Technical Analysis with Python

October 2, 2025

[ ]:
```
# Setup environment
import numpy as np
import pandas as pd
import pandas_datareader as pdr
from pandas.plotting import register_matplotlib_converters
register_matplotlib_converters()
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
import ta
import yfinance as yf
import warnings
warnings.filterwarnings('ignore')
```

[3]:
```
# Get data
tickers = 'AMZN GOOG NFLX META GLD'.split()
tickers
```

[3]:
```
['AMZN', 'GOOG', 'NFLX', 'META', 'GLD']
```

[4]:
```
# Fetch historical market data
start = dt.datetime(2024, 1, 1)
end = dt.datetime(2025, 12, 31)
data = yf.download(tickers, start=start, end=end, auto_adjust=True)['Close']
data
```

```
[**********************100%**********************]  5 of 5 completed
```

[4]:

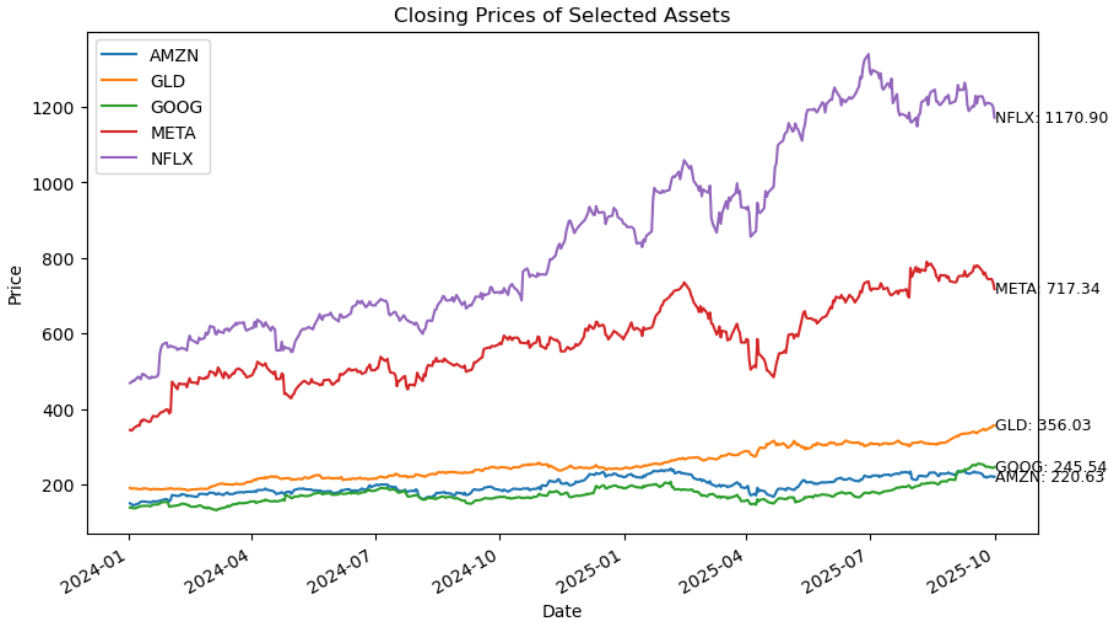
Ticker	AMZN	GLD	GOOG	META	NFLX
Date					
2024-01-02	149.929993	190.720001	138.611435	344.168335	468.500000
2024-01-03	148.470001	189.130005	139.406006	342.359497	470.260010
2024-01-04	144.570007	189.320007	137.101776	344.993195	474.670013
2024-01-05	145.240005	189.350006	136.456177	349.793640	474.059998
2024-01-08	149.100006	187.869995	139.574860	356.462524	485.029999
…	…	…	…	…	…
2025-09-25	218.149994	344.750000	246.570007	748.909973	1208.239990
2025-09-26	219.779999	346.739990	247.179993	743.750000	1210.609985

```
2025-09-29  222.169998  352.459991  244.360001  743.400024  1206.410034
2025-09-30  219.570007  355.470001  243.550003  734.380005  1198.920044
2025-10-01  220.630005  356.029999  245.539993  717.340027  1170.900024

[439 rows x 5 columns]
```

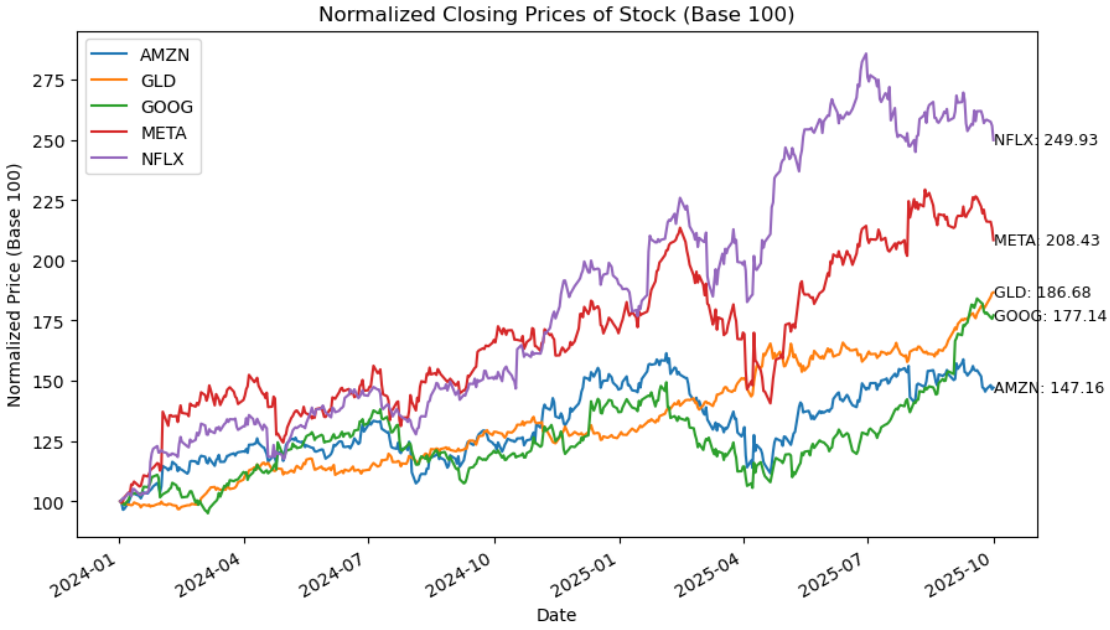
[5]:
```
# Basic data description statistics
print(data.describe())
print(data.info())
```

```
Ticker        AMZN         GLD        GOOG        META         NFLX
count   439.000000  439.000000  439.000000  439.000000   439.000000
mean    197.090752  253.096446  173.776613  576.305771   855.730500
std      22.643252   43.713753   23.327895  105.307353   246.906023
min     144.570007  184.419998  131.659012  342.359497   468.500000
25%     180.055000  218.040001  159.663727  495.684937   634.015015
50%     192.169998  245.000000  170.075638  570.635681   823.960022
75%     219.375000  298.110001  185.015808  655.525665  1099.200012
max     242.059998  356.029999  255.240005  789.467163  1339.130005
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 439 entries, 2024-01-02 to 2025-10-01
Data columns (total 5 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   AMZN    439 non-null    float64
 1   GLD     439 non-null    float64
 2   GOOG    439 non-null    float64
 3   META    439 non-null    float64
 4   NFLX    439 non-null    float64
dtypes: float64(5)
memory usage: 20.6 KB
None
```

[6]:
```
# Plot closing prices
data.plot(figsize=(10, 6))
plt.title('Closing Prices of Selected Assets')
# Display the ticker symbols and last closing prices in plot
for i, ticker in enumerate(tickers):
    plt.text(data.index[-1], data[ticker].iloc[-1], f'{ticker}: {data[ticker].
 ↪iloc[-1]:.2f}', fontsize=9, verticalalignment='center')
plt.xlabel('Date')
plt.ylabel('Price')
plt.legend()
plt.show()
```



[7]:
```
# Normalized prices
normalized_data = data / data.iloc[0] * 100
normalized_data.plot(figsize=(10, 6))
plt.title('Normalized Closing Prices of Stock (Base 100)')
for i, ticker in enumerate(tickers):
    plt.text(data.index[-1], normalized_data[ticker].iloc[-1], f'{ticker}:␣
 ↪{normalized_data[ticker].iloc[-1]:.2f}', fontsize=9,␣
 ↪verticalalignment='center')
plt.xlabel('Date')
plt.ylabel('Normalized Price (Base 100)')
plt.legend()
plt.show()
```



[8]:
```
# Calculate log returns, about monetary returns need to compound the interests.
pct_change = np.log1p(data).diff().dropna()
pct_change
```

[8]:
```
Ticker           AMZN       GLD       GOOG       META       NFLX
Date
2024-01-03 -0.009720 -0.008328  0.005675 -0.005254  0.003742
2024-01-04 -0.026439  0.000999 -0.016547  0.007641  0.009314
2024-01-05  0.004592  0.000158 -0.004686  0.013779 -0.001283
2024-01-08  0.026053 -0.007806  0.022435  0.018832  0.022829
2024-01-09  0.015010  0.000318  0.014241 -0.003426 -0.006067
…                …         …         …          …          …
2025-09-25 -0.009356  0.004144 -0.005077 -0.015547  0.003554
2025-09-26  0.007410  0.005739  0.002461 -0.006905  0.001958
2025-09-29  0.010767  0.016315 -0.011428 -0.000470 -0.003472
2025-09-30 -0.011719  0.008480 -0.003307 -0.012191 -0.006223
2025-10-01  0.004794  0.001570  0.008104 -0.023444 -0.023629

[438 rows x 5 columns]
```

[9]:
```
# Actual percentage change
changed = data.pct_change().dropna()
changed
```

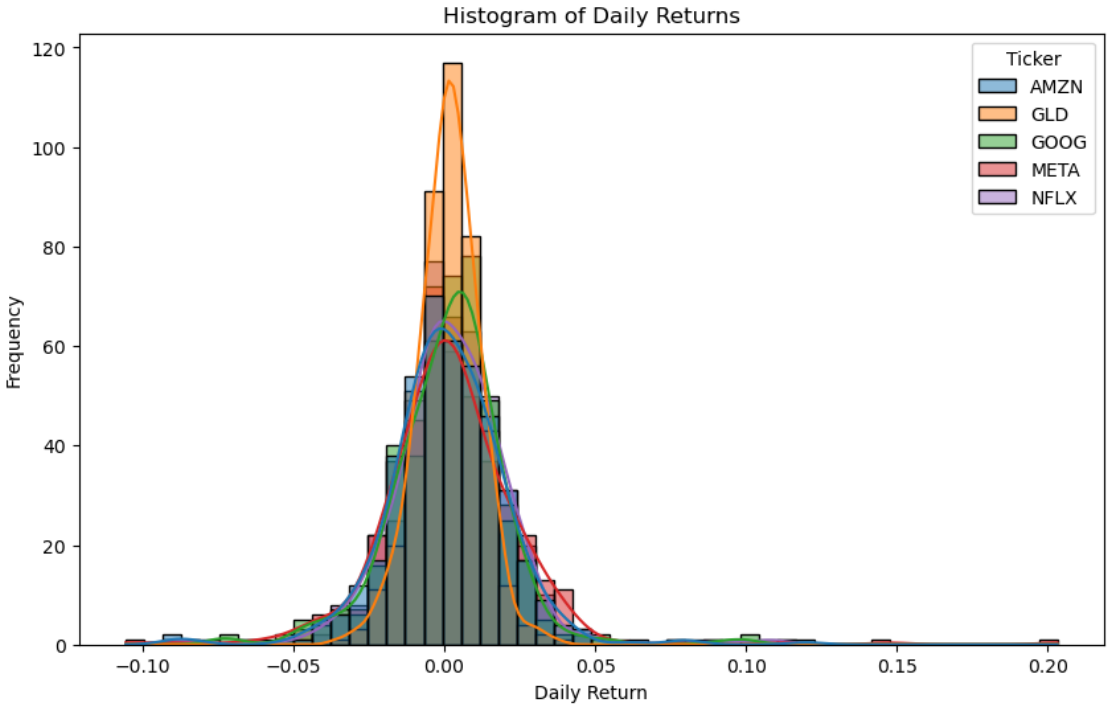
[9]:
```
Ticker           AMZN       GLD       GOOG       META       NFLX
Date
```

```
2024-01-03 -0.009738 -0.008337  0.005732 -0.005256  0.003757
2024-01-04 -0.026268  0.001005 -0.016529  0.007693  0.009378
2024-01-05  0.004634  0.000158 -0.004709  0.013915 -0.001285
2024-01-08  0.026577 -0.007816  0.022855  0.019065  0.023141
2024-01-09  0.015225  0.000319  0.014445 -0.003430 -0.006061
…                 …         …         …         …         …
2025-09-25 -0.009355  0.004165 -0.005084 -0.015447  0.003563
2025-09-26  0.007472  0.005772  0.002474 -0.006890  0.001962
2025-09-29  0.010875  0.016497 -0.011409 -0.000471 -0.003469
2025-09-30 -0.011703  0.008540 -0.003315 -0.012133 -0.006208
2025-10-01  0.004828  0.001575  0.008171 -0.023203 -0.023371

[438 rows x 5 columns]
```

