Python For Data Science Cheat Sheet
Pandas Basics

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Pandas

The Pandas library is built on NumPy and provides easy-to-use data structures and data analysis tools for the Python programming language.

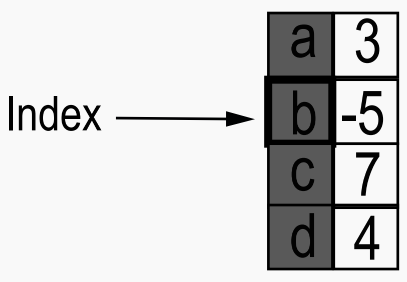
Use the following import convention:

```
>>>Import panda as pd
```

Pandas Data Structures

Series

A one-dimensional labeled array capable of holding any data type

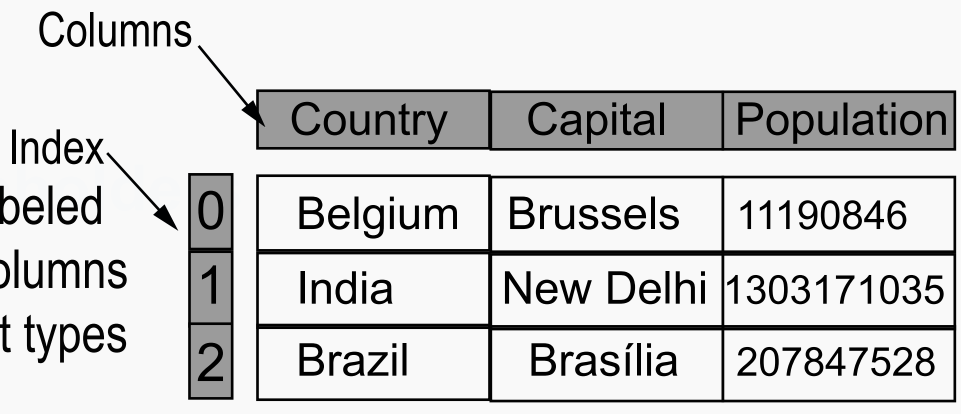


a	3
b	-5
c	7
d	4

```
>>> s = pd.Series([3, -5, 7, 4], index=['a', 'b', 'c', 'd'])
```

DataFrame

A two-dimensional labeled data structure with columns of potentially different types



	Country	Capital	Population
0	Belgium	Brussels	11190846
1	India	New Delhi	1303171035
2	Brazil	Brasília	207847528

```
>>> data = {'Country': ['Belgium', 'India', 'Brazil'],
     'Capital': ['Brussels', 'New Delhi', 'Brasília'],
     'Population': [11190846, 1303171035, 207847528]}

>>> df = pd.DataFrame(data,
         columns=['Country', 'Capital', 'Population'])
```

I/O

Read and Write to CSV

```
>>> pd.read_csv('file.csv', header=None, nrows=5)
>>> df.to_csv('myDataFrame.csv')
```

Read and Write to Excel

```
>>> pd.read_excel('file.xlsx')
>>> pd.to_excel('dir/myDataFrame.xlsx', sheet_name='Sheet1')
Read multiple sheets from the same file
>>> xlsx = pd.ExcelFile('file.xls')
>>> df = pd.read_excel(xlsx, 'Sheet1')
```

Read and Write to SQL Query or Database Table

```
>>> from sqlalchemy import create_engine
>>> engine = create_engine('sqlite:///:memory:')
>>> pd.read_sql("SELECT * FROM my_table;", engine)
>>> pd.read_sql_table('my_table', engine)
>>> pd.read_sql_query("SELECT * FROM my_table;", engine)
```

read_sql()is a convenience wrapper around read_sql_table() and read_sql_query()

```
>>> pd.to_sql('myDf', engine)
```

Asking For Help

```
>>> help(pd.Series.loc)
```

Selection

Also see NumPy Arrays

Getting

```
>>> s['b']
    -5
```

Get one element

```
>>> df[1:]
    Country   Capital    Population
    1 India   New Delhi  1303171035
    2 Brazil  Brasília   207847528
```

Get subset of a DataFrame

Selecting, Boolean Indexing & Setting

By Position

```
>>> df.iloc[[0],[0]]
   'Belgium'
>>> df.iat([0],[0])
   'Belgium'
```

