Data Processing Using Python

Basic Data Processing of Python

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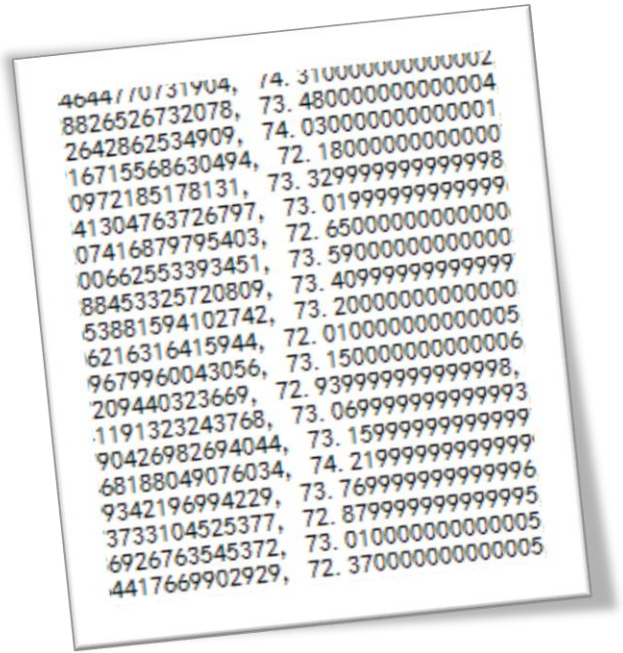
Basic Data Processing Procedure

Data Processing Using Python

1 DATA COLLECTION

Fetch Data with Python



How to get local data?

Open, read/write, close of file

- File open
- File read
- File write
- File close

Fetch Data with Python

rmbol	Company Name	Pric
OK	Nokia Corporation	8.4
APL	Apple Inc.	104.7
AC	Bank of America Cor…	16.6
	AT&T, Inc.	33.5
BR	Petr	12.5
QQ	PowerShares QQQ	97.9
B	Facebook, Inc.	80.0
IIO	iBio, Inc.	1.4
ELP	Yelp, Inc.	58.5
IFN	Infinera Corporation	13.0
SFT	Microsoft Corporation	44.7
O	The Coca-Cola Comp…	41.2
FE	Pfizer Inc	28.8

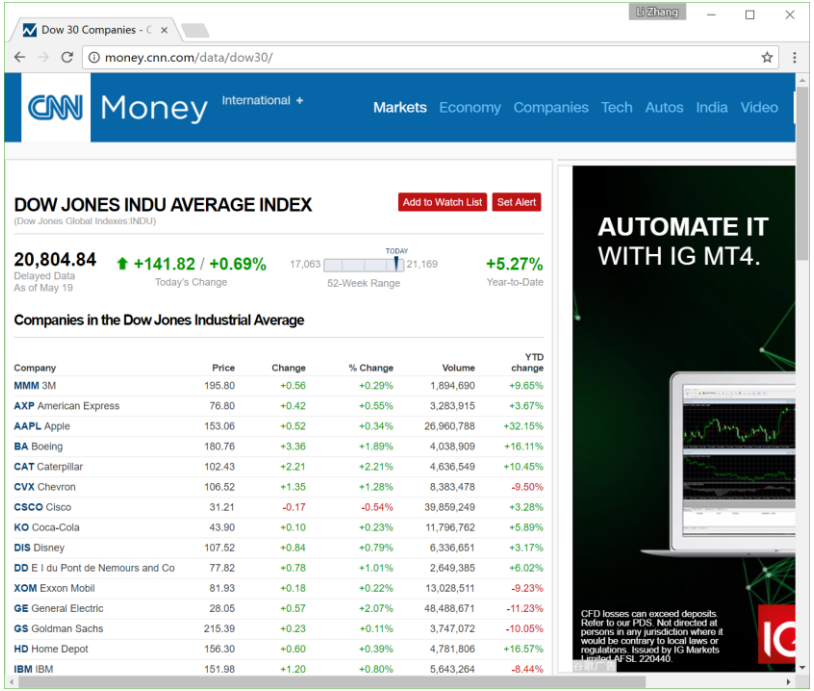
How to get (crawl) data from net?

Crawl pages and interpret content

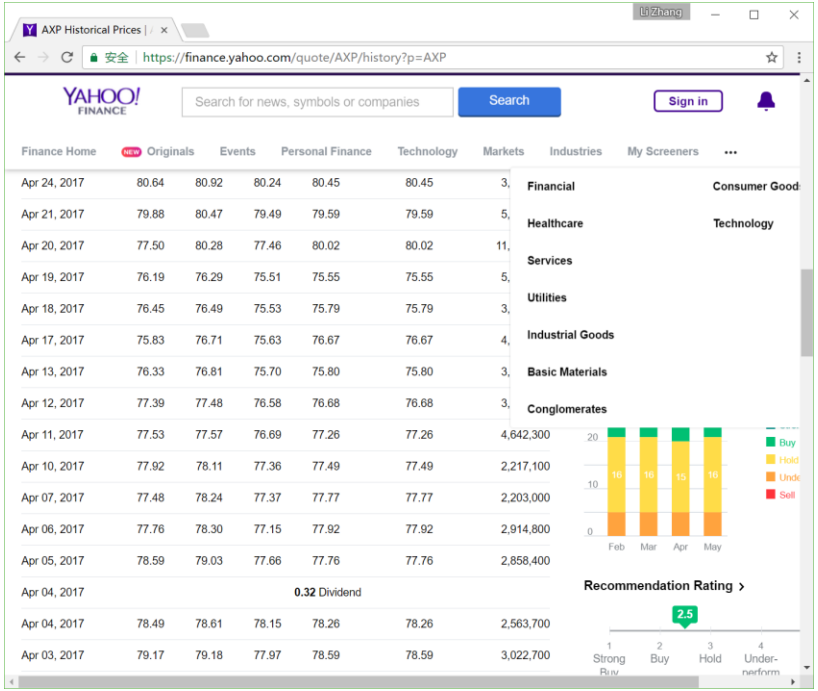
- Crawling
  - **Urllib** built-in module
    - urllib.request
  - **Requests**

