RAJALAKSHMIENGINEERING COLLEGE

(An Autonomous Institution)

RAJALAKSHMINAGAR,THANDALAM- 602 105

CS19P18- DEEP LEARNING CONCEPTS

LABORATORYRECORDNOTEBOOK

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BONAFIDE CERTIFICATE

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Certified that this is a Bonafide record of work done by the above student in the **CS19P18 - DEEP LEARNING CONCEPTS** during the year 2025 - 2026

SignatureofFacultyIn-charge

Submitted for the Practical ExaminationHeld on:...

InternalExaminer **ExternalExaminer**

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INSTALLATION AND CONFIGURATION OF TENSORFLOW

Aim:

To install and configure TensorFlow in anaconda environment in Windows 10.

Procedure:

1. Download Anaconda Navigator and install.
2. Open Anaconda prompt
3. Create a new environment dlc with python 3.7 using the following command:
   conda create -n dlc python=3.7
4. Activate newly created environment dlc using the following command:
   conda activate dlc
5. In dlc prompt, install tensorflow using the following command:
   pip install tensorflow
6. Next install Tensorflow-datasets using the following command:
   pip install tensorflow-datasets
7. Install scikit-learn package using the following command:
   pip install scikit-learn
8. Install pandas package using the following command:
   pip install pandas
9. Lastly, install jupyter notebook
   pip install jupyter notebook
10. Open jupyter notebook by typing the following in dlc prompt:
    jupyter notebook
11. Click create new and then choose python 3 (ipykernel)
12. Give the name to the file
13. Type the code and click Run button to execute (eg. Type import tensorflow and then run)

EX NO: 1 CREATE A NEURAL NETWORK TO RECOGNIZE HANDWRITTEN DIGITS USING MNIST DATASET

Aim:

To build a handwritten digit's recognition with MNIST dataset.

Procedure:

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

Code:

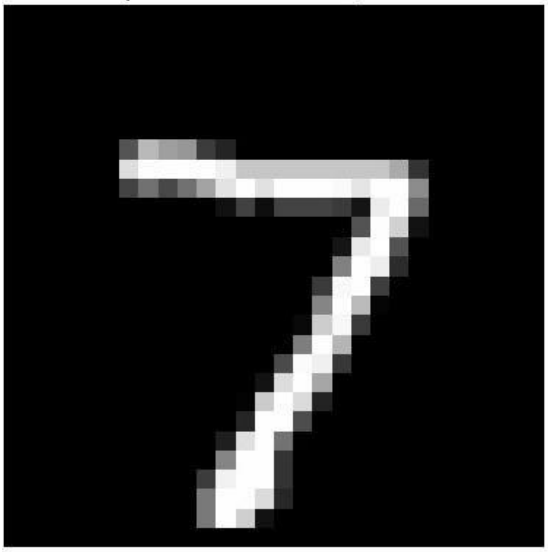
```
import numpy as np

import matplotlib.pyplot as plt

import tensorflow as tf

from tensorflow.keras.datasets import mnist

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Dense

from tensorflow.keras.utils import to_categorical


feature_vector_length = 784

num_classes = 10


(X_train, Y_train), (X_test, Y_test) = mnist.load_data()


input_shape = (feature_vector_length)

print(f'Feature shape: {input_shape}')


X_train = X_train.reshape(X_train.shape[0], feature_vector_length)

X_test = X_test.reshape(X_test.shape[0], feature_vector_length)

X_train = X_train.astype('float32') / 255

X_test = X_test.astype('float32') / 255

Y_train = to_categorical(Y_train, num_classes)

Y_test = to_categorical(Y_test, num_classes)


model = Sequential()

model.add(Dense(350, input_shape=input_shape, activation='relu'))

model.add(Dense(50, activation='relu'))

model.add(Dense(num_classes, activation='softmax'))


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

```
model.fit(X_train, Y_train, epochs=10, batch_size=250, verbose=1, validation_split=0.2)
```

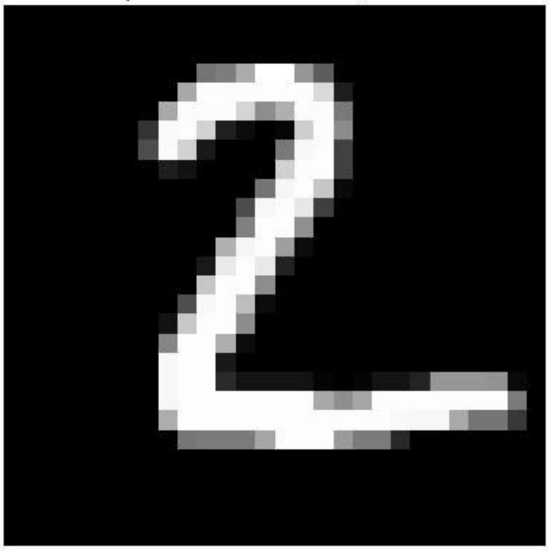
```
test_results = model.evaluate(X_test, Y_test, verbose=1)
print(f'Test results - Loss: {test_results[0]} - Accuracy: {test_results[1]}')


predictions = model.predict(X_test[:5])
predicted_classes = np.argmax(predictions, axis=1)
true_classes = np.argmax(Y_test[:5], axis=1)



for i in range(5):
    plt.imshow(X_test[i].reshape(28, 28), cmap='gray')
    plt.title(f"Sample {i+1} - Predicted: {predicted_classes[i]}, Actual: {true_classes[i]}")
    plt.axis('off')
    plt.show()
```

Output:

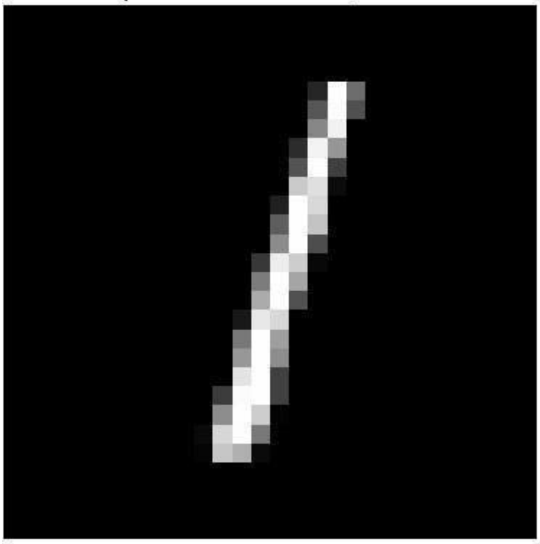
Sample 1 - Predicted: 7, Actual: 7



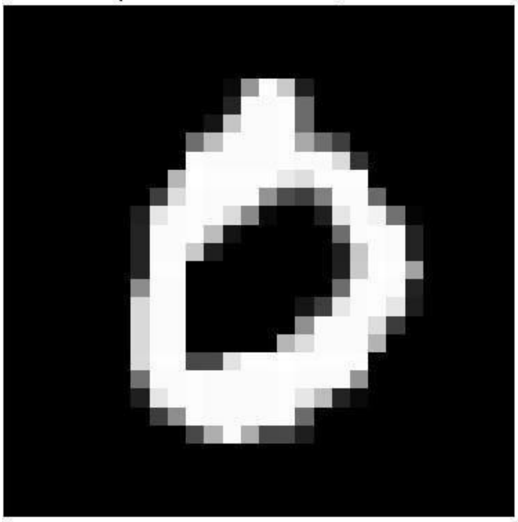
Sample 2 - Predicted: 2, Actual: 2



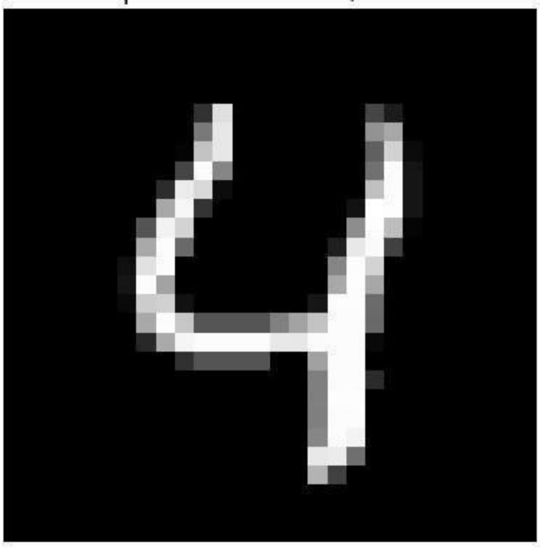
Sample 3 - Predicted: 1, Actual: 1



Sample 4 - Predicted: 0, Actual: 0



Sample 5 - Predicted: 4, Actual: 4



Result:

A handwritten digit's recognition with MNIST dataset is built and the output is verified.

EX NO:2 BUILD A CONVOLUTIONAL NEURAL NETWORK USING KERAS/TENSORFLOW

Aim:

To implement a Convolutional Neural Network (CNN) using Keras/TensorFlow to recognize and classify handwritten digits from the MNIST dataset with high accuracy.

Procedure:

1. Import required libraries (TensorFlow/Keras, NumPy, etc.).
2. Load the MNIST dataset from Keras.
3. Normalize and reshape the image data.
4. Convert labels to one-hot encoded vectors.
5. Build a CNN model with Conv2D, MaxPooling, Flatten, and Dense layers.
6. Compile the model using categorical crossentropy and Adam optimizer.
7. Train the model on training data.
8. Evaluate the model on test data.
9. Display accuracy and predictions.

Code:

```
import tensorflow as tf

from tensorflow.keras.models import Sequential

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

from tensorflow.keras.datasets import mnist

import matplotlib.pyplot as plt

import numpy as np


(train_images, train_labels), (test_images, test_labels) = mnist.load_data()

train_images = train_images / 255.0

test_images = test_images / 255.0

train_images = train_images.reshape(-1, 28, 28, 1)

test_images = test_images.reshape(-1, 28, 28, 1)

model = Sequential([

  Conv2D(32, (3, 3), activation='relu', input_shape=(28, 28, 1)),

  MaxPooling2D((2, 2)),

  Conv2D(64, (3, 3), activation='relu'),

  MaxPooling2D((2, 2)),

  Flatten(),

  Dense(64, activation='relu'),

  Dropout(0.5),

  Dense(10, activation='softmax')

])


model.compile(optimizer='adam',

        loss='sparse_categorical_crossentropy',

        metrics=['accuracy'])


history = model.fit(train_images, train_labels,

           epochs=5,
```

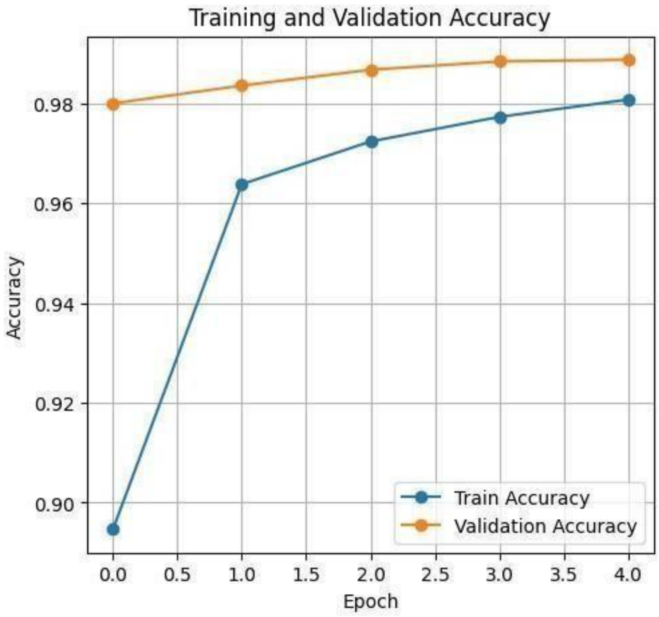
```
batch_size=64,
validation_split=0.2)
```

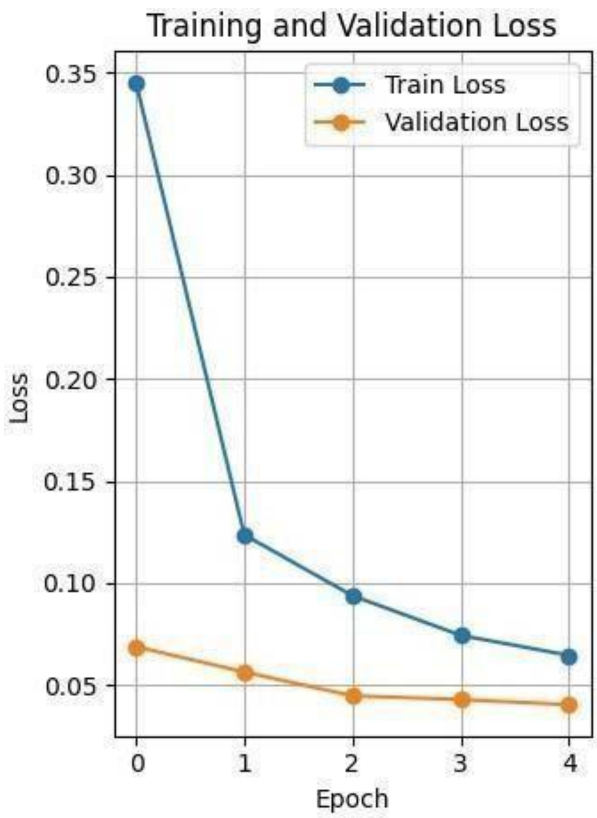
```
test_loss, test_acc = model.evaluate(test_images, test_labels)
print(f"\n Test accuracy: {test_acc:.4f}")
print(f" Test loss: {test_loss:.4f}")


plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Train Accuracy', marker='o')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy', marker='o')
plt.title('Training and Validation Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.grid(True)


plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Train Loss', marker='o')
plt.plot(history.history['val_loss'], label='Validation Loss', marker='o')
plt.title('Training and Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()


predictions = model.predict(test_images)
predicted_labels = np.argmax(predictions, axis=1)


num_samples = 10
```

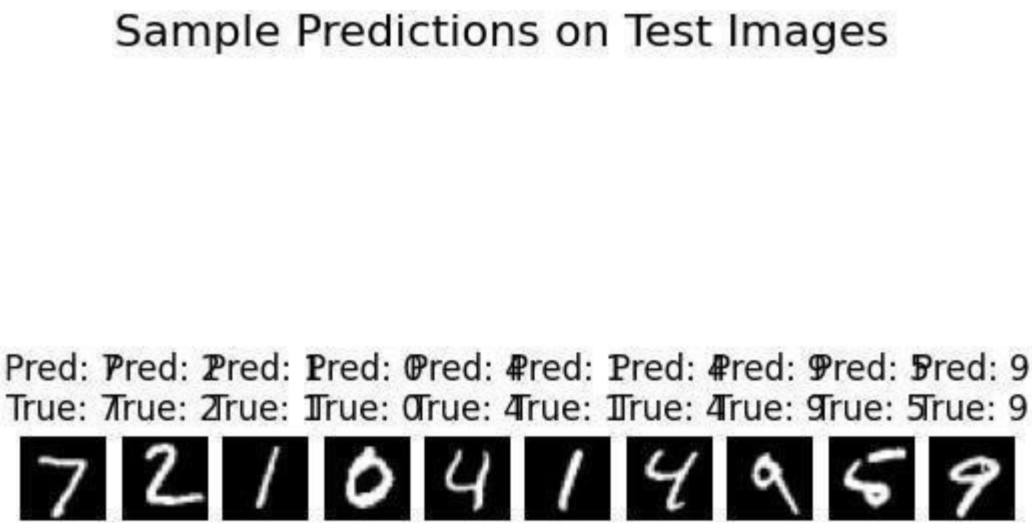
```
plt.figure(figsize=(15, 4))
```

```
for i in range(num_samples):
    plt.subplot(1, num_samples, i + 1)
    plt.imshow(test_images[i].reshape(28, 28), cmap='gray')
    plt.title(f"Pred: {predicted_labels[i]}\nTrue: {test_labels[i]}")
    plt.axis('off')
plt.suptitle("Sample Predictions on Test Images", fontsize=16)
plt.show()
```

Output:







Result:

A CNN using Keras/TensorFlow to recognize and classify handwritten digits from the MNIST dataset with high accuracy is built and the output is verified.

EX NO: 3 IMAGE CLASSIFICATION ON CIFAR-10 DATASET USING CNN

Aim:

To build a Convolutional Neural Network (CNN) model for classifying images from the CIFAR-10 dataset into one of the ten categories such as airplanes, cars, birds, cats, etc.

Procedure:

1. Download and load the CIFAR-10 dataset using Keras/TensorFlow.
2. Visualize and analyze sample images from the dataset.

3, Preprocess the data:

- Normalize the pixel values (divide by 255)
- Convert class labels to one-hot encoded format

4. Build a CNN model using Keras/TensorFlow:
   - Include convolutional, pooling, flatten, and dense layers.
5. Compile the model with suitable loss function and optimizer.
6. Train the model using training data and validate using test data.
7. Evaluate the model using accuracy and loss on test dataset.
8. Perform predictions on new/unseen CIFAR-10 images.

9 Visualize prediction results with sample images and predicted labels.

Code:

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

(x_train, y_train), (x_test, y_test) = tf.keras.datasets.cifar10.load_data()

x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0

y_train = tf.keras.utils.to_categorical(y_train, 10)
y_test = tf.keras.utils.to_categorical(y_test, 10)

model = tf.keras.Sequential()
model.add(tf.keras.layers.Conv2D(32, (3,3), activation='relu', input_shape=(32,32,3)))
model.add(tf.keras.layers.MaxPooling2D((2,2)))
model.add(tf.keras.layers.Conv2D(64, (3,3), activation='relu'))
model.add(tf.keras.layers.MaxPooling2D((2,2)))
model.add(tf.keras.layers.Conv2D(64, (3,3), activation='relu'))
model.add(tf.keras.layers.Flatten())
model.add(tf.keras.layers.Dense(64, activation='relu'))
model.add(tf.keras.layers.Dense(10, activation='softmax'))

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

model.fit(x_train, y_train, epochs=10, batch_size=64, validation_split=0.2)

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

```
index = int(input("Enter an index (0 to 9999) for test image: "))
```

```
if index < 0 or index >= len(x_test):

print("Invalid index. Using index 0 by default.") index = 0

test_image = x_test[index]
true_label = np.argmax(y_test[index])

prediction = model.predict(np.expand_dims(test_image, axis=0))
predicted_label = np.argmax(prediction)

plt.figure(figsize=(4, 4))
resized_image = tf.image.resize(test_image, [128, 128])
plt.imshow(resized_image)
plt.axis('off')
plt.title(f"Predicted: {class_names[predicted_label]}\nActual: {class_names[true_label]}")
plt.show()
```

Output:

Result:

A Convolutional Neural Network (CNN) model for classifying images from the CIFAR-10 dataset into one of the ten categories such as airplanes, cars, birds, cats, etc. is successfully built and the output is verified.

Ex No: 4 TRANSFER LEARNING WITH CNN AND VISUALIZATION

Aim:

To build a convolutional neural network with transfer learning and perform visualization

Procedure:

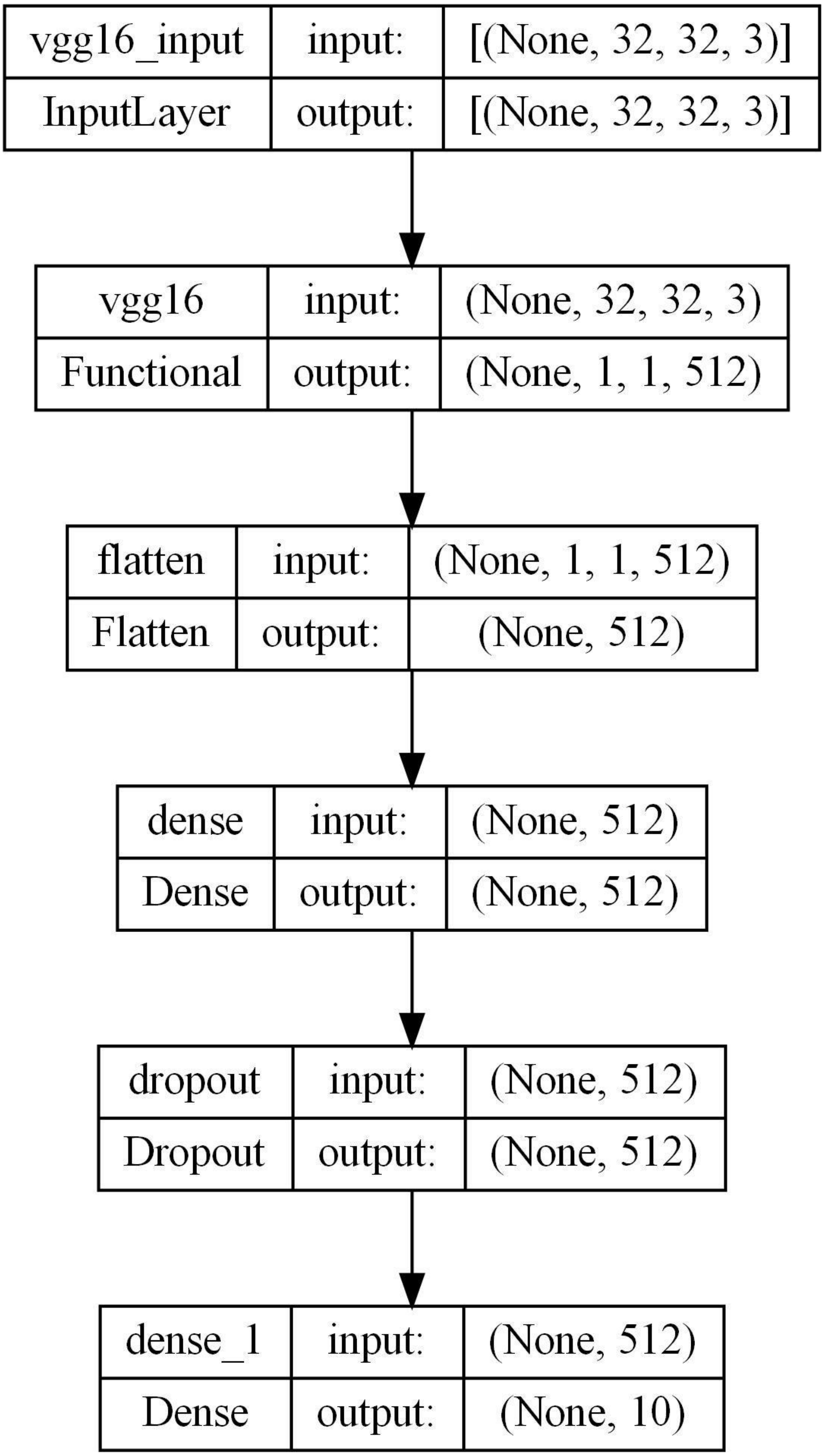
1. Download and load the dataset.
2. Perform analysis and preprocessing of the dataset.
3. Build a simple neural network model using Keras/TensorFlow.
4. Compile and fit the model.
5. Perform prediction with the test dataset.
6. Calculate performance metrics.

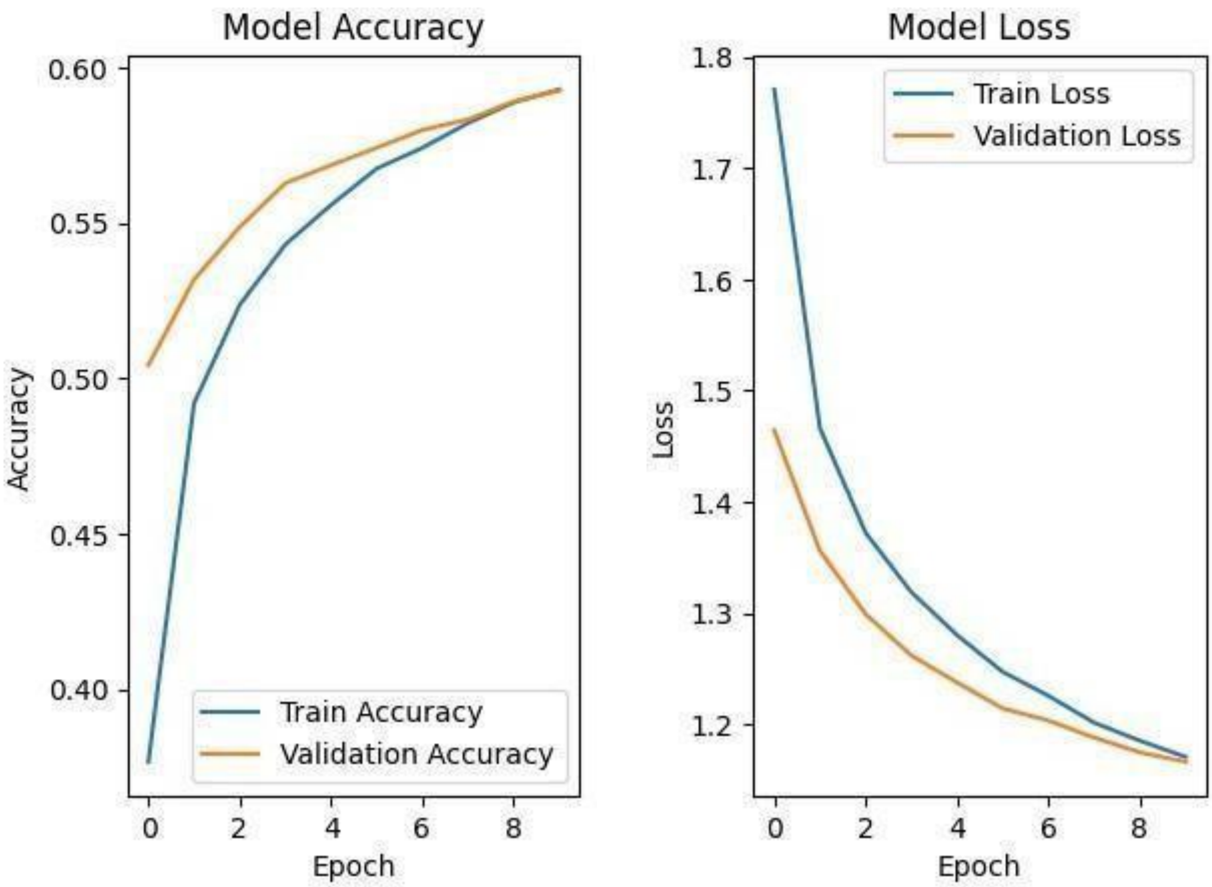
```
conda install -c conda-forge python-graphviz -y
import tensorflow as tf
from tensorflow.keras.applications import VGG16
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten, Dropout
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.datasets import cifar10
from tensorflow.keras.utils import plot_model
import matplotlib.pyplot as plt
import numpy as np
(x_train, y_train), (x_test, y_test) = cifar10.load_data()
x_train = x_train / 255.0
x_test = x_test / 255.0
vgg_base = VGG16(weights='imagenet', include_top=False, input_shape=(32, 32, 3))

for layer in vgg_base.layers:
    layer.trainable = False

model = Sequential()
model.add(vgg_base)
model.add(Flatten())
model.add(Dense(512, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(10, activation='softmax'))

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

plot_model(model, to_file='cnn.png', show_shapes=True,
           show_layer_names=True, dpi=300)

plt.figure(figsize=(20, 20))
img = plt.imread('cnn.png')
plt.imshow(img)
plt.axis('off')
plt.show()

history = model.fit(x_train, y_train,
                    epochs=10,
                    batch_size=32,
                    validation_split=0.2)

test_loss, test_acc = model.evaluate(x_test, y_test)
print(f'Test Loss: {test_loss:.4f}')
```

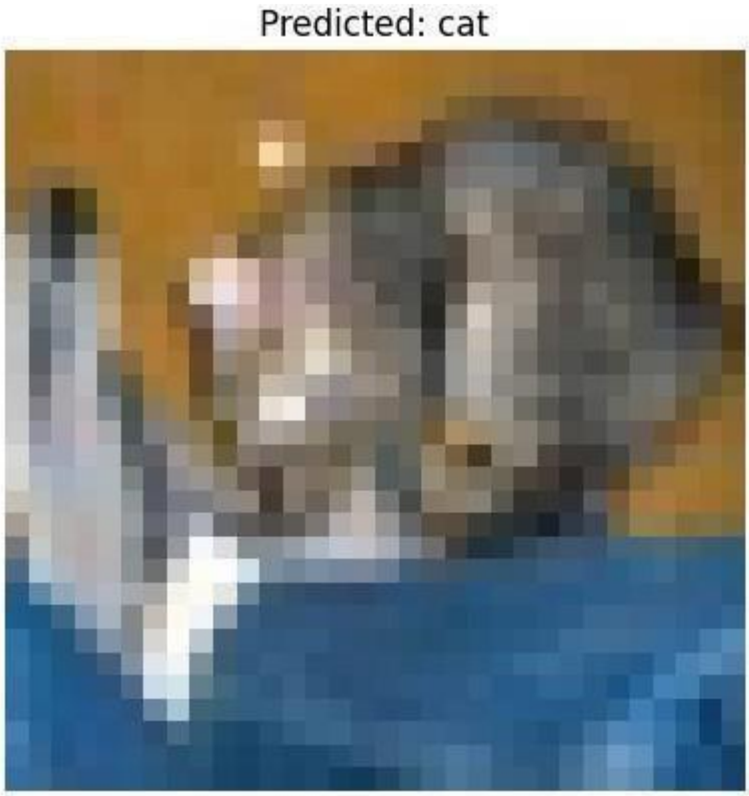
```
print(f'Test Accuracy: {test_acc * 100:.2f}%')

plt.figure(figsize=(12, 5))


plt.subplot(1, 2, 1)
```

```
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.xlabel('Epoch')

plt.ylabel('Accuracy')
plt.legend()


plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Model Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()

plt.tight_layout()
plt.show()

class_names = ['airplane', 'automobile', 'bird', 'cat', 'deer',
               'dog', 'frog', 'horse', 'ship', 'truck']


sample = x_test[0].reshape(1, 32, 32, 3)
prediction = model.predict(sample)
predicted_class = class_names[np.argmax(prediction)]


plt.imshow(x_test[0])
plt.title(f"Predicted: {predicted_class}")
plt.axis('off')
plt.show()
```

Output:


vgg16_input
input:
[(None, 32, 32, 3)]
InputLayer
output:
[(None, 32, 32, 3)]
vgg16
input:
(None, 32, 32, 3)
Functional
output:
(None, 1, 1, 512)
flatten
input:
(None, 1, 1, 512)
Flatten
output:
(None, 512)
dense
input:
(None, 512)
Dense
output:
(None, 512)
dropout
input:
(None, 512)
Dropout
output:
(None, 512)
dense_1
input:
(None, 512)
Dense
output:
(None, 10)


Model Accuracy
Accuracy
Epoch
Train Accuracy
Validation Accuracy
Model Loss
Loss
Epoch
Train Loss
Validation Loss


Predicted: cat

Result:

A CNN with transfer learning and perform visualization is built and the output is verified.

EX NO: 5 BUILD A RECURRENT NEURAL NETWORK (RNN) USING KERAS/TENSORFLOW

Aim:

To build a recurrent neural network with Keras/TensorFlow.

Procedure:

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

```
import numpy as np
importtensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import SimpleRNN, Dense
from sklearn.metrics import r2_score
np.random.seed(0)
seq_length = 10
num_samples = 1000

X = np.random.randn(num_samples, seq_length, 1)

y = X.sum(axis=1) + 0.1 * np.random.randn(num_samples, 1)

split_ratio = 0.8
split_index = int(split_ratio * num_samples)

X_train, X_test = X[:split_index], X[split_index:]
y_train, y_test = y[:split_index], y[split_index:]

model = Sequential()
model.add(SimpleRNN(units=50, activation='relu', input_shape=(seq_length, 1)))
model.add(Dense(units=1))

model.compile(optimizer='adam', loss='mean_squared_error')
model.summary()

batch_size = 30
epochs = 50 # Reduced epochs for quick demonstration
history = model.fit(
```

```
X_train, y_train,
batch_size=batch_size,
```

```
    epochs=epochs,
    validation_split=0.2
)
test_loss = model.evaluate(X_test, y_test)
print(f'Test Loss: {test_loss:.4f}')

y_pred = model.predict(X_test)
r2 = r2_score(y_test, y_pred)
print(f'Test Accuracy (R^2): {r2:.4f}')

new_data = np.random.randn(5, seq_length, 1)
predictions = model.predict(new_data)
print("Predictions for new data:")
print(predictions)
```

Output:

```
In [9]:  test_loss = model.evaluate(X_test, y_test)
         print(f'Test Loss: {test_loss:.4f}')

         7/7 [==============================] - 0s 5ms/step - loss: 0.0241
         Test Loss: 0.0241

In [10]: y_pred = model.predict(X_test)
         r2 = r2_score(y_test, y_pred)
         print(f'Test Accuracy (R^2): {r2:.4f}')

         7/7 [==============================] - 0s 5ms/step
         Test Accuracy (R^2): 0.9974

In [11]: new_data = np.random.randn(5, seq_length, 1)
         predictions = model.predict(new_data)
         print("Predictions for new data:")
         print(predictions)

         1/1 [==============================] - 0s 52ms/step
         Predictions for new data:
         [[ 1.7613161 ]
          [ 0.40740597]
          [-2.23266   ]
          [-0.6163975 ]
          [-3.7167645 ]]
```

Result:

A recurrent neural network with Keras/TensorFlow is successfully built and the output is verified.

EX NO: 6 SENTIMENT CLASSIFICATION OF TEXT USING RNN

Aim:

To implement a Recurrent Neural Network (RNN) using Keras/TensorFlow for classifying the sentiment of text data (e.g., movie reviews) as positive or negative.

Procedure:

1. Import necessary libraries.
2. Load and preprocess the text dataset (e.g., IMDb).
3. Pad sequences and prepare labels.
4. Build an RNN model with Embedding and SimpleRNN layers.
5. Compile the model with loss and optimizer.
6. Train the model on training data.
7. Evaluate the model on test data.
8. Predict sentiment for new inputs

```
import numpy as np
from tensorflow.keras.datasets import imdb
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Embedding, SimpleRNN, Dense
max_words = 5000
max_len = 200
(x_train, y_train), (x_test, y_test) = imdb.load_data(num_words=max_words)
X_train = pad_sequences(x_train, maxlen=max_len)
X_test = pad_sequences(x_test, maxlen=max_len)
model = Sequential()
model.add(Embedding(input_dim=max_words, output_dim=32, input_length=max_len))
model.add(SimpleRNN(32))
model.add(Dense(1, activation='sigmoid'))
model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
print("Training...")
model.fit(X_train, y_train, epochs=2, batch_size=64, validation_split=0.2)
loss, acc = model.evaluate(X_test, y_test)
print(f"\nTest Accuracy: {acc:.4f}")
word_index = imdb.get_word_index()
reverse_word_index = {v: k for (k, v) in word_index.items()}


def decode_review(review):
    return " ".join([reverse_word_index.get(i - 3, "?") for i in review])
sample_review = X_test[0]
prediction = model.predict(sample_review.reshape(1, -1))[0][0]
print("\nReview text:", decode_review(x_test[0]))
print("Predicted Sentiment:", "Positive " if prediction > 0.5 else "Negative ")
```

Output:

```
Test Accuracy: 0.8502
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/imdb_word_index.json
1641221/1641221 [==============================] - 0s 0us/step
```

In [6]:

```
def decode_review(review):
    return " ".join([reverse_word_index.get(i - 3, "?") for i in review])
sample_review = X_test[0]
prediction = model.predict(sample_review.reshape(1, -1))[0][0]
print("\nReview text:", decode_review(x_test[0]))
print("Predicted Sentiment:", "Positive " if prediction > 0.5 else "Negative ")
```

```
1/1 [==============================] - 0s 244ms/step

Review text: ? please give this one a miss br br ? ? and the rest of the cast ? terrible performances the show is flat flat
flat br br i don't know how michael ? could have allowed this one on his ? he almost seemed to know this wasn't going to wor
k out and his performance was quite ? so all you ? fans give this a miss
Predicted Sentiment: Negative
```

Result:

A Recurrent Neural Network (RNN) using Keras/TensorFlow for classifying the sentiment of text data (e.g., movie reviews) as positive or negative is successfully built and the output is verified.

Ex No: 7 BUILD AUTOENCODERS WITH KERAS/TENSORFLOW

Aim:

To build autoencoders with Keras/TensorFlow.

Procedure:

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

```
import numpy as np
import matplotlib.pyplot as plt
from keras.layers import Input, Dense
from keras.models import Model
from keras.datasets import mnist

(x_train, _), (x_test, _) = mnist.load_data()
x_train = x_train.astype('float32') / 255.
x_test = x_test.astype('float32') / 255.
x_train = x_train.reshape((len(x_train), np.prod(x_train.shape[1:])))
x_test = x_test.reshape((len(x_test), np.prod(x_test.shape[1:])))

input_img = Input(shape=(784,))
encoded = Dense(32, activation='relu')(input_img)
decoded = Dense(784, activation='sigmoid')(encoded)
autoencoder = Model(input_img, decoded)

autoencoder.compile(optimizer='adam', loss='binary_crossentropy')
autoencoder.fit(x_train, x_train,
        epochs=50,
        batch_size=256,
        shuffle=True,
        validation_data=(x_test, x_test))
test_loss = autoencoder.evaluate(x_test, x_test)
decoded_imgs = autoencoder.predict(x_test)

threshold = 0.5
correct_predictions = np.sum(
  np.where(x_test >= threshold, 1, 0) ==
  np.where(decoded_imgs >= threshold, 1, 0)
```

)

```
total_pixels = x_test.shape[0] * x_test.shape[1]
test_accuracy = correct_predictions / total_pixels
print("Test Loss:", test_loss)
print("Test Accuracy:", test_accuracy)


n = 10
plt.figure(figsize=(20, 4))
for i in range(n):
    # Display original
    ax = plt.subplot(2, n, i + 1)
    plt.imshow(x_test[i].reshape(28, 28))
    plt.gray()
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)

    # Display reconstruction with threshold
    ax = plt.subplot(2, n, i + 1 + n)
    reconstruction = decoded_imgs[i].reshape(28, 28)
    plt.imshow(np.where(reconstruction >= threshold, 1.0, 0.0))
    plt.gray()
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)
plt.show()
```

Output:

```
Test Loss: 0.09151389449834824
Test Accuracy: 0.9713761479591837
```

Result:

A hautoencoders with Keras/TensorFlow is successfully built and the output is verified.

Ex No: 8 **OBJECT DETECTION WITH YOLO3**

Aim:

To build an object detection model with YOLO3 using Keras/TensorFlow.

Procedure:

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

```
import cv2
import matplotlib.pyplot as plt
import numpy as np

# Define the paths to the YOLOv3 configuration, weights, and class names files
cfg_file = '/content/yolov3.cfg'
weight_file = '/content/yolov3.weights'
namesfile = '/content/coco.names'

# Load the YOLOv3 model
net = cv2.dnn.readNet(weight_file, cfg_file)

# Load class names
with open(namesfile, 'r') as f:
    classes = f.read().strip().split('\n')

# Load an image for object detection
image_path = '/content/hit.jpg'
image = cv2.imread(image_path)

# Get the height and width of the image
height, width = image.shape[:2]

# Create a blob from the image
blob = cv2.dnn.blobFromImage(image, 1/255.0, (416, 416), swapRB=True, crop=False)
net.setInput(blob)

# Get the names of the output layers
layer_names = net.getUnconnectedOutLayersNames()
```

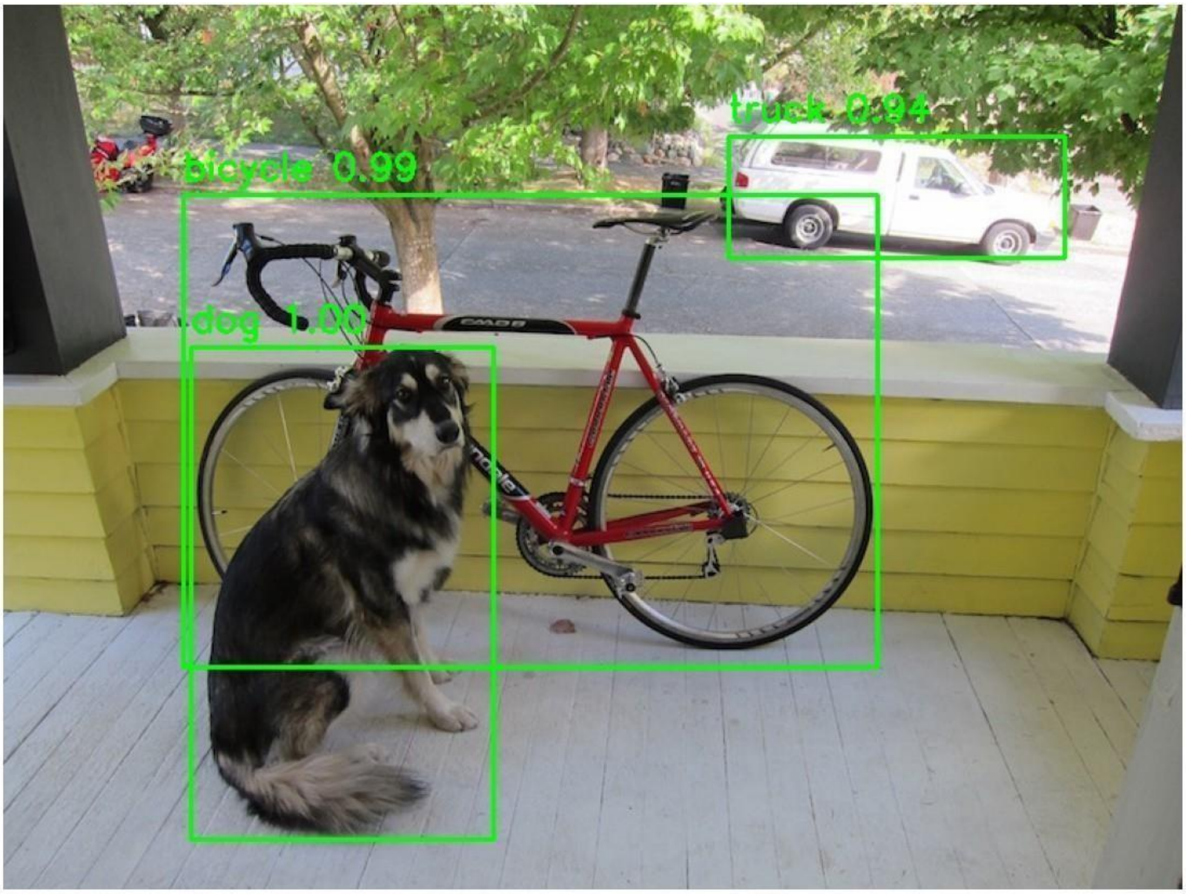
```
# Run forward pass
```

```
outs = net.forward(layer_names)

# Initialize lists to store detected objects' information
class_ids = []
confidences= []
boxes = []

# Define a confidence threshold for object detection
conf_threshold = 0.5

# Loop over the detections
for out in outs:
  for detection in out:
    scores = detection[5:]
    class_id = np.argmax(scores)
    confidence = scores[class_id]
    if confidence > conf_threshold:
      # Object detected
      center_x = int(detection[0] * width)
      center_y = int(detection[1] * height)
      w = int(detection[2] * width)
      h = int(detection[3] * height)

      # Rectangle coordinates
      x = int(center_x - w / 2)
      y = int(center_y - h / 2)

      class_ids.append(class_id)
      confidences.append(float(confidence))
```

```
boxes.append([x, y, w, h])
```

```
# Apply non-maximum suppression to eliminate overlapping boxes
nms_threshold = 0.4
indices = cv2.dnn.NMSBoxes(boxes, confidences, conf_threshold, nms_threshold)


# Draw bounding boxes and labels on the image
for i in indices.flatten(): # flatten for compatibility
    x, y, w, h = boxes[i]
    label = str(classes[class_ids[i]])
    confidence = confidences[i]


    cv2.rectangle(image, (x, y), (x + w, y + h), (0, 255, 0), 2)
    cv2.putText(image, f'{label} {confidence:.2f}', (x, y - 10),
                cv2.FONT_HERSHEY_SIMPLEX, 0.8, (0, 255, 0), 2)


# Display the result in Jupyter Notebook
plt.figure(figsize=(10, 8))
plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
plt.axis('off')
plt.show()
```

Output:



Result:

An object detection model with YOLO3 using Keras/TensorFlow is successfully built and the output is verified.

Ex No: 9 BUILD GENERATIVE ADVERSARIAL NEURAL NETWORK

Aim:

To build a generative adversarial neural network using Keras/TensorFlow.

Procedure:

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

```
import numpy as np
importtensorflow as tf
from tensorflow.keras.layers import Dense
from tensorflow.keras.models import Sequential
from tensorflow.keras.optimizers import Adam
from sklearn.datasets import load_iris
import matplotlib.pyplot as plt


# Load and Preprocess the Iris Dataset
iris = load_iris()
x_train = iris.data


 # Build the GAN model
  def build_generator():
   model = Sequential()
   model.add(Dense(128, input_shape=(100,), activation='relu'))
   model.add(Dense(4, activation='linear')) # Output 4 features
   return model


defbuild_discriminator():
   model = Sequential()
   model.add(Dense(128, input_shape=(4,), activation='relu'))
   model.add(Dense(1, activation='sigmoid'))
   return model


def build_gan(generator, discriminator):
   discriminator.trainable = False
   model = Sequential()
   model.add(generator)
```

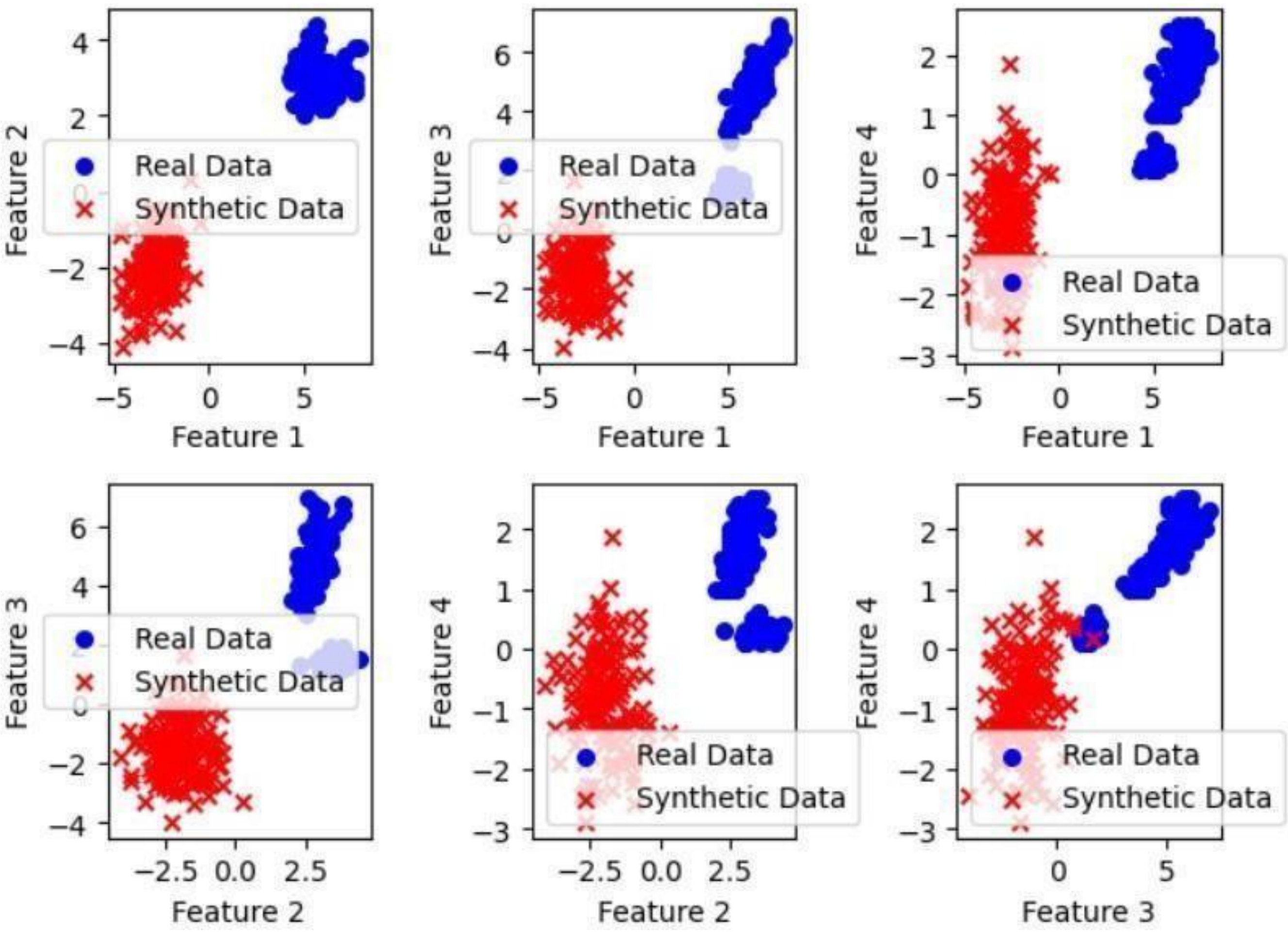
```
model.add(discriminator)

return model
```

```
generator = build_generator()
discriminator = build_discriminator()
gan = build_gan(generator, discriminator)


# Compile the Models
generator.compile(loss='mean_squared_error',  optimizer=Adam(0.0002,  0.5))
discriminator.compile(loss='binary_crossentropy', optimizer=Adam(0.0002, 0.5),
                  metrics=['accuracy'])
gan.compile(loss='binary_crossentropy', optimizer=Adam(0.0002, 0.5))


# Training Loop
epochs = 200
batch_size = 16


for epoch in range(epochs):
   # Train discriminator
   idx = np.random.randint(0, x_train.shape[0], batch_size)
   real_samples = x_train[idx]
   fake_samples = generator.predict(np.random.normal(0, 1, (batch_size, 100)), verbose=0)


   real_labels = np.ones((batch_size, 1))
   fake_labels = np.zeros((batch_size, 1))


   d_loss_real = discriminator.train_on_batch(real_samples, real_labels)
   d_loss_fake = discriminator.train_on_batch(fake_samples, fake_labels)


   # Traingenerator
   noise = np.random.normal(0, 1, (batch_size, 100))
```

```
g_loss = gan.train_on_batch(noise, real_labels)
```

```
    # Print progress
    print(f"Epoch {epoch}/{epochs} | Discriminator Loss: {0.5 * (d_loss_real[0] + d_loss_fake[0])} |
Generator Loss: {g_loss}")


# Generating Synthetic Data
synthetic_data = generator.predict(np.random.normal(0, 1, (150, 100)), verbose=0)


# Create scatter plots for feature pairs
plt.figure(figsize=(12, 8))
plot_idx = 1


for i in range(4):
    for j in range(i + 1, 4):
        plt.subplot(2, 3, plot_idx)
        plt.scatter(x_train[:, i], x_train[:, j], label='Real Data', c='blue', marker='o', s=30)
        plt.scatter(synthetic_data[:, i], synthetic_data[:, j], label='Synthetic Data', c='red', marker='x',
s=30)
        plt.xlabel(f'Feature {i + 1}')
        plt.ylabel(f'Feature {j + 1}')
        plt.legend()
        plot_idx += 1


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

Output:



Result:

A generative adversarial neural network using Keras/TensorFlow is successfully built and the output is verified.

Ex No: 10 MINI PROJECT – CNN OR RNN BASED APPLICATION

Aim:

To develop an application that is based on convolutional neural network inTensorFlow.

Instructions:

1. Student has to choose one of the projects listed in the below section with a team of maximum two members.
2. Apart from these topics, if a team has innovative ideas to do implementation, then they can discuss with their faculty in-charge and get approval to do the same.
3. After implementation, a Mini Project report needs to be prepared and signed by HoD and the faculty in-charge.

Mini Project Titles;

1. Plant Disease Detection using Deep Learning
2. Fake News Detection using Deep Learning
3. Breast Cancer Detection using Deep Learning
4. Chatbot using Recurrent Neural Network
5. Drowsy Driver Detection using Deep Learning
6. A Review of Liver Patient Analysis Methods using Deep Learning
7. Deep Learning based Thyroid Disease Classification.
8. Music Genre Classification System
9. Dog Breed Identification using Deep Learning
10. Human Face Detection using Deep Learning
11. Automated Attendance monitoring using Deep Learning

12.Skin Cancer Detection using Deep Learning.

CODE:

```
import os
import random
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow.keras import layers, models
from sklearn.manifold import TSNE
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
import itertools

print("TensorFlow:", tf.__version__)

# Optional: path to your uploaded screenshot (included here)
UPLOADED_FILE = "/mnt/data/c6688583-8793-4652-ab2e-38ae7658d278.png"
print("Uploaded file path (if you want to show or link it):", UPLOADED_FILE)

# 1) Load MNIST (built-in)
(x_train, y_train), (x_test, y_test) = tf.keras.datasets.mnist.load_data()
# Normalize, expand dims
x_train = (x_train.astype("float32") / 255.0)[..., np.newaxis]
x_test  = (x_test.astype("float32")  / 255.0)[..., np.newaxis]

# Keep small validation set for quick runs
val_split = 5000
x_val, y_val = x_train[-val_split:], y_train[-val_split:]
x_train, y_train = x_train[:-val_split], y_train[:-val_split]

print("Shapes:", x_train.shape, y_train.shape, x_val.shape, x_test.shape)

# 2) Model: tiny CNN with a small embedding vector (penultimate Dense)
def build_model(embedding_dim=32):
    inputs = layers.Input(shape=(28,28,1))
    x = layers.Conv2D(16, 3, activation='relu')(inputs)
    x = layers.MaxPooling2D()(x)
    x = layers.Conv2D(32, 3, activation='relu')(x)
    x = layers.MaxPooling2D()(x)
    x = layers.Flatten()(x)
    x = layers.Dense(embedding_dim, activation='relu', name='embedding')(x)  # embedding layer
    x = layers.Dropout(0.3)(x)
    outputs = layers.Dense(10, activation='softmax')(x)
    model = models.Model(inputs, outputs)
```

```
    model.compile(optimizer='adam',
                  loss='sparse_categorical_crossentropy',
                  metrics=['accuracy'])
    return model

model = build_model(embedding_dim=64)
model.summary()

# 3) Train quickly
EPOCHS = 6
history = model.fit(
    x_train, y_train,
    validation_data=(x_val, y_val),
    epochs=EPOCHS,
    batch_size=128,
    verbose=2
)

# 4) Evaluate
test_loss, test_acc = model.evaluate(x_test, y_test, verbose=0)
print(f"\nTest accuracy: {test_acc:.4f}  loss: {test_loss:.4f}")

# 5) Extract embeddings for test set (output of 'embedding' layer)
embedding_model = models.Model(inputs=model.input, outputs=model.get_layer('embedding').output)
embeddings = embedding_model.predict(x_test)  # shape: (num_test, embedding_dim)
print("Embeddings shape:", embeddings.shape)

# 6) Run t-SNE to reduce to 2D for visualization (use a subset for speed)
SUBSET = 2000  # reduce for speed; set to len(x_test) if you want full
idxs = np.random.choice(len(embeddings), SUBSET, replace=False)
emb_sub = embeddings[idxs]
labels_sub = y_test[idxs]

print("Running t-SNE (this may take ~20-60s depending on machine)...")
tsne = TSNE(n_components=2, perplexity=30, random_state=42, n_iter=1000, init='pca')
emb2d = tsne.fit_transform(emb_sub)
print("t-SNE done. Shape:", emb2d.shape)

# 7) Plot t-SNE scatter, colored by true label
plt.figure(figsize=(8,8))
cmap = plt.get_cmap('tab10')
for d in range(10):
```

```
    sel = labels_sub == d
    plt.scatter(emb2d[sel,0], emb2d[sel,1], label=str(d), alpha=0.6, s=10)
plt.legend(title="Digit", bbox_to_anchor=(1.05,1))
plt.title("t-SNE of penultimate-layer embeddings (MNIST)")
plt.xlabel("Dim 1"); plt.ylabel("Dim 2")
plt.tight_layout()
out_dir = "mnist_tsne_output"
os.makedirs(out_dir, exist_ok=True)
tsne_path = os.path.join(out_dir, "mnist_embeddings_tsne.png")
plt.savefig(tsne_path, dpi=150)
plt.show()
print("Saved t-SNE plot to", tsne_path)

# 8) Confusion matrix on test set
y_pred = np.argmax(model.predict(x_test), axis=1)
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=list(range(10)))
fig, ax = plt.subplots(figsize=(8,8))
disp.plot(ax=ax, cmap=plt.cm.Blues, colorbar=False)
plt.title("Confusion Matrix (MNIST)")
plt.savefig(os.path.join(out_dir, "mnist_confusion_matrix.png"), dpi=150)
plt.show()
print("Saved confusion matrix to", os.path.join(out_dir, "mnist_confusion_matrix.png"))

# 9) Show a small gallery of misclassified examples (up to 9)
mis_idx = np.where(y_pred != y_test)[0]
print(f"Total misclassified: {len(mis_idx)} (showing up to 9)")
sample_mis = mis_idx[:9]
fig, axes = plt.subplots(3,3, figsize=(6,6))
for ax, i in zip(axes.flatten(), sample_mis):
    ax.imshow(x_test[i].squeeze(), cmap='gray')
    ax.set_title(f"true:{y_test[i]} pred:{y_pred[i]}")
    ax.axis('off')
plt.tight_layout()
mis_path = os.path.join(out_dir, "mnist_misclassified.png")
plt.savefig(mis_path, dpi=150)
plt.show()
print("Saved misclassified gallery to", mis_path)

# 10) Save model and small README text for your GitHub
model_path = os.path.join(out_dir, "mnist_embedding_model.h5")
model.save(model_path)
```

```
print("Saved model to", model_path)

# END - print summary for README
print("\nOutputs saved in folder:", out_dir)
print(" - t-SNE plot:", tsne_path)
print(" - confusion matrix:", os.path.join(out_dir, "mnist_confusion_matrix.png"))
print(" - misclassified gallery:", mis_path)
print(" - saved model:", model_path)

# Quick helper: predict a single image (normalized 28x28)
def predict_single(img_array):
    a = img_array.copy()
    if a.ndim == 2: a = a[..., np.newaxis]
    a = np.expand_dims(a, axis=0)
    p = model.predict(a)[0]
    return np.argmax(p), np.max(p)

# Example usage:
# idx = 0
# print("True:", y_test[idx], "Pred,Conf:", predict_single(x_test[idx]))
```

OUTPUT: