

In [1]:

```

1 import numpy as np
2 import pandas as pd
3 import os
4 import sys

```

In [2]:

```
1 sys.version
```

Out[2]:

```
'3.7.6 (default, Jan 8 2020, 20:23:39) [MSC v.1916 64 bit (AMD64)]'
```

In [3]:

```
1 pd.__version__
```

Out[3]:

```
'1.0.1'
```

In [4]:

```
1 pwd
```

Out[4]:

```
'C:\\Users\\Adura\\Documents\\Data Science and Machine Learning Projects\\jupyter'
```

In [5]:

```
1 tech = pd.read_csv("tech_giants.csv")
```

In [6]:

```
1 tech.head()
```

Out[6]:

|   | date       | month | year | day | name  | open   | close  | high   | low    | volume   | volume_type |
|---|------------|-------|------|-----|-------|--------|--------|--------|--------|----------|-------------|
| 0 | 2014-01-02 | 1     | 2014 | 2   | FB    | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
| 1 | 2014-01-02 | 1     | 2014 | 2   | AAPL  | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
| 2 | 2014-01-02 | 1     | 2014 | 2   | GOOGL | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
| 3 | 2014-01-02 | 1     | 2014 | 2   | MSFT  | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
| 4 | 2014-01-02 | 1     | 2014 | 2   | AMZN  | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

In [7]:

```
1 tech.shape
```

Out[7]:

```
(7105, 11)
```

In [8]:

```
1 7105/250/5
```

Out[8]:

```
5.684
```

In [9]:

```
1 tech.columns
```

Out[9]:

```
Index(['date', 'month', 'year', 'day', 'name', 'open', 'close', 'high', 'low',  
      'volume', 'volume_type'],  
      dtype='object')
```

In [10]:

```
1 tech.year.value_counts()
```

Out[10]:

```
2015    1260  
2014    1260  
2016    1260  
2018    1255  
2017    1255  
2019     815  
Name: year, dtype: int64
```

In [11]:

```
1 tech.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7105 entries, 0 to 7104
Data columns (total 11 columns):
#   Column          Non-Null Count  Dtype
---  -
0   date            7105 non-null  object
1   month           7105 non-null  int64
2   year            7105 non-null  int64
3   day             7105 non-null  int64
4   name            7105 non-null  object
5   open            7105 non-null  float64
6   close           7105 non-null  float64
7   high            7105 non-null  float64
8   low             7105 non-null  float64
9   volume          7105 non-null  int64
10  volume_type     7105 non-null  object
dtypes: float64(4), int64(4), object(3)
memory usage: 610.7+ KB
```

In [12]:

```
1 tech.info(verbose=False)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7105 entries, 0 to 7104
Columns: 11 entries, date to volume_type
dtypes: float64(4), int64(4), object(3)
memory usage: 610.7+ KB
```

### ***Index and RangeIndex***

In [13]:

```
1 tech.volume.head(10)
```

Out[13]:

```
0    43257622
1     8398851
2    1822719
3    30643745
4     2140246
5    38287706
6     1669229
7    31134795
8    14043410
9     2213512
Name: volume, dtype: int64
```

In [14]:

```
1 tech.head(10)
```

Out[14]:

|   | date       | month | year | day | name  | open   | close  | high   | low    | volume   | volume_type |
|---|------------|-------|------|-----|-------|--------|--------|--------|--------|----------|-------------|
| 0 | 2014-01-02 | 1     | 2014 | 2   | FB    | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
| 1 | 2014-01-02 | 1     | 2014 | 2   | AAPL  | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
| 2 | 2014-01-02 | 1     | 2014 | 2   | GOOGL | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
| 3 | 2014-01-02 | 1     | 2014 | 2   | MSFT  | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
| 4 | 2014-01-02 | 1     | 2014 | 2   | AMZN  | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |
| 5 | 2014-01-03 | 1     | 2014 | 3   | FB    | 55.00  | 54.56  | 55.65  | 54.53  | 38287706 | medium      |
| 6 | 2014-01-03 | 1     | 2014 | 3   | GOOGL | 557.50 | 552.50 | 558.47 | 552.47 | 1669229  | medium      |
| 7 | 2014-01-03 | 1     | 2014 | 3   | MSFT  | 37.20  | 36.91  | 37.22  | 36.60  | 31134795 | medium      |
| 8 | 2014-01-03 | 1     | 2014 | 3   | AAPL  | 79.00  | 77.28  | 79.10  | 77.20  | 14043410 | low         |
| 9 | 2014-01-03 | 1     | 2014 | 3   | AMZN  | 398.29 | 396.44 | 402.71 | 396.22 | 2213512  | medium      |

In [15]:

```
1 type(tech.index)
```

Out[15]:

pandas.core.indexes.range.RangeIndex

In [16]:

```
1 type(tech.columns)
```

Out[16]:

pandas.core.indexes.base.Index

In [17]:

```
1 tech.set_index('date')
```

Out[17]:

|            | month | year | day | name  | open    | close   | high    | low     | volume   | volume_type |
|------------|-------|------|-----|-------|---------|---------|---------|---------|----------|-------------|
| date       |       |      |     |       |         |         |         |         |          |             |
| 2014-01-02 | 1     | 2014 | 2   | FB    | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 | medium      |
| 2014-01-02 | 1     | 2014 | 2   | AAPL  | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  | low         |
| 2014-01-02 | 1     | 2014 | 2   | GOOGL | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  | medium      |
| 2014-01-02 | 1     | 2014 | 2   | MSFT  | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 | medium      |
| 2014-01-02 | 1     | 2014 | 2   | AMZN  | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  | medium      |
| ...        | ...   | ...  | ... | ...   | ...     | ...     | ...     | ...     | ...      | ...         |
| 2019-08-23 | 8     | 2019 | 23  | MSFT  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 | medium      |
| 2019-08-23 | 8     | 2019 | 23  | AAPL  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 | medium      |
| 2019-08-23 | 8     | 2019 | 23  | GOOGL | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  | medium      |
| 2019-08-23 | 8     | 2019 | 23  | AMZN  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898  | medium      |
| 2019-08-23 | 8     | 2019 | 23  | FB    | 180.84  | 177.75  | 183.13  | 176.66  | 17331221 | medium      |

7105 rows × 10 columns

In [18]:

```
1 tech.set_index('date').loc['2019-08-01']
```

Out[18]:

|            | month | year | day | name  | open    | close   | high    | low     | volume   | volume_type |
|------------|-------|------|-----|-------|---------|---------|---------|---------|----------|-------------|
| date       |       |      |     |       |         |         |         |         |          |             |
| 2019-08-01 | 8     | 2019 | 1   | GOOGL | 1217.63 | 1211.78 | 1236.30 | 1207.00 | 1771271  | medium      |
| 2019-08-01 | 8     | 2019 | 1   | FB    | 194.17  | 192.73  | 198.47  | 190.88  | 17777013 | medium      |
| 2019-08-01 | 8     | 2019 | 1   | MSFT  | 137.00  | 138.06  | 140.94  | 136.93  | 40557502 | medium      |
| 2019-08-01 | 8     | 2019 | 1   | AMZN  | 1871.72 | 1855.32 | 1897.92 | 1844.01 | 4713311  | medium      |
| 2019-08-01 | 8     | 2019 | 1   | AAPL  | 213.90  | 208.43  | 218.03  | 206.74  | 54017922 | medium      |

Creation of MultiIndex

In [19]:

```
1 tech.set_index(['date', 'name'], inplace=True)
```

In [20]:

```
1 tech.head()
```

Out[20]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       |       | name  |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

In [21]:

```
1 tech.sort_index()
```

Out[21]:

|            |       | month | year | day | open    | close   | high    | low     | volume   | volume_type |
|------------|-------|-------|------|-----|---------|---------|---------|---------|----------|-------------|
| date       | name  |       |      |     |         |         |         |         |          |             |
| 2014-01-02 | AAPL  | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  | low         |
|            | AMZN  | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  | medium      |
|            | FB    | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 | medium      |
|            | GOOGL | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 | medium      |
| ...        | ...   | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      | ...         |
| 2019-08-23 | AAPL  | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 | medium      |
|            | AMZN  | 8     | 2019 | 23  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898  | medium      |
|            | FB    | 8     | 2019 | 23  | 180.84  | 177.75  | 183.13  | 176.66  | 17331221 | medium      |

In [22]:

```
1 type(tech.index)
```

Out[22]:

pandas.core.indexes.multi.MultiIndex

**MultilIndex from read\_csv()**

In [23]:

```
1 tech.head()
```

Out[23]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

**the read\_csv way**

In [24]:

```
1 pd.read_csv("tech_giants.csv", index_col=['date', 'name'])
```

Out[24]:

|            |       | month | year | day | open    | close   | high    | low     | volume   | volume_type |
|------------|-------|-------|------|-----|---------|---------|---------|---------|----------|-------------|
| date       | name  |       |      |     |         |         |         |         |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  | medium      |
| ...        | ...   | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      | ...         |
| 2019-08-23 | MSFT  | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 | medium      |
|            | AAPL  | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 | medium      |
|            | GOOGL | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  | medium      |
|            | AMZN  | 8     | 2019 | 23  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898  | medium      |
|            | FB    | 8     | 2019 | 23  | 180.84  | 177.75  | 183.13  | 176.66  | 17331221 | medium      |

7105 rows × 9 columns

***another approach***

In [25]:

```
1 tech.head()
```

Out[25]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

***pd.DataFrame(data, index=MultiIndexObject).... to be explored later******Indexing Hierarchical DataFrame***



In [26]:

```
1 tech.head()
```

Out[26]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

**Getting Google's Closing Price**

In [27]:

```
1 tech.loc['2014-01-02']
```

Out[27]:

|       |   | month | year | day    | open   | close  | high   | low      | volume | volume_type |
|-------|---|-------|------|--------|--------|--------|--------|----------|--------|-------------|
| name  |   |       |      |        |        |        |        |          |        |             |
| FB    | 1 | 2014  | 2    | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium |             |
| AAPL  | 1 | 2014  | 2    | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low    |             |
| GOOGL | 1 | 2014  | 2    | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium |             |
| MSFT  | 1 | 2014  | 2    | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium |             |
| AMZN  | 1 | 2014  | 2    | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium |             |

In [28]:

```
1 tech.loc['2014-01-02', 'GOOGL']
```

Out[28]:

```
month          1
year           2014
day            2
open           557.73
close           556.56
high           558.88
low            554.13
volume         1822719
volume_type    medium
Name: (2014-01-02, GOOGL), dtype: object
```

In [29]:

```
1 tech.loc['2014-01-02', 'GOOGL'].close # Google's close price for date
```

Out[29]:

556.56

In [30]:

```
1 tech.loc(['2014-01-02', 'GOOGL']).close
```

Out[30]:

556.56

In [31]:

```
1 #OR
2 tech.loc(['2014-01-02', 'GOOGL'), 'close']
```

Out[31]:

556.56

In [32]:

```
1 tech.head(10)
```

Out[32]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |
| 2014-01-03 | FB    | 1     | 2014 | 3   | 55.00  | 54.56  | 55.65  | 54.53  | 38287706 | medium      |
|            | GOOGL | 1     | 2014 | 3   | 557.50 | 552.50 | 558.47 | 552.47 | 1669229  | medium      |
|            | MSFT  | 1     | 2014 | 3   | 37.20  | 36.91  | 37.22  | 36.60  | 31134795 | medium      |
|            | AAPL  | 1     | 2014 | 3   | 79.00  | 77.28  | 79.10  | 77.20  | 14043410 | low         |
|            | AMZN  | 1     | 2014 | 3   | 398.29 | 396.44 | 402.71 | 396.22 | 2213512  | medium      |

**agnostic -> non-committal attitude or belief**

**iloc is agnostic to hierarchical dfs  
loc cares**

In [33]:

```
1 tech.iloc[2,4]
```

Out[33]:

556.56

*the label-based approach***Getting AAPL's open and close price for 2014-01-03**

In [34]:

```
1 tech.loc[('2014-01-03', 'AAPL'), ['open', 'close']]
```

Out[34]:

```
open      79
close    77.28
Name: (2014-01-03, AAPL), dtype: object
```

