```python
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)

```
/usr/local/lib/python3.12/dist-
packages/keras/src/layers/rnn/rnn.py:19
9:
Model: "sequential"
```

Layer (type)	Output Shape	Param #
simple_rnn (SimpleRNN)	(None, 50)	2,600
dense (Dense)	(None, 1)	51

```
 Total params: 2,651 (10.36 KB)
 Trainable params: 2,651 (10.36 KB)  Non-
trainable params: 0 (0.00 B)
Epoch 1/50
22/22 ───────────────── 5s 28ms/step - loss: 9.1232 - val_loss: 7.9147
Epoch 2/50
22/22 ───────────────── 0s 11ms/step - loss: 8.4019 - val_loss: 5.8570
Epoch 3/50
22/22 ───────────────── 0s 10ms/step - loss: 5.7004 - val_loss: 2.9529
Epoch 4/50
22/22 ───────────────── 0s 10ms/step - loss: 2.5640 - val_loss: 0.7930
Epoch 5/50
22/22 ───────────────── 0s 11ms/step - loss: 0.5711 - val_loss: 0.2981
Epoch 6/50
22/22 ───────────────── 0s 11ms/step - loss: 0.2254 - val_loss: 0.1551
Epoch 7/50
22/22 ───────────────── 0s 12ms/step - loss: 0.1256 - val_loss: 0.1127
Epoch 8/50
22/22 ───────────────── 0s 8ms/step - loss: 0.0974 - val_loss: 0.0858
Epoch 9/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0833 - val_loss: 0.0648
Epoch 10/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0605 - val_loss: 0.0661
Epoch 11/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0541 - val_loss: 0.0503
Epoch 12/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0385 - val_loss: 0.0467
Epoch 13/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0502 - val_loss: 0.0622
Epoch 14/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0393 - val_loss: 0.0487
Epoch 15/50
22/22 ───────────────── 0s 8ms/step - loss: 0.0456 - val_loss: 0.0597
Epoch 16/50
22/22 ───────────────── 0s 9ms/step - loss: 0.0460 - val_loss: 0.0413
Epoch 17/50
22/22 ───────────────── 0s 8ms/step - loss: 0.0362 - val_loss: 0.0493
Epoch 18/50
22/22 ───────────────── 0s 9ms/step - loss: 0.0392 - val_loss: 0.0613
Epoch 19/50
22/22 ───────────────── 0s 8ms/step - loss: 0.0321 - val_loss: 0.0380
Epoch 20/50
22/22 ───────────────── 0s 8ms/step - loss: 0.0333 - val_loss: 0.0444
Epoch 21/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0313 - val_loss: 0.0793
Epoch 22/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0481 - val_loss: 0.0325
Epoch 23/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0293 - val_loss: 0.0333
Epoch 24/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0250 - val_loss: 0.0443
Epoch 25/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0341 - val_loss: 0.0323
Epoch 26/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0253 - val_loss: 0.0272
Epoch 27/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0220 - val_loss: 0.0269
Epoch 28/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0355 - val_loss: 0.0554
Epoch 29/50
22/22 ───────────────── 0s 8ms/step - loss: 0.0299 - val_loss: 0.0266
Epoch 30/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0221 - val_loss: 0.0244
Epoch 31/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0187 - val_loss: 0.0274
Epoch 32/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0193 - val_loss: 0.0239
Epoch 33/50
22/22 ───────────────── 0s 7ms/step - loss: 0.0203 - val_loss: 0.0241
Epoch 34/50
22/22 ───────────────── 0s 9ms/step - loss: 0.0174 - val_loss: 0.0385
Epoch 35/50
```

```
22/22 ———————————— 0s 14ms/step - loss: 0.0248 - val_loss: 0.0262
Epoch 36/50
22/22 ———————————— 1s 12ms/step - loss: 0.0247 - val_loss: 0.0274
Epoch 37/50
22/22 ———————————— 0s 13ms/step - loss: 0.0302 - val_loss: 0.0277
Epoch 38/50
22/22 ———————————— 0s 11ms/step - loss: 0.0272 - val_loss: 0.0341
Epoch 39/50
22/22 ———————————— 0s 6ms/step - loss: 0.0220 - val_loss: 0.0297
Epoch 40/50
22/22 ———————————— 0s 7ms/step - loss: 0.0265 - val_loss: 0.0258
Epoch 41/50
22/22 ———————————— 0s 8ms/step - loss: 0.0177 - val_loss: 0.0229
Epoch 42/50
22/22 ———————————— 0s 7ms/step - loss: 0.0149 - val_loss: 0.0341
Epoch 43/50
22/22 ———————————— 0s 12ms/step - loss: 0.0183 - val_loss: 0.0221
Epoch 44/50
22/22 ———————————— 0s 10ms/step - loss: 0.0227 - val_loss: 0.0408
Epoch 45/50
22/22 ———————————— 0s 9ms/step - loss: 0.0268 - val_loss: 0.0298
Epoch 46/50
22/22 ———————————— 0s 10ms/step - loss: 0.0224 - val_loss: 0.0270
Epoch 47/50
22/22 ———————————— 0s 11ms/step - loss: 0.0205 - val_loss: 0.0266
Epoch 48/50
22/22 ———————————— 0s 11ms/step - loss: 0.0178 - val_loss: 0.0218
Epoch 49/50
22/22 ———————————— 0s 11ms/step - loss: 0.0145 - val_loss: 0.0201
Epoch 50/50
22/22 ———————————— 0s 9ms/step - loss: 0.0129 - val_loss: 0.0347
7/7 ———————————— 0s 5ms/step - loss: 0.0345
Test Loss: 0.0332
7/7 ———————————— 0s 24ms/step
Test Accuracy (R^2): 0.9964
1/1 ———————————— 0s 36ms/step
Predictions for new data:
[[ 1.6805735 ]
 [ 0.22280847]
 [-2.3447905 ]
 [-0.61556625]
 [-3.9474432 ]]
```