Building Functions

In [1]:
```
def total(list_obj):
    total = 0
    for val in list_obj:
        total += val
    return total

def mean(list_obj):
    n = len(list_obj)
    mean_ = total(list_obj) / n
    return mean_

def median(list_obj):
    n = len(list_obj)
    # sort the values and take the middle value if the
    #    list is of odd length
    # or the mean of the two middle values if the list
    #    of even length
    list_obj = sorted(list_obj)
    if n % 2 != 0:
        # list length is odd
        middle_index = int((n - 1) / 2)
        median_ = list_obj[middle_index]
    else:
        upper_middle_index = int(n / 2)
        lower_middle_index = upper_middle_index - 1
        # pass slice with two middle values to mean()
        median_ = mean(
            list_object[lower_middle_index:upper_middle_index])
    return median_

def mode(list_obj):
    max_count = 0
    counter_dict = {}
    for value in list_obj:
        counter_dict[value] = 0
    for value in list_obj:
        counter_dict[value] += 1
    count_list = list(counter_dict.values())
    max_count = max(count_list)
    mode_ = [key for key in counter_dict if counter_dict[key] == max_count]

    return mode_

def variance(list_obj, sample = False):
    # popvar(list) = sum((xi - list_mean)**2) / n for all xi in list
    # save mean value of list
    list_mean = mean(list_obj)
    # use n to calculate average of sum squared diffs
    n = len(list_obj)
    # create value we can add squared diffs to
    sum_sq_diff = 0
    for val in list_obj:
        # adds each squared diff to sum_sq_diff
        sum_sq_diff += (val - list_mean) ** 2
    if sample == False:
        # normalize result by dividing by n
```

```
        variance_ = sum_sq_diff / n
    else:
        # for samples, normalize by dividing by (n-1)
        variance_ = sum_sq_diff / (n - 1)

    return variance_

def SD(list_obj, sample = False):
    # Standard deviation is the square root of variance
    SD_ = variance(list_obj, sample) ** (1/2)

    return SD_

def covariance(list_obj1, list_obj2, sample = False):
    # determine the mean of each list
    mean1 = mean(list_obj1)
    mean2 = mean(list_obj2)
    # instantiate a variable holding the value of 0; this will be used to
    # sum the values generated in the for loop below
    cov = 0
    n1 = len(list_obj1)
    n2 = len(list_obj2)
    # check list lengths are equal
    if n1 == n2:
        n = n1
        # sum the product of the differences
        for i in range(n1):
            cov += (list_obj1[i] - mean1) * (list_obj2[i] - mean2)
        if sample == False:
            cov = cov / n
        # account for sample by dividing by one less than number of elements in l
        else:
            cov = cov / (n - 1)
        # return covariance
        return cov
    else:
        print("List lengths are not equal")
        print("List1:", n1)
        print("List2:", n2)


def correlation(list_obj1, list_obj2):
    # corr(x,y) = cov(x, y) / (SD(x) * SD(y))
    cov = covariance(list_obj1, list_obj2)
    SD1 = SD(list_obj1)
    SD2 = SD(list_obj2)
    corr = cov / (SD1 * SD2)
    return corr

def skewness(list_obj, sample = False):
    mean_ = mean(list_obj)
    SD_ = SD(list_obj, sample)
    skew = 0
    n = len(list_obj)
    for val in list_obj:
        skew += (val - mean_) ** 3
    skew = skew / (n * SD_ **3) if not sample else n * skew / ((n - 1)*(n - 2) *
```

```
    return skew

def kurtosis(list_obj, sample = False):
    mean_ = mean(list_obj)
    kurt = 0
    SD_ = SD(list_obj, sample)
    n = len(list_obj)
    for val in list_obj:
        kurt += (val - mean_) ** 4
    kurt = kurt / (n * SD_ ** 4) if sample == False else  n * (n + 1) * kurt / \
    ( (n - 1) * (n - 2) *(n - 3) * (SD_ ** 4)) - (3 *(n - 1) ** 2) / ((n - 2) * (

    return kurt
```