*position-based approach*

In [35]:

```
1 tech.head(10)
```

Out[35]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |
| 2014-01-03 | FB    | 1     | 2014 | 3   | 55.00  | 54.56  | 55.65  | 54.53  | 38287706 | medium      |
|            | GOOGL | 1     | 2014 | 3   | 557.50 | 552.50 | 558.47 | 552.47 | 1669229  | medium      |
|            | MSFT  | 1     | 2014 | 3   | 37.20  | 36.91  | 37.22  | 36.60  | 31134795 | medium      |
|            | AAPL  | 1     | 2014 | 3   | 79.00  | 77.28  | 79.10  | 77.20  | 14043410 | low         |
|            | AMZN  | 1     | 2014 | 3   | 398.29 | 396.44 | 402.71 | 396.22 | 2213512  | medium      |

In [36]:

```
1 tech.iloc[8, [3,4]]
```

Out[36]:

```
open      79
close     77.28
Name: (2014-01-03, AAPL), dtype: object
```

In [37]:

```
1 #OR
2 tech.iloc[8, 3:5]
```

Out[37]:

```
open      79
close     77.28
Name: (2014-01-03, AAPL), dtype: object
```

In [38]:

```
1 tech.loc[['2015-01-06', '2015-01-07']]
```

Out[38]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2015-01-06 | AAPL  | 1     | 2015 | 6   | 106.54 | 106.26 | 107.43 | 104.63 | 65797116 | medium      |
|            | FB    | 1     | 2015 | 6   | 77.23  | 76.15  | 77.59  | 75.36  | 27399288 | medium      |
|            | AMZN  | 1     | 2015 | 6   | 302.20 | 295.29 | 303.00 | 292.38 | 3519034  | medium      |
|            | MSFT  | 1     | 2015 | 6   | 46.38  | 45.65  | 46.75  | 45.54  | 36447854 | medium      |
|            | GOOGL | 1     | 2015 | 6   | 520.49 | 506.64 | 521.21 | 505.55 | 2731813  | medium      |
| 2015-01-07 | FB    | 1     | 2015 | 7   | 76.76  | 76.15  | 77.36  | 75.82  | 22045333 | medium      |
|            | MSFT  | 1     | 2015 | 7   | 45.98  | 46.23  | 46.46  | 45.49  | 29114061 | medium      |
|            | GOOGL | 1     | 2015 | 7   | 510.99 | 505.15 | 511.49 | 503.65 | 2345875  | medium      |
|            | AMZN  | 1     | 2015 | 7   | 297.54 | 298.42 | 301.28 | 295.33 | 2640349  | medium      |
|            | AAPL  | 1     | 2015 | 7   | 107.20 | 107.75 | 108.20 | 106.70 | 40105934 | medium      |

In [39]:

```
1 #OR
2 tech.loc['2015-01-06':'2015-01-08']
```

Out[39]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2015-01-06 | AAPL  | 1     | 2015 | 6   | 106.54 | 106.26 | 107.43 | 104.63 | 65797116 | medium      |
|            | FB    | 1     | 2015 | 6   | 77.23  | 76.15  | 77.59  | 75.36  | 27399288 | medium      |
|            | AMZN  | 1     | 2015 | 6   | 302.20 | 295.29 | 303.00 | 292.38 | 3519034  | medium      |
|            | MSFT  | 1     | 2015 | 6   | 46.38  | 45.65  | 46.75  | 45.54  | 36447854 | medium      |
|            | GOOGL | 1     | 2015 | 6   | 520.49 | 506.64 | 521.21 | 505.55 | 2731813  | medium      |
| 2015-01-07 | FB    | 1     | 2015 | 7   | 76.76  | 76.15  | 77.36  | 75.82  | 22045333 | medium      |
|            | MSFT  | 1     | 2015 | 7   | 45.98  | 46.23  | 46.46  | 45.49  | 29114061 | medium      |
|            | GOOGL | 1     | 2015 | 7   | 510.99 | 505.15 | 511.49 | 503.65 | 2345875  | medium      |
|            | AMZN  | 1     | 2015 | 7   | 297.54 | 298.42 | 301.28 | 295.33 | 2640349  | medium      |
|            | AAPL  | 1     | 2015 | 7   | 107.20 | 107.75 | 108.20 | 106.70 | 40105934 | medium      |
| 2015-01-08 | AAPL  | 1     | 2015 | 8   | 109.23 | 111.89 | 112.15 | 108.70 | 59364547 | medium      |
|            | AMZN  | 1     | 2015 | 8   | 300.59 | 300.46 | 303.14 | 296.11 | 3088398  | medium      |
|            | MSFT  | 1     | 2015 | 8   | 46.75  | 47.59  | 47.75  | 46.72  | 29645202 | medium      |
|            | FB    | 1     | 2015 | 8   | 76.74  | 78.18  | 78.23  | 76.08  | 23960953 | medium      |
|            | GOOGL | 1     | 2015 | 8   | 501.51 | 506.91 | 507.50 | 495.02 | 3662224  | medium      |

In [40]:

```
1 # tech.loc[['2015-01-06', '2015-01-07'], ['FB', 'AMZN']] would give an error
```

In [41]:

```
1 # fix for the cell above
2 tech.loc([['2015-01-06', '2015-01-07'], ['FB', 'AMZN']], ['close', 'volume'])
```

Out[41]:

|            |      | close  | volume   |
|------------|------|--------|----------|
| date       | name |        |          |
| 2015-01-06 | FB   | 76.15  | 27399288 |
|            | AMZN | 295.29 | 3519034  |
| 2015-01-07 | FB   | 76.15  | 22045333 |
|            | AMZN | 298.42 | 2640349  |

***what about slices***

In [42]:

```
1 tech.loc['2017-01-03':'2017-01-31', 'open':'low']
```

Out[42]:

|            |       | open   | close  | high   | low    |
|------------|-------|--------|--------|--------|--------|
| date       | name  |        |        |        |        |
| 2017-01-03 | AMZN  | 757.92 | 753.67 | 758.76 | 747.70 |
|            | FB    | 116.03 | 116.86 | 117.84 | 115.51 |
|            | MSFT  | 62.79  | 62.58  | 62.84  | 62.13  |
|            | AAPL  | 115.80 | 116.15 | 116.33 | 114.76 |
|            | GOOGL | 800.62 | 808.01 | 811.44 | 796.89 |
| ...        | ...   | ...    | ...    | ...    | ...    |
| 2017-01-31 | MSFT  | 64.86  | 64.65  | 65.15  | 64.26  |
|            | AAPL  | 121.15 | 121.35 | 121.39 | 120.62 |
|            | FB    | 130.17 | 130.32 | 130.66 | 129.52 |

***how to isolate google from the above?******using the slice object******tech.loc[:, 'GOOGL'], 'open':'low'] would give an error******tech.loc[['2017-01-03', '2017-01-31'], 'GOOGL'], 'open':'low'] gives an error- unhashable***

In [43]:

```
1 tech.loc[(slice('2017-01-03', '2017-01-31'), 'GOOGL'), 'open':'low']
```

Out[43]:

|            |       | open   | close  | high   | low    |
|------------|-------|--------|--------|--------|--------|
| date       | name  |        |        |        |        |
| 2017-01-03 | GOOGL | 800.62 | 808.01 | 811.44 | 796.89 |
| 2017-01-04 | GOOGL | 809.89 | 807.77 | 813.43 | 804.11 |
| 2017-01-05 | GOOGL | 807.50 | 813.02 | 813.74 | 805.92 |
| 2017-01-06 | GOOGL | 814.99 | 825.21 | 828.96 | 811.50 |
| 2017-01-09 | GOOGL | 826.37 | 827.18 | 830.43 | 821.62 |
| 2017-01-10 | GOOGL | 827.07 | 826.01 | 829.41 | 823.14 |
| 2017-01-11 | GOOGL | 826.62 | 829.86 | 829.90 | 821.47 |
| 2017-01-12 | GOOGL | 828.38 | 829.53 | 830.38 | 821.01 |
| 2017-01-13 | GOOGL | 831.00 | 830.94 | 834.65 | 829.52 |

***open price for FB and AMZN for all dates in the df***

In [44]:

```
1 tech.loc[(slice(None), ['FB', 'AMZN']), 'open']
```

Out[44]:

| date       | name |         |
|------------|------|---------|
| 2014-01-02 | FB   | 54.86   |
|            | AMZN | 398.80  |
| 2014-01-03 | FB   | 55.00   |
|            | AMZN | 398.29  |
| 2014-01-06 | AMZN | 396.13  |
|            |      | ...     |
| 2019-08-21 | AMZN | 1819.39 |
| 2019-08-22 | FB   | 183.43  |
|            | AMZN | 1828.00 |
| 2019-08-23 | AMZN | 1793.03 |
|            | FB   | 180.84  |

Name: open, Length: 2842, dtype: float64

***Using pd.IndexSlice******High and low for all days for AMZN and FB***

In [45]:

```
1 tech.loc[pd.IndexSlice[:, ['FB', 'AMZN']], 'high':'low']
```

Out[45]:

|            |      | high    | low     |
|------------|------|---------|---------|
| date       | name |         |         |
| 2014-01-02 | FB   | 55.22   | 54.19   |
|            | AMZN | 399.36  | 394.02  |
| 2014-01-03 | FB   | 55.65   | 54.53   |
|            | AMZN | 402.71  | 396.22  |
| 2014-01-06 | AMZN | 397.00  | 388.42  |
| ...        | ...  | ...     | ...     |
| 2019-08-21 | AMZN | 1829.58 | 1815.00 |
| 2019-08-22 | FB   | 184.11  | 179.91  |
|            | AMZN | 1829.41 | 1800.10 |

In [46]:

```
1 i = pd.IndexSlice
```

In [47]:

```
1 tech.loc[i[:, ['FB', 'AMZN']], 'high':'low']
```

Out[47]:

|            |      | high    | low     |
|------------|------|---------|---------|
| date       | name |         |         |
| 2014-01-02 | FB   | 55.22   | 54.19   |
|            | AMZN | 399.36  | 394.02  |
| 2014-01-03 | FB   | 55.65   | 54.53   |
|            | AMZN | 402.71  | 396.22  |
| 2014-01-06 | AMZN | 397.00  | 388.42  |
| ...        | ...  | ...     | ...     |
| 2019-08-21 | AMZN | 1829.58 | 1815.00 |
| 2019-08-22 | FB   | 184.11  | 179.91  |
|            | AMZN | 1829.41 | 1800.10 |

jan6 -jan10



In [48]:

```
1 tech.loc[i['2014-01-06':'2014-01-10'], ['FB', 'AMZN']], 'high':'low']
```

Out[48]:

|            |      | high   | low    |
|------------|------|--------|--------|
| date       | name |        |        |
| 2014-01-06 | AMZN | 397.00 | 388.42 |
|            | FB   | 57.26  | 54.05  |
| 2014-01-07 | FB   | 58.55  | 57.22  |
|            | AMZN | 398.47 | 394.29 |
| 2014-01-08 | AMZN | 403.00 | 396.04 |
|            | FB   | 58.41  | 57.23  |
| 2014-01-09 | AMZN | 406.89 | 398.44 |
|            | FB   | 58.96  | 56.65  |
| 2014-01-10 | FB   | 58.30  | 57.06  |
|            | AMZN | 403.76 | 393.80 |

**Cross Section with xs()***xs() is a type of label-based indexing*

In [49]:

```
1 tech.xs('2019-01-02')
```

Out[49]:

|       | month | year | day | open    | close   | high    | low     | volume   | volume_type |
|-------|-------|------|-----|---------|---------|---------|---------|----------|-------------|
| name  |       |      |     |         |         |         |         |          |             |
| MSFT  | 1     | 2019 | 2   | 99.55   | 101.12  | 101.75  | 98.94   | 35329345 | medium      |
| FB    | 1     | 2019 | 2   | 128.99  | 135.68  | 137.51  | 128.56  | 28146193 | medium      |
| GOOGL | 1     | 2019 | 2   | 1027.20 | 1054.68 | 1060.79 | 1025.28 | 1593395  | medium      |
| AMZN  | 1     | 2019 | 2   | 1465.20 | 1539.13 | 1553.36 | 1460.93 | 7983103  | medium      |
| AAPL  | 1     | 2019 | 2   | 154.89  | 157.92  | 158.85  | 154.23  | 37039737 | medium      |

In [50]:

```
1 tech.loc['2019-01-02']
```

Out[50]:

|       | month | year | day | open    | close   | high    | low     | volume   | volume_type |
|-------|-------|------|-----|---------|---------|---------|---------|----------|-------------|
| name  |       |      |     |         |         |         |         |          |             |
| MSFT  | 1     | 2019 | 2   | 99.55   | 101.12  | 101.75  | 98.94   | 35329345 | medium      |
| FB    | 1     | 2019 | 2   | 128.99  | 135.68  | 137.51  | 128.56  | 28146193 | medium      |
| GOOGL | 1     | 2019 | 2   | 1027.20 | 1054.68 | 1060.79 | 1025.28 | 1593395  | medium      |
| AMZN  | 1     | 2019 | 2   | 1465.20 | 1539.13 | 1553.36 | 1460.93 | 7983103  | medium      |
| AAPL  | 1     | 2019 | 2   | 154.89  | 157.92  | 158.85  | 154.23  | 37039737 | medium      |

**Syntax for loc indexer**

In [51]:

```
1 tech.loc[(slice(None), 'FB'), :]
```

Out[51]:

|            |      | month | year | day | open  | close | high  | low   | volume   | volume_type |
|------------|------|-------|------|-----|-------|-------|-------|-------|----------|-------------|
| date       | name |       |      |     |       |       |       |       |          |             |
| 2014-01-02 | FB   | 1     | 2014 | 2   | 54.86 | 54.71 | 55.22 | 54.19 | 43257622 | medium      |
| 2014-01-03 | FB   | 1     | 2014 | 3   | 55.00 | 54.56 | 55.65 | 54.53 | 38287706 | medium      |
| 2014-01-06 | FB   | 1     | 2014 | 6   | 54.39 | 57.20 | 57.26 | 54.05 | 68974359 | high        |
| 2014-01-07 | FB   | 1     | 2014 | 7   | 57.67 | 57.92 | 58.55 | 57.22 | 77329009 | high        |
| 2014-01-08 | FB   | 1     | 2014 | 8   | 57.59 | 58.23 | 58.41 | 57.23 | 56800776 | high        |
| ...        | ...  | ...   | ...  | ... | ...   | ...   | ...   | ...   | ...      | ...         |
| 2014-02-01 | FB   | 1     | 2014 | 1   | 58.55 | 58.55 | 58.55 | 58.55 | 58550000 | high        |

**Syntax using xs indexer**

In [52]:

```
1 tech.xs('FB', level=1)
```

Out[52]:

|            | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
| 2014-01-03 | 1     | 2014 | 3   | 55.00  | 54.56  | 55.65  | 54.53  | 38287706 | medium      |
| 2014-01-06 | 1     | 2014 | 6   | 54.39  | 57.20  | 57.26  | 54.05  | 68974359 | high        |
| 2014-01-07 | 1     | 2014 | 7   | 57.67  | 57.92  | 58.55  | 57.22  | 77329009 | high        |
| 2014-01-08 | 1     | 2014 | 8   | 57.59  | 58.23  | 58.41  | 57.23  | 56800776 | high        |
| ...        | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...      | ...         |
| 2019-08-19 | 8     | 2019 | 19  | 186.01 | 186.17 | 187.50 | 184.85 | 9699661  | low         |
| 2019-08-20 | 8     | 2019 | 20  | 185.45 | 183.81 | 186.00 | 182.39 | 10087592 | low         |
| 2019-08-21 | 8     | 2019 | 21  | 185.00 | 183.55 | 185.90 | 183.14 | 8409548  | low         |
| 2019-08-22 | 8     | 2019 | 22  | 183.43 | 182.04 | 184.11 | 179.91 | 10829509 | low         |
| 2019-08-23 | 8     | 2019 | 23  | 180.84 | 177.75 | 183.13 | 176.66 | 17331221 | medium      |

1421 rows × 9 columns

In [53]:

```
1 tech.xs('FB', level=1, drop_level=False)
```

Out[53]:

|            |      | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB   | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
| 2014-01-03 | FB   | 1     | 2014 | 3   | 55.00  | 54.56  | 55.65  | 54.53  | 38287706 | medium      |
| 2014-01-06 | FB   | 1     | 2014 | 6   | 54.39  | 57.20  | 57.26  | 54.05  | 68974359 | high        |
| 2014-01-07 | FB   | 1     | 2014 | 7   | 57.67  | 57.92  | 58.55  | 57.22  | 77329009 | high        |
| 2014-01-08 | FB   | 1     | 2014 | 8   | 57.59  | 58.23  | 58.41  | 57.23  | 56800776 | high        |
| ...        | ...  | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...      | ...         |
| 2019-08-19 | FB   | 8     | 2019 | 19  | 186.01 | 186.17 | 187.50 | 184.85 | 9699661  | low         |
| 2019-08-20 | FB   | 8     | 2019 | 20  | 185.45 | 183.81 | 186.00 | 182.39 | 10087592 | low         |
| 2019-08-21 | FB   | 8     | 2019 | 21  | 185.00 | 183.55 | 185.90 | 183.14 | 8409548  | low         |
| 2019-08-22 | FB   | 8     | 2019 | 22  | 183.43 | 182.04 | 184.11 | 179.91 | 10829509 | low         |
| 2019-08-23 | FB   | 8     | 2019 | 23  | 180.84 | 177.75 | 183.13 | 176.66 | 17331221 | medium      |

1421 rows × 9 columns

**Selecting from Multiple levels at once**

In [54]:

```
1 tech.xs(('2019-01-02', 'FB'), level=(0,1), axis=0)
```

Out[54]:

|            |      | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name |       |      |     |        |        |        |        |          |             |
| 2019-01-02 | FB   | 1     | 2019 | 2   | 128.99 | 135.68 | 137.51 | 128.56 | 28146193 | medium      |

**Skill Challenge**

In [55]:

```
1 tech_df2 = tech.loc['2015-07-13':'2016-08-17']
```

In [56]:

```
1 tech_df2.head()
```

Out[56]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2015-07-13 | MSFT  | 7     | 2015 | 13  | 44.98  | 45.54  | 45.62  | 44.95  | 28178329 | medium      |
|            | AMZN  | 7     | 2015 | 13  | 448.29 | 455.57 | 457.87 | 447.54 | 3956802  | medium      |
|            | FB    | 7     | 2015 | 13  | 88.66  | 90.10  | 90.22  | 88.42  | 29976670 | medium      |
|            | GOOGL | 7     | 2015 | 13  | 559.51 | 571.73 | 572.85 | 558.70 | 2089641  | medium      |
|            | AAPL  | 7     | 2015 | 13  | 125.03 | 125.66 | 125.76 | 124.32 | 41440538 | medium      |

In [57]:

```
1 tech_df2.loc[(slice(None), 'AAPL'), :].sample(10)
```

Out[57]:

|            |      | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name |       |      |     |        |        |        |        |          |             |
| 2015-09-09 | AAPL | 9     | 2015 | 9   | 113.76 | 110.15 | 114.02 | 109.77 | 85010804 | high        |
| 2015-08-11 | AAPL | 8     | 2015 | 11  | 117.81 | 113.49 | 118.18 | 113.33 | 97082814 | high        |
| 2015-09-08 | AAPL | 9     | 2015 | 8   | 111.65 | 112.31 | 112.56 | 110.32 | 54843626 | medium      |
| 2016-05-26 | AAPL | 5     | 2016 | 26  | 99.68  | 100.41 | 100.73 | 98.64  | 56331159 | medium      |
| 2016-02-08 | AAPL | 2     | 2016 | 8   | 93.13  | 95.01  | 95.70  | 93.04  | 54021375 | medium      |
| 2015-09-18 | AAPL | 9     | 2015 | 18  | 112.21 | 113.45 | 114.30 | 111.87 | 74285291 | high        |
| 2016-01-26 | AAPL | 1     | 2016 | 26  | 99.93  | 99.99  | 100.88 | 98.07  | 75077002 | high        |
| 2016-05-12 | AAPL | 5     | 2016 | 12  | 92.72  | 90.34  | 92.78  | 89.47  | 76314690 | high        |
| 2016-03-22 | AAPL | 3     | 2016 | 22  | 105.25 | 106.72 | 107.29 | 105.21 | 32444375 | medium      |
| 2015-10-02 | AAPL | 10    | 2015 | 2   | 108.01 | 110.38 | 111.01 | 107.55 | 58019758 | medium      |

In [58]:

```
1 #OR
2 tech_df2.xs(level=1, key='AAPL', drop_level=False).sample(10)
```

Out[58]:

|            |      | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name |       |      |     |        |        |        |        |          |             |
| 2015-07-21 | AAPL | 7     | 2015 | 21  | 132.85 | 130.75 | 132.92 | 130.32 | 76756427 | high        |
| 2016-05-11 | AAPL | 5     | 2016 | 11  | 93.48  | 92.51  | 93.57  | 92.46  | 28719109 | medium      |
| 2015-12-11 | AAPL | 12    | 2015 | 11  | 115.19 | 113.18 | 115.39 | 112.85 | 46886161 | medium      |
| 2015-07-15 | AAPL | 7     | 2015 | 15  | 125.72 | 126.82 | 127.15 | 125.58 | 33649200 | medium      |
| 2016-03-17 | AAPL | 3     | 2016 | 17  | 105.52 | 105.80 | 106.47 | 104.96 | 14894744 | low         |
| 2016-05-04 | AAPL | 5     | 2016 | 4   | 95.20  | 94.19  | 95.90  | 93.82  | 41025475 | medium      |
| 2015-09-17 | AAPL | 9     | 2015 | 17  | 115.66 | 113.92 | 116.49 | 113.72 | 64112641 | medium      |
| 2015-10-20 | AAPL | 10    | 2015 | 20  | 111.34 | 113.77 | 114.17 | 110.82 | 48967763 | medium      |
| 2016-08-03 | AAPL | 8     | 2016 | 3   | 104.81 | 105.79 | 105.84 | 104.77 | 30202641 | medium      |
| 2015-11-18 | AAPL | 11    | 2015 | 18  | 115.76 | 117.29 | 117.49 | 115.50 | 46674697 | medium      |

In [59]:

```
1 tech.loc[pd.IndexSlice[:, ['AAPL', 'GOOGL']], ['high', 'low']]
```

Out[59]:

|            |       | high    | low     |
|------------|-------|---------|---------|
| date       | name  |         |         |
| 2014-01-02 | AAPL  | 79.58   | 78.86   |
|            | GOOGL | 558.88  | 554.13  |
| 2014-01-03 | GOOGL | 558.47  | 552.47  |
|            | AAPL  | 79.10   | 77.20   |
| 2014-01-06 | AAPL  | 78.11   | 76.23   |
| ...        | ...   | ...     | ...     |
| 2019-08-21 | AAPL  | 213.65  | 211.60  |
| 2019-08-22 | AAPL  | 214.44  | 210.75  |
|            | GOOGL | 1198.78 | 1178.91 |
| 2019-08-23 | AAPL  | 212.05  | 201.00  |
|            | GOOGL | 1195.67 | 1150.00 |

2842 rows × 2 columns

**Anatomy of a MultiIndex Object**

In [60]:

```
1 tech.head()
```

Out[60]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

In [61]:

```
1 type(tech)
```

Out[61]:

pandas.core.frame.DataFrame

In [62]:

```
1 type(tech.index)
```

Out[62]:

pandas.core.indexes.multi.MultiIndex

In [63]:

```
1 tech.index.names
```

Out[63]:

FrozenList(['date', 'name'])

In [64]:

```
1 tech.columns
```

Out[64]:

```
Index(['month', 'year', 'day', 'open', 'close', 'high', 'low', 'volume',
      'volume_type'],
      dtype='object')
```

In [65]:

```
1 type(tech.columns)
```

Out[65]:

pandas.core.indexes.base.Index

In [66]:

```
1 #Levels
2 tech.index.nlevels
```

Out[66]:

2

In [67]:

```
1 len(tech.index.levels)
```

Out[67]:

2

In [68]:

```
1 tech.index.levels[0]
```

Out[68]:

```
Index(['2014-01-02', '2014-01-03', '2014-01-06', '2014-01-07', '2014-01-08',
      '2014-01-09', '2014-01-10', '2014-01-13', '2014-01-14', '2014-01-15',
      ...
      '2019-08-12', '2019-08-13', '2019-08-14', '2019-08-15', '2019-08-16',
      '2019-08-19', '2019-08-20', '2019-08-21', '2019-08-22', '2019-08-2
3'],
      dtype='object', name='date', length=1421)
```

In [69]:

```
1 tech.index.levels[1]
```

Out[69]:

```
Index(['AAPL', 'AMZN', 'FB', 'GOOGL', 'MSFT'], dtype='object', name='name')
```

In [70]:

```
1 #levshape -> checking the shape of the levels
2 tech.index.levshape
```

Out[70]:

(1421, 5)

In [71]:

```
1 tech.index.values
```

Out[71]:

```
array([('2014-01-02', 'FB'), ('2014-01-02', 'AAPL'),
      ('2014-01-02', 'GOOGL'), ..., ('2019-08-23', 'GOOGL'),
      ('2019-08-23', 'AMZN'), ('2019-08-23', 'FB')], dtype=object)
```

### **Adding Another Level**



In [72]:

```
1 tech.head()
```

Out[72]:

|            |       | month | year | day | open   | close  | high   | low    | volume   | volume_type |
|------------|-------|-------|------|-----|--------|--------|--------|--------|----------|-------------|
| date       | name  |       |      |     |        |        |        |        |          |             |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 | medium      |
|            | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  | low         |
|            | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  | medium      |
|            | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 | medium      |
|            | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  | medium      |

In [73]:

```
1 tech.set_index('volume_type', append=True, inplace=True)
```

In [74]:

```
1 tech.head()
```

Out[74]:

|            |       |             | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------|-------------|-------|------|-----|--------|--------|--------|--------|----------|
| date       | name  | volume_type |       |      |     |        |        |        |        |          |
| 2014-01-02 | FB    | medium      | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            | AAPL  | low         | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | GOOGL | medium      | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            | MSFT  | medium      | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
|            | AMZN  | medium      | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |

In [75]:

```
1 tech.index.nlevels
```

Out[75]:

3

In [76]:

```
1 tech.index.levels[2]
```

Out[76]:

```
Index(['high', 'low', 'medium'], dtype='object', name='volume_type')
```

**Get: jan 2019 high-value trading days**

In [77]:

```
1 tech.loc[(slice('2019-01-01', '2019-01-31'), slice(None), 'high'), :]
```

Out[77]:

|            |      |             | month | year | day | open    | close   | high    | low     | volume   |
|------------|------|-------------|-------|------|-----|---------|---------|---------|---------|----------|
| date       | name | volume_type |       |      |     |         |         |         |         |          |
| 2019-01-03 | AAPL | high        | 1     | 2019 | 3   | 143.98  | 142.19  | 145.72  | 142.00  | 91312195 |
| 2019-01-04 | AMZN | high        | 1     | 2019 | 4   | 1530.00 | 1575.39 | 1594.00 | 1518.31 | 9182575  |
| 2019-01-08 | AMZN | high        | 1     | 2019 | 8   | 1664.69 | 1656.58 | 1676.61 | 1616.61 | 8881428  |
| 2019-01-31 | AMZN | high        | 1     | 2019 | 31  | 1692.85 | 1718.73 | 1736.41 | 1679.08 | 10910338 |
|            | FB   | high        | 1     | 2019 | 31  | 165.60  | 166.69  | 171.68  | 165.00  | 77233602 |

Get: all high trading days

In [78]:

```
1 tech.xs(level=2, key='high')
```

Out[78]:

|            |       |  | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------|--|-------|------|-----|---------|---------|---------|---------|----------|
| date       | name  |  |       |      |     |         |         |         |         |          |
| 2014-01-06 | FB    |  | 1     | 2014 | 6   | 54.39   | 57.20   | 57.26   | 54.05   | 68974359 |
| 2014-01-07 | FB    |  | 1     | 2014 | 7   | 57.67   | 57.92   | 58.55   | 57.22   | 77329009 |
| 2014-01-08 | FB    |  | 1     | 2014 | 8   | 57.59   | 58.23   | 58.41   | 57.23   | 56800776 |
| 2014-01-09 | FB    |  | 1     | 2014 | 9   | 58.66   | 57.22   | 58.96   | 56.65   | 92349222 |
| 2014-01-13 | FB    |  | 1     | 2014 | 13  | 57.89   | 55.91   | 58.25   | 55.38   | 63106519 |
| ...        | ...   |  | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-04-30 | GOOGL |  | 4     | 2019 | 30  | 1190.63 | 1198.96 | 1200.98 | 1183.00 | 6658855  |
| 2019-06-03 | FB    |  | 6     | 2019 | 3   | 175.00  | 164.15  | 175.05  | 161.01  | 56059609 |
|            | AMZN  |  | 6     | 2019 | 3   | 1760.01 | 1692.69 | 1766.29 | 1672.00 | 9098708  |

Get FB high-trading days

In [79]:

```
1 tech.xs(level=(2,1), key=('high', 'FB'), drop_level=False)
```

Out[79]:

|            |      |             | month | year | day | open  | close | high  | low   | volume   |
|------------|------|-------------|-------|------|-----|-------|-------|-------|-------|----------|
| date       | name | volume_type |       |      |     |       |       |       |       |          |
| 2014-01-06 | FB   | high        | 1     | 2014 | 6   | 54.39 | 57.20 | 57.26 | 54.05 | 68974359 |
| 2014-01-07 | FB   | high        | 1     | 2014 | 7   | 57.67 | 57.92 | 58.55 | 57.22 | 77329009 |
| 2014-01-08 | FB   | high        | 1     | 2014 | 8   | 57.59 | 58.23 | 58.41 | 57.23 | 56800776 |
| 2014-01-09 | FB   | high        | 1     | 2014 | 9   | 58.66 | 57.22 | 58.96 | 56.65 | 92349222 |
| 2014-01-13 | FB   | high        | 1     | 2014 | 13  | 57.89 | 55.91 | 58.25 | 55.38 | 63106519 |
| ...        | ...  | ...         | ...   | ...  | ... | ...   | ...   | ...   | ...   | ...      |
| 2014-01-16 | FB   | high        | 1     | 2014 | 16  | 57.89 | 55.91 | 58.25 | 55.38 | 63106519 |

Get: AMZN low trading days

In [80]:

```
1 tech.loc[(slice(None), 'AMZN', 'low'), :]
```

Out[80]:

|            |      |             | month | year | day | open   | close  | high   | low    | volume  |
|------------|------|-------------|-------|------|-----|--------|--------|--------|--------|---------|
| date       | name | volume_type |       |      |     |        |        |        |        |         |
| 2014-01-07 | AMZN | low         | 1     | 2014 | 7   | 395.04 | 398.03 | 398.47 | 394.29 | 1916684 |
| 2014-01-09 | AMZN | low         | 1     | 2014 | 9   | 403.75 | 401.01 | 406.89 | 398.44 | 2103793 |
| 2014-01-22 | AMZN | low         | 1     | 2014 | 22  | 408.00 | 404.54 | 408.06 | 402.00 | 2069759 |
| 2014-03-10 | AMZN | low         | 3     | 2014 | 10  | 372.27 | 370.53 | 372.73 | 367.00 | 2107820 |
| 2014-06-04 | AMZN | low         | 6     | 2014 | 4   | 306.85 | 306.78 | 309.50 | 303.84 | 2111176 |
| ...        | ...  | ...         | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...     |
| 2014-06-04 | AMZN | low         | 6     | 2014 | 4   | 306.85 | 306.78 | 309.50 | 303.84 | 2111176 |

In [81]:

```
1 tech.loc[(slice(None), 'AMZN', 'low'), :].shape[0]
```

Out[81]:

87

Get: AMZN high trading days

In [82]:

```
1 tech.xs(level=[1,2], key=['AMZN', 'high'])
```

Out[82]:

|            | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------|------|-----|---------|---------|---------|---------|----------|
| date       |       |      |     |         |         |         |         |          |
| 2014-01-30 | 1     | 2014 | 30  | 393.77  | 403.01  | 406.25  | 387.70  | 10900116 |
| 2014-01-31 | 1     | 2014 | 31  | 372.20  | 358.69  | 375.45  | 357.76  | 16181519 |
| 2014-02-03 | 2     | 2014 | 3   | 358.99  | 346.15  | 360.85  | 340.10  | 10290934 |
| 2014-04-04 | 4     | 2014 | 4   | 335.15  | 323.00  | 335.44  | 315.61  | 12534578 |
| 2014-04-24 | 4     | 2014 | 24  | 329.98  | 337.15  | 337.40  | 322.95  | 9293735  |
| ...        | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-01-04 | 1     | 2019 | 4   | 1530.00 | 1575.39 | 1594.00 | 1518.31 | 9182575  |
| 2019-01-08 | 1     | 2019 | 8   | 1664.69 | 1656.58 | 1676.61 | 1616.61 | 8881428  |
| 2019-01-31 | 1     | 2019 | 31  | 1692.85 | 1718.73 | 1736.41 | 1679.08 | 10910338 |
| 2019-02-01 | 2     | 2019 | 1   | 1638.88 | 1626.23 | 1673.06 | 1622.01 | 11506213 |
| 2019-06-03 | 6     | 2019 | 3   | 1760.01 | 1692.69 | 1766.29 | 1672.00 | 9098708  |

74 rows × 8 columns

In [83]:

```
1 tech.xs(level=[1,2], key=['AMZN', 'high']).shape[0]
```

Out[83]:

74

In [84]:

```
1 #AMZN medium trading days
2 tech.xs(level=[1,2], key=['AMZN', 'medium'])
```

Out[84]:

|            | month | year | day | open    | close   | high    | low     | volume  |
|------------|-------|------|-----|---------|---------|---------|---------|---------|
| date       |       |      |     |         |         |         |         |         |
| 2014-01-02 | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246 |
| 2014-01-03 | 1     | 2014 | 3   | 398.29  | 396.44  | 402.71  | 396.22  | 2213512 |
| 2014-01-06 | 1     | 2014 | 6   | 396.13  | 393.63  | 397.00  | 388.42  | 3172207 |
| 2014-01-08 | 1     | 2014 | 8   | 398.47  | 401.92  | 403.00  | 396.04  | 2316903 |
| 2014-01-10 | 1     | 2014 | 10  | 402.04  | 397.66  | 403.76  | 393.80  | 2681701 |
| ...        | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...     |
| 2019-08-15 | 8     | 2019 | 15  | 1781.99 | 1776.12 | 1788.00 | 1761.96 | 3809948 |
| 2019-08-16 | 8     | 2019 | 16  | 1792.89 | 1792.57 | 1802.91 | 1784.55 | 3054240 |
| 2019-08-19 | 8     | 2019 | 19  | 1818.08 | 1816.12 | 1826.00 | 1812.61 | 2820303 |
| 2019-08-22 | 8     | 2019 | 22  | 1828.00 | 1805.60 | 1829.41 | 1800.10 | 2658388 |
| 2019-08-23 | 8     | 2019 | 23  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898 |

1260 rows × 8 columns

In [85]:

```
1 tech.xs(level=[1,2], key=['AMZN', 'medium']).shape[0]
```

Out[85]:

1260

Shuffling Levels

In [86]:

```
1 tech.head()
```

Out[86]:

|            |       |             | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------|-------------|-------|------|-----|--------|--------|--------|--------|----------|
| date       | name  | volume_type |       |      |     |        |        |        |        |          |
| 2014-01-02 | FB    | medium      | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            | AAPL  | low         | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | GOOGL | medium      | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            | MSFT  | medium      | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
|            | AMZN  | medium      | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |

swaplevel

In [87]:

```
1 tech.swaplevel(2,1)
```

Out[87]:

|            |             |       | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------------|-------|-------|------|-----|---------|---------|---------|---------|----------|
| date       | volume_type | name  |       |      |     |         |         |         |         |          |
| 2014-01-02 | medium      | FB    | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
|            | low         | AAPL  | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
|            | medium      | GOOGL | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |
|            |             | AMZN  | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
| ...        | ...         | ...   | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-08-23 | medium      | MSFT  | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
|            |             | AAPL  | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
|            |             | GOOGL | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |
|            |             | AMZN  | 8     | 2019 | 23  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898  |
|            |             | FB    | 8     | 2019 | 23  | 180.84  | 177.75  | 183.13  | 176.66  | 17331221 |

