**Plant Disease Detection System for Sustainable Agriculture**

**Problem Statement**

Develop a CNN-based model capable of detecting and classifying plant diseases from images of leaves of various crops such as apple, cherry, grape, and corn. The model should accurately identify both healthy and diseased leaves while predicting the specific type of disease. This system will aid in precision agriculture by enabling early detection and effective disease management.

**Pipeline**

**Step 1: Define the Problem Clearly**

* You want to build a system that looks at leaf images and tells whether the plant is healthy or sick.
* If the plant is sick, it should also tell what disease it has.
* This helps farmers treat crops early and avoid big losses.

**Step 2: Collect and Understand the Data**

* Use a dataset with labeled leaf images from crops like apple, cherry, grape, and corn.
* The images should include both healthy and diseased leaves.
* Example diseases: Apple Scab, Grape Black Rot, Corn Rust, etc

**Step 3: Preprocess the Images**

* Resize all images to the same size (e.g., 224x224 pixels).
* Clean the data by removing poor-quality or wrong images.
* Use data augmentation (rotate, flip, zoom) to increase the variety of images and improve the model’s learning.

**Step 4: Build the CNN Model**

* Create a Convolutional Neural Network (CNN) that can learn features from the leaf images.
* A simple CNN includes:
  + Convolutional layers (to extract features)
  + Pooling layers (to reduce size)
  + Dense layers (to make predictions)

**Step 5: Train the Model**

* Feed the training images into the CNN model.
* Let the model learn patterns that help it identify diseases.
* Use tools like Keras or TensorFlow to train and adjust the model.
* Monitor the accuracy and loss using validation data.

**Step 6: Test and Evaluate the Model**

* Use the test data to see how well the model works on new images.
* Check:
  + Accuracy – How many predictions are correct?
  + Confusion Matrix – Which diseases are confused?
  + Precision and Recall – How well does it catch diseases?

**Step 7: Support Sustainable Agriculture**

* The system helps farmers detect problems early.
* Reduces the use of unnecessary pesticides.
* Improves crop quality and promotes sustainable farming practices.