In [2]:

```
lst = [4,5,6,7,8,9,4]

print("total:", total(lst))
print("mean:", mean(lst))
print("median:", median(lst))
print("mode:", mode(lst))
print("variance:", variance(lst, sample = False))
print("variance (sample):", variance(lst, sample = True))
print("SD:", SD(lst, sample = False))
print("SD: (sample):", SD(lst, sample = True))

lst2 = [5,23,7,5,3,2,1]
print("Covariance:", covariance(lst, lst2, sample = False))
print("Covariance (sample):", covariance(lst, lst2, sample = True))
print("Correlation:", correlation(lst, lst2))
print("Skewness:", skewness(lst, sample = False))
print("Skewness (sample):", skewness(lst, sample = True))
print("Kurtosis:", kurtosis(lst, sample = False))
print("Kurtosis (sample):", kurtosis(lst, sample = True))
```

```
total: 43
mean: 6.142857142857143
median: 6
mode: [4]
variance: 3.265306122448979
variance (sample): 3.809523809523809
SD: 1.8070158058105024
SD: (sample): 1.9518001458970662
Covariance: -3.510204081632653
Covariance (sample): -4.095238095238095
Correlation: -0.2788447874269649
Skewness: 0.22234764798058862
Skewness (sample): 0.288195490292613
Kurtosis: 1.6473437499999997
Kurtosis (sample): -1.4463750000000002
```

Create a function that generates a datastructure with statistics for each column of data

In [3]:

```
import pandas as pd
def gather_statistics(df, sample = True):
    # create a dictionary of dictionaries with an
    #  entry for each column of data in a dataframe, df
    dct = {key:{} for key in df}
    # call each column of data and its name (key)
    # df.items() makes a list of tuples where
    #  tuple index 0 refers to the key,
    #   index 1 refers to object pointed to by key
    for key, val in df.items():
        # inplace = True alters the object itself
        val.dropna(axis=0, inplace =True)
        dct[key]["mean"] = round(mean(val), 3)
        dct[key]["median"] = round(median(val), 3)
        dct[key]["variance"] = round(variance(val, sample), 3)
        dct[key]["S.D."] = round(SD(val, sample), 3)
        dct[key]["skewness"] = round(skewness(val, sample), 3)
        dct[key]["kurtosis"] = round(kurtosis(val, sample), 3)

    stats_df = pd.DataFrame(dct)
    return stats_df
```

In [4]:

```
!pip install pandas-datareader
```

```
Collecting pandas-datareader
  Downloading pandas_datareader-0.10.0-py3-none-any.whl (109 kB)
Requirement already satisfied: pandas>=0.23 in c:\users\proma.gupta\anaconda3\l
ib\site-packages (from pandas-datareader) (1.2.4)
Requirement already satisfied: lxml in c:\users\proma.gupta\anaconda3\lib\site-
packages (from pandas-datareader) (4.6.3)
Requirement already satisfied: requests>=2.19.0 in c:\users\proma.gupta\anacond
a3\lib\site-packages (from pandas-datareader) (2.25.1)
Requirement already satisfied: python-dateutil>=2.7.3 in c:\users\proma.gupta\a
naconda3\lib\site-packages (from pandas>=0.23->pandas-datareader) (2.8.1)
Requirement already satisfied: numpy>=1.16.5 in c:\users\proma.gupta\anaconda3
\lib\site-packages (from pandas>=0.23->pandas-datareader) (1.20.1)
Requirement already satisfied: pytz>=2017.3 in c:\users\proma.gupta\anaconda3\l
ib\site-packages (from pandas>=0.23->pandas-datareader) (2021.1)
Requirement already satisfied: six>=1.5 in c:\users\proma.gupta\anaconda3\lib\s
ite-packages (from python-dateutil>=2.7.3->pandas>=0.23->pandas-datareader) (1.
15.0)
Requirement already satisfied: chardet<5,>=3.0.2 in c:\users\proma.gupta\anacon
da3\lib\site-packages (from requests>=2.19.0->pandas-datareader) (4.0.0)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\proma.gupta\an
aconda3\lib\site-packages (from requests>=2.19.0->pandas-datareader) (1.26.4)
Requirement already satisfied: idna<3,>=2.5 in c:\users\proma.gupta\anaconda3\l
ib\site-packages (from requests>=2.19.0->pandas-datareader) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\proma.gupta\anaco
nda3\lib\site-packages (from requests>=2.19.0->pandas-datareader) (2020.12.5)
Installing collected packages: pandas-datareader
Successfully installed pandas-datareader-0.10.0
```

