Python Pandas (http://pandas.pydata.org/pandas-docs/stable/) Cheat Sheet

As a data analyst, these are common tasks I perform using Pandas

Setting display output options (http://pandas.pydata.org/pandas-docs/stable/generated/pandas.set_option.html)

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In [70]:

```
import pandas as pd
pd.set_option("display.max_rows",1000)    # or pd.options.display.max_rows=1000
pd.set_option("display.max_columns",20)   # or pd.options.display.max_columns=20
pd.set_option('precision',7)
pd.set_option('large_repr', 'truncate')
```

Quick summary statistics using df.describe() and data types using df.info(). Also check out pandas-summary (https://github.com/mouradmourafiq/pandas-summary) - an extension for data frame's describe() method.

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In [4]:

```
import pandas as pd
data = pd.DataFrame({'group': ['a', 'a', 'a', 'b','b', 'b', 'c', 'c','c'],
                 'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
data
```

Out[4]:

	group	ounces
0	a	4.0
1	a	3.0
2	a	12.0
3	b	6.0
4	b	7.5
5	b	8.0
6	c	3.0
7	c	5.0
8	c	6.0

In [5]:

```
data.describe()
```

Out[5]:

	ounces
count	9.000000
mean	6.055556
std	2.855307
min	3.000000
25%	4.000000
50%	6.000000
75%	7.500000
max	12.000000

df.info() shows data types, number of rows and columns, and memory usage of your data frame

In [6]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9 entries, 0 to 8
Data columns (total 2 columns):
group     9 non-null object
ounces    9 non-null float64
dtypes: float64(1), object(1)
memory usage: 216.0+ bytes
```

Sorting More Than One Column

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Just pass a list of columns you want to sort and pass corresponding list of True/False to the ascending parameter

In [16]:

```
data.sort_values(by=['group','ounces'], ascending=[False, True], inplace=True)
data
```

Out[16]:

	group	ounces
6	c	3.0
7	c	5.0
8	c	6.0
3	b	6.0
4	b	7.5
5	b	8.0
1	a	3.0
0	a	4.0
2	a	12.0

Removing duplicates

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In [19]:

```
import pandas as pd
data = pd.DataFrame({'k1': ['one'] * 3 + ['two'] * 4, 'k2': [3, 2, 1, 3, 3, 4, 4]})
```

In [20]:

```
data.sort_values(by='k2')
data
```

Out[20]:

	k1	k2
0	one	3
1	one	2
2	one	1
3	two	3
4	two	3
5	two	4
6	two	4

In [21]:

```
data.drop_duplicates()  # by default, duplicate is defined by all columns
```

Out[21]:

	k1	k2
0	one	3
1	one	2
2	one	1
3	two	3
5	two	4

Define duplicates by column name(s):

In [22]:

```
data.drop_duplicates(subset='k1')  # duplicate in column k1 only
```

Out[22]:

	k1	k2
0	one	3
3	two	3

Creating a new column based on values from another column

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In [5]:

```
import pandas as pd
data = pd.DataFrame({'food': ['bacon', 'pulled pork', 'bacon', 'Pastrami','corned beef', 'Bacon', 'pastrami', 'honey ham','nova lox']
                  'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
data
```

Out[5]:

	food	ounces
0	bacon	4.0
1	pulled pork	3.0
2	bacon	12.0
3	Pastrami	6.0
4	corned beef	7.5
5	Bacon	8.0
6	pastrami	3.0
7	honey ham	5.0
8	nova lox	6.0

Suppose you wanted to add a column indicating the type of animal that each food came from. Let’s write down a mapping of each distinct meat type to the kind of animal using a dictionary and a function:

In [7]:

```
meat_to_animal = {
'bacon': 'pig',
'pulled pork': 'pig',
'pastrami': 'cow',
'corned beef': 'cow',
'honey ham': 'pig',
'nova lox': 'salmon'
}

def meat2animal(series):
    if series["food"]=='bacon':
        return 'pig'
    elif series["food"]=='pulled pork':
        return 'pig'
    elif series["food"]=='pastrami':
        return 'cow'
    elif series["food"]=='corned beef':
        return 'cow'
    elif series["food"]=='honey ham':
        return 'pig'
    else:
        return 'salmon'
```

In [8]:

```
data['animal'] = data['food'].map(str.lower).map(meat_to_animal)
data
```

Out[8]:

	food	ounces	animal
0	bacon	4.0	pig
1	pulled pork	3.0	pig
2	bacon	12.0	pig
3	Pastrami	6.0	cow
4	corned beef	7.5	cow
5	Bacon	8.0	pig
6	pastrami	3.0	cow
7	honey ham	5.0	pig
8	nova lox	6.0	salmon

Or we could use apply() and apply the meat2animal() function to the new column:

In [9]:

```
# axis=1 means to apply the function for each row, but I prefer to use axis='columns' instead
data['animal2'] = data.apply(meat2animal,axis='columns')
data
```

Out[9]:

	food	ounces	animal	animal2
0	bacon	4.0	pig	pig
1	pulled pork	3.0	pig	pig
2	bacon	12.0	pig	pig
3	Pastrami	6.0	cow	salmon
4	corned beef	7.5	cow	cow
5	Bacon	8.0	pig	salmon
6	pastrami	3.0	cow	cow
7	honey ham	5.0	pig	pig
8	nova lox	6.0	salmon	salmon

We can also use dataframe.assign() (http://pandas.pydata.org/pandas-docs/stable/dsintro.html#dsintro-chained-assignment) function which was added in pandas version 0.16

In [4]:

```
import pandas as pd
import numpy as np

df = pd.DataFrame({'data1' : np.random.randn(5),
                   'data2' : np.random.randn(5)})

df.assign(ratio = df['data1'] / df['data2'])
```

Out[4]:

	data1	data2	ratio
0	0.246394	-0.496658	-0.496105
1	1.690199	1.245658	1.356873
2	-0.132093	0.834331	-0.158322
3	-0.046662	0.717323	-0.065050
4	-0.355658	0.439520	-0.809196

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Removing or dropping a column

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In [10]:

```
data.drop('animal2', axis='columns', inplace=True)  # dropping/removing a column
data
```

Out[10]:

	food	ounces	animal
0	bacon	4.0	pig
1	pulled pork	3.0	pig
2	bacon	12.0	pig
3	Pastrami	6.0	cow
4	corned beef	7.5	cow
5	Bacon	8.0	pig
6	pastrami	3.0	cow
7	honey ham	5.0	pig
8	nova lox	6.0	salmon

Replacing Values in a Series

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In [30]:

```
import pandas as pd
data = pd.Series([1., -999., 2., -999., -1000., 3.])
data
```

Out[30]:

```
0       1
1    -999
2       2
3    -999
4   -1000
5       3
dtype: float64
```

If you want to replace -999 with NaN:

In [32]:

```
data.replace(-999, np.nan, inplace=True)
data
```

Out[32]:

```
0       1
1     NaN
2       2
3     NaN
4   -1000
5       3
dtype: float64
```

If you want to replace multiple values at once, you instead pass a list then the substitute value:

In [35]:

```
import pandas as pd
data = pd.Series([1., -999., 2., -999., -1000., 3.])
data
```

Out[35]:

```
0       1
1    -999
2       2
3    -999
4   -1000
5       3
dtype: float64
```

In [37]:

```
data.replace([-999, -1000], np.nan, inplace=True)
data
```

Out[37]:

```
0     1
1   NaN
2     2
3   NaN
4   NaN
5     3
dtype: float64
```

Renaming Axis Indexes

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In [47]:

```
import pandas as pd
data = pd.DataFrame(np.arange(12).reshape((3, 4)),index=['Ohio', 'Colorado', 'New York'],columns=['one', 'two', 'three', 'four'])
data
```

Out[47]:

	one	two	three	four
Ohio	0	1	2	3
Colorado	4	5	6	7
New York	8	9	10	11

3 rows × 4 columns

In [48]:

```
data.index.map(str.upper)
```

Out[48]:

```
array(['OHIO', 'COLORADO', 'NEW YORK'], dtype=object)
```

In [51]:

```
data.index = data.index.map(str.upper)
data
```

Out[51]:

	one	two	three	four
OHIO	0	1	2	3
COLORADO	4	5	6	7
NEW YORK	8	9	10	11

3 rows × 4 columns

If you want to create a transformed version of a data set without modifying the original, a useful method is rename:

In [65]:

```
data.rename(index=str.title, columns=str.upper, inplace=True)  # str.title means to make the 1st letter capitalized only
data
```

Out[65]:

	ONE	TWO	THREE	FOUR
Ohio	0	1	2	3
Colorado	4	5	6	7
New York	8	9	10	11

3 rows × 4 columns

Renaming Indexes or Columns

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rename() **can be used in conjunction with a dict-like object providing new values for a subset of the axis labels:**

In [46]:

```
import pandas as pd
data = pd.DataFrame(np.arange(12).reshape((3, 4)),index=['Ohio', 'Colorado', 'New York'],columns=['one', 'two', 'three', 'four'])
data
```

Out[46]:

	one	two	three	four
Ohio	0	1	2	3
Colorado	4	5	6	7
New York	8	9	10	11

In [47]:

```
data.rename(index={'Ohio': 'INDIANA'},columns={'three': 'peekaboo'},inplace=True)
data
```

Out[47]:

	one	two	peekaboo	four
INDIANA	0	1	2	3
Colorado	4	5	6	7
New York	8	9	10	11

You can also apply str functions to modify the index or column labels

In [48]:

```
data.rename(index=str.title, columns=str.upper, inplace=True)  # str.title means to make the 1st letter capitalized only
data
```

Out[48]:

	ONE	TWO	PEEKABOO	FOUR
Indiana	0	1	2	3
Colorado	4	5	6	7
New York	8	9	10	11

Binning Data Into Intervals

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In [71]:

```
ages = [20, 22, 25, 27, 21, 23, 37, 31, 61, 45, 41, 32]
```

Let's divide these into bins of 18 to 25, 26 to 35, 35 to 60, and finally 60 and older. To do so, you have to use *cut()* function:

In [73]:

```
bins = [18, 25, 35, 60, 100]
```

In [75]:

```
cats = pd.cut(ages, bins)
cats
```

Out[75]:

```
  (18, 25]
  (18, 25]
  (18, 25]
  (25, 35]
  (18, 25]
  (18, 25]
  (35, 60]
  (25, 35]
 (60, 100]
  (35, 60]
  (35, 60]
  (25, 35]
Levels (4): Index(['(18, 25]', '(25, 35]', '(35, 60]', '(60, 100]'], dtype=object)
```

In [77]:

```
cats.labels
```

Out[77]:

```
array([0, 0, 0, 1, 0, 0, 2, 1, 3, 2, 2, 1], dtype=int32)
```

In [78]:

```
cats.levels
```

Out[78]:

```
Index(['(18, 25]', '(25, 35]', '(35, 60]', '(60, 100]'], dtype='object')
```

In [79]:

```
pd.value_counts(cats)
```

Out[79]:

```
(18, 25]     5
(35, 60]     3
(25, 35]     3
(60, 100]    1
dtype: int64
```

If you want the right value to be exclusive in the intervals:

In [80]:

```
pd.cut(ages, [18, 26, 36, 61, 100], right=False)
```

Out[80]:

```
  [18, 26)
  [18, 26)
  [18, 26)
  [26, 36)
  [18, 26)
  [18, 26)
  [36, 61)
  [26, 36)
 [61, 100)
  [36, 61)
  [36, 61)
  [26, 36)
Levels (4): Index(['[18, 26)', '[26, 36)', '[36, 61)', '[61, 100)'], dtype=object)
```

You can also pass your own bin names by passing a list or array to the labels option:

In [83]:

```
group_names = ['Youth', 'YoungAdult', 'MiddleAged', 'Senior']
pd.cut(ages, bins, labels=group_names)
pd.value_counts(pd.cut(ages, bins, labels=group_names))
```

Out[83]:

```
Youth         5
YoungAdult    3
MiddleAged    3
Senior        1
dtype: int64
```

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Grouping Data (see also value_count() and pivot_table())

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In [1]:

```
import pandas as pd

df = pd.DataFrame({'key1' : ['a', 'a', 'b', 'b', 'a'],
                   'key2' : ['one', 'two', 'one', 'two', 'one'],
                   'data1' : np.random.randn(5),
                   'data2' : np.random.randn(5)})
df
```

Out[1]:

	data1	data2	key1	key2
0	-1.206295	0.277025	a	one
1	-0.210670	1.700554	a	two
2	1.090656	0.141390	b	one
3	-0.755093	1.402054	b	two
4	0.251278	0.767201	a	one

5 rows × 4 columns

In [3]:

```
grouped = df['data1'].groupby(df['key1'])
grouped.mean()
```

Out[3]:

```
key1
a      -0.388562
b       0.167782
dtype: float64
```

Sub-selecting or Slicing a Data Frame

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Filtering by label name: [loc]
Filtering by index row and/or column: [iloc]

In [1]:

```
import numpy as np
import pandas as pd

dates = pd.date_range('20130101',periods=6)
df = pd.DataFrame(np.random.randn(6,4),index=dates,columns=list('ABCD'))
df
```

Out[1]:

	A	B	C	D
2013-01-01	0.618255	0.699026	-0.857985	-0.167018
2013-01-02	1.193699	0.304388	0.036477	0.073046
2013-01-03	-1.409751	0.599982	1.359995	0.901001
2013-01-04	0.165882	-0.156601	-0.764553	0.665824
2013-01-05	0.190956	-0.515755	-0.866012	-0.908422
2013-01-06	0.849617	-1.473412	0.013182	0.443061

Getting first n rows of data frame using index slicing syntax

In [2]:

```
df[0:3]  # get first 3 rows of the data frame
```

Out[2]:

	A	B	C	D
2013-01-01	1.495158	2.136794	0.034707	-0.128909
2013-01-02	0.562039	-1.150613	0.265513	0.093981
2013-01-03	0.973170	0.877070	0.682884	-0.026271

Slicing based on data frame's index range

In [3]:

```
df['20130102':'20130104'] # get rows by index range
```

Out[3]:

	A	B	C	D
2013-01-02	0.562039	-1.150613	0.265513	0.093981
2013-01-03	0.973170	0.877070	0.682884	-0.026271
2013-01-04	-1.146283	1.350325	-0.040049	1.069154

Slicing based on column labels/names using loc

[view df]

In [4]:

```
df.loc[:,['A','B']]  # syntax is: df.loc[rows_index, cols_index]
```

Out[4]:

	A	B
2013-01-01	1.495158	2.136794
2013-01-02	0.562039	-1.150613
2013-01-03	0.973170	0.877070
2013-01-04	-1.146283	1.350325
2013-01-05	0.919800	-0.058590
2013-01-06	1.286808	-0.357197

Slicing based on row index label and column label combined using loc

In [5]:

```
df.loc['20130102':'20130104',['A','B']]
```

Out[5]:

	A	B
2013-01-02	0.562039	-1.150613
2013-01-03	0.973170	0.877070
2013-01-04	-1.146283	1.350325

Slicing based on index position of the row or column using iloc

[view df]

In [6]:

```
df.iloc[3]  # returns 4th row (index=3) of the data frame
```

Out[6]:

```
A   -1.146283
B    1.350325
C   -0.040049
D    1.069154
Name: 2013-01-04 00:00:00, dtype: float64
```

In [7]:

```
df.iloc[3:5,0:2]  # returns specific range of rows and columns of the data frame
```

Out[7]:

	A	B
2013-01-04	-1.146283	1.350325
2013-01-05	0.919800	-0.058590

In [9]:

```
df.iloc[[1,5],[0,2]] # returns specific rows and columns using lists containing columns or row indexes
```

Out[9]:

	A	C
2013-01-02	0.562039	0.265513
2013-01-06	1.286808	-0.205763

In [10]:

```
df.iloc[1:3,:]  # returning specific rows and returning all columns
```

Out[10]:

	A	B	C	D
2013-01-02	0.562039	-1.150613	0.265513	0.093981
2013-01-03	0.973170	0.877070	0.682884	-0.026271

In [11]:

```
df.iloc[:,1:3]  # returning all rows and specific columns
```

Out[11]:

	B	C
2013-01-01	2.136794	0.034707
2013-01-02	-1.150613	0.265513
2013-01-03	0.877070	0.682884
2013-01-04	1.350325	-0.040049
2013-01-05	-0.058590	0.083294
2013-01-06	-0.357197	-0.205763

In [12]:

```
df.iloc[1,1]  # getting secific scalar/single value
```

Out[12]:

```
-1.1506133975623973
```

Boolean Indexing (http://pandas.pydata.org/pandas-docs/stable/indexing.html#boolean-indexing)

[view df]

The boolean operators are: **|** for or, **&** for and, and **~** for not. These **must** be grouped by using parentheses.

In [33]:

```
df[df.A > -0.5]  # or df[df["A"] > -0.5], this syntax works when there is a space in the column name
```

Out[33]:

	A	B	C	D
2013-01-03	2.351035	0.085318	-2.265766	0.432268
2013-01-04	0.447390	0.205224	-0.614702	0.212125
2013-01-05	-0.455682	-2.765288	0.475253	0.432910
2013-01-06	1.000494	-0.462591	-0.638053	0.481087

or I've seen some people do boolean filtering by passing "criteria" variable to the data frame like so:

In [34]:

```
criteria = df.A > -0.5
df[criteria]
```

Out[34]:

	A	B	C	D
2013-01-03	2.351035	0.085318	-2.265766	0.432268
2013-01-04	0.447390	0.205224	-0.614702	0.212125
2013-01-05	-0.455682	-2.765288	0.475253	0.432910
2013-01-06	1.000494	-0.462591	-0.638053	0.481087

In [2]:

```
df2 = df.copy()
df2['E']=['one', 'one','two','three','four','three']
df2
```

Out[2]:

	A	B	C	D	E
2013-01-01	0.618255	0.699026	-0.857985	-0.167018	one
2013-01-02	1.193699	0.304388	0.036477	0.073046	one
2013-01-03	-1.409751	0.599982	1.359995	0.901001	two
2013-01-04	0.165882	-0.156601	-0.764553	0.665824	three
2013-01-05	0.190956	-0.515755	-0.866012	-0.908422	four
2013-01-06	0.849617	-1.473412	0.013182	0.443061	three

In [36]:

