# HESSIAN

http://hessian.be

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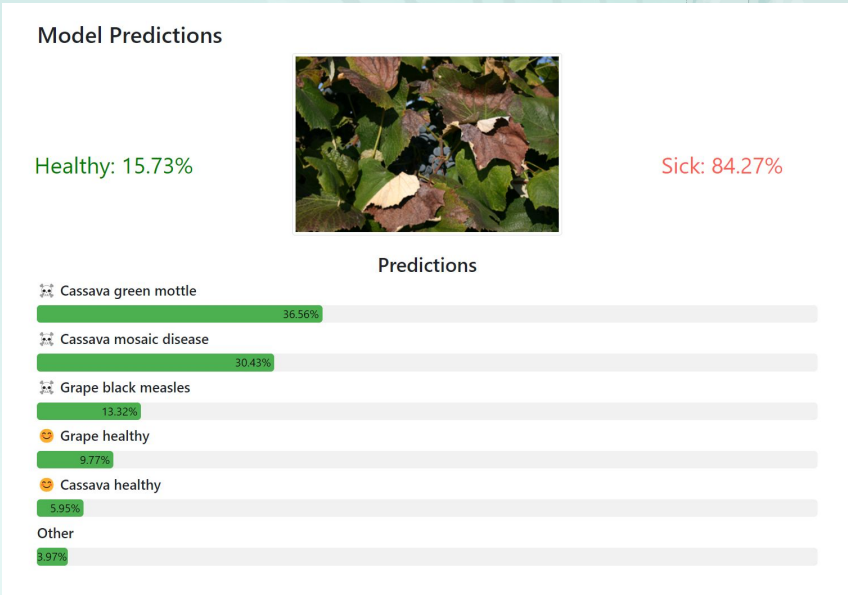
01
Introduction

# Introduction (1/2)

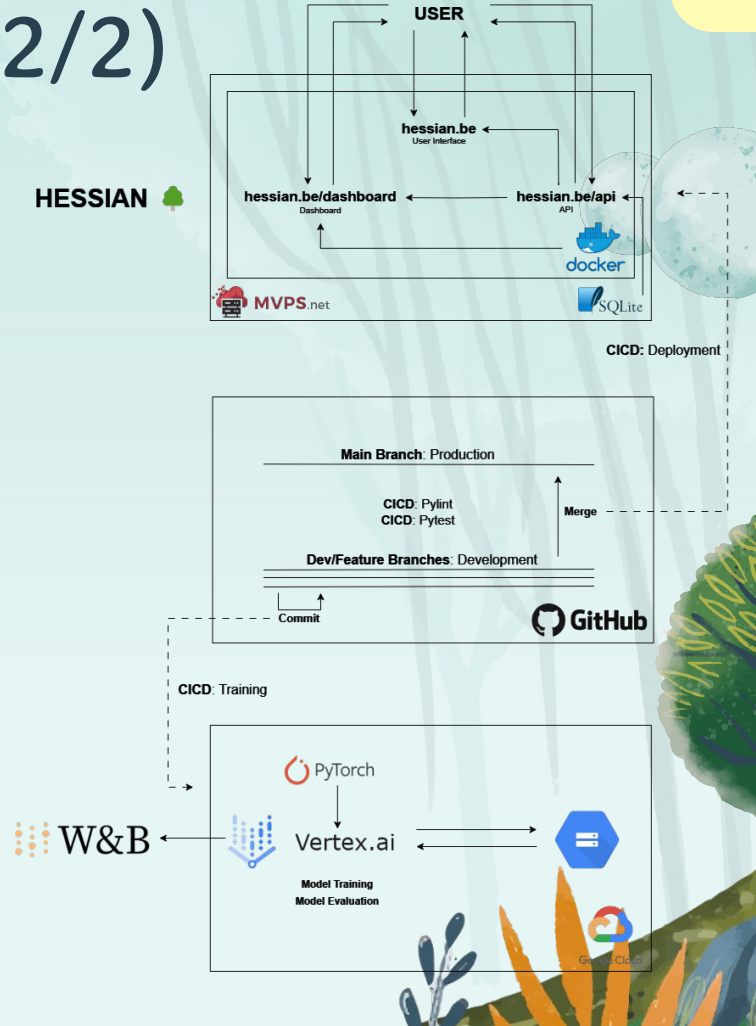
- Between 17.2% and 30.3% of global harvests are lost due to plant diseases each year [1].

- **HESSIAN** helps farmers quickly diagnose potential plant diseases before they spread
  - 3 models with different accuracies and costs
  - API and user-friendly online platform



# Introduction (2/2)

- How has **HESSIAN** achieved that?
  - Data collection, analysis, and preprocessing
  - Models selection, training, and evaluation
    - PyTorch, Vertex AI, W&B, GCS
  - Publicly available API
    - Flask, SQLite, Docker
    - Hosted on a VPS
    - http://hessian.be/api
  - User interface querying the API
    - HTML, CSS, Javascript
    - http://hessian.be
  - Dashboard monitoring the model serving
    - http://hessian.be/dashboard
  - CICD
    - Pylint, Pytest, Deployment, Training
  - Gitflow Principles
    - Main branch for production
    - Dev/Feature branches for development




02
Model Devlopment

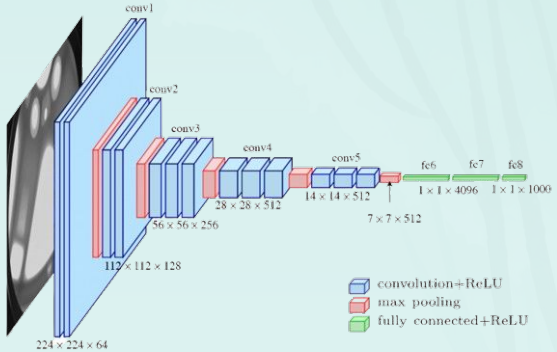
# Model Development: Data (1/3)

- Fixed images dataset
  - 95868 unique images
  - 61 classes
    - 14 healthy
    - 47 ill
  - Imbalance for the Cassava mosaic disease class ±13000
- Image transformation
  - Resized to 224x224 format
  - Normalized with the mean and standard deviation of each channel



# Model Development: Models (2/3)

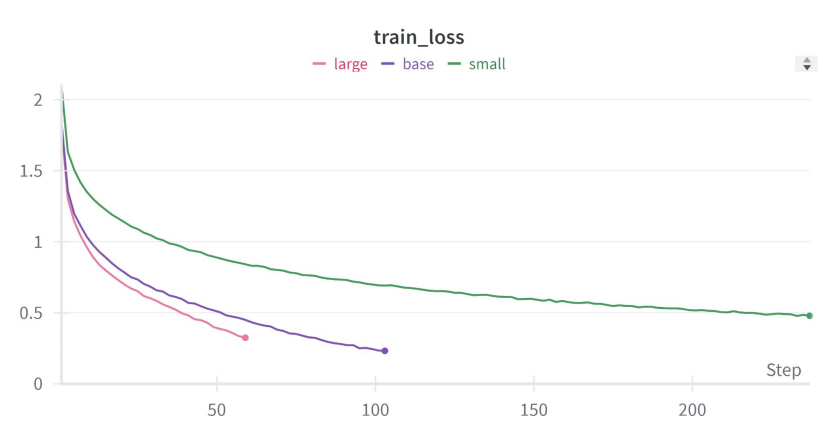
- Inspired by the AlexNet architecture
- Classical PyTorch training pipeline
- 3 different sizes of model
  - Different Accuracies
  - Different Prices

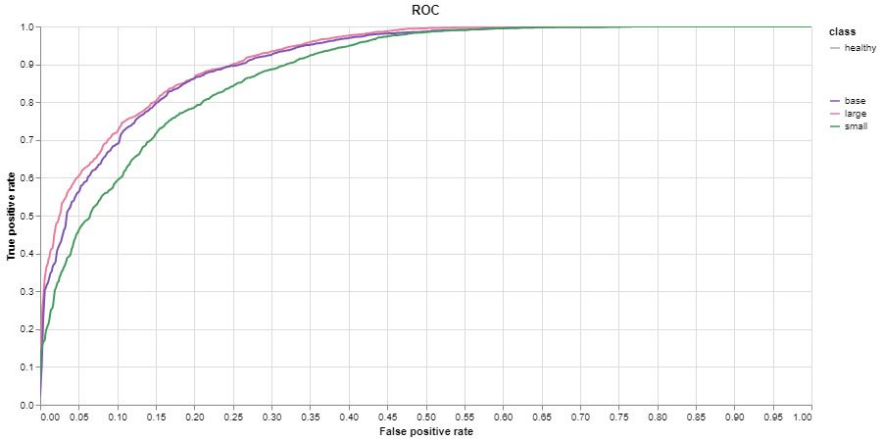



| Model Variant | Number of Parameters | Global Accuracy | Binary Accuracy | Costs |
|---|---|---|---|---|
| Small | 134,709 | 71% | 88% | 0.02€ |
| Base | 526,957 | 73% | 89% | 0.04€ |
| Large | 2,076,365 | 76% | 90% | 0.05€ |

# Model Development: Monitoring (3/3)

- Training and evaluation monitored with Weights & Biases
  - (Demo Report)

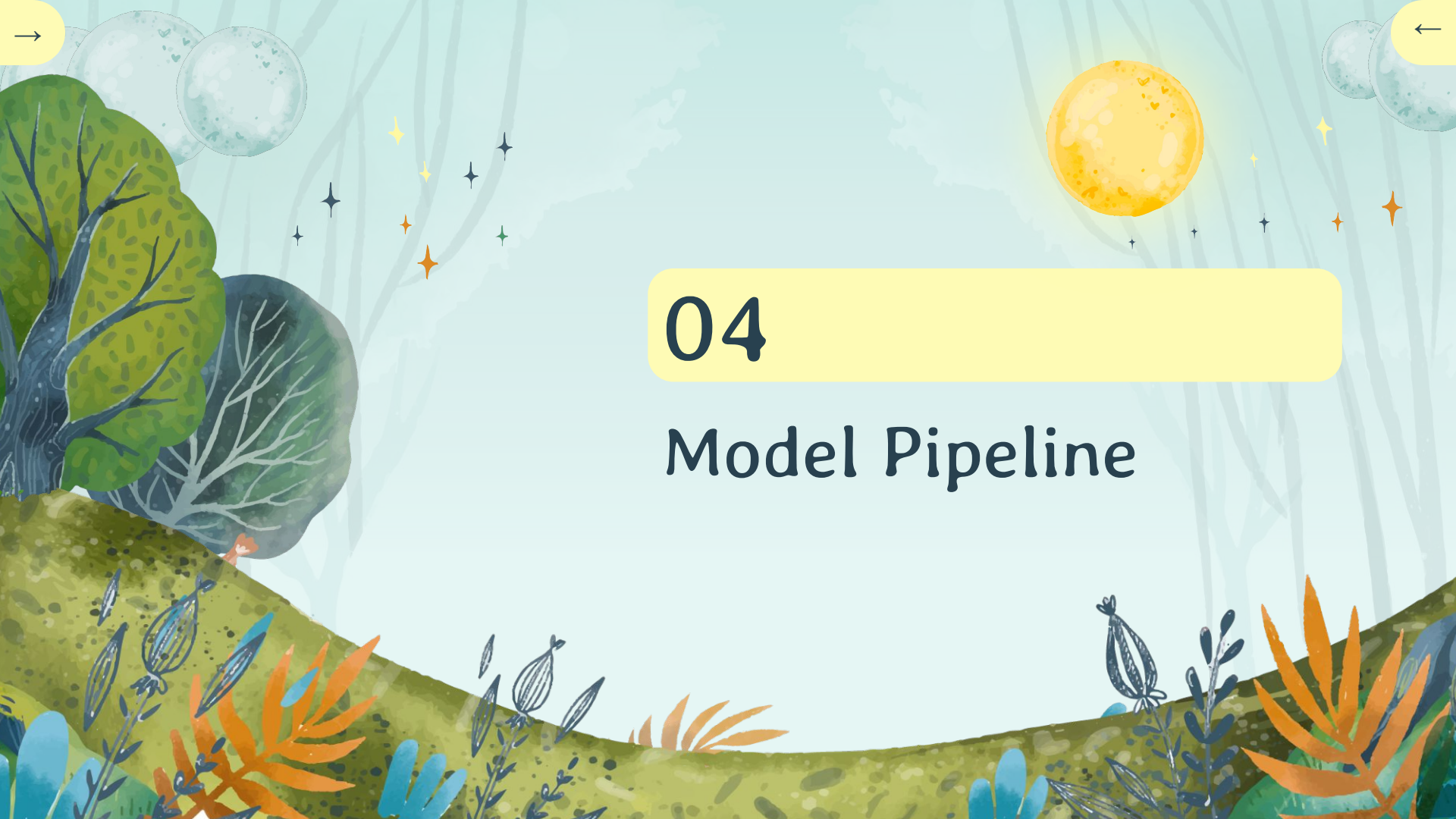



03
Model Deployment

# Model Deployment: API (1/1)

- Dockerized API based on the Python 3.10.13 image
- API publicly available
  - Queried with HTTP requests
  - Inference requests (image + model size) & Billing details
  - Hosted on a virtual private server (VPS) provided by MVPS
  - Flask to build the web server
  - SQLite to build the database
    - Store requests and billing details
  - http://hessian.be/api
  - (Demo Billing Request Postman)
- User interface to query the API in a user-friendly manner
  - http://hessian.be
  - (Demo Image Inference)


04
Model Pipeline

# Model Pipeline: Training (1/1)

- Dockerized training script
  - Usage of Docker volumes to store training data and model weights directly on the host
  - Include W&B monitoring
- Use of Vertex AI to train our models
  - Use of a pre-built PyTorch image
    - Manage dependencies with a custom-made Python source distribution package
  - Use of Google Secret Manager to store sensitive data
  - (Demo Show Logs)
- Use of Google Cloud Storage (GCS)
  - Automatically upload model weights during training
  - (Demo GSC Organization)


05
Monitoring & CICD

# Monitoring & CICD: Dashboard (1/2)

- Dashboard monitoring our application
  - Hardware usage of our server (CPU and RAM)
  - API latency
  - Statistics about API usage
  - http://hessian.be/dashboard
- (Demo dashboard)

# Monitoring & CICD: CICD (2/2)

- Using Github Actions
- **Deployment workflow**
  - Triggered on a merged pull request into main branch
  - Connection to VPS and deploy web server and models (demo)
  - Usage of Github Secrets for VPS connection
- **Pylint workflow**
  - Triggered by deployment workflow before deploying
  - Checks code compliance with PEP8 guidelines
- **Pytest workflow**
  - Triggered by deployment workflow once everything is deployed
  - Ensures that the deployed API is working as expected
- **Training workflow**
  - Triggered when a commit name matches “!train-hessian!”
  - Starts training on Vertex AI (demo)
  - Usage of Github Secrets

# Thanks!

## Do you have any questions?

# Sources


- [1] Jean B. Ristaino et al. “The persistent threat of emerging plant disease pandemics to global food security”. In: Proceedings of the National Academy of Sciences 118.23 (2021), e2022239118. doi: 10.1073/pnas.2022239118. URL: https://www.pnas.org/doi/10.1073/pnas.2022239118 (page 1).