1. Environment Setup and Warning Suppression

```
!pip install -U ipywidgets nbformat nbconvert
```

```
import warnings
warnings.filterwarnings('ignore')
```

```
import os
os.environ['TF_ENABLE_ONEDNN_OPTS'] = '0'
os.environ['TF_CPP_MIN_LOG_LEVEL'] = '2'
```

2. Importing Libraries (TensorFlow, Keras, Matplotlib)

```
import zipfile
from keras.models import Sequential , Model
from keras.layers import Dense , Dropout , Flatten
from keras.applications import VGG16
from keras.optimizers import Adam
from keras.preprocessing import image
import random
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import matplotlib.pyplot as plt
import numpy as np
```

```
seed_value = 42
random.seed(seed_value)
np.random.seed(seed_value)
tf.random.set_seed(seed_value)
```

```
batch_size = 32
epochs = 5
image_row , image_col = 224 , 224
input_shape = (image_row , image_col , 3)
```

```
import tarfile
import urllib.request
import os
import shutil
```

Downloading the Aircraft Damage Dataset

```
url = "https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/ZjXM4RKxlBK9__ZjHBLl5A/aircraft-damage-dataset-v1.tar

tar_filename = "aircraft_damage_dataset_v1.tar"
extracted_folder = "aircraft_damage_dataset_v1"
```

```
urllib.request.urlretrieve(url , tar_filename)
print(f'{tar_filename} downloaded successfully')
```

```
aircraft_damage_dataset_v1.tar downloaded successfully
```

```
if os.path.exists(extracted_folder):
    print(f'{extracted_folder} already exists')

    shutil.rmtree(extracted_folder)
    print(f'{extracted_folder} removed successfully')
```

```
with tarfile.open(tar_filename , 'r') as tar:
    tar.extractall()
    print(f'{tar_filename} extracted successfully')
```

```
aircraft_damage_dataset_v1.tar extracted successfully
```

Defining Directory Paths

```
aircraft_damage_dataset_v1/
├── train/
│   ├── dent/
│   └── crack/
├── valid/
│   ├── dent/
│   └── crack/
└── test/
    ├── dent/
    └── crack/
```

```
extract_path = "aircraft_damage_dataset_v1"
train_dir = os.path.join(extract_path , 'train')
valid_dir = os.path.join(extract_path , 'valid')
test_dir = os.path.join(extract_path,'test')
```

Data Preprocessing and Rescaling

```
train_datagen = ImageDataGenerator(rescale= 1./255)
valid_datagen = ImageDataGenerator(rescale= 1./255)
test_datagen = ImageDataGenerator(rescale= 1./255)
```

```
train_generator =  train_datagen.flow_from_directory(
    train_dir,
    target_size=(image_row, image_col),
    batch_size=batch_size,
    seed = seed_value,
    class_mode='binary',
    shuffle=True
)

valid_generator = valid_datagen.flow_from_directory(
    valid_dir,
    target_size=(image_row, image_col),
    batch_size=batch_size,
    seed = seed_value,
    class_mode='binary',
    shuffle=True
)

test_generator = test_datagen.flow_from_directory(
    test_dir,
    target_size=(image_row, image_col),
    batch_size = batch_size,
    seed = seed_value,
    class_mode='binary',
    shuffle=True
)
```

```
Found 300 images belonging to 2 classes.
Found 96 images belonging to 2 classes.
Found 50 images belonging to 2 classes.
```

Loading VGG16 Base Model (Transfer Learning)

```
base_model = VGG16(
    weights = 'imagenet',
    include_top = False,
    input_shape = input_shape
)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernel
58889256/58889256 ━━━━━━━━━━━━━━━━━━━━ 0s 0us/step
```

Building the Classification Head

```
output = base_model.layers[-1].output
output = tf.keras.layers.Flatten()(output)
base_model = Model(base_model.input , output)

for layer in base_model.layers:
    layer.trainable = False
```

```
model = Sequential()
model.add(base_model)
model.add(Dense(512,activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(512,activation='relu'))
model.add(Dropout(0.3))
model.add(Dense(1,activation='sigmoid'))
```

Compiling the Model

```
model.compile(
    optimizer = Adam(learning_rate=0.0001),
    loss = 'binary_crossentropy',
    metrics=['accuracy']
)
```

Training the Model

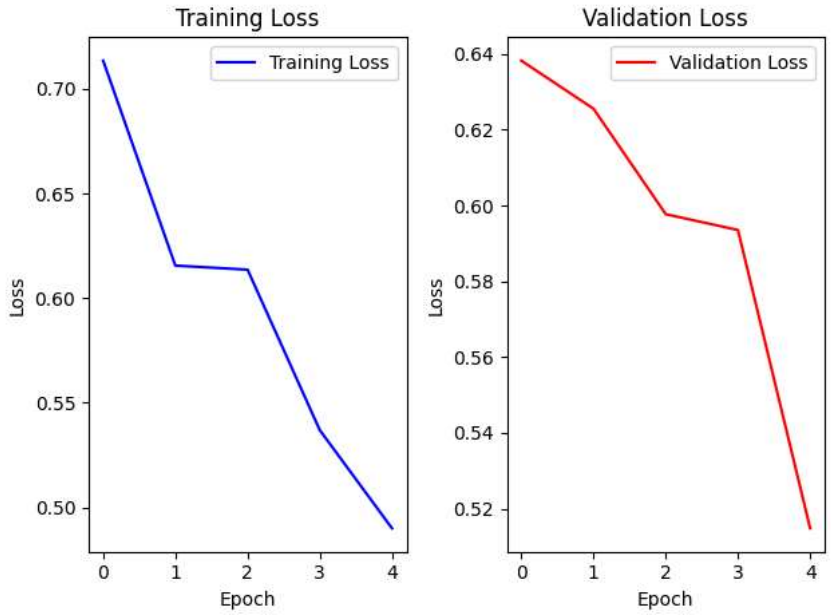
```
history = model.fit(
    train_generator,
    epochs = epochs,
    validation_data = valid_generator,
)
```

```
Epoch 1/5
10/10 ━━━━━━━━━━━━━━━━━━━━ 28s 1s/step - accuracy: 0.5464 - loss: 0.7536 - val_accuracy: 0.6562 - val_loss: 0.6382
Epoch 2/5
10/10 ━━━━━━━━━━━━━━━━━━━━ 2s 246ms/step - accuracy: 0.6848 - loss: 0.6159 - val_accuracy: 0.6042 - val_loss: 0.6255
Epoch 3/5
10/10 ━━━━━━━━━━━━━━━━━━━━ 2s 248ms/step - accuracy: 0.6644 - loss: 0.6694 - val_accuracy: 0.6354 - val_loss: 0.5977
Epoch 4/5
10/10 ━━━━━━━━━━━━━━━━━━━━ 2s 234ms/step - accuracy: 0.7150 - loss: 0.5337 - val_accuracy: 0.6354 - val_loss: 0.5935
Epoch 5/5
10/10 ━━━━━━━━━━━━━━━━━━━━ 2s 238ms/step - accuracy: 0.7349 - loss: 0.5298 - val_accuracy: 0.7396 - val_loss: 0.5148
```

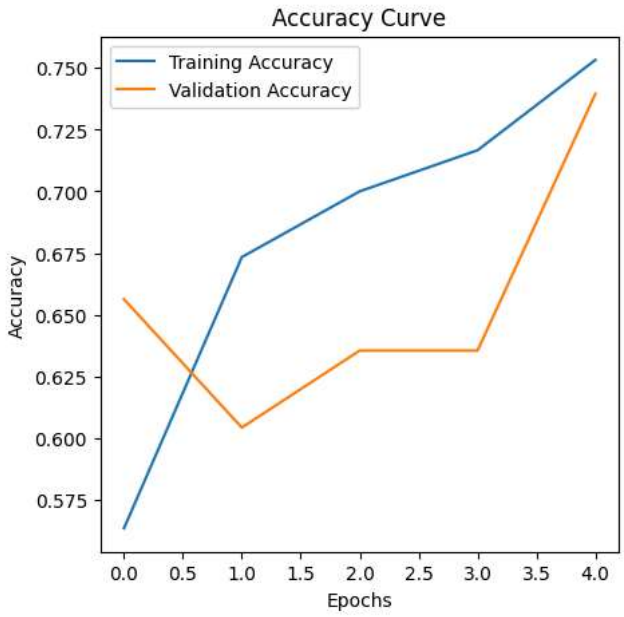
Visualizing Training History (Accuracy & Loss)

```
train_history = history.history

plt.subplot(1, 2, 1)
plt.plot(train_history['loss'], label='Training Loss', color='blue')
plt.title("Training Loss")
plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(train_history['val_loss'], label='Validation Loss', color='red')
```

```
plt.title("Validation Loss")
plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.legend()

plt.tight_layout()
plt.show()
```




```
train_history = history.history

plt.figure(figsize=(5, 5))
plt.plot(train_history['accuracy'], label='Training Accuracy')
plt.plot(train_history['val_accuracy'], label='Validation Accuracy')

plt.title('Accuracy Curve')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```




```
test_loss , test_accuracy = model.evaluate(test_generator,steps=test_generator.samples // test_generator.batch_size)
print(f'Test Loss: {test_loss:.4f}')
print(f"Test Accuracy: {test_accuracy:.4f}")
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 334ms/step - accuracy: 0.7812 - loss: 0.5293
Test Loss: 0.5293
Test Accuracy: 0.7812
```

```
import numpy as np
import matplotlib.pyplot as plt

def plot_images_grid(test_images, true_labels, predicted_labels, class_names):
    num_images = len(test_images)
    cols = 3
    rows = (num_images + cols - 1) // cols

    plt.figure(figsize=(6 * cols, 6 * rows))
    for i in range(num_images):
        plt.subplot(rows, cols, i + 1)
        plt.imshow(test_images[i])
        plt.axis('off')

        true_label_name = class_names[true_labels[i]]
        pred_label_name = class_names[predicted_labels[i]]
        color = 'green' if true_labels[i] == predicted_labels[i] else 'red'
        plt.title(f"T: {true_label_name}\nP: {pred_label_name}", color=color, fontsize=20)

    plt.tight_layout()
    plt.show()

def test_model_on_images(test_generator, model):
    num_samples = int(input("Enter the number of images to display: "))
    all_images = []
    all_true_labels = []

    while len(all_images) < num_samples:
        images, labels = next(test_generator)
        all_images.extend(images)
        all_true_labels.extend(labels)

    test_images = np.array(all_images[:num_samples])
    test_labels = np.array(all_true_labels[:num_samples])

    predictions = model.predict(test_images)
    predicted_classes = (predictions > 0.5).astype(int).flatten()

    class_indices = test_generator.class_indices
    class_names = {v: k for k, v in class_indices.items()}

    plot_images_grid(test_images, test_labels, predicted_classes, class_names)
```

Test Samples

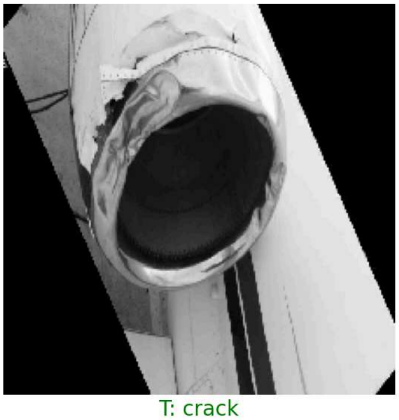
```
test_model_on_images(test_generator, model)
```

```
Enter the number of images to display: 6
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 88ms/step
```

T: dent
P: dent

T: crack
P: crack

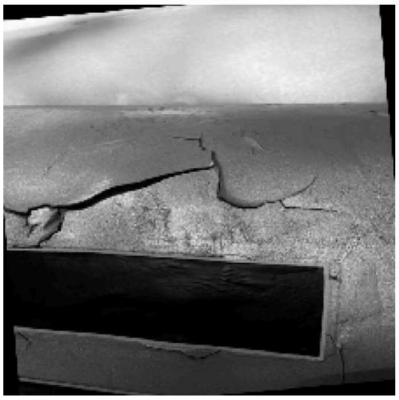
T: dent
P: dent



T: crack
P: crack

T: dent
P: dent

T: crack
P: crack



```
import torch
from PIL import Image
from transformers import BlipProcessor , BlipForConditionalGeneration
```

Visioning Model BlipForConditionalGeneration | Captioning

```
processor = BlipProcessor.from_pretrained("Salesforce/blip-image-captioning-base")
model = BlipForConditionalGeneration.from_pretrained("Salesforce/blip-image-captioning-base")
```

```
Using a slow image processor as `use_fast` is unset and a slow processor was saved with this model. `use_fast=True` will be the
preprocessor_config.json: 100%  287/287 [00:00<00:00, 9.58kB/s]
tokenizer_config.json: 100%  506/506 [00:00<00:00, 19.5kB/s]
vocab.txt: 232k/? [00:00<00:00, 6.97MB/s]
tokenizer.json: 711k/? [00:00<00:00, 14.1MB/s]
special_tokens_map.json: 100%  125/125 [00:00<00:00, 14.0kB/s]
config.json: 4.56k/? [00:00<00:00, 382kB/s]
pytorch_model.bin: 100%  990M/990M [00:06<00:00, 116MB/s]
model.safetensors: 100%  990M/990M [00:11<00:00, 86.9MB/s]
```

```
class BlipCaptionSummaryLayer(tf.keras.layers.Layer):
    def __init__(self, processor, model, **kwargs):
        """
        Initialize the custom Keras layer with the BLIP processor and model.

        Args:
            processor: The BLIP processor for preparing inputs for the model.
            model: The BLIP model for generating captions or summaries.
        """
        super().__init__(**kwargs)
        self.processor = processor
        self.model = model

    def call(self, image_path, task):
        # Use tf.py_function to run the custom image processing and text generation
        return tf.py_function(self.process_image, [image_path, task], tf.string)

    def process_image(self, image_path, task):
        """
        Perform image loading, preprocessing, and text generation.

        Args:
            image_path: Path to the image file as a string.
            task: The type of task ("caption" or "summary").

        Returns:
            The generated caption or summary as a string.
        """
        try:
            image_path_str = image_path.numpy().decode("utf-8")

            image = Image.open(image_path_str).convert("RGB")

            if task.numpy().decode("utf-8") == "caption":
                prompt = "This is a picture of"  # Modify prompt for more natural output
            else:
                prompt = "This is a detailed photo showing"  # Modify for summary

            inputs = self.processor(images=image, text=prompt, return_tensors="pt")

            output = self.model.generate(**inputs)

            result = self.processor.decode(output[0], skip_special_tokens=True)
            return result
        except Exception as e:
            print(f"Error: {e}")
            return "Error processing image"
```

```
def generate_text(image_path, task):
    blip_layer = BlipCaptionSummaryLayer(processor, model)

    return blip_layer(image_path, task)
```

Generate Text

```
image_path = tf.constant("aircraft_damage_dataset_v1/test/dent/144_10_JPG_jpg.rf.4d008cc33e217c1606b76585469d626b.jpg")  # actu

# Generate a caption for the image
caption = generate_text(image_path, tf.constant("caption"))
# Decode and print the generated caption
print("Caption:", caption.numpy().decode("utf-8"))

# Generate a summary for the image
summary = generate_text(image_path, tf.constant("summary"))
# Decode and print the generated summary
print("Summary:", summary.numpy().decode("utf-8"))
```

```
Caption: this is a picture of a plane
Summary: this is a detailed photo showing the engine of a boeing 747
```

```
image_url = "aircraft_damage_dataset_v1/test/dent/144_10_JPG_jpg.rf.4d008cc33e217c1606b76585469d626b.jpg"
img = plt.imread(image_url)
plt.imshow(img)
plt.axis('off')
plt.show()
```

```
img1 ="/content/aircraft_damage_dataset_v1/test/crack/101_1_JPG_jpg.rf.695bc0b3ba5ada38ee27d71dbacaf408.jpg"
img2 = "/content/aircraft_damage_dataset_v1/test/dent/143_13_JPG_jpg.rf.29ff136584e5e0cc50f837396e6995a2.jpg"
img3 = "/content/aircraft_damage_dataset_v1/test/dent/136_15_JPG_jpg.rf.35554276cb237619af1cf7fb465e3f46.jpg"
img4 = "/content/aircraft_damage_dataset_v1/test/crack/14_23_JPG_jpg.rf.b7dbf66f2939f210dcf0bcbd1d814e8f.jpg"

image_tensor = tf.constant(img3)
task_tensor = tf.constant("caption")
img = plt.imread(img3)
plt.imshow(img)
plt.axis('off')
plt.show()

caption_output = generate_text(image_tensor, task_tensor)

caption_output
```