

Thesis_20Dec

December 20, 2024

```
[ ]: # Install necessary libraries
```

```
!pip install yfinance ccxt pandas numpy matplotlib pandas_ta tensorflow
```

Requirement already satisfied: yfinance in /usr/local/lib/python3.10/dist-packages (0.2.50)

Collecting ccxt

Downloading ccxt-4.4.41-py2.py3-none-any.whl.metadata (116 kB)

116.4/116.4

kB 3.3 MB/s eta 0:00:00

Requirement already satisfied: pandas in /usr/local/lib/python3.10/dist-packages (2.2.2)

Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages (1.26.4)

Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-packages (3.8.0)

Collecting pandas_ta

Downloading pandas_ta-0.3.14b.tar.gz (115 kB)

115.1/115.1

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Preparing metadata (setup.py) ... done

Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.17.1)

Requirement already satisfied: requests>=2.31 in /usr/local/lib/python3.10/dist-packages (from yfinance) (2.32.3)

Requirement already satisfied: multitasking>=0.0.7 in /usr/local/lib/python3.10/dist-packages (from yfinance) (0.0.11)

Requirement already satisfied: lxml>=4.9.1 in /usr/local/lib/python3.10/dist-packages (from yfinance) (5.3.0)

Requirement already satisfied: platformdirs>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from yfinance) (4.3.6)

Requirement already satisfied: pytz>=2022.5 in /usr/local/lib/python3.10/dist-packages (from yfinance) (2024.2)

Requirement already satisfied: frozendict>=2.3.4 in /usr/local/lib/python3.10/dist-packages (from yfinance) (2.4.6)

Requirement already satisfied: peewee>=3.16.2 in /usr/local/lib/python3.10/dist-packages (from yfinance) (3.17.8)

Requirement already satisfied: beautifulsoup4>=4.11.1 in

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/usr/local/lib/python3.10/dist-packages (from yfinance) (4.12.3)
Requirement already satisfied: html5lib>=1.1 in /usr/local/lib/python3.10/dist-
packages (from yfinance) (1.1)
Requirement already satisfied: setuptools>=60.9.0 in
/usr/local/lib/python3.10/dist-packages (from ccxt) (75.1.0)
Requirement already satisfied: certifi>=2018.1.18 in
/usr/local/lib/python3.10/dist-packages (from ccxt) (2024.12.14)
Requirement already satisfied: cryptography>=2.6.1 in
/usr/local/lib/python3.10/dist-packages (from ccxt) (43.0.3)
Requirement already satisfied: typing-extensions>=4.4.0 in
/usr/local/lib/python3.10/dist-packages (from ccxt) (4.12.2)
Collecting aiohttp<=3.10.11 (from ccxt)
  Downloading aiohttp-3.10.11-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (7.7 kB)
Collecting aiodns>=1.1.1 (from ccxt)
  Downloading aiodns-3.2.0-py3-none-any.whl.metadata (4.0 kB)
Requirement already satisfied: yarl>=1.7.2 in /usr/local/lib/python3.10/dist-
packages (from ccxt) (1.18.3)
Requirement already satisfied: python-dateutil>=2.8.2 in
/usr/local/lib/python3.10/dist-packages (from pandas) (2.8.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/dist-
packages (from pandas) (2024.2)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (1.3.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-
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Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (4.55.3)
Requirement already satisfied: kiwisolver>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (1.4.7)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (24.2)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-
packages (from matplotlib) (11.0.0)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib) (3.2.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-
packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=24.3.25 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.6.0)
Requirement already satisfied: google-pasta>=0.1.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=3.10.0 in /usr/local/lib/python3.10/dist-
packages (from tensorflow) (3.12.1)

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Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (18.1.1)

Requirement already satisfied: ml-dtypes<0.5.0,>=0.3.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.1)

Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.4.0)

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 /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.25.5)

Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.17.0)

Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.5.0)

Requirement already satisfied: wrapt>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.17.0)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.68.1)

Requirement already satisfied: tensorboard<2.18,>=2.17 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.17.1)

Requirement already satisfied: keras>=3.2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.5.0)

Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.37.1)

Collecting pycares>=4.0.0 (from aiodns>=1.1.1->ccxt)

Downloading pycares-4.5.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (4.1 kB)

Requirement already satisfied: aiohappyeyeballs>=2.3.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<=3.10.11->ccxt) (2.4.4)

Requirement already satisfied: aiosignal>=1.1.2 in /usr/local/lib/python3.10/dist-packages (from aiohttp<=3.10.11->ccxt) (1.3.2)

Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<=3.10.11->ccxt) (24.3.0)

Requirement already satisfied: frozenlist>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from aiohttp<=3.10.11->ccxt) (1.5.0)

