**Plant Disease Detection System for Sustainable Agriculture**

1. **Introduction**  
   Plant diseases pose a significant challenge to sustainable agriculture, leading to reduced crop yields and economic losses. Early and accurate detection of plant diseases can enable timely interventions, improving crop management practices. This document outlines the problem statement and pipeline for developing a Convolutional Neural Network (CNN)-based plant disease detection system, as discussed in the session.
2. **Problem Statement**

The objective is to 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, ultimately supporting sustainable farming practices.

**Pipeline**  
The pipeline for developing the plant disease detection system, as discussed in the class, includes the following steps:

**Data Collection and Data Loading**

* Collect a dataset of leaf images for crops such as apple, cherry, grape, and corn etc. This could include publicly available datasets which contains labelled images of healthy and diseased leaves.
* Load the dataset into the system, ensuring proper organization for further processing.

**Dataset Splitting**

* Divide the dataset into three subsets:
  + **Train**: Used for training the model, containing multiple categories (e.g., category1, category2, ..., category N) representing different diseases or healthy states.
  + **Test**: Used for evaluating the final model performance, with similar categories.
  + **Validation (Valid)**: Used to monitor model performance during training and prevent overfitting, also categorized (e.g., cat1, cat2, ...).

**Model Training**

* Train a CNN-based model using the training dataset.
* The model will learn to classify leaf images into categories (healthy or specific diseases) based on features extracted from the images.
* Fine-tune the model using the validation set to optimize performance and reduce overfitting.

**Model Evaluation and Deployment**

* Evaluate the trained model using the test dataset, measuring metrics such as accuracy, precision, recall, and F1-score.
* Deploy the model for practical use, potentially as a web or mobile application, allowing farmers to upload leaf images and receive disease predictions.