lstm-predicttemp-rnn

September 14, 2023

[4]:
```python
import tensorflow as tf
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

[5]:
```python
zip_path = tf.keras.utils.get_file(
    origin ='https://storage.googleapis.com/tensorflow/tf-keras-datasets/
↪jena_climate_2009_2016.csv.zip',
    fname ='jena_climate_2009_2016.csv.zip',
    extract=True)
csv_path, _= os.path.splitext(zip_path)
```

[6]:
```python
temp = pd.read_csv(csv_path)
```

[7]:
```python
temp.shape
```

[7]:
```
(420551, 15)
```

[8]:
```python
dft = temp[5::6]
```

[9]:
```python
dft.head()
```

[9]:
```
              Date Time  p (mbar)  T (degC)  Tpot (K)  Tdew (degC)  rh (%)  \
5   01.01.2009 01:00:00    996.50     -8.05    265.38        -8.78    94.4
11  01.01.2009 02:00:00    996.62     -8.88    264.54        -9.77    93.2
17  01.01.2009 03:00:00    996.84     -8.81    264.59        -9.66    93.5
23  01.01.2009 04:00:00    996.99     -9.05    264.34       -10.02    92.6
29  01.01.2009 05:00:00    997.46     -9.63    263.72       -10.65    92.2

    VPmax (mbar)  VPact (mbar)  VPdef (mbar)  sh (g/kg)  H2OC (mmol/mol)  \
5           3.33          3.14          0.19       1.96             3.15
11          3.12          2.90          0.21       1.81             2.91
17          3.13          2.93          0.20       1.83             2.94
23          3.07          2.85          0.23       1.78             2.85
29          2.94          2.71          0.23       1.69             2.71
```

```
    rho (g/m**3)  wv (m/s)  max. wv (m/s)  wd (deg)
5        1307.86      0.21           0.63     192.7
11       1312.25      0.25           0.63     190.3
17       1312.18      0.18           0.63     167.2
23       1313.61      0.10           0.38     240.0
29       1317.19      0.40           0.88     157.0
```

[10]:
```
dft["Date Time"] = pd.to_datetime(dft["Date Time"])
```

