Machine Learning : Final Project (TOPIC -2)
Nilam Bhosale (Student ID - 1138964)
Durvesh Shah (Student ID - 1131901)

Convolutional Neural Network : Resnet101

- **A convolutional neural network with 101 layers is known as ResNet-101. The ImageNet database contains a pre-trained version of the network that has been trained on over a million photos. The network can identify images into 1000 different object categories, including keyboard, mouse, pencil, and a variety of animals. As a result, the network has picked up rich feature representations for a variety of images.**

1. Cifar10 Dataset

- The CIFAR-10 dataset contains 60000 32x32 colour images divided into ten classes, each with 6000 images. There are 50000 images for training and 10,000 images for testing.
- Each of the 10000 images in the dataset is separated into five training batches and one test batch. The test batch contains exactly 1000 images from each class, chosen at random. The remaining images are distributed in training batches in a random order, however some batches may contain more images from one class than others. The training batches contain exactly 5000 images from each class between them.

- **Dataset : CIFAR-10**
- **Libraries used while implementing Resnet-101 model - Tensorflow, Keras, matplotlib, numpy, cv2 and os**
- **CNN Model - Resnet101**
- **Input shape/Image Width and Height - 227x227x3**
- **Batch Size - 28**
- **Learning Rate - 0.000057**
- **No of Epochs - 15**
- **Environment - Google Colab**

- Name of Python Class file attached in courselink : cifar10.py
  - Log files :
    - Cifar10_Run1.pdf
    - Cifar10_Run2.pdf
    - Cifar10_Run3.pdf
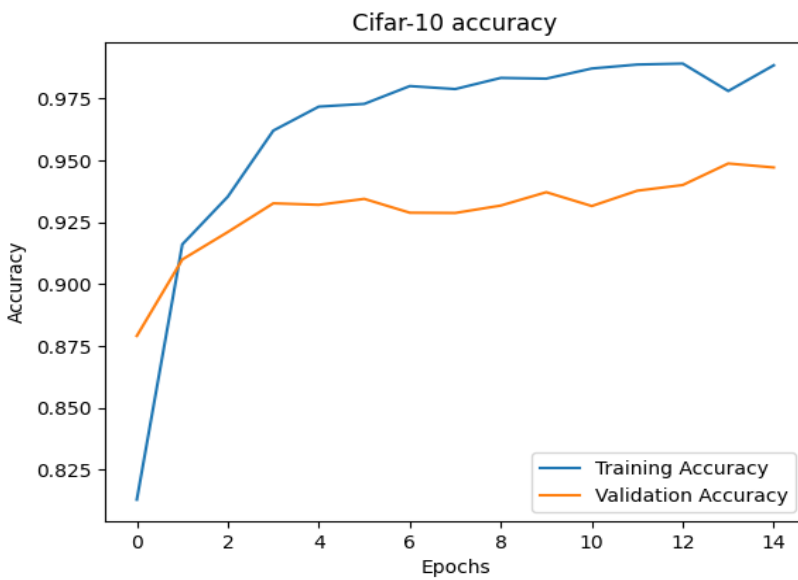 - code and output logs are uploaded in courselink

B] Output :

