### ****Collect the Dataset****

There are many open sources for collecting data (e.g., Kaggle, UCI Repository).  
In this project, we used 3 image classes:

Biodegradable

Recyclable

Trash

The dataset was downloaded from Kaggle.

**Link**: Dataset

After downloading, the data was unzipped and read into a pandas DataFrame.  
We visualized and analyzed it to understand class distribution and balance.

### ****Activity 1.1: Importing the Libraries****

python

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import tensorflow as tf import keras import pandas as pd import numpy as np import matplotlib.pyplot as plt import os, random

### ****Activity 1.2: Read the Dataset****

Dataset formats supported:

.csv, .json, .txt, .zip

We unzipped the dataset, organized it by class, and used pandas for analysis.

### ****Data Visualization****

Using Python's random and IPython.display, we selected and displayed images from each folder:

✅ Biodegradable → Correctly predicted

✅ Recyclable → Correctly predicted

✅ Trash → Correctly predicted

This helped validate both the dataset and the model’s predictions.

### ****Data Augmentation****

This was skipped since the dataset was already cleaned and cropped.  
In general, augmentation includes:

Rotation

Flipping

Scaling

Brightness/contrast changes

Skipping did not affect accuracy but slightly increased training time.

### ****Architecture****

csharp

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project/

├── app.py # Flask web backend

├── templates/ # HTML frontend templates

├── static/ # Uploaded images, CSS

└── Vgg16.h5 # Trained model (transfer learning)

### ****Conclusion****

CleanTech is an AI-based solution for automatic waste classification using transfer learning.  
It enables accurate, real-time image prediction through a web interface, contributing to smart waste management systems and environmental sustainability.