

# Project Description

**Title:** Object Classification using Machine Learning and Deep Learning

## **Objective:**

The objective of this project is to develop a classification model capable of accurately identifying objects in images. The project will explore two different approaches: one using traditional machine learning techniques with Scale-Invariant Feature Transform (SIFT) feature extraction and the bag-of-words representation. and Support Vector Classifier (SVC), and another utilising deep learning with Convolutional Neural Networks (CNN).

## **Methodology:**

### **1. Data Collection and Preprocessing:**

- Obtain a dataset containing images of various objects with corresponding labels.
- Preprocess the images by resizing, normalising, and augmenting them to enhance the model's generalisation.

### **2. Feature Extraction with SIFT and Bag-of-Words:**

- Extract SIFT features from the preprocessed images.
- Construct a visual vocabulary by clustering the SIFT descriptors using techniques like k-means clustering.
- Represent each image as a histogram of visual words using the bag-of-words approach.

### **3. Machine Learning with Bag-of-Words Representation:**

- Train a machine learning classifier (e.g., Support Vector Classifier, Random Forest, or Gradient Boosting) on the bag-of-words representation of images.
- Optimise hyperparameters using techniques like grid search or random search.
- Evaluate the model's performance using metrics like accuracy, precision, recall, F1-score, confusion matrix.

### **4. Deep Learning with CNN :**

- Design a CNN architecture suitable for image classification.
- Split the dataset into training, validation, and testing sets.
- Train the CNN model on the raw images or features extracted from a pre-trained CNN.
- Validate the model's performance on the validation set and adjust the architecture if necessary.
- Evaluate the final model on the testing set using various performance metrics.

#### 5. Comparison and Analysis:

- Compare the performance of the machine learning approach with the bag-of-words representation to the deep learning approach (if implemented).
- Analyse the strengths and weaknesses of each method, considering factors like accuracy, computational efficiency, and scalability.
- Identify scenarios where the hybrid approach may be more suitable than using deep learning alone.