Ex No: 3 **BUILD A CONVOLUTIONAL NEURAL NETWORK**
Date: 16/08/2024

Aim:

To build a simple convolutional neural network with Keras/TensorFlow.

Procedure:

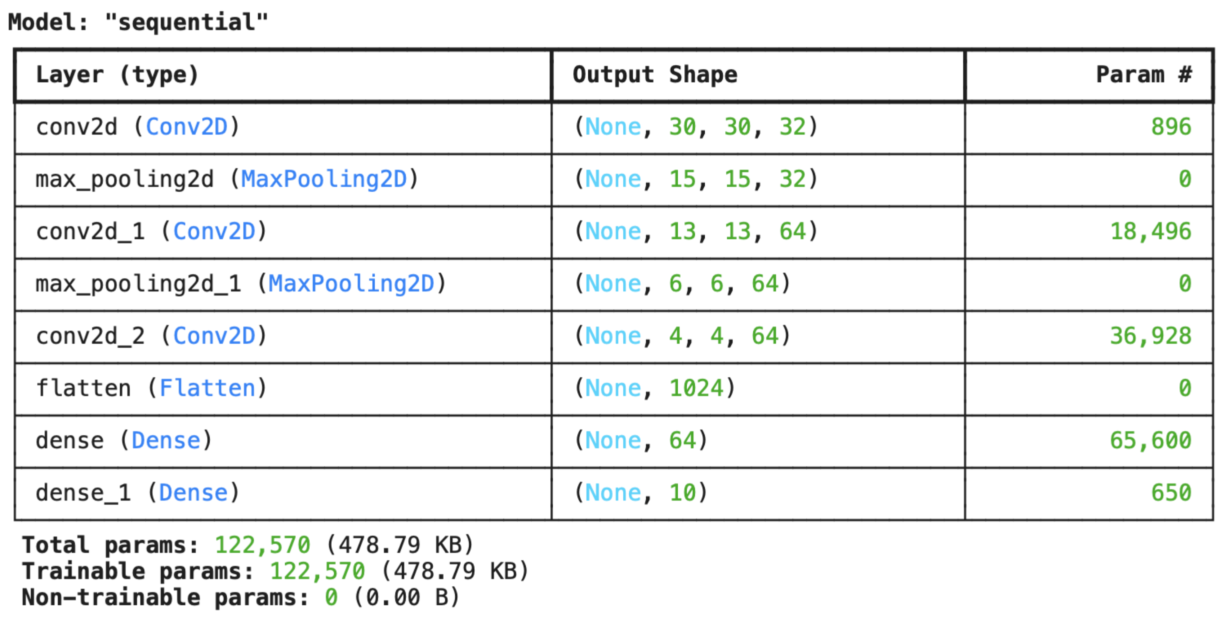
1. Download and load the dataset.
2. Perform analysis and preprocessing of the dataset.
3. Build a simple convolutional neural network model using Keras/TensorFlow.
4. Compile and fit the model.
5. Perform prediction with the test dataset.
6. Calculate performance metrics.

Program:

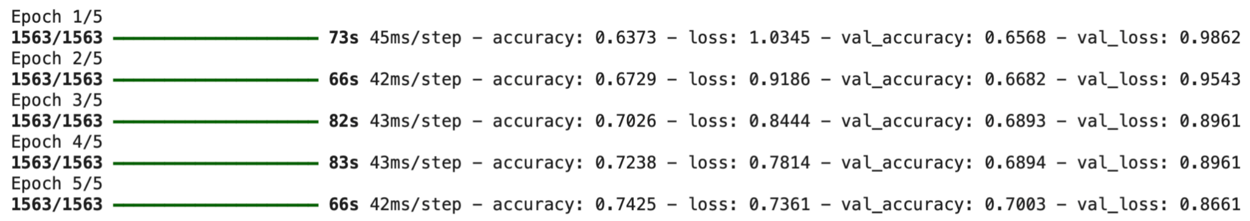
```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

import seaborn as sns

import tensorflow as tf

import keras

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Dense,Dropout, Flatten, Conv2D, MaxPooling2D, BatchNormalization, LeakyReLU, Activation

from tensorflow.keras import datasets, layers, models

from tensorflow.keras.optimizers import SGD,Adam

import warnings

warnings.filterwarnings('ignore')

(train_images, train_labels), (test_images, test_labels) = datasets.cifar10.load_data()

# Normalize pixel values to be between 0 and 1
```

```
train_images, test_images = train_images / 255.0, test_images / 255.0
class_names = ['airplane', 'automobile', 'bird', 'cat', 'deer',
               'dog', 'frog', 'horse', 'ship', 'truck']

plt.figure(figsize=(10,10))
for i in range(25):
  plt.subplot(5,5,i+1)
  plt.xticks([])
  plt.yticks([])
  plt.grid(False)
  plt.imshow(train_images[i])
  # The CIFAR labels happen to be arrays,
  # which is why you need the extra index
  plt.xlabel(class_names[train_labels[i][0]])
plt.show()
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(10))
model.summary()
```

Output:



```
Model: "sequential"
┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━┓
┃ Layer (type)                         ┃ Output Shape                ┃         Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━┩
│ conv2d (Conv2D)                      │ (None, 30, 30, 32)          │             896 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ max_pooling2d (MaxPooling2D)         │ (None, 15, 15, 32)          │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ conv2d_1 (Conv2D)                    │ (None, 13, 13, 64)          │          18,496 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ max_pooling2d_1 (MaxPooling2D)       │ (None, 6, 6, 64)            │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ conv2d_2 (Conv2D)                    │ (None, 4, 4, 64)            │          36,928 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ flatten (Flatten)                    │ (None, 1024)                │               0 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ dense (Dense)                        │ (None, 64)                  │          65,600 │
├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤
│ dense_1 (Dense)                      │ (None, 10)                  │             650 │
└──────────────────────────────────────┴─────────────────────────────┴─────────────────┘
 Total params: 122,570 (478.79 KB)
 Trainable params: 122,570 (478.79 KB)
 Non-trainable params: 0 (0.00 B)
```



```
Epoch 1/5
1563/1563 ━━━━━━━━━━━━━━━━━━━━ 73s 45ms/step - accuracy: 0.6373 - loss: 1.0345 - val_accuracy: 0.6568 - val_loss: 0.9862
Epoch 2/5
1563/1563 ━━━━━━━━━━━━━━━━━━━━ 66s 42ms/step - accuracy: 0.6729 - loss: 0.9186 - val_accuracy: 0.6682 - val_loss: 0.9543
Epoch 3/5
1563/1563 ━━━━━━━━━━━━━━━━━━━━ 82s 43ms/step - accuracy: 0.7026 - loss: 0.8444 - val_accuracy: 0.6893 - val_loss: 0.8961
Epoch 4/5
1563/1563 ━━━━━━━━━━━━━━━━━━━━ 83s 43ms/step - accuracy: 0.7238 - loss: 0.7814 - val_accuracy: 0.6894 - val_loss: 0.8961
Epoch 5/5
1563/1563 ━━━━━━━━━━━━━━━━━━━━ 66s 42ms/step - accuracy: 0.7425 - loss: 0.7361 - val_accuracy: 0.7003 - val_loss: 0.8661
```

Result:

Thus the program to build a simple convolutional neural network using Keras/TensorFlow is implemented successfully.