Requirement already satisfied: multidict<7.0,>=4.5 in /usr/local/lib/python3.10/dist-packages (from aiohttp<=3.10.11->ccxt) (6.1.0)

Requirement already satisfied: async-timeout<6.0,>=4.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<=3.10.11->ccxt) (4.0.3)

Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.10/dist-packages (from astunparse>=1.6.0->tensorflow) (0.45.1)

Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.10/dist-packages (from beautifulsoup4>=4.11.1->yfinance) (2.6)

Requirement already satisfied: cffi>=1.12 in /usr/local/lib/python3.10/dist-packages (from cryptography>=2.6.1->ccxt) (1.17.1)

Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dist-packages (from html5lib>=1.1->yfinance) (0.5.1)

Requirement already satisfied: rich in /usr/local/lib/python3.10/dist-packages

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(from keras>=3.2.0->tensorflow) (13.9.4)
Requirement already satisfied: namex in /usr/local/lib/python3.10/dist-packages
(from keras>=3.2.0->tensorflow) (0.0.8)
Requirement already satisfied: optree in /usr/local/lib/python3.10/dist-packages
(from keras>=3.2.0->tensorflow) (0.13.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests>=2.31->yfinance) (3.4.0)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-
packages (from requests>=2.31->yfinance) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests>=2.31->yfinance) (2.2.3)
Requirement already satisfied: markdown>=2.6.8 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.18,>=2.17->tensorflow) (3.7)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.18,>=2.17->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.18,>=2.17->tensorflow) (3.1.3)
Requirement already satisfied: propcache>=0.2.0 in
/usr/local/lib/python3.10/dist-packages (from yarl>=1.7.2->ccxt) (0.2.1)
Requirement already satisfied: pycparser in /usr/local/lib/python3.10/dist-
packages (from cffi>=1.12->cryptography>=2.6.1->ccxt) (2.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in
/usr/local/lib/python3.10/dist-packages (from
werkzeug>=1.0.1->tensorboard<2.18,>=2.17->tensorflow) (3.0.2)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.10/dist-packages (from rich->keras>=3.2.0->tensorflow)
(3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.10/dist-packages (from rich->keras>=3.2.0->tensorflow)
(2.18.0)
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.10/dist-
packages (from markdown-it-py>=2.2.0->rich->keras>=3.2.0->tensorflow) (0.1.2)
Downloading ccxt-4.4.41-py2.py3-none-any.whl (5.6 MB)
5.6/5.6 MB
49.7 MB/s eta 0:00:00
Downloading aiodns-3.2.0-py3-none-any.whl (5.7 kB)
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aiohttp-3.10.11-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.2
MB)
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Downloading
pycares-4.5.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (288
kB)
288.6/288.6 kB

```

18.9 MB/s eta 0:00:00

Building wheels for collected packages: pandas_ta

Building wheel for pandas_ta (setup.py) ... done

Created wheel for pandas_ta: filename=pandas_ta-0.3.14b0-py3-none-any.whl
size=218909

sha256=a83a489d38e241b04fe4fdc7a72117554c3fdcad5b892e87ef61461abd66f911

Stored in directory: /root/.cache/pip/wheels/69/00/ac/f7fa862c34b0e2ef32017510
0c233377b4c558944f12474cf0

Successfully built pandas_ta

Installing collected packages: pycares, pandas_ta, aiohttp, aiodns, ccxt

Attempting uninstall: aiohttp

Found existing installation: aiohttp 3.11.10

Uninstalling aiohttp-3.11.10:

Successfully uninstalled aiohttp-3.11.10

Successfully installed aiodns-3.2.0 aiohttp-3.10.11 ccxt-4.4.41

pandas_ta-0.3.14b0 pycares-4.5.0

```
[ ]: from google.colab import drive  
drive.mount('/content/drive')
```

```
[ ]: # Import necessary 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  
from tensorflow.keras.callbacks import EarlyStopping  
import pandas_ta as ta
```

```
[ ]: # 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  
  
# Fetch data for Apple and Tesla  
apple_data = fetch_stock_data('AAPL', '2020-01-01')  
tesla_data = fetch_stock_data('TSLA', '2020-01-01')  
  
# Display first few rows  
print("Apple Stock Data:")  
print(apple_data.head())
```

```
print("\nTesla Stock Data:")
print(tesla_data.head())
```

Apple Stock Data:

	timestamp	open	high	low	close	\
0	2020-01-02 00:00:00-05:00	71.799858	72.856598	71.545372	72.796005	
1	2020-01-03 00:00:00-05:00	72.020432	72.851761	71.862892	72.088295	
2	2020-01-06 00:00:00-05:00	71.206077	72.701500	70.954010	72.662720	
3	2020-01-07 00:00:00-05:00	72.672402	72.929314	72.100410	72.320969	
4	2020-01-08 00:00:00-05:00	72.022843	73.787300	72.022843	73.484337	

	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