```
df2[df2['E'].isin(['two','four'])]  # read as "return rows where column E contains two or four"
```

Out[36]:

	A	B	C	D	E
2013-01-03	2.351035	0.085318	-2.265766	0.432268	two
2013-01-05	-0.455682	-2.765288	0.475253	0.432910	four

We can also do partial string matching. So let's say you don't know the exact spelling a word is you want to match, you can do this:

In [3]:

```
df2[df2.E.str.contains("tw|ou")]
```

Out[3]:

	A	B	C	D	E
2013-01-03	-1.409751	0.599982	1.359995	0.901001	two
2013-01-05	0.190956	-0.515755	-0.866012	-0.908422	four

Using ~ to do a "NOT"

In [38]:

```
df2[~df2['E'].isin(['two','four'])]  # column E containing values not in two or four
```

Out[38]:

	A	B	C	D	E
2013-01-01	-0.564503	-1.195000	0.441140	-0.291384	one
2013-01-02	-0.893038	-0.372430	-0.436048	-0.545141	one
2013-01-04	0.447390	0.205224	-0.614702	0.212125	three
2013-01-06	1.000494	-0.462591	-0.638053	0.481087	three

Filtering using query() method

In [52]:

```
import numpy as np
import pandas as pd

dates = pd.date_range('20130101',periods=6)
df = pd.DataFrame(np.random.randn(6,4),index=dates,columns=list('ABCD'))
df
```

Out[52]:

	A	B	C	D
2013-01-01	-0.683630	-0.961407	1.052018	0.512382
2013-01-02	-0.755844	1.672273	0.365384	1.030149
2013-01-03	-0.532466	0.616725	1.066731	-1.056756
2013-01-04	0.153878	-1.270198	0.346587	0.150570
2013-01-05	1.645820	0.817894	0.168950	-0.833291
2013-01-06	-0.768034	1.145290	-0.612168	0.325120

In [58]:

```
df.query('A > C')
```

Out[58]:

	A	B	C	D
2013-01-05	1.64582	0.817894	0.16895	-0.833291

In [69]:

```
df.query('A > 0')
```

Out[69]:

	A	B	C	D
2013-01-04	0.153878	-1.270198	0.346587	0.150570
2013-01-05	1.645820	0.817894	0.168950	-0.833291

In [68]:

```
df.query('A > 0 & A < 1')
```

Out[68]:

	A	B	C	D
2013-01-04	0.153878	-1.270198	0.346587	0.15057

In [65]:

```
df.query('A > B | A > C')  # where A is greater than B or A is greater than C
```

Out[65]:

	A	B	C	D
2013-01-01	-0.683630	-0.961407	1.052018	0.512382
2013-01-04	0.153878	-1.270198	0.346587	0.150570
2013-01-05	1.645820	0.817894	0.168950	-0.833291

Obtaining columns with partial column labels

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In [40]:

```
import pandas as pd

df = pd.DataFrame({'key1' : ['a', 'a', 'b', 'b', 'a'],
                   'key2' : ['one', 'two', 'one', 'two', 'one'],
                   'data1' : np.random.randn(5),
                   'data2' : np.random.randn(5)})
df
```

Out[40]:

	data1	data2	key1	key2
0	0.740132	1.220225	a	one
1	1.223369	0.830145	a	two
2	-2.046775	-1.149754	b	one
3	-3.068403	0.675124	b	two
4	-0.467039	0.640412	a	one

In [42]:

```
df.filter(like='data')
```

Out[42]:

	data1	data2
0	0.740132	1.220225
1	1.223369	0.830145
2	-2.046775	-1.149754
3	-3.068403	0.675124
4	-0.467039	0.640412

Getting Value Counts

It is so tempting to use the groupby() function or pivot_table, but most of the time, value_counts() function is all we need.

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In [1]:

```
import pandas as pd
data = pd.DataFrame({'group': ['a', 'a', 'a', 'b','b', 'b', 'c', 'c','c'],
                     'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
data
```

Out[1]:

	group	ounces
0	a	4.0
1	a	3.0
2	a	12.0
3	b	6.0
4	b	7.5
5	b	8.0
6	c	3.0
7	c	5.0
8	c	6.0

In [3]:

```
data.group.value_counts()
```

Out[3]:

```
a    3
b    3
c    3
Name: group, dtype: int64
```

Getting Cumulative Sum

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In [3]:

```
data.group.value_counts().cumsum()
```

Out[3]:

```
a    3
b    6
c    9
dtype: int64
```

Pivot table example - see also this excellent article (http://pbpython.com/pandas-pivot-table-explained.html) on pivot tables

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In [51]:

```
import pandas as pd
data = pd.DataFrame({'group': ['a', 'a', 'a', 'b','b', 'b', 'c', 'c','c'],
                     'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
data
```

Out[51]:

	group	ounces
0	a	4.0
1	a	3.0
2	a	12.0
3	b	6.0
4	b	7.5
5	b	8.0
6	c	3.0
7	c	5.0
8	c	6.0

Calculating the means of each group

In [3]:

```
data.pivot_table(values='ounces',index='group',aggfunc=np.mean)
```

Out[3]:

```
group
a        6.333333
b        7.166667
c        4.666667
Name: ounces, dtype: float64
```

Getting counts by group

In [5]:

```
data.pivot_table(values='ounces',index='group',aggfunc='count')
```

Out[5]:

```
group
a        3
b        3
c        3
Name: ounces, dtype: int64
```

Getting cumulative sum or running total of the group counts

In [6]:

```
data.pivot_table(values='ounces',index='group',aggfunc='count').cumsum()
```

Out[6]:

```
group
a        3
b        6
c        9
Name: ounces, dtype: int64
```

In [14]:

```
import pandas as pd

# sample data can be dowloaded here: http://pbpython.com/extras/sales-funnel.xlsx
df = pd.read_csv('/home/pybokeh/Downloads/sales-funnel.csv')
```

In [5]:

```
df.head()
```

Out[5]:

	Account	Name	Rep	Manager	Product	Quantity	Price	Status
0	714466	Trantow-Barrows	Craig Booker	Debra Henley	CPU	1	30000	presented
1	714466	Trantow-Barrows	Craig Booker	Debra Henley	Software	1	10000	presented
2	714466	Trantow-Barrows	Craig Booker	Debra Henley	Maintenance	2	5000	pending
3	737550	Fritsch, Russel and Anderson	Craig Booker	Debra Henley	CPU	1	35000	declined
4	146832	Kiehn-Spinka	Daniel Hilton	Debra Henley	CPU	2	65000	won

In [15]:

```
by_rep = pd.pivot_table(data=df, index='Rep', columns='Product', values='Quantity', aggfunc='count', fill_value=0)
by_rep
```

Out[15]:

Product	CPU	Maintenance	Monitor	Software
Rep				
Cedric Moss	2	1	0	1
Craig Booker	2	1	0	1
Daniel Hilton	2	0	0	1
John Smith	1	1	0	0
Wendy Yule	2	1	1	0

Creating a new column based on a grouping using transform() method

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Let's get sample data from dplython library which is a clone of dplyr

In [6]:

```
from dplython import *
```

In [7]:

```
diamonds.head()
```

Out[7]:

	Unnamed: 0	carat	cut	color	clarity	depth	table	price	x	y	z
0	1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
1	2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
2	3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
3	4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
4	5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75

Goal: Create a column that contains the difference between a diamond's carat and the average of the carats for *that diamond's* color.

Key take-away is to use the transform method of your specific column of the groupby object.

In [21]:

```
(diamonds.assign(carat_diff=diamonds
                 .groupby('color')['carat']
                 .transform(lambda x:x-x.mean())
                )
                .sort_values(by=['color','carat_diff'])
                .head(10)
)
```

Out[21]:

	Unnamed: 0	carat	cut	color	clarity	depth	table	price	x	y	z	carat_diff
31597	31598	0.20	Ideal	D	VS2	61.5	57.0	367	3.81	3.77	2.33	-0.457795
31600	31601	0.20	Premium	D	VS2	62.3	60.0	367	3.73	3.68	2.31	-0.457795
31601	31602	0.20	Premium	D	VS2	61.7	60.0	367	3.77	3.72	2.31	-0.457795
38276	38277	0.21	Premium	D	VS2	61.6	59.0	386	3.82	3.78	2.34	-0.447795
38277	38278	0.21	Premium	D	VS2	60.6	60.0	386	3.85	3.81	2.32	-0.447795
38278	38279	0.21	Premium	D	VS2	59.1	62.0	386	3.89	3.86	2.29	-0.447795
38279	38280	0.21	Premium	D	VS2	58.3	59.0	386	3.96	3.93	2.30	-0.447795
54	55	0.22	Premium	D	VS2	59.3	62.0	404	3.91	3.88	2.31	-0.437795
28	29	0.23	Very Good	D	VS2	60.5	61.0	357	3.96	3.97	2.40	-0.427795
34	35	0.23	Very Good	D	VS1	61.9	58.0	402	3.92	3.96	2.44	-0.427795

For those curious how to do this using dplyr / dplython:

In [20]:

```
# Using dplyr/dplython syntax
(diamonds >>
  group_by(X.color) >>
  mutate(carat_diff = X.carat - X.carat.mean()) >>
  ungroup() >>
  arrange(X.color, X.carat_diff) >>
  head(10)
)
```

```
/home/pybokeh/envs/jupyter/lib/python3.5/site-packages/dplython/dplython.py:379: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-vers
  df[key] = val.applyFcns(df)
/home/pybokeh/envs/jupyter/lib/python3.5/site-packages/dplython/dplython.py:429: FutureWarning: sort(columns=....)
  return lambda df: DplyFrame(df.sort(names))
```

Out[20]:

	Unnamed: 0	carat	cut	color	clarity	depth	table	price	x	y	z	carat_diff
25981	31598	0.20	Ideal	D	VS2	61.5	57.0	367	3.81	3.77	2.33	-0.457795
25982	31601	0.20	Premium	D	VS2	62.3	60.0	367	3.73	3.68	2.31	-0.457795
25983	31602	0.20	Premium	D	VS2	61.7	60.0	367	3.77	3.72	2.31	-0.457795
26960	38277	0.21	Premium	D	VS2	61.6	59.0	386	3.82	3.78	2.34	-0.447795
26961	38278	0.21	Premium	D	VS2	60.6	60.0	386	3.85	3.81	2.32	-0.447795
26962	38279	0.21	Premium	D	VS2	59.1	62.0	386	3.89	3.86	2.29	-0.447795
26963	38280	0.21	Premium	D	VS2	58.3	59.0	386	3.96	3.93	2.30	-0.447795
22409	55	0.22	Premium	D	VS2	59.3	62.0	404	3.91	3.88	2.31	-0.437795
22404	29	0.23	Very Good	D	VS2	60.5	61.0	357	3.96	3.97	2.40	-0.427795
22405	35	0.23	Very Good	D	VS1	61.9	58.0	402	3.92	3.96	2.44	-0.427795

Here's a comparison (http://nbviewer.jupyter.org/github/pybokeh/jupyter_notebooks/blob/master/dplython/dplython_example.ipynb) I made between dplython and pandas.

Percent of rows

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In [24]:

```
perc_of_rows = by_rep.apply(lambda x : x / x.sum() * 100, axis='columns') # or axis=1
perc_of_rows
```

Out[24]:

Product	CPU	Maintenance	Monitor	Software
Rep				
Cedric Moss	50.000000	25	0	25.000000
Craig Booker	50.000000	25	0	25.000000
Daniel Hilton	66.666667	0	0	33.333333
John Smith	50.000000	50	0	0.000000
Wendy Yule	50.000000	25	25	0.000000

Percent of columns

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In [22]:

```
perc_of_columns = by_rep.apply(lambda x : x / x.sum() * 100, axis='index') # or axis=0
perc_of_columns
```

Out[22]:

Product	CPU	Maintenance	Monitor	Software
Rep				
Cedric Moss	22.222222	25	0	33.333333
Craig Booker	22.222222	25	0	33.333333
Daniel Hilton	22.222222	0	0	33.333333
John Smith	11.111111	25	0	0.000000
Wendy Yule	22.222222	25	100	0.000000

Transpose a data frame

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Let's say you have a data frame with several columns and having a hard time scrolling to see what the data looks like. Transpose it!

In [2]:

```
import pandas as pd

df = pd.DataFrame({'key1' : ['a', 'a', 'b', 'b', 'a'],
                   'key2' : ['one', 'two', 'one', 'two', 'one'],
                   'data1' : np.random.randn(5),
                   'data2' : np.random.randn(5)})
df
```

Out[2]:

	data1	data2	key1	key2
0	-0.548420	0.381045	a	one
1	-0.327573	0.273854	a	two
2	-1.356345	-0.045686	b	one
3	-0.476385	1.075987	b	two
4	-0.923575	-0.973773	a	one

In [3]:

```
df.head(1).transpose()
```

Out[3]:

	0
data1	-0.5484204
data2	0.3810447
key1	a
key2	one

You can also do df.dtypes to accomplish similar output, but it's nice to see actual data along with the columns.

In [4]:

```
df.dtypes
```

Out[4]:

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

Converting a data frame index to a column

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In [49]:

```
import pandas as pd
data = pd.DataFrame({'group': ['a', 'a', 'a', 'b','b', 'b', 'c', 'c','c'],
                 'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
data
```

Out[49]:

	group	ounces
0	a	4.0
1	a	3.0
2	a	12.0
3	b	6.0
4	b	7.5
5	b	8.0
6	c	3.0
7	c	5.0
8	c	6.0

In [50]:

```
data.reset_index(level=0, inplace=True)
data
```

Out[50]:

	index	group	ounces
0	0	a	4.0
1	1	a	3.0
2	2	a	12.0
3	3	b	6.0
4	4	b	7.5
5	5	b	8.0
6	6	c	3.0
7	7	c	5.0
8	8	c	6.0

How to set the data frame's index to be one of the columns

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In [6]:

```
import pandas as pd
col = ['a','b','c']
data = pd.DataFrame([[1,2,3],[10,11,12],[20,21,22]],columns=col)
data
```

Out[6]:

	a	b	c
0	1	2	3
1	10	11	12
2	20	21	22

In [7]:

```
data = data.set_index('a')
data
```

Out[7]:

	b	c
a		
1	2	3
10	11	12
20	21	22

To remove the index name ("a"), do:

In [8]:

```
data.index.name = None
data
```

Out[8]:

	b	c
1	2	3
10	11	12
20	21	22

How to add or fill in missing dates

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In [1]:

```
import pandas as pd

idx = pd.date_range('09-01-2013', '09-30-2013')

s = pd.Series({'09-02-2013': 2,
               '09-03-2013': 10,
               '09-06-2013': 5,
               '09-07-2013': 1})
s
```

Out[1]:

```
09-02-2013     2
09-03-2013    10
09-06-2013     5
09-07-2013     1
dtype: int64
```

From above, we have holes in our data. Let's fill in those missing holes using the idx date_range we specified above.

In [63]:

```
s.index = pd.DatetimeIndex(s.index)

s = s.reindex(idx, fill_value=0)
s
```

Out[63]:

```
2013-09-01     0
2013-09-02     2
2013-09-03    10
2013-09-04     0
2013-09-05     0
2013-09-06     5
2013-09-07     1
2013-09-08     0
2013-09-09     0
2013-09-10     0
2013-09-11     0
2013-09-12     0
2013-09-13     0
2013-09-14     0
2013-09-15     0
2013-09-16     0
2013-09-17     0
2013-09-18     0
2013-09-19     0
2013-09-20     0
2013-09-21     0
2013-09-22     0
2013-09-23     0
2013-09-24     0
2013-09-25     0
2013-09-26     0
2013-09-27     0
2013-09-28     0
2013-09-29     0
2013-09-30     0
Freq: D, dtype: int64
```

How to connect and query against a database registered as an ODBC data source (Windows)

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In [ ]:

```
import pyodbc           # If using PostgreSQL, MySQL, SQLite, Redshift, MS SQL Server, or Oracle, use db.py instead
import pandas as pd
from getpass import getpass    # Module that will create a text input widget AND mask your password

userid = 'your_userid'
pw = getpass(prompt='Enter your password: ')

cnxn_string = 'DSN=your_dsn;UID=' + userid + ';PWD=' + pw

cnxn = pyodbc.connect(cnxn_string)
cursor = cnxn.cursor()

sql = """
SELECT * from your_table...
"""

df = pd.read_sql(sql, cnxn, index_col=None, parse_dates={'some_column':"%Y-%m-%d"})

# Close connections
cursor.close()
cnxn.close()
```

Also check out Yhat's db.py (https://github.com/yhat/db.py). Currently, doesn't support IBM DB2. So I'm stuck with pyodbc at work for now.

How to convert data in wide format to long format using pd.melt()

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When using ggplot (https://github.com/yhat/ggplot) to plot data where you have multiple data series you want to plot, you need to convert data in wide format to long format.

In [7]:

```
from pandas_datareader import data as web
from datetime import datetime
import pandas as pd

stocks = {'tech':['GOOGL', 'MSFT', 'LNKD', 'YHOO', 'FB','HPQ','AMZN'],
          'auto':['TM','F','GM','HMC','NSANY','HYMTF'],
          'housing':['HD','WMT','LOW']
          }

start_date = datetime(2014,1,1)
end_date = datetime(2014, 11, 30)

def get_px(stock, start, end):
    return web.get_data_yahoo(stock, start, end)['Adj Close']

df = pd.DataFrame({n: get_px(n, start_date, end_date) for n in stocks['tech']})
```

Below is what data looks like in 'wide' format:

In [8]:

```
df.head(10)
```

Out[8]:

	AMZN	FB	GOOGL	HPQ	LNKD	MSFT	YHOO
Date							
2014-01-02	397.970001	54.709999	557.117134	26.726783	207.639999	35.448341	39.590000
2014-01-03	396.440002	54.560001	553.053047	27.383841	207.419998	35.209856	40.119999
2014-01-06	393.630005	57.200001	559.219245	27.335529	203.919998	34.465786	39.930000
2014-01-07	398.029999	57.919998	570.000007	27.229239	209.639999	34.732887	40.919998
2014-01-08	401.920013	58.230000	571.186226	26.523869	209.059998	34.112826	41.020000
2014-01-09	401.010010	57.220001	565.685676	26.678471	215.250000	33.893420	40.919998
2014-01-10	397.660004	57.939999	565.655647	26.765435	218.750000	34.379931	41.230000
2014-01-13	390.980011	55.910000	562.052070	27.171264	213.539993	33.368755	39.990002
2014-01-14	397.540009	57.740002	575.275276	27.876635	216.220001	34.131905	41.139999
2014-01-15	395.869995	57.599998	574.884895	27.866972	216.000000	35.066764	41.070000

In [9]:

```
# Create a column from the index values
df.reset_index(level=0, inplace=True)
df.head(10)
```

Out[9]:

	Date	AMZN	FB	GOOGL	HPQ	LNKD	MSFT	YHOO
0	2014-01-02	397.970001	54.709999	557.117134	26.726783	207.639999	35.448341	39.590000
1	2014-01-03	396.440002	54.560001	553.053047	27.383841	207.419998	35.209856	40.119999
2	2014-01-06	393.630005	57.200001	559.219245	27.335529	203.919998	34.465786	39.930000
3	2014-01-07	398.029999	57.919998	570.000007	27.229239	209.639999	34.732887	40.919998
4	2014-01-08	401.920013	58.230000	571.186226	26.523869	209.059998	34.112826	41.020000
5	2014-01-09	401.010010	57.220001	565.685676	26.678471	215.250000	33.893420	40.919998
6	2014-01-10	397.660004	57.939999	565.655647	26.765435	218.750000	34.379931	41.230000
7	2014-01-13	390.980011	55.910000	562.052070	27.171264	213.539993	33.368755	39.990002
8	2014-01-14	397.540009	57.740002	575.275276	27.876635	216.220001	34.131905	41.139999
9	2014-01-15	395.869995	57.599998	574.884895	27.866972	216.000000	35.066764	41.070000

This is what data looks like in 'long' format:

In [10]:

```
df_long = pd.melt(df, id_vars=['Date']).dropna()
df_long.head()
```

Out[10]:

	Date	variable	value
0	2014-01-02	AMZN	397.970001
1	2014-01-03	AMZN	396.440002
2	2014-01-06	AMZN	393.630005
3	2014-01-07	AMZN	398.029999
4	2014-01-08	AMZN	401.920013

In [11]:

```
df_long.tail()
```

Out[11]:

	Date	variable	value
1605	2014-11-21	YHOO	51.040001
1606	2014-11-24	YHOO	51.830002
1607	2014-11-25	YHOO	51.720001
1608	2014-11-26	YHOO	51.930000
1609	2014-11-28	YHOO	51.740002

In [12]:

```
df_long.rename(columns={'variable': 'Stock', 'value':'Price'},inplace=True)
df_long.head(10)
```

Out[12]:

	Date	Stock	Price
0	2014-01-02	AMZN	397.970001
1	2014-01-03	AMZN	396.440002
2	2014-01-06	AMZN	393.630005
3	2014-01-07	AMZN	398.029999
4	2014-01-08	AMZN	401.920013
5	2014-01-09	AMZN	401.010010
6	2014-01-10	AMZN	397.660004
7	2014-01-13	AMZN	390.980011
8	2014-01-14	AMZN	397.540009
9	2014-01-15	AMZN	395.869995

Now we can plot the stock prices. Since the data is in long format, we can take advantage of ggplot's color= parameter, which will magically make line charts with different colors for each stock. If the data was in wide format, you would have had to manually specify all the different stocks to plot or use a loop construct.

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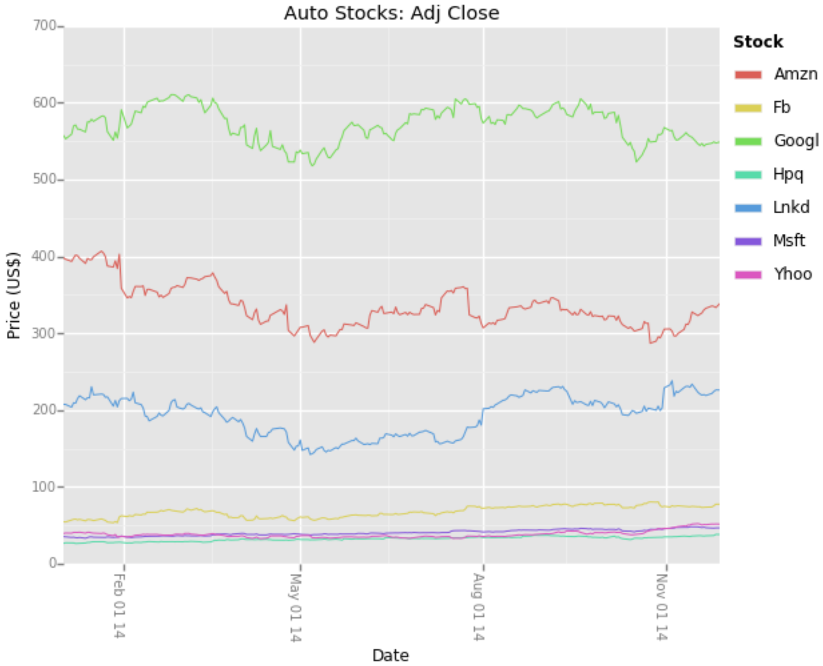
In [13]:

```
%matplotlib inline
import matplotlib.pyplot as plt
from ggplot import *

stock_plot = ggplot(df_long, aes(x='Date', y='Price', color='Stock')) + \
        geom_line() + \
        ylab('Price (US$)') + \
        ggtitle('Auto Stocks: Adj Close') + \
        scale_x_date(labels='%b %d %y',breaks=date_breaks('3 months') )

# Have to use MATPLOTLIB api to rotate x tick labels.  Hopefully some day, ggplot will implement a rotation option.
fig = stock_plot.draw()
ax = fig.gca()
labels = ax.get_xticklabels()
for label in labels:
    label.set_rotation(270)
plt.show()
```



ggplot (http://blog.yhathq.com/posts/ggplot-for-python.html) is AWESOME!

How to convert data in long format to wide format using pd.pivot()

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In [21]:

```
pivoted = df_long.pivot(index='Date', columns='Stock', values='Price')
pivoted.head()
```

Out[21]:

Stock	AMZN	FB	GOOGL	HPQ	LNKD	MSFT	YHOO
Date							
2014-01-02	397.97	54.71	557.12	27.17	207.64	35.91	39.59
2014-01-03	396.44	54.56	553.05	27.84	207.42	35.67	40.12
2014-01-06	393.63	57.20	559.22	27.79	203.92	34.92	39.93
2014-01-07	398.03	57.92	570.00	27.68	209.64	35.19	40.92
2014-01-08	401.92	58.23	571.19	26.96	209.06	34.56	41.02

Using category data type to control sort order

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In [27]:

```
import pandas as pd
data = pd.DataFrame({'medal': ['bronze', 'silver', 'silver', 'gold','bronze', 'bronze', 'gold', 'gold','gold'],
                  'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
data
```

Out[27]:

	medal	ounces
0	bronze	4.0
1	silver	3.0
2	silver	12.0
3	gold	6.0
4	bronze	7.5
5	bronze	8.0
6	gold	3.0
7	gold	5.0
8	gold	6.0

In [28]:

```
data["medal"] = data["medal"].astype("category")
data.dtypes
```

Out[28]:

```
medal     category
ounces     float64
dtype: object
```

In [29]:

```
data.sort_values(by=["medal"])
```

Out[29]:

	medal	ounces
0	bronze	4.0
4	bronze	7.5
5	bronze	8.0
3	gold	6.0
6	gold	3.0
7	gold	5.0
8	gold	6.0
1	silver	3.0
2	silver	12.0

Now define the order of the cetgorical data using set_categories()

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In [30]:

```
data["medal"].cat.set_categories([ "gold","silver","bronze"],inplace=True)
```

In [31]:

```
data.sort_values(by=["medal"])
```

Out[31]:

	medal	ounces
3	gold	6.0
6	gold	3.0
7	gold	5.0
8	gold	6.0
1	silver	3.0
2	silver	12.0
0	bronze	4.0
4	bronze	7.5
5	bronze	8.0

Merging 2 data frames using merge()

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In [72]:

```
import pandas as pd
left = pd.DataFrame({'group': ['a', 'a', 'a', 'b','b', 'b', 'c', 'c','c'],
                 'ounces': [4, 3, 12, 6, 7.5, 8, 3, 5, 6]})
left
```

Out[72]:

	group	ounces
0	a	4.0
1	a	3.0
2	a	12.0
3	b	6.0
4	b	7.5
5	b	8.0
6	c	3.0
7	c	5.0
8	c	6.0

In [76]:

```
right = pd.DataFrame({'label': ['a','b','c'],
                      'value': ['alpha','beta','charlie']})
right
```

Out[76]:

	label	value
0	a	alpha
1	b	beta
2	c	charlie

By default, merge() does an inner join, but you can specify 'left', 'right', or 'outer' joins

In [85]:

```
inner_joined = pd.merge(left, right, how='inner', left_on='group', right_on='label')
inner_joined
```

Out[85]:

	group	ounces	label	value
0	a	4.0	a	alpha
1	a	3.0	a	alpha
2	a	12.0	a	alpha
3	b	6.0	b	beta
4	b	7.5	b	beta
5	b	8.0	b	beta
6	c	3.0	c	charlie
7	c	5.0	c	charlie
8	c	6.0	c	charlie

NOTE: To merge 2 Series, you have to use pd.concat() (http://stackoverflow.com/questions/18062135/combining-two-series-into-a-dataframe-in-pandas) instead

For more on merge, join, and concatenate, see the official docs (http://pandas.pydata.org/pandas-docs/stable/merging.html)

Finding rows of a data frame containing missing data

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In [1]:

```
import numpy as np
import pandas as pd
df = pd.DataFrame([range(3), [0, np.NaN, 0], [0, 0, np.NaN], range(3), range(3)])
df
```

Out[1]:

	0	1	2
0	0	1	2
1	0	NaN	0
2	0	0	NaN
3	0	1	2
4	0	1	2

In [2]:

```
df.isnull().any(axis=1)
```

Out[2]:

```
0    False
1     True
2     True
3    False
4    False
dtype: bool
```

In [3]:

```
df[df.isnull().any(axis=1)]
```

Out[3]:

	0	1	2
1	0	NaN	0
2	0	0	NaN

Converting a data type of a column in a data frame

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In [10]:

```
import pandas as pd

a = [['a', '1.2', '4.2'], ['b', '70', '0.03'], ['x', '5', '0']]
df = pd.DataFrame(a, columns=['one', 'two', 'three'])
df
```

Out[10]:

	one	two	three
0	a	1.2	4.2
1	b	70	0.03
2	x	5	0

In [13]:

```
df.dtypes
```

Out[13]:

```
one      object
two      object
three    object
dtype: object
```

In [14]:

```
df[['two', 'three']] = df[['two', 'three']].astype(float)
```

In [15]:

```
df.dtypes
```

Out[15]:

```
one       object
two      float64
three    float64
dtype: object
```

Plotting data frames using MATPLOTLIB version 1.5 and up

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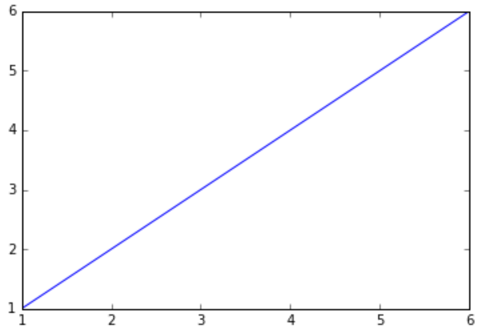
Starting with version 1.5, you can now pass a "data" parameter inside MATPLOTLIB's plot() function

Prior to version 1.5:

In [3]:

```
%matplotlib inline
import pandas as pd
import matplotlib.pyplot as plt

df = pd.DataFrame({"var1":[1,2,3,4,5,6], "var2":[1,2,3,4,5,6]})
plt.plot(df["var1"], df["var2"])
plt.show()
```



With version 1.5+