In [5]:

```
import pandas_datareader.data as web
import datetime

start = datetime.datetime(2012, 1, 1)
end = datetime.datetime.today()

print(start, end)
```

```
2012-01-01 00:00:00 2021-09-29 08:56:00.589282
```

In [6]:

```
data_dict = {}
stocks = ["MSFT", "AAPL", "FB", "TSLA"]
for key in stocks:
    data_dict[key] = web.DataReader(key, "yahoo", start, end)
    data_dict[key].style.set_caption(key)
```

In [7]:

```
print(key +" Closing Price")
data_dict[key]
```

```
TSLA Closing Price
```

Out[7]:

	High	Low	Open	Close	Volume	Adj Close
Date						
2012-01-03	5.900000	5.530000	5.788000	5.616000	4640500.0	5.616000
2012-01-04	5.734000	5.500000	5.642000	5.542000	3150500.0	5.542000
2012-01-05	5.586000	5.370000	5.552000	5.424000	5027500.0	5.424000
2012-01-06	5.558000	5.282000	5.440000	5.382000	4931500.0	5.382000
2012-01-09	5.498000	5.224000	5.400000	5.450000	4485000.0	5.450000
...	...	...	...	...	...	...
2021-09-23	758.200012	747.919983	755.000000	753.640015	11947500.0	753.640015
2021-09-24	774.799988	744.559998	745.890015	774.390015	21336900.0	774.390015
2021-09-27	799.000000	769.309998	773.119995	791.359985	28070700.0	791.359985
2021-09-28	795.640015	766.179993	787.200012	777.559998	25341800.0	777.559998
2021-09-29	790.459229	779.099976	779.799988	790.380005	2958894.0	790.380005

2452 rows × 6 columns

In [8]:

```
data_dict.keys()
```

Out[8]:

```
dict_keys(['MSFT', 'AAPL', 'FB', 'TSLA'])
```

In [9]:

```
data_dict.values()
```

```
2021-09-23  147.080002  145.639999  146.649994  146.830002   64838200.0
2021-09-24  147.470001  145.559998  145.660004  146.919998   53434200.0
2021-09-27  145.960007  143.820007  145.470001  145.369995   74150700.0
2021-09-28  144.750000  141.690002  143.250000  141.910004  108842900.0
2021-09-29  144.259995  142.029999  142.470001  143.990005   13158384.0

             Adj Close
Date
2012-01-03   12.610315
2012-01-04   12.678085
2012-01-05   12.818838
2012-01-06   12.952841
2012-01-09   12.932299
...                ...
2021-09-23  146.830002
2021-09-24  146.919998
2021-09-27  145.369995
2021-09-28  141.910004
2021-09-29  143.990005
```

In [10]:
```
for val in data_dict.values():
    print(val["Close"])
```

```
Date
2012-01-03     26.770000
2012-01-04     27.400000
2012-01-05     27.680000
2012-01-06     28.110001
2012-01-09     27.740000
                 ...
2021-09-23    299.559998
2021-09-24    299.350006
2021-09-27    294.170013
2021-09-28    283.519989
2021-09-29    286.040009
Name: Close, Length: 2452, dtype: float64
Date
2012-01-03     14.686786
2012-01-04     14.765714
2012-01-05     14.929643
2012-01-06     15.085714
2012-01-09     15.061786
                 ...
2021-09-23    146.830002
2021-09-24    146.919998
2021-09-27    145.369995
2021-09-28    141.910004
2021-09-29    143.990005
Name: Close, Length: 2452, dtype: float64
Date
2012-05-18     38.230000
2012-05-21     34.029999
2012-05-22     31.000000
2012-05-23     32.000000
2012-05-24     33.029999
                 ...
2021-09-23    345.959991
2021-09-24    352.959991
2021-09-27    353.579987
2021-09-28    340.649994
2021-09-29    342.920013
Name: Close, Length: 2357, dtype: float64
Date
2012-01-03      5.616000
2012-01-04      5.542000
2012-01-05      5.424000
2012-01-06      5.382000
2012-01-09      5.450000
                 ...
2021-09-23    753.640015
2021-09-24    774.390015
2021-09-27    791.359985
2021-09-28    777.559998
2021-09-29    790.380005
Name: Close, Length: 2452, dtype: float64
```

In [11]:
```
close_data = pd.concat((df["Close"] for df in data_dict.values()),
                       keys = data_dict.keys(),
                        axis = 1)
close_data
```

Out[11]:

	MSFT	AAPL	FB	TSLA
Date				
2012-01-03	26.770000	14.686786	NaN	5.616000
2012-01-04	27.400000	14.765714	NaN	5.542000
2012-01-05	27.680000	14.929643	NaN	5.424000
2012-01-06	28.110001	15.085714	NaN	5.382000
2012-01-09	27.740000	15.061786	NaN	5.450000
...	...	...	...	...
2021-09-23	299.559998	146.830002	345.959991	753.640015
2021-09-24	299.350006	146.919998	352.959991	774.390015
2021-09-27	294.170013	145.369995	353.579987	791.359985
2021-09-28	283.519989	141.910004	340.649994	777.559998
2021-09-29	286.040009	143.990005	342.920013	790.380005

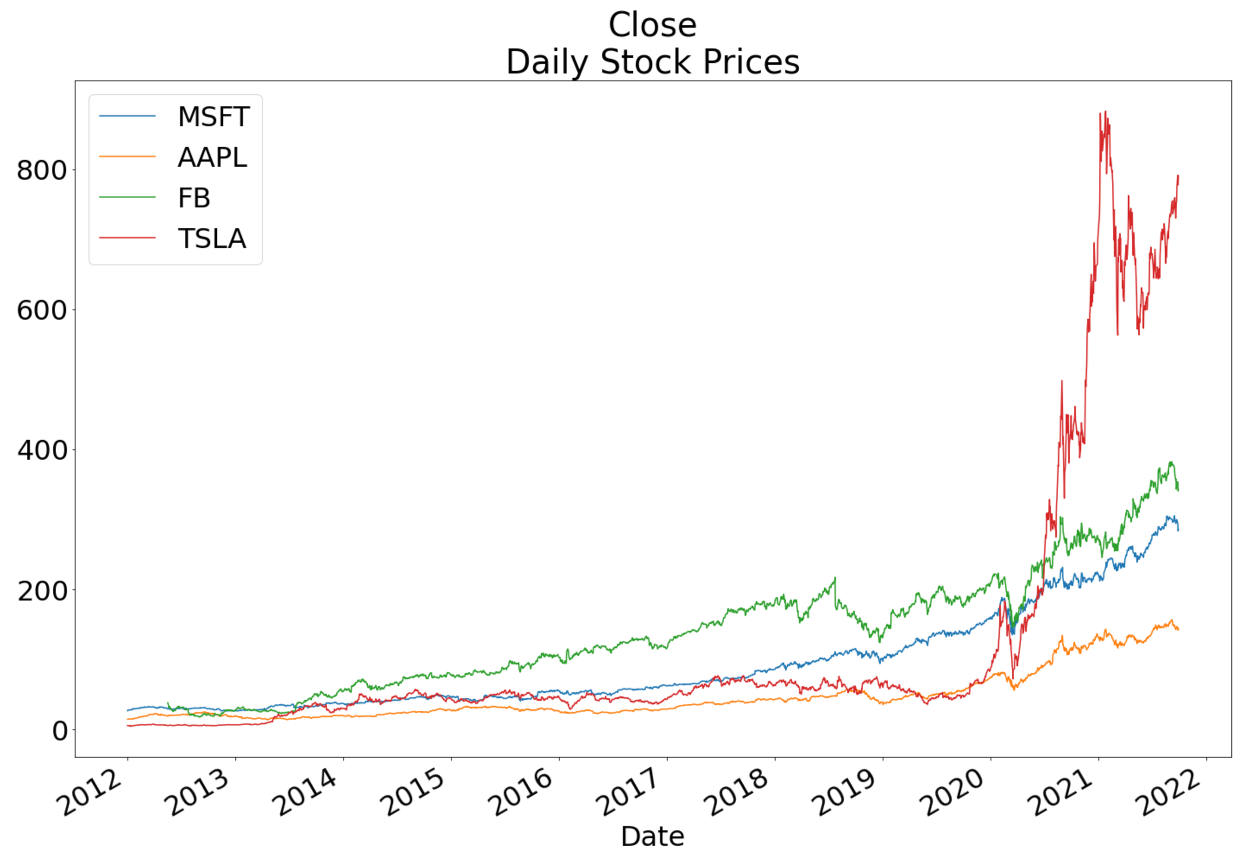
2452 rows × 4 columns

Pandas has built in matplotlib extension

In [12]:

```
import matplotlib.pyplot as plt

plt.rcParams.update({"font.size":32})
fig, ax = plt.subplots(figsize = (24,16))
close_data.plot.line(ax = ax, legend = True)
plt.title("Close\nDaily Stock Prices")
```

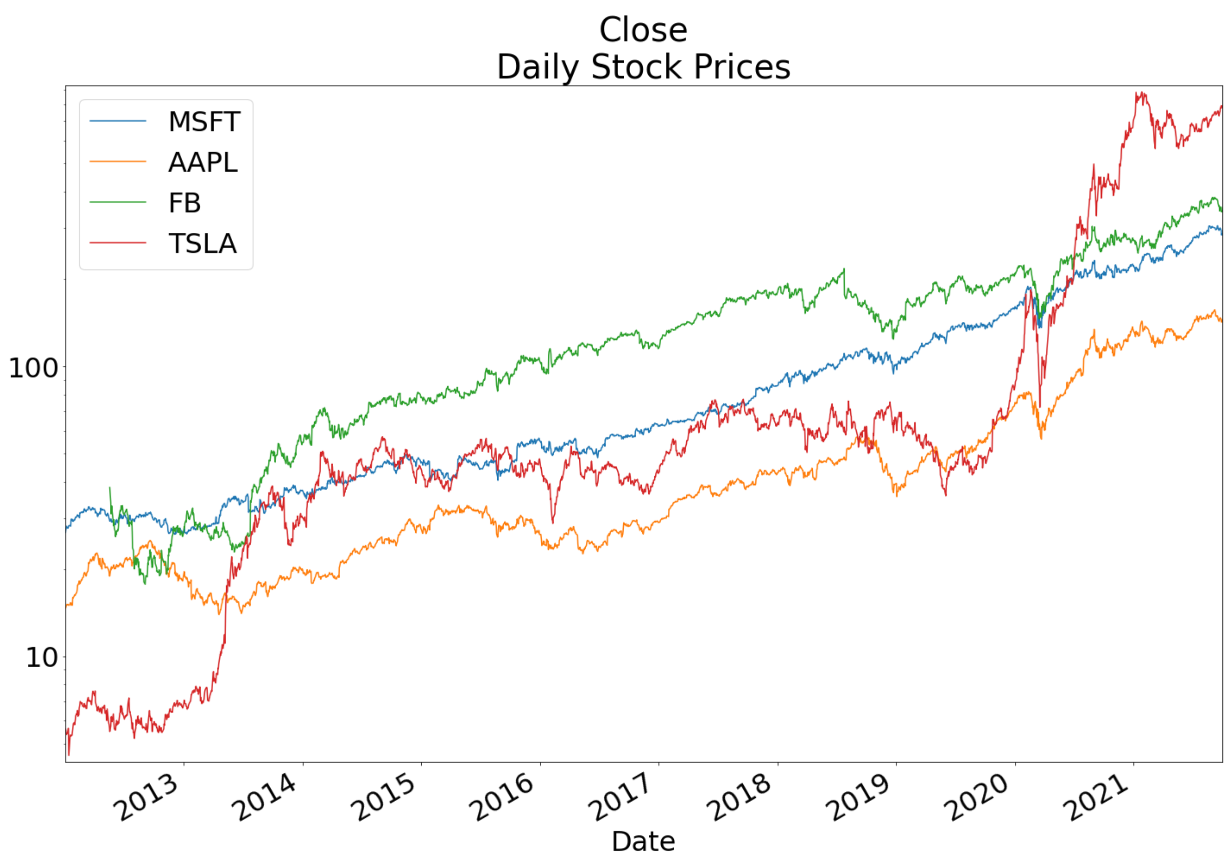
Out[12]: Text(0.5, 1.0, 'Close\nDaily Stock Prices')



In [13]:
```
import matplotlib.pyplot as plt

plt.rcParams.update({"font.size":32})
plt.rcParams['axes.xmargin'] = 0
plt.rcParams['axes.ymargin'] = .01

fig, ax = plt.subplots(figsize = (24,16))
close_data.plot.line(ax = ax, legend = True)

plt.title("Close\nDaily Stock Prices")
ax.set_yscale("log")
# reset y-ticklabels so that they are not in
# scientific notation
y_vals = ax.get_yticks()
ax.set_yticklabels([int(y) if y >= 1 else round(y, 1) for y in y_vals])
```

```
<ipython-input-13-0eb7047172d3>:15: UserWarning: FixedFormatter should only be used together with FixedLocator
  ax.set_yticklabels([int(y) if y >= 1 else round(y, 1) for y in y_vals])
```

Out[13]:
```
[Text(0, 0.1, '0.1'),
 Text(0, 1.0, '1'),
 Text(0, 10.0, '10'),
 Text(0, 100.0, '100'),
 Text(0, 1000.0, '1000'),
 Text(0, 10000.0, '10000')]
```



In [14]:
```
price_change_data = close_data.pct_change() * 100
price_change_data
```

Out[14]:

	MSFT	AAPL	FB	TSLA
Date				
2012-01-03	NaN	NaN	NaN	NaN
2012-01-04	2.353377	0.537408	NaN	-1.317670
2012-01-05	1.021900	1.110200	NaN	-2.129196
2012-01-06	1.553469	1.045381	NaN	-0.774333
2012-01-09	-1.316261	-0.158618	NaN	1.263468
...	...	...	...	...
2021-09-23	0.328224	0.671920	0.801259	0.226083
2021-09-24	-0.070100	0.061293	2.023355	2.753304
2021-09-27	-1.730413	-1.054998	0.175656	2.191398
2021-09-28	-3.620364	-2.380128	-3.656879	-1.743832
2021-09-29	0.888833	1.465719	0.666379	1.648748

2452 rows × 4 columns