```
C:\Users\bxash\AppData\Local\Temp\ipykernel_13868\524758945.py:1:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  dft["Date Time"] = pd.to_datetime(dft["Date Time"])
```

[11]:
```
dft.dtypes
```

[11]:
```
Date Time          datetime64[ns]
p (mbar)                  float64
T (degC)                  float64
Tpot (K)                  float64
Tdew (degC)               float64
rh (%)                    float64
VPmax (mbar)              float64
VPact (mbar)              float64
VPdef (mbar)              float64
sh (g/kg)                 float64
H2OC (mmol/mol)           float64
rho (g/m**3)              float64
wv (m/s)                  float64
max. wv (m/s)             float64
wd (deg)                  float64
dtype: object
```

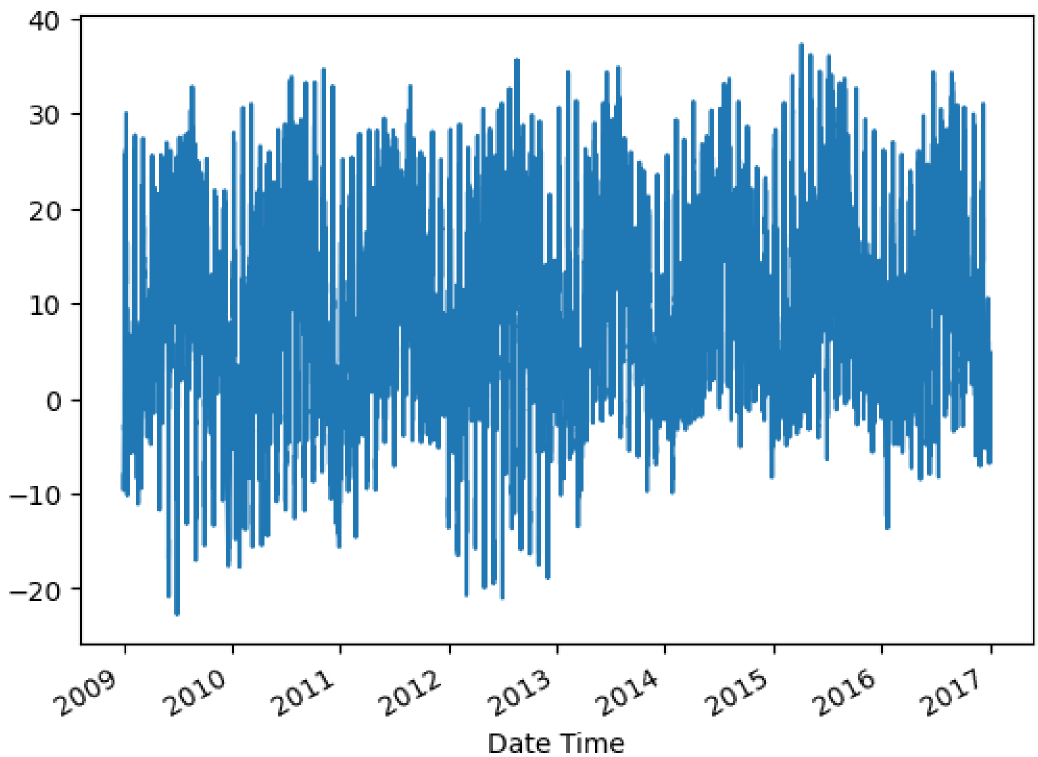
[12]:
```
dft.set_index("Date Time", inplace=True)
```

[13]:
```
tmp = dft["T (degC)"]
tmp
```

[13]:
```
Date Time
2009-01-01 01:00:00   -8.05
2009-01-01 02:00:00   -8.88
2009-01-01 03:00:00   -8.81
2009-01-01 04:00:00   -9.05
```

```
2009-01-01 05:00:00   -9.63
                        …
2016-12-31 19:10:00   -0.98
2016-12-31 20:10:00   -1.40
2016-12-31 21:10:00   -2.75
2016-12-31 22:10:00   -2.89
2016-12-31 23:10:00   -3.93
Name: T (degC), Length: 70091, dtype: float64
```

[14]:
```
tmp.plot()
plt.show()
```



[15]:
```
'''def df_to_XY(dataframe, windowsize):
    df_to_nparr = dataframe.to_numpy()
    x = []
    y = []
    tx = []
    for e in range(len(df_to_nparr)-windowsize):
        tx.append([e])
        if len(tx) >= windowsize:
            x.append([[tx[e:e+windowsize]]])
            y.append(tx[e+windowsize])
```

```
    return x.to_numpy(), y.to_numpy()

    ANOTHER APPROACH'''
```

[15]: 'def df_to_XY(dataframe, windowsize):\n   df_to_nparr = dataframe.to_numpy()\n
x = []\n   y = []\n   tx = []\n   for e in
range(len(df_to_nparr)-windowsize):\n   tx.append([e])\n   if len(tx)
>= windowsize:\n   x.append([[tx[e:e+windowsize]]])\n
y.append(tx[e+windowsize])\n   return x.to_numpy(), y.to_numpy()\n   \n
ANOTHER APPROACH'

[16]:
```
def df_to_XY(dataframe, windowsize):
    df_to_nparr = dataframe.to_numpy()
    X = []
    Y = []
    for e in range(len(df_to_nparr) - windowsize):
        entry = [[i] for i in df_to_nparr[e:e+windowsize]]
        X.append(entry)
        Y.append(df_to_nparr[e+windowsize])
    return np.array(X), np.array(Y)
```

[17]:
```
WINDOWSIZE = 5
X, Y = df_to_XY(tmp, WINDOWSIZE)
```

0.1 Train-Test Split

[18]:
```
X.shape, Y.shape
```

[18]: ((70086, 5, 1), (70086,))

[19]:
```
X_train, Y_train = X[:60000], Y[:60000]
X_cv, Y_cv = X[60000:65000], Y[60000:65000]
X_test, Y_test = X[65000:], Y[65000:]
```

[20]:
```
X_train.shape, Y_train.shape
```

[20]: ((60000, 5, 1), (60000,))

[21]:
```
X_cv.shape
```

[21]: (5000, 5, 1)

0.2 Model

[22]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import *
from tensorflow.keras.callbacks import ModelCheckpoint
from tensorflow.keras.losses import MeanSquaredError
from tensorflow.keras.metrics import RootMeanSquaredError
from tensorflow.keras.optimizers import Adam
```

