**PROBLEM STATEMENT:**

Agriculture, the backbone of many developing economies, faces significant challenges due to plant diseases that threaten food security and farmer livelihoods. Traditional disease identification methods are time-consuming, dependent on expert knowledge, and inaccessible to many small-scale farmers, particularly in rural areas. In the context of sustainable development and green technology, there is a pressing need for an affordable, efficient, and scalable solution to diagnose plant diseases early and accurately.

This project addresses that need by developing a **Plant Disease Detection System using Machine Learning**, which leverages deep learning techniques—particularly Convolutional Neural Networks (CNNs)—to analyze leaf images and identify diseases with high accuracy. The system empowers farmers and agricultural stakeholders with a fast, user-friendly, and cost-effective tool, contributing to better crop health management, reduced chemical usage, and a more sustainable farming ecosystem aligned with the goals of Edunet's Green Technology Internship Initiative.

**PIPELINE:**

**1. Introduction**

We are building a system that detects plant diseases using Convolutional Neural Networks (CNN). It works similar to how humans recognize things visually — for example, identifying an object in a picture. The model will take an image of a plant leaf and tell whether it’s healthy or what disease it might have.

**2. Data Collection & Dataset Preparation**

* First, we collect a set of plant leaf images (both healthy and diseased).
* We divide the data into:
  + Training set – to train the model
  + Validation set – to check during training
  + Testing set – to test final performance

**3. Setting Up in Google Colab**

* Open Google Colab and sign in.
* Create a new notebook.
* Change the runtime to GPU (for faster processing).
* Save the setup and move to dataset handling.

**4. Dataset Upload and Unzip**

* Keep your dataset as a ZIP folder.
* Steps:
  + Upload it to Google Drive.
  + Mount Drive inside Colab.
  + Use Python code to unzip and access the dataset.

**5. Image Preprocessing**

* All images must be resized to the same dimensions (e.g., 100x100 or 224x224).
* Normalize the image pixel values.
* This helps the CNN model learn better.

**6. Image Augmentation**

* To improve accuracy and prevent overfitting, we do image augmentation.
* Techniques include:
  + Rotate
  + Flip
  + Zoom
  + Shift
* This creates more variety from the same set of images (like turning 4000 images into more by adding variations).

**7. CNN Model Building**

* We create a CNN model using layers like:
  + Convolution → Activation (ReLU) → Pooling → Dense layers
* This model will learn to recognize disease patterns in the leaf images.

**8. Training & Evaluation**

* Train the model using training data.
* Use validation data to check accuracy during training.
* After training, test the model on new leaf images to check if it's working well.
* It should say whether the plant is diseased or healthy, and what disease it has (if any).