

# **IBM DATA SCIENCE PROJECT**

Land Type Classification using Sentinel-2 Satellite  
Images

Digital Egypt Pioneers - AI & Data Science Track

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# PROJECT OVERVIEW

## PROJECT GOAL

providing an easy-to-use interface where users can upload satellite images and receive a classification prediction indicating the type of land use

## DATASET

EuroSAT (RGB and multispectral patches labeled by land class)

## METHODOLOGY

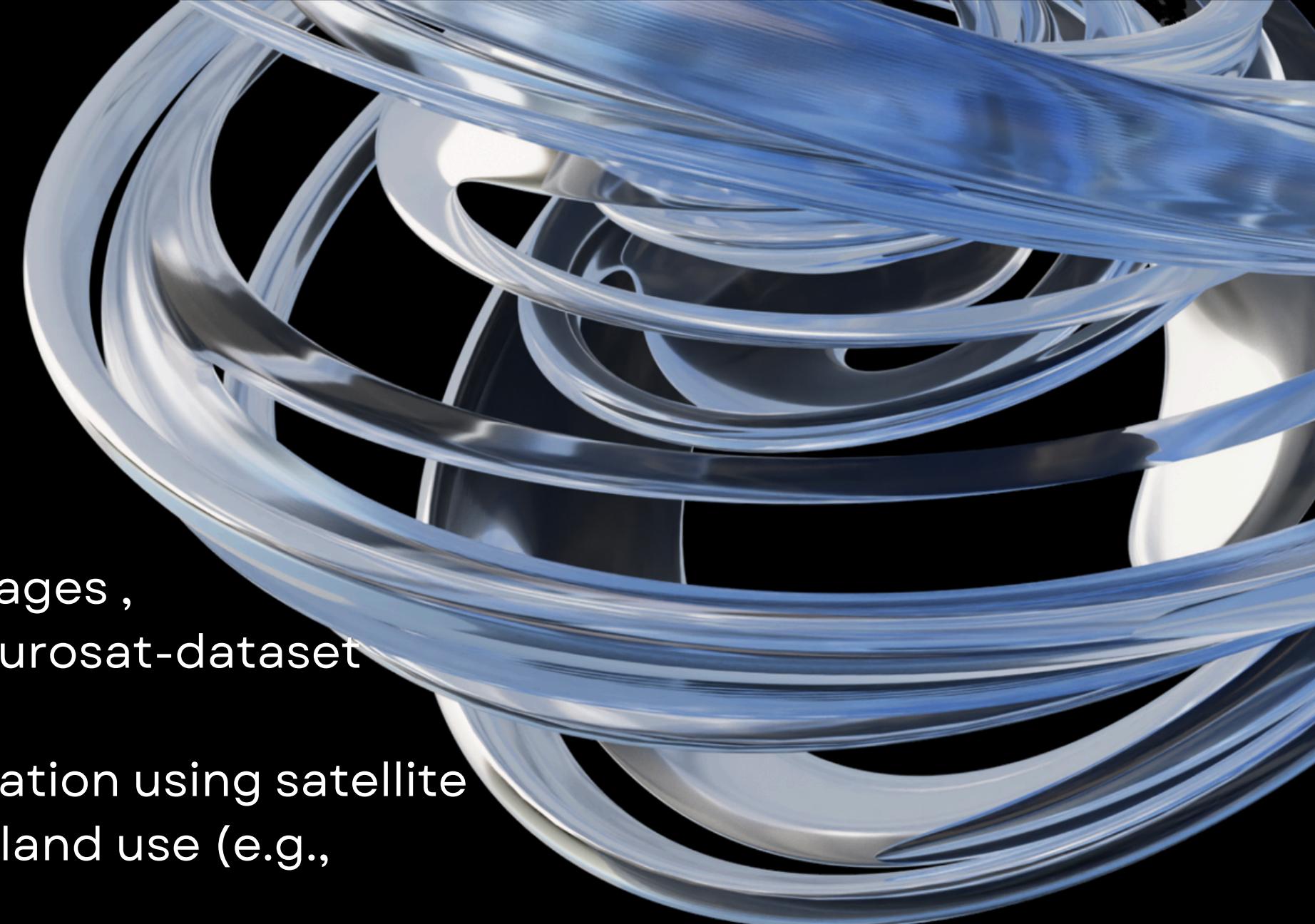
- Data Acquisition & Preprocessing
- Exploratory Data Analysis (EDA)
- Model Selection & Architecture
- Model Training & Evaluation
- Deployment & Testing

## IMPACT

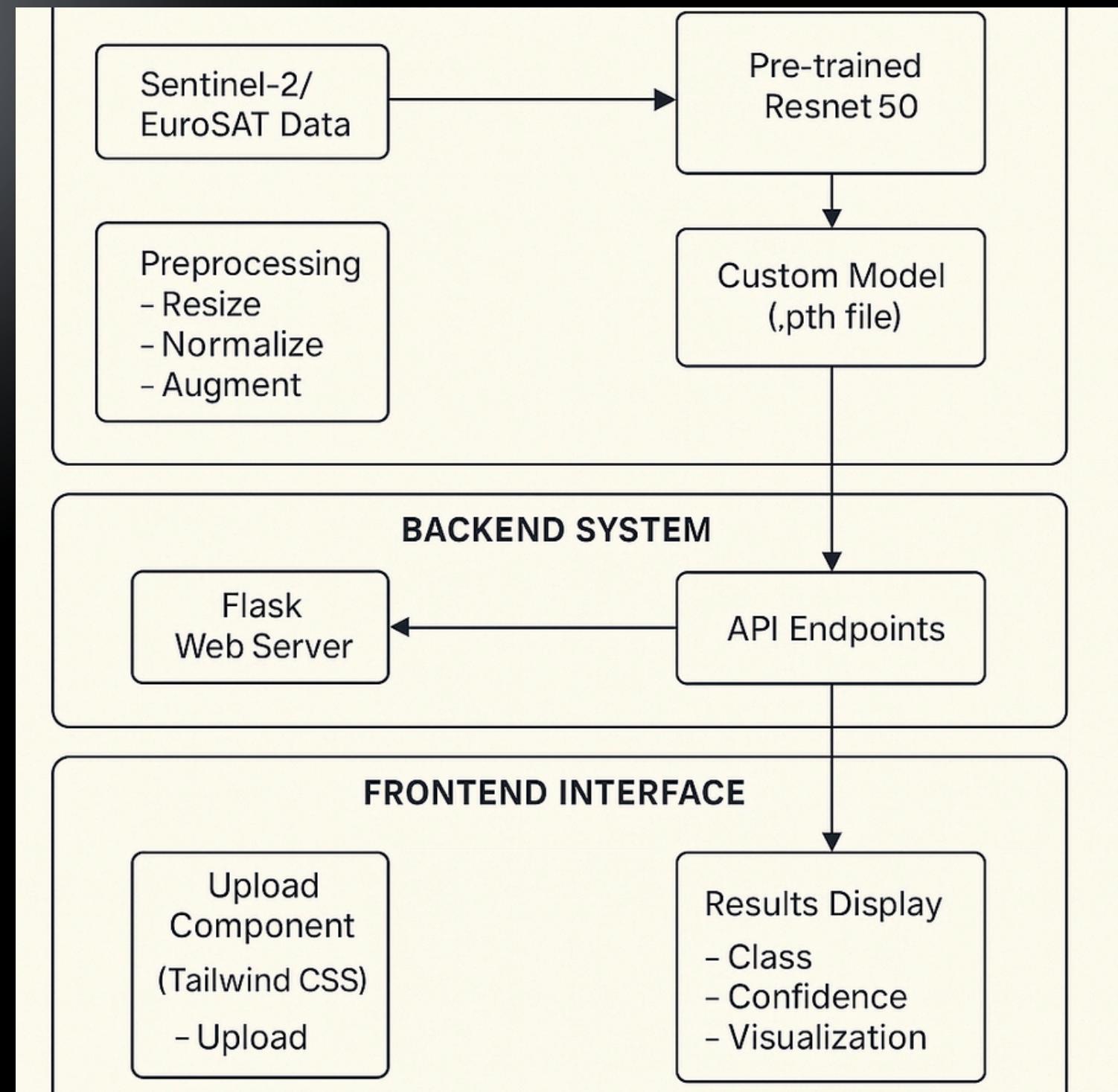
Supports environmental monitoring, urban planning, and resource management. this project demonstrates the use of deep learning for geospatial image analysis and computer vision tasks.

# PROJECT IDEA

- Source: EuroSAT, based on Sentinel-2 satellite images ,  
<https://www.kaggle.com/datasets/apollo2506/eurosat-dataset>
- The project aims to automate land cover classification using satellite imagery (EuroSAT dataset) to identify 10 types of land use (e.g., forests, crops, urban areas).
- Users can upload satellite images via a web interface, and the system predicts the land type using a trained ResNet-50 model.
- This tool is useful for environmental monitoring, agriculture, urban planning, and climate research.



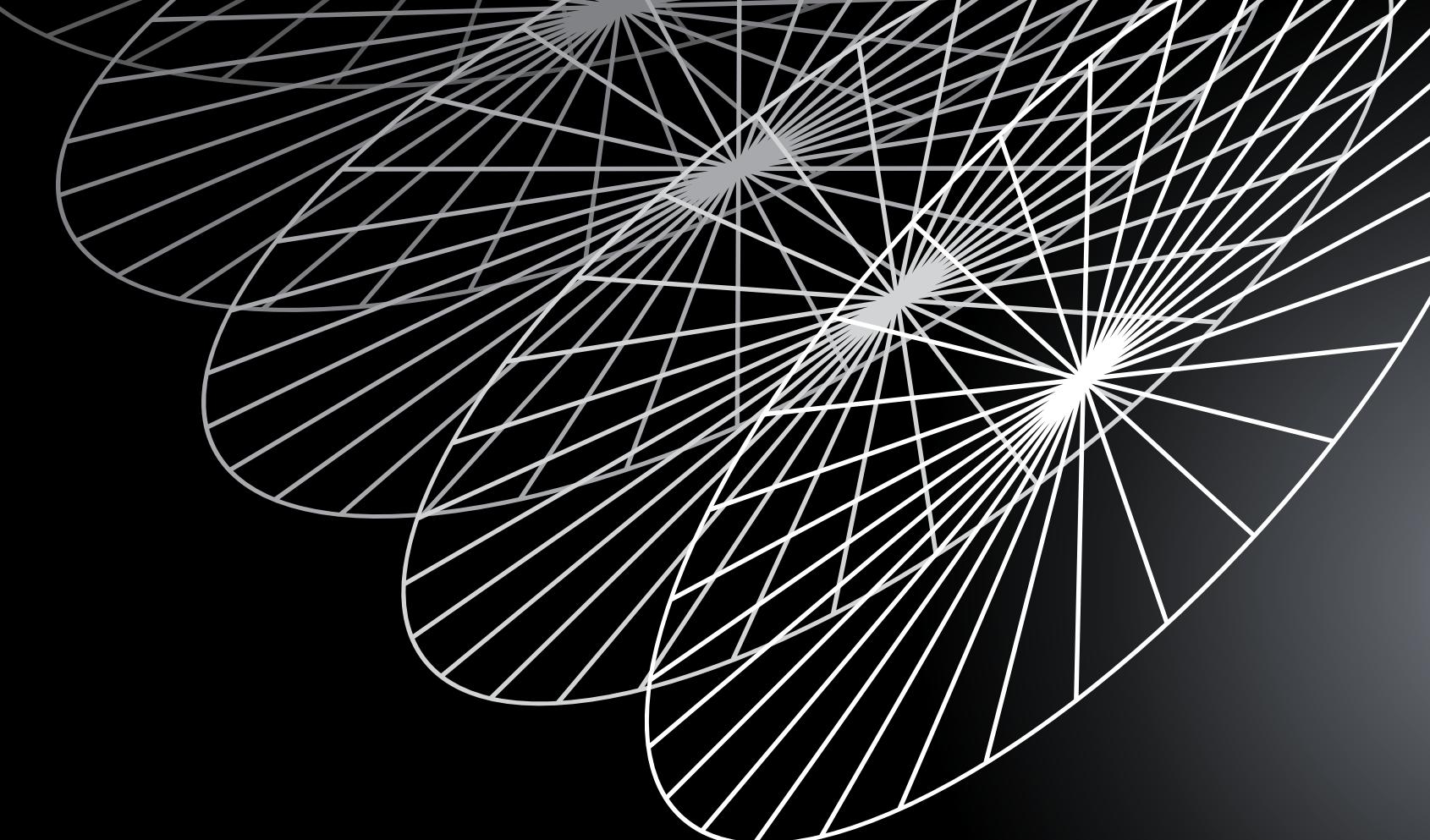
# SYSTEM ARCHITECTURE



# 1. DATA PIPELINE

- Data Source: EuroSAT dataset containing labeled satellite imagery
- Preprocessing Workflow:
  1. Image resizing (64x64 pixels)
  2. Data augmentation (flips, rotations, color jittering) for training set
  3. Normalization of pixel values (mean=0.5, std=0.5)
  4. Train/validation/test split (70%/10%/20%)