[23]:
```
mod1 = Sequential()
mod1.add(InputLayer((5, 1)))
mod1.add(LSTM(64))
mod1.add(Dense(8, 'relu'))
mod1.add(Dense(1, 'linear'))

mod1.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm (LSTM)                 (None, 64)                16896

 dense (Dense)               (None, 8)                 520

 dense_1 (Dense)             (None, 1)                 9

=================================================================
Total params: 17425 (68.07 KB)
Trainable params: 17425 (68.07 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

[24]:
```
bmod = ModelCheckpoint('mod1/', save_best_only=True)
mod1.compile(loss=MeanSquaredError(), optimizer=Adam(learning_rate=0.001),
 ↪metrics=[RootMeanSquaredError()])
```

[25]:
```
mod1.fit(X_train, Y_train, validation_data=(X_cv, Y_cv), epochs=10,
 ↪callbacks=[bmod])
```

```
Epoch 1/10
1873/1875 [============================>.] - ETA: 0s - loss: 5.7552 -
root_mean_squared_error: 2.3990INFO:tensorflow:Assets written to: mod1\assets

INFO:tensorflow:Assets written to: mod1\assets

1875/1875 [==============================] - 12s 5ms/step - loss: 5.7505 -
root_mean_squared_error: 2.3980 - val_loss: 0.5007 -
val_root_mean_squared_error: 0.7076
```

```
Epoch 2/10
1874/1875 [============================>.] - ETA: 0s - loss: 0.6877 -
root_mean_squared_error: 0.8293INFO:tensorflow:Assets written to: mod1\assets

INFO:tensorflow:Assets written to: mod1\assets

1875/1875 [==============================] - 12s 6ms/step - loss: 0.6876 -
root_mean_squared_error: 0.8292 - val_loss: 0.4926 -
val_root_mean_squared_error: 0.7018
Epoch 3/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.6679 -
root_mean_squared_error: 0.8173 - val_loss: 0.5011 -
val_root_mean_squared_error: 0.7079
Epoch 4/10
1875/1875 [==============================] - ETA: 0s - loss: 0.6614 -
root_mean_squared_error: 0.8132INFO:tensorflow:Assets written to: mod1\assets

INFO:tensorflow:Assets written to: mod1\assets

1875/1875 [==============================] - 11s 6ms/step - loss: 0.6614 -
root_mean_squared_error: 0.8132 - val_loss: 0.4866 -
val_root_mean_squared_error: 0.6976
Epoch 5/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.6568 -
root_mean_squared_error: 0.8104 - val_loss: 0.4924 -
val_root_mean_squared_error: 0.7017
Epoch 6/10
1875/1875 [==============================] - 9s 5ms/step - loss: 0.6527 -
root_mean_squared_error: 0.8079 - val_loss: 0.5155 -
val_root_mean_squared_error: 0.7180
Epoch 7/10
1875/1875 [==============================] - 9s 5ms/step - loss: 0.6525 -
root_mean_squared_error: 0.8078 - val_loss: 0.4920 -
val_root_mean_squared_error: 0.7014
Epoch 8/10
1875/1875 [==============================] - 9s 5ms/step - loss: 0.6483 -
root_mean_squared_error: 0.8052 - val_loss: 0.5272 -
val_root_mean_squared_error: 0.7261
Epoch 9/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.6425 -
root_mean_squared_error: 0.8016 - val_loss: 0.5369 -
val_root_mean_squared_error: 0.7327
Epoch 10/10
1870/1875 [============================>.] - ETA: 0s - loss: 0.6446 -
root_mean_squared_error: 0.8028INFO:tensorflow:Assets written to: mod1\assets

INFO:tensorflow:Assets written to: mod1\assets

1875/1875 [==============================] - 11s 6ms/step - loss: 0.6446 -
root_mean_squared_error: 0.8029 - val_loss: 0.4805 -
val_root_mean_squared_error: 0.6932
```

[25]: <keras.src.callbacks.History at 0x2badd838450>

[26]:
```
from tensorflow.keras.models import load_model
mod1 = load_model('mod1/')
```

[27]:
```
train_predictions = mod1.predict(X_train).flatten()
```

```
1875/1875 [==============================] - 5s 2ms/step
```

[28]:
```
train_results = pd.DataFrame(data={'Predictions':train_predictions, 'Actuals':
  ↪Y_train})
train_results
```

[28]:

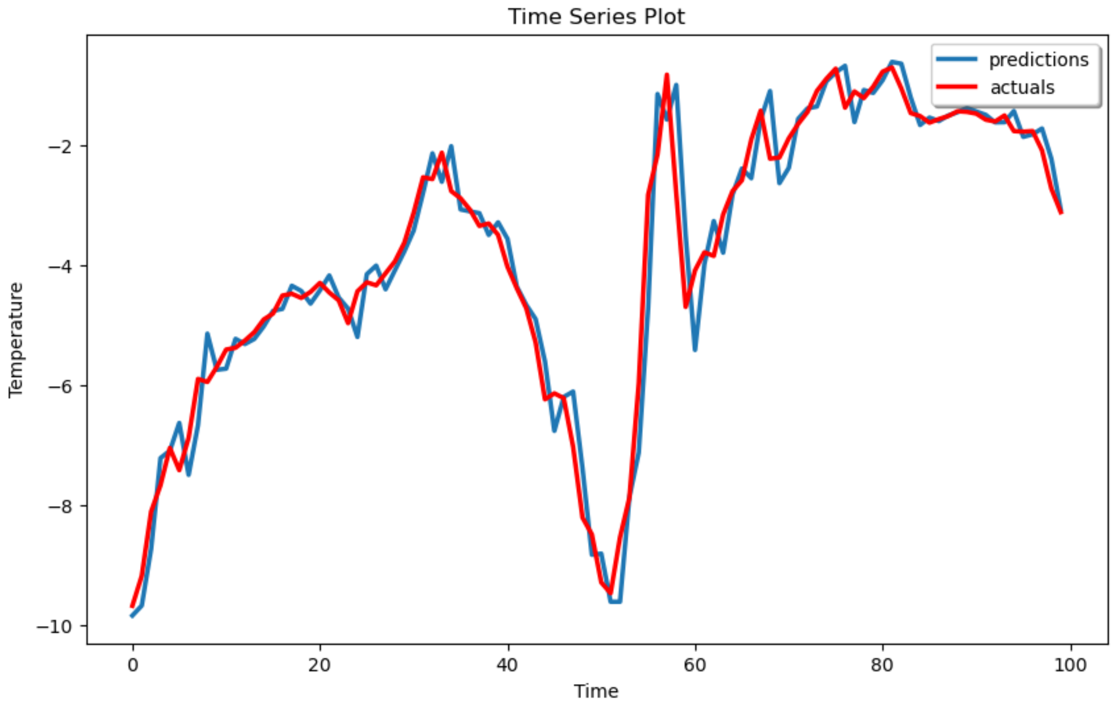
	Predictions	Actuals
0	-9.832454	-9.67
1	-9.666286	-9.17
2	-8.721109	-8.10
3	-7.208200	-7.66
4	-7.084429	-7.04
…	…	…
59995	6.074428	6.07
59996	7.052327	9.88
59997	11.927038	13.53
59998	15.324376	15.43
59999	16.450827	15.54

[60000 rows x 2 columns]

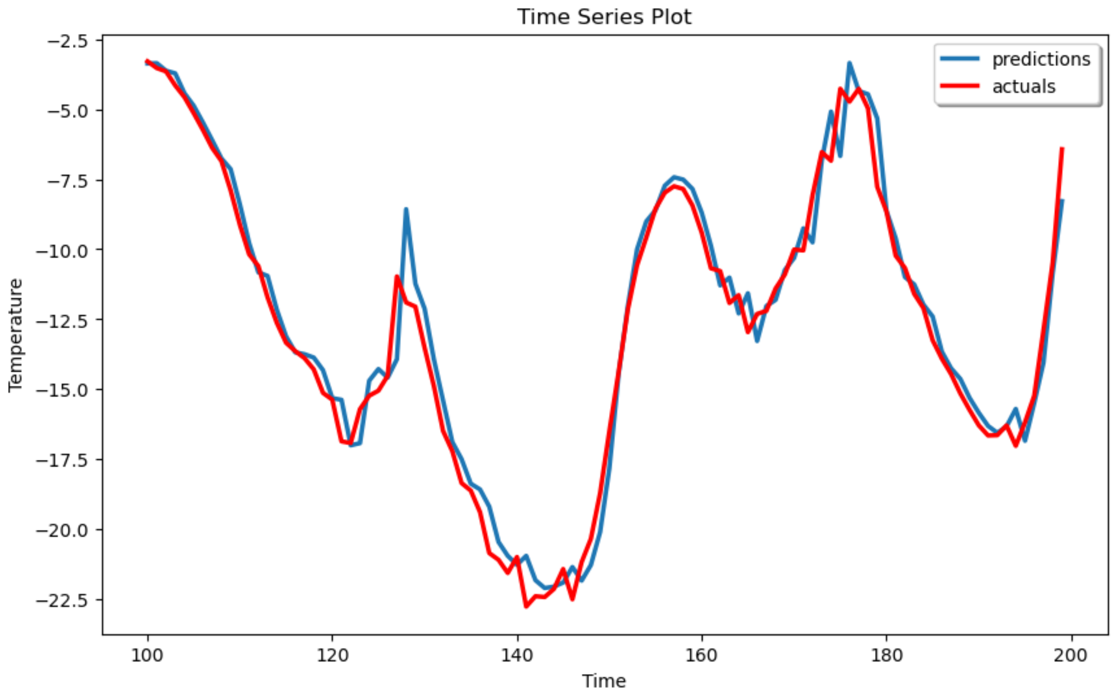
0.3 Plot

0.4 Plot for Train Set

[29]:
```
plt.figure(figsize=(10,6))
plt.plot(train_results['Predictions'][:100], linewidth=2.5, label="predictions")
plt.plot(train_results['Actuals'][:100], linewidth=2.5, c="red",␣
  ↪label="actuals")
plt.title("Time Series Plot")
plt.xlabel("Time")
plt.ylabel("Temperature")
plt.legend(shadow=True, fancybox=True)
plt.show()
```



[30]:
```
plt.figure(figsize=(10,6))
plt.plot(train_results['Predictions'][100:200], linewidth=2.5,␣
 ↪label="predictions")
plt.plot(train_results['Actuals'][100:200], linewidth=2.5, c="red",␣
 ↪label="actuals")
plt.title("Time Series Plot")
plt.xlabel("Time")
plt.ylabel("Temperature")
plt.legend(shadow=True, fancybox=True)
plt.show()
```



[31]:
```
cv_predictions = mod1.predict(X_cv).flatten()
```

```
157/157 [==============================] - 1s 2ms/step
```

[32]:
```
cv_results = pd.DataFrame(data={'Predictions_cv':cv_predictions, 'Actuals_cv':
    ↪Y_cv})
cv_results
```

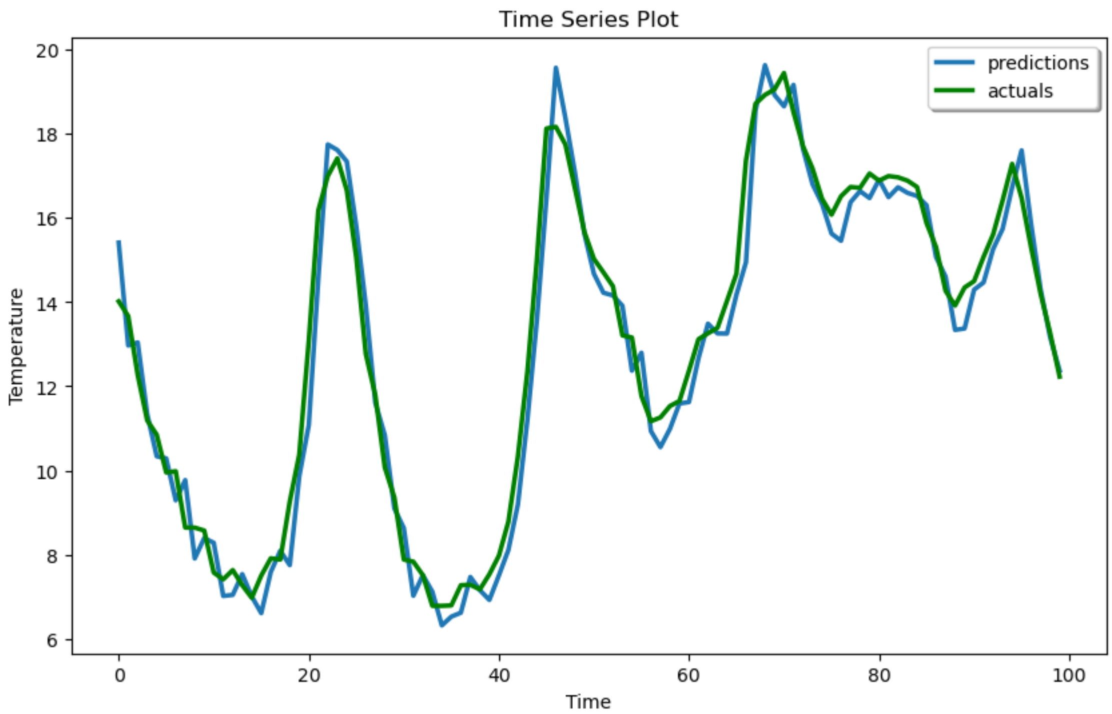
[32]:

	Predictions_cv	Actuals_cv
0	15.417228	14.02
1	12.970976	13.67
2	13.042710	12.27
3	11.338698	11.19
4	10.336488	10.85
…	…	…
4995	17.414299	18.27
4996	17.706203	17.85
4997	16.913465	16.65
4998	15.702159	15.85
4999	14.967059	15.09

[5000 rows x 2 columns]

1 Plot for Cross Validation Set

[33]:
```
plt.figure(figsize=(10,6))
plt.plot(cv_results['Predictions_cv'][:100], linewidth=2.5, label="predictions")
plt.plot(cv_results['Actuals_cv'][:100], linewidth=2.5, c="green",␣
 ↪label="actuals")
plt.title("Time Series Plot")
plt.xlabel("Time")
plt.ylabel("Temperature")
plt.legend(shadow=True, fancybox=True)
plt.show()
```



1.1 Plot for Test Set

[34]:
```
test_predictions = mod1.predict(X_test).flatten()
test_results = pd.DataFrame(data={'Predictions_test':test_predictions,␣
 ↪'Actuals_test':Y_test})
test_results
```

```
159/159 [==============================] - 0s 2ms/step
```

[34]:

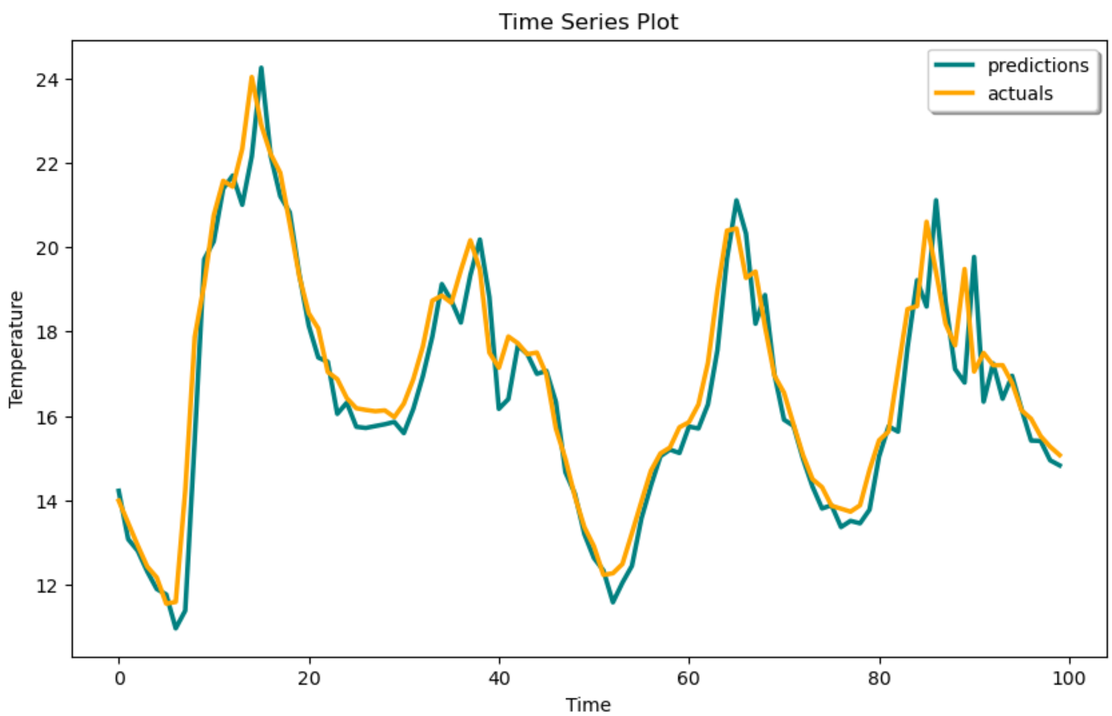
	Predictions_test	Actuals_test
0	14.222408	13.99
1	13.077388	13.46

```
2              12.803817         12.93
3              12.314048         12.43
4              11.896609         12.17
…                  …           …
5081           -0.876601         -0.98
5082           -1.511445         -1.40
5083           -1.659057         -2.75
5084           -3.109476         -2.89
5085           -3.051029         -3.93

[5086 rows x 2 columns]
```

[38]:

```
plt.figure(figsize=(10,6))
plt.plot(test_results['Predictions_test'][:100], linewidth=2.5, c="teal",␣
 ↪label="predictions")
plt.plot(test_results['Actuals_test'][:100], linewidth=2.5, c="orange",␣
 ↪label="actuals")
plt.title("Time Series Plot")
plt.xlabel("Time")
plt.ylabel("Temperature")
plt.legend(shadow=True, fancybox=True)
plt.show()
```



[36]:

```
plt.figure(figsize=(10,6))
plt.plot(test_results['Predictions_test'][100:200], linewidth=2.5, c="teal",␣
 ↪label="predictions")
plt.plot(test_results['Actuals_test'][100:200], linewidth=2.5, c="orange",␣
 ↪label="actuals")
plt.title("Time Series Plot")
plt.xlabel("Time")
plt.ylabel("Temperature")
plt.legend(shadow=True, fancybox=True)
plt.show()
```