Thesis_19Dec

December 20, 2024

[1]:
```
# Install necessary libraries
!pip install yfinance ccxt pandas numpy matplotlib tensorflow pandas_ta
```

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Requirement already satisfied: yfinance in
c:\users\mousami.soni\anaconda3\lib\site-packages (0.2.44)
Requirement already satisfied: ccxt in c:\users\mousami.soni\anaconda3\lib\site-
packages (4.4.41)
Requirement already satisfied: pandas in
c:\users\mousami.soni\anaconda3\lib\site-packages (1.4.4)
Requirement already satisfied: numpy in
c:\users\mousami.soni\anaconda3\lib\site-packages (1.24.3)
Requirement already satisfied: matplotlib in
c:\users\mousami.soni\anaconda3\lib\site-packages (3.5.2)
Requirement already satisfied: tensorflow in
c:\users\mousami.soni\anaconda3\lib\site-packages (2.13.0)
Requirement already satisfied: pandas_ta in
c:\users\mousami.soni\anaconda3\lib\site-packages (0.3.14b0)
Requirement already satisfied: lxml>=4.9.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (4.9.1)
Requirement already satisfied: requests>=2.31 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (2.32.3)
Requirement already satisfied: pytz>=2022.5 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (2024.2)
Requirement already satisfied: platformdirs>=2.0.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (2.5.2)
Requirement already satisfied: peewee>=3.16.2 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (3.17.6)
Requirement already satisfied: multitasking>=0.0.7 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (0.0.11)
Requirement already satisfied: html5lib>=1.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (1.1)
Requirement already satisfied: frozendict>=2.3.4 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (2.4.5)
Requirement already satisfied: beautifulsoup4>=4.11.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from yfinance) (4.11.1)
Requirement already satisfied: certifi>=2018.1.18 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (2022.9.14)
Requirement already satisfied: aiohttp<=3.10.11 in
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c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (3.8.3)
Requirement already satisfied: aiodns>=1.1.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (3.2.0)
Requirement already satisfied: yarl>=1.7.2 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (1.8.2)
Requirement already satisfied: setuptools>=60.9.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (63.4.1)
Requirement already satisfied: typing-extensions>=4.4.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (4.5.0)
Requirement already satisfied: cryptography>=2.6.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from ccxt) (37.0.1)
Requirement already satisfied: python-dateutil>=2.8.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from pandas) (2.8.2)
Requirement already satisfied: fonttools>=4.22.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from matplotlib) (4.25.0)
Requirement already satisfied: cycler>=0.10 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from matplotlib) (0.11.0)
Requirement already satisfied: packaging>=20.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from matplotlib) (21.3)
Requirement already satisfied: pillow>=6.2.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from matplotlib) (9.2.0)
Requirement already satisfied: pyparsing>=2.2.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from matplotlib) (3.0.9)
Requirement already satisfied: kiwisolver>=1.0.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from matplotlib) (1.4.2)
Requirement already satisfied: tensorflow-intel==2.13.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow) (2.13.0)
Requirement already satisfied: keras<2.14,>=2.13.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (2.13.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (0.31.0)
Requirement already satisfied: opt-einsum>=2.3.2 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (3.3.0)
Requirement already satisfied: six>=1.12.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (1.16.0)
Requirement already satisfied: tensorboard<2.14,>=2.13 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (2.13.0)
Requirement already satisfied: libclang>=13.0.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (16.0.6)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (0.4.0)
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Requirement already satisfied: wrapt>=1.11.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (1.14.1)
Requirement already satisfied: google-pasta>=0.1.1 in
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intel==2.13.0->tensorflow) (0.2.0)
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intel==2.13.0->tensorflow) (1.4.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in
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intel==2.13.0->tensorflow) (1.56.2)
Requirement already satisfied: h5py>=2.9.0 in
