Pandas分组与聚合1.分组 (groupby)一、GroupBy对象：DataFrameGroupBy，SeriesGroupBy二、GroupBy对象支持迭代操作三、GroupBy对象可以转换成

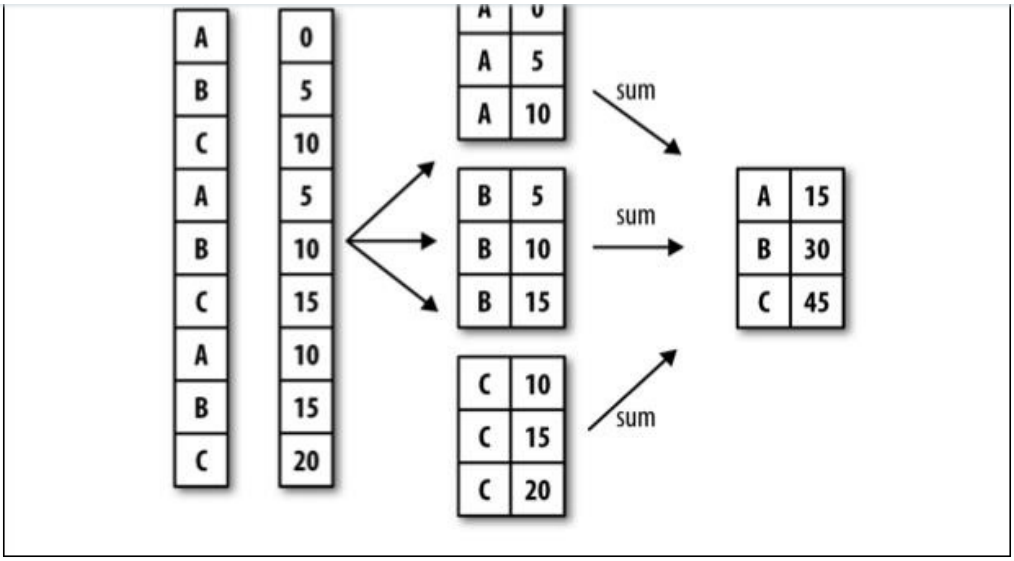
意气相许的许 发表于 Python攻城狮

文章来源：Python数据分析

1.分组 (groupby)

- 对数据集进行分组，然后对每组进行统计分析
- SQL能够对数据进行过滤，分组聚合
- pandas能利用groupby进行更加复杂的分组运算
- 分组运算过程：split->apply->combine

    - 拆分：进行分组的根据
    - 应用：每个分组运行的计算规则
    - 合并：把每个分组的计算结果合并起来



示例代码：

```
import pandas as pd
import numpy as np

dict_obj = {'key1' : ['a', 'b', 'a', 'b',
                      'a', 'b', 'a', 'a'],
            'key2' : ['one', 'one', 'two', 'three',
                      'two', 'two', 'one', 'three'],
            'data1': np.random.randn(8),
            'data2': np.random.randn(8)}
df_obj = pd.DataFrame(dict_obj)
print(df_obj)
```

运行结果：

```
      data1     data2 key1   key2
0  0.974685 -0.672494    a    one
1 -0.214324  0.758372    b    one
2  1.508838  0.392787    a    two
3  0.522911  0.630814    b  three
4  1.347359 -0.177858    a    two
5 -0.264616  1.017155    b    two
6 -0.624708  0.450885    a    one
7 -1.019229 -1.143825    a  three
```

一、GroupBy对象：DataFrameGroupBy，SeriesGroupBy

1. 分组操作

> groupby()进行分组，GroupBy对象没有进行实际运算，只是包含分组的中间数据
>
> 按列名分组：obj.groupby(‘label’)

示例代码：

```
# dataframe的 data1 列根据 key1 进行分组
print(type(df_obj['data1'].groupby(df_obj['key1'])))
```

运行结果：

```
<class 'pandas.core.groupby.DataFrameGroupBy'>
<class 'pandas.core.groupby.SeriesGroupBy'>
```

2. 分组运算

> 对GroupBy对象进行分组运算/多重分组运算，如mean()
>
> 非数值数据不进行分组运算

示例代码：

```
# 分组运算
grouped1 = df_obj.groupby('key1')
print(grouped1.mean())

grouped2 = df_obj['data1'].groupby(df_obj['key1'])
print(grouped2.mean())
```

运行结果：

```
          data1     data2
key1
a      0.437389 -0.230101
b      0.014657  0.802114
key1
a    0.437389
b    0.014657
Name: data1, dtype: float64
```

> size() 返回每个分组的元素个数

示例代码：

```
# size
print(grouped1.size())
print(grouped2.size())
```

运行结果：

```
b    3
dtype: int64
key1
a    5
b    3
dtype: int64
```


3. 按自定义的key分组

> obj.groupby(self_def_key)
>
> 自定义的key可为列表或多层列表
>
> obj.groupby([‘label1’, ‘label2’])->多层dataframe

```
# 按自定义key分组，列表
self_def_key = [0, 1, 2, 3, 3, 4, 5, 7]
print(df_obj.groupby(self_def_key).size())

# 按自定义key分组，多层列表
print(df_obj.groupby([df_obj['key1'], df_obj['key2']]).size())

# 按多个列多层分组
grouped2 = df_obj.groupby(['key1', 'key2'])
print(grouped2.size())

# 多层分组按key的顺序进行
grouped3 = df_obj.groupby(['key2', 'key1'])
print(grouped3.mean())
# unstack可以将多层索引的结果转换成单层的dataframe
print(grouped3.mean().unstack())
```

运行结果：

```
0    1
1    1
2    1
3    2
4    1
5    1
7    1
dtype: int64

key1  key2
a     one      2
      three    1
      two      2
b     one      1
      three    1
      two      1
dtype: int64


key1  key2
a     one      2
      three    1
      two      2
```

```
dtype: int64
```



```
              data1     data2
key2  key1
one   a     0.174988 -0.110804
      b    -0.214324  0.758372
three a    -1.019229 -1.143825
      b     0.522911  0.630814
two   a     1.428099  0.107465
      b    -0.264616  1.017155

          data1               data2
key1          a         b         a         b
key2
one    0.174988 -0.214324 -0.110804  0.758372
three -1.019229  0.522911 -1.143825  0.630814
two    1.428099 -0.264616  0.107465  1.017155
```

二、GroupBy对象支持迭代操作

> 每次迭代返回一个元组 (group_name, group_data)
>
> 可用于分组数据的具体运算

1. 单层分组

示例代码：

```
# 单层分组，根据key1
for group_name, group_data in grouped1:
    print(group_name)
    print(group_data)
```

运行结果：

```
a
      data1     data2 key1   key2
0  0.974685 -0.672494    a    one
2  1.508838  0.392787    a    two
4  1.347359 -0.177858    a    two
6 -0.624708  0.450885    a    one
7 -1.019229 -1.143825    a  three

b
      data1     data2 key1   key2
1 -0.214324  0.758372    b    one
3  0.522911  0.630814    b  three
5 -0.264616  1.017155    b    two
```

2. 多层分组

```
# 多层分组，根据key1 和 key2
for group_name, group_data in grouped2:
    print(group_name)
    print(group_data)
```

运行结果：

```
('a', 'one')
      data1     data2 key1 key2
0  0.974685 -0.672494    a  one
6 -0.624708  0.450885    a  one

('a', 'three')
      data1     data2 key1   key2
7 -1.019229 -1.143825    a  three

('a', 'two')
      data1     data2 key1 key2
2  1.508838  0.392787    a  two
4  1.347359 -0.177858    a  two

('b', 'one')
      data1     data2 key1 key2
1 -0.214324  0.758372    b  one

('b', 'three')
      data1     data2 key1   key2
3  0.522911  0.630814    b  three

('b', 'two')
      data1     data2 key1 key2
5 -0.264616  1.017155    b  two
```

三、GroupBy对象可以转换成列表或字典

示例代码：

```
# GroupBy对象转换list
print(list(grouped1))

# GroupBy对象转换dict
print(dict(list(grouped1)))
```