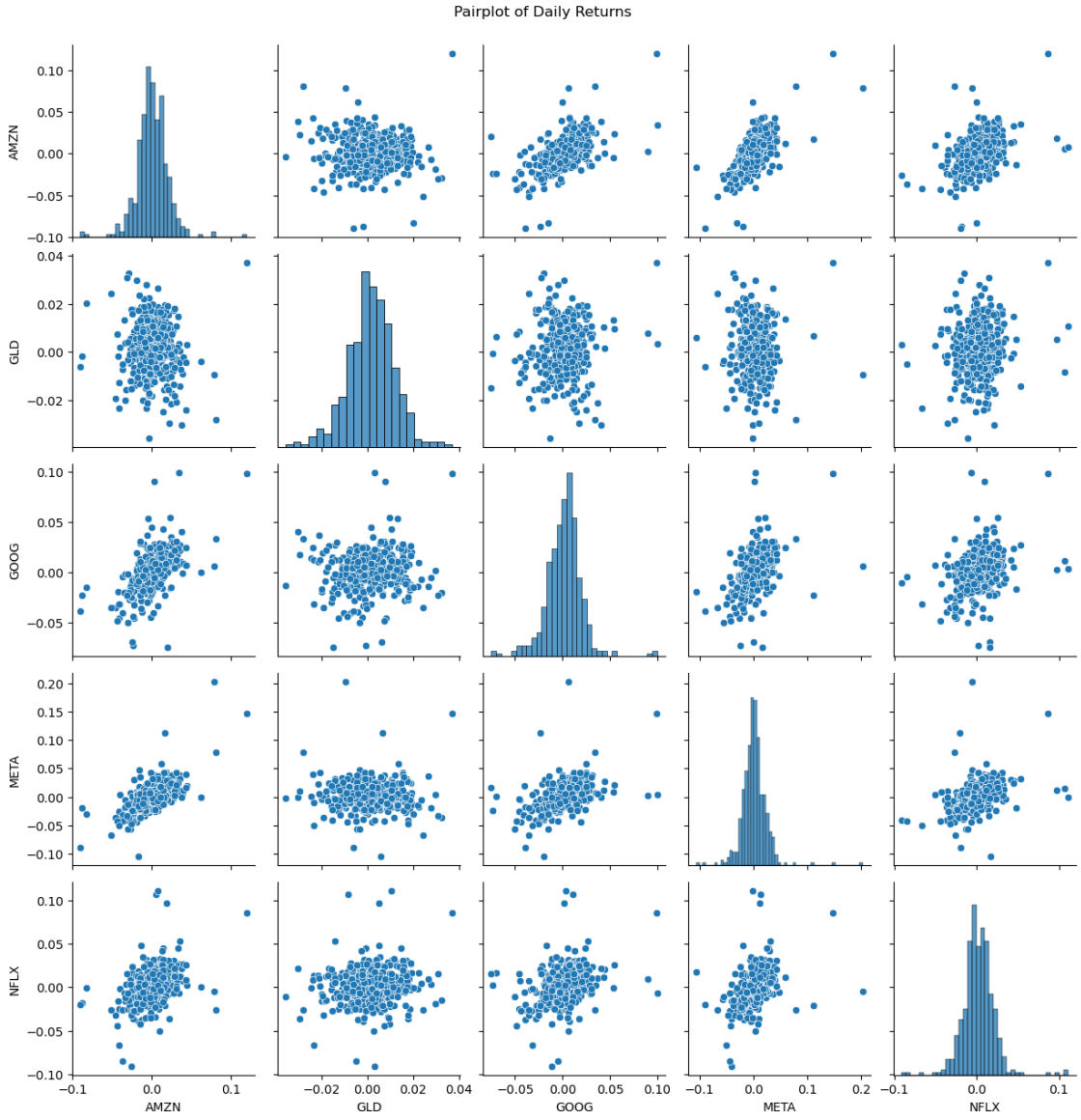
[10]:
```
# Describe percentage change
changed.describe()
```

[10]:
```
Ticker        AMZN         GLD        GOOG        META        NFLX
count   438.000000  438.000000  438.000000  438.000000  438.000000
mean      0.001075    0.001479    0.001483    0.001953    0.002286
std       0.019661    0.010291    0.018866    0.023785    0.019702
min      -0.089791   -0.035683   -0.075061   -0.105613   -0.090933
25%      -0.009291   -0.004563   -0.008674   -0.009626   -0.007303
50%       0.000423    0.001918    0.003144    0.001087    0.002076
75%       0.012161    0.008190    0.011533    0.012064    0.013201
max       0.119770    0.036991    0.099652    0.203176    0.110870
```

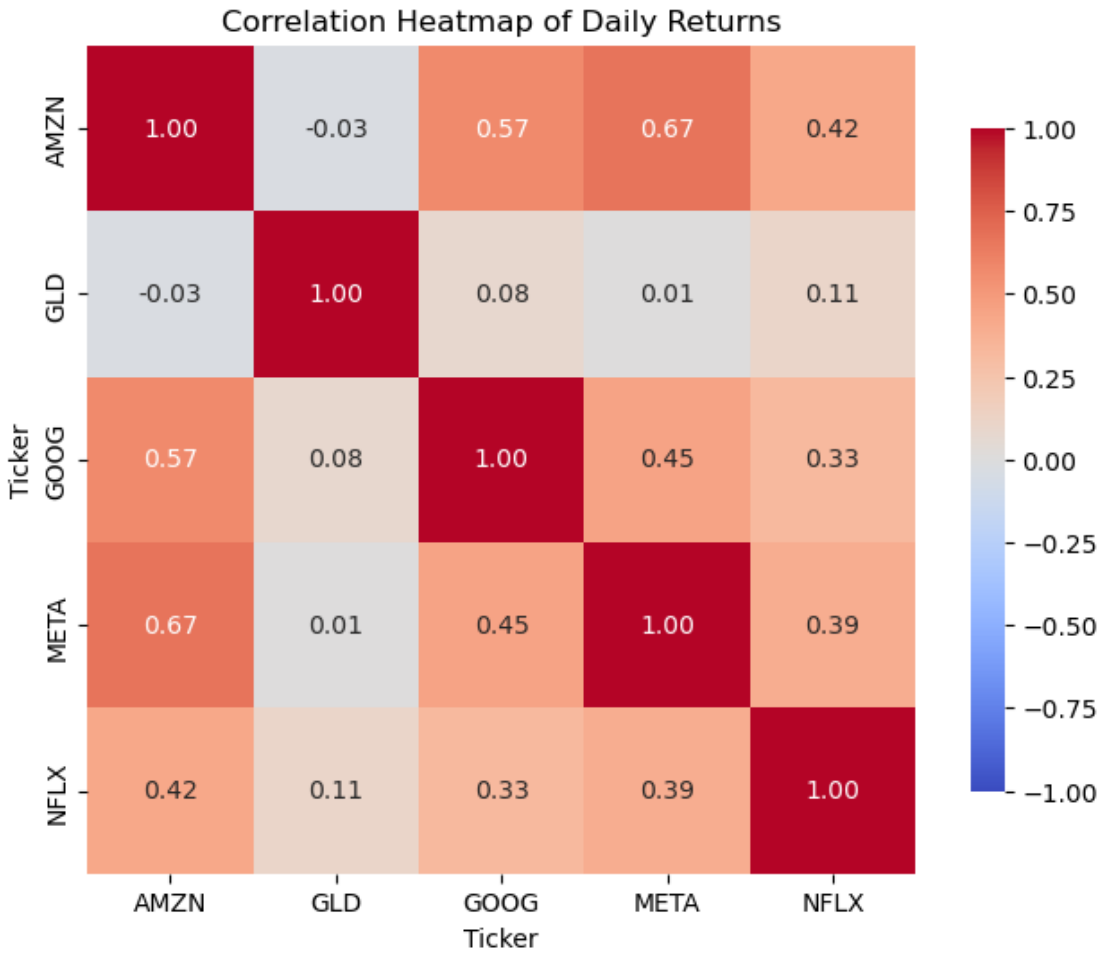
[11]:
```
# Plot histogram of daily returns
plt.figure(figsize=(10, 6))
sns.histplot(changed, bins=50, kde=True, alpha=0.5)
plt.title('Histogram of Daily Returns')
plt.xlabel('Daily Return')
plt.ylabel('Frequency')
plt.show()
```



[12]:
```
# Pairplot of daily returns
sns.pairplot(changed)
plt.suptitle('Pairplot of Daily Returns', y=1.02)
plt.show()
```

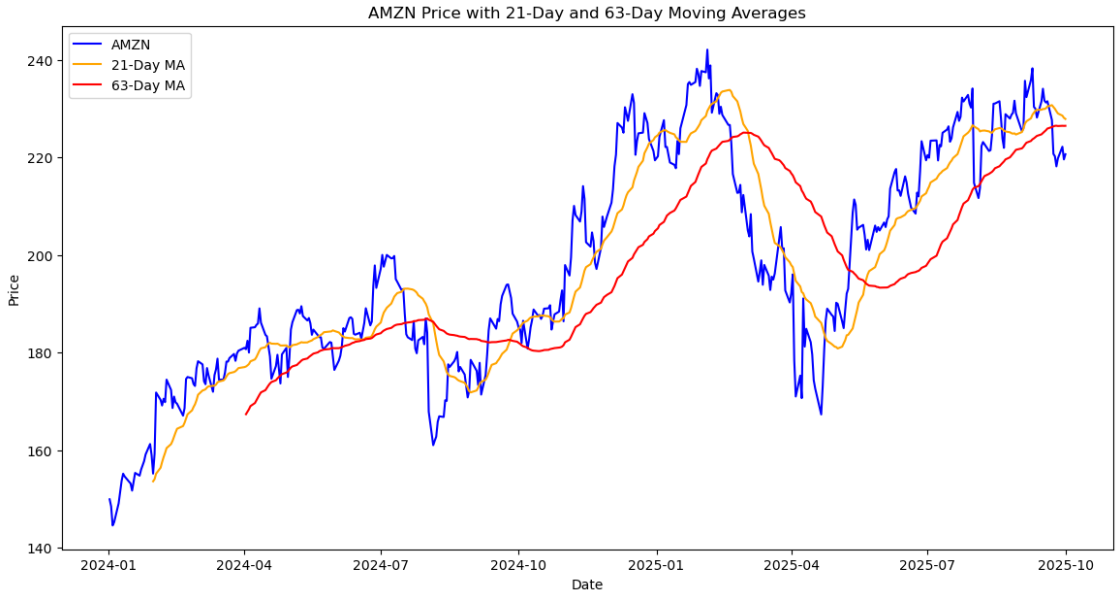


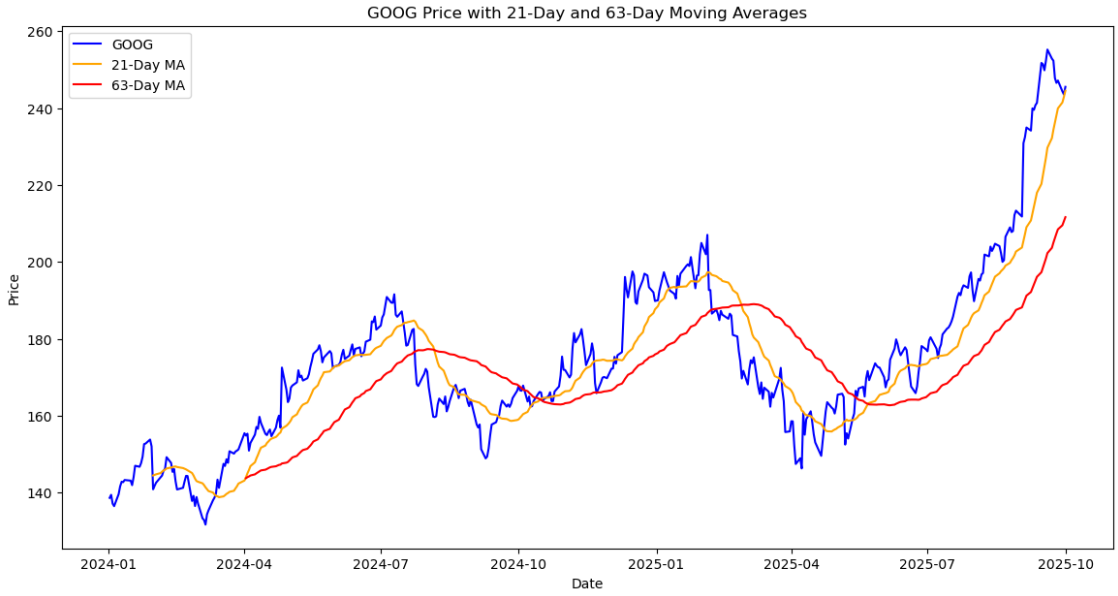
[13]:
```
# Correlation heatmap
plt.figure(figsize=(8, 6))
sns.heatmap(changed.corr(), annot=True, cmap='coolwarm', fmt=".2f", vmin=-1,␣
 ↪vmax=1, center=0, square=True, cbar_kws={"shrink": .8})
plt.title('Correlation Heatmap of Daily Returns')
plt.show()
```