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intel==2.13.0->tensorflow) (3.7.0)
Requirement already satisfied: flatbuffers>=23.1.21 in
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intel==2.13.0->tensorflow) (24.3.25)
Requirement already satisfied: astunparse>=1.6.0 in
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intel==2.13.0->tensorflow) (1.6.3)
Requirement already satisfied: tensorflow-estimator<2.14,>=2.13.0 in
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intel==2.13.0->tensorflow) (2.13.0)
Requirement already satisfied:
protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3
in c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (4.23.4)
Requirement already satisfied: termcolor>=1.1.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from tensorflow-
intel==2.13.0->tensorflow) (2.1.1)
Requirement already satisfied: pycares>=4.0.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiodns>=1.1.1->ccxt)
(4.4.0)
Requirement already satisfied: attrs>=17.3.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiohttp<=3.10.11->ccxt)
(21.4.0)
Requirement already satisfied: multidict<7.0,>=4.5 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiohttp<=3.10.11->ccxt)
(6.0.3)
Requirement already satisfied: charset-normalizer<3.0,>=2.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiohttp<=3.10.11->ccxt)
(2.0.4)
Requirement already satisfied: aiosignal>=1.1.2 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiohttp<=3.10.11->ccxt)
(1.3.1)
Requirement already satisfied: async-timeout<5.0,>=4.0.0a3 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiohttp<=3.10.11->ccxt)
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(4.0.2)
Requirement already satisfied: frozenlist>=1.1.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from aiohttp<=3.10.11->ccxt)
(1.3.3)
Requirement already satisfied: soupsieve>1.2 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
beautifulsoup4>=4.11.1->yfinance) (2.3.1)
Requirement already satisfied: cffi>=1.12 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
cryptography>=2.6.1->ccxt) (1.15.1)
Requirement already satisfied: webencodings in
c:\users\mousami.soni\anaconda3\lib\site-packages (from html5lib>=1.1->yfinance)
(0.5.1)
Requirement already satisfied: idna<4,>=2.5 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
requests>=2.31->yfinance) (3.3)
Requirement already satisfied: urllib3<3,>=1.21.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
requests>=2.31->yfinance) (1.26.11)
Requirement already satisfied: wheel<1.0,>=0.23.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
astunparse>=1.6.0->tensorflow-intel==2.13.0->tensorflow) (0.37.1)
Requirement already satisfied: pycparser in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
cffi>=1.12->cryptography>=2.6.1->ccxt) (2.21)
Requirement already satisfied: werkzeug>=1.0.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (2.0.3)
Requirement already satisfied: google-auth<3,>=1.6.3 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (2.22.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (0.7.1)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (1.0.0)
Requirement already satisfied: markdown>=2.6.8 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (3.3.4)
Requirement already satisfied: rsa<5,>=3.1.4 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from google-
auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow)
(4.9)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from google-
auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow)
(0.2.8)
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Requirement already satisfied: cachetools<6.0,>=2.0.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from google-
auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow)
(5.3.1)
Requirement already satisfied: requests-oauthlib>=0.7.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from google-auth-
oauthlib<1.1,>=0.5->tensorboard<2.14,>=2.13->tensorflow-
intel==2.13.0->tensorflow) (1.3.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from
pyasn1-modules>=0.2.1->google-
auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow)
(0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in
c:\users\mousami.soni\anaconda3\lib\site-packages (from requests-
oauthlib>=0.7.0->google-auth-
oauthlib<1.1,>=0.5->tensorboard<2.14,>=2.13->tensorflow-
intel==2.13.0->tensorflow) (3.2.2)
```

[2]:
```python
# Import libraries
import yfinance as yf
import ccxt
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense, Dropout
```

[3]:
```python
# Function to fetch stock data using yfinance
def fetch_stock_data(ticker, start_date='2010-01-01', end_date=None):
    stock = yf.Ticker(ticker)
    df = stock.history(start=start_date, end=end_date)
    df = df[['Open', 'High', 'Low', 'Close', 'Volume']].reset_index()
    df.columns = ['timestamp', 'open', 'high', 'low', 'close', 'volume']
    return df

