In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
```

In [2]:

```
df = pd.read_csv("MSFT.csv")
df.head()
```

Out[2]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	1986-03-13	0.088542	0.101563	0.088542	0.097222	0.061434	1031788800
1	1986-03-14	0.097222	0.102431	0.097222	0.100694	0.063628	308160000
2	1986-03-17	0.100694	0.103299	0.100694	0.102431	0.064725	133171200
3	1986-03-18	0.102431	0.103299	0.098958	0.099826	0.063079	67766400
4	1986-03-19	0.099826	0.100694	0.097222	0.098090	0.061982	47894400

In [3]:

```
df.isnull().sum()
```

Out[3]:

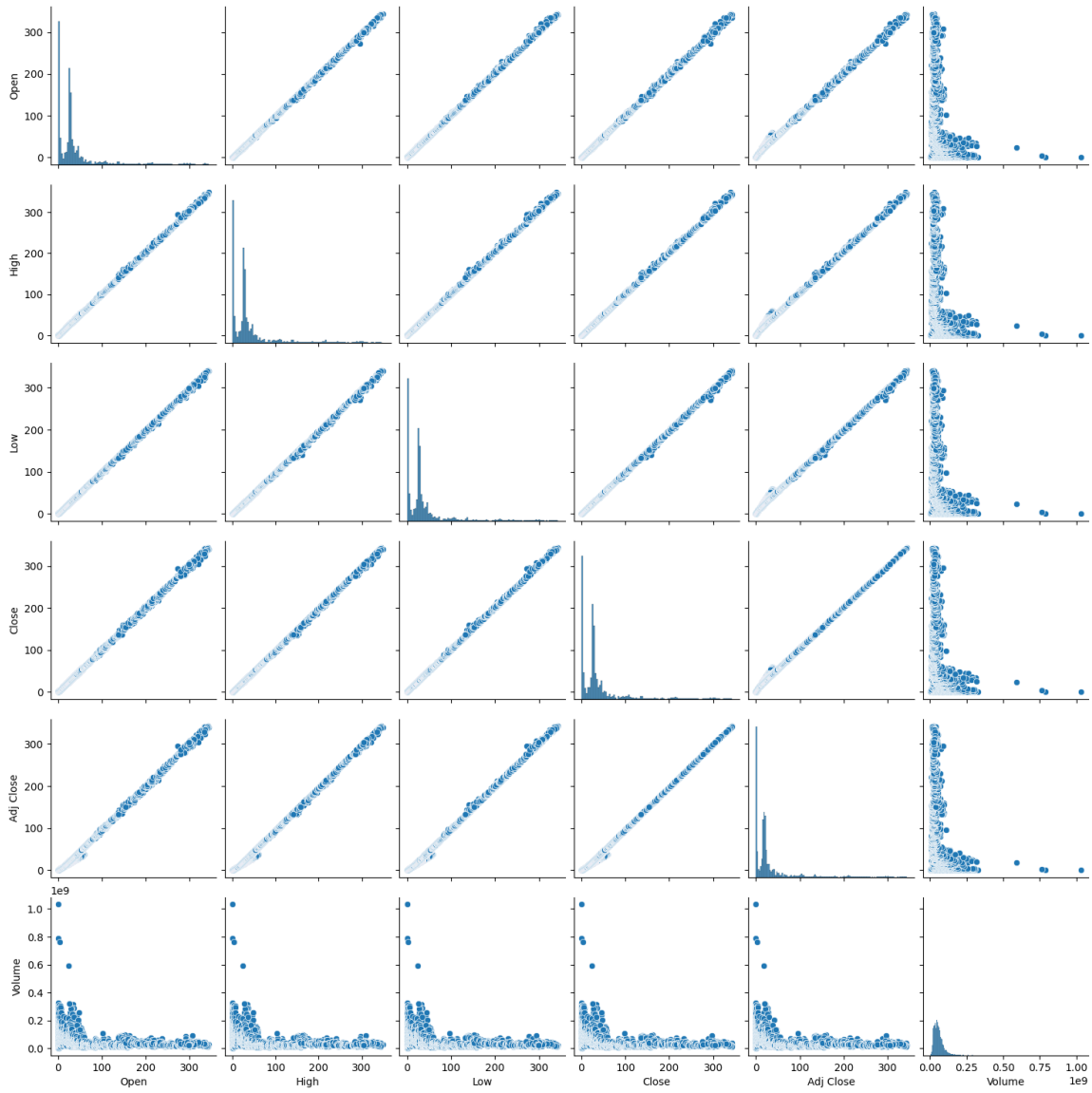
```
Date         0
Open         0
High         0
Low          0
Close        0
Adj Close    0
Volume       0
dtype: int64
```

In [4]:

```
sns.pairplot(df)
```

Out[4]:

```
<seaborn.axisgrid.PairGrid at 0x2957fc1a8c0>
```

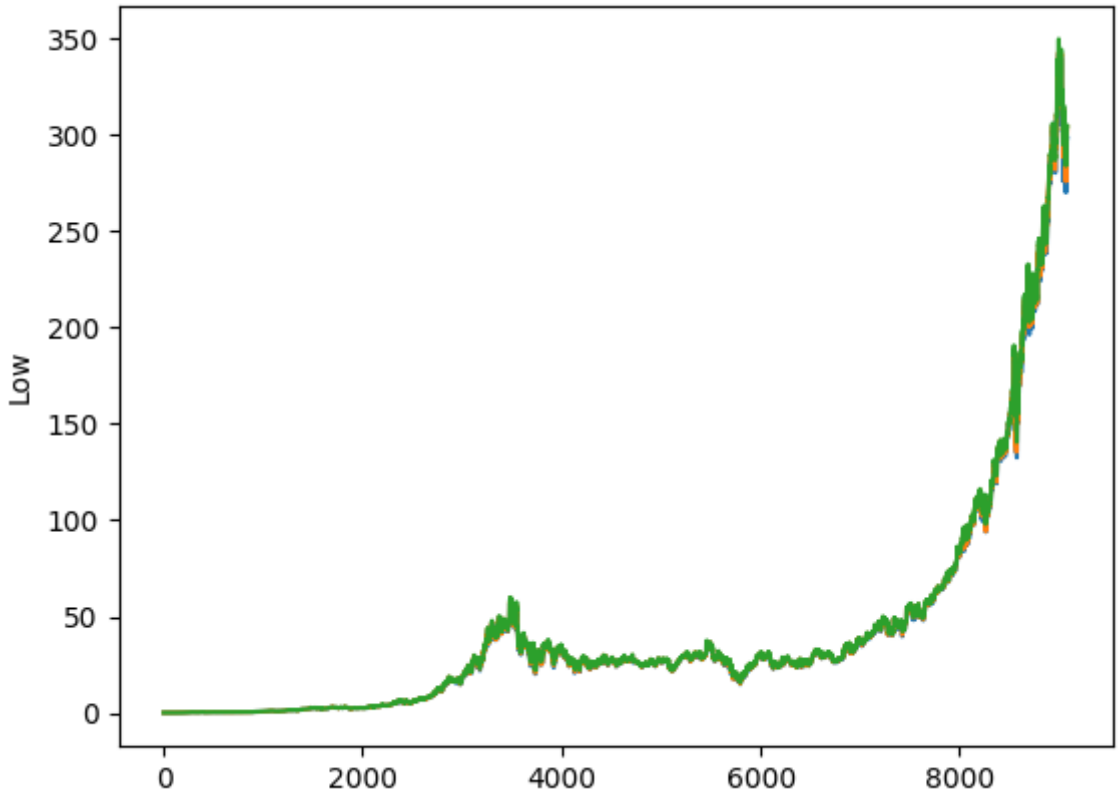


In [7]:

```
sns.lineplot(df['Low'])
sns.lineplot(df['Close'])
sns.lineplot(df['High'])
```

Out[7]:

```
<AxesSubplot:ylabel='Low'>
```



In [40]:

```
from sklearn.preprocessing import MinMaxScaler
price = df[['Close']]
scaler = MinMaxScaler(feature_range=(-1, 1))
price['Close'] = scaler.fit_transform(price['Close'].values.reshape(-1,1))
```

```
C:\Users\HP\AppData\Local\Temp\ipykernel_10788\3492330880.py:4: SettingWit
hCopyWarning:
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-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://
pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-
view-versus-a-copy)
  price['Close'] = scaler.fit_transform(price['Close'].values.reshape(-1,
1))
```

In [41]:

```
def split_data(stock, lookback):
    data_raw = stock.to_numpy() # convert to numpy array
    data = []

    # create all possible sequences of length seq_len
    for index in range(len(data_raw) - lookback):
        data.append(data_raw[index: index + lookback])

    data = np.array(data);
    test_set_size = int(np.round(0.2*data.shape[0]));
    train_set_size = data.shape[0] - (test_set_size);

    x_train = data[:train_set_size,:-1,:]
    y_train = data[:train_set_size,-1,:]

    x_test = data[train_set_size:,:-1]
    y_test = data[train_set_size:,-1,:]

    return [x_train, y_train, x_test, y_test]
lookback = 20 # choose sequence length
x_train, y_train, x_test, y_test = split_data(price, lookback)
```

In [42]:

```
x_train = torch.from_numpy(x_train).type(torch.Tensor)
x_test = torch.from_numpy(x_test).type(torch.Tensor)
y_train_lstm = torch.from_numpy(y_train).type(torch.Tensor)
y_test_lstm = torch.from_numpy(y_test).type(torch.Tensor)
y_train_gru = torch.from_numpy(y_train).type(torch.Tensor)
y_test_gru = torch.from_numpy(y_test).type(torch.Tensor)
```

In [32]:

```
from torch.nn import LSTM, Sequential
import torch.nn as nn
import torch
```

In [33]:

```
class LSTM(nn.Module):
    def __init__(self, input_dim, hidden_dim, num_layers, output_dim):
        super(LSTM, self).__init__()
        self.hidden_dim = hidden_dim
        self.num_layers = num_layers

        self.lstm = nn.LSTM(input_dim, hidden_dim, num_layers, batch_first=True)
        self.fc = nn.Linear(hidden_dim, output_dim)
    def forward(self, x):
        h0 = torch.zeros(self.num_layers, x.size(0), self.hidden_dim).requires_grad_()
        c0 = torch.zeros(self.num_layers, x.size(0), self.hidden_dim).requires_grad_()
        out, (hn, cn) = self.lstm(x, (h0.detach(), c0.detach()))
        out = self.fc(out[:, -1, :])
        return out
```

In [46]:

```
input_dim = 1
hidden_dim = 32
num_layers = 2
output_dim = 1
num_epochs = 10
```

In [47]:

```
model = LSTM(input_dim=input_dim, hidden_dim=hidden_dim, output_dim=output_dim, num_layer
criterion = torch.nn.MSELoss(reduction='mean')
optimiser = torch.optim.Adam(model.parameters(), lr=0.01)
```

In [48]:

```
import time
hist = np.zeros(num_epochs)
start_time = time.time()
lstm = []
for t in range(num_epochs):
    y_train_pred = model(x_train)
    loss = criterion(y_train_pred, y_train_lstm)
    print("Epoch ", t, "MSE: ", loss.item())
    hist[t] = loss.item()
    optimiser.zero_grad()
    loss.backward()
    optimiser.step()

training_time = time.time()-start_time
print("Training time: {}".format(training_time))
```

```
Epoch  0 MSE:  1.178270697593689
Epoch  1 MSE:  0.8862443566322327
Epoch  2 MSE:  0.6314018964767456
Epoch  3 MSE:  0.342550128698349
Epoch  4 MSE:  0.04467328265309334
Epoch  5 MSE:  0.168000727891922
Epoch  6 MSE:  0.16461090743541718
Epoch  7 MSE:  0.0658588856458664
Epoch  8 MSE:  0.011744066141545773
Epoch  9 MSE:  0.009960762225091457
Training time: 14.617993831634521
```