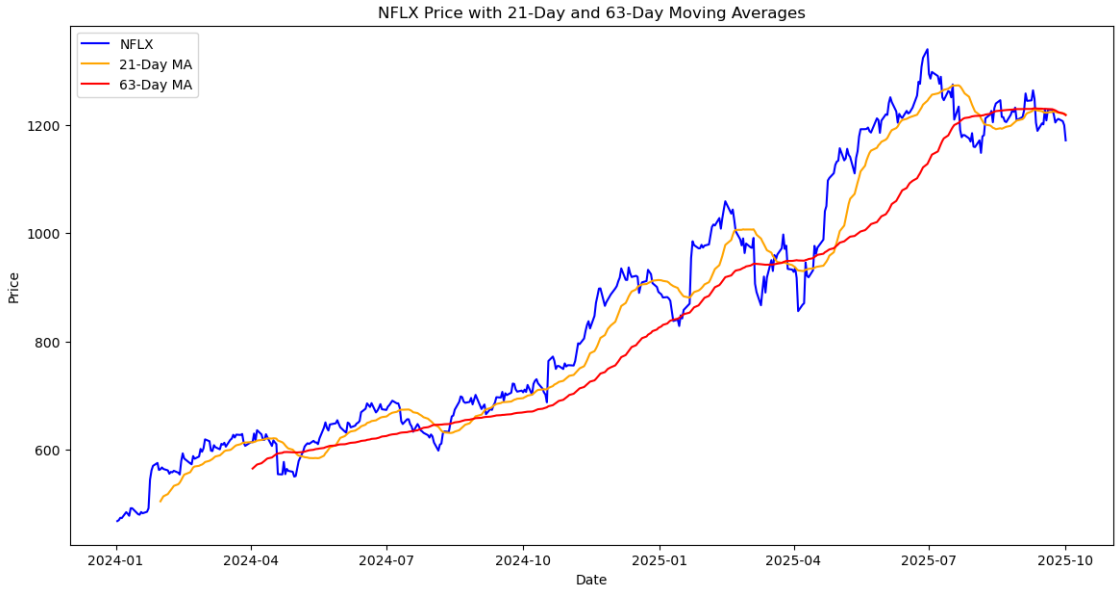


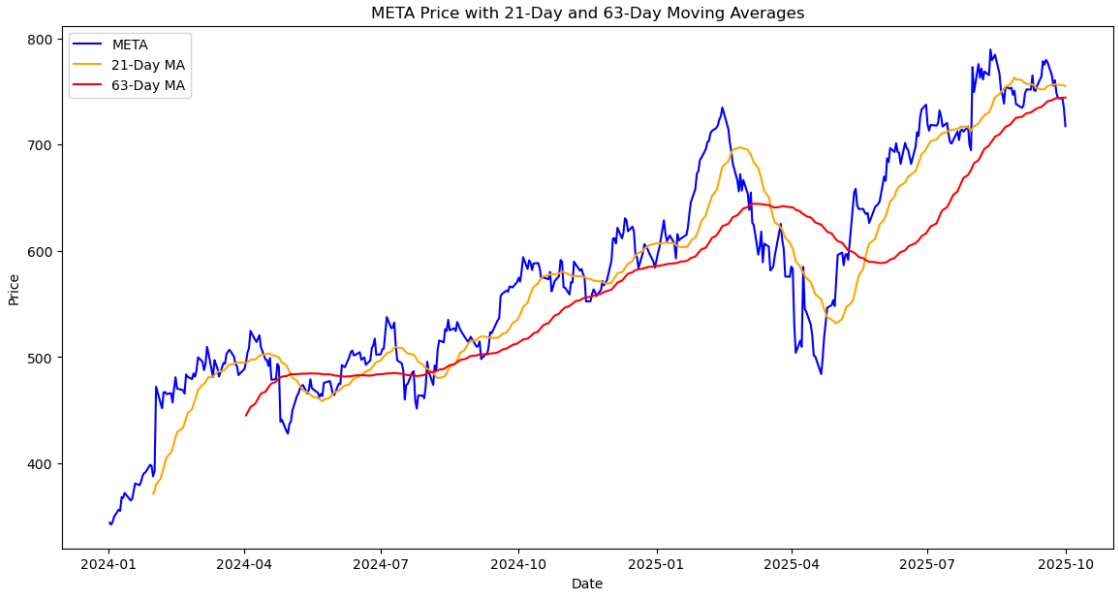
Techincal Analysis of Stock Prices

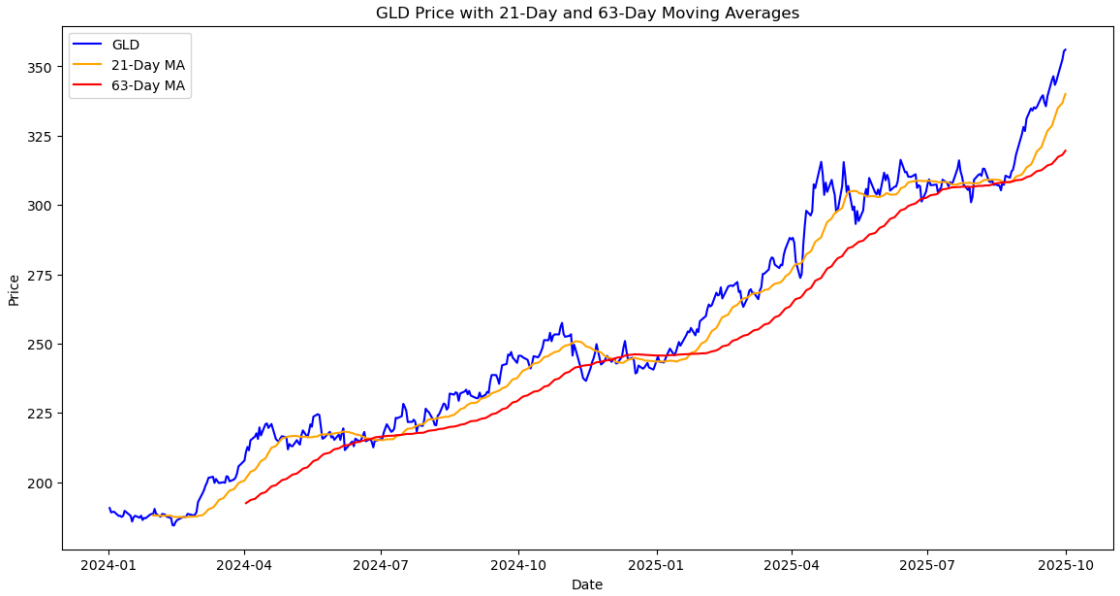
[14]:
```
# Moving averages in 1 month and 3 months

mo_21 = data.rolling(window=21).mean() # 21 trading days in a months
mo_63 = data.rolling(window=63).mean() # 63 trading days in 3 months
for ticker in tickers:
    plt.rcParams['figure.figsize'] = (14, 7)
    plt.plot(data.index, data[ticker], label=ticker, color='blue')
    plt.plot(mo_21.index, mo_21[ticker], label='21-Day MA', color='orange')
    plt.plot(mo_63.index, mo_63[ticker], label='63-Day MA', color='red')
    plt.title(f'{ticker} Price with 21-Day and 63-Day Moving Averages')
    plt.xlabel('Date')
    plt.ylabel('Price')
    plt.legend()
    plt.show()
```


AMZN Price with 21-Day and 63-Day Moving Averages
AMZN
21-Day MA
63-Day MA
Price
Date
240
220
200
180
160
140
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10


GOOG Price with 21-Day and 63-Day Moving Averages
GOOG
21-Day MA
63-Day MA
Price
Date
260
240
220
200
180
160
140
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

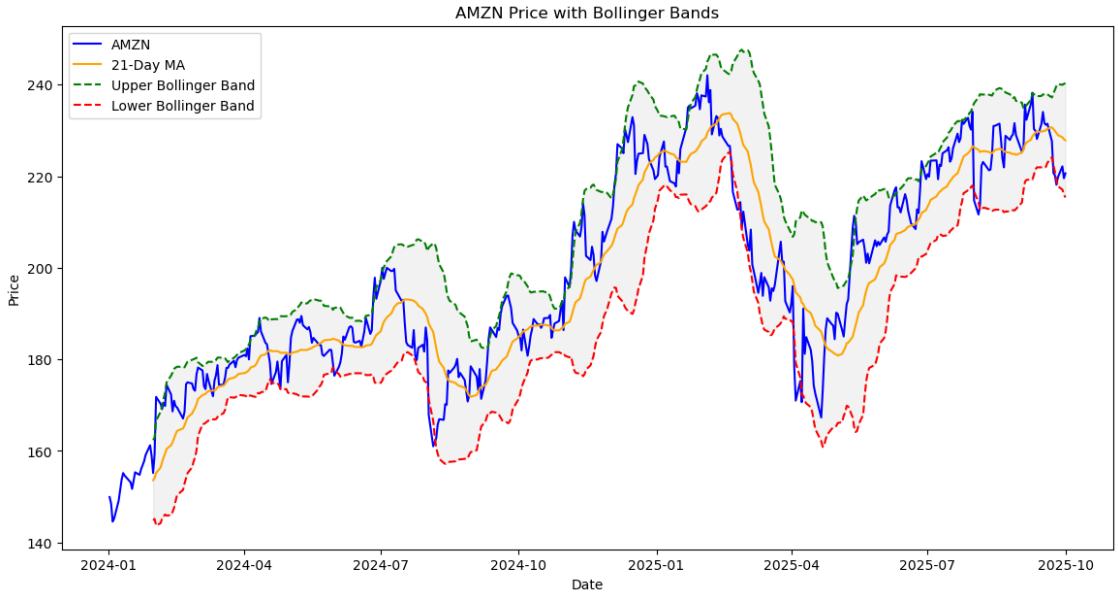

NFLX Price with 21-Day and 63-Day Moving Averages
NFLX
21-Day MA
63-Day MA
Price
Date
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
600
800
1000
1200

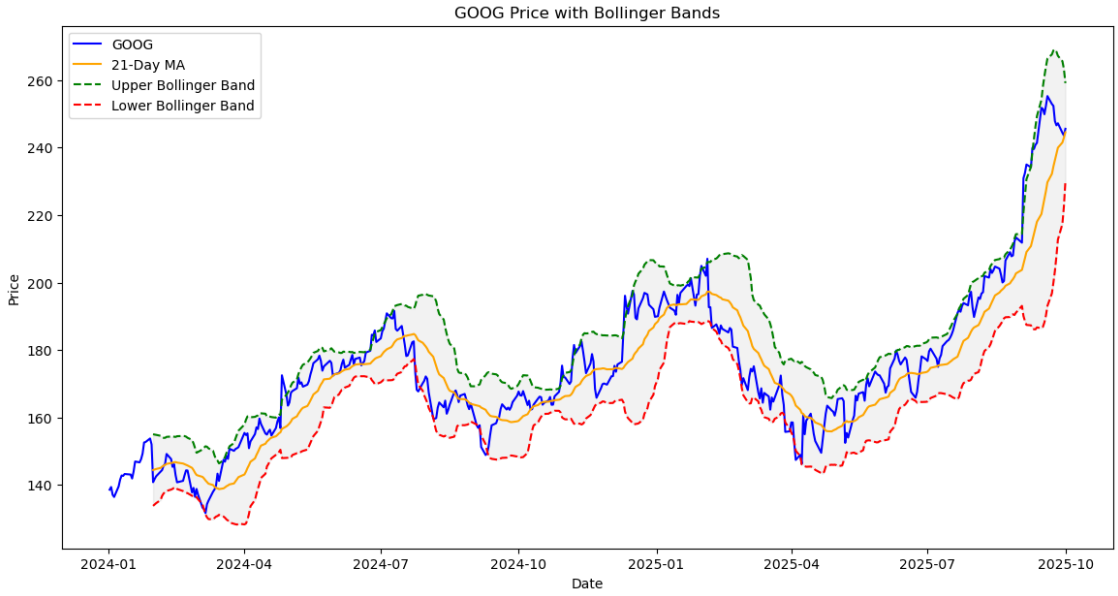

META Price with 21-Day and 63-Day Moving Averages
META
21-Day MA
63-Day MA
Price
Date
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
400
500
600
700
800

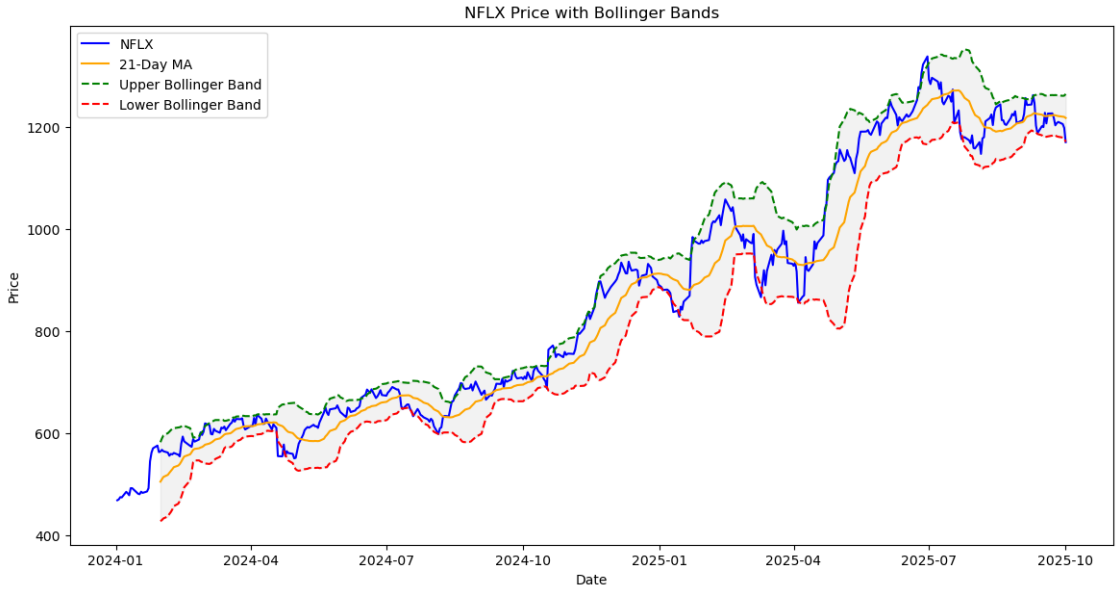


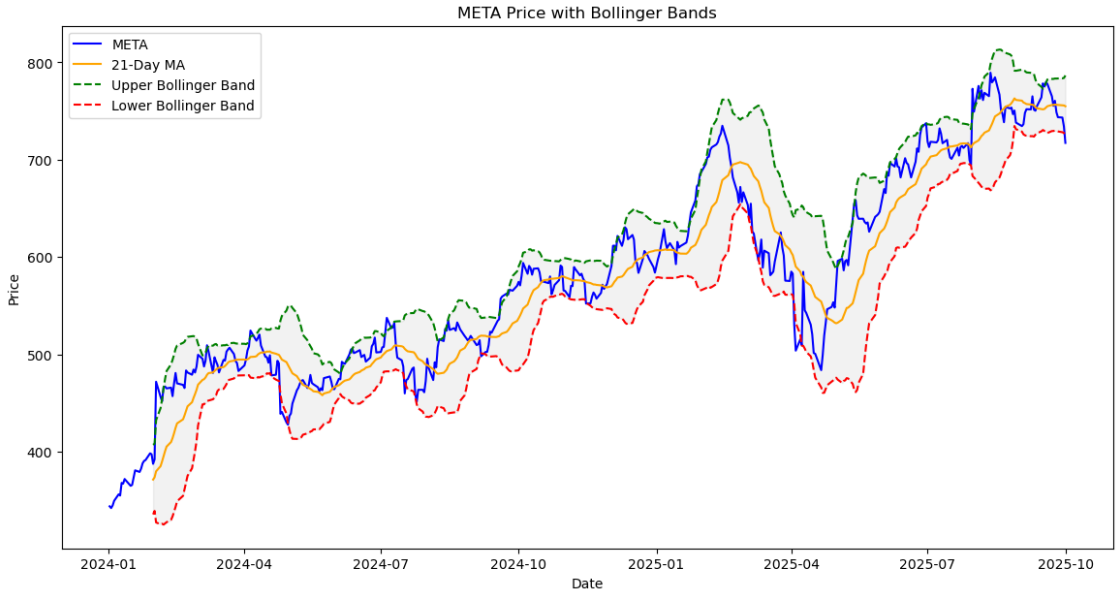
Bollinger Bands - A volatility indicator that consists of a moving average and two standard deviation lines above and below it.

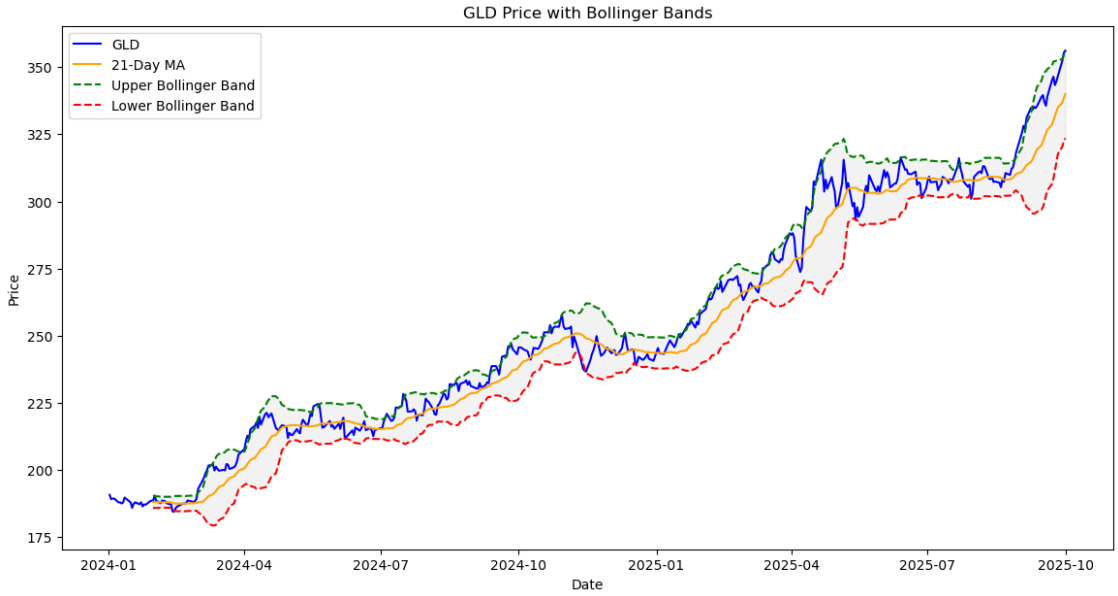
[15]:
```
# The standard deviation in 21 days
std_21 = data.rolling(window=21).std()
upper_band = mo_21 + (std_21 * 2)
lower_band = mo_21 - (std_21 * 2)
for ticker in tickers:
    plt.figure(figsize=(14, 7))
    plt.plot(data.index, data[ticker], label=ticker, color='blue')
    plt.plot(mo_21.index, mo_21[ticker], label='21-Day MA', color='orange')
    plt.plot(upper_band.index, upper_band[ticker], label='Upper Bollinger␣
 ↪Band', color='green', linestyle='--')
    plt.plot(lower_band.index, lower_band[ticker], label='Lower Bollinger␣
 ↪Band', color='red', linestyle='--')
    plt.fill_between(data.index, lower_band[ticker], upper_band[ticker],␣
 ↪color='grey', alpha=0.1)
    plt.title(f'{ticker} Price with Bollinger Bands')
    plt.xlabel('Date')
    plt.ylabel('Price')
    plt.legend()
    plt.show()
```


AMZN Price with Bollinger Bands
AMZN
21-Day MA
Upper Bollinger Band
Lower Bollinger Band
Price
Date
140
160
180
200
220
240
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10


GOOG Price with Bollinger Bands
GOOG
21-Day MA
Upper Bollinger Band
Lower Bollinger Band
Price
Date
140
160
180
200
220
240
260
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

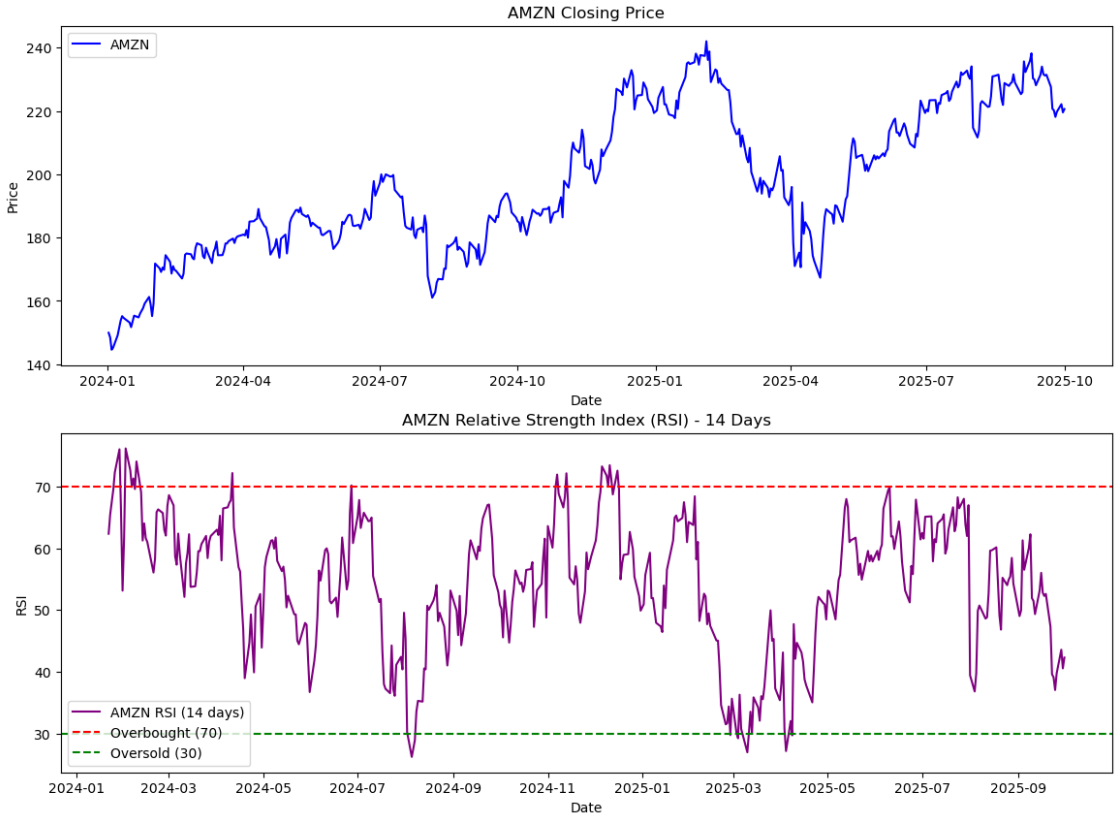

NFLX Price with Bollinger Bands
NFLX
21-Day MA
Upper Bollinger Band
Lower Bollinger Band
Price
Date
400
600
800
1000
1200
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

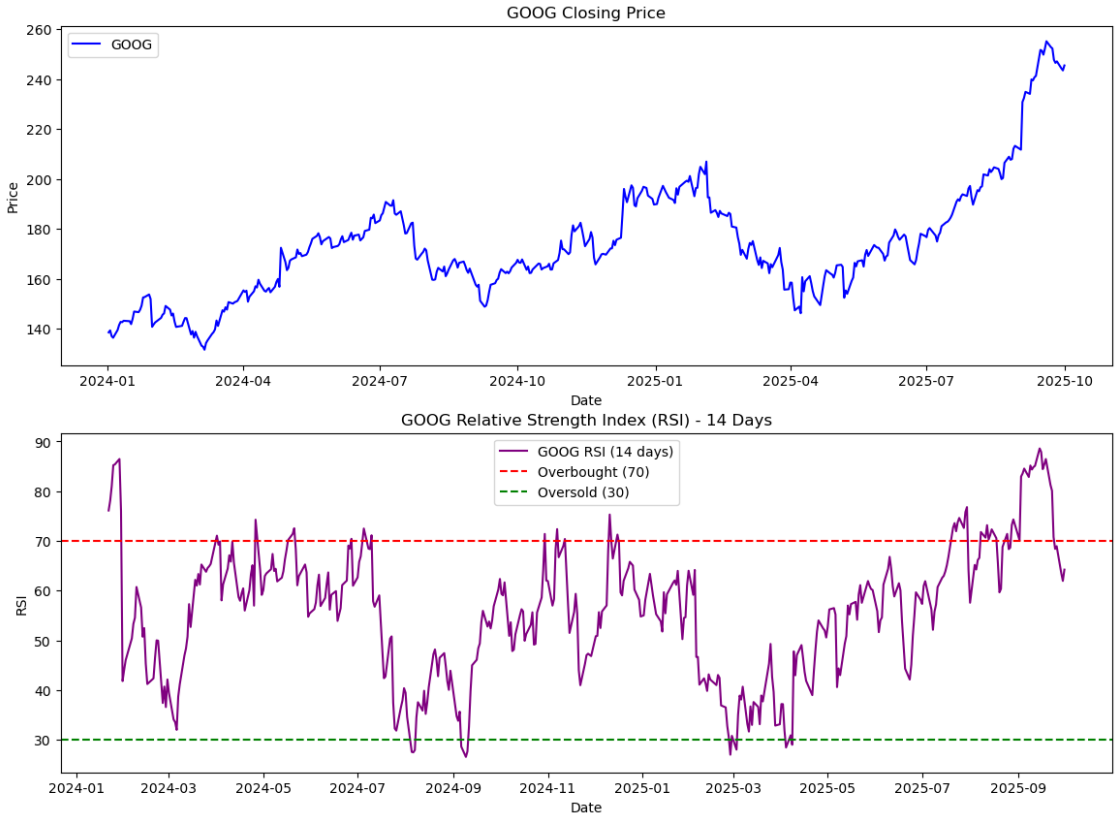

META Price with Bollinger Bands
META
21-Day MA
Upper Bollinger Band
Lower Bollinger Band
Price
Date
400
500
600
700
800
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

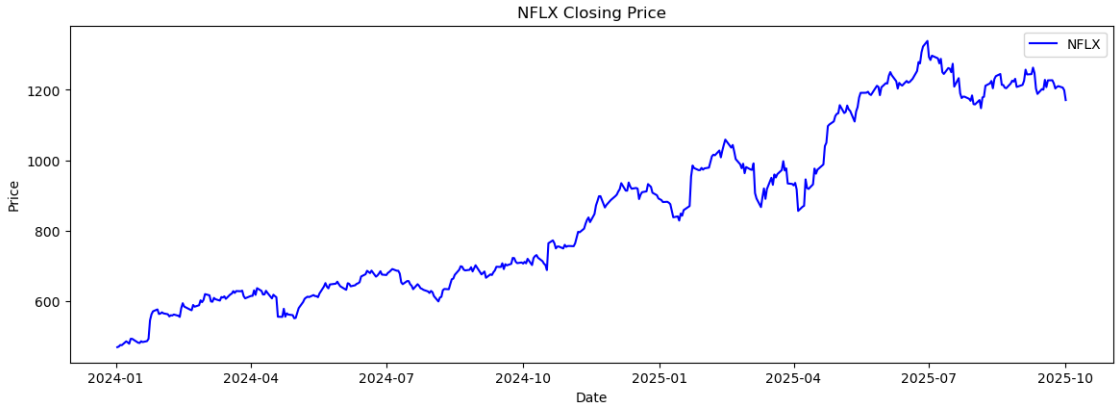


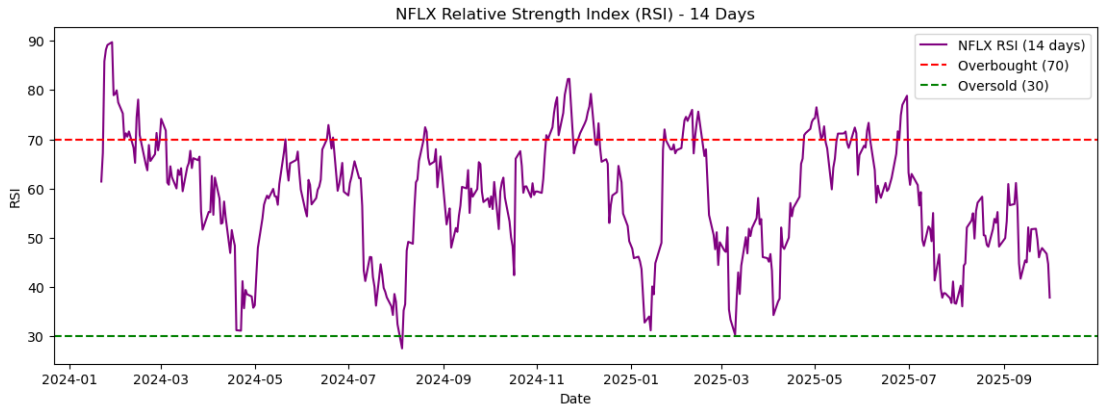
RSI (Relative Strength Index) - A momentum oscillator that measures the speed and change of price movements, typically used to identify overbought or oversold conditions.

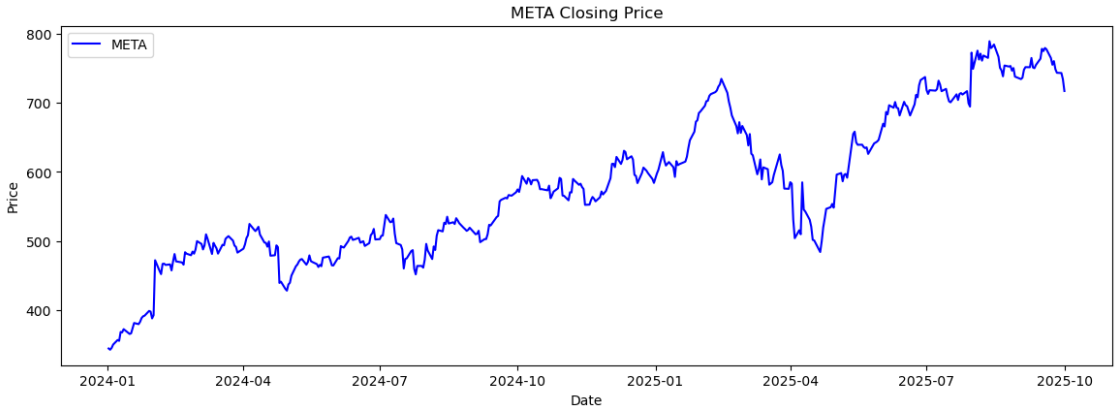
[16]:
```
# Momentum (RSI) for 14 days for each ticker
momentum_14 = pd.DataFrame({ticker: ta.momentum.rsi(data[ticker], window=14)␣
 ↪for ticker in data.columns})
momentum_14.dropna()
# Plot RSI for each ticker
for ticker in tickers:
    fig, ax = plt.subplots(2,1, figsize=(14, 10))
    plt.subplot(2,1,1)
    plt.plot(data.index, data[ticker], label=ticker, color='blue')
    plt.title(f'{ticker} Closing Price')
    plt.xlabel('Date')
    plt.ylabel('Price')
    plt.legend()
    plt.subplot(2,1,2)
    plt.plot(momentum_14.index, momentum_14[ticker], label=f'{ticker} RSI (14␣
 ↪days)', color='purple')
    plt.axhline(70, color='red', linestyle='--', label='Overbought (70)')
    plt.axhline(30, color='green', linestyle='--', label='Oversold (30)')
    plt.title(f'{ticker} Relative Strength Index (RSI) - 14 Days')
    plt.xlabel('Date')
    plt.ylabel('RSI')
    plt.legend()
    plt.show()
```

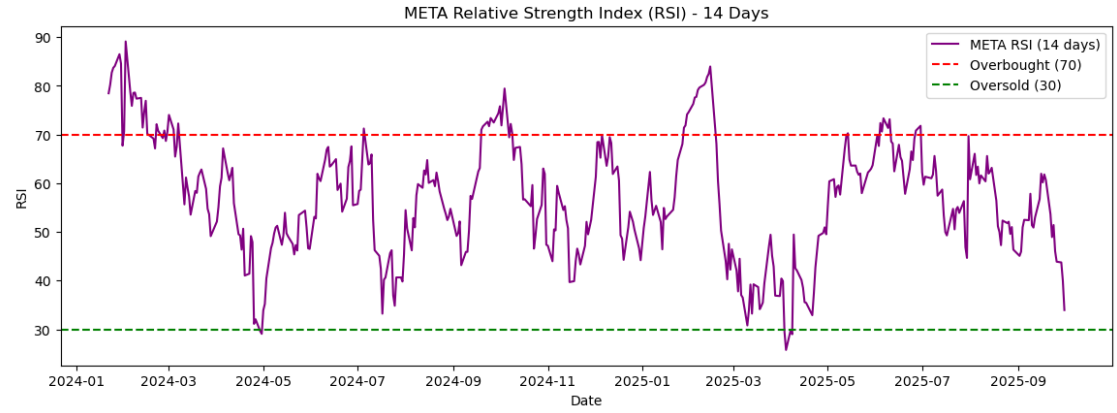

AMZN Closing Price
AMZN
Price
Date
AMZN Relative Strength Index (RSI) - 14 Days
AMZN RSI (14 days)
Overbought (70)
Oversold (30)
RSI
Date

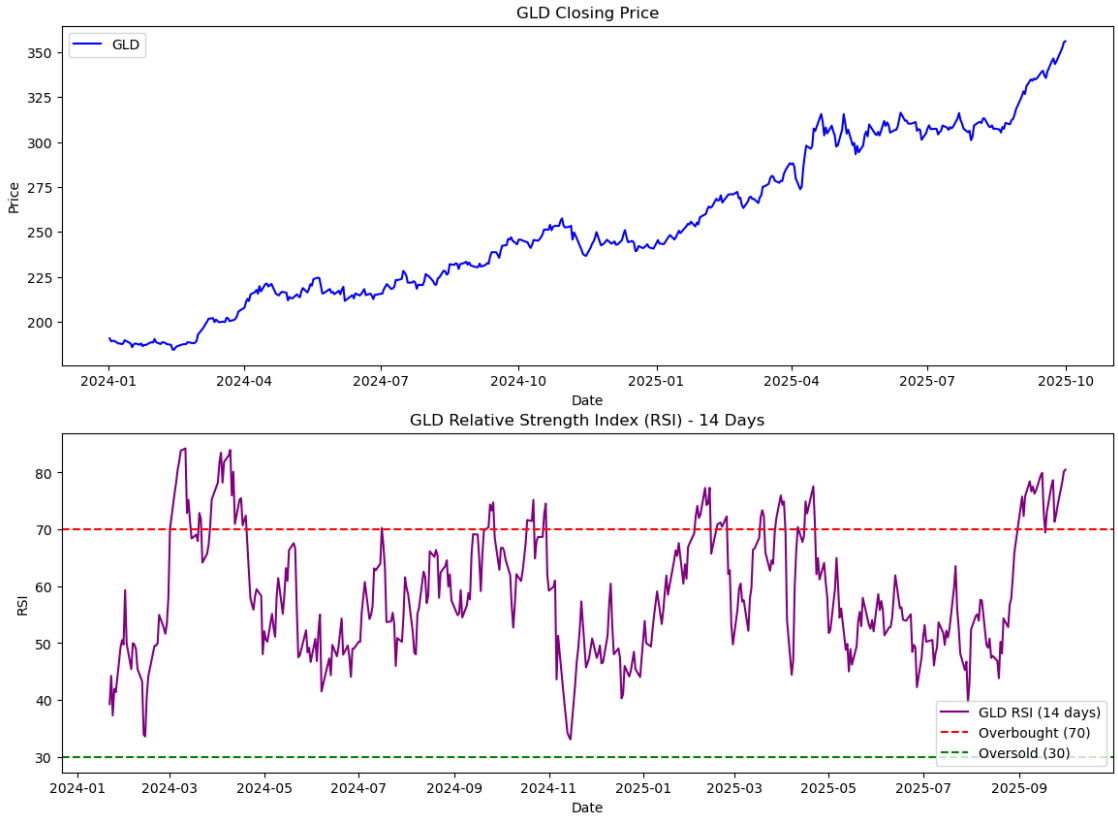

GOOG Closing Price
GOOG
Price
Date
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
GOOG Relative Strength Index (RSI) - 14 Days
GOOG RSI (14 days)
Overbought (70)
Oversold (30)
RSI
Date
2024-01
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09


NFLX Closing Price
NFLX
Price
Date
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
600
800
1000
1200


NFLX Relative Strength Index (RSI) - 14 Days
NFLX RSI (14 days)
Overbought (70)
Oversold (30)
RSI
Date
2024-01
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09
30
40
50
60
70
80
90

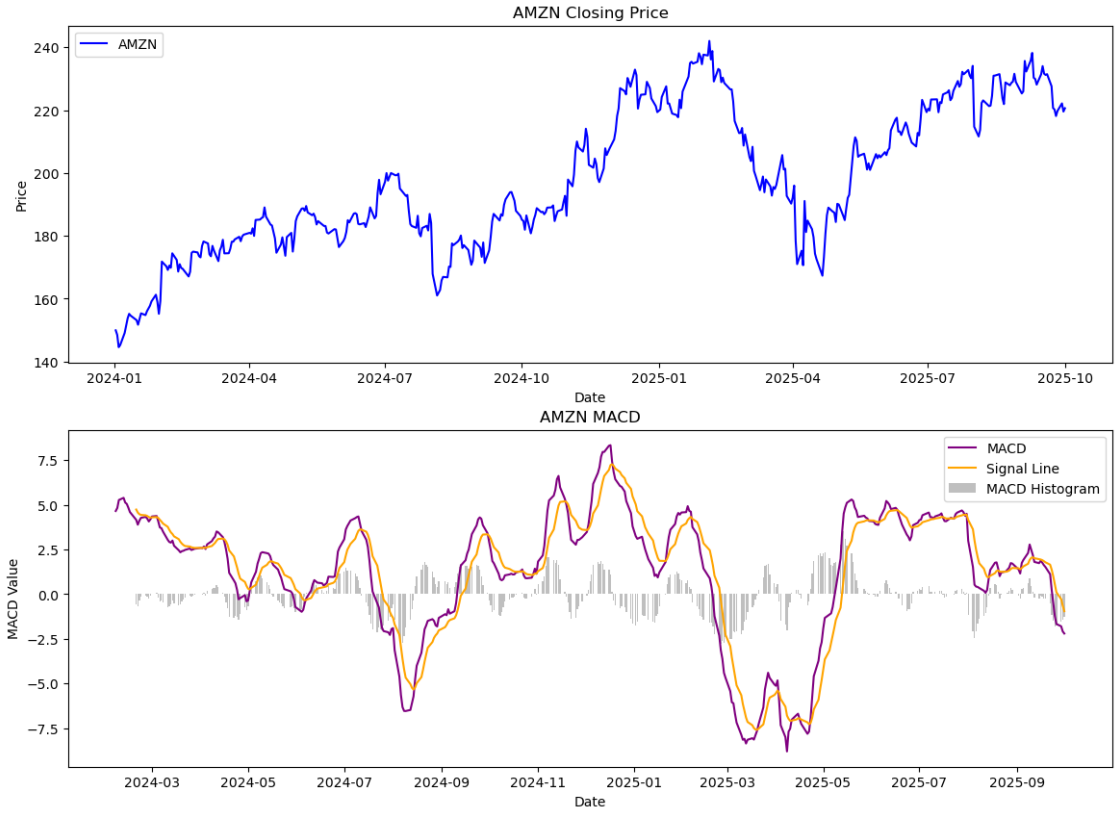

META Closing Price
META
Price
800
700
600
500
400
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
Date

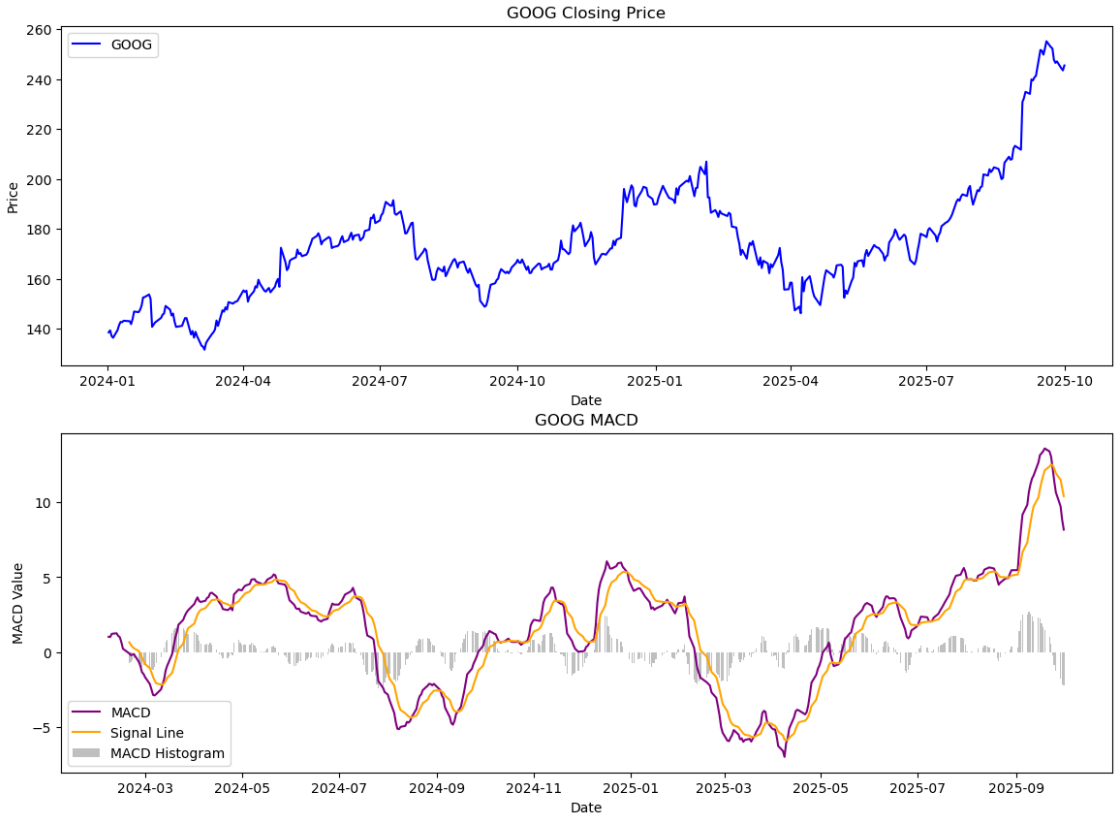

META Relative Strength Index (RSI) - 14 Days
META RSI (14 days)
Overbought (70)
Oversold (30)
RSI
90
80
70
60
50
40
30
2024-01
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09
Date

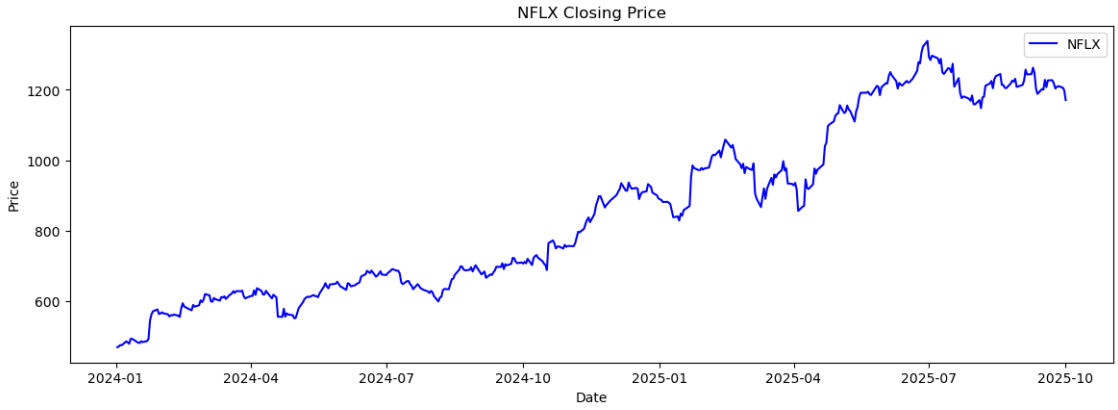


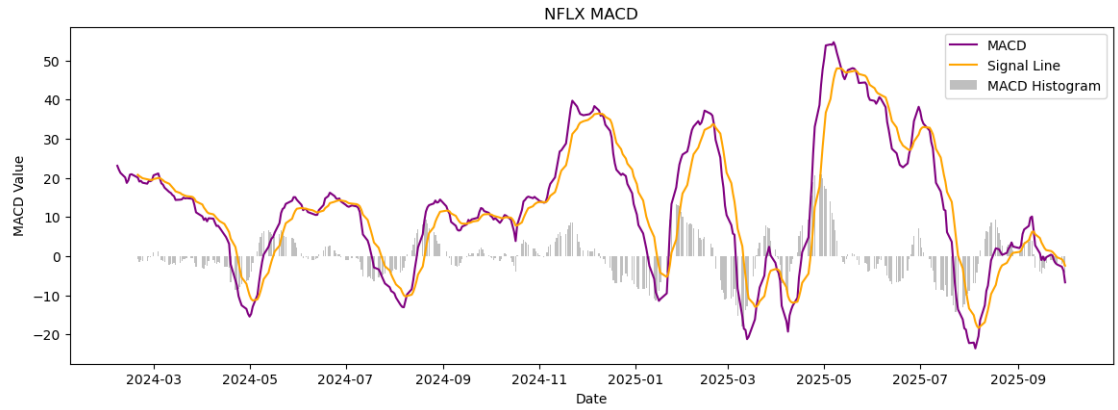
[17]:
```
# MACD for each ticker
macd = pd.DataFrame({ticker: ta.trend.macd(data[ticker]) for ticker in data.
 ↪columns})
macd_signal = pd.DataFrame({ticker: ta.trend.macd_signal(data[ticker]) for␣
 ↪ticker in data.columns})
macd_diff = pd.DataFrame({ticker: ta.trend.macd_diff(data[ticker]) for ticker␣
 ↪in data.columns})
# Plot MACD for each ticker
for ticker in tickers:
    fig, ax = plt.subplots(2,1, figsize=(14, 10))
    plt.subplot(2,1,1)
    plt.plot(data.index, data[ticker], label=ticker, color='blue')
    plt.title(f'{ticker} Closing Price')
    plt.xlabel('Date')
    plt.ylabel('Price')
    plt.legend()
    plt.subplot(2,1,2)
    plt.plot(macd.index, macd[ticker], label='MACD', color='purple')
    plt.plot(macd_signal.index, macd_signal[ticker], label='Signal Line',␣
 ↪color='orange')
```

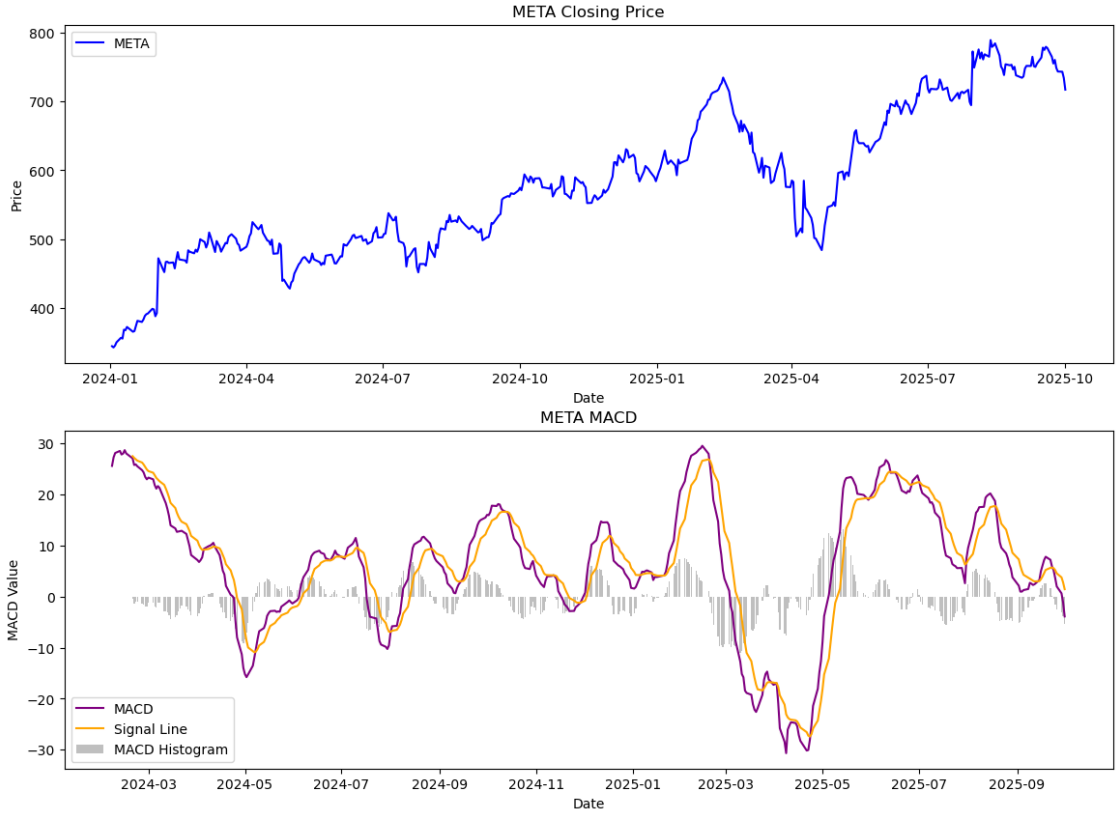
```
    plt.bar(macd_diff.index, macd_diff[ticker], label='MACD Histogram',␣
↪color='grey', alpha=0.5)
    plt.title(f'{ticker} MACD')
    plt.xlabel('Date')
    plt.ylabel('MACD Value')
    plt.legend()
    plt.show()
```

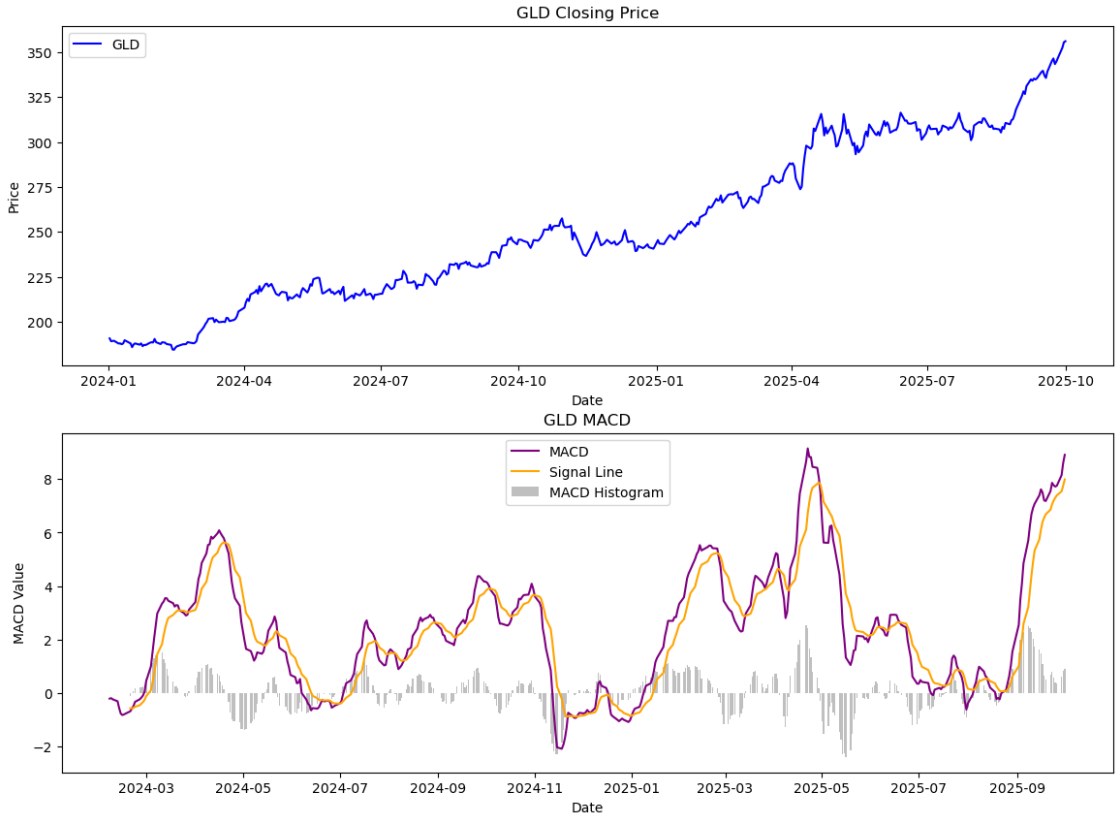



GOOG Closing Price
GOOG
Price
260
240
220
200
180
160
140
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
Date
GOOG MACD
MACD Value
10
5
0
−5
MACD
Signal Line
MACD Histogram
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09
Date


NFLX Closing Price
NFLX
Price
1200
1000
800
600
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
Date


NFLX MACD
MACD
Signal Line
MACD Histogram
MACD Value
50
40
30
20
10
0
−10
−20
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09
Date

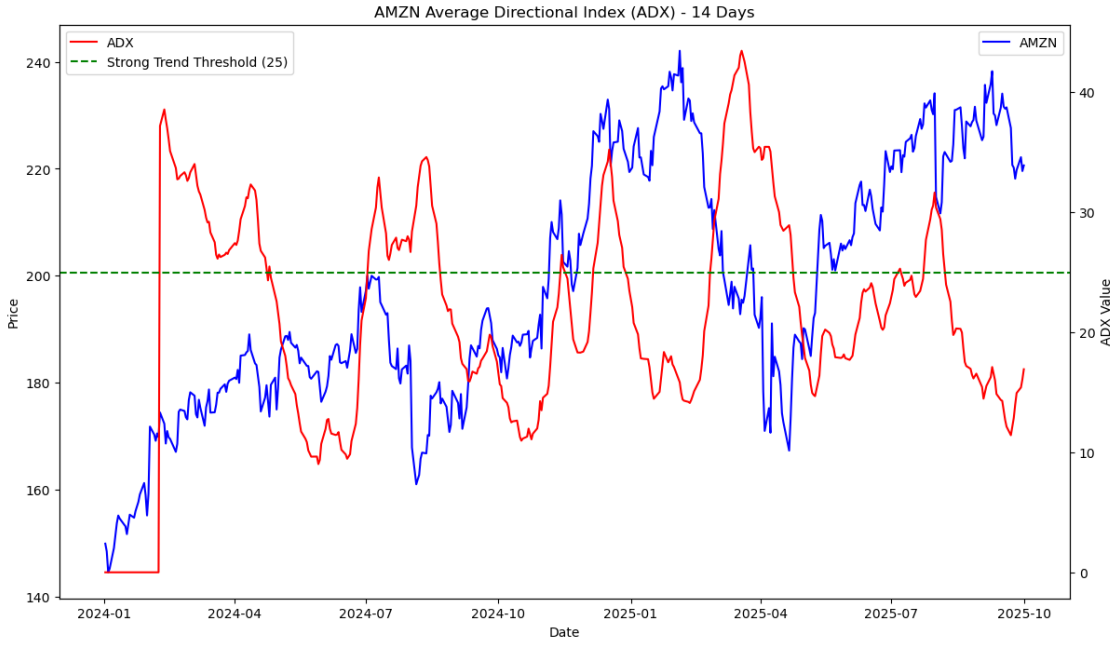

META Closing Price
META
Price
800
700
600
500
400
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10
Date
META MACD
MACD Value
30
20
10
0
−10
−20
−30
MACD
Signal Line
MACD Histogram
2024-03
2024-05
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09
Date

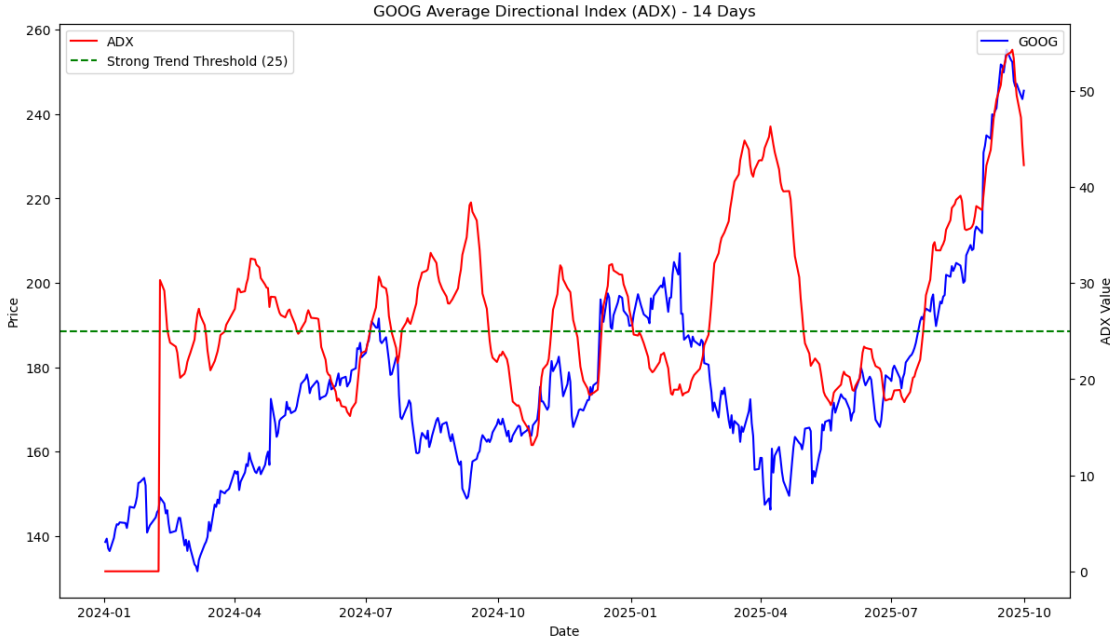


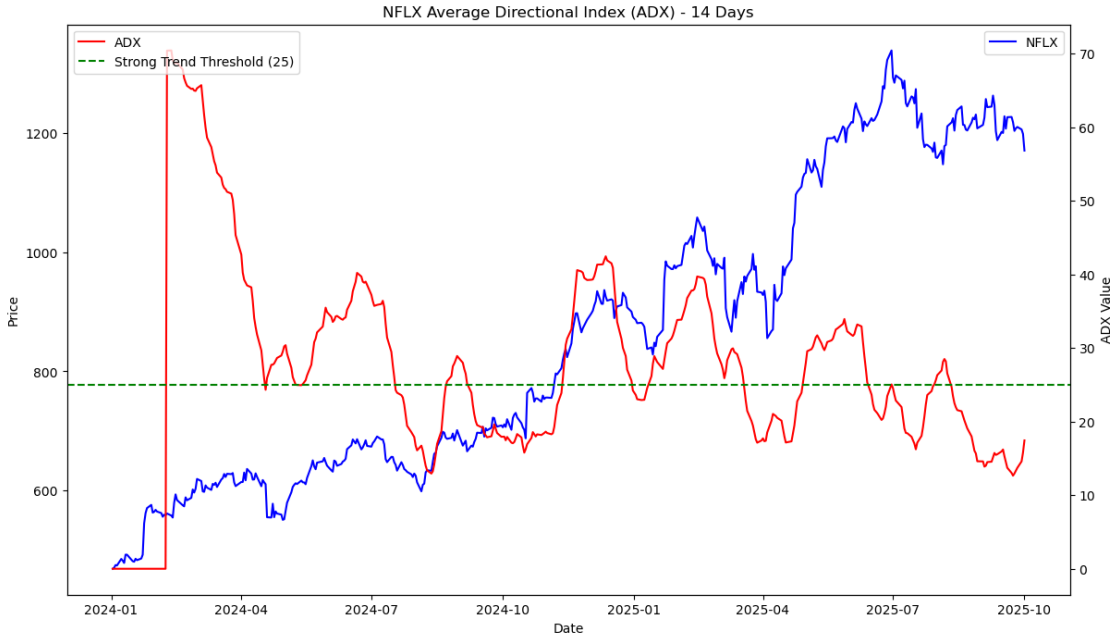
[22]:
```
# Download OHLC data for ADX calculation
ohlc_data = yf.download(tickers, start=start, end=end,␣
 ↪auto_adjust=True)[['High', 'Low', 'Close']]

# Calculate ADX for each ticker
adx = pd.DataFrame({
    ticker: ta.trend.adx(
        ohlc_data['High'][ticker],
        ohlc_data['Low'][ticker],
        ohlc_data['Close'][ticker],
        window=14
    )
    for ticker in tickers
})

# Plot ADX for each ticker
for ticker in tickers:
    fig, ax1 = plt.subplots(figsize=(14, 8))
    ax1.plot(data.index, data[ticker], label=ticker, color='blue')
    ax1.set_xlabel('Date')
    ax1.set_ylabel('Price')
```

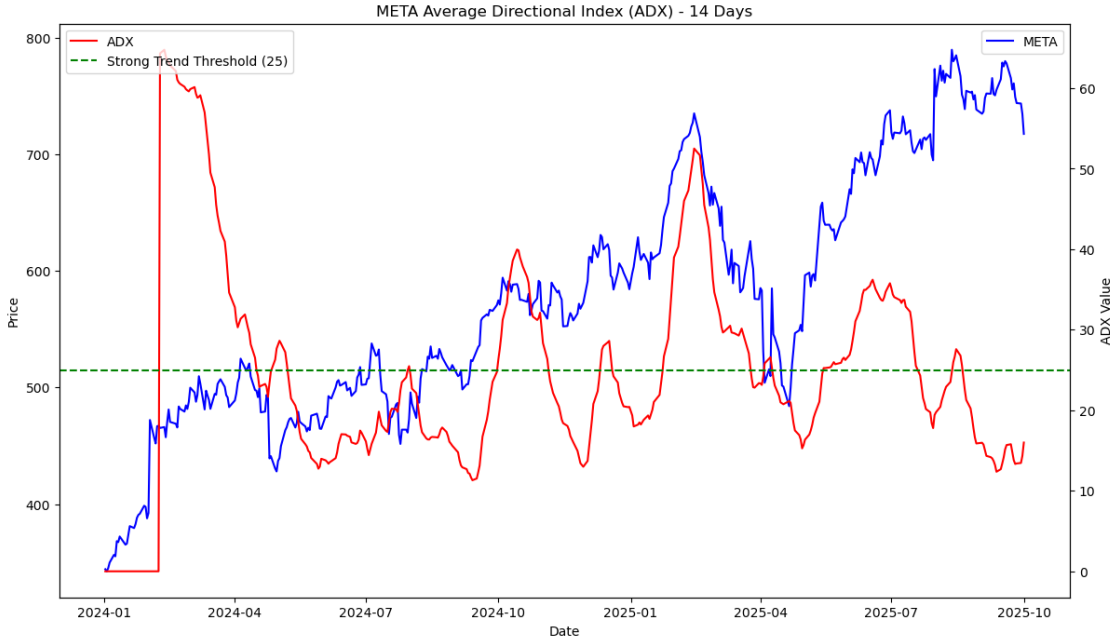
```
    #ax1.set_title(f'{ticker} Closing Price')
    ax1.legend(loc='upper right')

    ax2 = ax1.twinx()
    ax2.plot(adx.index, adx[ticker], label='ADX', color='red')
    ax2.axhline(25, color='green', linestyle='--', label='Strong Trend␣
↪Threshold (25)')
    ax2.set_ylabel('ADX Value')
    ax2.set_title(f'{ticker} Average Directional Index (ADX) - 14 Days')
    ax2.legend(loc='upper left')

    plt.show()
```

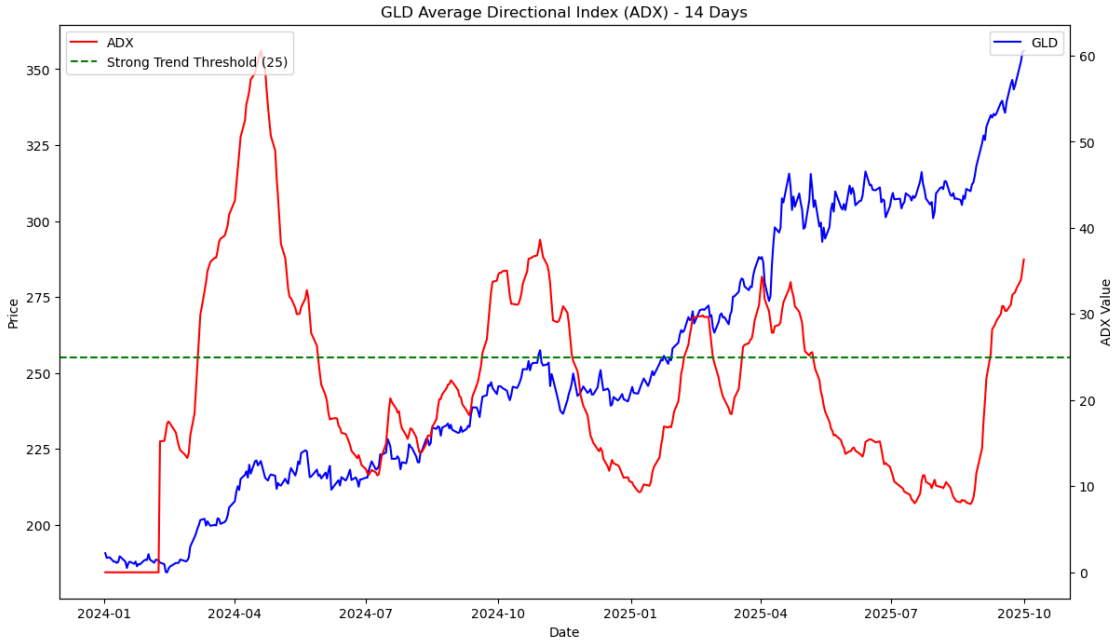
```
[**********************100%**********************]  5 of 5 completed
```




