

RAJALAKSHMI ENGINEERING COLLEGE

(An Autonomous Institution)

RAJALAKSHMI NAGAR, THANDALAM- 602 105



**RAJALAKSHMI
ENGINEERING
COLLEGE**

CS19P18 - DEEP LEARNING CONCEPTS LABORATORY

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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

Signature of Faculty In-charge

Submitted for the Practical Examination Held on:

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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
DATE:14/07/2025 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 tensorflow as tf
from tensorflow import keras

from sklearn.datasets import make_classification
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score
# Generate a synthetic dataset

X, y = make_classification(n_samples=1000, n_features=20, random_state=42)
# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
# Standardize features (optional but often beneficial)
scaler = StandardScaler()

X_train = scaler.fit_transform(X_train)
```

```

X_test = scaler.transform(X_test)

# Define the model
model = keras.Sequential([
    keras.layers.Input(shape=(X_train.shape[1],)), # Input layer
    keras.layers.Dense(64, activation='relu'), # Hidden layer with 64 neurons and ReLU activation
    keras.layers.Dense(1, activation='sigmoid') # Output layer with 1 neuron and sigmoid activation
])

# Train the model

history = model.fit(X_train, y_train, epochs=10, batch_size=32, validation_split=0.1)
# Evaluate the model on the test set
y_pred = model.predict(X_test)
y_pred_classes = (y_pred > 0.5).astype(int)
# Calculate accuracy on the test set
accuracy = accuracy_score(y_test, y_pred_classes)
# Calculate test loss
test_loss = model.evaluate(X_test, y_test)
print(f"Test accuracy: {accuracy * 100:.2f}%")
print(f"Test loss: {test_loss[0]:.4f}")

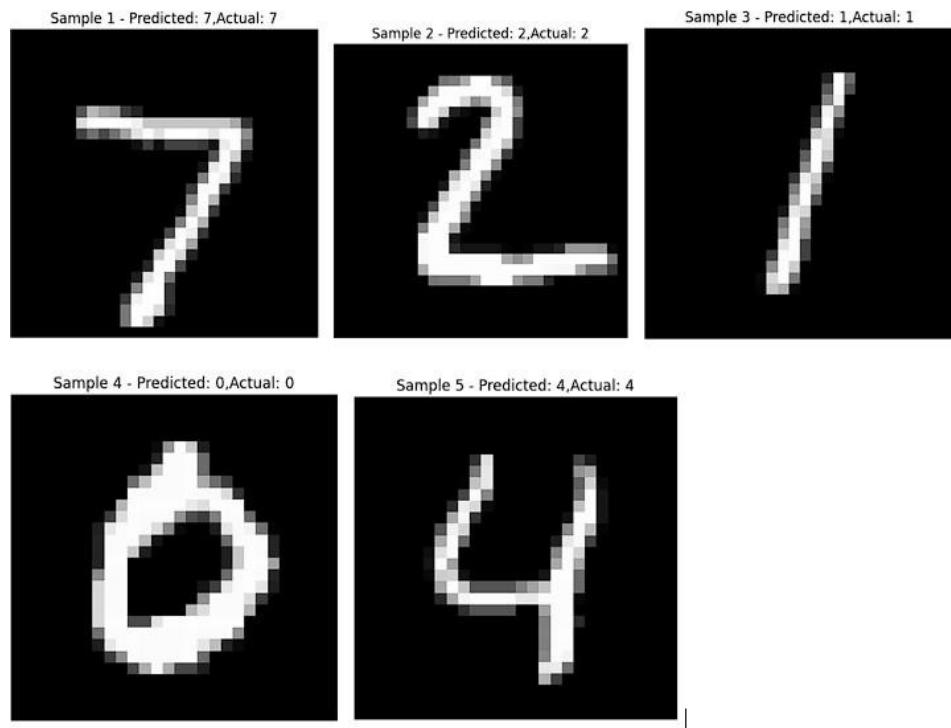
```

Output:

```

Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11/1190434 [=====] 100% 0s 0us/step
/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/10
192/192 [=====] 4s 15ms/step - accuracy: 0.7900 - loss: 0.7140 - val_accuracy: 0.9495 - val_loss: 0.1838
Epoch 2/10
192/192 [=====] 4s 20ms/step - accuracy: 0.9548 - loss: 0.1602 - val_accuracy: 0.9618 - val_loss: 0.1274
Epoch 3/10
192/192 [=====] 4s 12ms/step - accuracy: 0.9718 - loss: 0.0971 - val_accuracy: 0.9684 - val_loss: 0.1091
Epoch 4/10
192/192 [=====] 3s 12ms/step - accuracy: 0.9806 - loss: 0.0686 - val_accuracy: 0.9705 - val_loss: 0.0958
Epoch 5/10
192/192 [=====] 3s 13ms/step - accuracy: 0.9863 - loss: 0.0487 - val_accuracy: 0.9758 - val_loss: 0.0859
Epoch 6/10
192/192 [=====] 5s 13ms/step - accuracy: 0.9903 - loss: 0.0376 - val_accuracy: 0.9739 - val_loss: 0.0868
Epoch 7/10
192/192 [=====] 3s 12ms/step - accuracy: 0.9917 - loss: 0.0293 - val_accuracy: 0.9726 - val_loss: 0.0937
Epoch 8/10
192/192 [=====] 2s 12ms/step - accuracy: 0.9941 - loss: 0.0222 - val_accuracy: 0.9772 - val_loss: 0.0770
Epoch 9/10
192/192 [=====] 3s 15ms/step - accuracy: 0.9963 - loss: 0.0158 - val_accuracy: 0.9779 - val_loss: 0.0787
Epoch 10/10
192/192 [=====] 5s 12ms/step - accuracy: 0.9976 - loss: 0.0115 - val_accuracy: 0.9781 - val_loss: 0.0817
313/313 [=====] 1s 3ms/step - accuracy: 0.9765 - loss: 0.0787
Test results - Loss: 0.07009122520685196 - Accuracy: 0.9800000190734863
1/1 [=====] 0s 71ms/step

```



Result:

Thus, the implementation to build a simple neural network using Keras/TensorFlow has been successfully executed.

EX NO:2 **BUILD A CONVOLUTIONAL NEURAL NETWORK**
DATE:21/07/2025 **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()

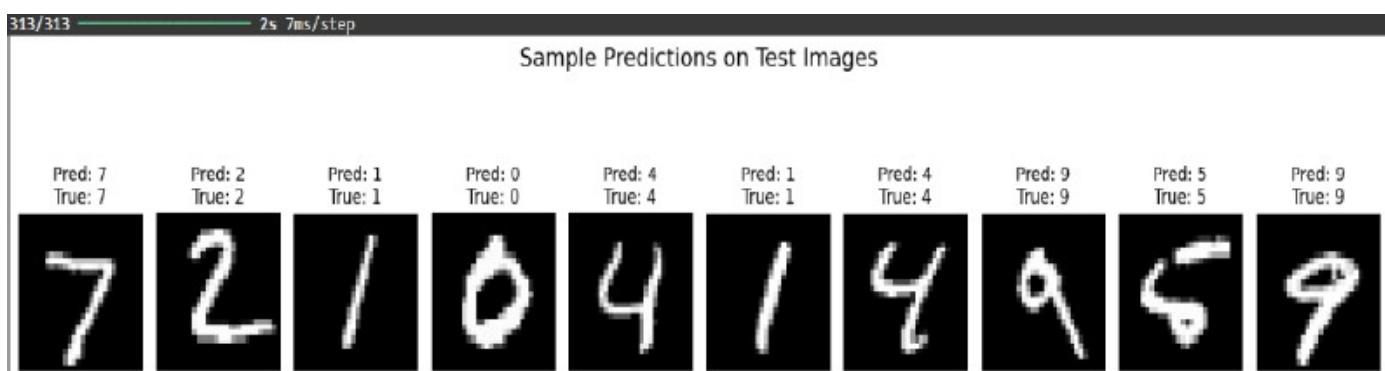
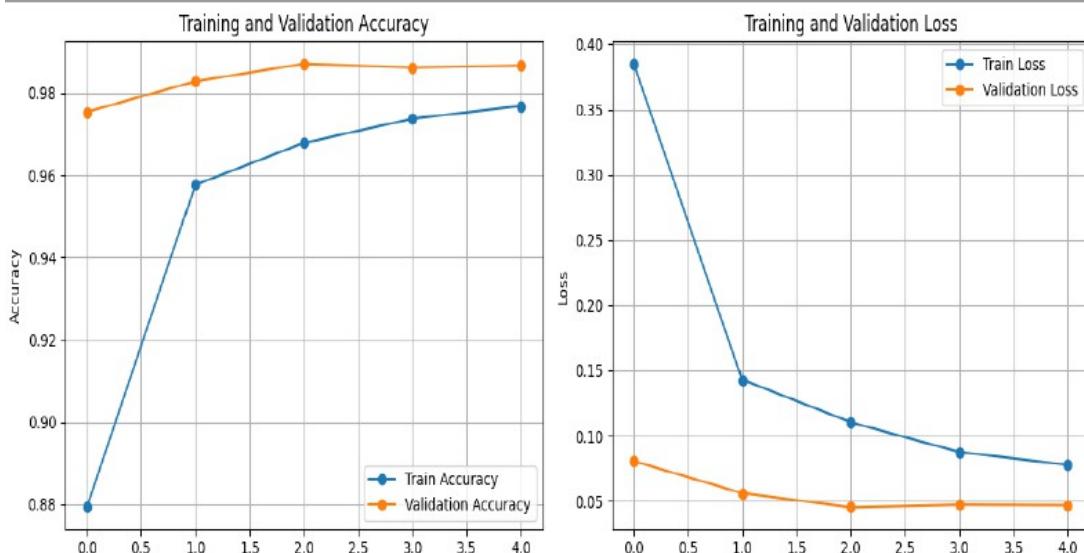
```

Output:

```

/usr/local/lib/python3.11/dist-packages/keras/src/layers/convolutional/base_conv.py:107: UserWarning: Do not pass an `input_shape` / `input_dim` argument to a layer's __init__(). Instead, pass activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/5
750/750 - 38s 48ms/step - accuracy: 0.7641 - loss: 0.7198 - val_accuracy: 0.9754 - val_loss: 0.0806
Epoch 2/5
750/750 - 41s 49ms/step - accuracy: 0.9542 - loss: 0.1575 - val_accuracy: 0.9828 - val_loss: 0.0559
Epoch 3/5
750/750 - 41s 49ms/step - accuracy: 0.9667 - loss: 0.1147 - val_accuracy: 0.9871 - val_loss: 0.0452
Epoch 4/5
750/750 - 41s 49ms/step - accuracy: 0.9737 - loss: 0.0872 - val_accuracy: 0.9862 - val_loss: 0.0472
Epoch 5/5
750/750 - 41s 49ms/step - accuracy: 0.9753 - loss: 0.0801 - val_accuracy: 0.9867 - val_loss: 0.0468
313/313 - 3s 9ms/step - accuracy: 0.9845 - loss: 0.0458

```



Result:

Thus, the Convolution Neural Network (CNN) using Keras / Tensorflow to recognize and classify handwritten digits from MNIST dataset has been implemented successfully.

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

DATE:28/07/2025

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:

```
import tensorflow 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:

```

loading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
98071/170498071 2s 0us/step
h 1/10
625 51s 79ms/step - accuracy: 0.3104 - loss: 1.8651 - val_accuracy: 0.5242 - val_loss: 1.3433
h 2/10
625 51s 81ms/step - accuracy: 0.5359 - loss: 1.3072 - val_accuracy: 0.5898 - val_loss: 1.1679
h 3/10
625 88s 91ms/step - accuracy: 0.5960 - loss: 1.1372 - val_accuracy: 0.6009 - val_loss: 1.1314
h 4/10
625 50s 81ms/step - accuracy: 0.6345 - loss: 1.0355 - val_accuracy: 0.6460 - val_loss: 1.0102
h 5/10
625 84s 83ms/step - accuracy: 0.6662 - loss: 0.9524 - val_accuracy: 0.6433 - val_loss: 1.0243
h 6/10
625 51s 82ms/step - accuracy: 0.6868 - loss: 0.8809 - val_accuracy: 0.6774 - val_loss: 0.9246
h 7/10
625 49s 78ms/step - accuracy: 0.7089 - loss: 0.8233 - val_accuracy: 0.6843 - val_loss: 0.9061
h 8/10
625 49s 78ms/step - accuracy: 0.7337 - loss: 0.7592 - val_accuracy: 0.6893 - val_loss: 0.8919
h 9/10
625 83s 80ms/step - accuracy: 0.7495 - loss: 0.7176 - val_accuracy: 0.7007 - val_loss: 0.8667
h 10/10
625 83s 82ms/step - accuracy: 0.7608 - loss: 0.6766 - val_accuracy: 0.6884 - val_loss: 0.9299
0s 121ms/step

```

Predicted: cat
 Actual: cat



Result

Thus, the Convolution Neural Network (CNN) model for classifying images from CIFAR-10 dataset is implemented successfully.

Ex No: 4 TRANSFER LEARNING WITH CNN AND VISUALIZATION

DATE:04/08/2025

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.

Code:

```
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()

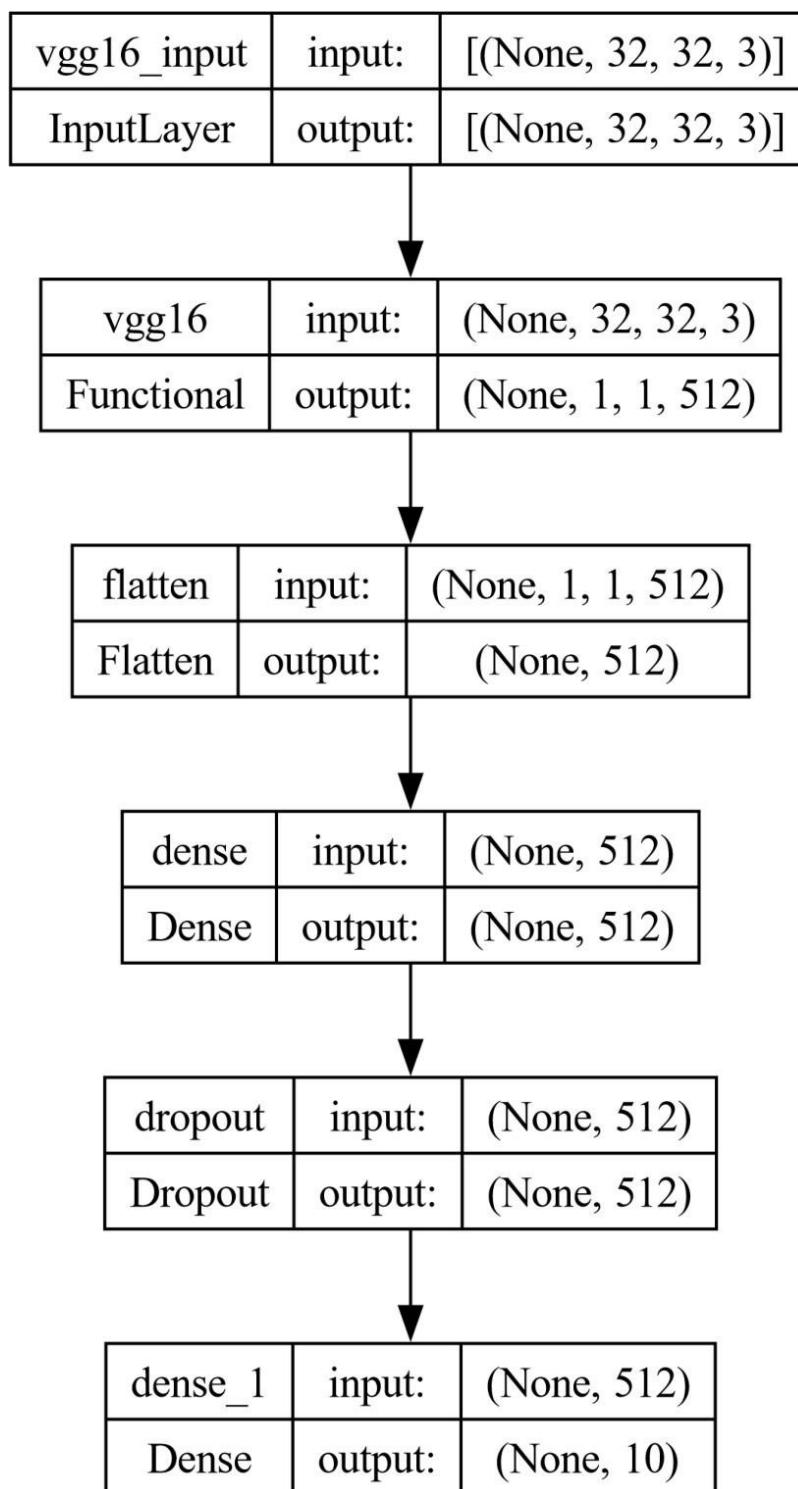
plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Model Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.tight_layout()
plt.show()

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()

```

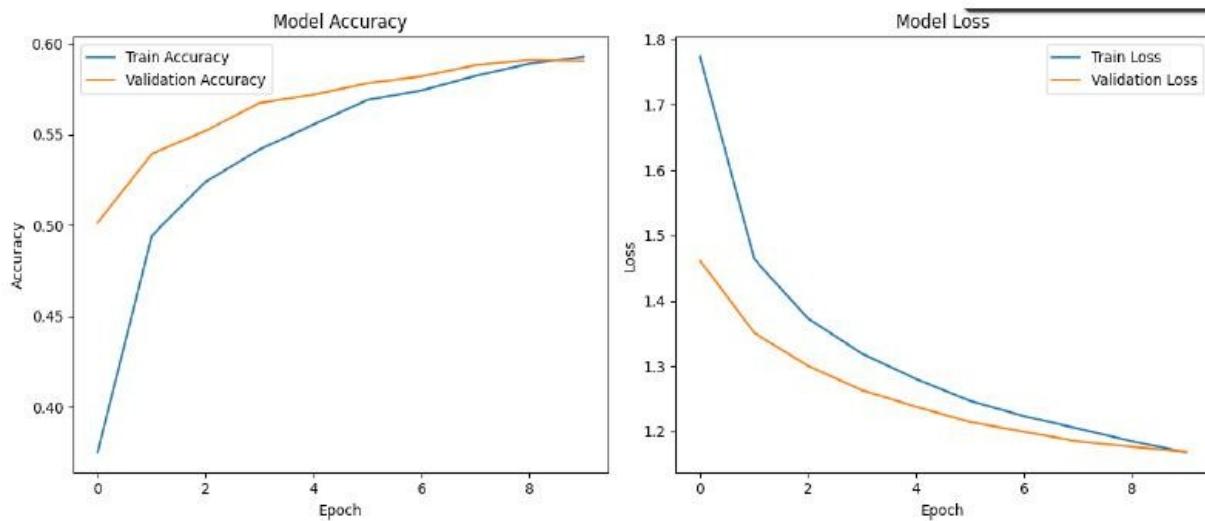
Output:



```

Epoch 1/10
1250/1250 - 580s 463ms/step - accuracy: 0.2851 - loss: 2.0021 - val_accuracy: 0.5015 - val_loss: 1.4614
Epoch 2/10
1250/1250 - 618s 460ms/step - accuracy: 0.4840 - loss: 1.4918 - val_accuracy: 0.5393 - val_loss: 1.3512
Epoch 3/10
1250/1250 - 574s 460ms/step - accuracy: 0.5235 - loss: 1.3748 - val_accuracy: 0.5521 - val_loss: 1.3007
Epoch 4/10
1250/1250 - 624s 461ms/step - accuracy: 0.5373 - loss: 1.3335 - val_accuracy: 0.5674 - val_loss: 1.2630
Epoch 5/10
1250/1250 - 577s 462ms/step - accuracy: 0.5587 - loss: 1.2804 - val_accuracy: 0.5720 - val_loss: 1.2381
Epoch 6/10
1250/1250 - 538s 430ms/step - accuracy: 0.5692 - loss: 1.2482 - val_accuracy: 0.5783 - val_loss: 1.2146
Epoch 7/10
1250/1250 - 600s 461ms/step - accuracy: 0.5717 - loss: 1.2292 - val_accuracy: 0.5821 - val_loss: 1.1994
Epoch 8/10
1250/1250 - 620s 460ms/step - accuracy: 0.5770 - loss: 1.2138 - val_accuracy: 0.5882 - val_loss: 1.1849
Epoch 9/10
1250/1250 - 575s 460ms/step - accuracy: 0.5898 - loss: 1.1833 - val_accuracy: 0.5911 - val_loss: 1.1766
Epoch 10/10
1250/1250 - 624s 461ms/step - accuracy: 0.5937 - loss: 1.1666 - val_accuracy: 0.5905 - val_loss: 1.1690
313/313 - 108s 345ms/step - accuracy: 0.5793 - loss: 1.1799
Test Loss: 1.1821
Test Accuracy: 58.40%

```



Result

Thus, the Convolution Neural Network (CNN) with transfer learning and perform visualization has been implemented successfully

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.

Code:

```
import numpy as np
import tensorflow 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:

Model: "sequential"

Layer (type)	Output Shape	Param #
simple_rnn (SimpleRNN)	(None, 50)	2600
dense (Dense)	(None, 1)	51

Total params: 2,651
Trainable params: 2,651
Non-trainable params: 0

```

Epoch 1/50
22/22 [=====] - 2s 23ms/step - loss: 8.7454
- val_loss: 6.3263
Epoch 2/50
22/22 [=====] - 0s 4ms/step - loss: 5.8837
- val_loss: 3.7798
Epoch 3/50
22/22 [=====] - 0s 5ms/step - loss: 3.7728
- val_loss: 2.3105
Epoch 4/50
22/22 [=====] - 0s 5ms/step - loss: 1.7141
- val_loss: 0.5373
Epoch 5/50
22/22 [=====] - 0s 4ms/step - loss: 0.2878
- val_loss: 0.2417
Epoch 6/50
22/22 [=====] - 0s 4ms/step - loss: 0.1304
- val_loss: 0.1146
Epoch 7/50

1/1 [=====] - 0s 20ms/step
Predictions for new data:
[[ 1.5437698]
 [ 0.4290885]
 [-2.1180325]
 [-0.5443404]
 [-3.8416493]]
```

Result:

Thus, the Recurrent Neural Network (RNN) has been implemented using Tensorflow.

EX NO: 6 SENTIMENT CLASSIFICATION OF TEXT USING RNN**DATE:15/09/2025****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

Code:

```
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:

313/313 ————— 6s 17ms/step - accuracy: 0.6261 - loss: 0.6246 - val_accuracy: 0.8182 - val_loss: 0.4225

Epoch 2/2

313/313 ————— 5s 17ms/step - accuracy: 0.8167 - loss: 0.4321 - val_accuracy: 0.8284 - val_loss: 0.4171

782/782 ————— 3s 4ms/step - accuracy: 0.8329 - loss: 0.4071

Test Accuracy: 0.8304

1/1 ————— 0s 118ms/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 m ichael ? could have allowed this one on his ? he almost seemed to know this wasn't going to work out and his performance was quite ? so all you ? fans gi ve this a miss

Predicted Sentiment: Negative

Result

Thus, the Recurrent Neural Network (RNN) using Keras has been implemented for classifying sentiment of text successfully.

Ex No: 7 BUILD AUTOENCODERS WITH KERAS/TENSORFLOW**DATE:22/09/2025****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.

Code:

```
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:

```

Epoch 1/50
235/235 ━━━━━━━━━━ 6s 18ms/step - loss: 0.3805 - val_loss: 0.1906
Epoch 2/50
235/235 ━━━━━━━━ 5s 19ms/step - loss: 0.1808 - val_loss: 0.1547
Epoch 3/50
235/235 ━━━━━━ 5s 19ms/step - loss: 0.1501 - val_loss: 0.1342
Epoch 4/50
235/235 ━━━━ 3s 10ms/step - loss: 0.1321 - val_loss: 0.1221
Epoch 5/50
235/235 ━━ 2s 9ms/step - loss: 0.1210 - val_loss: 0.1138
Epoch 6/50
235/235 ━ 3s 11ms/step - loss: 0.1134 - val_loss: 0.1081
Epoch 7/50
235/235 5s 9ms/step - loss: 0.1079 - val_loss: 0.1039
Epoch 8/50
235/235 2s 9ms/step - loss: 0.1042 - val_loss: 0.1006
Epoch 9/50
235/235 3s 9ms/step - loss: 0.1011 - val_loss: 0.0981
Epoch 10/50
235/235 3s 11ms/step - loss: 0.0989 - val_loss: 0.0963
Epoch 11/50
235/235 3s 12ms/step - loss: 0.0972 - val_loss: 0.0951
Epoch 12/50
235/235 3s 11ms/step - loss: 0.0964 - val_loss: 0.0943
Epoch 13/50
235/235 2s 10ms/step - loss: 0.0954 - val_loss: 0.0938
Epoch 14/50
235/235 2s 10ms/step - loss: 0.0950 - val_loss: 0.0934
Epoch 15/50
235/235 3s 11ms/step - loss: 0.0944 - val_loss: 0.0932

```

```
→ Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11490434/11490434 1s 0us/step
```

```
→ Test Loss: 0.09166844934225082
Test Accuracy: 0.9712756377551021
```



Result

Thus, an Autoencoder has been implemented using Keras / Tensorflow.

Ex No:8

OBJECT DETECTION WITH YOLO3

DATE:29/09/2025

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.

Code:

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

# --- 1. DEFINE FILE PATHS ---
# This is the only version you should use.
# Your test proved all these files are in the correct place.
cfg_file = 'yolov3.cfg'
weight_file = 'yolov3.weights'
names_file = 'coco.names'
image_path = 'my_image.jpg' # <-- THIS IS THE CORRECT PATH

# --- 2. LOAD YOLO MODEL AND CLASS NAMES ---
try:
    net = cv2.dnn.readNet(weight_file, cfg_file)
except cv2.error as e:
    print(f"Error loading model: {e}")
    exit()

with open(names_file, 'r') as f:
    classes = f.read().strip().split('\n')

# --- 3. LOAD AND PROCESS THE IMAGE ---
image = cv2.imread(image_path)

if image is None:
    print(f"Error: Could not read the image file at '{image_path}'")
    # Add a printout of files to help debug if it fails again
    print(f"Files in the current directory are: {os.listdir()}")
else:
```

```
height, width = image.shape[:2]
blob = cv2.dnn.blobFromImage(image, 1/255.0, (416, 416), swapRB=True, crop=False)
net.setInput(blob)
```

```
# --- 4. RUN FORWARD PASS AND GET DETECTIONS ---
```

```
layer_names = net.getUnconnectedOutLayersNames()
outs = net.forward(layer_names)
```

```
# --- 5. PROCESS DETECTIONS AND APPLY NMS ---
```

```
class_ids = []
confidences = []
boxes = []
conf_threshold = 0.5
nms_threshold = 0.4
```

```
for out in outs:
```

```
    for detection in out:
```

```
        scores = detection[5:]
        class_id = np.argmax(scores)
        confidence = scores[class_id]
        if confidence > conf_threshold:
            center_x = int(detection[0] * width)
            center_y = int(detection[1] * height)
            w = int(detection[2] * width)
            h = int(detection[3] * height)
            x = int(center_x - w / 2)
            y = int(center_y - h / 2)
            boxes.append([x, y, w, h])
            confidences.append(float(confidence))
            class_ids.append(class_id)
```

```
indices = cv2.dnn.NMSBoxes(boxes, confidences, conf_threshold, nms_threshold)
```

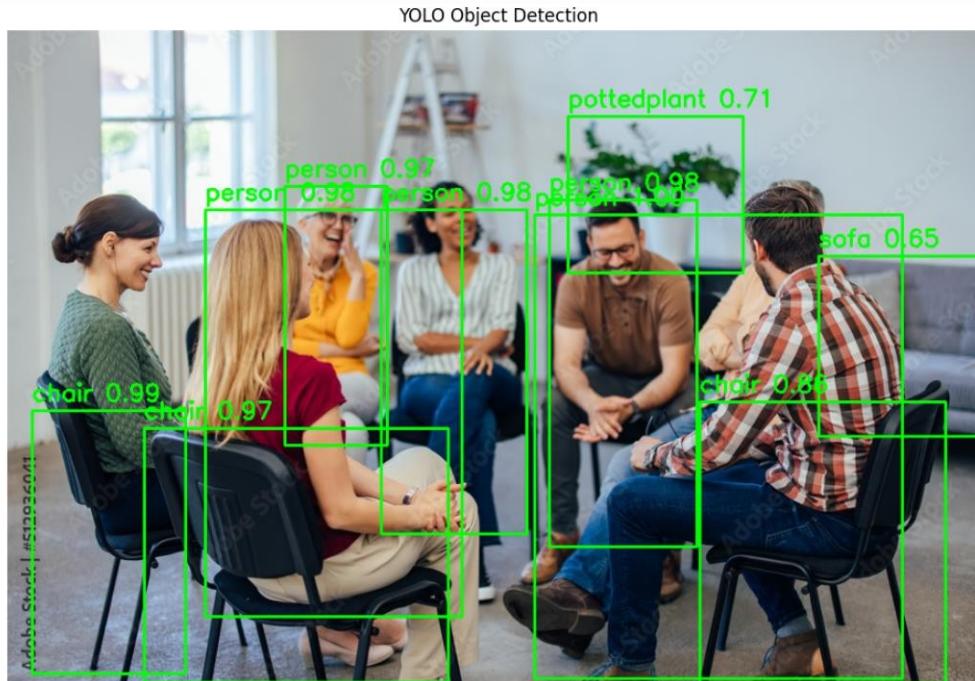
```
# --- 6. DRAW BOUNDING BOXES AND DISPLAY THE FINAL IMAGE ---
```

```
if len(indices) > 0:
```

```
    for i in indices.flatten():
        x, y, w, h = boxes[i]
        label = str(classes[class_ids[i]])
        confidence = confidences[i]
        color = (0, 255, 0)
        cv2.rectangle(image, (x, y), (x + w, y + h), color, 2)
        cv2.putText(image, f'{label} {confidence:.2f}', (x, y - 10),
                   cv2.FONT_HERSHEY_SIMPLEX, 0.8, color, 2)
```

```
plt.figure(figsize=(12, 10))
plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
plt.title("YOLO Object Detection")
plt.axis('off')
plt.show()
```

Output:



Result

Thus, object detection using YOLOV5 has been implemented successfully.

Ex No: 9 BUILD GENERATIVE ADVERSARIAL NEURAL NETWORK**DATE:29/09/2025****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.

Code:

```
import numpy as np
import tensorflow 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

def build_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)

    # Train generator
    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:

Epoch	Discriminator Loss	Generator Loss
0/200	0.8773080408573151	0.764731228351593
1/200	0.9332943856716156	0.7988691329956055
2/200	0.9277275502681732	0.8127573728561401
3/200	0.8921994566917419	0.7757299542427063
4/200	0.913447916507721	0.7737997174263
5/200	0.8916181325912476	0.8003895282745361
6/200	0.9026078879833221	0.814433217048645
7/200	0.9135120809078217	0.8237183690071106
8/200	0.879832923412323	0.7563657760620117
9/200	0.9439513385295868	0.7623365521430969
10/200	0.9355685114860535	0.7924684286117554
11/200	0.9386743903160095	0.7614541053771973
12/200	0.960555225610733	0.7792538404464722
13/200	0.9134297668933868	0.792992115020752
14/200	0.8851655125617981	0.7628173232078552
15/200	0.9505723416805267	0.7851851582527161
16/200	0.92226842045784	0.769191563129425
17/200	0.8982412815093994	0.7685977220535278
18/200	0.9125983119010925	0.7730982899665833
19/200	0.9367325305938721	0.7837406396865845
20/200	0.9531015455722809	0.7827053070068359
21/200	0.9306998252868652	0.76667914032936096
22/200	0.8887360095977783	0.7845874428749084
23/200	0.9426513016223907	0.746765673160553
24/200	0.9331325888633728	0.761589765548706
25/200	0.9080778360366821	0.7709233164787292
26/200	0.9232879281044006	0.7773635387420654
27/200	0.9102294743061066	0.7809370756149292
28/200	0.9312145709991455	0.7647197246551514
29/200	0.9415165781974792	0.7561923861503601
30/200	0.930676281452179	0.7709008455276489
31/200	0.9495892226696014	0.759508481903076

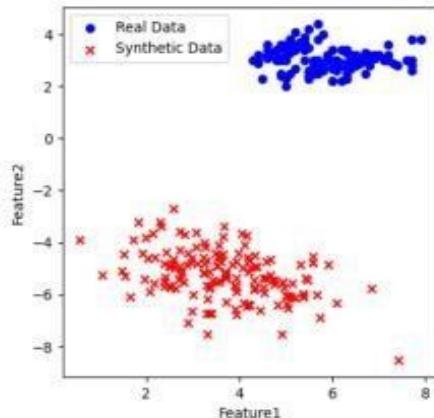
```

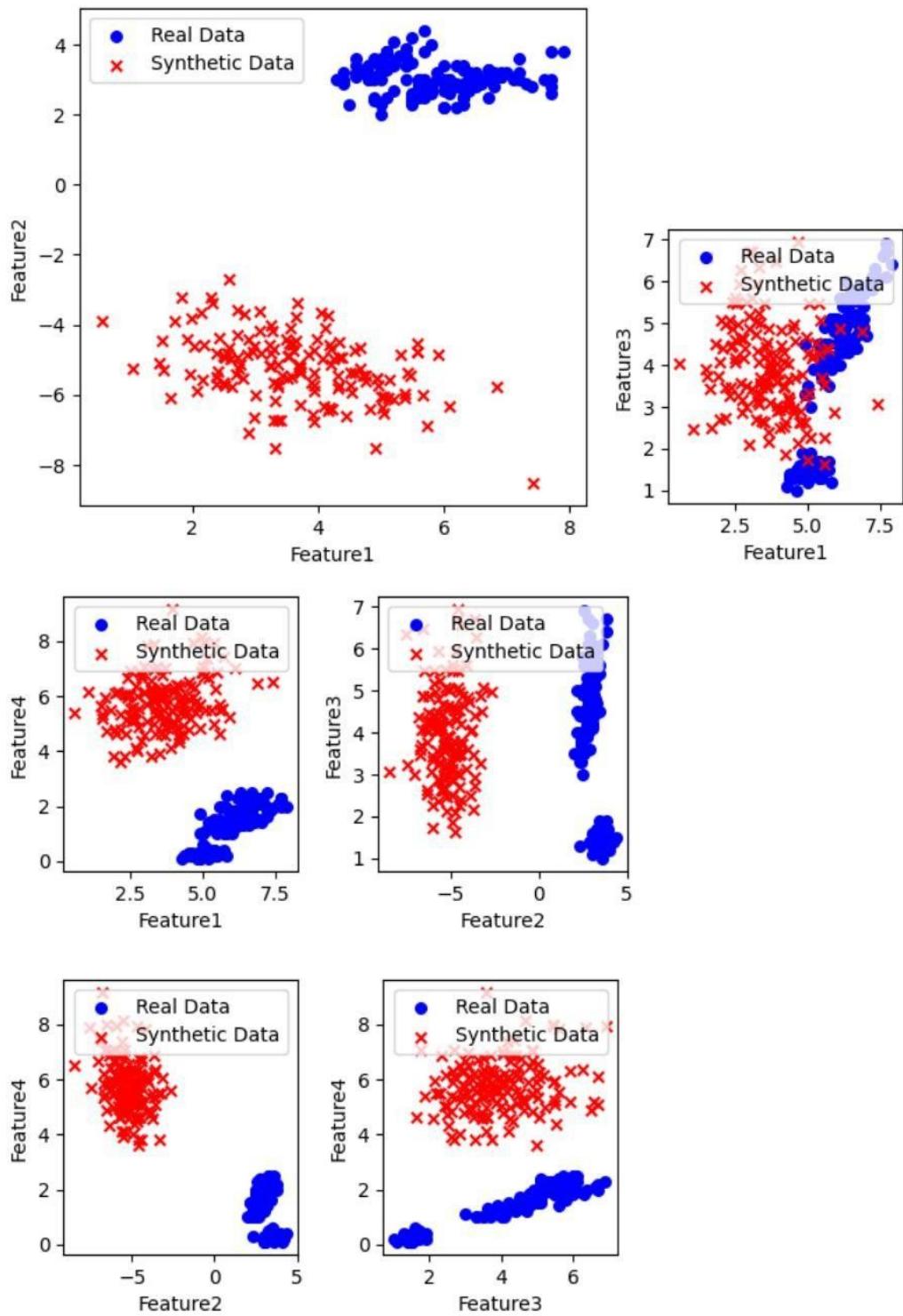
In [33]: synthetic_data = generator.predict(np.random.normal(0, 1, (150, 100)), verbose=0)
plt.figure(figsize=(12, 8))
plot_idx1

for i in range(4):
    for j in range(i+1, 4):
        plt.subplot(2, 2, plot_idx1)
        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_idx1 += 1

    plt.tight_layout()
    plt.show()

```





Result

Thus, a generative adversarial neural network using Keras / Tensorflow has been implemented successfully.

Ex No: 10 MINI PROJECT – COLOR DETECTION SYSTEM

Aim:

To design and implement a deep learning based autocorrect system that suggests the correct spelling and provides dynamic word predictions based on user input.

Code:

```
# =====
# STEP 1: Import libraries
# =====

import numpy as np
import re
import os
import tensorflow as tf
from tensorflow.keras.models import Sequential, load_model
from tensorflow.keras.layers import Embedding, LSTM, Dense, Bidirectional
from tensorflow.keras.preprocessing.text import Tokenizer
import ipywidgets as widgets
from IPython.display import display, clear_output

print("☒ TensorFlow version:", tf.__version__)
print("☒ Num GPUs Available:", len(tf.config.list_physical_devices('GPU')))

# =====
# STEP 2: Load & preprocess dataset
# =====

DATASET_PATH = r"C:\Users\Akash\Downloads\project\words_dataset.txt"

with open(DATASET_PATH, 'r', encoding='utf-8') as f:
    text = f.read().lower()

    # Clean text (keep only letters & spaces)
    text = re.sub(r'[^a-z\s]', ' ', text)

    # Tokenize words
```

```
words = text.split()
print("Total words in dataset:", len(words))
print("Unique words:", len(set(words)))

# Optional speedup
sample_size = 10000
words = words[:sample_size]

# =====
# STEP 3: Prepare sequences
# =====

tokenizer = Tokenizer()
tokenizer.fit_on_texts(words)

total_words = len(tokenizer.word_index) + 1
print("Vocabulary size:", total_words)

# Create bigram sequences (previous word → next word)
input_sequences = []
for i in range(1, len(words)):
    seq = words[i - 1:i + 1]
    encoded = tokenizer.texts_to_sequences(seq)
    if len(encoded) == 2:
        input_sequences.append([encoded[0][0], encoded[1][0]])

input_sequences = np.array(input_sequences)
X, y = input_sequences[:, 0], input_sequences[:, 1]

print("Training samples:", X.shape[0])

# =====
# STEP 4: Build or Load Model
# =====

MODEL_PATH = "autocorrect_model.h5"
```

```

if os.path.exists(MODEL_PATH):
    print("⌚ Loading saved model...")
    model = load_model(MODEL_PATH)
else:
    print("🛠 Building new model...")
    model = Sequential([
        Embedding(total_words, 64, input_length=1),
        Bidirectional(LSTM(64)),
        Dense(total_words, activation='softmax')
    ])

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

model.fit(X, y, epochs=5, batch_size=32, verbose=1)
model.save(MODEL_PATH)
print("✅ Model saved!")

# =====
# STEP 5: Suggestion function
# =====

reverse_word_index = {v: k for k, v in tokenizer.word_index.items()}

def suggest_words(prefix, top_n=3):
    """Suggest likely words for the given prefix"""
    seq = tokenizer.texts_to_sequences([prefix])
    if not seq or not seq[0]:
        return [] # handle empty or unknown prefix
    seq = np.array(seq)
    pred = model.predict(seq, verbose=0)[0]
    top_indices = pred.argsort()[-top_n:][:-1]
    return [reverse_word_index.get(i, prefix) for i in top_indices]

```

```
# =====
# STEP 6: Create Interactive Input Box
# =====

print("\n⌚ Autocorrect System is Ready!\n(Type in the box below to get suggestions.)")

# Create input box
input_box = widgets.Text(
    value="",
    placeholder='Type a word here...',
    description='Word:',
    disabled=False,
    layout=widgets.Layout(width='400px')
)

# Output area for suggestions
output_area = widgets.Output(layout={"border": '1px solid gray', 'padding': '5px', 'width': '400px'})

# Function to show suggestions dynamically
def on_type(change):
    with output_area:
        clear_output()
        word = input_box.value.strip().lower()
        if word:
            suggestions = suggest_words(word, top_n=3)
            if suggestions:
                print(f"⌚ Suggestions for '{word}': {' '.join(suggestions)}")
            else:
                print(f"⚠️ No suggestions found for '{word}'")
        else:
            print("⌨️ Start typing to see suggestions...")

# Attach event listener
```

```
input_box.observe(on_type, names='value')

# =====
# STEP 7: Display UI Properly
# =====

display(widgets.VBox([input_box, output_area]))
```

Output:

```
✓ TensorFlow version: 2.11.0
✓ Num GPUs Available: 0
Total words in dataset: 10292
Unique words: 83
Vocabulary size: 84
Training samples: 9999
📁 Loading saved model...
```

Word:

🔮 Suggestions: apple, orange, watermelon

Result:

The program will be successfully execute.