```
!pip install tensorflow
!pip install matplotlib
!pip install ipywidgets
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.12/dist-packages (2.19.0)
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Requirement already satisfied: matplotlib-inline>=0.1 in /usr/local/lib/python3.12/dist-packages (from ipykernel>=4.5.1->ipywidge
```

```
# Import necessary libraries
from tensorflow.keras.applications.vgg16 import VGG16, preprocess_input, decode_predictions
from tensorflow.keras.preprocessing.image import load_img, img_to_array
from IPython.display import display
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image, ImageFilter
import io
import ipywidgets as widgets
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

Introduction

This lab is designed to introduce you to the basics of deep learning by interacting with a pre-built model. You'll understand the workflow of a deep learning project, including data preprocessing, model architecture, and making predictions. The goal is to familiarize yourself with the basics of deep learning without writing any code.

```
# Load the VGG16 model
model = VGG16(weights='imagenet')

# Display the model architecture
model.summary()
```

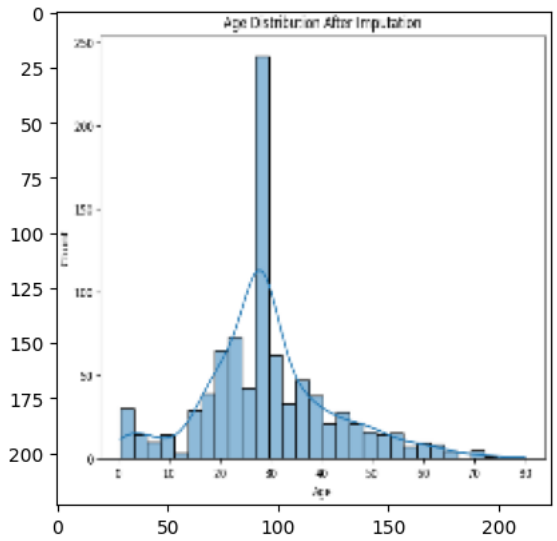
Model: "vgg16"

Layer (type)	Output Shape	Param #
input_layer (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)

```
# Load and preprocess an image
def load_and_preprocess_image(image_path):
    # Load the image
    img = load_img(image_path, target_size=(224, 224))

    # Convert the image to a numpy array
    img_array = img_to_array(img)

    # Expand dimensions to fit the model input
    img_array = np.expand_dims(img_array, axis=0)

    # Preprocess the image
    img_array = preprocess_input(img_array)

    return img, img_array

# Load and preprocess a sample image
```

```
sample_image, processed_image = load_and_preprocess_image('/content/drive/MyDrive/sample.png')

# Display the sample image
plt.imshow(sample_image)
plt.show()
```




```
# Make predictions
predictions = model.predict(processed_image)

# Decode and print the predictions
decoded_predictions = decode_predictions(predictions, top=3)[0]
print(decoded_predictions)
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 782ms/step
Downloading data from https://storage.googleapis.com/download.tensorflow.org/data/imagenet_class_index.json
35363/35363 ━━━━━━━━━━━━━━━━━━━━ 0s 0us/step
[('n04118776', 'rule', np.float32(0.47885337)), ('n06359193', 'web_site', np.float32(0.112881325)), ('n04238763', 'slide_rule', np.
```

```
# Upload button to load images
upload = widgets.FileUpload()
display(upload)

# Button to make predictions
predict_button = widgets.Button(description="Make Prediction")
display(predict_button)

# Function to handle button click
def on_click(change):
    img_data = list(upload.value.values())[0]['content']
    img = Image.open(io.BytesIO(img_data))
    img = img.resize((224, 224))

    # Preprocess and predict
    img_array = img_to_array(img)
    img_array = np.expand_dims(img_array, axis=0)
    img_array = preprocess_input(img_array)
    predictions = model.predict(img_array)
    decoded_predictions = decode_predictions(predictions, top=3)[0]

    # Display predictions
    print(decoded_predictions)

predict_button.on_click(on_click)
```

Upload (0)

Make Prediction

Conclusion and Discussion

Reflect on the lab activities. Discuss how the pre-trained model was able to make predictions, the role of data preprocessing, and the impact of input modifications on the model's predictions.

The laboratory showed a deep learning research that utilized features learned from millions of pictures using the Transfer Learning with the VGG16 pre-trained model on the ImageNet dataset. The high quality of the model is due to its weights, which are visual knowledge encoded. Some preprocessing data examples are resizing an image to 224 x 224 pixels and normalizing pixel values. Experiments show that the model is limited in its abstract knowledge and dependence on specific learnt patterns, demonstrating that its predictions are sensitive to input transformations such as rotation or noise.