7105 rows × 8 columns

In [88]:

```
1 tech.swaplevel('volume_type', 'name')
```

Out[88]:

|            |             |       | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------------|-------|-------|------|-----|---------|---------|---------|---------|----------|
| date       | volume_type | name  |       |      |     |         |         |         |         |          |
| 2014-01-02 | medium      | FB    | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
|            | low         | AAPL  | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
|            | medium      | GOOGL | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |
|            |             | AMZN  | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
| ...        | ...         | ...   | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-08-23 | medium      | MSFT  | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
|            |             | AAPL  | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
|            |             | GOOGL | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |

In [89]:

```
1 tech = tech.swaplevel('volume_type', 'name')
```

In [90]:

```
1 tech.head()
```

Out[90]:

|            |             |       | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------------|-------|-------|------|-----|--------|--------|--------|--------|----------|
| date       | volume_type | name  |       |      |     |        |        |        |        |          |
| 2014-01-02 | medium      | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            | low         | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | medium      | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
|            |             | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |

*the alternative method:reorder\_levels()*

In [91]:

```
1 tech.reorder_levels([2,0,1])
```

Out[91]:

|       |            |             | month | year | day | open   | close  | high   | low    | volume   |
|-------|------------|-------------|-------|------|-----|--------|--------|--------|--------|----------|
| name  | date       | volume_type |       |      |     |        |        |        |        |          |
| FB    | 2014-01-02 | medium      | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
| AAPL  | 2014-01-02 | low         | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
| GOOGL | 2014-01-02 | medium      | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
| MSFT  | 2014-01-02 | medium      | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
| AMZN  | 2014-01-02 | medium      | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
| ...   | ...        | ...         | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...      |
| MSFT  | 2014-01-02 | medium      | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...      |

In [92]:

```
1 tech.index
```

Out[92]:

```
MultiIndex([('2014-01-02', 'medium', 'FB'),
            ('2014-01-02', 'low', 'AAPL'),
            ('2014-01-02', 'medium', 'GOOGL'),
            ('2014-01-02', 'medium', 'MSFT'),
            ('2014-01-02', 'medium', 'AMZN'),
            ('2014-01-03', 'medium', 'FB'),
            ('2014-01-03', 'medium', 'GOOGL'),
            ('2014-01-03', 'medium', 'MSFT'),
            ('2014-01-03', 'low', 'AAPL'),
            ('2014-01-03', 'medium', 'AMZN'),
            ...
            ('2019-08-22', 'medium', 'MSFT'),
            ('2019-08-22', 'low', 'FB'),
            ('2019-08-22', 'medium', 'AMZN'),
            ('2019-08-22', 'medium', 'AAPL'),
            ('2019-08-22', 'low', 'GOOGL'),
            ('2019-08-23', 'medium', 'MSFT'),
            ('2019-08-23', 'medium', 'AAPL'),
            ('2019-08-23', 'medium', 'GOOGL'),
            ('2019-08-23', 'medium', 'AMZN'),
            ('2019-08-23', 'medium', 'FB')],
            names=['date', 'volume_type', 'name'], length=7105)
```



In [93]:

```
1 tech.index.reorder_levels([2,0,1])
```

Out[93]:

```
MultiIndex([( 'FB', '2014-01-02', 'medium'),
            ( 'AAPL', '2014-01-02', 'low'),
            ('GOOGL', '2014-01-02', 'medium'),
            ( 'MSFT', '2014-01-02', 'medium'),
            ( 'AMZN', '2014-01-02', 'medium'),
            ( 'FB', '2014-01-03', 'medium'),
            ('GOOGL', '2014-01-03', 'medium'),
            ( 'MSFT', '2014-01-03', 'medium'),
            ( 'AAPL', '2014-01-03', 'low'),
            ( 'AMZN', '2014-01-03', 'medium'),
            ...
            ( 'MSFT', '2019-08-22', 'medium'),
            ( 'FB', '2019-08-22', 'low'),
            ( 'AMZN', '2019-08-22', 'medium'),
            ( 'AAPL', '2019-08-22', 'medium'),
            ('GOOGL', '2019-08-22', 'low'),
            ( 'MSFT', '2019-08-23', 'medium'),
            ( 'AAPL', '2019-08-23', 'medium'),
            ('GOOGL', '2019-08-23', 'medium'),
            ( 'AMZN', '2019-08-23', 'medium'),
            ( 'FB', '2019-08-23', 'medium')],
            names=['name', 'date', 'volume_type'], length=7105)
```

### Removing MultiIndex Levels

**df.drop\_levels.**  
**df.reset\_index(drop=bool)**

In [94]:

```
1 tech.droplevel(1)# does not restore the level back to the df
```

Out[94]:

|            |       | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------|-------|------|-----|---------|---------|---------|---------|----------|
| date       | name  |       |      |     |         |         |         |         |          |
| 2014-01-02 | FB    | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
|            | AAPL  | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
|            | GOOGL | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
|            | MSFT  | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |
|            | AMZN  | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
| ...        | ...   | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-08-23 | MSFT  | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
|            | AAPL  | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
|            | GOOGL | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |

In [95]:

```
1 tech.reset_index(level=1) # restores the level to the column of the dataframe because t
```

Out[95]:

|            |       | volume_type | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------|-------------|-------|------|-----|---------|---------|---------|---------|----------|
| date       | name  |             |       |      |     |         |         |         |         |          |
| 2014-01-02 | FB    | medium      | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
|            | AAPL  | low         | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
|            | GOOGL | medium      | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
|            | MSFT  | medium      | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |
|            | AMZN  | medium      | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
| ...        | ...   | ...         | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-08-23 | MSFT  | medium      | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
|            | AAPL  | medium      | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
|            | GOOGL | medium      | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |

### Removing Several levels at once

In [96]:

```
1 tech.head()
```

Out[96]:

|            |             |       | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------------|-------|-------|------|-----|--------|--------|--------|--------|----------|
| date       | volume_type | name  |       |      |     |        |        |        |        |          |
| 2014-01-02 | medium      | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            | low         | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | medium      | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
|            |             | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |

In [97]:

```
1 tech.droplevel(['volume_type', 'name'])
```

Out[97]:

|            | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------|------|-----|---------|---------|---------|---------|----------|
| date       |       |      |     |         |         |         |         |          |
| 2014-01-02 | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
| 2014-01-02 | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
| 2014-01-02 | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
| 2014-01-02 | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |
| 2014-01-02 | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
| ...        | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-08-23 | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
| 2019-08-23 | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
| 2019-08-23 | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |
| 2019-08-23 | 8     | 2019 | 23  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898  |
| 2019-08-23 | 8     | 2019 | 23  | 180.84  | 177.75  | 183.13  | 176.66  | 17331221 |

7105 rows × 8 columns

In [98]:

```
1 tech.droplevel([1, 2])
```

Out[98]:

|            | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------|------|-----|---------|---------|---------|---------|----------|
| date       |       |      |     |         |         |         |         |          |
| 2014-01-02 | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
| 2014-01-02 | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
| 2014-01-02 | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
| 2014-01-02 | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |
| 2014-01-02 | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
| ...        | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2019-08-23 | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
| 2019-08-23 | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
| 2019-08-23 | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |

In [99]:

```
1 tech.reset_index(level=[1,2], drop=False)
```

Out[99]:

|            | volume_type | name  | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------------|-------|-------|------|-----|--------|--------|--------|--------|----------|
| date       |             |       |       |      |     |        |        |        |        |          |
| 2014-01-02 | medium      | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
| 2014-01-02 | low         | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
| 2014-01-02 | medium      | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
| 2014-01-02 | medium      | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
| 2014-01-02 | medium      | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
| ...        | ...         | ...   | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...      |

In [100]:

```
1 #Total reset
2 tech.head()
```

Out[100]:

|            |        |             | month | year | day | open   | close  | high   | low    | volume   |
|------------|--------|-------------|-------|------|-----|--------|--------|--------|--------|----------|
| date       |        | volume_type | name  |      |     |        |        |        |        |          |
| 2014-01-02 | medium | FB          | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            | low    | AAPL        | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | medium | GOOGL       | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            |        | MSFT        | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
|            |        | AMZN        | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |

In [101]:

```
1 tech.reset_index()
```

Out[101]:

|      | date       | volume_type | name  | month | year | day | open   | close  | high   | low    | volume   |
|------|------------|-------------|-------|-------|------|-----|--------|--------|--------|--------|----------|
| 0    | 2014-01-02 | medium      | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
| 1    | 2014-01-02 | low         | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
| 2    | 2014-01-02 | medium      | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
| 3    | 2014-01-02 | medium      | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |
| 4    | 2014-01-02 | medium      | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
| ...  | ...        | ...         | ...   | ...   | ...  | ... | ...    | ...    | ...    | ...    | ...      |
| 7100 | 2019-08-23 | medium      | MSFT  | 8     | 2019 | 23  | 137.19 | 133.39 | 138.35 | 132.80 | 38515386 |

**MultilIndex sort\_index()**

In [102]:

```
1 tech.loc[(slice('2014-01-02', '2014-04-02'), slice(None), 'AAPL'), 'open':'low']
```

Out[102]:

|  | date       | volume_type | name | open  | close | high  | low   |
|--|------------|-------------|------|-------|-------|-------|-------|
|  | 2014-01-02 | low         | AAPL | 79.38 | 79.02 | 79.58 | 78.86 |
|  | 2014-01-03 | low         | AAPL | 79.00 | 77.28 | 79.10 | 77.20 |
|  | 2014-01-06 | low         | AAPL | 76.78 | 77.70 | 78.11 | 76.23 |
|  | 2014-01-07 | low         | AAPL | 77.76 | 77.15 | 77.99 | 76.85 |
|  | 2014-01-08 | low         | AAPL | 76.97 | 77.64 | 77.94 | 76.96 |
|  | ...        | ...         | ...  | ...   | ...   | ...   | ...   |
|  | 2014-03-27 | low         | AAPL | 77.11 | 76.78 | 77.36 | 76.45 |
|  | 2014-03-28 | low         | AAPL | 76.82 | 76.69 | 76.99 | 76.32 |
|  | 2014-03-31 | low         | AAPL | 77.03 | 76.68 | 77.26 | 76.56 |

In [103]:

```
1 tech.sort_index(inplace=True)
```

In [104]:

```
1 tech.head()
```

Out[104]:

|            |             |       | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------------|-------|-------|------|-----|--------|--------|--------|--------|----------|
| date       | volume_type | name  |       |      |     |        |        |        |        |          |
| 2014-01-02 | low         | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | medium      | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
|            |             | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            |             | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [105]:

```
1 tech.loc[(slice('2014-01-02', '2014-04-02'), slice(None), slice('AAPL', 'FB')), 'open']
```

Out[105]:

|            |             |      | open   | close  | high   | low    |
|------------|-------------|------|--------|--------|--------|--------|
| date       | volume_type | name |        |        |        |        |
| 2014-01-02 | low         | AAPL | 79.38  | 79.02  | 79.58  | 78.86  |
|            | medium      | AMZN | 398.80 | 397.97 | 399.36 | 394.02 |
|            |             | FB   | 54.86  | 54.71  | 55.22  | 54.19  |
| 2014-01-03 | low         | AAPL | 79.00  | 77.28  | 79.10  | 77.20  |
|            | medium      | AMZN | 398.29 | 396.44 | 402.71 | 396.22 |
| ...        | ...         | ...  | ...    | ...    | ...    | ...    |
| 2014-04-01 | low         | AAPL | 76.84  | 77.38  | 77.41  | 76.68  |
|            | medium      | AMZN | 338.35 | 342.99 | 344.43 | 338.00 |
| 2014-04-02 | high        | FB   | 63.24  | 62.72  | 63.91  | 62.21  |
|            | low         | AAPL | 77.48  | 77.51  | 77.64  | 77.18  |
|            | medium      | AMZN | 345.99 | 341.96 | 348.30 | 340.38 |

189 rows × 4 columns

In [106]:

```
1 tech.loc[(slice('2014-01-02', '2014-04-02'), slice(None), slice('AAPL','FB')), 'open':
```

Out[106]:

|            |             |      | open   | close  | high   | low    |
|------------|-------------|------|--------|--------|--------|--------|
| date       | volume_type | name |        |        |        |        |
| 2014-01-02 | low         | AAPL | 79.38  | 79.02  | 79.58  | 78.86  |
|            | medium      | AMZN | 398.80 | 397.97 | 399.36 | 394.02 |
|            |             | FB   | 54.86  | 54.71  | 55.22  | 54.19  |
| 2014-01-03 | low         | AAPL | 79.00  | 77.28  | 79.10  | 77.20  |
|            | medium      | AMZN | 398.29 | 396.44 | 402.71 | 396.22 |
| ...        | ...         | ...  | ...    | ...    | ...    | ...    |
| 2014-04-01 | low         | AAPL | 76.84  | 77.38  | 77.41  | 76.68  |
|            | medium      | AMZN | 338.35 | 342.99 | 344.43 | 338.00 |
| 2014-04-02 | high        | FB   | 63.24  | 62.72  | 63.91  | 62.21  |
|            | low         | AAPL | 77.48  | 77.51  | 77.64  | 77.18  |
|            | medium      | AMZN | 345.99 | 341.96 | 348.30 | 340.38 |

189 rows × 4 columns

Sorting Different Levels in Different Orders

In [107]:

```
1 tech.sort_index(level=(0,2), ascending=[False, True])
```

Out[107]:

|            |             |       | month | year | day | open    | close   | high    | low     | volume   |
|------------|-------------|-------|-------|------|-----|---------|---------|---------|---------|----------|
| date       | volume_type | name  |       |      |     |         |         |         |         |          |
| 2019-08-23 | medium      | AAPL  | 8     | 2019 | 23  | 209.43  | 202.64  | 212.05  | 201.00  | 46882843 |
|            |             | AMZN  | 8     | 2019 | 23  | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 5277898  |
|            |             | FB    | 8     | 2019 | 23  | 180.84  | 177.75  | 183.13  | 176.66  | 17331221 |
|            |             | GOOGL | 8     | 2019 | 23  | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 1813141  |
|            |             | MSFT  | 8     | 2019 | 23  | 137.19  | 133.39  | 138.35  | 132.80  | 38515386 |
| ...        | ...         | ...   | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...      |
| 2014-01-02 | low         | AAPL  | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398851  |
|            | medium      | AMZN  | 1     | 2014 | 2   | 398.80  | 397.97  | 399.36  | 394.02  | 2140246  |
|            |             | FB    | 1     | 2014 | 2   | 54.86   | 54.71   | 55.22   | 54.19   | 43257622 |
|            |             | GOOGL | 1     | 2014 | 2   | 557.73  | 556.56  | 558.88  | 554.13  | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35   | 37.16   | 37.40   | 37.10   | 30643745 |

7105 rows × 8 columns

**More MultiIndex Methods()**

In [108]:

```
1 tidx = tech.index
```

In [109]:

```
1 type(tidx)
```

Out[109]:

pandas.core.indexes.multi.MultiIndex

In [110]:

```
1 tidx.is_lexsorted() # lexicographically sorted
```

Out[110]:

True

**in lexsor; 10 comes before 7**



In [111]:

```
1 tidx.sortlevel(0, ascending=False, sort_remaining=True)
```

Out[111]:

```
(MultiIndex([('2019-08-23', 'medium', 'MSFT'),
             ('2019-08-23', 'medium', 'GOOGL'),
             ('2019-08-23', 'medium', 'FB'),
             ('2019-08-23', 'medium', 'AMZN'),
             ('2019-08-23', 'medium', 'AAPL'),
             ('2019-08-22', 'medium', 'MSFT'),
             ('2019-08-22', 'medium', 'AMZN'),
             ('2019-08-22', 'medium', 'AAPL'),
             ('2019-08-22', 'low', 'GOOGL'),
             ('2019-08-22', 'low', 'FB'),
             ...
             ('2014-01-03', 'medium', 'MSFT'),
             ('2014-01-03', 'medium', 'GOOGL'),
             ('2014-01-03', 'medium', 'FB'),
             ('2014-01-03', 'medium', 'AMZN'),
             ('2014-01-03', 'low', 'AAPL'),
             ('2014-01-02', 'medium', 'MSFT'),
             ('2014-01-02', 'medium', 'GOOGL'),
             ('2014-01-02', 'medium', 'FB'),
             ('2014-01-02', 'medium', 'AMZN'),
             ('2014-01-02', 'low', 'AAPL')]),
             names=['date', 'volume_type', 'name'], length=7105),
array([7104, 7103, 7102, ..., 2, 1, 0], dtype=int64))
```

In [112]:

```
1 tidx.sortlevel([0,1,2], ascending=[True, True, True])
```

Out[112]:

```
(MultiIndex([('2014-01-02', 'low', 'AAPL'),
             ('2014-01-02', 'medium', 'AMZN'),
             ('2014-01-02', 'medium', 'FB'),
             ('2014-01-02', 'medium', 'GOOGL'),
             ('2014-01-02', 'medium', 'MSFT'),
             ('2014-01-03', 'low', 'AAPL'),
             ('2014-01-03', 'medium', 'AMZN'),
             ('2014-01-03', 'medium', 'FB'),
             ('2014-01-03', 'medium', 'GOOGL'),
             ('2014-01-03', 'medium', 'MSFT'),
             ...
             ('2019-08-22', 'low', 'FB'),
             ('2019-08-22', 'low', 'GOOGL'),
             ('2019-08-22', 'medium', 'AAPL'),
             ('2019-08-22', 'medium', 'AMZN'),
             ('2019-08-22', 'medium', 'MSFT'),
             ('2019-08-23', 'medium', 'AAPL'),
             ('2019-08-23', 'medium', 'AMZN'),
             ('2019-08-23', 'medium', 'FB'),
             ('2019-08-23', 'medium', 'GOOGL'),
             ('2019-08-23', 'medium', 'MSFT')]),
             names=['date', 'volume_type', 'name'], length=7105),
array([ 0, 1, 2, ..., 7102, 7103, 7104], dtype=int64))
```

In [113]:

```
1 tech.head()
```

Out[113]:

|            |             |       | month | year | day | open   | close  | high   | low    | volume   |
|------------|-------------|-------|-------|------|-----|--------|--------|--------|--------|----------|
| date       | volume_type | name  |       |      |     |        |        |        |        |          |
| 2014-01-02 | low         | AAPL  | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|            | medium      | AMZN  | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
|            |             | FB    | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|            |             | GOOGL | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|            |             | MSFT  | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [114]:

```
1 tidx.names
```

Out[114]:

```
FrozenList(['date', 'volume_type', 'name'])
```

In [115]:

```
1 tidx.set_names(['Trading Date', 'Volume Category', 'Ticker'], inplace=True)
2 #also tech.index.set_names()
```

In [116]:

```
1 tidx
```

Out[116]:

```
MultiIndex([(2014-01-02, 'low', 'AAPL'),
            (2014-01-02, 'medium', 'AMZN'),
            (2014-01-02, 'medium', 'FB'),
            (2014-01-02, 'medium', 'GOOGL'),
            (2014-01-02, 'medium', 'MSFT'),
            (2014-01-03, 'low', 'AAPL'),
            (2014-01-03, 'medium', 'AMZN'),
            (2014-01-03, 'medium', 'FB'),
            (2014-01-03, 'medium', 'GOOGL'),
            (2014-01-03, 'medium', 'MSFT'),
            ...,
            (2019-08-22, 'low', 'FB'),
            (2019-08-22, 'low', 'GOOGL'),
            (2019-08-22, 'medium', 'AAPL'),
            (2019-08-22, 'medium', 'AMZN'),
            (2019-08-22, 'medium', 'MSFT'),
            (2019-08-23, 'medium', 'AAPL'),
            (2019-08-23, 'medium', 'AMZN')])
```

In [117]:

```
1 tech.head()
```

Out[117]:

|              |                 |        | month | year | day | open   | close  | high   | low    | volume   |
|--------------|-----------------|--------|-------|------|-----|--------|--------|--------|--------|----------|
| Trading Date | Volume Category | Ticker |       |      |     |        |        |        |        |          |
| 2014-01-02   | low             | AAPL   | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|              | medium          | AMZN   | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
|              |                 | FB     | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|              |                 | GOOGL  | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|              |                 | MSFT   | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [118]:

```
1 tidx.to_flat_index()
```

Out[118]:

```
Index([ ('2014-01-02', 'low', 'AAPL'), ('2014-01-02', 'medium', 'AMZN'),
        ('2014-01-02', 'medium', 'FB'), ('2014-01-02', 'medium', 'GOOGL'),
        ('2014-01-02', 'medium', 'MSFT'), ('2014-01-03', 'low', 'AAPL'),
        ('2014-01-03', 'medium', 'AMZN'), ('2014-01-03', 'medium', 'FB'),
        ('2014-01-03', 'medium', 'GOOGL'), ('2014-01-03', 'medium', 'MSFT'),
        ...
        ('2019-08-22', 'low', 'FB'), ('2019-08-22', 'low', 'GOOGL'),
        ('2019-08-22', 'medium', 'AAPL'), ('2019-08-22', 'medium', 'AMZN'),
        ('2019-08-22', 'medium', 'MSFT'), ('2019-08-23', 'medium', 'AAPL'),
        ('2019-08-23', 'medium', 'AMZN'), ('2019-08-23', 'medium', 'FB'),
        ('2019-08-23', 'medium', 'GOOGL'), ('2019-08-23', 'medium', 'MSF
T')],
      dtype='object', length=7105)
```

In [119]:

```
1 tech.close
```

Out[119]:

| Trading Date | Volume Category | Ticker |         |
|--------------|-----------------|--------|---------|
| 2014-01-02   | low             | AAPL   | 79.02   |
|              | medium          | AMZN   | 397.97  |
|              |                 | FB     | 54.71   |
|              |                 | GOOGL  | 556.56  |
|              |                 | MSFT   | 37.16   |
| 2019-08-23   |                 | ...    |         |
|              | medium          | AAPL   | 202.64  |
|              |                 | AMZN   | 1749.62 |
|              |                 | FB     | 177.75  |
|              |                 | GOOGL  | 1153.58 |
|              |                 | MSFT   | 133.39  |

Name: close, Length: 7105, dtype: float64

In [120]:

```
1 type(tech.close)
```

Out[120]:

pandas.core.series.Series

Reshaping with stack()

In [121]:

```
1 tech.head()
```

Out[121]:

|              |                 |        | month | year | day | open   | close  | high   | low    | volume   |
|--------------|-----------------|--------|-------|------|-----|--------|--------|--------|--------|----------|
| Trading Date | Volume Category | Ticker |       |      |     |        |        |        |        |          |
| 2014-01-02   | low             | AAPL   | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|              | medium          | AMZN   | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
|              |                 | FB     | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|              |                 | GOOGL  | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|              |                 | MSFT   | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [122]:

```
1 tech.stack()
```

Out[122]:

| Trading Date | Volume Category | Ticker |        |             |  |
|--------------|-----------------|--------|--------|-------------|--|
| 2014-01-02   | low             | AAPL   | month  | 1.00        |  |
|              |                 |        | year   | 2014.00     |  |
|              |                 |        | day    | 2.00        |  |
|              |                 |        | open   | 79.38       |  |
|              |                 |        | close  | 79.02       |  |
| ...          |                 |        |        |             |  |
| 2019-08-23   | medium          | MSFT   | open   | 137.19      |  |
|              |                 |        | close  | 133.39      |  |
|              |                 |        | high   | 138.35      |  |
|              |                 |        | low    | 132.80      |  |
|              |                 |        | volume | 38515386.00 |  |

Length: 56840, dtype: float64

In [123]:

```
1 type(tech.stack())
```

Out[123]:

pandas.core.series.Series

In [124]:

```
1 stacked = tech.stack()
```

In [125]:

```
1 stacked.head()
```

Out[125]:

| Trading Date | Volume | Category | Ticker |       |         |
|--------------|--------|----------|--------|-------|---------|
| 2014-01-02   | low    |          | AAPL   | month | 1.00    |
|              |        |          |        | year  | 2014.00 |
|              |        |          |        | day   | 2.00    |
|              |        |          |        | open  | 79.38   |
|              |        |          |        | close | 79.02   |

dtype: float64

In [126]:

```
1 type(stacked)
```

Out[126]:

pandas.core.series.Series

In [127]:

```
1 stacked.index.nlevels
```

Out[127]:

4

In [128]:

```
1 names = stacked.index.names
```

In [129]:

```
1 names
```

Out[129]:

FrozenList(['Trading Date', 'Volume Category', 'Ticker', None])

In [130]:

```
1 stacked.index.set_names([*names[:-1], 'Previously a Column Axis'], inplace=True)
```

In [131]:

```
1 stacked
```

Out[131]:

| Trading Date                  | Volume | Category | Ticker | Previously a Column Axis |           |
|-------------------------------|--------|----------|--------|--------------------------|-----------|
| 2014-01-02                    | low    |          | AAPL   | month                    | 1.        |
| 00                            |        |          |        | year                     | 2014.     |
| 00                            |        |          |        | day                      | 2.        |
| 00                            |        |          |        | open                     | 79.       |
| 38                            |        |          |        | close                    | 79.       |
| 02                            |        |          |        |                          | ...       |
| 2019-08-23                    | medium |          | MSFT   | open                     | 137.      |
| 19                            |        |          |        | close                    | 133.      |
| 39                            |        |          |        | high                     | 138.      |
| 35                            |        |          |        | low                      | 132.      |
| 80                            |        |          |        | volume                   | 38515386. |
| 00                            |        |          |        |                          |           |
| Length: 56840, dtype: float64 |        |          |        |                          |           |

In [132]:

```
1 stacked.head()
```

Out[132]:

| Trading Date   | Volume | Category | Ticker | Previously a Column Axis |         |
|----------------|--------|----------|--------|--------------------------|---------|
| 2014-01-02     | low    |          | AAPL   | month                    | 1.00    |
|                |        |          |        | year                     | 2014.00 |
|                |        |          |        | day                      | 2.00    |
|                |        |          |        | open                     | 79.38   |
|                |        |          |        | close                    | 79.02   |
| dtype: float64 |        |          |        |                          |         |

**Unstack()**

In [133]:

```
1 tech.head()
```

Out[133]:

|              |                 |        | month | year | day | open   | close  | high   | low    | volume   |
|--------------|-----------------|--------|-------|------|-----|--------|--------|--------|--------|----------|
| Trading Date | Volume Category | Ticker |       |      |     |        |        |        |        |          |
| 2014-01-02   | low             | AAPL   | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
|              | medium          | AMZN   | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
|              |                 | FB     | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
|              |                 | GOOGL  | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
|              |                 | MSFT   | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [134]:

```
1 stacked.index.nlevels
```

Out[134]:

4

In [135]:

```
1 stacked
```

Out[135]:

| Trading Date                  | Volume Category | Ticker | Previously a Column Axis |         |
|-------------------------------|-----------------|--------|--------------------------|---------|
| 2014-01-02                    | low             | AAPL   | month                    |         |
| 1.00                          |                 |        |                          |         |
|                               |                 |        | year                     | 201     |
| 4.00                          |                 |        |                          |         |
|                               |                 |        | day                      |         |
| 2.00                          |                 |        |                          |         |
|                               |                 |        | open                     | 7       |
| 9.38                          |                 |        |                          |         |
|                               |                 |        | close                    | 7       |
| 9.02                          |                 |        |                          |         |
|                               |                 |        |                          | ...     |
| 2019-08-23                    | medium          | MSFT   | open                     | 13      |
| 7.19                          |                 |        |                          |         |
|                               |                 |        | close                    | 13      |
| 3.39                          |                 |        |                          |         |
|                               |                 |        | high                     | 13      |
| 8.35                          |                 |        |                          |         |
|                               |                 |        | low                      | 13      |
| 2.80                          |                 |        |                          |         |
|                               |                 |        | volume                   | 3851538 |
| 6.00                          |                 |        |                          |         |
| Length: 56840, dtype: float64 |                 |        |                          |         |

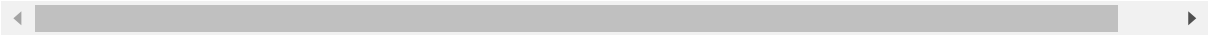
In [136]:

```
1 stacked.unstack()
```

Out[136]:

|                 |                    |        | Previously<br>a Column<br>Axis | month  | year | day     | open    | close   | high    | low    | volume |
|-----------------|--------------------|--------|--------------------------------|--------|------|---------|---------|---------|---------|--------|--------|
| Trading<br>Date | Volume<br>Category | Ticker |                                |        |      |         |         |         |         |        |        |
| 2014-01-02      | low                | AAPL   | 1.0                            | 2014.0 | 2.0  | 79.38   | 79.02   | 79.58   | 78.86   | 83988  |        |
|                 | medium             | AMZN   | 1.0                            | 2014.0 | 2.0  | 398.80  | 397.97  | 399.36  | 394.02  | 21402  |        |
|                 |                    | FB     | 1.0                            | 2014.0 | 2.0  | 54.86   | 54.71   | 55.22   | 54.19   | 432576 |        |
|                 |                    | GOOGL  | 1.0                            | 2014.0 | 2.0  | 557.73  | 556.56  | 558.88  | 554.13  | 18227  |        |
|                 |                    | MSFT   | 1.0                            | 2014.0 | 2.0  | 37.35   | 37.16   | 37.40   | 37.10   | 306437 |        |
| ...             | ...                | ...    | ...                            | ...    | ...  | ...     | ...     | ...     | ...     | ...    |        |
| 2019-08-23      | medium             | AAPL   | 8.0                            | 2019.0 | 23.0 | 209.43  | 202.64  | 212.05  | 201.00  | 468828 |        |
|                 |                    | AMZN   | 8.0                            | 2019.0 | 23.0 | 1793.03 | 1749.62 | 1804.90 | 1745.23 | 52778  |        |
|                 |                    | FB     | 8.0                            | 2019.0 | 23.0 | 180.84  | 177.75  | 183.13  | 176.66  | 173312 |        |
|                 |                    | GOOGL  | 8.0                            | 2019.0 | 23.0 | 1185.17 | 1153.58 | 1195.67 | 1150.00 | 18131  |        |
|                 |                    | MSFT   | 8.0                            | 2019.0 | 23.0 | 137.19  | 133.39  | 138.35  | 132.80  | 385153 |        |

7105 rows × 8 columns



*unstack() does the opposite of stack()*



In [137]:

```
1 stacked.unstack().unstack()
```

Out[137]:

|                 |                    | Previously<br>a Column<br>Axis | month |      | year |       |        |        |        |        |        |      |
|-----------------|--------------------|--------------------------------|-------|------|------|-------|--------|--------|--------|--------|--------|------|
|                 |                    | Ticker                         | AAPL  | AMZN | FB   | GOOGL | MSFT   | AAPL   | AMZN   | FB     | GOOGL  | MSFT |
| Trading<br>Date | Volume<br>Category |                                |       |      |      |       |        |        |        |        |        |      |
| 2014-01-02      | low                | 1.0                            | NaN   | NaN  | NaN  | NaN   | NaN    | 2014.0 | NaN    | NaN    | NaN    | Na   |
|                 | medium             | NaN                            | 1.0   | 1.0  | 1.0  | 1.0   | NaN    | 2014.0 | 2014.0 | 2014.0 | 2014.0 | 2014 |
| 2014-01-03      | low                | 1.0                            | NaN   | NaN  | NaN  | NaN   | NaN    | 2014.0 | NaN    | NaN    | NaN    | Na   |
|                 | medium             | NaN                            | 1.0   | 1.0  | 1.0  | 1.0   | NaN    | 2014.0 | 2014.0 | 2014.0 | 2014.0 | 2014 |
| 2014-01-06      | high               | NaN                            | NaN   | 1.0  | NaN  | NaN   | NaN    | NaN    | NaN    | 2014.0 | NaN    | Na   |
| ...             | ...                | ...                            | ...   | ...  | ...  | ...   | ...    | ...    | ...    | ...    | ...    | ...  |
| 2019-08-21      | low                | NaN                            | 8.0   | 8.0  | 8.0  | 8.0   | NaN    | 2019.0 | 2019.0 | 2019.0 | 2019.0 | 2019 |
|                 | medium             | 8.0                            | NaN   | NaN  | NaN  | NaN   | NaN    | 2019.0 | NaN    | NaN    | NaN    | Na   |
| 2019-08-22      | low                | NaN                            | NaN   | 8.0  | 8.0  | NaN   | NaN    | NaN    | NaN    | 2019.0 | 2019.0 | Na   |
|                 | medium             | 8.0                            | 8.0   | NaN  | NaN  | 8.0   | 2019.0 | 2019.0 | NaN    | NaN    | NaN    | 2019 |
| 2019-08-23      | medium             | 8.0                            | 8.0   | 8.0  | 8.0  | 8.0   | 2019.0 | 2019.0 | 2019.0 | 2019.0 | 2019.0 | 2019 |

2090 rows × 40 columns



In [138]:

```
1 stacked.unstack().unstack(fill_value=-1)# fill value can also be a string, the level po
```

Out[138]:

|                 |                    | Previously<br>a Column<br>Axis | month |      |      |       |      | year   |        |        |        |        |
|-----------------|--------------------|--------------------------------|-------|------|------|-------|------|--------|--------|--------|--------|--------|
|                 |                    | Ticker                         | AAPL  | AMZN | FB   | GOOGL | MSFT | AAPL   | AMZN   | FB     | GOOGL  | MSFT   |
| Trading<br>Date | Volume<br>Category |                                |       |      |      |       |      |        |        |        |        |        |
| 2014-01-02      | low                |                                | 1.0   | -1.0 | -1.0 | -1.0  | -1.0 | 2014.0 | -1.0   | -1.0   | -1.0   | -1.0   |
|                 | medium             |                                | -1.0  | 1.0  | 1.0  | 1.0   | 1.0  | -1.0   | 2014.0 | 2014.0 | 2014.0 | 2014.0 |
| 2014-01-03      | low                |                                | 1.0   | -1.0 | -1.0 | -1.0  | -1.0 | 2014.0 | -1.0   | -1.0   | -1.0   | -1.0   |
|                 | medium             |                                | -1.0  | 1.0  | 1.0  | 1.0   | 1.0  | -1.0   | 2014.0 | 2014.0 | 2014.0 | 2014.0 |
| 2014-01-06      | high               |                                | -1.0  | -1.0 | 1.0  | -1.0  | -1.0 | -1.0   | -1.0   | 2014.0 | -1.0   | -1.0   |
| ...             | ...                |                                | ...   | ...  | ...  | ...   | ...  | ...    | ...    | ...    | ...    | ...    |
| 2019-08-21      | low                |                                | -1.0  | 8.0  | 8.0  | 8.0   | 8.0  | -1.0   | 2019.0 | 2019.0 | 2019.0 | 2019.0 |
|                 | medium             |                                | 8.0   | -1.0 | -1.0 | -1.0  | -1.0 | 2019.0 | -1.0   | -1.0   | -1.0   | -1.0   |
| 2019-08-22      | low                |                                | -1.0  | -1.0 | 8.0  | 8.0   | -1.0 | -1.0   | -1.0   | 2019.0 | 2019.0 | -1.0   |
|                 | medium             |                                | 8.0   | 8.0  | -1.0 | -1.0  | 8.0  | 2019.0 | 2019.0 | -1.0   | -1.0   | 2019.0 |
| 2019-08-23      | medium             |                                | 8.0   | 8.0  | 8.0  | 8.0   | 8.0  | 2019.0 | 2019.0 | 2019.0 | 2019.0 | 2019.0 |

2090 rows × 40 columns

Creating MultiLevel Columns Manually

In [139]:

```
1 stacked.head()
```

Out[139]:

| Trading Date   | Volume Category | Ticker | Previously a Column Axis |         |
|----------------|-----------------|--------|--------------------------|---------|
| 2014-01-02     | low             | AAPL   | month                    | 1.00    |
|                |                 |        | year                     | 2014.00 |
|                |                 |        | day                      | 2.00    |
|                |                 |        | open                     | 79.38   |
|                |                 |        | close                    | 79.02   |
|                |                 |        |                          |         |
| dtype: float64 |                 |        |                          |         |

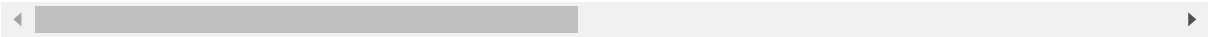
In [140]:

```
1 stacked.unstack().unstack()
```

