# WEEK - 13

**Aim:-** To analyze and understand the architecture and working principle of a pretrained deep learning model (such as VGG16, ResNet, Inception) used for image classification and feature extraction.

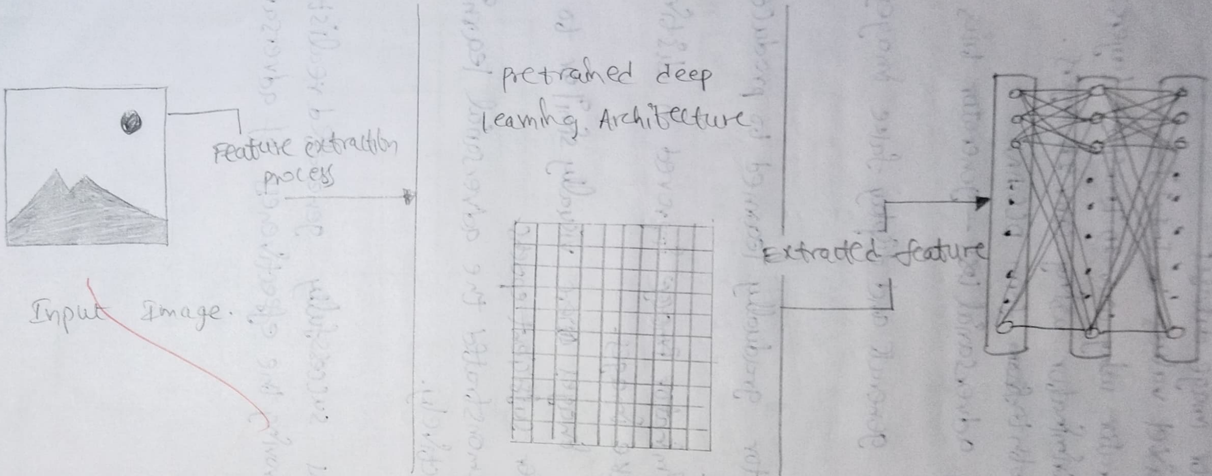
**Algorithm:-**

1) Import a pre-trained model from Keras applications.
2) Load model with pretrained weights.
3) Display model summary (layers, parameters).
4) Analyze layer Types (conv, pool, Dense).
5) Identify trainable vs non-trainable parameters.
6) optionally, visualize feature maps.

**pseudocode:-**

```
    Begin
Import deep learning library (eg:-Tensorflow, pytorch)
load a pre trained model
        -> include weights = 'imagenet'
        -> exclude top layer if using for feature extraction
Display model summary
    -> print layer names, types, output shape & parameter
       counts.
For each layer in model:
        -> Identify type (conv, pool, Dense, etc...)
        -> Note activation function and No. of filters.
visualize architecture diagram
    -> show flow from input image to output class.

Train the model
Freeze lower layers if needed.
```

# Usage of pretrained Architecture


Feature extraction process
Input Image.
pretrained deep learning Architecture
Extracted feature

observation :-

→ The pre-trained model has convolutional, pooling and fully connected layers.

→ Convolutional layers extract features, pooling layers reduce size.

→ pre-trained weights allow faster training and better accuracy.

→ Sample images are correctly classified (or) have meaningful features extracted.

Conclusion :-

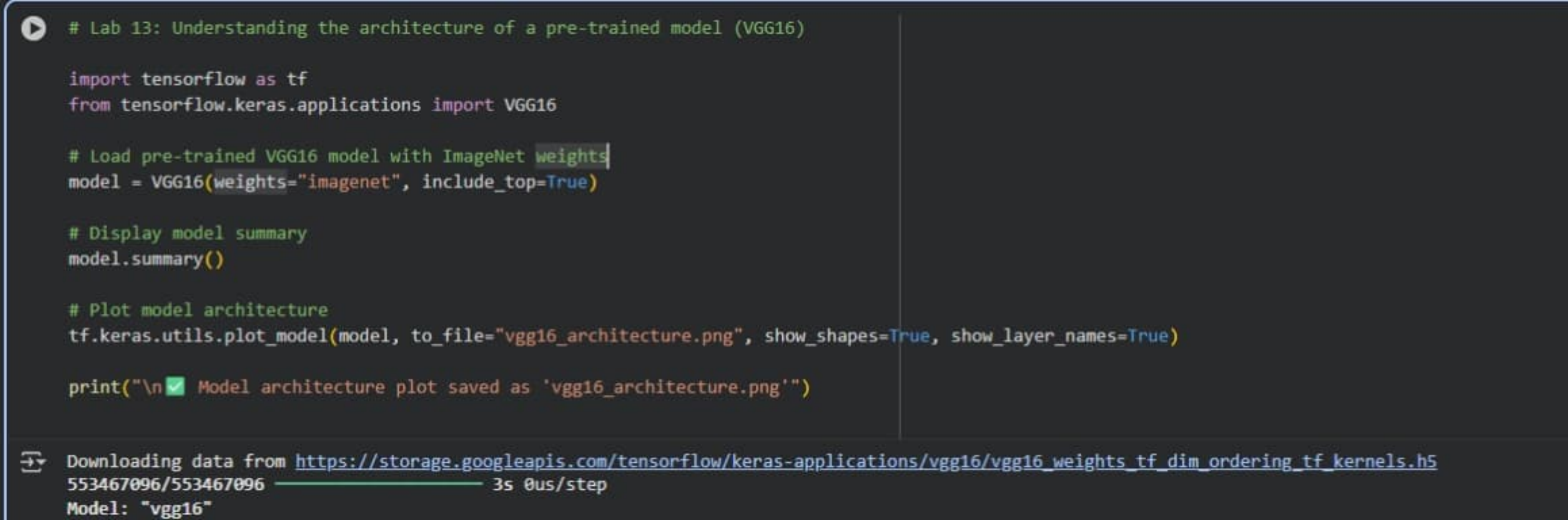
pre trained models save time and computation by using already-learned image features, making them powerful for transfer learning and real world AI applications.

Results :-

The Architecture of pre-trained CNN's was successfully analyzed and visualized.

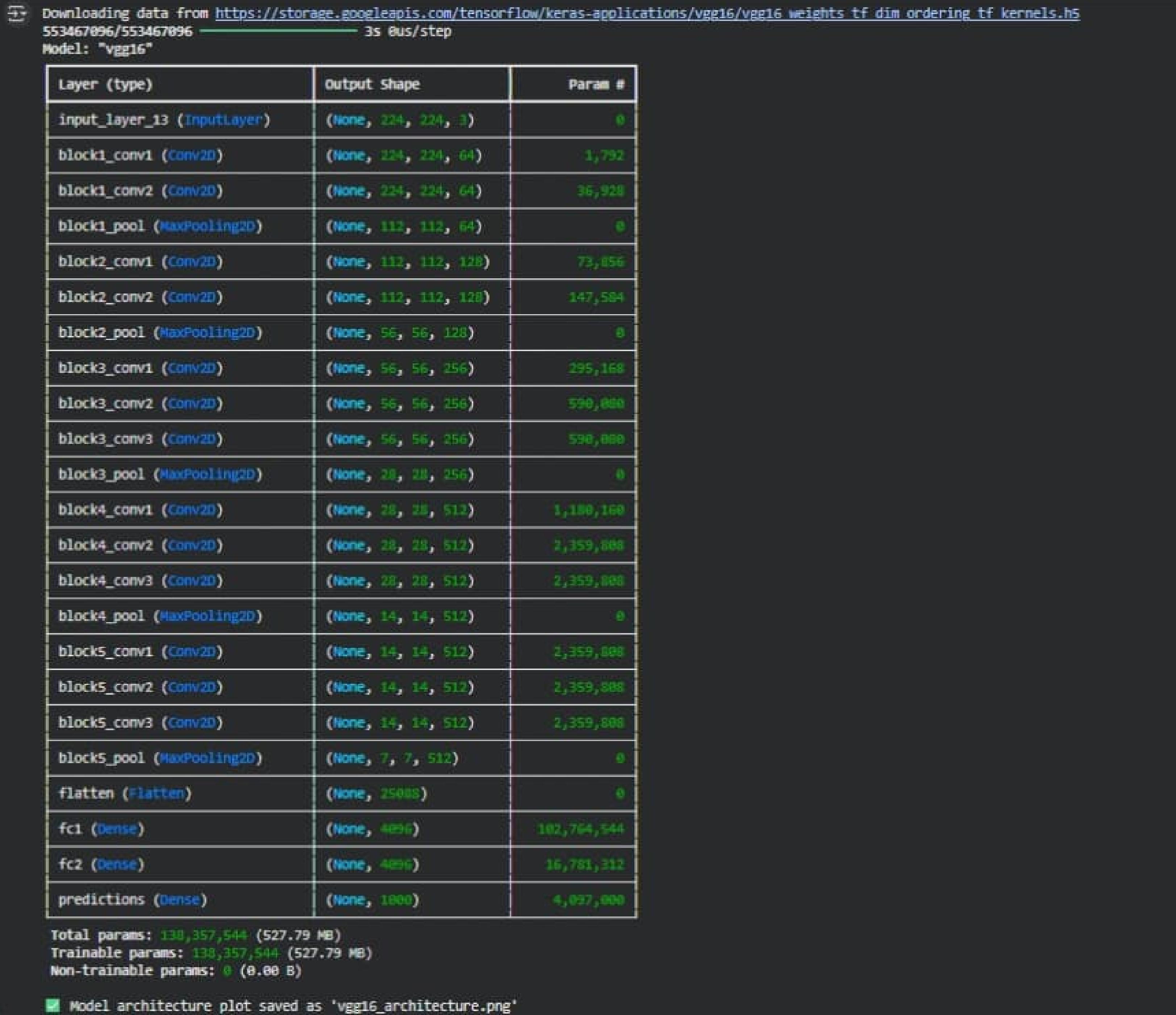
output :-

```
        Total parameters : 138357544
        Trainable parameters : 138357544
        Non Trainable parameters : 0

    Layer Names:

            conv1 : conv2D
             bn1 : BatchNormal2D
            relu : Relu
            maxpool : maxpool2D
            layer1 : sequential
            layer2 : sequential
            layer3 : sequential
            layer4 : sequential
            avgpool : AdaptiveAvgpool2D
              fc : Linear
```



```python
# Lab 13: Understanding the architecture of a pre-trained model (VGG16)

import tensorflow as tf
from tensorflow.keras.applications import VGG16

# Load pre-trained VGG16 model with ImageNet weights
model = VGG16(weights="imagenet", include_top=True)

# Display model summary
model.summary()

# Plot model architecture
tf.keras.utils.plot_model(model, to_file="vgg16_architecture.png", show_shapes=True, show_layer_names=True)

print("\n✅ Model architecture plot saved as 'vgg16_architecture.png'")
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels.h5
553467096/553467096 ━━━━━━━━━━━━━━━━━━━━ 3s 0us/step
Model: "vgg16"
```



```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels.h5
553467096/553467096 ━━━━━━━━━━━━━━━━━━━━ 3s 0us/step
Model: "vgg16"
┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━┓
┃ Layer (type)                    ┃ Output Shape           ┃       Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━┩
│ input_layer_13 (InputLayer)     │ (None, 224, 224, 3)    │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block1_conv1 (Conv2D)           │ (None, 224, 224, 64)   │         1,792 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block1_conv2 (Conv2D)           │ (None, 224, 224, 64)   │        36,928 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block1_pool (MaxPooling2D)      │ (None, 112, 112, 64)   │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block2_conv1 (Conv2D)           │ (None, 112, 112, 128)  │        73,856 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block2_conv2 (Conv2D)           │ (None, 112, 112, 128)  │       147,584 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block2_pool (MaxPooling2D)      │ (None, 56, 56, 128)    │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block3_conv1 (Conv2D)           │ (None, 56, 56, 256)    │       295,168 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block3_conv2 (Conv2D)           │ (None, 56, 56, 256)    │       590,080 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block3_conv3 (Conv2D)           │ (None, 56, 56, 256)    │       590,080 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block3_pool (MaxPooling2D)      │ (None, 28, 28, 256)    │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block4_conv1 (Conv2D)           │ (None, 28, 28, 512)    │     1,180,160 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block4_conv2 (Conv2D)           │ (None, 28, 28, 512)    │     2,359,808 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block4_conv3 (Conv2D)           │ (None, 28, 28, 512)    │     2,359,808 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block4_pool (MaxPooling2D)      │ (None, 14, 14, 512)    │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block5_conv1 (Conv2D)           │ (None, 14, 14, 512)    │     2,359,808 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block5_conv2 (Conv2D)           │ (None, 14, 14, 512)    │     2,359,808 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block5_conv3 (Conv2D)           │ (None, 14, 14, 512)    │     2,359,808 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ block5_pool (MaxPooling2D)      │ (None, 7, 7, 512)      │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ flatten (Flatten)               │ (None, 25088)          │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ fc1 (Dense)                     │ (None, 4096)           │   102,764,544 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ fc2 (Dense)                     │ (None, 4096)           │    16,781,312 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ predictions (Dense)             │ (None, 1000)           │     4,097,000 │
└─────────────────────────────────┴────────────────────────┴───────────────┘
 Total params: 138,357,544 (527.79 MB)
 Trainable params: 138,357,544 (527.79 MB)
 Non-trainable params: 0 (0.00 B)

✅ Model architecture plot saved as 'vgg16_architecture.png'
```