运行结果：

```
[('a',       data1     data2 key1   key2
0  0.974685 -0.672494    a    one
2  1.508838  0.392787    a    two
4  1.347359 -0.177858    a    two
6 -0.624708  0.450885    a    one
7 -1.019229 -1.143825    a  three),
('b',       data1     data2 key1   key2
```

```
{'a':       data1     data2 key1   key2
0  0.974685 -0.672494    a    one
2  1.508838  0.392787    a    two
4  1.347359 -0.177858    a    two
6 -0.624708  0.450885    a    one
7 -1.019229 -1.143825    a  three,
'b':       data1     data2 key1   key2
1 -0.214324  0.758372    b    one
3  0.522911  0.630814    b  three
5 -0.264616  1.017155    b    two}
```

1. 按列分组、按数据类型分组

示例代码：

```
# 按列分组
print(df_obj.dtypes)

# 按数据类型分组
print(df_obj.groupby(df_obj.dtypes, axis=1).size())
print(df_obj.groupby(df_obj.dtypes, axis=1).sum())
```

运行结果：

```
data1    float64
data2    float64
key1      object
key2      object
dtype: object

float64    2
object     2
dtype: int64

    float64  object
0  0.302191    a one
1  0.544048    b one
2  1.901626    a two
3  1.153725  b three
4  1.169501    a two
5  0.752539    b two
6 -0.173823    a one
7 -2.163054  a three
```

2. 其他分组方法

示例代码：

```
df_obj2 = pd.DataFrame(np.random.randint(1, 10, (5,5)),
                       columns=['a', 'b', 'c', 'd', 'e'],
                       index=['A', 'B', 'C', 'D', 'E'])
df_obj2.ix[1, 1:4] = np.NaN
print(df_obj2)
```

```
   a    b    c    d  e
A  7  2.0  4.0  5.0  8
B  4  NaN  NaN  NaN  1
C  3  2.0  5.0  4.0  6
D  3  1.0  9.0  7.0  3
E  6  1.0  6.0  8.0  1
```

3. 通过字典分组

示例代码：

```
# 通过字典分组
mapping_dict = {'a':'Python', 'b':'Python', 'c':'Java', 'd':'C', 'e':'Java'}
print(df_obj2.groupby(mapping_dict, axis=1).size())
print(df_obj2.groupby(mapping_dict, axis=1).count()) # 非NaN的个数
print(df_obj2.groupby(mapping_dict, axis=1).sum())
```

运行结果：

```
C         1
Java      2
Python    2
dtype: int64

   C  Java  Python
A  1     2       2
B  0     1       1
C  1     2       2
D  1     2       2
E  1     2       2

     C  Java  Python
A  5.0  12.0     9.0
B  NaN   1.0     4.0
C  4.0  11.0     5.0
D  7.0  12.0     4.0
E  8.0   7.0     7.0
```

4. 通过函数分组，函数传入的参数为行索引或列索引

示例代码：

```
# 通过函数分组
df_obj3 = pd.DataFrame(np.random.randint(1, 10, (5,5)),
                       columns=['a', 'b', 'c', 'd', 'e'],
                       index=['AA', 'BBB', 'CC', 'D', 'EE'])
#df_obj3

def group_key(idx):
    """
        idx 为列索引或行索引
    """
```

```
print(df_obj3.groupby(group_key).size())

# 以上自定义函数等价于
#df_obj3.groupby(len).size()
```


运行结果：

```
1    1
2    3
3    1
dtype: int64
```

5. 通过索引级别分组

示例代码：

```
# 通过索引级别分组
columns = pd.MultiIndex.from_arrays([['Python', 'Java', 'Python', 'Java', 'Python'],
                                     ['A', 'A', 'B', 'C', 'B']], names=['language', 'inde
df_obj4 = pd.DataFrame(np.random.randint(1, 10, (5, 5)), columns=columns)
print(df_obj4)

# 根据language进行分组
print(df_obj4.groupby(level='language', axis=1).sum())
# 根据index进行分组
print(df_obj4.groupby(level='index', axis=1).sum())
```

运行结果：

```
language Python Java Python Java Python
index         A    A      B    C      B
0             2    7      8    4      3
1             5    2      6    1      2
2             6    4      4    5      2
3             4    7      4    3      1
4             7    4      3    4      8

language  Java  Python
0           11      13
1            3      13
2            9      12
3           10       9
4            8      18

index   A   B  C
0       9  11  4
1       7   8  1
2      10   6  5
3      11   5  3
4      11  11  4
```

- 数组产生标量的过程，如mean()、count()等
- 常用于对分组后的数据进行计算

示例代码：

```
dict_obj = {'key1' : ['a', 'b', 'a', 'b',
                      'a', 'b', 'a', 'a'],
            'key2' : ['one', 'one', 'two', 'three',
                      'two', 'two', 'one', 'three'],
            'data1': np.random.randint(1,10, 8),
            'data2': np.random.randint(1,10, 8)}
df_obj5 = pd.DataFrame(dict_obj)
print(df_obj5)
```

运行结果：

```
   data1  data2 key1   key2
0      3      7    a    one
1      1      5    b    one
2      7      4    a    two
3      2      4    b  three
4      6      4    a    two
5      9      9    b    two
6      3      5    a    one
7      8      4    a  three
```

1. 内置的聚合函数

> sum(), mean(), max(), min(), count(), size(), describe()

示例代码：

```
print(df_obj5.groupby('key1').sum())
print(df_obj5.groupby('key1').max())
print(df_obj5.groupby('key1').min())
print(df_obj5.groupby('key1').mean())
print(df_obj5.groupby('key1').size())
print(df_obj5.groupby('key1').count())
print(df_obj5.groupby('key1').describe())
```

运行结果：

```
      data1  data2
key1
a        27     24
b        12     18

      data1  data2 key2
key1
a         8      7  two
b         9      9  two
```

```
a         3      4  one
b         1      4  one

      data1  data2
key1
a       5.4    4.8
b       4.0    6.0

key1
a    5
b    3
dtype: int64

      data1  data2  key2
key1
a         5      5     5
b         3      3     3

               data1     data2
key1
a    count  5.000000  5.000000
     mean   5.400000  4.800000
     std    2.302173  1.303840
     min    3.000000  4.000000
     25%    3.000000  4.000000
     50%    6.000000  4.000000
     75%    7.000000  5.000000
     max    8.000000  7.000000
b    count  3.000000  3.000000
     mean   4.000000  6.000000
     std    4.358899  2.645751
     min    1.000000  4.000000
     25%    1.500000  4.500000
     50%    2.000000  5.000000
     75%    5.500000  7.000000
     max    9.000000  9.000000
```

2. 可自定义函数，传入agg方法中

> grouped.agg(func)
>
> func的参数为groupby索引对应的记录

示例代码：

```
# 自定义聚合函数
def peak_range(df):
    """
        返回数值范围
    """
    #print type(df) #参数为索引所对应的记录
    return df.max() - df.min()

print(df_obj5.groupby('key1').agg(peak_range))
print(df_obj.groupby('key1').agg(lambda df : df.max() - df.min()))
```

```
      data1  data2
key1
a         5      3
b         8      5

         data1     data2
key1
a     2.528067  1.594711
b     0.787527  0.386341
In [25]:
```

3. 应用多个聚合函数

同时应用多个函数进行聚合操作，使用函数列表

示例代码：

```
# 应用多个聚合函数

# 同时应用多个聚合函数
print(df_obj.groupby('key1').agg(['mean', 'std', 'count', peak_range])) # 默认列名为函数名

print(df_obj.groupby('key1').agg(['mean', 'std', 'count', ('range', peak_range)])) # 通过
```

运行结果：

```
         data1                               data2
          mean       std count peak_range      mean       std count peak_range
key1
a     0.437389  1.174151     5   2.528067 -0.230101  0.686488     5   1.594711
b     0.014657  0.440878     3   0.787527  0.802114  0.196850     3   0.386341

         data1                              data2
          mean       std count     range      mean       std count     range
key1
a     0.437389  1.174151     5  2.528067 -0.230101  0.686488     5  1.594711
b     0.014657  0.440878     3  0.787527  0.802114  0.196850     3  0.386341
```

4. 对不同的列分别作用不同的聚合函数，使用dict

示例代码：

```
# 每列作用不同的聚合函数
dict_mapping = {'data1':'mean',
                'data2':'sum'}
print(df_obj.groupby('key1').agg(dict_mapping))

dict_mapping = {'data1':['mean','max'],
                'data2':'sum'}
print(df_obj.groupby('key1').agg(dict_mapping))
```

```
         data1     data2
key1
a     0.437389 -1.150505
b     0.014657  2.406341

         data1               data2
          mean       max       sum
key1
a     0.437389  1.508838 -1.150505
b     0.014657  0.522911  2.406341
```

5. 常用的内置聚合函数

函数名	说明
count	分组中非NA值的数量
sum	非NA值的和
mean	非NA值的平均值
median	非NA值的算术中位数
std、var	无偏（分母为n - 1）标准差和方差
min、max	非NA值的最小值和最大值
prod	非NA值的积
first、last	第一个和最后一个非NA值

数据的分组运算

示例代码：

```
import pandas as pd
import numpy as np

dict_obj = {'key1' : ['a', 'b', 'a', 'b',
                      'a', 'b', 'a', 'a'],
            'key2' : ['one', 'one', 'two', 'three',
```

```
df_obj = pd.DataFrame(dict_obj)
print(df_obj)

# 按key1分组后，计算data1，data2的统计信息并附加到原始表格中，并添加表头前缀
k1_sum = df_obj.groupby('key1').sum().add_prefix('sum_')
print(k1_sum)
```

运行结果：

```
   data1  data2 key1   key2
0      5      1    a    one
1      7      8    b    one
2      1      9    a    two
3      2      6    b  three
4      9      8    a    two
5      8      3    b    two
6      3      5    a    one
7      8      3    a  three

      sum_data1  sum_data2
key1
a            26         26
b            17         17
```

> 聚合运算后会改变原始数据的形状，
>
> 如何保持原始数据的形状？

1. merge

> 使用merge的外连接，比较复杂

示例代码：

```
# 方法1，使用merge
k1_sum_merge = pd.merge(df_obj, k1_sum, left_on='key1', right_index=True)
print(k1_sum_merge)
```

运行结果：

```
   data1  data2 key1   key2  sum_data1  sum_data2
0      5      1    a    one         26         26
2      1      9    a    two         26         26
4      9      8    a    two         26         26
6      3      5    a    one         26         26
7      8      3    a  three         26         26
1      7      8    b    one         17         17
3      2      6    b  three         17         17
5      8      3    b    two         17         17
```

如：grouped.transform(np.sum)

示例代码：

```
# 方法2，使用transform
k1_sum_tf = df_obj.groupby('key1').transform(np.sum).add_prefix('sum_')
df_obj[k1_sum_tf.columns] = k1_sum_tf
print(df_obj)
```

运行结果：

```
   data1  data2 key1   key2 sum_data1 sum_data2           sum_key2
0      5      1    a    one        26        26  onetwotwoonethree
1      7      8    b    one        17        17       onethreetwo
2      1      9    a    two        26        26  onetwotwoonethree
3      2      6    b  three        17        17       onethreetwo
4      9      8    a    two        26        26  onetwotwoonethree
5      8      3    b    two        17        17       onethreetwo
6      3      5    a    one        26        26  onetwotwoonethree
7      8      3    a  three        26        26  onetwotwoonethree
```

也可传入自定义函数，

示例代码：

```
# 自定义函数传入transform
def diff_mean(s):
    """
        返回数据与均值的差值
    """
    return s - s.mean()

print(df_obj.groupby('key1').transform(diff_mean))
```

运行结果：

```
      data1     data2 sum_data1 sum_data2
0 -0.200000 -4.200000         0         0
1  1.333333  2.333333         0         0
2 -4.200000  3.800000         0         0
3 -3.666667  0.333333         0         0
4  3.800000  2.800000         0         0
5  2.333333 -2.666667         0         0
6 -2.200000 -0.200000         0         0
7  2.800000 -2.200000         0         0
```

groupby.apply(func)

func函数也可以在各分组上分别调用，最后结果通过pd.concat组装到一起（数据合并）

```
import pandas as pd
import numpy as np

dataset_path = './starcraft.csv'
df_data = pd.read_csv(dataset_path, usecols=['LeagueIndex', 'Age', 'HoursPerWeek',
                                             'TotalHours', 'APM'])

def top_n(df, n=3, column='APM'):
    """
        返回每个分组按 column 的 top n 数据
    """
    return df.sort_values(by=column, ascending=False)[:n]

print(df_data.groupby('LeagueIndex').apply(top_n))
```

运行结果：

		LeagueIndex	Age	HoursPerWeek	TotalHours	APM
LeagueIndex						
1	2214	1	20.0	12.0	730.0	172.9530
	2246	1	27.0	8.0	250.0	141.6282
	1753	1	20.0	28.0	100.0	139.6362
2	3062	2	20.0	6.0	100.0	179.6250
	3229	2	16.0	24.0	110.0	156.7380
	1520	2	29.0	6.0	250.0	151.6470
3	1557	3	22.0	6.0	200.0	226.6554
	484	3	19.0	42.0	450.0	220.0692
	2883	3	16.0	8.0	800.0	208.9500
4	2688	4	26.0	24.0	990.0	249.0210
	1759	4	16.0	6.0	75.0	229.9122
	2637	4	23.0	24.0	650.0	227.2272
5	3277	5	18.0	16.0	950.0	372.6426
	93	5	17.0	36.0	720.0	335.4990
	202	5	37.0	14.0	800.0	327.7218
6	734	6	16.0	28.0	730.0	389.8314
	2746	6	16.0	28.0	4000.0	350.4114
	1810	6	21.0	14.0	730.0	323.2506
7	3127	7	23.0	42.0	2000.0	298.7952
	104	7	21.0	24.0	1000.0	286.4538
	1654	7	18.0	98.0	700.0	236.0316
8	3393	8	NaN	NaN	NaN	375.8664
	3373	8	NaN	NaN	NaN	364.8504
	3372	8	NaN	NaN	NaN	355.3518

1. 产生层级索引：外层索引是分组名，内层索引是df_obj的行索引

示例代码：

```
# apply函数接收的参数会传入自定义的函数中
print(df_data.groupby('LeagueIndex').apply(top_n, n=2, column='Age'))
```

运行结果：

```
1            3146            1  40.0         12.0       150.0   38.5590
             3040            1  39.0         10.0       500.0   29.8764
2            920             2  43.0         10.0       730.0   86.0586
             2437            2  41.0          4.0       200.0   54.2166
3            1258            3  41.0         14.0       800.0   77.6472
             2972            3  40.0         10.0       500.0   60.5970
4            1696            4  44.0          6.0       500.0   89.5266
             1729            4  39.0          8.0       500.0   86.7246
5            202             5  37.0         14.0       800.0  327.7218
             2745            5  37.0         18.0      1000.0  123.4098
6            3069            6  31.0          8.0       800.0  133.1790
             2706            6  31.0          8.0       700.0   66.9918
7            2813            7  26.0         36.0      1300.0  188.5512
             1992            7  26.0         24.0      1000.0  219.6690
8            3340            8   NaN          NaN         NaN  189.7404
             3341            8   NaN          NaN         NaN  287.8128
```

2. 禁止层级索引, group_keys=False

示例代码：

```
print(df_data.groupby('LeagueIndex', group_keys=False).apply(top_n))
```

运行结果：

```
      LeagueIndex   Age  HoursPerWeek  TotalHours       APM
2214            1  20.0          12.0       730.0  172.9530
2246            1  27.0           8.0       250.0  141.6282
1753            1  20.0          28.0       100.0  139.6362
3062            2  20.0           6.0       100.0  179.6250
3229            2  16.0          24.0       110.0  156.7380
1520            2  29.0           6.0       250.0  151.6470
1557            3  22.0           6.0       200.0  226.6554
484             3  19.0          42.0       450.0  220.0692
2883            3  16.0           8.0       800.0  208.9500
2688            4  26.0          24.0       990.0  249.0210
1759            4  16.0           6.0        75.0  229.9122
2637            4  23.0          24.0       650.0  227.2272
3277            5  18.0          16.0       950.0  372.6426
93              5  17.0          36.0       720.0  335.4990
202             5  37.0          14.0       800.0  327.7218
734             6  16.0          28.0       730.0  389.8314
2746            6  16.0          28.0      4000.0  350.4114
1810            6  21.0          14.0       730.0  323.2506
3127            7  23.0          42.0      2000.0  298.7952
104             7  21.0          24.0      1000.0  286.4538
1654            7  18.0          98.0       700.0  236.0316
3393            8   NaN           NaN         NaN  375.8664
3373            8   NaN           NaN         NaN  364.8504
3372            8   NaN           NaN         NaN  355.3518
```

> apply可以用来处理不同分组内的缺失数据填充，填充该分组的均值。