Select single value by row & column

By Label

```
>>> df.loc[[0], ['Country']]
   'Belgium'
>>> df.at([0], ['Country'])
   'Belgium'
```

Select single value by row & column labels

By Label/Position

```
>>> df.ix[2]
    Country    Brazil
    Capital    Brasília
    Population 207847528
```

Select single row of subset of rows

```
>>> df.ix[:,'Capital']
    0 Brussels
    1 New Delhi
    2 Brasília
```

Select a single column of subset of columns

```
>>> df.ix[1,'Capital']
   'New Delhi'
```

Select rows and columns

Boolean Indexing

```
>>> s[~(s > 1)]
>>> s[(s < -1) | (s > 2)]
>>> df[df['Population']
    >1200000000]
```

Series s where value is not >1

s where value is <-1 or >2

Use filter to adjust DataFrame

Setting

```
>>> s['a'] = 6
```

Set index a of Series s to 6

Dropping

`>>> s.drop(['a', 'c'])`	Drop values from rows (axis=0)
`>>> df.drop('Country', axis=1)`	Drop values from columns(axis=1)

Sort & Rank

`>>> df.sort_index()`	Sort by labels along an axis
`>>> df.sort_values(by='Country')`	Sort by the values along an axis
`>>> df.rank()`	Assign ranks to entries

Retrieving Series/DataFrame Information

Basic Information

`>>> df.shape`	(rows,columns)
`>>> df.index`	Describe index
`>>> df.columns`	Describe DataFrame columns
`>>> df.info()`	Info on DataFrame
`>>> df.count()`	Number of non-NA values

Summary

`>>> df.sum()`	Sum of values
`>>> df.cumsum()`	Cummulative sum of values
`>>> df.min()/df.max()`	Minimum/maximum values
`>>> df.idxmin()/df.idxmax()`	Minimum/Maximum index value
`>>> df.describe()`	Summary statistics
`>>> df.mean()`	Mean of values
`>>> df.median()`	Median of values

Applying Functions

`>>> f = lambda x: x*2`	
`>>> df.apply(f)`	Apply function
`>>> df.applymap(f)`	Apply function element-wise

Data Alignment

Internal Data Alignment

NA values are introduced in the indices that don't overlap:

```
>>> s3 = pd.Series([7, -2, 3], index=['a', 'c', 'd'])
>>> s + s3
    a 10.0
    b NaN
    c 5.0
    d 7.0
    Arithmetic Operations
```

Arithmetic Operations with Fill Methods

You can also do the internal data alignment yourself with the help of the fill methods:

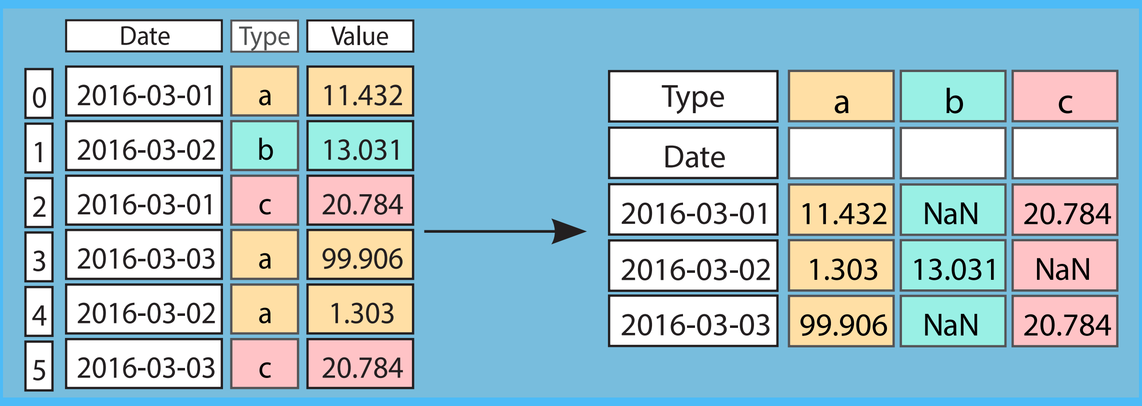
```
>>> s.add(s3, fill_value=0)
    a 10.0
    b -5.0
    c 5.0
    d 7.0
>>> s.sub(s3, fill_value=2)
>>> s.div(s3, fill_value=4)
>>> s.mul(s3, fill_value=3)
```

