Project Title: Apple Disease Detection Using Deep Learning

**Objective:**  
Develop a deep learning-based system to automatically detect and classify apple diseases from leaf images, helping farmers identify problems early and reduce crop loss.

**Technology Stack:**

* **Programming Language:** Python
* **Deep Learning Frameworks:** TensorFlow / Keras or PyTorch
* **Data Source:** Kaggle datasets (e.g., Apple Leaf Disease Dataset)
* **Environment:** Jupyter Notebook / VS Code / Google Colab
* **Optional Deployment:** Flask/Django for web app, Streamlit for simple UI

**Dataset Details:**

* **Kaggle Dataset:** Contains images of healthy and diseased apple leaves.
* **Classes may include:**
  + Apple Scab
  + Black Rot
  + Cedar-Apple Rust
  + Healthy leaves
* **Data Preprocessing:**
  + Resize images to uniform size (e.g., 224x224)
  + Normalize pixel values
  + Data augmentation (rotation, flipping, zooming) to improve model robustness

**Model Architecture:**

* Use **Convolutional Neural Networks (CNNs)** for image classification.
* Possible architectures:
  + Custom CNN with 3–5 convolutional layers
  + Transfer learning: VGG16, ResNet50, MobileNet for higher accuracy with limited data

**Workflow:**

1. **Data Collection:** Download and organize images from Kaggle.
2. **Preprocessing:** Clean, resize, normalize, augment.
3. **Model Design:** Define CNN or use transfer learning.
4. **Training:** Split data into train/test/validation sets; use appropriate loss (categorical cross-entropy) and optimizer (Adam).
5. **Evaluation:** Metrics: Accuracy, Precision, Recall, F1-score, Confusion Matrix.
6. **Deployment (Optional):**
   * Create a web interface where users upload leaf images.
   * Model predicts disease and shows suggested treatment.

**Challenges & Considerations:**

* Class imbalance in datasets (some diseases may have fewer images).
* Lighting and background variations in leaf images.
* Avoid overfitting via regularization and augmentation.

**Expected Outcome:**

* High accuracy (>90%) in classifying apple leaf diseases.
* An interactive interface for farmers to detect apple diseases easily.