    (third party library)
  - **Scrapy** framework
- Interpreting
  - **BeautifulSoup** library
  - **re** module

Dow Jones Constituent



dji



quotes

Data Format

0		1	2
0	MMM	3M	195.8
1	AXP	American Express	76.8
2	AAPL	Apple	153.06
3	BA	Boeing	180.76
4	CAT	Caterpillar	102.43
5	CVX	Chevron	106.52
6	CSCO	Cisco	31.21
7	KO	Coca-Cola	43.9
8	DIS	Disney	107.52
9	DD	E I du Pont de Nemours	77.82
10	XOM	Exxon Mobil	81.93
11	GE	General Electric	28.05
12	GS	Goldman Sachs	215.39
13	HD	Home Depot	156.3
14	IBM	IBM	151.98
15	INTC	Intel	35.4
16	JNJ	Johnson & Johnson	127
17	JPM	JPMorgan Chase	84.78
18	MCD	McDonald's	148.15
19	MRK	Merck	63.78
20	MSFT	Microsoft	67.69
21	NKE	Nike	51.77
22	PFE	Pfizer	32.46
23	PG	Procter & Gamble	86.24
24	TRV	Travelers Companies Inc	120.79
25	UTX	United Technologies	121.16
26	UNH	UnitedHealth	172.59
27	VZ	Verizon	45.42
28	V	Visa	92.48
29	WMT	Wal-Mart	78.77

djidf

	close	date	high	low	open	volume
0	76.8	1495200600	77.35	76.3	76.55	3278200
1	76.38	1495114200	76.85	75.97	76.27	3545700
2	76.37	1495027800	78.13	76.24	78.13	4441600
3	78.13	1494941400	78.64	77.84	78.6	2457500
4	78.33	1494855000	78.62	77.48	77.48	3327000
5	77.49	1494595800	77.81	77.22	77.7	2865800
6	77.92	1494509400	78.45	77.25	78.2	3780600
7	78.65	1494423000	78.66	78.14	78.28	2396900
8	78.44	1494336600	78.74	78.09	78.16	2570600
9	78.16	1494250200	78.74	77.95	78.5	2608600
10	78.32	1493991000	78.73	77.88	78.61	2936700
11	78.33	1493904600	79.42	77.99	79.23	3902200
12	78.83	1493818200	79.51	78.69	79.23	3800600
13	79.54	1493731800	79.66	79.15	79.15	3334900
14	79.23	1493645400	79.49	78.88	79.22	3458100
15	79.25	1493386200	80.17	79.05	79.94	5313200
16	80.33	1493299800	80.87	80.08	80.77	2922700
17	80.52	1493213400	80.92	80.15	80.62	3661600
18	80.63	1493127000	81.4	80.63	81.06	5061300
19	80.45	1493040600	80.92	80.24	80.64	3563200
20	79.59	1492781400	80.47	79.49	79.88	5837800

quotesdf

Easier Approach to Data

How to easily and rapidly fetch historical data of companies from financial websites?

Time Period: May 20, 2016 - May 20, 2017 Show: Historical Prices Frequency: Daily Apply

Currency in USD

Download Data

Date	Open	High	Low	Close	Adj Clos	Volume
2016/5/20	63.16	64.14	62.95	63.92	63.92	5278200
2016/5/23	63.86	64.1	63.56	63.59	63.59	3074100
2016/5/24	63.79	65.1	63.79	64.87	64.87	3946100
2016/5/25	65.04	65.76	65.01	65.31	65.31	5755900
2016/5/26	65.29	65.37	64.95	65.23	65.23	3593500
2016/5/27	65.39	65.7	65.33	65.52	65.52	3925700
2016/5/31	65.7	65.92	65.4	65.76	65.76	5256000

File

```
# Filename: quotes_fromcsv.py
import pandas as pd
quotesdf = pd.read_csv('axp.csv')
print(quotesdf)
```