Reshaping Data

Pivot

```
>>> df3= df2.pivot(index='Date',
                   columns='Type',
                   values='Value')
```

Spread rows into columns



	Date	Type	Value
0	2016-03-01	a	11.432
1	2016-03-02	b	13.031
2	2016-03-01	c	20.784
3	2016-03-03	a	99.906
4	2016-03-02	a	1.303
5	2016-03-03	c	20.784

Type	a	b	c
Date			
2016-03-01	11.432	NaN	20.784
2016-03-02	1.303	13.031	NaN
2016-03-03	99.906	NaN	20.784

```
>>> df4 = pd.pivot_table(df2,
                          values='Value',
                          index='Date',
                          columns='Type'])
```

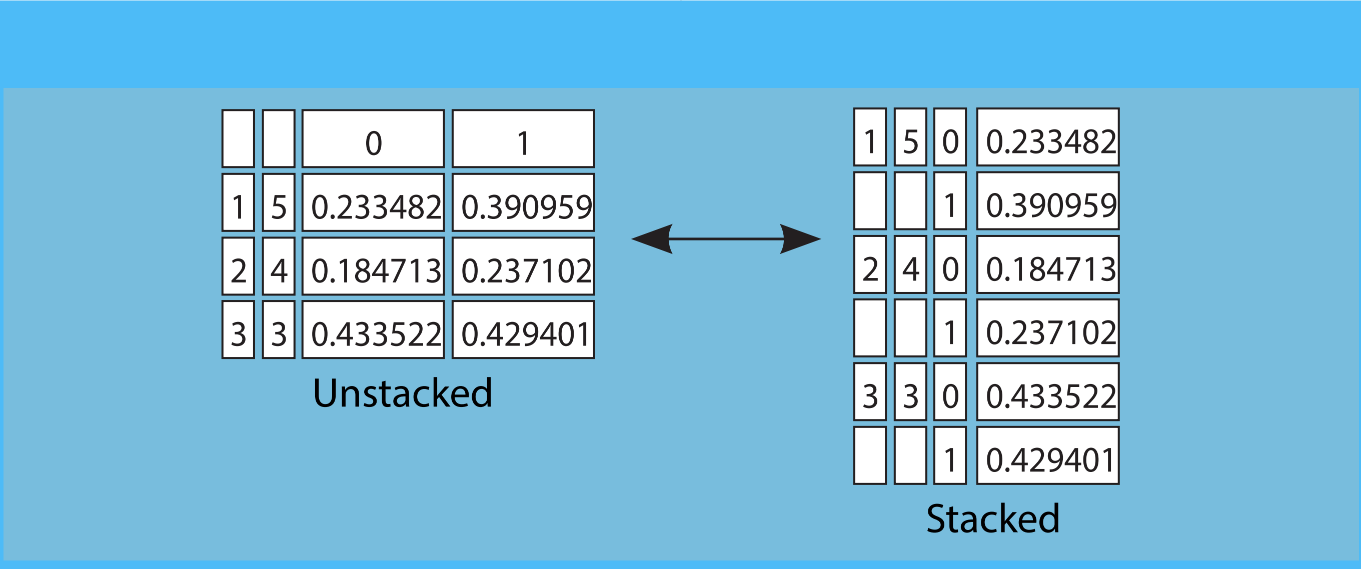
Spread rows into columns

Stack / Unstack

```
>>> stacked = df5.stack()
>>> stacked.unstack()
```

Pivot a level of column labels

Pivot a level of index labels



		0	1
1	5	0.233482	0.390959
2	4	0.184713	0.237102
3	3	0.433522	0.429401

Unstacked

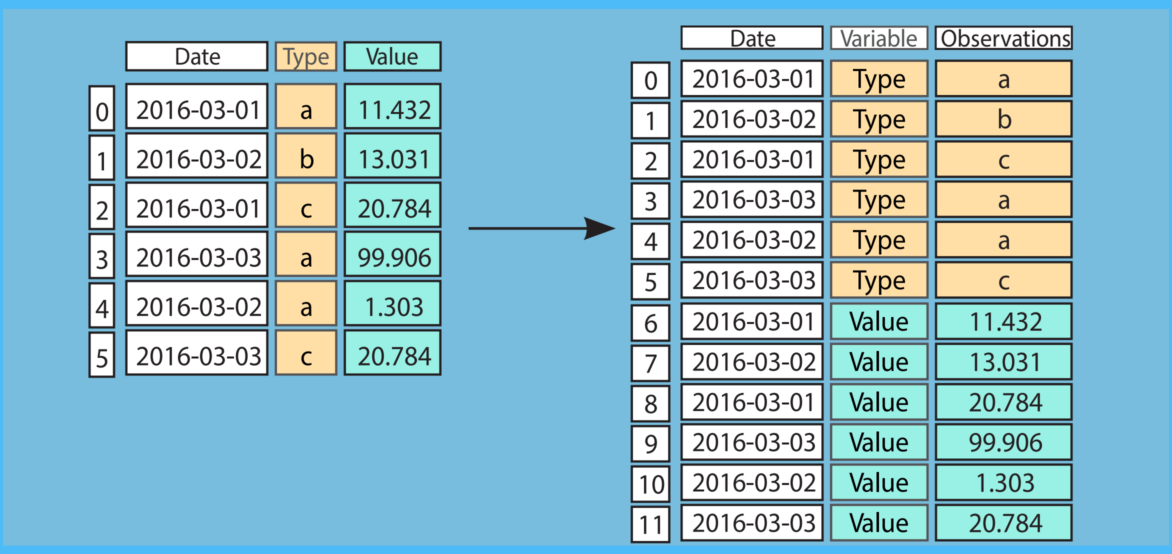
1	5	0	0.233482
		1	0.390959
2	4	0	0.184713
		1	0.237102
3	3	0	0.433522
		1	0.429401

Stacked

Melt

```
>>> pd.melt(df2,
            id_vars=["Date"],
            value_vars=["Type", "Value"],
            value_name="Observations")
```

Gather columns into rows



	Date	Type	Value
0	2016-03-01	a	11.432
1	2016-03-02	b	13.031
2	2016-03-01	c	20.784
3	2016-03-03	a	99.906
4	2016-03-02	a	1.303
5	2016-03-03	c	20.784

	Date	Variable	Observations
0	2016-03-01	Type	a
1	2016-03-02	Type	b
2	2016-03-01	Type	c
3	2016-03-03	Type	a
4	2016-03-02	Type	a
5	2016-03-03	Type	c
6	2016-03-01	Value	11.432
7	2016-03-02	Value	13.031
8	2016-03-01	Value	20.784
9	2016-03-03	Value	99.906
10	2016-03-02	Value	1.303
11	2016-03-03	Value	20.784

Iteration

```
>>> df.iteritems()
>>> df.iterrows()
```

(Column-index, Series) pairs

(Row-index, Series) pairs

Advanced Indexing

Also see NumPy Arrays

Selecting

`>>> df3.loc[:,(df3>1).any()]`	Select cols with any vals >1
`>>> df3.loc[:,(df3>1).all()]`	Select cols with vals > 1
`>>> df3.loc[:,df3.isnull().any()]`	Select cols with NaN
`>>> df3.loc[:,df3.notnull().all()]`	Select cols without NaN

Indexing With isin

`>>> df[(df.Country.isin(df2.Type))]`	Find same elements
`>>> df3.filter(items="a","b"])`	Filter on values
`>>> df.select(lambda x: not x%5)`	Select specific elements

Where

`>>> s.where(s > 0)`	Subset the data

Query

`>>> df6.query('second > first')`	Query DataFrame

Setting/Resetting Index

`>>> df.set_index('Country')`	Set the index
`>>> df4 = df.reset_index()`	Reset the index

`>>> df = df.rename(index=str,`
`columns={"Country":"cntry",`
`"Capital":"cptl",`
`"Population":"ppltn"})`
	Rename DataFrame

Reindexing

```
>>> s2 = s.reindex(['a','c','d','e','b'])
```

Forward Filling

```
>>> df.reindex(range(4),
              method='ffill')
   Country Capital    Population
0 Belgium Brussels   11190846
1 India    New Delhi 1303171035
2 Brazil   Brasília  207847528
3 Brazil   Brasília  207847528
```

Backward Filling

```
>>> s3 = s.reindex(range(5),
                   method='bfill')
  0 3
  1 3
  2 3
  3 3
  4 3
```

MultiIndexing

```
>>> arrays = [np.array([1,2,3]),
              np.array([5,4,3])]
>>> df5 = pd.DataFrame(np.random.rand(3, 2), index=arrays)
>>> tuples = list(zip(*arrays))
>>> index = pd.MultiIndex.from_tuples(tuples,
                                      names=['first', 'second'])
>>> df6 = pd.DataFrame(np.random.rand(3, 2), index=index)
>>> df2.set_index(["Date", "Type"])
```

Duplicate Data

`>>> s3.unique()`	Return unique values
`>>> df2.duplicated('Type')`	Check duplicates
`>>> df2.drop_duplicates('Type', keep='last')`	Drop duplicates
`>>> df.index.duplicated()`	Check index duplicates

Grouping Data

Aggregation

```
>>> df2.groupby(by=['Date','Type']).mean()
>>> df4.groupby(level=0).sum()
>>> df4.groupby(level=0).agg({'a':lambda x:sum(x)/len(x),
                              'b': np.sum})
```

Transformation

```
>>> customSum = lambda x: (x+x%2)
>>> df4.groupby(level=0).transform(customSum)
```

Missing Data

`>>> df.dropna()`	Drop NaN values
`>>> df3.fillna(df3.mean())`	Fill NaN values with a predetermined value
`>>> df2.replace("a", "f")`	Replace values with others

Combining Data

data1

X1	X2
a	11.432
b	1.303
c	99.906

data2

X1	X3
a	20.784
b	NaN
d	20.784

Merge

```
>>> pd.merge(data1,
             data2,
             how='left',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN
c	99.906	NaN

```
>>> pd.merge(data1,
             data2,
             how='right',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN
d	NaN	20.784

```
>>> pd.merge(data1,
             data2,
             how='inner',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN

```
>>> pd.merge(data1,
             data2,
             how='outer',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN
c	99.906	NaN
d	NaN	20.784

Join

```
>>> data1.join(data2, how='right')
```

Concatenate

Vertical

```
>>> s.append(s2)
```

Horizontal/Vertical

```
>>> pd.concat([s,s2],axis=1, keys=['One','Two'])
>>> pd.concat([data1, data2], axis=1, join='inner')
```

Dates

```
>>> df2['Date']= pd.to_datetime(df2['Date'])
>>> df2['Date']= pd.date_range('2000-1-1', periods=6,
                               freq='M')
>>> dates = [datetime(2012,5,1), datetime(2012,5,2)]
>>> index = pd.DatetimeIndex(dates)
>>> index = pd.date_range(datetime(2012,2,1), end, freq='BM')
```

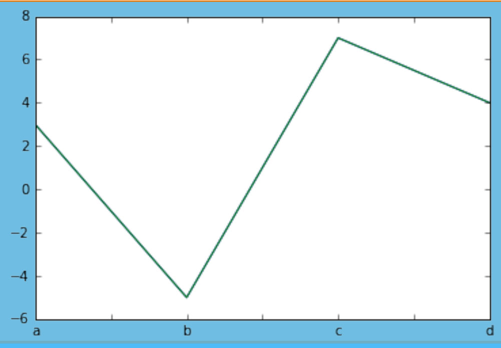
Visualization

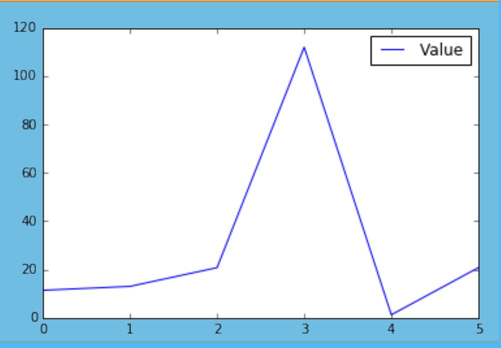
Also see Matplotlib

```
>>> import matplotlib.pyplot as plt
```

```
>>> s.plot()
>>> plt.show()
```

```
>>> df2.plot()
>>> plt.show()
```


8
6
4
2
0
−2
−4
−6
a
b
c
d


Value