# Midterm Project Report – Object Detection Challenge

## 1. Introduction

This report presents the process and outcomes of enhancing an object detection model based on the provided exercise using a lightweight architecture, under limited computational resources. The model was trained, evaluated, and tested in Google Colab using the CIFAR-10 dataset, adapted for a simple object detection task.

## 2. Dataset Selection and Preparation

The CIFAR-10 dataset was selected due to its small size, compatibility with free-tier cloud environments, and availability through TensorFlow Datasets. Although CIFAR-10 is a classification dataset, it was adapted to mimic object detection by incorporating image augmentation, resizing, and label-based evaluation.

Key steps:

* - Downloaded and explored CIFAR-10 dataset
* - Normalized and resized all images to 96x96
* - Performed data augmentation (flips, shifts, rotations)
* - Adapted training and validation sets with class balancing in mind

## 3. Model Architecture and Training

I used a pre-trained MobileNetV2 model with modified top layers. The convolutional base was partially frozen to retain learned features, while top layers were custom-built for the classification task. I also tested different input shapes (32x32 and 96x96) to match model requirements.

Key configurations:

* - Base model: MobileNetV2 (pre-trained on ImageNet)
* - Top layers: Flatten + Dense(128) + Dense(num\_classes)
* - Optimizer: Adam, Loss: categorical\_crossentropy
* - Training: 10-15 epochs, batch size: 32

## 4. Results and Evaluation

Model performance was evaluated using training/validation accuracy, test set accuracy, and confusion matrix analysis.

Final test accuracy: ~56%

Observations from confusion matrix:

* - Misclassifications were frequent between similar-looking categories
* - Model performed better with larger image sizes (96x96)

The following visualizations were produced in Colab:

* - Accuracy and loss curves across epochs
* - Confusion matrix heatmap

## 5. Reflection

This project reinforced the importance of pre-trained models, data preparation, and adapting image dimensions to model expectations. Using limited resources pushed us to optimize data and architecture while monitoring performance carefully.

## 6. Conclusion

The CIFAR-10 experiment with MobileNetV2 successfully demonstrated the adaptation of a classification dataset to mimic object detection. Accuracy improved with larger image dimensions and data augmentation, and results were visualized with accuracy/loss plots and a confusion matrix.