GOOG Average Directional Index (ADX) - 14 Days
ADX
Strong Trend Threshold (25)
GOOG
Price
ADX Value
Date
260
240
220
200
180
160
140
50
40
30
20
10
0
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

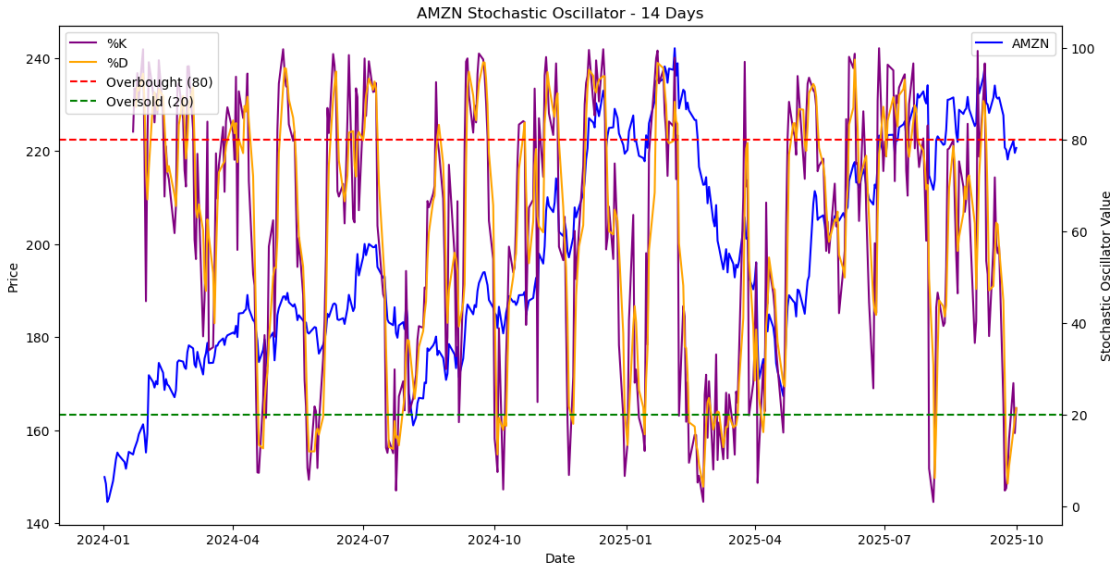

NFLX Average Directional Index (ADX) - 14 Days
ADX
Strong Trend Threshold (25)
NFLX
Price
ADX Value
Date
1200
1000
800
600
70
60
50
40
30
20
10
0
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

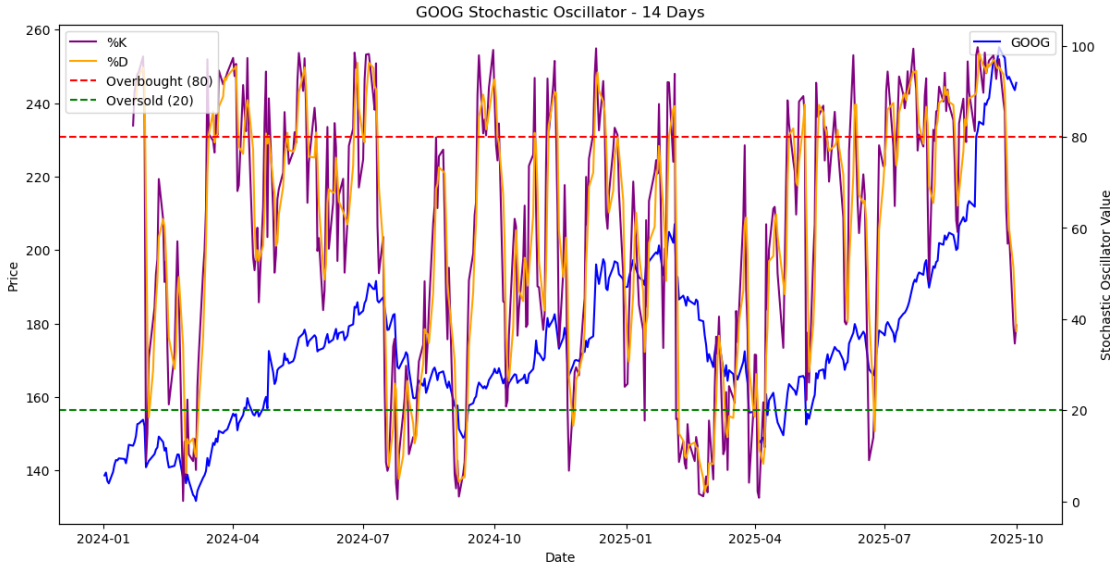


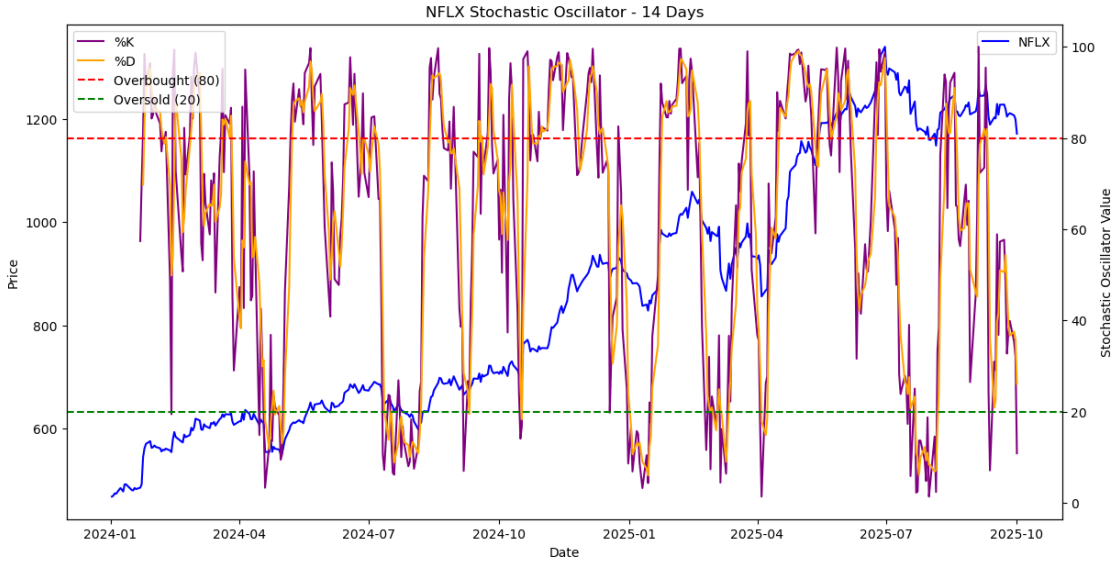


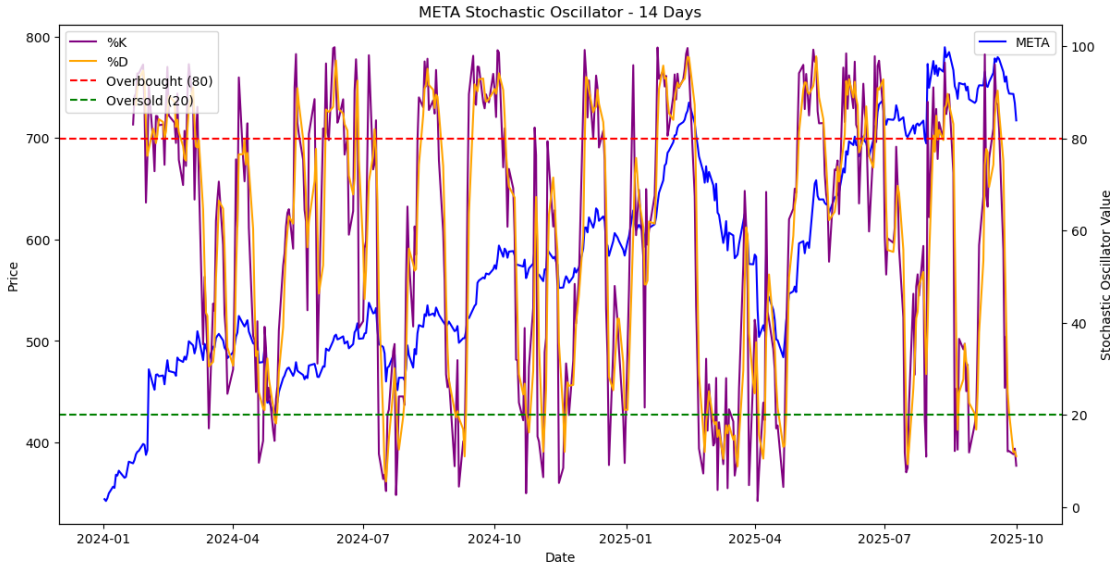
[23]:
```
# Stochastic Oscillator for each ticker
stoch_k = pd.DataFrame({ticker: ta.momentum.stoch(ohlc_data['High'][ticker],␣
 ↪ohlc_data['Low'][ticker], ohlc_data['Close'][ticker], window=14,␣
 ↪smooth_window=3) for ticker in tickers})
```

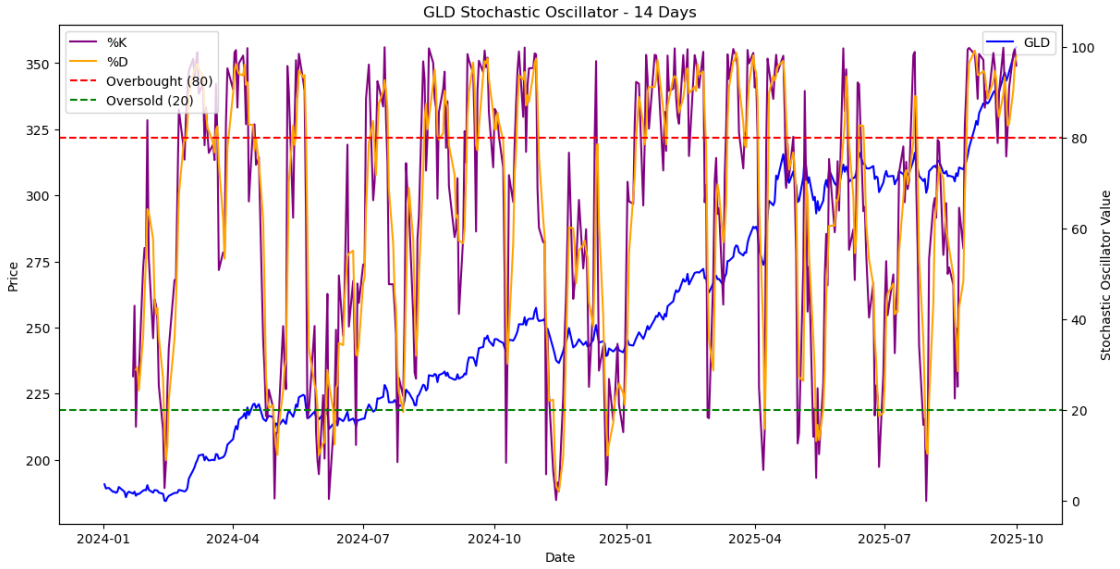
```
stoch_d = pd.DataFrame({ticker: ta.momentum.
 ↪stoch_signal(ohlc_data['High'][ticker], ohlc_data['Low'][ticker],␣
 ↪ohlc_data['Close'][ticker], window=14, smooth_window=3) for ticker in␣
 ↪tickers})
# Plot Stochastic Oscillator for each ticker
for ticker in tickers:
    fig, ax1 = plt.subplots(figsize=(14, 7))
    ax1.plot(data.index, data[ticker], label=ticker, color='blue')
    ax1.set_xlabel('Date')
    ax1.set_ylabel('Price')
    #ax1.set_title(f'{ticker} Closing Price')
    ax1.legend(loc='upper right')

    ax2 = ax1.twinx()
    ax2.plot(stoch_k.index, stoch_k[ticker], label='%K', color='purple')
    ax2.plot(stoch_d.index, stoch_d[ticker], label='%D', color='orange')
    ax2.axhline(80, color='red', linestyle='--', label='Overbought (80)')
    ax2.axhline(20, color='green', linestyle='--', label='Oversold (20)')
    ax2.set_ylabel('Stochastic Oscillator Value')
    ax2.set_title(f'{ticker} Stochastic Oscillator - 14 Days')
    ax2.legend(loc='upper left')

    plt.show()
```




GOOG Stochastic Oscillator - 14 Days
%K
%D
Overbought (80)
Oversold (20)
GOOG
Price
Stochastic Oscillator Value
Date
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10


NFLX Stochastic Oscillator - 14 Days
%K
%D
Overbought (80)
Oversold (20)
NFLX
Price
Stochastic Oscillator Value
Date
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10


META Stochastic Oscillator - 14 Days
%K
%D
Overbought (80)
Oversold (20)
META
Price
Stochastic Oscillator Value
Date
800
700
600
500
400
100
80
60
40
20
0
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10


GLD Stochastic Oscillator - 14 Days
%K
%D
Overbought (80)
Oversold (20)
GLD
Price
Stochastic Oscillator Value
Date
350
325
300
275
250
225
200
100
80
60
40
20
0
2024-01
2024-04
2024-07
2024-10
2025-01
2025-04
2025-07
2025-10

[ ]: