Build a CNN Based Classifier for Classifying the Common objects using CIFAR10 Datasets.

Requirements:

- Five Number of Convolutional 2D Layers starting with 1024 filters.
- Kernel size 3 x 3
- Two Average Pooling Layers, Each after two Convolutional 2D layers.
- Stride 2
- Padding 'valid'
- Optimizer Adam
- Loss function catagorical_crossentropy

```
import tensorflow as tf
from tensorflow.keras.datasets import cifar10
from tensorflow.keras.layers import Conv2D, AveragePooling2D, Flatten, Dense
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
# Load CIFAR-10 dataset (normalized for better training)
(x_train, y_train), (x_test, y_test) = cifar10.load_data()
x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0
```

```
# Convert class labels to one-hot encoded vectors
num_classes = 10
y_train = tf.keras.utils.to_categorical(y_train, num_classes)
y_test = tf.keras.utils.to_categorical(y_test, num_classes)
```

```
print(x_train.shape[1:])
```

```
(32, 32, 3)
```

```
# Define the CNN model
model = Sequential()

# First convolutional layer
model.add(Conv2D(1024, kernel_size=(3, 3), activation='relu', padding='valid', input_shape=(32, 32, 3)))

# Second convolutional layer
model.add(Conv2D(512, kernel_size=(3, 3),  activation='relu', padding='valid'))

#First Average Pooling Layer
model.add(AveragePooling2D(pool_size=(2, 2),strides=(2, 2)))

# Third convolutional layer
model.add(Conv2D(256, kernel_size=(3, 3), activation='relu', padding='valid'))

# Fourth convolutional layer
model.add(Conv2D(128, kernel_size=(3, 3), activation='relu', padding='valid'))

#Second Average Pooling
model.add(AveragePooling2D(pool_size=(2, 2),strides=(2, 2)))

# Fifth convolutional layer
model.add(Conv2D(64, kernel_size=(3, 3), activation='relu', padding='valid'))

# Flatten the output for feeding into the dense layers
model.add(Flatten())

# Dense layer with 10 units (number of classes) for classification
model.add(Dense(num_classes, activation='softmax'))
```

```
# Compile the model
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

```
# Train the model
history=model.fit(x_train, y_train, epochs=5, batch_size=32, validation_data=(x_test, y_test))
```

```
Epoch 1/5
1563/1563 [==============================] - 121s 77ms/step - loss: 1.7141 - accuracy: 0.3750 - val_loss: 1.3935 - val_accuracy: 0.4
Epoch 2/5
1563/1563 [==============================] - 122s 78ms/step - loss: 1.2816 - accuracy: 0.5371 - val_loss: 1.3590 - val_accuracy: 0.5
Epoch 3/5
```

```
1563/1563 [==============================] - 122s 78ms/step - loss: 1.0761 - accuracy: 0.6157 - val_loss: 1.0378 - val_accuracy: 0.6
Epoch 4/5
1563/1563 [==============================] - 118s 76ms/step - loss: 0.9224 - accuracy: 0.6768 - val_loss: 0.9283 - val_accuracy: 0.6
Epoch 5/5
1563/1563 [==============================] - 122s 78ms/step - loss: 0.8096 - accuracy: 0.7177 - val_loss: 0.9082 - val_accuracy: 0.6
```

```
# Evaluate the model on the test set
test_loss, test_acc = model.evaluate(x_test, y_test)
print('Test accuracy:', test_acc)
```

```
313/313 [==============================] - 7s 23ms/step - loss: 0.9082 - accuracy: 0.6825
Test accuracy: 0.6825000047683716
```

```
from sklearn.metrics import confusion_matrix, classification_report
import matplotlib.pyplot as plt
```

```
# Make predictions on the test set
predictions = model.predict(x_test)
```

```
313/313 [==============================] - 7s 22ms/step
```

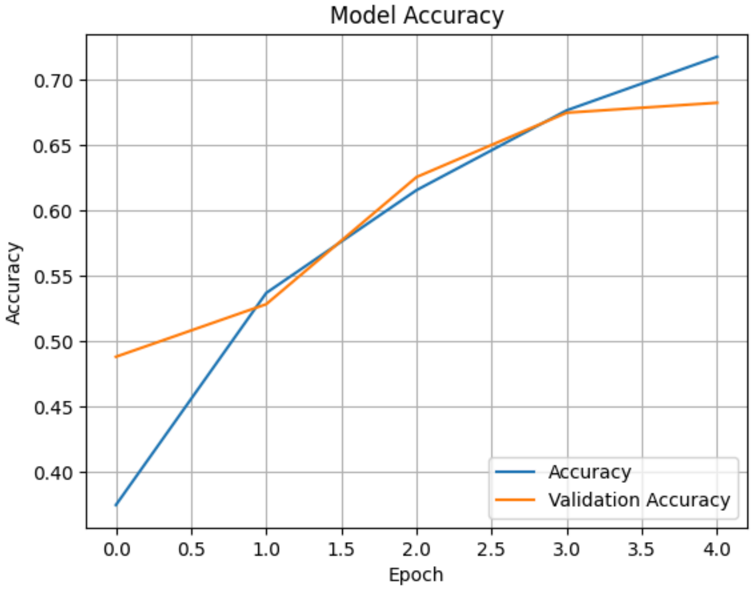
```
# Calculate confusion matrix
cm = confusion_matrix(y_test.argmax(axis=1), predictions.argmax(axis=1))
print('Confusion Matrix:\n', cm)
```

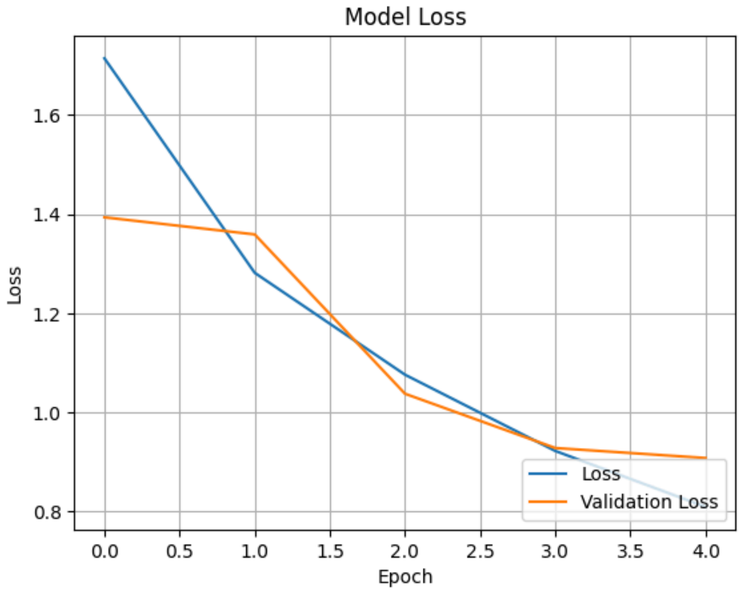
```
Confusion Matrix:
 [[738  23 125  15  12   8   7   1  30  41]
 [ 23 832  20   8   4  16  14   0  12  71]
 [ 56   4 695  32  44  88  54  15   6   6]
 [ 18   7 119 414  54 312  51  15   2   8]
 [ 20   4 152  52 572  86  60  44   4   6]
 [  4   5  74  78  41 752  16  27   1   2]
 [  6   4  87  52  27  59 760   1   1   3]
 [ 10   1  83  27  95 159   4 604   1  16]
 [130  51  63  17   7  16   5   1 673  37]
 [ 29 106  12  18   7  21   7   5  10 785]]
```

```
# Generate classification report
print('Classification Report:\n', classification_report(y_test.argmax(axis=1), predictions.argmax(axis=1)))
```

```
Classification Report:
               precision    recall  f1-score   support

           0       0.71      0.74      0.73      1000
           1       0.80      0.83      0.82      1000
           2       0.49      0.69      0.57      1000
           3       0.58      0.41      0.48      1000
           4       0.66      0.57      0.61      1000
           5       0.50      0.75      0.60      1000
           6       0.78      0.76      0.77      1000
           7       0.85      0.60      0.71      1000
           8       0.91      0.67      0.77      1000
           9       0.81      0.79      0.79      1000

    accuracy                           0.68     10000
   macro avg       0.71      0.68      0.69     10000
weighted avg       0.71      0.68      0.69     10000
```

```
# Plot accuracy and loss curves
plt.plot(history.history['accuracy'], label='Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(loc='lower right')
plt.grid(True)
plt.show()

plt.plot(history.history['loss'], label='Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Model Loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(loc='lower right')
plt.grid(True)
plt.show()
```


Model Accuracy
Accuracy
Epoch
Accuracy
Validation Accuracy
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0


Model Loss
Loss
Epoch
Loss
Validation Loss
0.8
1.0
1.2
1.4
1.6
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0