

GROUP B

AI/MACHINE LEARNING PROJECT PROPOSAL

PROGRAMME:BCT

YEAR:3.1

UNIT NAME:ARTIFICIAL INTELLIGENCE

GROUP MEMBERS

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PROJECT TITLE

1.0 *Machine Learning - Crop Recommendation System*

2.0 ABSTRACT

-This project presents an intelligent web-based crop recommendation system that assists farmers and agricultural professionals in identifying the most suitable crops for their environmental conditions.

- By combining soil nutrient data, weather parameters, and machine learning models, the system provides accurate, data-driven recommendations that enhance productivity and support sustainable farming practices.

-The solution is deployed with a web-based user interface hosted on **Cloudflare**, and a **FastAPI backend** hosted on **Render** hand on hand with the model itself, demonstrating practical end-to-end system integration.

3.0 INTRODUCTION

- Agricultural productivity heavily depends on choosing crops that fit specific soil and climate conditions. Unfortunately, most farmers make decisions based on guesswork, resulting in poor yields and losses.
Our system bridges this gap by using **machine learning** to analyze soil and weather data (Nitrogen, Phosphorus, Potassium, pH, temperature, humidity, and rainfall) to recommend the most suitable crops for a given environment.
 - The project integrates both **frontend and backend components**, trained and fine-tuned collaboratively by all team members using **Google Colab**, to form a complete intelligent crop recommendation platform.
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4.0 OBJECTIVES

4.1 Main Objective

To develop an intelligent system that predicts and recommends the most suitable crops based on soil and climate data using machine learning.

4.2 Specific Objectives

- To collect, clean, and preprocess real agricultural data.
 - To train and fine-tune a neural network model for multi-crop prediction.
 - To design and deploy a responsive web interface with live input validation.
 - To connect the frontend and backend using a secure API endpoint.
 - To evaluate system accuracy and usability through testing and feedback
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5.0 METHODOLOGY

5.1 Data Collection

All team members participated in collecting and compiling environmental and crop data from agricultural research datasets, weather archives, and verified online sources.

Each record included:

 Nitrogen (N), Phosphorus (P), Potassium (K), Temperature (°C), Humidity (%), Soil pH, and Rainfall (mm).

5.2 Data Cleaning and Preprocessing

The collected data was thoroughly cleaned to remove duplicates, handle missing values, and standardize units. The dataset was normalized and transformed into tensors suitable for machine learning using **Python (Pandas, NumPy, Scikit-learn)**.

Labels were encoded using **MultiLabelBinarizer** to support multi-crop prediction.

5.3 Model Training and Fine-Tuning

- The model was trained collaboratively by all members using **GoogleColab**. An initial **Random Forest Classifier** was used to establish baseline accuracy.
After that, a **Multi-Layer Perceptron (MLP)** neural network was implemented in **PyTorch**, achieving stronger learning patterns.

Model Summary:

- Model Algorithm: MLP Neural Network
- Framework: PyTorch
- Loss Function: Binary Cross-Entropy (BCE)
- Optimizer: Adam
- Epochs: 50
- Validation Split: 20%
- Learning Rate: 0.001
- Training Platform: Google Colab

--All team members will continue to participate **fine-tuning hyperparameters** to improve convergence and reduce validation loss

6.0 SYSTEM DESIGN

6.1 Frontend (Cloudflare Pages)

The frontend was deployed at:

<https://group-b.pages.dev>

Features:

- User-friendly crop recommendation interface
- Gradient-styled input form and prediction area
- Input placeholders showing realistic ranges (e.g., *Nitrogen: 20–150 ppm*)
- Validation ensuring all entries are within range
- Alert system if users try to input more than **10 crops**
- Real-time range feedback (✓ for optimal conditions)

6.2 Backend (FastAPI on Render)

Backend deployed at:

<https://crop-sys.onrender.com/predict> —The backend integrates the trained PyTorch model (`crop.pth`) and `mlb.pkl` to process user input, predict top crops, and return JSON results.

Example API request (POST):

```
{  
  "N": 60,
```

```
"P": 40,  
"K": 70,  
"temperature": 26,  
"humidity": 60,  
"ph": 6.3,  
"rainfall": 300  
}  
  API Response Example:  
{  
  "top_crops": [  
    "ocotillo_fouquieria",  
    "pepper_bell",  
    "okra_clemson",  
    "cilantro_santo",  
    "tomato_cherokee",  
    "pomegranate_wonderful",  
    "cucumber_persian"  
  ]  
}
```

6.3 DOCUMENTATION OF THE PROGRESS

—We are currently documenting our progress on <https://group-b-docs.pages.dev>

7.0 CURRENT PROJECT STATUS

Completed:

- Data collection and cleaning
- Model training and validation
- Frontend and backend deployment
- API endpoint functional and tested
- Fine-tuning process ongoing

Current Stage:

→Keen Testing and fine-tuning the MLP model to improve accuracy.

8.0 MORE ON TEAM COLLABORATION

Member	Role	Key Responsibilities
Haron	Project Lead & Model Tuning	Coordinating work, tuning model parameters
Thaddeus	Backend Developer	FastAPI setup, API endpoint development, server deployment
Steve	Frontend Developer/UX DESIGNER	User interface design, validation system, responsiveness
Edmond	API Integration & Software Testing	Integrating backend with frontend, testing prediction reliability
Samwuel	Data Specialist	Data cleaning, preprocessing, feature scaling, and validation testing

- *All members collaboratively participated in data collection, model training on Colab, and fine-tuning activities.*
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9.0 EXPECTED OUTCOMES

1. A working, accessible web-based crop recommendation system.
2. Trained model capable of predicting multiple suitable crops for given conditions.
3. Improved understanding of machine learning workflows from data to deployment.
4. Increased awareness of applying AI in Kenyan agriculture.

10.0 POSSIBLE FUTURE IMPROVEMENTS

- ◆ Expanding the dataset to include more Kenyan regions and soil types.
- ◆ Integrating real-time weather data using APIs.

- ◆ Adding a mobile app version for offline field use.
- ◆ Improving prediction explanations using interpretable AI (XAI).
- ◆ Incorporating Swahili and local language support for inclusivity.

(If some of these are not achieved immediately, they serve as a roadmap for continued system)

11.0 CONCLUSION

- This project represents a successful collaborative effort to apply machine learning in solving a real agricultural challenge.
 - By integrating data science, software development, and teamwork, the Group B team created a functional crop recommendation system that demonstrates the power of AI for sustainable farming in Kenya.
 - Through testing and continuous fine-tuning, the model has achieved strong predictive performance, and the system stands ready for real-world evaluation and improvement.
- MISSION:  “*Empowering farmers through intelligent crop insights — one prediction at a time.*”