Out[140]:

| Trading Date | Volume Category | Previously a Column Axis |      |      |     |       |      |        |        |        |        |
|--------------|-----------------|--------------------------|------|------|-----|-------|------|--------|--------|--------|--------|
|              |                 | Ticker                   | AAPL | AMZN | FB  | GOOGL | MSFT | AAPL   | AMZN   | FB     | GOOGL  |
| 2014-01-02   | low             |                          | 1.0  | NaN  | NaN | NaN   | NaN  | 2014.0 | NaN    | NaN    | NaN    |
|              | medium          |                          | NaN  | 1.0  | 1.0 | 1.0   | 1.0  | NaN    | 2014.0 | 2014.0 | 2014.0 |
| 2014-01-03   | low             |                          | 1.0  | NaN  | NaN | NaN   | NaN  | 2014.0 | NaN    | NaN    | NaN    |
|              | medium          |                          | NaN  | 1.0  | 1.0 | 1.0   | 1.0  | NaN    | 2014.0 | 2014.0 | 2014.0 |
| 2014-01-06   | high            |                          | NaN  | NaN  | 1.0 | NaN   | NaN  | NaN    | NaN    | 2014.0 | NaN    |
| ...          | ...             |                          | ...  | ...  | ... | ...   | ...  | ...    | ...    | ...    | ...    |
| 2019-08-21   | low             |                          | NaN  | 8.0  | 8.0 | 8.0   | 8.0  | NaN    | 2019.0 | 2019.0 | 2019.0 |
|              | medium          |                          | 8.0  | NaN  | NaN | NaN   | NaN  | 2019.0 | NaN    | NaN    | NaN    |
| 2019-08-22   | low             |                          | NaN  | NaN  | 8.0 | 8.0   | NaN  | NaN    | NaN    | 2019.0 | 2019.0 |
|              | medium          |                          | 8.0  | 8.0  | NaN | NaN   | 8.0  | 2019.0 | 2019.0 | NaN    | NaN    |
| 2019-08-23   | medium          |                          | 8.0  | 8.0  | 8.0 | 8.0   | 8.0  | 2019.0 | 2019.0 | 2019.0 | 2019.0 |

2090 rows × 40 columns



Build Manually

- criteria:
- 2 level multiindex column axis, containing:
  - trading volume(high and low) and tickers(MSFT & AMZN)
  - 10 random closing price observations

In [141]:

```
1 tech.reset_index(inplace=True)
```

In [142]:

```
1 tech.head()
```

Out[142]:

|   | Trading Date | Volume Category | Ticker | month | year | day | open   | close  | high   | low    | volume   |
|---|--------------|-----------------|--------|-------|------|-----|--------|--------|--------|--------|----------|
| 0 | 2014-01-02   | low             | AAPL   | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
| 1 | 2014-01-02   | medium          | AMZN   | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
| 2 | 2014-01-02   | medium          | FB     | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
| 3 | 2014-01-02   | medium          | GOOGL  | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
| 4 | 2014-01-02   | medium          | MSFT   | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [143]:

```
1 #Step 1: Create multiindex
2 pd.MultiIndex.from_product([['low', 'high'], ['MSFT', 'AMZN']],
3                             names=['Volume Category', 'Ticker'])
```

Out[143]:

```
MultiIndex([( 'low', 'MSFT'),
            ( 'low', 'AMZN'),
            ('high', 'MSFT'),
            ('high', 'AMZN')],
           names=['Volume Category', 'Ticker'])
```

In [144]:

```
1 cols = pd.MultiIndex.from_product([['low', 'high'], ['MSFT', 'AMZN']],
2                                   names=['Volume Category', 'Ticker'])
```

In [145]:

```
1 cols
```

Out[145]:

```
MultiIndex([( 'low', 'MSFT'),
            ( 'low', 'AMZN'),
            ('high', 'MSFT'),
            ('high', 'AMZN')],
           names=['Volume Category', 'Ticker'])
```

In [146]:

```
1 #Step 2: prep the underlying data
2 low = tech['Volume Category'] == 'low'
3 high= tech['Volume Category'] == 'high'
4 amzn = tech.Ticker == 'AMZN'
5 msft = tech.Ticker == 'MSFT'
```

In [147]:

```
1 tech[tech['Volume Category'] == 'low']
```

Out[147]:

|      | Trading Date | Volume Category | Ticker | month | year | day | open    | close   | high    | low     | volume |
|------|--------------|-----------------|--------|-------|------|-----|---------|---------|---------|---------|--------|
| 0    | 2014-01-02   | low             | AAPL   | 1     | 2014 | 2   | 79.38   | 79.02   | 79.58   | 78.86   | 8398   |
| 5    | 2014-01-03   | low             | AAPL   | 1     | 2014 | 3   | 79.00   | 77.28   | 79.10   | 77.20   | 14043  |
| 11   | 2014-01-06   | low             | AAPL   | 1     | 2014 | 6   | 76.78   | 77.70   | 78.11   | 76.23   | 14765  |
| 16   | 2014-01-07   | low             | AAPL   | 1     | 2014 | 7   | 77.76   | 77.15   | 77.99   | 76.85   | 11347  |
| 17   | 2014-01-07   | low             | AMZN   | 1     | 2014 | 7   | 395.04  | 398.03  | 398.47  | 394.29  | 1916   |
| ...  | ...          | ...             | ...    | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...    |
| 7091 | 2019-08-21   | low             | FB     | 8     | 2019 | 21  | 185.00  | 183.55  | 185.90  | 183.14  | 8409   |
| 7092 | 2019-08-21   | low             | GOOGL  | 8     | 2019 | 21  | 1195.82 | 1191.58 | 1200.56 | 1187.92 | 708    |
| 7093 | 2019-08-21   | low             | MSFT   | 8     | 2019 | 21  | 138.55  | 138.79  | 139.49  | 138.00  | 14982  |
| 7095 | 2019-08-22   | low             | FB     | 8     | 2019 | 22  | 183.43  | 182.04  | 184.11  | 179.91  | 10829  |
| 7096 | 2019-08-22   | low             | GOOGL  | 8     | 2019 | 22  | 1193.80 | 1191.52 | 1198.78 | 1178.91 | 867    |

597 rows × 11 columns



In [148]:

```
1 tech.head()
```

Out[148]:

|   | Trading Date | Volume Category | Ticker | month | year | day | open   | close  | high   | low    | volume   |
|---|--------------|-----------------|--------|-------|------|-----|--------|--------|--------|--------|----------|
| 0 | 2014-01-02   | low             | AAPL   | 1     | 2014 | 2   | 79.38  | 79.02  | 79.58  | 78.86  | 8398851  |
| 1 | 2014-01-02   | medium          | AMZN   | 1     | 2014 | 2   | 398.80 | 397.97 | 399.36 | 394.02 | 2140246  |
| 2 | 2014-01-02   | medium          | FB     | 1     | 2014 | 2   | 54.86  | 54.71  | 55.22  | 54.19  | 43257622 |
| 3 | 2014-01-02   | medium          | GOOGL  | 1     | 2014 | 2   | 557.73 | 556.56 | 558.88 | 554.13 | 1822719  |
| 4 | 2014-01-02   | medium          | MSFT   | 1     | 2014 | 2   | 37.35  | 37.16  | 37.40  | 37.10  | 30643745 |

In [149]:

```
1 tech.loc[(tech['Volume Category']=='low') & (tech['Ticker']=='AMZN')]
```

Out[149]:

|      | Trading Date | Volume Category | Ticker | month | year | day | open    | close   | high    | low     | volum  |
|------|--------------|-----------------|--------|-------|------|-----|---------|---------|---------|---------|--------|
| 17   | 2014-01-07   | low             | AMZN   | 1     | 2014 | 7   | 395.04  | 398.03  | 398.47  | 394.29  | 191668 |
| 27   | 2014-01-09   | low             | AMZN   | 1     | 2014 | 9   | 403.75  | 401.01  | 406.89  | 398.44  | 210379 |
| 67   | 2014-01-22   | low             | AMZN   | 1     | 2014 | 22  | 408.00  | 404.54  | 408.06  | 402.00  | 206975 |
| 227  | 2014-03-10   | low             | AMZN   | 3     | 2014 | 10  | 372.27  | 370.53  | 372.73  | 367.00  | 210782 |
| 526  | 2014-06-04   | low             | AMZN   | 6     | 2014 | 4   | 306.85  | 306.78  | 309.50  | 303.84  | 211117 |
| ...  | ...          | ...             | ...    | ...   | ...  | ... | ...     | ...     | ...     | ...     | ...    |
| 5395 | 2018-04-17   | low             | AMZN   | 4     | 2018 | 17  | 1445.00 | 1441.50 | 1447.00 | 1427.48 | 7167   |
| 5521 | 2018-05-22   | low             | AMZN   | 5     | 2018 | 22  | 1589.89 | 1581.40 | 1589.89 | 1575.25 | 211563 |
| 6921 | 2019-07-03   | low             | AMZN   | 7     | 2019 | 3   | 1935.89 | 1939.00 | 1941.59 | 1930.50 | 169029 |
| 7085 | 2019-08-20   | low             | AMZN   | 8     | 2019 | 20  | 1814.50 | 1801.38 | 1816.82 | 1799.88 | 193283 |
| 7090 | 2019-08-21   | low             | AMZN   | 8     | 2019 | 21  | 1819.39 | 1823.54 | 1829.58 | 1815.00 | 203923 |

87 rows × 11 columns

In [150]:

```
1 tech.loc[(tech['Volume Category']=='low') & (tech['Ticker']=='AMZN')].close.sample(10).
```

Out[150]:

```
array([1801.38, 436.04, 780.37, 310.3 , 1186.1 , 854.59, 559.44,
       386.04, 847.38, 339.04])
```

In [151]:

```
1 tech.loc[low & amzn].close.sample(10).values
```

Out[151]:

```
array([ 849.88, 423.67, 853.42, 401.01, 426.95, 1823.54, 426.87,
       1801.38, 370.53, 770.6 ])
```

In [152]:

```
1 tech.loc[low & msft].close.sample(10).values
```

Out[152]:

```
array([126.24,  99.05, 120.77,  64.93, 103.07, 137.46, 119.93,  63.28,  
       73.16,  85.51])
```

In [153]:

```
1 data = [  
2     tech[low & msft].close.sample(10).values,  
3     tech[low & amzn].close.sample(10).values,  
4     tech[high & msft].close.sample(10).values,  
5     tech[high & amzn].close.sample(10).values  
6 ]
```

In [154]:

```
1 tech[low & msft].close.sample(10).values
```

Out[154]:

```
array([ 63.24, 103.07,  65.39,  64.41,  74.68,  53.93,  73.98, 109.67,  
       47.88,  77.91])
```

In [155]:

```
1 data = [ [*i] for i in zip(*data)]
```

In [156]:

```
1 data
```

Out[156]:

```
[[85.72, 335.78, 102.32, 1692.69],  
 [99.05, 436.29, 43.07, 987.71],  
 [64.41, 535.02, 88.18, 1460.83],  
 [120.77, 1186.1, 50.99, 296.58],  
 [103.07, 771.24, 44.53, 1495.46],  
 [65.68, 310.35, 106.16, 599.03],  
 [72.72, 430.99, 42.66, 1429.95],  
 [57.6, 1441.5, 43.48, 1046.0],  
 [65.39, 1581.4, 52.06, 1699.19],  
 [47.45, 404.54, 41.68, 299.9]]
```

In [157]:

```
1 df = pd.DataFrame(data, columns=cols)
```



In [158]:

```
1 df
```

Out[158]:

| Volume Category | low    |        | high    |        |         |
|-----------------|--------|--------|---------|--------|---------|
|                 | Ticker | MSFT   | AMZN    | MSFT   | AMZN    |
| 0               |        | 85.72  | 335.78  | 102.32 | 1692.69 |
| 1               |        | 99.05  | 436.29  | 43.07  | 987.71  |
| 2               |        | 64.41  | 535.02  | 88.18  | 1460.83 |
| 3               |        | 120.77 | 1186.10 | 50.99  | 296.58  |
| 4               |        | 103.07 | 771.24  | 44.53  | 1495.46 |
| 5               |        | 65.68  | 310.35  | 106.16 | 599.03  |
| 6               |        | 72.72  | 430.99  | 42.66  | 1429.95 |
| 7               |        | 57.60  | 1441.50 | 43.48  | 1046.00 |
| 8               |        | 65.39  | 1581.40 | 52.06  | 1699.19 |
| 9               |        | 47.45  | 404.54  | 41.68  | 299.90  |

In [ ]:

```
1
```