```
[ ]: # 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

# Fetch data for Bitcoin and Ethereum
btc_data = fetch_crypto_data('BTC/USD')
```

```
eth_data = fetch_crypto_data('ETH/USD')
```

```
# Display first few rows
```

```
print("Bitcoin Data:")
```

```
print(btc_data.head())
```

```
print("\nEthereum Data:")
```

```
print(eth_data.head())
```

Bitcoin Data:

	timestamp	open	high	low	close	volume
0	2023-01-01	16528.7	16618.7	16490.0	16614.9	1389.076949
1	2023-01-02	16615.0	16777.7	16550.0	16669.2	969.461261
2	2023-01-03	16668.3	16770.2	16599.6	16669.3	2014.398974
3	2023-01-04	16669.7	16987.4	16650.1	16848.9	2316.939638
4	2023-01-05	16849.3	16873.3	16752.7	16824.9	1457.987495

Ethereum Data:

	timestamp	open	high	low	close	volume
0	2023-01-01	1195.00	1203.73	1190.86	1199.76	9172.167712
1	2023-01-02	1199.85	1223.95	1192.58	1213.71	8749.184504
2	2023-01-03	1213.61	1219.29	1204.07	1213.92	13209.923566
3	2023-01-04	1214.00	1271.27	1212.25	1256.32	30445.187644
4	2023-01-05	1256.39	1259.05	1242.06	1250.50	11128.564124

```
[ ]: # Function to add technical indicators
```

```
def add_technical_indicators(data):
```

```
    data['SMA_20'] = ta.sma(data['close'], length=20)
```

```
    data['EMA_20'] = ta.ema(data['close'], length=20)
```

```
    data['RSI_14'] = ta.rsi(data['close'], length=14)
```

```
    return data
```

```
# Add indicators to each dataset
```

```
apple_data = add_technical_indicators(apple_data)
```

```
tesla_data = add_technical_indicators(tesla_data)
```

```
btc_data = add_technical_indicators(btc_data)
```

```
eth_data = add_technical_indicators(eth_data)
```

```
# Confirm that indicators are added
```

```
print("Apple Data with Indicators:\n", apple_data.head())
```

```
print("Tesla Data with Indicators:\n", tesla_data.head())
```

```
print("BTC Data with Indicators:\n", btc_data.head())
```

```
print("ETH Data with Indicators:\n", eth_data.head())
```

Apple Data with Indicators:

	timestamp	open	high	low	close	\
--	-----------	------	------	-----	-------	---

0	2020-01-02	00:00:00-05:00	71.799858	72.856598	71.545372	72.796005
1	2020-01-03	00:00:00-05:00	72.020432	72.851761	71.862892	72.088295
2	2020-01-06	00:00:00-05:00	71.206077	72.701500	70.954010	72.662720
3	2020-01-07	00:00:00-05:00	72.672402	72.929314	72.100410	72.320969
4	2020-01-08	00:00:00-05:00	72.022843	73.787300	72.022843	73.484337

	volume	SMA_20	EMA_20	RSI_14
0	135480400	NaN	NaN	NaN
1	146322800	NaN	NaN	NaN
2	118387200	NaN	NaN	NaN
3	108872000	NaN	NaN	NaN
4	132079200	NaN	NaN	NaN

Tesla Data with Indicators:

	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	SMA_20	EMA_20	RSI_14
0	142981500	NaN	NaN	NaN
1	266677500	NaN	NaN	NaN
2	151995000	NaN	NaN	NaN
3	268231500	NaN	NaN	NaN
4	467164500	NaN	NaN	NaN

BTC Data with Indicators:

	timestamp	open	high	low	close	volume	SMA_20	EMA_20
0	2023-01-01	16528.7	16618.7	16490.0	16614.9	1389.076949	NaN	NaN
1	2023-01-02	16615.0	16777.7	16550.0	16669.2	969.461261	NaN	NaN
2	2023-01-03	16668.3	16770.2	16599.6	16669.3	2014.398974	NaN	NaN
3	2023-01-04	16669.7	16987.4	16650.1	16848.9	2316.939638	NaN	NaN
4	2023-01-05	16849.3	16873.3	16752.7	16824.9	1457.987495	NaN	NaN

	RSI_14
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN

ETH Data with Indicators:

	timestamp	open	high	low	close	volume	SMA_20	\
0	2023-01-01	1195.00	1203.73	1190.86	1199.76	9172.167712	NaN	
1	2023-01-02	1199.85	1223.95	1192.58	1213.71	8749.184504	NaN	
2	2023-01-03	1213.61	1219.29	1204.07	1213.92	13209.923566	NaN	
3	2023-01-04	1214.00	1271.27	1212.25	1256.32	30445.187644	NaN	
4	2023-01-05	1256.39	1259.05	1242.06	1250.50	11128.564124	NaN	

	EMA_20	RSI_14
0	NaN	NaN
1	NaN	NaN
2	NaN	NaN
3	NaN	NaN
4	NaN	NaN

```
[ ]: # Function to preprocess data for LSTM
def prepare_lstm_data(data, target_col='close', seq_length=60):
    data = data.dropna()
    features = data[['close', 'SMA_20', 'EMA_20', 'RSI_14']]
    scaler = MinMaxScaler()
    features_scaled = scaler.fit_transform(features)

    X, y = [], []
    for i in range(seq_length, len(features_scaled)):
        X.append(features_scaled[i-seq_length:i])
        y.append(features_scaled[i, 0])

    X, y = np.array(X), np.array(y)
    split = int(0.8 * len(X))
    return X[:split], X[split:], y[:split], y[split:], scaler

# Prepare data for stocks and cryptocurrencies
X_train_apple, X_test_apple, y_train_apple, y_test_apple, apple_scaler = \
    prepare_lstm_data(apple_data)
X_train_tesla, X_test_tesla, y_train_tesla, y_test_tesla, tesla_scaler = \
    prepare_lstm_data(tesla_data)
X_train_btc, X_test_btc, y_train_btc, y_test_btc, btc_scaler = \
    prepare_lstm_data(btc_data)
X_train_eth, X_test_eth, y_train_eth, y_test_eth, eth_scaler = \
    prepare_lstm_data(eth_data)

# Display shapes of training data
print("Apple Training Data Shape:", X_train_apple.shape)
print("Tesla Training Data Shape:", X_train_tesla.shape)
print("BTC Training Data Shape:", X_train_btc.shape)
print("ETH Training Data Shape:", X_train_eth.shape)
```

```
Apple Training Data Shape: (937, 60, 4)
Tesla Training Data Shape: (937, 60, 4)
BTC Training Data Shape: (512, 60, 4)
ETH Training Data Shape: (512, 60, 4)
```

```
[ ]: # Function to build and train LSTM model
```

```

def build_and_train_lstm(X_train, y_train, X_test, y_test, epochs=20,
    ↪batch_size=32):
    model = Sequential([
        LSTM(50, return_sequences=True, input_shape=(X_train.shape[1], X_train.
    ↪shape[2])),
        Dropout(0.2),
        LSTM(50, return_sequences=False),
        Dropout(0.2),
        Dense(25),
        Dense(1)
    ])
    model.compile(optimizer='adam', loss='mean_squared_error')
    early_stop = EarlyStopping(monitor='val_loss', patience=5,
    ↪restore_best_weights=True)
    history = model.fit(X_train, y_train, epochs=epochs, batch_size=batch_size,
    ↪validation_data=(X_test, y_test), callbacks=[early_stop])
    return model, history

# Train models for stocks and cryptocurrencies
apple_model, _ = build_and_train_lstm(X_train_apple, y_train_apple,
    ↪X_test_apple, y_test_apple)
tesla_model, _ = build_and_train_lstm(X_train_tesla, y_train_tesla,
    ↪X_test_tesla, y_test_tesla)
btc_model, _ = build_and_train_lstm(X_train_btc, y_train_btc, X_test_btc,
    ↪y_test_btc)
eth_model, _ = build_and_train_lstm(X_train_eth, y_train_eth, X_test_eth,
    ↪y_test_eth)

```

/usr/local/lib/python3.10/dist-packages/keras/src/layers/rnn/rnn.py:204:
 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 1/20
30/30          7s 107ms/step -
loss: 0.0713 - val_loss: 0.0078
Epoch 2/20
30/30          2s 58ms/step -
loss: 0.0052 - val_loss: 0.0066
Epoch 3/20
30/30          2s 56ms/step -
loss: 0.0040 - val_loss: 0.0031
Epoch 4/20
30/30          2s 79ms/step -
loss: 0.0029 - val_loss: 0.0047
Epoch 5/20

```

```

30/30          3s 86ms/step -
loss: 0.0030 - val_loss: 0.0018
Epoch 6/20
30/30          5s 80ms/step -
loss: 0.0028 - val_loss: 0.0026
Epoch 7/20
30/30          3s 105ms/step -
loss: 0.0025 - val_loss: 0.0019
Epoch 8/20
30/30          2s 59ms/step -
loss: 0.0020 - val_loss: 0.0037
Epoch 9/20
30/30          2s 56ms/step -
loss: 0.0020 - val_loss: 0.0027
Epoch 10/20
30/30          3s 57ms/step -
loss: 0.0018 - val_loss: 0.0013
Epoch 11/20
30/30          3s 95ms/step -
loss: 0.0015 - val_loss: 0.0024
Epoch 12/20
30/30          2s 70ms/step -
loss: 0.0016 - val_loss: 0.0014
Epoch 13/20
30/30          2s 56ms/step -
loss: 0.0015 - val_loss: 0.0020
Epoch 14/20
30/30          2s 57ms/step -
loss: 0.0016 - val_loss: 0.0015
Epoch 15/20
30/30          3s 56ms/step -
loss: 0.0017 - val_loss: 0.0028
Epoch 1/20
30/30          7s 77ms/step -
loss: 0.0360 - val_loss: 0.0070
Epoch 2/20
30/30          2s 57ms/step -
loss: 0.0056 - val_loss: 0.0046
Epoch 3/20
30/30          2s 59ms/step -
loss: 0.0048 - val_loss: 0.0032
Epoch 4/20
30/30          2s 56ms/step -
loss: 0.0035 - val_loss: 0.0028
Epoch 5/20
30/30          3s 56ms/step -
loss: 0.0031 - val_loss: 0.0020
Epoch 6/20

```

```

30/30          4s 97ms/step -
loss: 0.0031 - val_loss: 0.0019
Epoch 7/20
30/30          2s 57ms/step -
loss: 0.0030 - val_loss: 0.0031
Epoch 8/20
30/30          3s 56ms/step -
loss: 0.0032 - val_loss: 0.0017
Epoch 9/20
30/30          2s 57ms/step -
loss: 0.0027 - val_loss: 0.0017
Epoch 10/20
30/30          3s 59ms/step -
loss: 0.0021 - val_loss: 0.0015
Epoch 11/20
30/30          3s 80ms/step -
loss: 0.0021 - val_loss: 0.0018
Epoch 12/20
30/30          3s 89ms/step -
loss: 0.0020 - val_loss: 0.0015
Epoch 13/20
30/30          5s 76ms/step -
loss: 0.0022 - val_loss: 0.0014
Epoch 14/20
30/30          2s 72ms/step -
loss: 0.0026 - val_loss: 0.0019
Epoch 15/20
30/30          2s 58ms/step -
loss: 0.0020 - val_loss: 0.0021
Epoch 16/20
30/30          4s 92ms/step -
loss: 0.0020 - val_loss: 0.0013
Epoch 17/20
30/30          2s 81ms/step -
loss: 0.0019 - val_loss: 0.0012
Epoch 18/20
30/30          2s 56ms/step -
loss: 0.0017 - val_loss: 0.0012
Epoch 19/20
30/30          3s 57ms/step -
loss: 0.0018 - val_loss: 0.0013
Epoch 20/20
30/30          2s 57ms/step -
loss: 0.0014 - val_loss: 0.0018
Epoch 1/20
16/16          5s 123ms/step -
loss: 0.0263 - val_loss: 0.0273
Epoch 2/20

```

```

16/16          1s 86ms/step -
loss: 0.0042 - val_loss: 0.0262
Epoch 3/20
16/16          2s 50ms/step -
loss: 0.0040 - val_loss: 0.0086
Epoch 4/20
16/16          1s 51ms/step -
loss: 0.0029 - val_loss: 0.0069
Epoch 5/20
16/16          1s 49ms/step -
loss: 0.0022 - val_loss: 0.0065
Epoch 6/20
16/16          1s 50ms/step -
loss: 0.0019 - val_loss: 0.0105
Epoch 7/20
16/16          1s 51ms/step -
loss: 0.0019 - val_loss: 0.0075
Epoch 8/20
16/16          1s 49ms/step -
loss: 0.0018 - val_loss: 0.0034
Epoch 9/20
16/16          1s 50ms/step -
loss: 0.0020 - val_loss: 0.0077
Epoch 10/20
16/16          1s 49ms/step -
loss: 0.0019 - val_loss: 0.0034
Epoch 11/20
16/16          1s 55ms/step -
loss: 0.0014 - val_loss: 0.0073
Epoch 12/20
16/16          1s 87ms/step -
loss: 0.0018 - val_loss: 0.0080
Epoch 13/20
16/16          1s 85ms/step -
loss: 0.0014 - val_loss: 0.0038
Epoch 14/20
16/16          2s 50ms/step -
loss: 0.0014 - val_loss: 0.0076
Epoch 15/20
16/16          1s 51ms/step -
loss: 0.0018 - val_loss: 0.0081
Epoch 1/20
16/16          4s 72ms/step -
loss: 0.0823 - val_loss: 0.0320
Epoch 2/20
16/16          1s 48ms/step -
loss: 0.0153 - val_loss: 0.0147
Epoch 3/20

```

```

16/16          1s 49ms/step -
loss: 0.0091 - val_loss: 0.0102
Epoch 4/20
16/16          1s 50ms/step -
loss: 0.0089 - val_loss: 0.0072
Epoch 5/20
16/16          1s 79ms/step -
loss: 0.0086 - val_loss: 0.0064
Epoch 6/20
16/16          1s 86ms/step -
loss: 0.0065 - val_loss: 0.0058
Epoch 7/20
16/16          1s 88ms/step -
loss: 0.0067 - val_loss: 0.0065
Epoch 8/20
16/16          2s 49ms/step -
loss: 0.0062 - val_loss: 0.0068
Epoch 9/20
16/16          1s 50ms/step -
loss: 0.0050 - val_loss: 0.0056
Epoch 10/20
16/16          1s 48ms/step -
loss: 0.0053 - val_loss: 0.0054
Epoch 11/20
16/16          1s 49ms/step -
loss: 0.0048 - val_loss: 0.0052
Epoch 12/20
16/16          1s 49ms/step -
loss: 0.0047 - val_loss: 0.0051
Epoch 13/20
16/16          1s 50ms/step -
loss: 0.0047 - val_loss: 0.0050
Epoch 14/20
16/16          1s 49ms/step -
loss: 0.0046 - val_loss: 0.0045
Epoch 15/20
16/16          1s 48ms/step -
loss: 0.0054 - val_loss: 0.0053
Epoch 16/20
16/16          1s 58ms/step -
loss: 0.0050 - val_loss: 0.0047
Epoch 17/20
16/16          1s 83ms/step -
loss: 0.0042 - val_loss: 0.0050
Epoch 18/20
16/16          1s 88ms/step -
loss: 0.0051 - val_loss: 0.0054
Epoch 19/20

```

16/16 2s 49ms/step -
loss: 0.0043 - val_loss: 0.0046

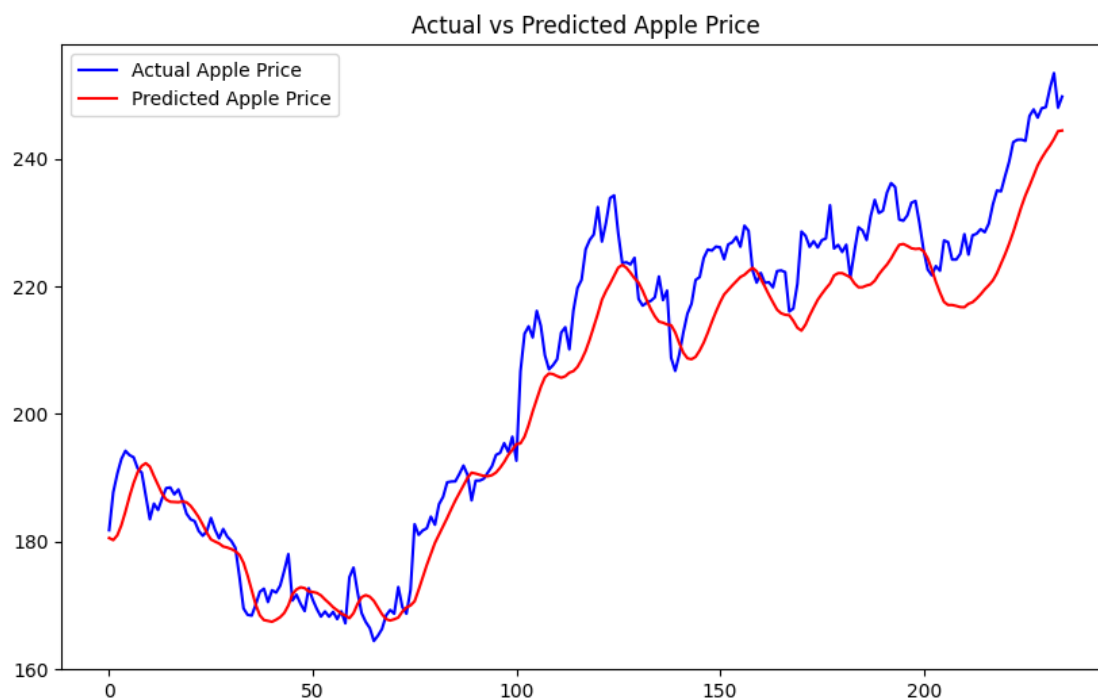
```
[ ]: # Function to evaluate and plot results for LSTM models
def evaluate_lstm(model, X_test, y_test, scaler, name="Asset"):
    predictions = model.predict(X_test)
    predictions = scaler.inverse_transform(np.concatenate([predictions, np.
↪zeros((predictions.shape[0], 3))], axis=1))[:, 0]
    actual = scaler.inverse_transform(np.concatenate([y_test.reshape(-1, 1), np.
↪zeros((y_test.shape[0], 3))], axis=1))[:, 0]

    plt.figure(figsize=(10, 6))
    plt.plot(actual, color='blue', label=f'Actual {name} Price')
    plt.plot(predictions, color='red', label=f'Predicted {name} Price')
    plt.title(f'Actual vs Predicted {name} Price')
    plt.legend()
    plt.show()

# Evaluate models for stocks
evaluate_lstm(apple_model, X_test_apple, y_test_apple, apple_scaler, "Apple")
evaluate_lstm(tesla_model, X_test_tesla, y_test_tesla, tesla_scaler, "Tesla")

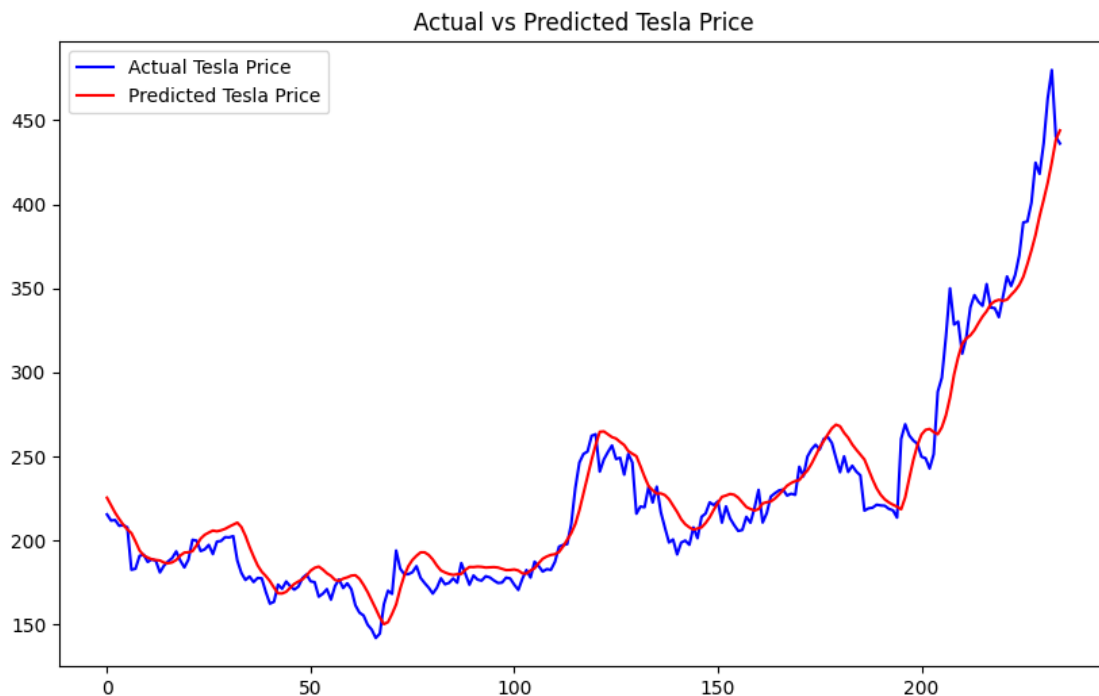
# Evaluate models for cryptocurrencies
evaluate_lstm(btc_model, X_test_btc, y_test_btc, btc_scaler, "Bitcoin")
evaluate_lstm(eth_model, X_test_eth, y_test_eth, eth_scaler, "Ethereum")
```

8/8 3s 181ms/step



8/8

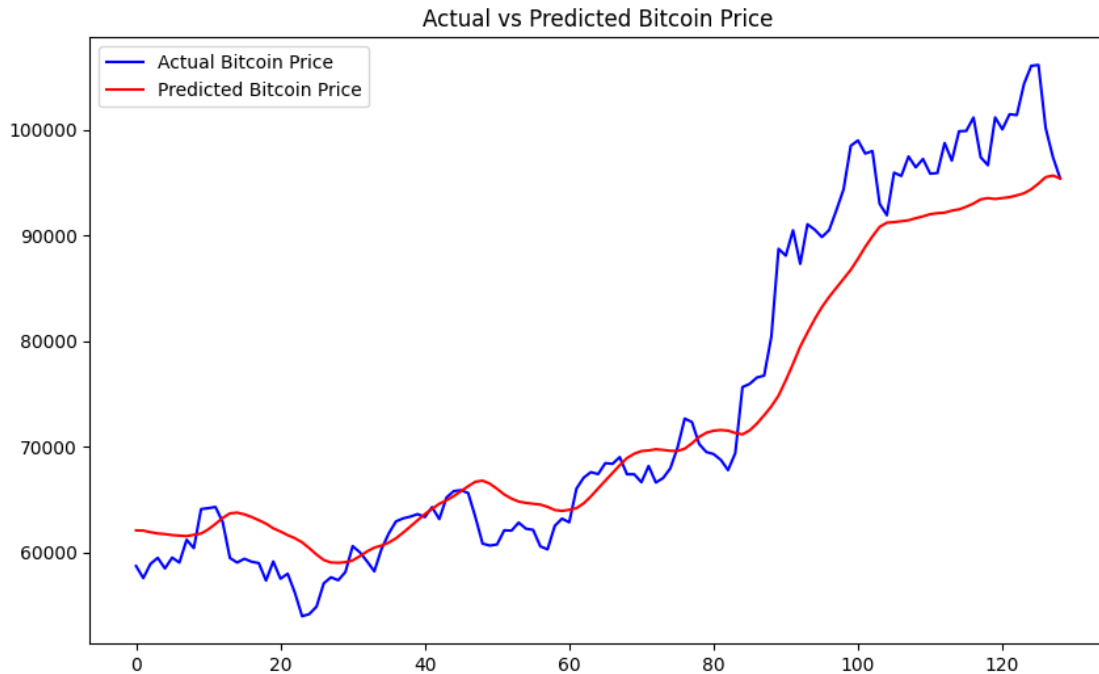
1s 54ms/step



WARNING:tensorflow:5 out of the last 17 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_distributed at 0x7a2876dead40> triggered tf.function retracing. Tracing is expensive and the excessive number of tracings could be due to (1) creating @tf.function repeatedly in a loop, (2) passing tensors with different shapes, (3) passing Python objects instead of tensors. For (1), please define your @tf.function outside of the loop. For (2), @tf.function has reduce_retracing=True option that can avoid unnecessary retracing. For (3), please refer to https://www.tensorflow.org/guide/function#controlling_retracing and https://www.tensorflow.org/api_docs/python/tf/function for more details.

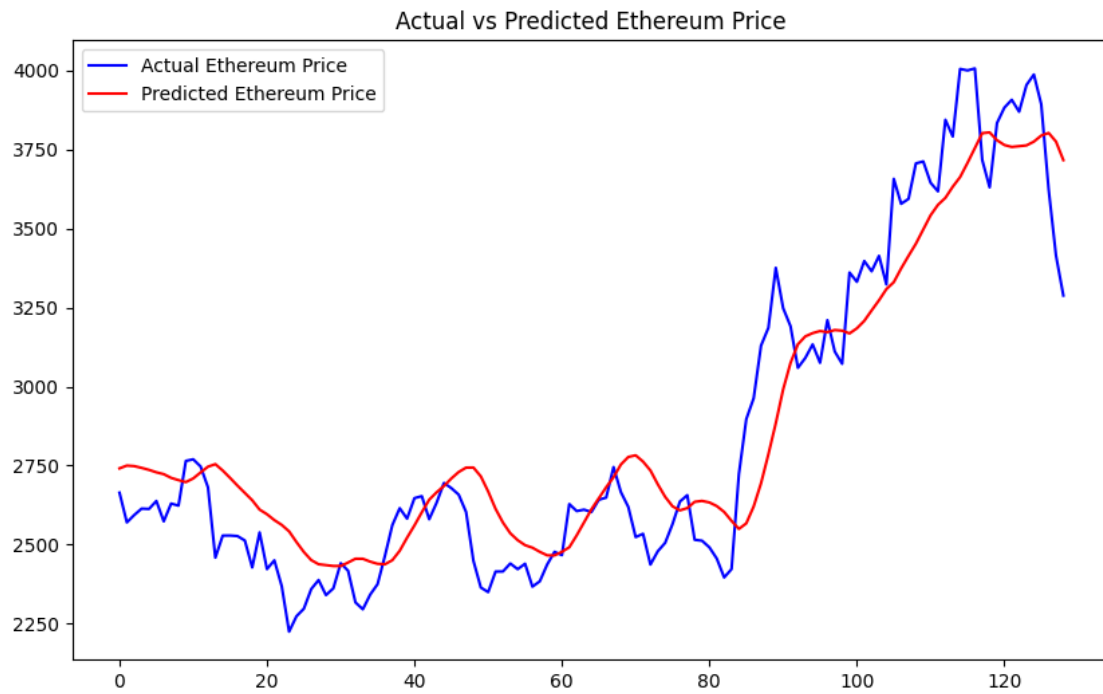
5/5

1s 83ms/step



WARNING:tensorflow:5 out of the last 14 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_distributed at 0x7a287e9e77f0> triggered tf.function retracing. Tracing is expensive and the excessive number of tracings could be due to (1) creating @tf.function repeatedly in a loop, (2) passing tensors with different shapes, (3) passing Python objects instead of tensors. For (1), please define your @tf.function outside of the loop. For (2), @tf.function has reduce_retracing=True option that can avoid unnecessary retracing. For (3), please refer to https://www.tensorflow.org/guide/function#controlling_retracing and https://www.tensorflow.org/api_docs/python/tf/function for more details.

5/5 1s 86ms/step



[]: