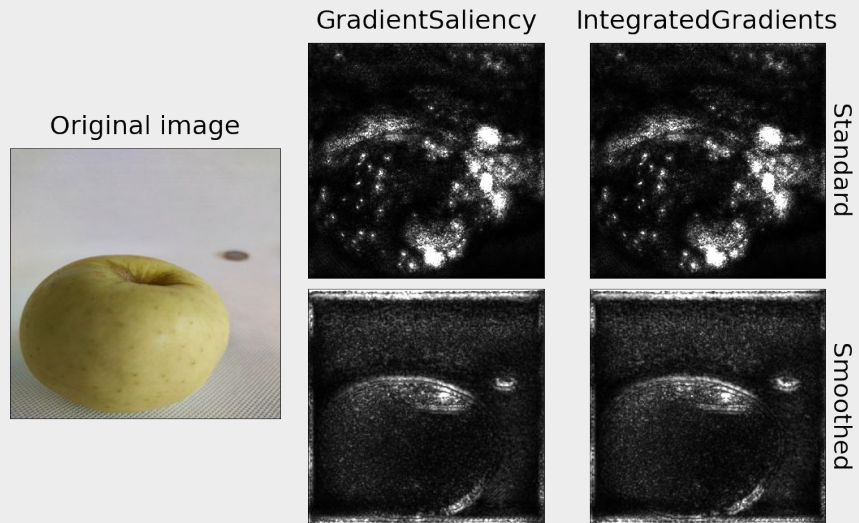
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Martínez, Enoc and Valentin Kozlov. OBSEA Fish detector.  
<https://github.com/EnocMartinez/obsea-fish-detection>

## Medical imaging using federated learning

## AI for precise weight measurement of fruits

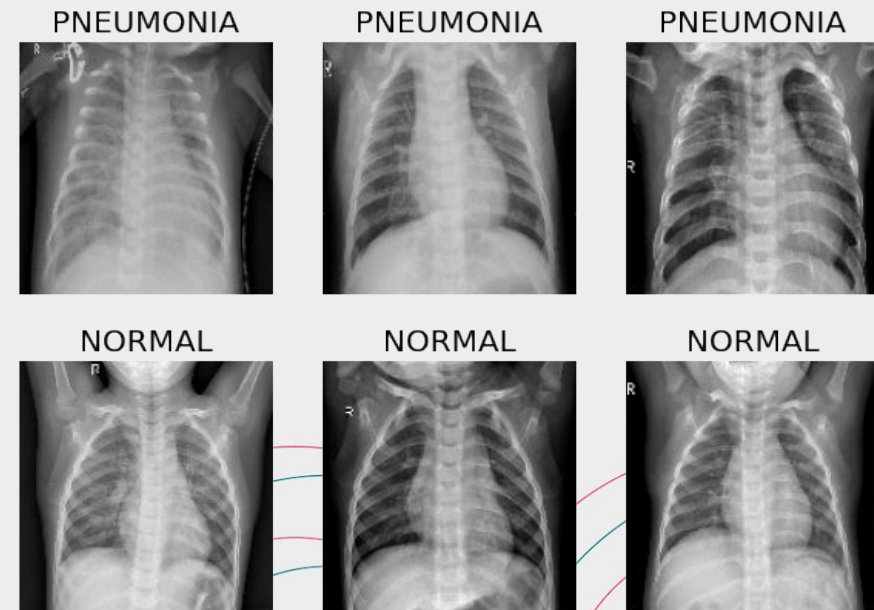


Izquierdo, Pablo, from CSIC DigitalAlimenta project.  
<https://digitalalimenta.csic.es/>



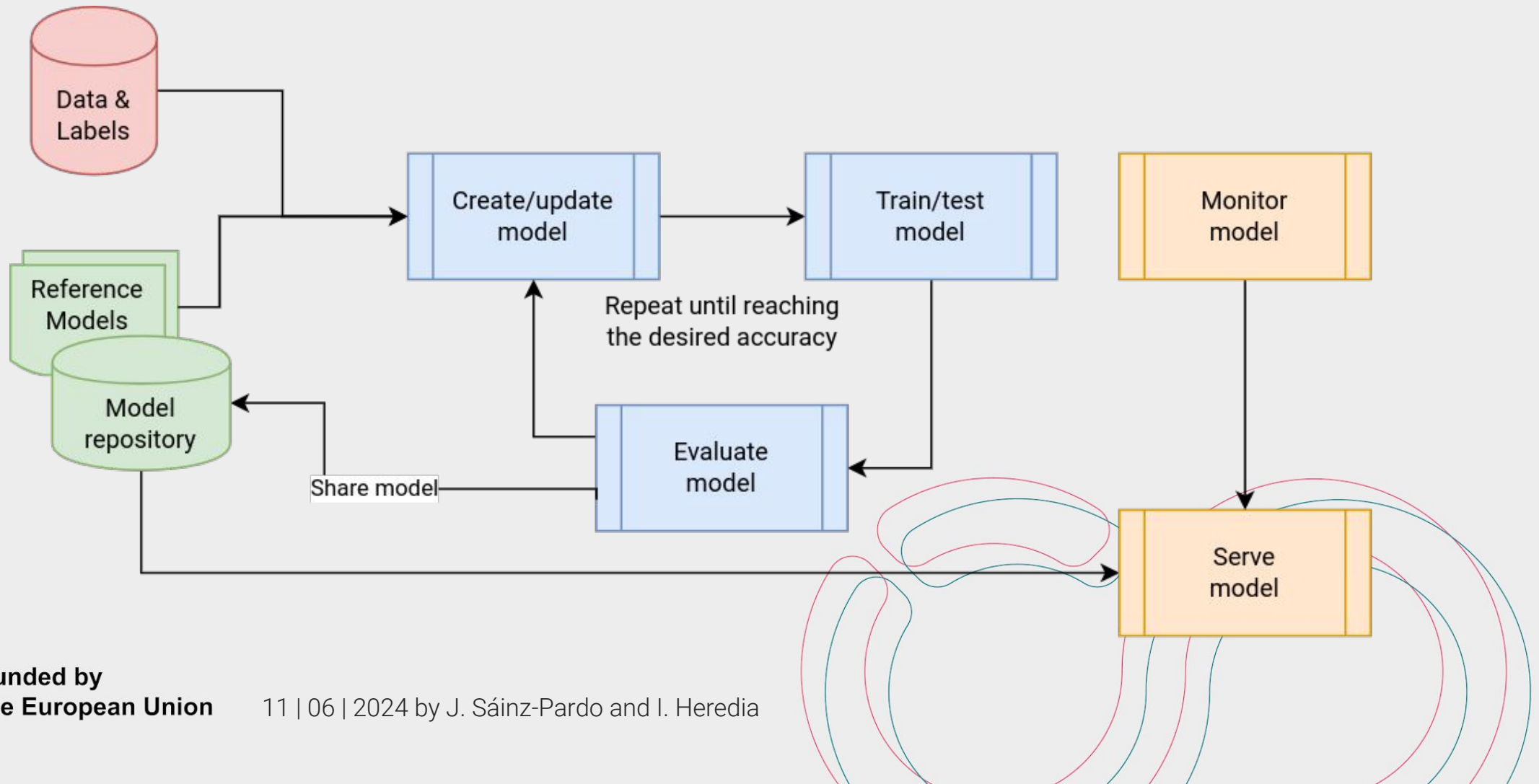
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Sáinz-Pardo Díaz, Judith, and López García, Álvaro. "Study of the performance and scalability of federated learning for medical imaging with intermittent clients." *Neurocomputing* 518 (2023): 142-154.  
<https://doi.org/10.1016/j.neucom.2022.11.011>

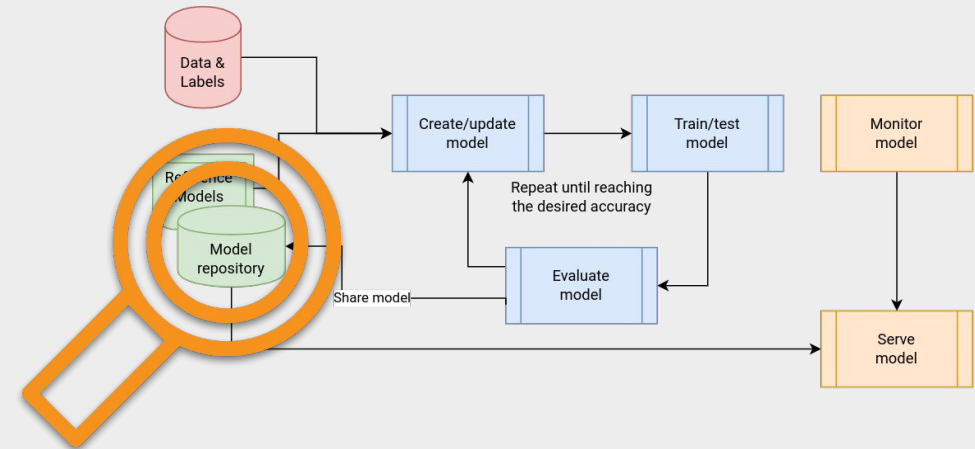




## The Machine Learning Lifecycle



## Model marketplace



AI4 | eosc

Dashboard

Marketplace

Deployments

Useful links

Identity and Access

AI4EOSC documentation

Project page

Storage

Status

Experiment tracking

Marketplace

Modules

Tools

AI4OS Development Environment

This is a Docker image for developing new modules

New deployment

Dogs breed detector

Identify a dogs breed on the image (133 known breeds)

Trainable Inference Pre-trained

DEEP OC Massive Online Data Streams

Deep learning for proactive network monitoring and security protection.

Trainable Inference Pre-trained

DEEP OC Retinopathy Test

A Tensorflow model to classify Retinopathy.

Trainable Inference Pre-trained

Train an image classifier

Train your own image classifier with your custom dataset. It comes also pretrained on the 1K ImageNet classes.

Trainable Inference Pre-trained

Plants species classifier

Classify plant images among 10K species from the iNaturalist dataset.

Trainable Inference Pre-trained

Upscale multispectral satellites

Speech keywords classifier

Judith Sáinz-Pardo Díaz

Search modules

### Plants species classifier

Classify plant images among 10K species from the iNaturalist dataset.

The deep learning revolution has brought significant advances in a number of fields [1], primarily linked to image and speech recognition. The standardization of image classification tasks like the [ImageNet Large Scale Visual Recognition Challenge](#) [2] has resulted in a reliable way to compare top performing architectures.

The use of deep learning for plant classification is not novel [3, 4] but has mainly focused in leaves and has been restricted to a limited amount of species, therefore making it of limited use for large-scale biodiversity monitoring purposes.

This Docker container contains a trained Convolutional Neural network optimized for plant identification using images. The architecture used is an Xception [5] network using Keras on top of Tensorflow. A detailed article about this network and the results obtained with it can be found in [6].

The PREDICT method expects an RGB image as input (or the url of an RGB image) and will return a JSON with the top 5 predictions.

The original training dataset was the great collection of images which are available in [PlantNet](#) under a Creative-Common AttributionShareAlike 2.0 license. It consists of around 250K images belonging to more than 6K plant species of Western Europe. These species are distributed in 1500 genera and 200 families.

A new iteration of the application has been trained using plant images from [iNaturalist](#). This dataset has around 4.4M observations with 7M images from 58K worldwide species. We have restricted our training to the 10K most popular species.



Build status	License	Created
build passing	Apache 2.0	2019-01-01

#### Categories

- tensorflow
- docker
- deep learning
- trainable
- inference
- pre-trained
- image classification
- api-v2

#### Additional Resources

Get the code

[Github](#) [Dockerhub](#)

Get the data

[Dataset](#)

Found an issue?

[Report issue](#)

Deploy via the IM

[Train module](#)



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## Create your own model

**Configure training: AI4OS Development Environment**

Marketplace / Plants species classifier / Train Show help

1 General configuration 2 Hardware configuration 3 Storage configuration

**Hardware options**

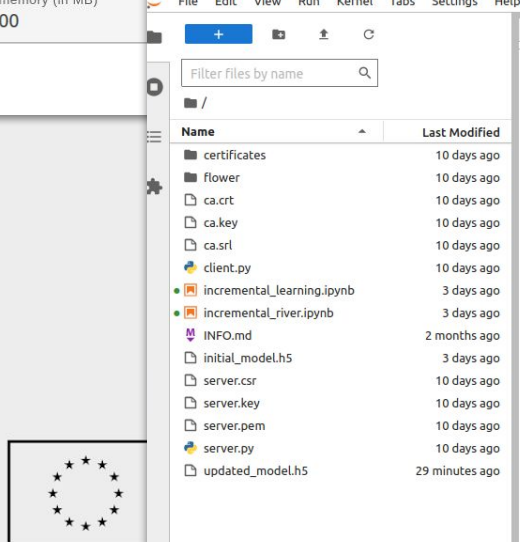
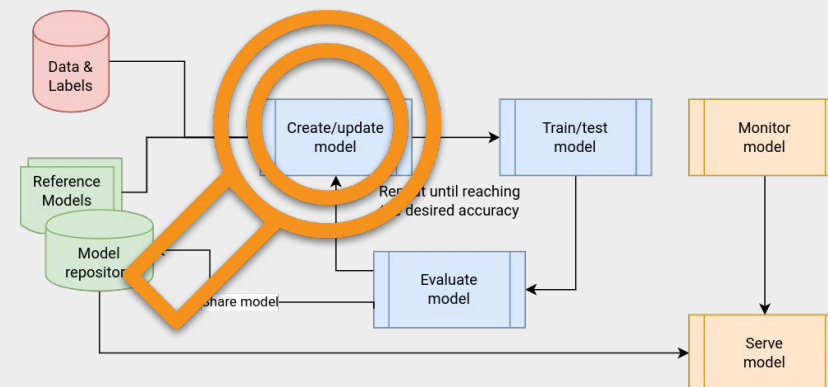
Number of CPUs: 8

Number of GPUs: 1

GPU model: Tesla V100-PCIE-32GB

RAM memory (in MB): 16000

Disk memory (in MB): 10000



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## Welcome to AI4OS Development Environment

### Table of Content

- Introduction
- Configure git for commits
- Start your project with AI4OS Data Science template
- Access remote storages
- AI4OS Documentation
- AI4OS related services
- List of installed tools
- Acknowledgments

### Introduction

AI4OS Development Environment (AI4Dev) aims to facilitate the integration of your code with AI4OS software solutions, development, and testing it directly in the cloud environment. Please, see the [List of installed tools](#) and [AI4OS Documentation](#) for more details.

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## Welcome to AI4OS Development Environment

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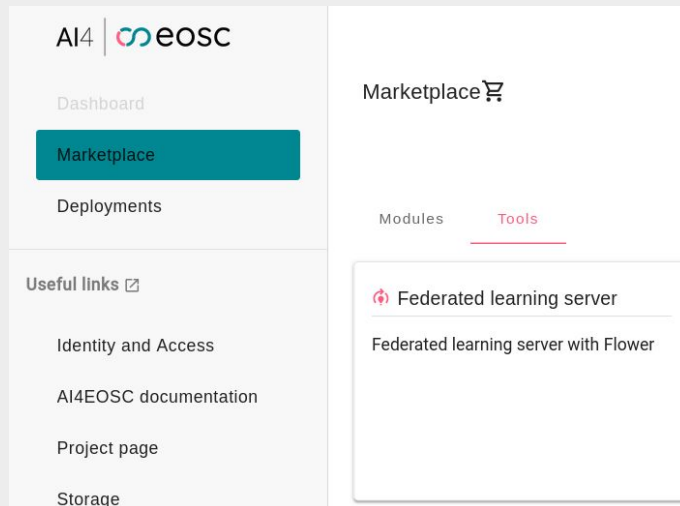
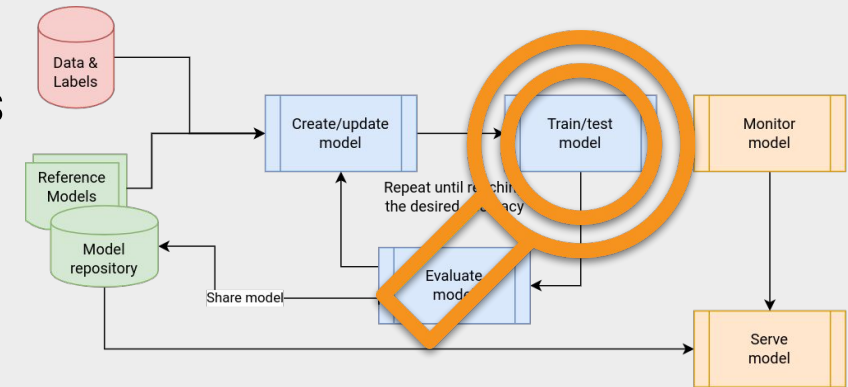
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### Introduction

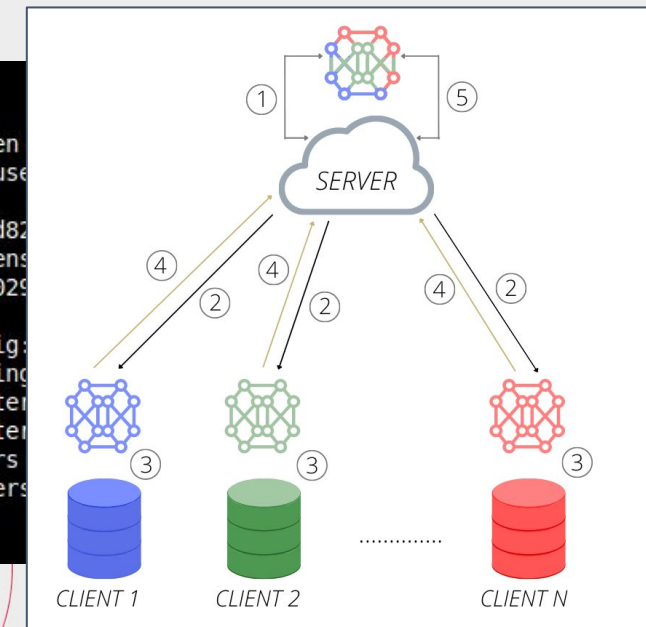
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## Training: federated learning

- Collaborative and decentralized approach to build ML models
  - No need to centralize a dataset (i.e. technical or privacy restrictions)
- Management of experiments through platform dashboard
- Participating clients both within AI4EOSC platform or external (with authentication)

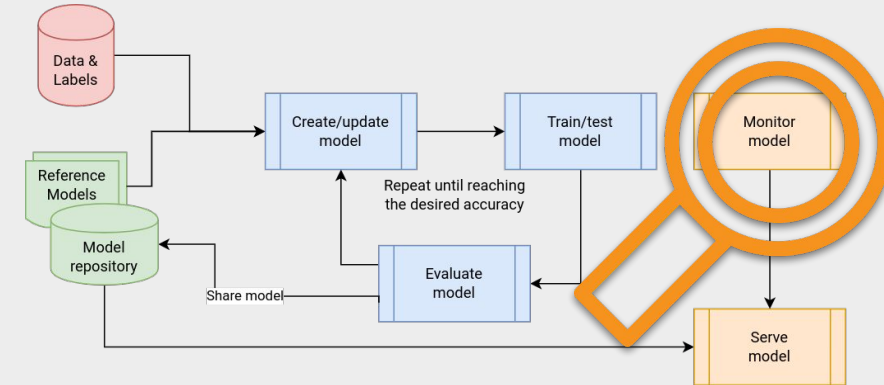


```
root@8878206726fb:/srv# cd federated-server/fedserver
root@8878206726fb:/srv/federated-server/fedserver# python3 server.py
INFO flwr 2024-04-18 14:10:23,381 | vault.py:76 | Configured Vault Bearer token
INFO flwr 2024-04-18 14:10:23,381 | vault.py:77 | Reading tokens stored in: 'use
a3f-0242ac130005/federated'
Getting tokens from Vault -> users/7d7a87545b700b38b54e2b5b4713084fd2b8d7e5ed82
INFO flwr 2024-04-18 14:10:23,790 | vault.py:79 | Configured Vault Bearer tokens
86bf6d2843ad31a8879a5fab0c1318', '6707ded3dab865271f4a5ac637601cbb38269b808f2029
INFO flwr 2024-04-18 14:10:23,790 | server.py:80 | Token interceptor created
INFO flwr 2024-04-18 14:10:23,791 | app.py:158 | Starting Flower server, config:
INFO flwr 2024-04-18 14:10:23,800 | app.py:172 | Flower ECE: gRPC server running
INFO flwr 2024-04-18 14:10:23,800 | server.py:91 | Initializing global parameters
INFO flwr 2024-04-18 14:10:23,800 | server.py:282 | Requesting initial parameters
INFO flwr 2024-04-18 14:10:49,423 | server.py:288 | Received initial parameters
INFO flwr 2024-04-18 14:10:49,424 | server.py:93 | Evaluating initial parameters
INFO flwr 2024-04-18 14:10:49,424 | server.py:106 | FL starting
```



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- Monitoring of models in production is not enough
  - Model learns from data, data is not stationary
  - Concept learnt by the model may change over time
- Data and concept drift detection→ essential to build more robust models
- Frouros: state-of-the-art Python library for drift detection in ML problems: <https://github.com/IFCA/frouros>
- MLOps is an engineering practice that aims to automate and streamline the ML lifecycle
- MLflow tracking server: <https://mlflow.cloud.ai4eosc.eu>





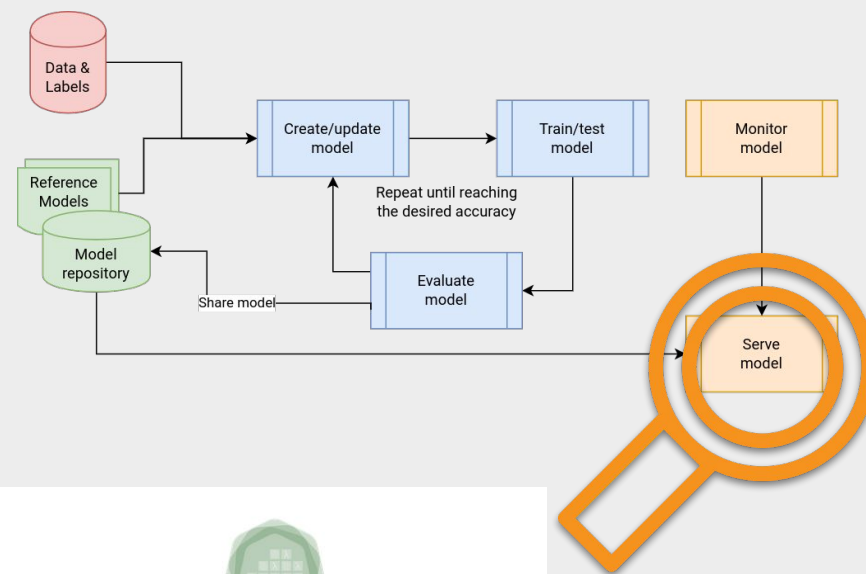
**Serve the model:** inference<https://inference.cloud.ai4eosc.eu/ui/>

We use [OSCAR](#) to serve AI models for inference (AI as a Service).

It supports two serverless event-driven execution modes:

- **Asynchronous mode:** Files uploaded to the object-store automatically trigger the invocation of a data-processing script, that is run inside a container (out of user-defined Docker image) within a scalable Kubernetes cluster (e.g. batch jobs).
- **Synchronous mode:** Scalable HTTP-based endpoints (based on KNative). Direct requests to the model.

On top, we support building AI workflows using [Flowfuse](#) and [Elyra](#) through [AI4Compose](#).

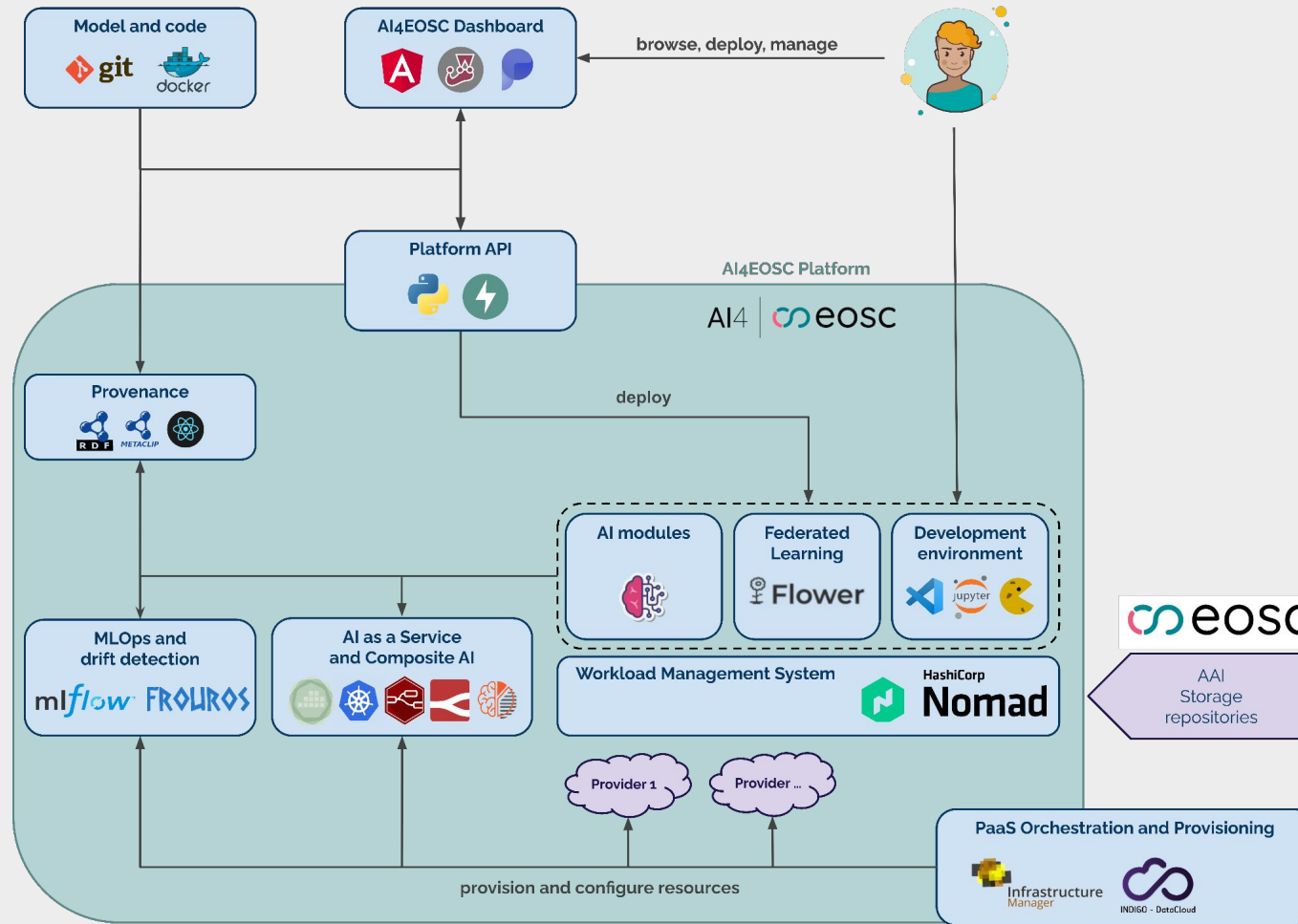


The screenshot shows the login interface for the AI4 | eosc OSCAR service. At the top is the AI4 | eosc logo and the word 'OSCAR' in green. Below this are two input fields: 'User' and 'Password', each with a corresponding icon (a person for user and a lock for password). A green 'SIGN IN' button is positioned below the password field. At the bottom, there is a blue button labeled 'SIGN IN VIA EGI CHECK-IN'.



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Interactive C4 diagrams available [here](#).



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# Showcasing the AI4EOSC platform



<https://dashboard.cloud.ai4eosc.eu>



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*AI4EOSC empowers scientific research by...*

- Providing users with advanced AI tools:
  - Model retraining (iterative learning, fine tuning)
  - Federated learning (including client authentication)
  - Parallel training in multiple GPUs (distributed training - data parallelism)
  - Model monitoring: MLOps, drift detection
  - Model inference
- Providing a simple and intuitive IDE for developing AI/ML/DL models (VSCode or JupyterLab)
- Allowing seamless access to computational resources to accelerate model development
- Deploying your models in production in a serverless environment

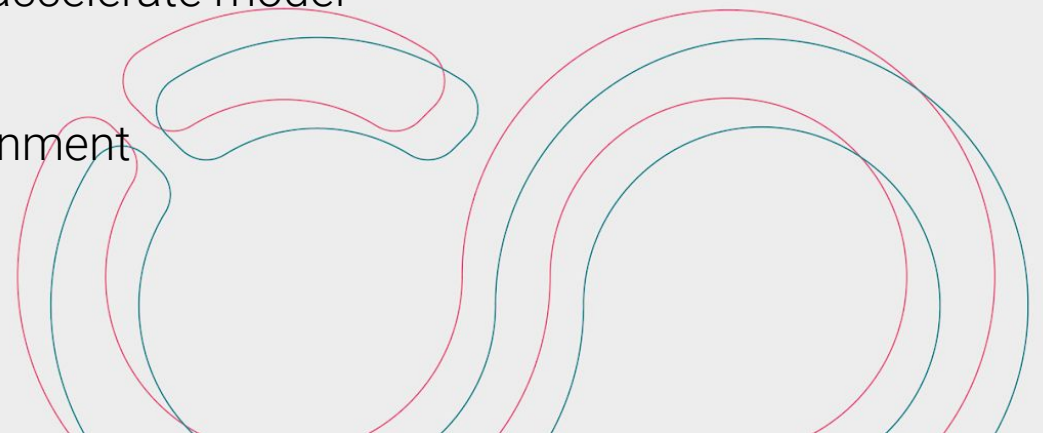
**More info:**

<https://ai4eosc.eu/>  
<https://docs.ai4os.eu/>



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# Thank you for your attention!

Judith Sáinz-Pardo Díaz  
Ignacio Heredia Cachá

[sainzpardo@ifca.unican.es](mailto:sainzpardo@ifca.unican.es)  
[iheredia@ifca.unican.es](mailto:iheredia@ifca.unican.es)

Álvaro López García  
(project coordinator)

[aloga@ifca.unican.es](mailto:aloga@ifca.unican.es)



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