**Output: Achieved >90% accuracy on validation data**

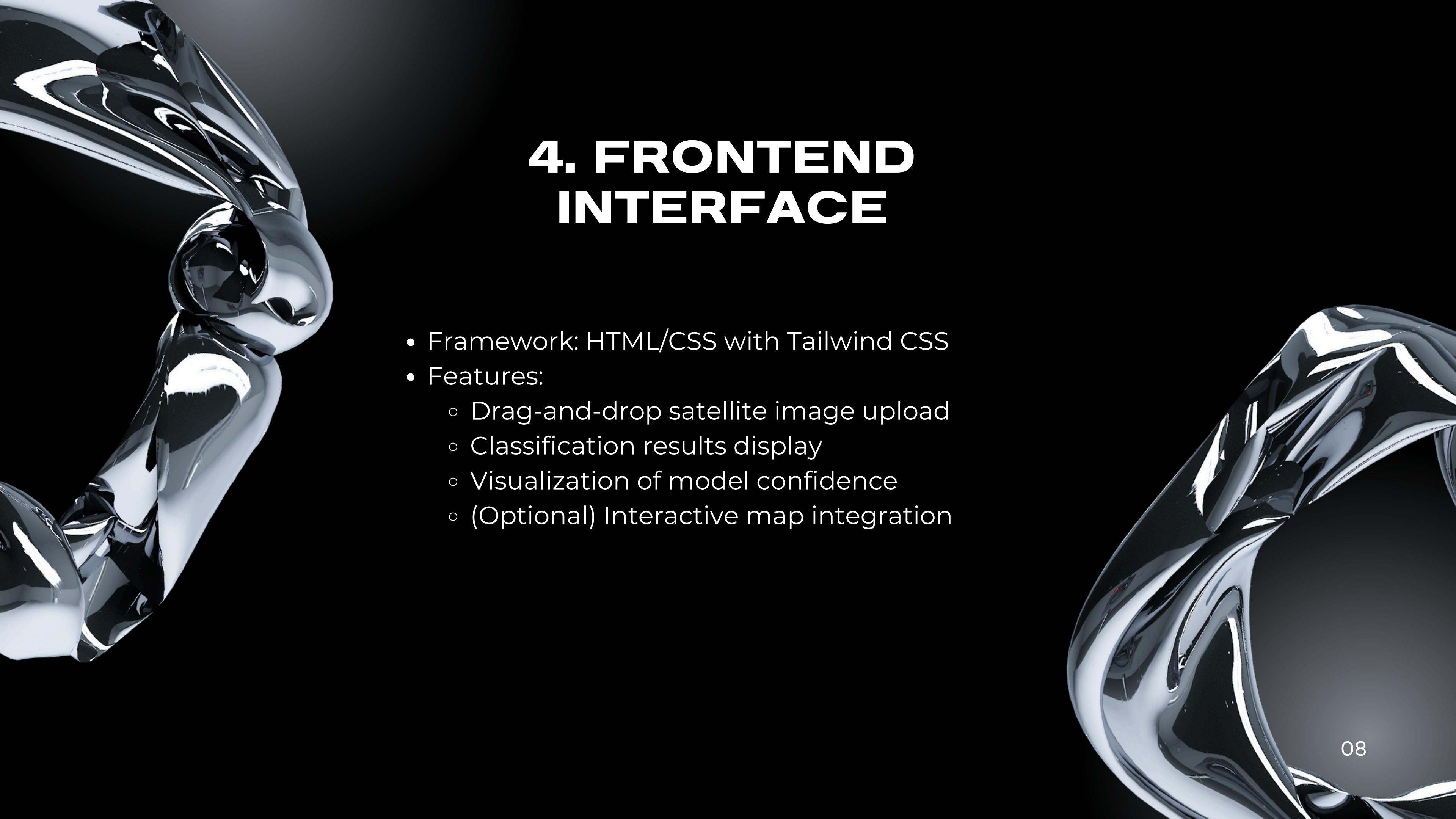


## 2. MODEL ARCHITECTURE

- Base Model: Pre-trained ResNet-50 (transfer learning)
- Modifications: Custom fully-connected layer for 10 land type classes
- Training Strategy:
  1. SGD optimizer with learning rate  $1e-3$
  2. Cross-entropy loss function
  3. Best model selection based on validation loss

### 3. BACKEND SYSTEM

- Framework: Flask web server
- API Endpoints:
  - Image upload endpoint
  - Prediction endpoint returning classified land type
  - (Optional) Confidence scores endpoint
- Model Serving: Pre-trained model loaded from saved .pth file



## 4. FRONTEND INTERFACE

- Framework: HTML/CSS with Tailwind CSS
- Features:
  - Drag-and-drop satellite image upload
  - Classification results display
  - Visualization of model confidence
  - (Optional) Interactive map integration

# CONCLUSION

## KEY FEATURES & CAPABILITIES

- Multi-class Land Classification: Accurately identifies 10 different land types
- High Accuracy: ~94% precision and recall on test data
- Responsive UI: User-friendly interface for satellite image analysis
- Visualizations: Displays prediction probabilities for better interpretability
- Scalable Architecture: Designed to handle multiple concurrent requests

## FUTURE ENHANCEMENTS

- Model Enhancements:
  1. Use ensemble methods and integrate U-Net for pixel-level segmentation.
  2. Enable multi-temporal data analysis.
- System Upgrades:
  1. Add API key authentication and caching for repeated queries.
  2. Enable batch processing and GeoJSON support.
- Data Pipeline Expansion:
  1. Include real-time Sentinel-2 acquisition and more satellite sources.
  2. Apply advanced preprocessing like atmospheric correction.

# THANK YOU

Land Type Classification using Sentinel-2 Satellite Images  
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Question and Answer Time

[Project Link](#)