# Function to fetch cryptocurrency data using ccxt
def fetch_crypto_data(symbol='BTC/USD', exchange_name='kraken', timeframe='1d',␣
 ↪limit=1000):
    exchange_class = getattr(ccxt, exchange_name)
    exchange = exchange_class()
    ohlcv = exchange.fetch_ohlcv(symbol, timeframe=timeframe, limit=limit)
    data = pd.DataFrame(ohlcv, columns=['timestamp', 'open', 'high', 'low',␣
 ↪'close', 'volume'])
    data['timestamp'] = pd.to_datetime(data['timestamp'], unit='ms')
    return data
```

```python
# Fetch data for stocks
apple_data = fetch_stock_data('AAPL', start_date='2020-01-01')
tesla_data = fetch_stock_data('TSLA', start_date='2020-01-01')

# Fetch data for cryptocurrencies
btc_data = fetch_crypto_data('BTC/USD')
eth_data = fetch_crypto_data('ETH/USD')

# Display data
print("Apple Stock Data:\n", apple_data.head())
print("Tesla Stock Data:\n", tesla_data.head())
print("Bitcoin Crypto Data:\n", btc_data.head())
print("Ethereum Crypto Data:\n", eth_data.head())
```

```
Apple Stock Data:
                  timestamp       open       high        low      close  \
0 2020-01-02 00:00:00-05:00  71.799866  72.856606  71.545380  72.796013
1 2020-01-03 00:00:00-05:00  72.020416  72.851746  71.862877  72.088280
2 2020-01-06 00:00:00-05:00  71.206085  72.701508  70.954017  72.662727
3 2020-01-07 00:00:00-05:00  72.672409  72.929322  72.100418  72.320976
4 2020-01-08 00:00:00-05:00  72.022858  73.787315  72.022858  73.484352

      volume
0  135480400
1  146322800
2  118387200
3  108872000
4  132079200
Tesla Stock Data:
                  timestamp       open       high        low      close  \
0 2020-01-02 00:00:00-05:00  28.299999  28.713333  28.114000  28.684000
1 2020-01-03 00:00:00-05:00  29.366667  30.266666  29.128000  29.534000
2 2020-01-06 00:00:00-05:00  29.364668  30.104000  29.333332  30.102667
3 2020-01-07 00:00:00-05:00  30.760000  31.441999  30.224001  31.270666
4 2020-01-08 00:00:00-05:00  31.580000  33.232666  31.215334  32.809334

      volume
0  142981500
1  266677500
2  151995000
3  268231500
4  467164500
Bitcoin Crypto Data:
    timestamp     open     high      low    close       volume
0 2022-12-31  16600.0  16629.7  16464.1  16528.2  1846.942331
1 2023-01-01  16528.7  16618.7  16490.0  16614.9  1389.076949
```

```
2 2023-01-02  16615.0  16777.7  16550.0  16669.2   969.461261
3 2023-01-03  16668.3  16770.2  16599.6  16669.3  2014.398974
4 2023-01-04  16669.7  16987.4  16650.1  16848.9  2316.939638
Ethereum Crypto Data:
    timestamp     open     high      low    close        volume
0 2022-12-31  1198.90  1207.11  1190.71  1195.00  14936.669542
1 2023-01-01  1195.00  1203.73  1190.86  1199.76   9172.167712
2 2023-01-02  1199.85  1223.95  1192.58  1213.71   8749.184504
3 2023-01-03  1213.61  1219.29  1204.07  1213.92  13209.923566
4 2023-01-04  1214.00  1271.27  1212.25  1256.32  30445.187644
```

[4]:
```python
# Function to preprocess data for LSTM
def preprocess_data(df, feature_col='close', window_size=60):
    # Select the feature to predict (e.g., 'close' price)
    data = df[[feature_col]].values

    # Scale the data to the range [0, 1]
    scaler = MinMaxScaler(feature_range=(0, 1))
    scaled_data = scaler.fit_transform(data)

    # Create the training dataset
    X, y = [], []
    for i in range(window_size, len(scaled_data)):
        X.append(scaled_data[i-window_size:i, 0])
        y.append(scaled_data[i, 0])

    # Convert to NumPy arrays and reshape
    X, y = np.array(X), np.array(y)
    X = np.reshape(X, (X.shape[0], X.shape[1], 1))  # LSTM expects 3D input

    return X, y, scaler

# Preprocess data for all assets
window_size = 60
X_apple, y_apple, apple_scaler = preprocess_data(apple_data,␣
 ↪window_size=window_size)
X_tesla, y_tesla, tesla_scaler = preprocess_data(tesla_data,␣
 ↪window_size=window_size)
X_btc, y_btc, btc_scaler = preprocess_data(btc_data, window_size=window_size)
X_eth, y_eth, eth_scaler = preprocess_data(eth_data, window_size=window_size)

# Display shapes of data
print("Apple Data Shape:", X_apple.shape)
print("Tesla Data Shape:", X_tesla.shape)
print("Bitcoin Data Shape:", X_btc.shape)
print("Ethereum Data Shape:", X_eth.shape)
```

```
Apple Data Shape: (1191, 60, 1)
```

```
Tesla Data Shape: (1191, 60, 1)
Bitcoin Data Shape: (660, 60, 1)
Ethereum Data Shape: (660, 60, 1)
```

[5]:
```python
# Function to build an LSTM model
def build_lstm_model(input_shape):
    model = Sequential()
    model.add(LSTM(units=50, return_sequences=True, input_shape=input_shape))
    model.add(Dropout(0.2))
    model.add(LSTM(units=50, return_sequences=False))
    model.add(Dropout(0.2))
    model.add(Dense(units=1))  # Output layer to predict the closing price
    model.compile(optimizer='adam', loss='mean_squared_error')
    return model

# Build LSTM models
apple_model = build_lstm_model((X_apple.shape[1], 1))
tesla_model = build_lstm_model((X_tesla.shape[1], 1))
btc_model = build_lstm_model((X_btc.shape[1], 1))
eth_model = build_lstm_model((X_eth.shape[1], 1))

# Train LSTM models
apple_model.fit(X_apple, y_apple, epochs=20, batch_size=32)
tesla_model.fit(X_tesla, y_tesla, epochs=20, batch_size=32)
btc_model.fit(X_btc, y_btc, epochs=20, batch_size=32)
eth_model.fit(X_eth, y_eth, epochs=20, batch_size=32)
```

```
Epoch 1/20
38/38 [==============================] - 5s 33ms/step - loss: 0.0347
Epoch 2/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0050
Epoch 3/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0038
Epoch 4/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0037
Epoch 5/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0033
Epoch 6/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0031
Epoch 7/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0030
Epoch 8/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0031
Epoch 9/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0028
Epoch 10/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0027
Epoch 11/20
```

```
38/38 [==============================] - 1s 33ms/step - loss: 0.0026
Epoch 12/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0032
Epoch 13/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0027
Epoch 14/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0029
Epoch 15/20
38/38 [==============================] - 1s 32ms/step - loss: 0.0034
Epoch 16/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0028
Epoch 17/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0029
Epoch 18/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0025
Epoch 19/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0026
Epoch 20/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0024
Epoch 1/20
38/38 [==============================] - 4s 33ms/step - loss: 0.0326
Epoch 2/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0053
Epoch 3/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0042
Epoch 4/20
38/38 [==============================] - 1s 32ms/step - loss: 0.0038
Epoch 5/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0039
Epoch 6/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0036
Epoch 7/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0034
Epoch 8/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0032
Epoch 9/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0031
Epoch 10/20
38/38 [==============================] - 1s 32ms/step - loss: 0.0030
Epoch 11/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0030
Epoch 12/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0028
Epoch 13/20
38/38 [==============================] - 1s 34ms/step - loss: 0.0024
Epoch 14/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0025
Epoch 15/20
```

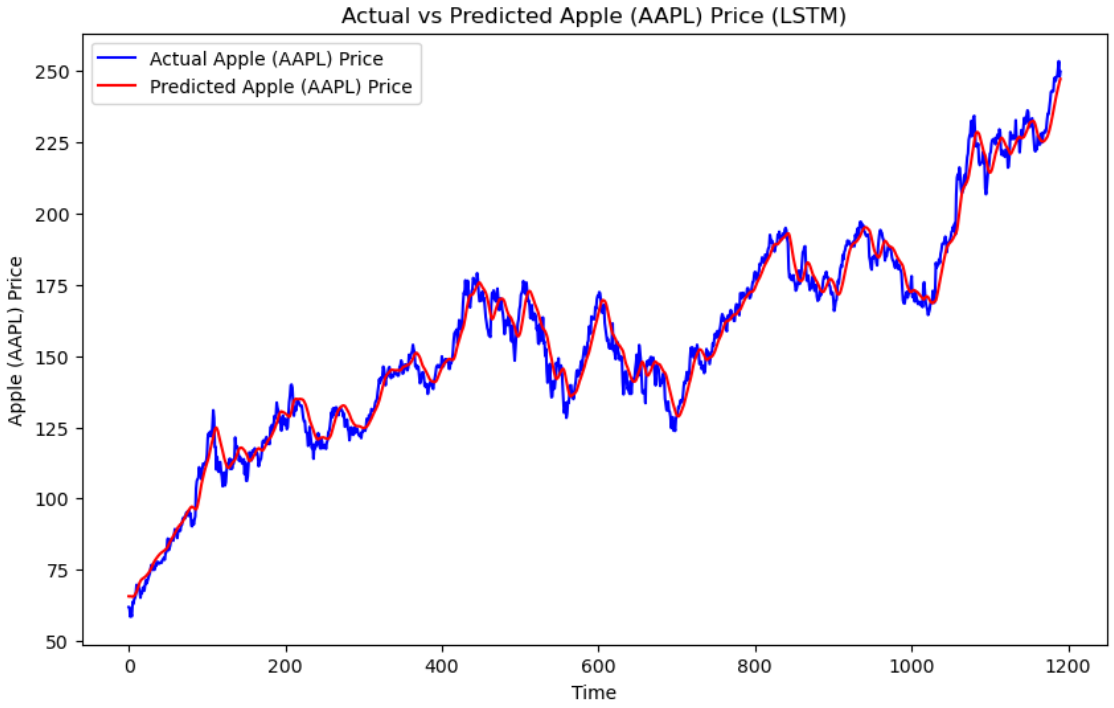
```
38/38 [==============================] - 1s 32ms/step - loss: 0.0024
Epoch 16/20
38/38 [==============================] - 1s 32ms/step - loss: 0.0025
Epoch 17/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0025
Epoch 18/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0028
Epoch 19/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0024
Epoch 20/20
38/38 [==============================] - 1s 33ms/step - loss: 0.0023
Epoch 1/20
21/21 [==============================] - 4s 34ms/step - loss: 0.0351
Epoch 2/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0065
Epoch 3/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0034
Epoch 4/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0034
Epoch 5/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0032
Epoch 6/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0037
Epoch 7/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0031
Epoch 8/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0032
Epoch 9/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0024
Epoch 10/20
21/21 [==============================] - 1s 36ms/step - loss: 0.0027
Epoch 11/20
21/21 [==============================] - 1s 35ms/step - loss: 0.0028
Epoch 12/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0025
Epoch 13/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0024
Epoch 14/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0027
Epoch 15/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0023
Epoch 16/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0024
Epoch 17/20
21/21 [==============================] - 1s 35ms/step - loss: 0.0027
Epoch 18/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0023
Epoch 19/20
```

```
21/21 [==============================] - 1s 33ms/step - loss: 0.0022
Epoch 20/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0021
Epoch 1/20
21/21 [==============================] - 4s 33ms/step - loss: 0.0550
Epoch 2/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0105
Epoch 3/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0077
Epoch 4/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0075
Epoch 5/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0065
Epoch 6/20
21/21 [==============================] - 1s 35ms/step - loss: 0.0067
Epoch 7/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0070
Epoch 8/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0057
Epoch 9/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0058
Epoch 10/20
21/21 [==============================] - 1s 35ms/step - loss: 0.0062
Epoch 11/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0058
Epoch 12/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0053
Epoch 13/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0050
Epoch 14/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0052
Epoch 15/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0059
Epoch 16/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0051
Epoch 17/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0046
Epoch 18/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0049
Epoch 19/20
21/21 [==============================] - 1s 33ms/step - loss: 0.0044
Epoch 20/20
21/21 [==============================] - 1s 34ms/step - loss: 0.0043
```

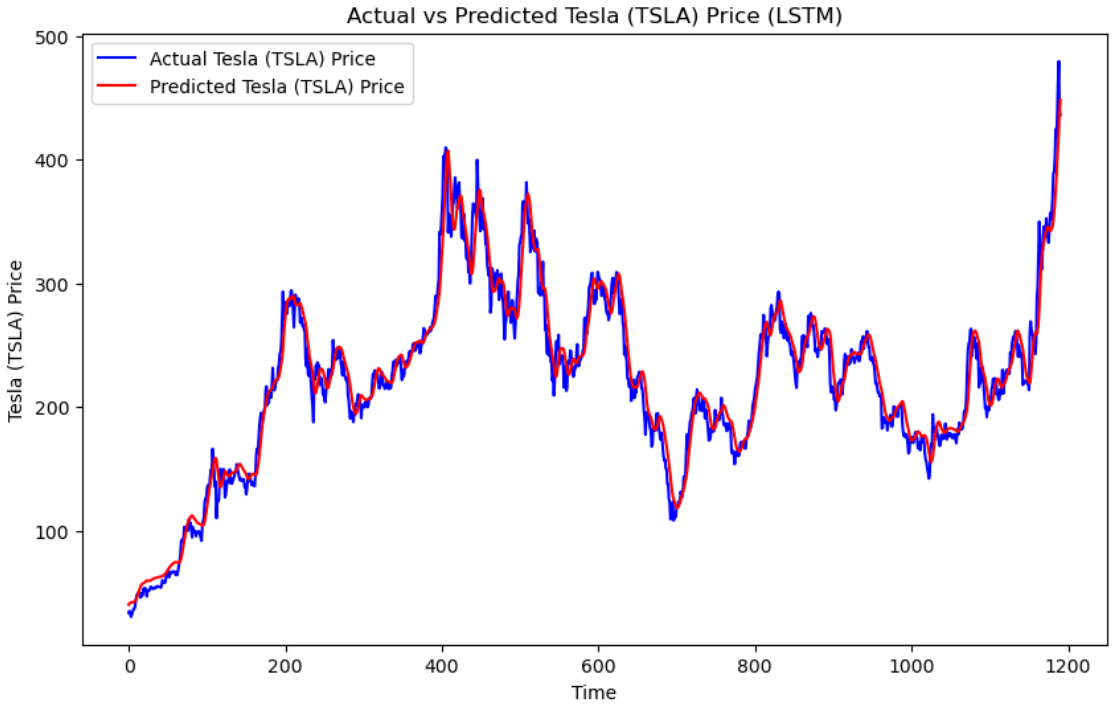
[5]: <keras.src.callbacks.History at 0x1b6fb7e7b80>

[6]:
```
# Function to predict and visualize results
def evaluate_stock_model(model, X_data, y_data, scaler, stock_name="Stock"):
    # Predicting the prices
    predicted_prices = model.predict(X_data)

    # Rescale the predicted prices back to the original scale
    predicted_prices = scaler.inverse_transform(predicted_prices)
    actual_prices = scaler.inverse_transform(y_data.reshape(-1, 1))

    # Plot the actual vs predicted prices
    plt.figure(figsize=(10, 6))
    plt.plot(actual_prices, color='blue', label=f"Actual {stock_name} Price")
    plt.plot(predicted_prices, color='red', label=f"Predicted {stock_name}␣
 ↪Price")
    plt.title(f"Actual vs Predicted {stock_name} Price (LSTM)")
    plt.xlabel("Time")
    plt.ylabel(f"{stock_name} Price")
    plt.legend()
    plt.show()

# Evaluate models
evaluate_stock_model(apple_model, X_apple, y_apple, apple_scaler,␣
 ↪stock_name="Apple (AAPL)")
evaluate_stock_model(tesla_model, X_tesla, y_tesla, tesla_scaler,␣
 ↪stock_name="Tesla (TSLA)")
evaluate_stock_model(btc_model, X_btc, y_btc, btc_scaler, stock_name="Bitcoin␣
 ↪(BTC)")
evaluate_stock_model(eth_model, X_eth, y_eth, eth_scaler, stock_name="Ethereum␣
 ↪(ETH)")
```

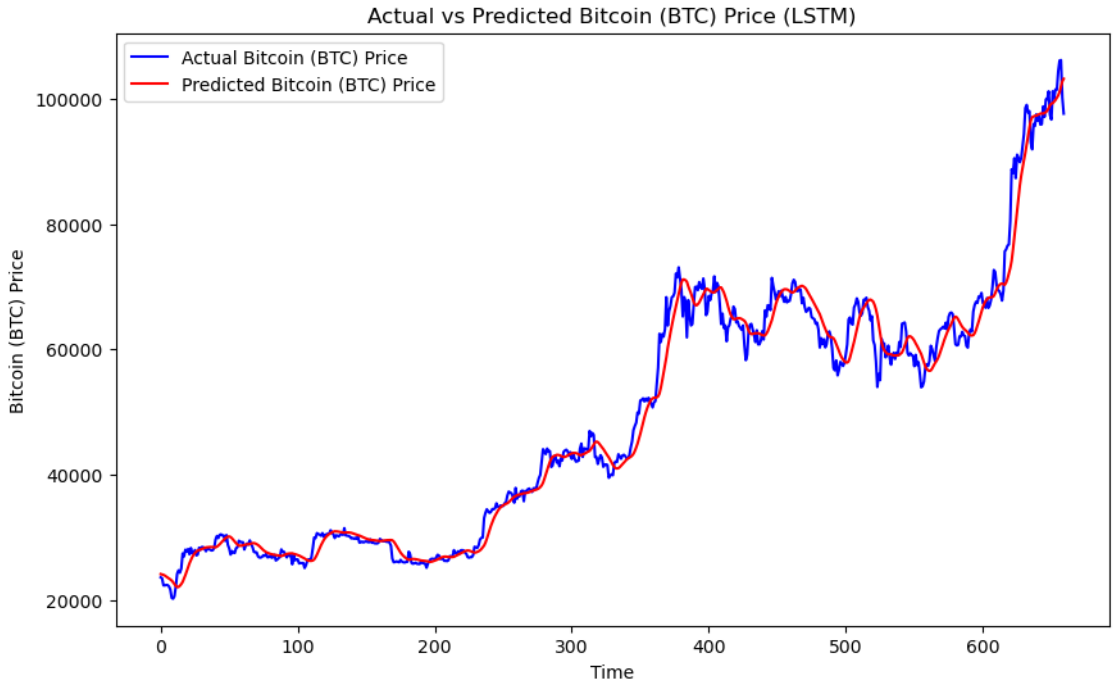
```
38/38 [==============================] - 1s 12ms/step
```



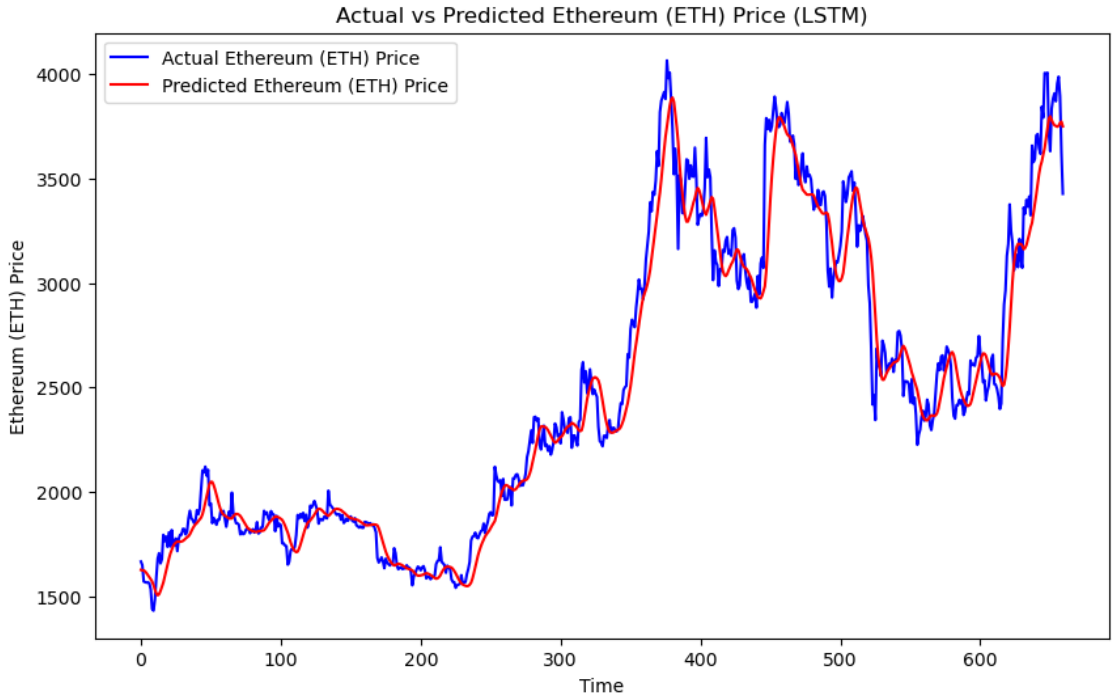

```
38/38 [==============================] - 1s 12ms/step
```



```
21/21 [==============================] - 1s 12ms/step
```




```
21/21 [==============================] - 1s 12ms/step
```



[ ]: