LAB 4 > dltlab9.py > ...

```python
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import SimpleRNN, Dense
from sklearn.model_selection import train_test_split

# 1. Generate sine wave dataset
x = np.linspace(0, 100, 1000)
y = np.sin(x)

# 2. Create sequences
seq_length = 50
X, Y = [], []
for i in range(len(y) - seq_length):
    X.append(y[i:i+seq_length])
    Y.append(y[i+seq_length])
X, Y = np.array(X), np.array(Y)

# 3. Train-test split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, shuffle=False)

# 4. Reshape for RNN [samples, timesteps, features]
X_train = X_train.reshape((X_train.shape[0], X_train.shape[1], 1))
X_test = X_test.reshape((X_test.shape[0], X_test.shape[1], 1))

# 5. Build RNN model
model = Sequential([
    SimpleRNN(50, activation='tanh', input_shape=(seq_length, 1)),
    Dense(1)
])
model.compile(optimizer='adam', loss='mse')

# 6. Train for 10 epochs
history = model.fit(X_train, Y_train, epochs=10, validation_data=(X_test, Y_test), verbose=1)

# 7. Evaluate
loss = model.evaluate(X_test, Y_test, verbose=0)
print(f"\n✅ Test MSE: {loss:.6f}")
```

LAB 4 > dltlab9.py > ...

```
25
26  # 5. Build RNN model
27  model = Sequential([
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33  # 6. Train for 10 epochs
34  history = model.fit(X_train, Y_train, epochs=10, validation_data=(X_test, Y_test), verbose=1)
35
36  # 7. Evaluate
37  loss = model.evaluate(X_test, Y_test, verbose=0)
38  print(f"\n✅ Test MSE: {loss:.6f}")
39
40  # 8. Predictions
41  preds = model.predict(X_test[:5])
42  for i in range(5):
43      print(f"Predicted: {preds[i][0]:.4f}, Actual: {Y_test[i]:.4f}")
44
45  # 9. Plot actual vs predicted
46  plt.figure(figsize=(10,4))
47  plt.plot(Y_test[:100], label="Actual")
48  plt.plot(model.predict(X_test[:100]), label="Predicted")
49  plt.legend()
50  plt.show()
51
```

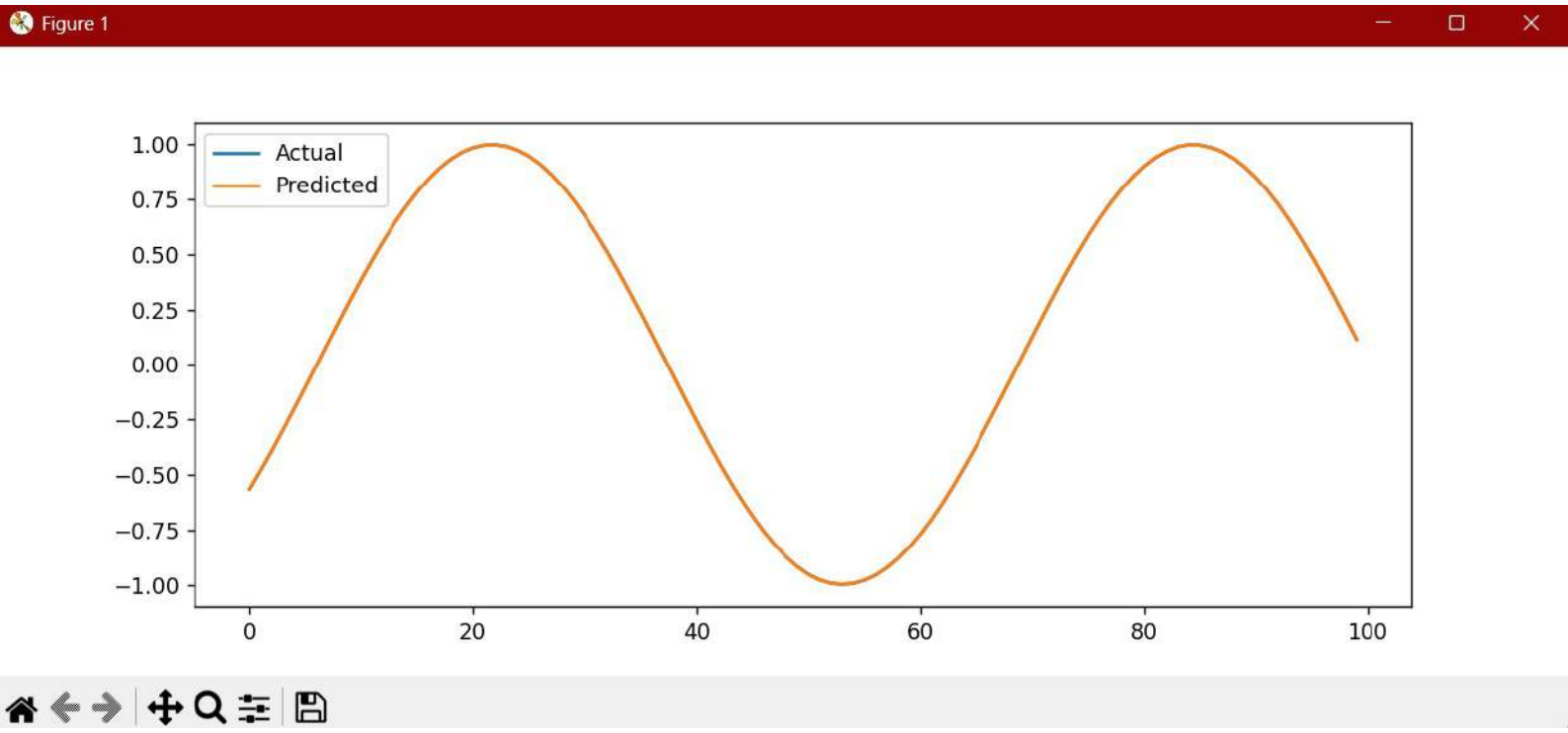
Figure 1
Actual
Predicted
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
20
40
60
80
100

```
PS C:\Users\aarus\OneDrive\Desktop\SRM\DLT> & C:/Python313/python.exe "c:/Users/aarus/OneDrive/Desktop/SRM/DLT/LAB 4/dltlab9.py"
2025-11-04 20:53:30.970940: I tensorflow/core/util/port.cc:153] oneDNN custom operations are on. You may see slightly different numerical results due to floating-point round-off errors from different computation orders. To turn them off, set the environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
2025-11-04 20:53:32.746544: I tensorflow/core/util/port.cc:153] oneDNN custom operations are on. You may see slightly different numerical results due to floating-point round-off errors from different computation orders. To turn them off, set the environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
2025-11-04 20:53:34.030252: I tensorflow/core/platform/cpu_feature_guard.cc:210] This TensorFlow binary is optimized to use available CPU instructions in performance-critical operations.
To enable the following instructions: SSE3 SSE4.1 SSE4.2 AVX AVX2 AVX_VNNI FMA, in other operations, rebuild TensorFlow with the appropriate compiler flags.
C:\Users\aarus\AppData\Roaming\Python\Python313\site-packages\keras\src\layers\rnn\rnn.py:199: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(**kwargs)
Epoch 1/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 1s 10ms/step - loss: 0.0249 - val_loss: 0.0023
Epoch 2/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 8.6976e-04 - val_loss: 6.3778e-05
Epoch 3/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 8.0694e-05 - val_loss: 4.0406e-05
Epoch 4/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 1.4458e-05 - val_loss: 4.9586e-06
Epoch 5/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 3.7427e-06 - val_loss: 2.9340e-06
Epoch 6/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 2.4921e-06 - val_loss: 2.0929e-06
Epoch 7/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - loss: 2.0416e-06 - val_loss: 2.5048e-06
Epoch 8/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 2.0540e-06 - val_loss: 1.8623e-06
Epoch 9/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 1.7890e-06 - val_loss: 2.6045e-06
Epoch 10/10
24/24 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 1.7926e-06 - val_loss: 1.4344e-06

✅ Test MSE: 0.000001
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 81ms/step
Predicted: -0.5639, Actual: -0.5649
Predicted: -0.4781, Actual: -0.4796
Predicted: -0.3882, Actual: -0.3895
Predicted: -0.2951, Actual: -0.2955
Predicted: -0.1993, Actual: -0.1986
4/4 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step
PS C:\Users\aarus\OneDrive\Desktop\SRM\DLT>
```