Easier Approach to Data

图书Api V2

回Api V2 首页

注意： 1. 下文中提到的图书并不包括杂志。 2. count最大为100，大于100的

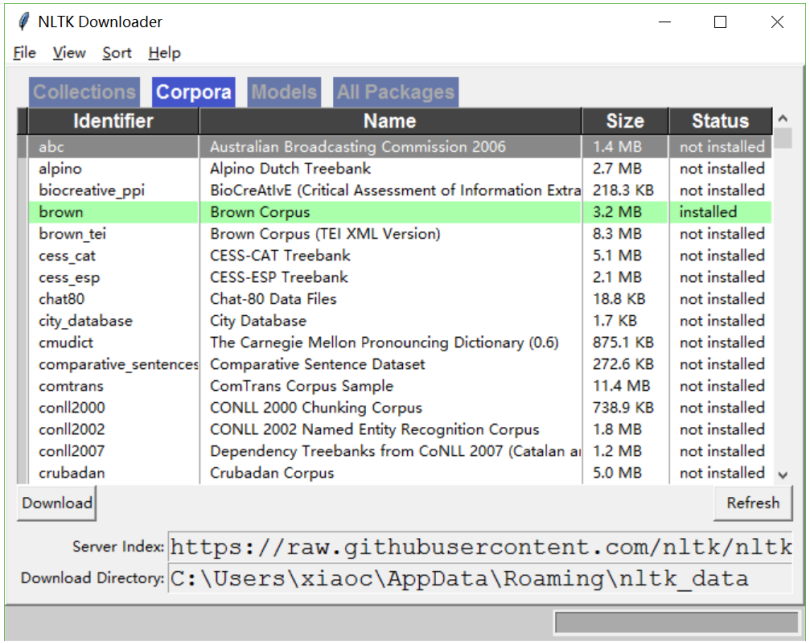
scope: book_basic_r

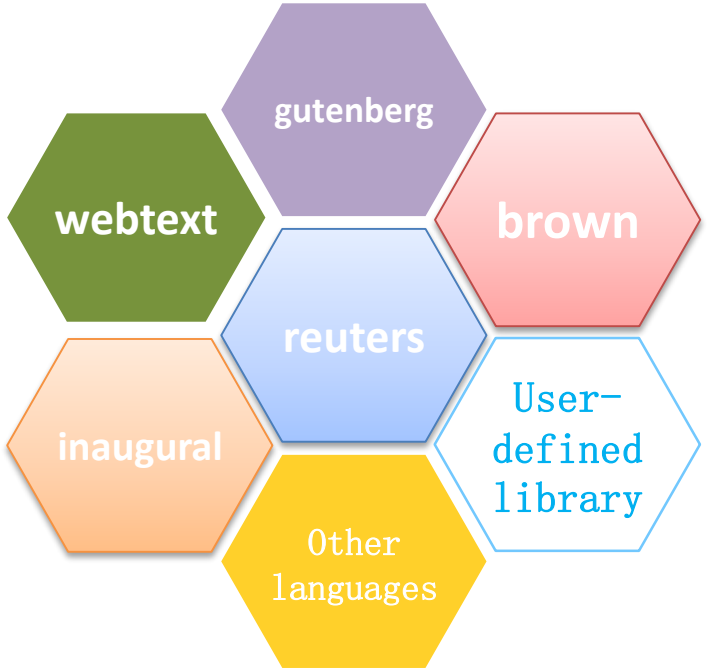
获取图书信息	GET	/v2/book/:id
根据isbn获取图书信息	GET	/v2/book/isbn/:name
搜索图书	GET	/v2/book/search

Source

```
>>> r = requests.get('https://api.douban.com/v2/book/1084336')
>>> r.text
'{"rating":{"max":10,"numRaters":218148,"average":"9.0","min":0
},"subtitle":"","author":["[法] 圣埃克苏佩里"],"pubdate":"2003-
8","tags":[{"count":52078,"name":"小王子","title":"小王子
"},{"count":43966,"name":"童话", … , "price":"22.00元"}'
```

NLTK library





Easier Approach to Data


```
>>> from nltk.corpus import gutenberg
>>> import nltk
>>> print(gutenberg.fileids())
['austen-emma.txt', 'austen-persuasion.txt', 'austen-sense.txt', 'bible-kjv.txt', 'blake-poems.txt', 'bryant-stories.txt', 'burgess-busterbrown.txt', 'carroll-alice.txt', 'chesterton-ball.txt', 'chesterton-brown.txt', 'chesterton-thursday.txt', 'edgeworth-parents.txt', 'melville-moby_dick.txt', 'milton-paradise.txt', 'shakespeare-caesar.txt', 'shakespeare-hamlet.txt', 'shakespeare-macbeth.txt', 'whitman-leaves.txt']
>>> texts = gutenberg.words('shakespeare-hamlet.txt')
>>> print(texts)
['[', 'The', 'Tragedie', 'of', 'Hamlet', 'by', ...]
```

brown

DATA PREPARATION

Data Format

Logical structure of 30 dji constituent stocks' historical data

Company Code	Company Name	Latest price

Logical structure of American Express stock data

Closing price	Date	Highest price	Lowest Price	Opening Price	Volume

Data Arrangement

Add column indices for djidf

File

```
# Filename: stock.py
import requests
import re
import pandas as pd
def retrieve_dji_list():
    …
    return dji_list
dji_list = retrieve_dji_list()
djidf = pd.DataFrame(dji_list)
cols = ['code', 'name', 'lasttrade']
djidf.columns = cols
print(quotesdf)
```

0		1	2
0	MMM	3M	195.8
1	AXP	American Express	76.8
2	AAPL	Apple	153.06
3	BA	Boeing	180.76
4	CAT	Caterpillar	102.43
5	CVX	Chevron	106.52
6	CSCO	Cisco	31.21
7	KO	Coca-Cola	43.9
8	DIS	Disney	107.52
9	DD	E I du Pont de Nemours	77.82
10	XOM	Exxon Mobil	81.93
11	GE	General Electric	28.05
12	GS	Goldman Sachs	215.39
13	HD	Home Depot	156.3
14	IBM	IBM	151.98
15	INTC	Intel	35.4
16	JNJ	Johnson & Johnson	127
17	JPM	JPMorgan Chase	84.78
18	MCD	McDonald's	148.15
19	MRK	Merck	63.78
20	MSFT	Microsoft	67.69
21	NKE	Nike	51.77
22	PFE	Pfizer	32.46
23	PG	Procter & Gamble	86.24
24	TRV	Travelers Companies Inc	120.79
25	UTX	United Technologies	121.16
26	UNH	UnitedHealth	172.59
27	VZ	Verizon	45.42
28	V	Visa	92.48
29	WMT	Wal-Mart	78.77

Data Arrangement

djidf : after adding columns

code	name	lasttrade
MMM		
AXP		
AAPL		
…		
WMT		

Quotesdf: Original data has columns

close	date	high	low	open	volume
	1464010200				
	1464096600				
	1464183000				
	…				
	1495200600				

Data Arrangement

Use 1,2,… as index (row indices)

```
quotesdf = pd.DataFrame(quotes)
```

```
quotesdf.index = range(1,len(quotes)+1)
```

	close	date	high	low	open	volume
0	63.590000	1464010200	64.099998	63.560001	63.860001	3074100
1	64.870003	1464096600	65.099998	63.790001	63.790001	3946100
2	65.309998	1464183000	65.760002	65.010002	65.040001	5755900
3	65.230003	1464269400	65.370003	64.949997	65.290001	3593500
4	65.519997	1464355800	65.699997	65.330002	65.389999	3925700

	close	date	high	low	open	volume
1	63.590000	1464010200	64.099998	63.560001	63.860001	3074100
2	64.870003	1464096600	65.099998	63.790001	63.790001	3946100
3	65.309998	1464183000	65.760002	65.010002	65.040001	5755900
4	65.230003	1464269400	65.370003	64.949997	65.290001	3593500
5	65.519997	1464355800	65.699997	65.330002	65.389999	3925700

Data Arrangement

If directly use data as index, could the time in quotes be converted into ordinary form? (as is shown in picture)

1464010200

	close	high	low	open	volume
2016-05-23	63.590000	64.099998	63.560001	63.860001	3074100
2016-05-24	64.870003	65.099998	63.790001	63.790001	3946100
2016-05-25	65.309998	65.760002	65.010002	65.040001	5755900
2016-05-26	65.230003	65.370003	64.949997	65.290001	3593500
2016-05-27	65.519997	65.699997	65.330002	65.389999	3925700
2016-05-31	65.760002	65.919998	65.400002	65.699997	5256000
2016-06-01	65.910004	65.959999	65.180000	65.760002	3816000
2016-06-02	66.410004	66.410004	65.599998	65.860001	3052200
2016-06-03	65.489998	65.820000	64.769997	65.529999	4336100
2016-06-06	65.940002	66.199997	65.500000	65.550003	3915200
2016-06-07	65.889999	66.599998	65.879997	66.150002	3779500
2016-06-08	66.260002	66.580002	65.940002	65.940002	2601100

Source

```
>>> from datetime import date
>>> firstday = date.fromtimestamp(1464010200)
>>> lastday = date.fromtimestamp(1495200600)
>>> firstday
datetime.date(2016, 5, 23)
>>> lastday
datetime.date(2017, 5, 19)
```

Time Sequence

File

```
# Filename: quotes_history_v2.py
def retrieve_quotes_historical(stock_code):
        …
      return  [item for item in quotes if not 'type' in item]
quotes = retrieve_quotes_historical('AXP')
list1 = []
for i in range(len(quotes)):
   x = date.fromtimestamp(quotes[i]['date'])
   y = date.strftime(x,'%Y-%m-%d')
   list1.append(y)
quotesdf_ori = pd.DataFrame(quotes, index = list1)
quotesdf_m = quotesdf_ori.drop(['unadjclose'], axis = 1)
quotesdf = quotesdf_m.drop(['date'], axis = 1)
print(quotesdf)
```

Convert into ordinary time

Convert into fixed format

Delete unadjclose column

Delete date column

Create Time Sequence

Source

```
>>> import pandas as pd
>>> dates = pd.date_range('20170520', periods=7)
>>> dates
<class 'pandas.tseries.index.DatetimeIndex'>
[2017-05-20, ..., 2017-05-26]
Length: 7, Freq: D, Timezone: None
>>> import numpy as np
>>> datesdf = pd.DataFrame(np.random.randn(7,3), index=dates, columns = list('ABC'))
>>> datesdf
                   A         B         C
2017-05-20  1.302600 -1.214708  1.411628
2017-05-21 -0.512343  2.277474  0.403811
2017-05-22 -0.788498 -0.217161  0.173284
2017-05-23  1.042167 -0.453329 -2.107163
2017-05-24 -1.628075  1.663377  0.943582
2017-05-25 -0.091034  0.335884  2.455431
2017-05-26 -0.679055 -0.865973  0.246970
```

3

DATA DISPLAY

Data Display

djidf

	code	name	lasttrade
0	MMM	3M	195.80
1	AXP	American Express	76.80
2	AAPL	Apple	153.06
3	BA	Boeing	180.76
4	CAT	Caterpillar	102.43
5	CVX	Chevron	106.52
6	CSCO	Cisco	31.21
7	KO	Coca-Cola	43.90
8	DIS	Disney	107.52
9	DD	E I du Pont de Nemours and Co	77.82
10	XOM	Exxon Mobil	81.93
11	GE	General Electric	28.05
12	GS	Goldman Sachs	215.39
13	HD	Home Depot	156.30
14	IBM	IBM	151.98
15	INTC	Intel	35.40
16	JNJ	Johnson & Johnson	127.00
17	JPM	JPMorgan Chase	84.78
18	MCD	McDonald's	148.15
19	MRK	Merck	63.78
20	MSFT	Microsoft	67.69
21	NKE	Nike	51.77
22	PFE	Pfizer	32.46
23	PG	Procter & Gamble	86.24
24	TRV	Travelers Companies Inc	120.79
25	UTX	United Technologies	121.16
26	UNH	UnitedHealth	172.59
27	VZ	Verizon	45.42
28	V	Visa	92.48
29	WMT	Wal-Mart	78.77

quotesdf

	close	high	low	open	volume
2016-05-23	63.590000	64.099998	63.560001	63.860001	3074100
2016-05-24	64.870003	65.099998	63.790001	63.790001	3946100
2016-05-25	65.309998	65.760002	65.010002	65.040001	5755900
2016-05-26	65.230003	65.370003	64.949997	65.290001	3593500
2016-05-27	65.519997	65.699997	65.330002	65.389999	3925700
2016-05-31	65.760002	65.919998	65.400002	65.699997	5256000
2016-06-01	65.910004	65.959999	65.180000	65.760002	3816000
2016-06-02	66.410004	66.410004	65.599998	65.860001	3052200
2016-06-03	65.489998	65.820000	64.769997	65.529999	4336100
2016-06-06	65.940002	66.199997	65.500000	65.550003	3915200
2016-06-07	65.889999	66.599998	65.879997	66.150002	3779500
2016-06-08	66.260002	66.580002	65.940002	65.940002	2601100
2016-06-09	65.709999	65.779999	64.900002	65.720001	3883800
2016-06-10	64.970001	65.480003	64.709999	65.260002	3939100
2016-06-13	63.669998	64.889999	63.630001	64.800003	5883400
2016-06-14	61.070000	63.660000	60.380001	63.590000	12323200
2016-06-15	61.419998	62.160000	60.860001	61.470001	5979900

Data Display

Display method:

- Show row indices
- Show column indices
- Show the value of data
- Show the description of data

Source

```
>>> list(djidf.index)
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
23, 24, 25, 26, 27, 28, 29]
>>> list(djidf.columns)
['code', 'name', 'lasttrade']
>>> dijdf.values
array([['MMM', '3M', 195.8],
       ...,
       ['WMT', 'Wal-Mart', 78.77]], dtype=object)
>>> djidf.describe
<bound method NDFrame.describe of    code       name  lasttrade
0                                MM         3M     195.80
...,
29                              WMT   Wal-Mart      78.77>
```

Data Display

Format of Data

Source

```
>>> djidf.lasttrade
1    199.54
2     77.44
3    153.87
...
30    78.31
Name: lasttrade, dtype: float64
```

```
dji_list = []
for item in dji_list_in_text:
    dji_list.append([item[0], item[1], float(item[2])])
```

Data Display

Show the basic information of first 5 and last 5 stocks in DJI constituent

Display :

- Row Display
  - Specific way
  - Slice
- Column Display

Source

djidf[:5]

```
>>> djidf.head(5)
    code                name  lasttrade
0   MMM                   3M     195.80
1    AXP     American Express      76.80
2   AAPL                Apple     153.06
3     BA               Boeing     180.76
4    CAT           Caterpillar     102.43
```

djidf[-5:]

```
>>> djidf.tail(5)
    code                name  lasttrade
25   UTX  United Technologies     121.16
26   UNH         UnitedHealth     172.59
27    VZ              Verizon      45.42
28     V                 Visa      92.48
29   WMT             Wal-Mart      78.77
```

Data Processing Using Python

DATA SELECTION

Data Selection

	code	name	lasttrade
0	MMM	3M	195.80
1	AXP	American Express	76.80
2	AAPL	Apple	153.06
3	BA	Boeing	180.76
4	CAT	Caterpillar	102.43
5	CVX	Chevron	106.52
6	CSCO	Cisco	31.21
7	KO	Coca-Cola	43.90
8	DIS	Disney	107.52
9	DD	E I du Pont de Nemours and Co	77.82
10	XOM	Exxon Mobil	81.93
11	GE	General Electric	28.05
12	GS	Goldman Sachs	215.39
13	HD	Home Depot	156.30
14	IBM	IBM	151.98
15	INTC	Intel	35.40
16	JNJ	Johnson & Johnson	127.00
17	JPM	JPMorgan Chase	84.78
18	MCD	McDonald's	148.15
19	MRK	Merck	63.78
20	MSFT	Microsoft	67.69
21	NKE	Nike	51.77
22	PFE	Pfizer	32.46
23	PG	Procter & Gamble	86.24
24	TRV	Travelers Companies Inc	120.79
25	UTX	United Technologies	121.16
26	UNH	UnitedHealth	172.59
27	VZ	Verizon	45.42
28	V	Visa	92.48
29	WMT	Wal-Mart	78.77

Way of selection :

- Row selection
- Column selection
- Area selection
- Condition selection

	close	high	low	open	volume
2016-05-23	63.590000	64.099998	63.560001	63.860001	3074100
2016-05-24	64.870003	65.099998	63.790001	63.790001	3946100
2016-05-25	65.309998	65.760002	65.010002	65.040001	5755900
2016-05-26	65.230003	65.370003	64.949997	65.290001	3593500
2016-05-27	65.519997	65.699997	65.330002	65.389999	3925700
2016-05-31	65.760002	65.919998	65.400002	65.699997	5256000
2016-06-01	65.910004	65.959999	65.180000	65.760002	3816000
2016-06-02	66.410004	66.410004	65.599998	65.860001	3052200
2016-06-03	65.489998	65.820000	64.769997	65.529999	4336100
2016-06-06	65.940002	66.199997	65.500000	65.550003	3915200
2016-06-07	65.889999	66.599998	65.879997	66.150002	3779500
2016-06-08	66.260002	66.580002	65.940002	65.940002	2601100
2016-06-09	65.709999	65.779999	64.900002	65.720001	3883800
2016-06-10	64.970001	65.480003	64.709999	65.260002	3939100
2016-06-13	63.669998	64.889999	63.630001	64.800003	5883400
2016-06-14	61.070000	63.660000	60.380001	63.590000	12323200
2016-06-15	61.419998	62.160000	60.860001	61.470001	5979900

Data Selection

The stock information of American Express from 2017/5/1 to 2017/5/5 ?

Way of selection :

- Row Selection
  - Slicing
  - Indexing

Source

```
>>> quotesdf['2017-05-01':'2017-05-05']
```

	close	high	low	open	volume
2017-05-01	79.230003	79.489998	78.879997	79.220001	3458100
2017-05-02	79.540001	79.660004	79.150002	79.150002	3334900
2017-05-03	78.830002	79.510002	78.690002	79.230003	3800600
2017-05-04	78.330002	79.419998	77.989998	79.230003	3902200
2017-05-05	78.320000	78.730003	77.879997	78.610001	2936700

Data Selection

The code of DJI constituent companies ?

Way of Selection :

- Column Selection
  - By Column Name

Source

```
>>> djidf['code']
0       MMM
1       AXP
2       AAPL
...
29      WMT
Name: code, dtype: object
>>> djidf.code
0       MMM
1       AXP
2       AAPL
...
29      WMT
Name: code, dtype: object
```

Infeasible:

djidf['code', 'lasttrade']

djidf['code':'lasttrade']

Data Selection

1. Show stock information of DJI constituent companies whose row index is between 1 and 5.
2. Show the code of all stocks and their last trade price.

Way of Selection :

- Row & Column
  - label (loc)

Source

```
>>> djidf.loc[1:5,]
   code                 name  lasttrade
1   AXP     American Express      76.80
2  AAPL                Apple     153.06
3    BA               Boeing     180.76
4   CAT           Caterpillar     102.43
5   CVX              Chevron     106.52
>>> djidf.loc[:, ['code','lasttrade']]
    code  lasttrade
0   MMM      195.80
1    AXP      76.80
2   AAPL     153.06
...
29   WMT      78.77
```

Data Selection

1. The code and last trade of stocks whose row index is between 1 and 5.
2. The last trade of stock whose row index is 1.

Way of Selection :

- Area in row and column
  - label (loc)
- A single value
  - at

Source

```
>>> djidf.loc[1:5, ['code','lasttrade']]
    code  lasttrade
1    AXP      76.80
2   AAPL     153.06
3     BA     180.76
4    CAT     102.43
5    CVX     106.52
>>> djidf.loc[1, 'lasttrade']
76.799999999999997
>>> djidf.at[1, 'lasttrade']
76.799999999999997
```

Data Selection

Way of Selection :

- Row, column and area
  - iloc (location)
- At a point
  - iat

Source

```
>>> djidf.loc[1:5,['code','lasttrade']]
    code  lasttrade
1    AXP       76.80
2   AAPL      153.06
3     BA      180.76
4    CAT      102.43
5    CVX      106.52
```

Source

```
>>> djidf.loc[1,'lasttrade']
76.799999999999997
>>> djidf.at[1,'lasttrade']
76.799999999999997
```

If use [1:6, 0:2], then the column index will choose column 0 and 1

Source

```
>>> djidf.iloc[1:6,[0,2]]
    code  lasttrade
1    AXP       76.80
2   AAPL      153.06
3     BA      180.76
4    CAT      102.43
5    CVX      106.52
```

Source

```
>>> djidf.iloc[1,2]
76.799999999999997
>>> djidf.iat[1,2]
76.799999999999997
```

Data Selection

1. Stock information of American Express during March 2017.
2. Find all records whose close price are higher than 80 during 1st season, 2017.

Way of selection :

- Conditional filtering

Source

```
>>> quotesdf[(quotesdf.index >= '2017-03-01') & (quotesdf.index <= '2017-03-31')]
                close       high        low       open   volume
2017-03-01  81.919998  82.000000  81.019997  81.050003  4746400
2017-03-02  80.099998  81.660004  80.059998  81.660004  4409800
...
2017-03-31  79.110001  79.430000  78.800003  78.930000  5228400
>>> quotesdf[(quotesdf.index >= '2017-01-01') & (quotesdf.index <= '2017-03-31') & (quotesdf.close >= 80)]
                open       close       high        low   volume
2017-02-23  80.050003  80.449997  79.769997  79.870003  3339500
2017-02-27  80.169998  80.309998  79.589996  79.750000  2619400
2017-02-28  80.059998  80.489998  79.769997  80.120003  4415300
2017-03-01  81.919998  82.000000  81.019997  81.050003  4746400
2017-03-02  80.099998  81.660004  80.059998  81.660004  4409800
```

Data Processing Using Python

5 BASIC STATISTICS

Basic Statistics and Filtering

1. Compute the average of last trade price for all 30 DJI constituents.
2. Select the name of all companies whose last trade price are higher than 180.

Source

```
>>> djidf.lasttrade.mean()
101.26500000000001
>>> djidf[djidf.lasttrade >= 180].name
0                3M
3            Boeing
12    Goldman Sachs
Name: name, dtype: object
```

Basic Statistics and Filtering

Compute the total number of rise and fall days in form.

Source

```
>>> len(quotesdf[quotesdf.close > quotesdf.open])
123
>>> len(quotesdf)-123
128
```

Compute the number of rise and fall days according to close price of every adjacent pair of days.

Source

```
>>> status = np.sign(np.diff(quotesdf.close))
>>> status
array([ 1.,  1., -1., ..., -1.,  1.,  1.])
>>> status[np.where( status == 1.)].size
132
>>> status[np.where( status == -1.)].size
118
```

Sorting

Sort 30 DJI constituent stocks according to the last trade price, and choose the first three companies.

Source

```
>>> tempdf = djidf.sort_values(by = 'lasttrade', ascending = False)
      code                 name     lasttrade
12      GS        Goldman Sachs        215.39
0      MMM                   3M        195.80
3       BA                Boeing        180.76
26     UNH          UnitedHealth        172.59
...
>>> tempdf[:3].name
12    Goldman Sachs
0                3M
3             Boeing
Name: name, dtype: object
```

Counting

Calculate the number of opening days during January 2017.

Source

```
>>> t = quotesdf[(quotesdf.index >= '2017-01-01')  &  (quotesdf.index < '2017-02-01')]
>>> len(t)
20
```

Counting

Calculate the number of opening days for each month in the past year.

File

```
# Filename: quotes_month.py
import time
...
listtemp = []
for i in range(len(quotesdf)):
    temp = time.strptime(quotesdf.index[i],"%Y-%m-%d")
    listtemp.append(temp.tm_mon)
tempdf = quotesdf.copy()
tempdf['month'] = listtemp
print(tempdf['month'].value_counts())
```

	close	high	low	open	volume	month
2016-05-24	64.870003	65.099998	63.790001	63.790001	3946100	5
2016-05-25	65.309998	65.760002	65.010002	65.040001	5755900	5
2016-05-26	65.230003	65.370003	64.949997	65.290001	3593500	5
2016-05-27	65.519997	65.699997	65.330002	65.389999	3925700	5
2016-05-31	65.760002	65.919998	65.400002	65.699997	5256000	5
2016-06-01	65.910004	65.959999	65.180000	65.760002	3816000	6
2016-06-02	66.410004	66.410004	65.599998	65.860001	3052200	6

Output:

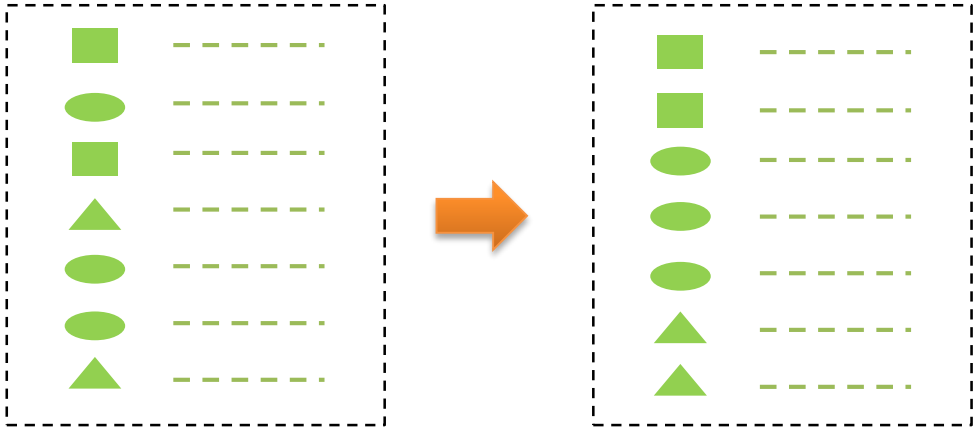
```
8    23
3    23
6    22
12   21
11   21
10   21
9    21
5    21
7    20
1    20
4    19
2    19
Name: month,
dtype: int64
```

Data Processing Using Python

6

GROUPING

Grouping



Order of Grouping

① Splitting

② Applying

③ Combining

Grouping

Calculate the number of opening days for each month in the past year.

Source

	close	high	low	open	volume	month
2016-05-24	64.870003	65.099998	63.790001	63.790001	3946100	5
2016-05-25	65.309998	65.760002	65.010002	65.040001	5755900	5
2016-05-26	65.230003	65.370003	64.949997	65.290001	3593500	5
2016-05-27	65.519997	65.699997	65.330002	65.389999	3925700	5
2016-05-31	65.760002	65.919998	65.400002	65.699997	5256000	5
2016-06-01	65.910004	65.959999	65.180000	65.760002	3816000	6
2016-06-02	66.410004	66.410004	65.599998	65.860001	3052200	6

```
>>> x = tempdf.groupby('month').count()
       close  high  low  open  volume
month
1         20    20   20    20      20
2         19    19   19    19      19
3         23    23   23    23      23
...
11        21    21   21    21      21
12        21    21   21    21      21
>>> x.close
```

Output:

```
month
1     20
2     19
3     23
4     19
5     21
6     22
7     20
8     23
9     21
10    21
11    21
12    21
Name: month, dtype: int64
```

Grouping

Calculate the total volume of each month in the past year.

Source

```
>>> tempdf.groupby('month').sum().volume
month
1      103887100
2       65816600
3       98700800
4       77893800
...
10     116243400
11      99527200
12      75948200
Name: volume, dtype: float64
```

mean()

min()

max()

...

Grouping

Calculate the total volume of each month in the past year faster?

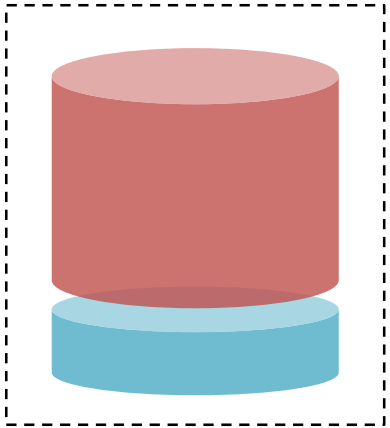

```
tempdf.groupby('month').sum().volume
```

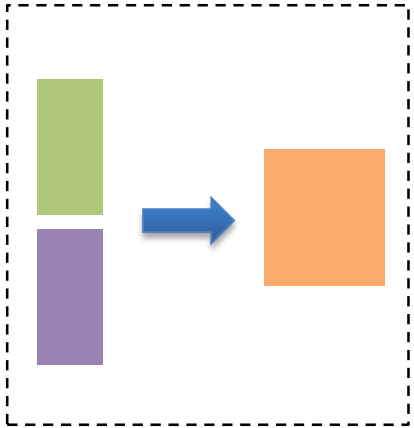
```
>>> tempdf.groupby('month').volume.sum()
month
1     103887100
2      65816600
3      98700800
4      77893800
...
12     75948200
Name: volume, dtype: float64
```

Data Processing Using Python

MERGE

Merge





Form of Merge

- Append
  - add additional row into DataFrame
- Concat
  - Connect pandas objects
- Join
  - Connect SQL type

Append

Merge the trade information between January 1st and 5th into the record of first two days in the past year.

Source

```
>>> p = quotesdf[:2]
>>> p
                open       close        high         low   volume
2016-05-23  63.590000  64.099998  63.560001  63.860001  3074100
2016-05-24  64.870003  65.099998  63.790001  63.790001  3946100
>>> q = quotesdf['2017-01-01':'2017-01-05']
>>> q
                open       close        high         low   volume
2017-01-03  75.349998  75.750000  74.739998  74.889999  5853900
2017-01-04  76.260002  76.550003  75.059998  75.260002  4635800
2017-01-05  75.320000  76.180000  74.820000  76.000000  3383000
>>> p.append(q)
                open       close        high         low   volume
2016-05-23  63.590000  64.099998  63.560001  63.860001  3074100
2016-05-24  64.870003  65.099998  63.790001  63.790001  3946100
2017-01-03  75.349998  75.750000  74.739998  74.889999  5853900
2017-01-04  76.260002  76.550003  75.059998  75.260002  4635800
2017-01-05  75.320000  76.180000  74.820000  76.000000  3383000
```

Concat

Merge the first 5 and last 5 records of stock information in the past year.

Source

```
>>> pieces = [tempdf[:5], tempdf[len(tempdf)-5:]]
>>> pd.concat(pieces)
```

	open	close	high	low	volume	month
2016-05-23	63.590000	64.099998	63.560001	63.860001	3074100	5
2016-05-24	64.870003	65.099998	63.790001	63.790001	3946100	5
2016-05-25	65.309998	65.760002	65.010002	65.040001	5755900	5
2016-05-26	65.230003	65.370003	64.949997	65.290001	3593500	5
2016-05-27	65.519997	65.699997	65.330002	65.389999	3925700	5
2017-05-15	78.330002	78.620003	77.480003	77.480003	3327000	5
2017-05-16	78.129997	78.639999	77.839996	78.599998	2457500	5
2017-05-17	76.370003	78.129997	76.239998	78.129997	4441600	5
2017-05-18	76.379997	76.849998	75.970001	76.269997	3545700	5
2017-05-19	76.800003	77.349998	76.300003	76.550003	3278200	5

Concat

Can two objects with different logical structures be merged together?

objs	axis
join	join_axes
keys	levels
names	verify_integrity
ignore_index	

Source

```
>>> piece1 = quotesdf[:3]
>>> piece2 = tempdf[:3]
>>> pd.concat([piece1,piece2], ignore_index = True)
```

	close	high	low	month	open	volume
0	63.590000	64.099998	63.560001	NaN	63.860001	3074100
1	64.870003	65.099998	63.790001	NaN	63.790001	3946100
2	65.309998	65.760002	65.010002	NaN	65.040001	5755900
3	63.590000	64.099998	63.560001	5.0	63.860001	3074100
4	64.870003	65.099998	63.790001	5.0	63.790001	3946100
5	65.309998	65.760002	65.010002	5.0	65.040001	5755900

Join

code	name
AXP	
KO	

volume	code	month
	AXP	
	AXP	
	KO	
	KO	

code	name	volume	month
AXP			
AXP			
KO			
KO			

Join

Merge the monthly volume information of American Express and Coca-Cola with DJI constituents information。

code|name|volume|month

	code	name	lasttrade
0	MMM	3M	195.80
1	AXP	American Express	76.80
2	AAPL	Apple	153.06
3	BA	Boeing	180.76
4	CAT	Caterpillar	102.43
5	CVX	Chevron	106.52
6	CSCO	Cisco	31.21
7	KO	Coca-Cola	43.90
8	DIS	Disney	107.52
9	DD	E I du Pont de Nemours and Co	77.82
10	XOM	Exxon Mobil	81.93
11	GE	General Electric	28.05
12	GS	Goldman Sachs	215.39
13	HD	Home Depot	156.30
14	IBM	IBM	151.98
15	INTC	Intel	35.40
16	JNJ	Johnson & Johnson	127.00
17	JPM	JPMorgan Chase	84.78
18	MCD	McDonald's	148.15
19	MRK	Merck	63.78
20	MSFT	Microsoft	67.69
21	NKE	Nike	51.77
22	PFE	Pfizer	32.46
23	PG	Procter & Gamble	86.24
24	TRV	Travelers Companies Inc	120.79
25	UTX	United Technologies	121.16
26	UNH	UnitedHealth	172.59
27	VZ	Verizon	45.42
28	V	Visa	92.48
29	WMT	Wal-Mart	78.77

djidf

month	volume	code	month
1	103887100	AXP	1
2	65816600	AXP	2
3	98700800	AXP	3
4	77893800	AXP	4
5	76209200	AXP	5
6	121788800	AXP	6
7	90064900	AXP	7
8	77514100	AXP	8
9	95572800	AXP	9
10	116243400	AXP	10
11	99527200	AXP	11
12	75948200	AXP	12
1	240321400	KO	1
2	333983800	KO	2
3	339185400	KO	3
4	232465400	KO	4
5	239687800	KO	5
6	265483400	KO	6
7	235959400	KO	7
8	235118300	KO	8
9	251007200	KO	9
10	264839100	KO	10
11	316557000	KO	11
12	283871000	KO	12

AKdf

Join

Source

```
>>> pd.merge(djidf.drop(['lasttrade'], axis = 1), AKdf, on = 'code')
```

	code	name	volume	month
0	AXP	American Express	103887100	1
1	AXP	American Express	65816600	2
2	AXP	American Express	98700800	3
3	AXP	American Express	77893800	4
4	AXP	American Express	76209200	5
…				
19	KO	Coca-Cola	235118300	8
20	KO	Coca-Cola	251007200	9
21	KO	Coca-Cola	264839100	10
22	KO	Coca-Cola	316557000	11
23	KO	Coca-Cola	283871000	12

	code	name	volume	month
0	AXP	American Express	103887100	1
1	AXP	American Express	65816600	2
2	AXP	American Express	98700800	3
3	AXP	American Express	77893800	4
4	AXP	American Express	76209200	5
5	AXP	American Express	121788800	6
6	AXP	American Express	90064900	7
7	AXP	American Express	77514100	8
8	AXP	American Express	95572800	9
9	AXP	American Express	116243400	10
10	AXP	American Express	99527200	11
11	AXP	American Express	75948200	12
12	KO	Coca-Cola	240321400	1
13	KO	Coca-Cola	333983800	2
14	KO	Coca-Cola	339185400	3
15	KO	Coca-Cola	232465400	4
16	KO	Coca-Cola	239687800	5
17	KO	Coca-Cola	265483400	6
18	KO	Coca-Cola	235959400	7
19	KO	Coca-Cola	235118300	8
20	KO	Coca-Cola	251007200	9
21	KO	Coca-Cola	264839100	10
22	KO	Coca-Cola	316557000	11
23	KO	Coca-Cola	283871000	12

Parameter of merge()

left	right	how
on	left_on	right_on
left_index	right_index	sort
suffixes	copy	