#Run1 :
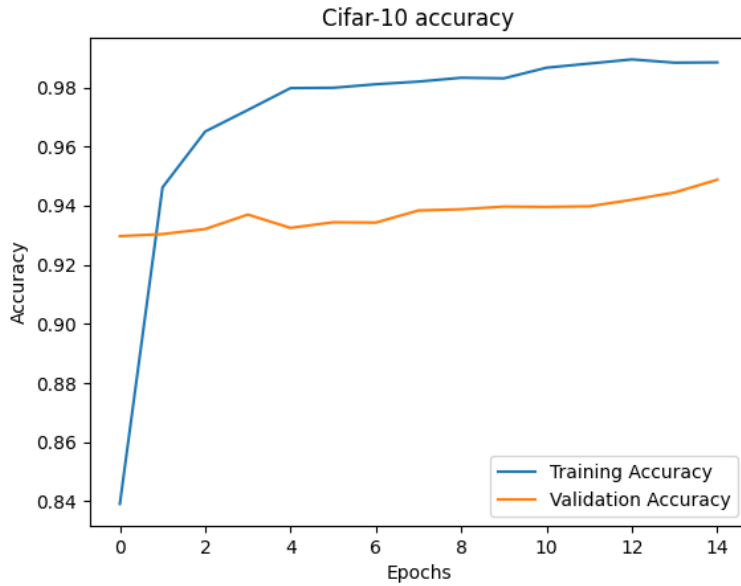
Output Details #Run 1 :
- **Average Training Accuracy : 0.9830**
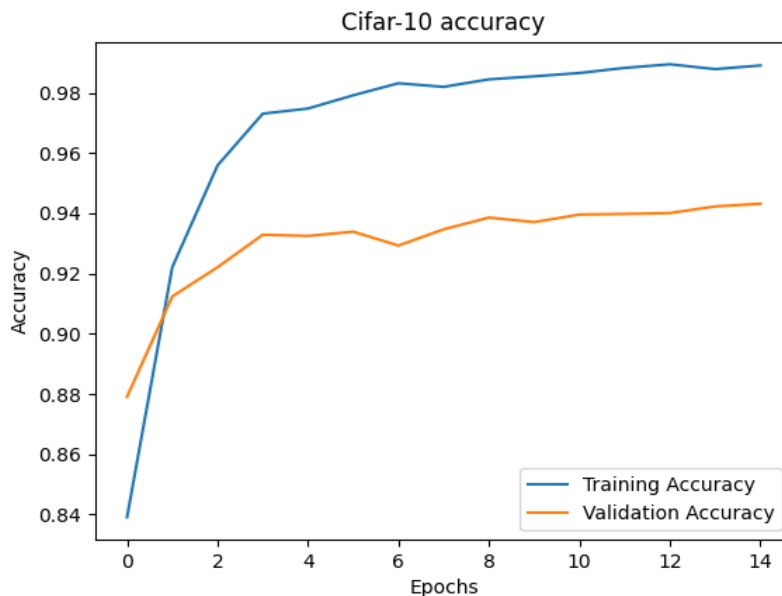- **Average Testing Accuracy : 0.9501**

#Run2 :

Output Details #Run 2 :
- **Average Training Accuracy : 0.9888**
- **Average Testing Accuracy : 0.9478**

#Run3 :

Output Details #Run 3 :
- **Average Training Accuracy : 0.9891**
- **Average Testing Accuracy : 0.9492**

2. Caltech-101 Dataset

- Caltech-101 is made up of images of things from 101 different classes, plus one background clutter class. A single object is labelled on each photograph. Each class has approximately 40 to 800 photos, for a total of approximately 9000 photographs. Images come in a variety of sizes, with common edge lengths ranging from 200 to 300 pixels. Only image-level labels are included in this version.

- **Dataset : Caltech-101**
- **Libraries used while implementing Resnet101 model - Tensorflow, Keras, matplotlib, numpy, cv2 and os**
- **CNN Model - Resnet101**

- **Input shape/Image Width and Height - 227x227x3**
- **Batch Size - 28**
- **Learning Rate - 0.00055**
- **No of Epochs - 50**
- **Environment - Google Colab**

- Name of Python Class file attached in courselink : Caltech_101.py
  - Log files :
    - Caltech_101_Run1.pdf
    - Caltech_101_Run2.pdf
    - Caltech_101_Run3.pdf
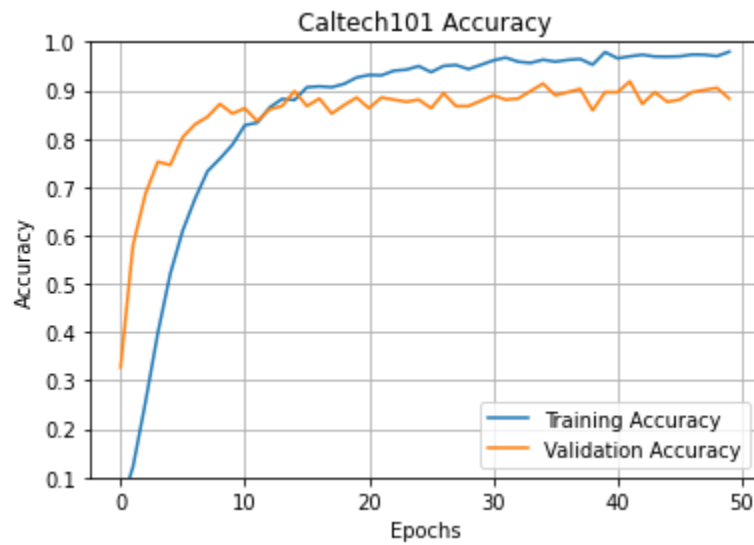
  - code and output logs are uploaded in courselink
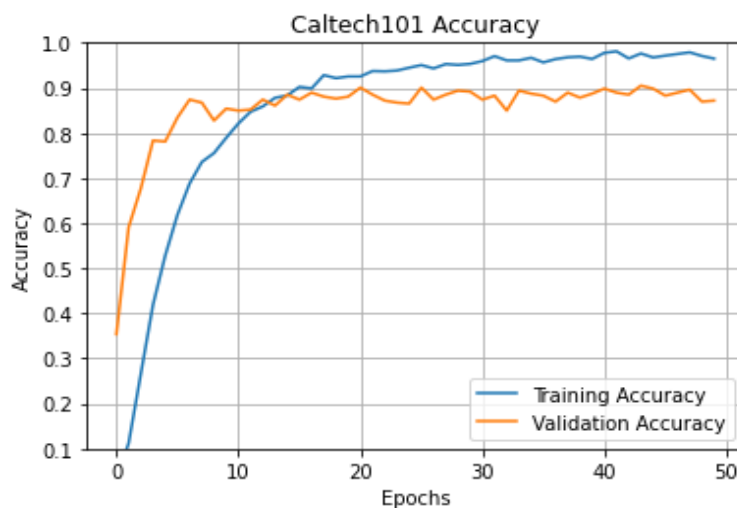
#Run1 :

Output Details #Run 1 :
- **Average Training Accuracy : 0.9648**
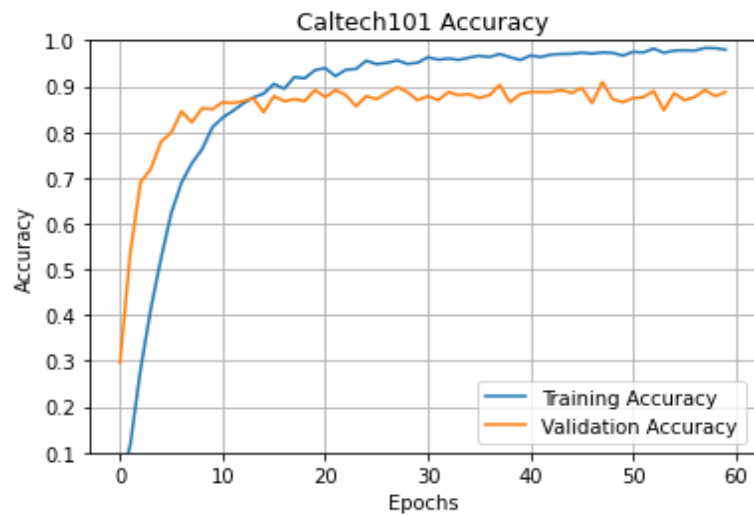- **Average Testing Accuracy : 0.8897**

#Run2 :

Output Details #Run 2 :
- **Average Training Accuracy : 0.9795**
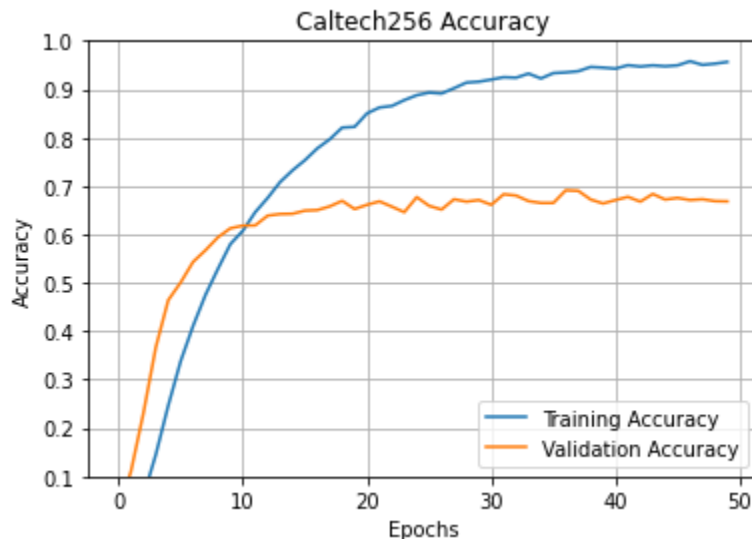- **Average Testing Accuracy : 0.8990**

#Run3 :

Output Details #Run 3 :
- **Average Training Accuracy : 0.9795**
- **Average Testing Accuracy : 0.9002**

3. Caltech-256 Dataset

- Caltech-256 is a 257-class object recognition dataset that contains 30,607 real-world photos of various sizes (256 object classes and an additional clutter class). At least 80 photos are used to represent each class. The Caltech-101 dataset is a subset of this one.
- **Dataset : Caltech-256**
- **Libraries used while implementing Resnet101 model - Tensorflow, Keras, matplotlib, numpy, cv2 and os**
- **CNN Model - Resnet101**
- **Input shape/Image Width and Height - 227x227x3**
- **Batch Size - 28**
- **Learning Rate - 0.0005**
- **No of Epochs - 50**
- **Environment - Google Colab**

- Name of Python Class file attached in courselink : cifar10.py
  - Log files :
    - Caltech_256_Run1.pdf
    - Caltech_256_Run2.pdf
    - Caltech_256_Run3.pdf
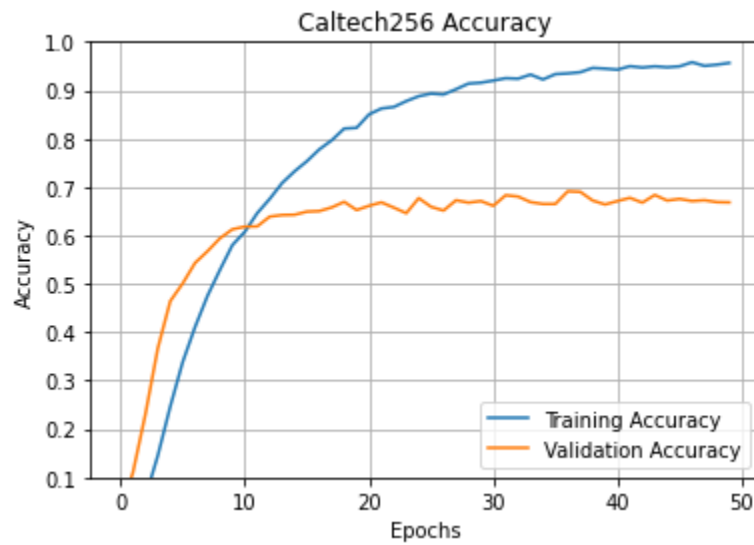 - code and output logs are uploaded in courselink

#Run1 :

Output Details #Run 1 :
- **Average Training Accuracy : 0.9563**
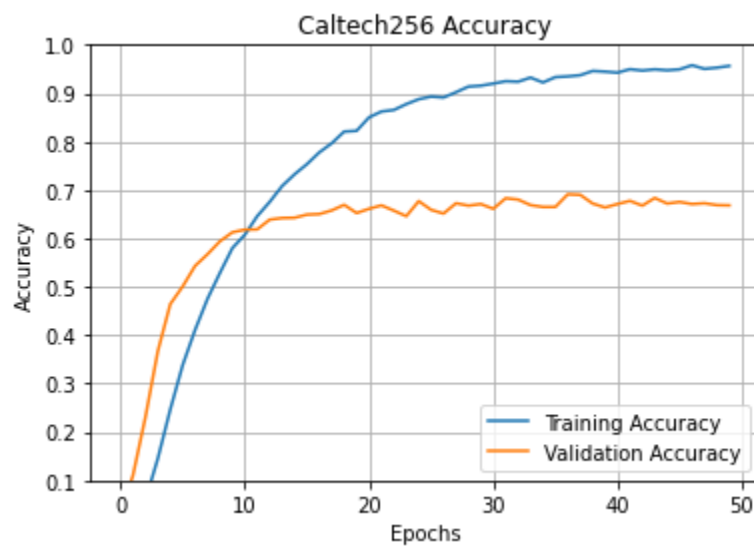- **Average Testing Accuracy : 0.6805**

#Run2 :

Output Details #Run 1 :
- **Average Training Accuracy : 0.9540**
- **Average Testing Accuracy : 0.6892**

#Run3 :

Output Details #Run 3 :
- **Average Training Accuracy : 0.9598**
- **Average Testing Accuracy : 0.6823**

A] Overall Testing Accuracy for Cifar-10 Dataset

	Run 1	Run2	Run3	Average
Testing Accuracy	95.01%	94.78%	94.92%	**94.90% = ~95%**

Final Approximate Accuracy for Cifar10 : 95%

B] Overall Testing Accuracy for Caltech-101 Dataset

	Run 1	Run2	Run3	Average
Testing Accuracy	88.97%	89.90%	90.02%	**89.63% = ~90%**

Final Approximate Accuracy for Caltech- 101 : 90%

C] Overall Testing Accuracy for Caltech256 Dataset

	Run 1	Run2	Run3	Average
Testing Accuracy	68.05%	68.92%	68.23%	**68.53% = ~69%**

Final Approximate Accuracy for Caltech- 256 : 69%

Top-1 Accuracy = (Cifar + Caltech101 + Caltech256)/3
$$= (95 + 90 + 69)/3$$
$$= 84.66\%$$
$$= 85\%$$