Data Wrangling

with pandas Cheat Sheet

http://pandas.pydata.org

Pandas API Reference Pandas User Guide

Creating DataFrames

	a	b	c
1	4	7	10
2	5	8	11
3	6	9	12

```
df = pd.DataFrame(
          {"a" : [4, 5, 6],
           "b" : [7, 8, 9],
           "c" : [10, 11, 12]},
        index = [1, 2, 3])
```

Specify values for each column.

```
df = pd.DataFrame(
     [[4, 7, 10],
      [5, 8, 11],
      [6, 9, 12]],
     index=[1, 2, 3],
     columns=['a', 'b', 'c'])
```

Specify values for each row.

		a	b	c
N	v			
D	1	4	7	10
	2	5	8	11
e	2	6	9	12

```
df = pd.DataFrame(
          {"a" : [4 ,5, 6],
           "b" : [7, 8, 9],
           "c" : [10, 11, 12]},
index = pd.MultiIndex.from_tuples(
        [('d', 1), ('d', 2),
         ('e', 2)], names=['n', 'v']))
```

Create DataFrame with a MultiIndex

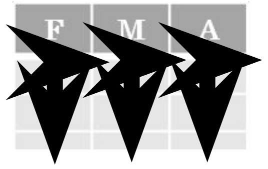
Method Chaining

Most pandas methods return a DataFrame so that another pandas method can be applied to the result. This improves readability of code.

```
df = (pd.melt(df)
        .rename(columns={
                'variable':'var',
                'value':'val'})
        .query('val >= 200')
     )
```

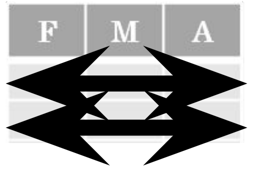
Tidy Data – A foundation for wrangling in pandas

In a tidy data set:



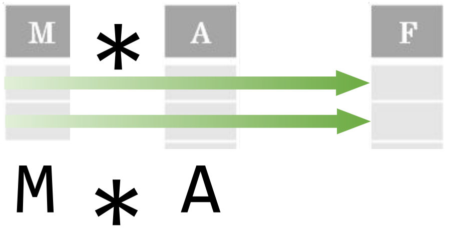
Each **variable** is saved in its own **column**

&

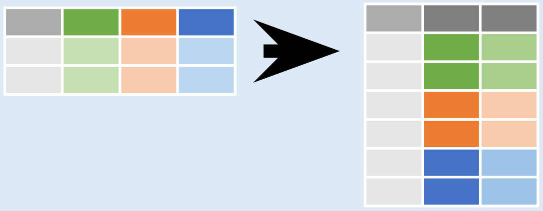


Each **observation** is saved in its own **row**

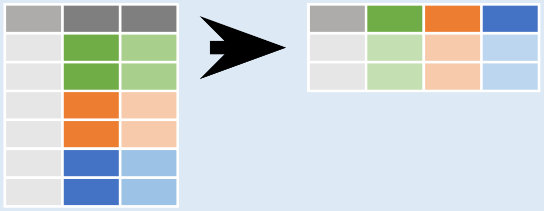
Tidy data complements pandas's **vectorized operations**. pandas will automatically preserve observations as you manipulate variables. No other format works as intuitively with pandas.



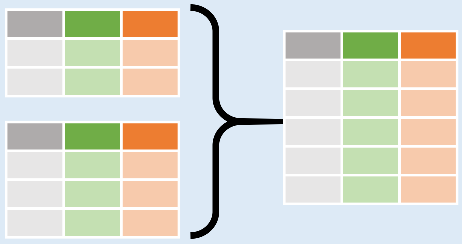
Reshaping Data – Change layout, sorting, reindexing, renaming



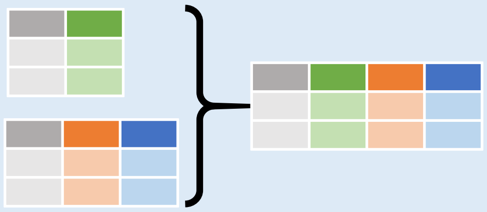
`pd.melt(df)`
Gather columns into rows.



`df.pivot(columns='var', values='val')`
Spread rows into columns.



`pd.concat([df1,df2])`
Append rows of DataFrames



`pd.concat([df1,df2], axis=1)`
Append columns of DataFrames

`df.sort_values('mpg')`
Order rows by values of a column (low to high).

`df.sort_values('mpg', ascending=False)`
Order rows by values of a column (high to low).

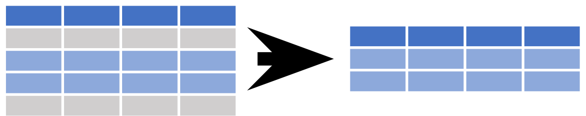
`df.rename(columns = {'y':'year'})`
Rename the columns of a DataFrame

`df.sort_index()`
Sort the index of a DataFrame

`df.reset_index()`
Reset index of DataFrame to row numbers, moving index to columns.

`df.drop(columns=['Length', 'Height'])`
Drop columns from DataFrame

Subset Observations - rows



`df[df.Length > 7]`
Extract rows that meet logical criteria.

`df.drop_duplicates()`
Remove duplicate rows (only considers columns).

`df.sample(frac=0.5)`
Randomly select fraction of rows.

`df.sample(n=10)` Randomly select n rows.

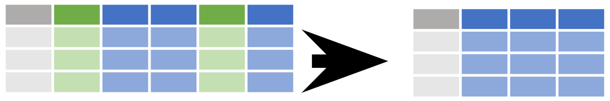
`df.nlargest(n, 'value')`
Select and order top n entries.

`df.nsmallest(n, 'value')`
Select and order bottom n entries.

`df.head(n)`
Select first n rows.

`df.tail(n)`
Select last n rows.

Subset Variables - columns



`df[['width', 'length', 'species']]`
Select multiple columns with specific names.

`df['width']` *or* `df.width`
Select single column with specific name.

`df.filter(regex='regex')`
Select columns whose name matches regular expression *regex*.

Using query

query() allows Boolean expressions for filtering rows.

```
df.query('Length > 7')
df.query('Length > 7 and Width < 8')
df.query('Name.str.startswith("abc")',
         engine="python")
```

Subsets - rows and columns

Use **df.loc[]** and **df.iloc[]** to select only rows, only columns or both.
Use **df.at[]** and **df.iat[]** to access a single value by row and column.
First index selects rows, second index columns.

`df.iloc[10:20]`
Select rows 10-20.

`df.iloc[:, [1, 2, 5]]`
Select columns in positions 1, 2 and 5 (first column is 0).

`df.loc[:, 'x2':'x4']`
Select all columns between x2 and x4 (inclusive).

`df.loc[df['a'] > 10, ['a', 'c']]`
Select rows meeting logical condition, and only the specific columns .

`df.iat[1, 2]` Access single value by index

`df.at[4, 'A']` Access single value by label

Logic in Python (and pandas)			
`<`	Less than	`!=`	Not equal to
`>`	Greater than	`df.column.isin(values)`	Group membership
`==`	Equals	`pd.isnull(obj)`	Is NaN
`<=`	Less than or equals	`pd.notnull(obj)`	Is not NaN
`>=`	Greater than or equals	`&,|,~,^,df.any(),df.all()`	Logical and, or, not, xor, any, all

regex (Regular Expressions) Examples	
`'\.'`	Matches strings containing a period '.'
`'Length$'`	Matches strings ending with word 'Length'
`'^Sepal'`	Matches strings beginning with the word 'Sepal'
`'^x[1-5]$'`	Matches strings beginning with 'x' and ending with 1,2,3,4,5
`'^(?!Species$).*'`	Matches strings except the string 'Species'

Cheatsheet for pandas (http://pandas.pydata.org/ originally written by Irv Lustig, Princeton Consultants, inspired by Rstudio Data Wrangling Cheatsheet

Summarize Data

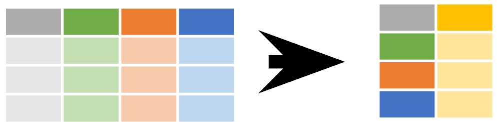
`df['w'].value_counts()`
Count number of rows with each unique value of variable

`len(df)`
# of rows in DataFrame.

`df.shape`
Tuple of # of rows, # of columns in DataFrame.

`df['w'].nunique()`
# of distinct values in a column.

`df.describe()`
Basic descriptive and statistics for each column (or GroupBy).



pandas provides a large set of **summary functions** that operate on different kinds of pandas objects (DataFrame columns, Series, GroupBy, Expanding and Rolling (see below)) and produce single values for each of the groups. When applied to a DataFrame, the result is returned as a pandas Series for each column. Examples:

`sum()`
Sum values of each object.

`count()`
Count non-NA/null values of each object.

`median()`
Median value of each object.

`quantile([0.25,0.75])`
Quantiles of each object.

`apply(`*function*`)`
Apply function to each object.

`min()`
Minimum value in each object.

`max()`
Maximum value in each object.

`mean()`
Mean value of each object.

`var()`
Variance of each object.

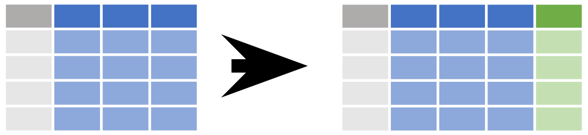
`std()`
Standard deviation of each object.

Handling Missing Data

`df.dropna()`
Drop rows with any column having NA/null data.

`df.fillna(value)`
Replace all NA/null data with value.

Make New Columns



`df.assign(Area=lambda df: df.Length*df.Height)`
Compute and append one or more new columns.

`df['Volume'] = df.Length*df.Height*df.Depth`
Add single column.

`pd.qcut(df.col, n, labels=False)`
Bin column into n buckets.

Vector function
Vector function

pandas provides a large set of **vector functions** that operate on all columns of a DataFrame or a single selected column (a pandas Series). These functions produce vectors of values for each of the columns, or a single Series for the individual Series. Examples:

`max(axis=1)`
Element-wise max.

`clip(lower=-10,upper=10)`
Trim values at input thresholds

`min(axis=1)`
Element-wise min.

`abs()`
Absolute value.

Group Data

`df.groupby(by="col")`
Return a GroupBy object, grouped by values in column named "col".

`df.groupby(level="ind")`
Return a GroupBy object, grouped by values in index level named "ind".

All of the summary functions listed above can be applied to a group. Additional GroupBy functions:

`size()`
Size of each group.

`agg(`*function*`)`
Aggregate group using function.

The examples below can also be applied to groups. In this case, the function is applied on a per-group basis, and the returned vectors are of the length of the original DataFrame.

`shift(1)`
Copy with values shifted by 1.

`rank(method='dense')`
Ranks with no gaps.

`rank(method='min')`
Ranks. Ties get min rank.

`rank(pct=True)`
Ranks rescaled to interval [0, 1].

`rank(method='first')`
Ranks. Ties go to first value.

`shift(-1)`
Copy with values lagged by 1.

`cumsum()`
Cumulative sum.

`cummax()`
Cumulative max.

`cummin()`
Cumulative min.

`cumprod()`
Cumulative product.

Windows

`df.expanding()`
Return an Expanding object allowing summary functions to be applied cumulatively.

`df.rolling(n)`
Return a Rolling object allowing summary functions to be applied to windows of length n.

Dropping a Column

```
> df = pd.DataFrame([('falcon', 'bird', 389.0),
('parrot', 'bird', 24.0),('lion', 'mammal', 80.5),
('monkey','mammal', np.nan)],columns=('name', 'class',
'max_speed'))
> df.pop('class')
```

The pop functions is used to drop a column in a dataframe

Combine Data Sets

adf

x1	x2
A	1
B	2
C	3

+

bdf

x1	x3
A	T
B	F
D	T

=

Standard Joins

x1	x2	x3
A	1	T
B	2	F
C	3	NaN

```
pd.merge(adf, bdf,
         how='left', on='x1')
```
Join matching rows from bdf to adf.

x1	x2	x3
A	1.0	T
B	2.0	F
D	NaN	T

```
pd.merge(adf, bdf,
         how='right', on='x1')
```
Join matching rows from adf to bdf.

x1	x2	x3
A	1	T
B	2	F

```
pd.merge(adf, bdf,
         how='inner', on='x1')
```
Join data. Retain only rows in both sets.

x1	x2	x3
A	1	T
B	2	F
C	3	NaN
D	NaN	T

```
pd.merge(adf, bdf,
         how='outer', on='x1')
```
Join data. Retain all values, all rows.

Filtering Joins

x1	x2
A	1
B	2

`adf[adf.x1.isin(bdf.x1)]`
All rows in adf that have a match in bdf.

x1	x2
C	3

`adf[~adf.x1.isin(bdf.x1)]`
All rows in adf that do not have a match in bdf.

ydf

x1	x2
A	1
B	2
C	3

+

zdf

x1	x2
B	2
C	3
D	4

=

Set-like Operations

x1	x2
B	2
C	3

`pd.merge(ydf, zdf)`
Rows that appear in both ydf and zdf (Intersection).

x1	x2
A	1
B	2
C	3
D	4

`pd.merge(ydf, zdf, how='outer')`
Rows that appear in either or both ydf and zdf (Union).

x1	x2
A	1

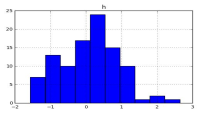
```
pd.merge(ydf, zdf, how='outer',
         indicator=True)
.query('_merge == "left_only"')
.drop(columns=['_merge'])
```
Rows that appear in ydf but not zdf (Setdiff).

Cheatsheet for pandas (http://pandas.pydata.org/) originally written by Irv Lustig, Princeton Consultants, inspired by Rstudio Data Wrangling Cheatsheet

Plotting

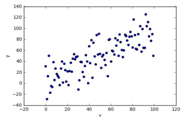
`df.plot.hist()`

Histogram for each column



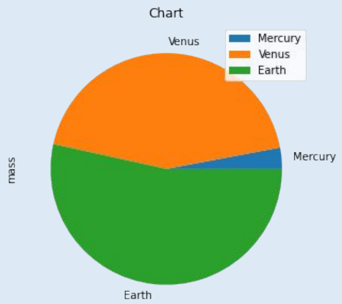
`df.plot.scatter(x='w',y='h')`

Scatter chart using pairs of points

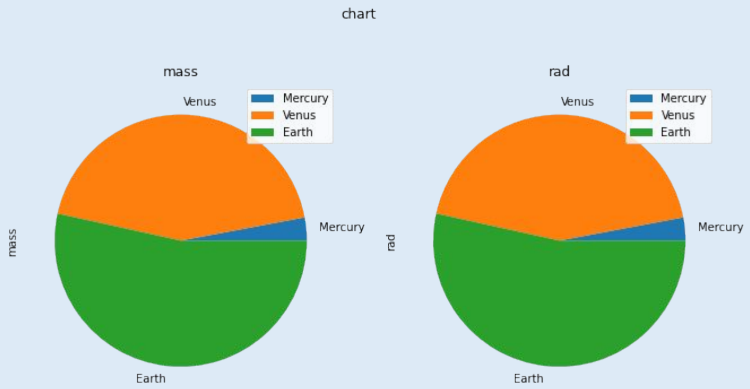


Pie Charts

```
> df = pd.DataFrame(
 { 'mass': [0.330, 4.87 , 5.97],
   'radius': [2439.7, 6051.8, 6378.1]
 }, index=['Mercury', 'Venus', 'Earth'])
> plot = df.plot.pie(y='mass', figsize=(5, 5),
  title="Chart")
```

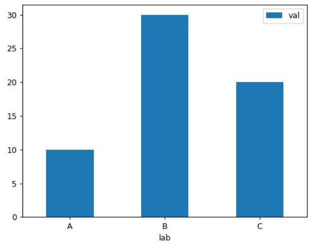


```
> plot = df.plot.pie(subplots=True, figsize=(11, 6))
ax1 = plt.subplot(plot[0])
ax1.title.set_text('mass')
ax1 = plt.subplot(plot[1])
ax1.title.set_text('rad')
```

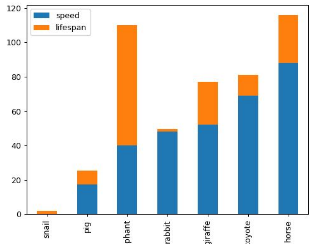


Bar Plots

`df.plot.bar()`

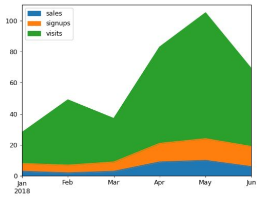


`df.plot.bar(stacked=True)`

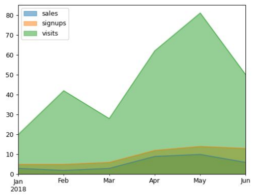


Area Plots

`df.plot.area()`

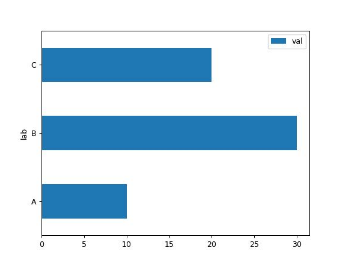


`df.plot.area(stacked=False)`

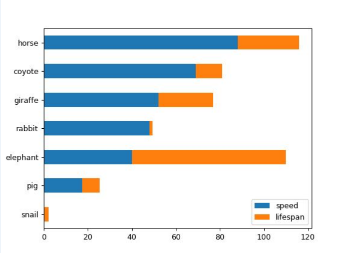


Horizontal Bar Plot

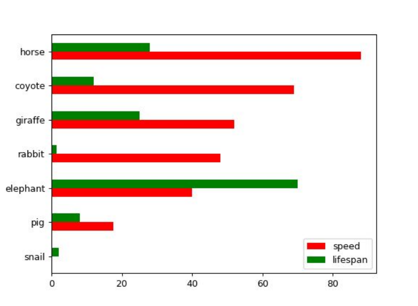
`df.plot.barh(x='lab', y='val')`



`df.plot.barh(stacked=True)`

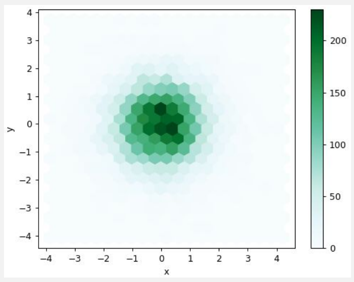


`df.plot.barh(color={"speed": "red", "lifespan": "green"})`



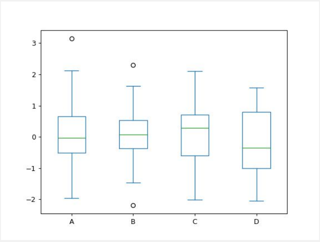
Hexbins

`df.plot.hexbin(x='x', y='y', gridsize=20)`



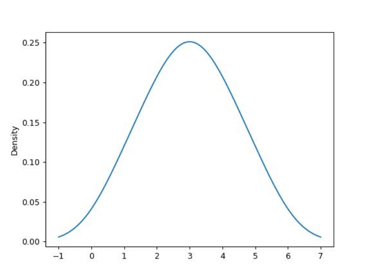
Box Plots

`df.plot.box()`

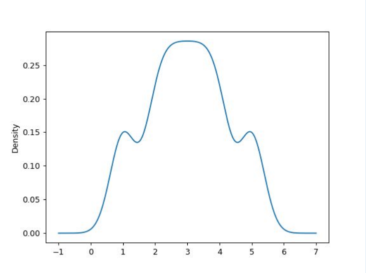


Density Plots

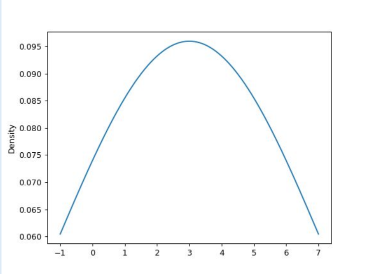
`s.plot.kde()`



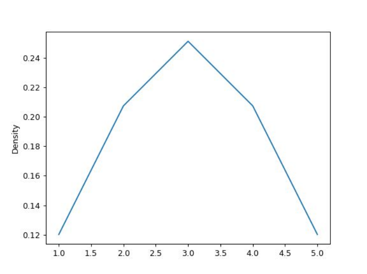
`s.plot.kde(bw_method=0.3)`



`s.plot.kde(bw_method=3)`



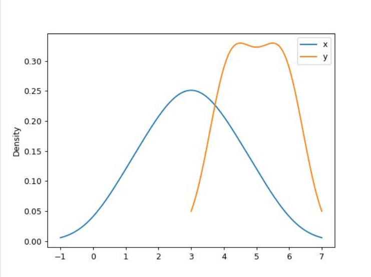
`s.plot.kde(ind=[1, 2, 3, 4, 5])`



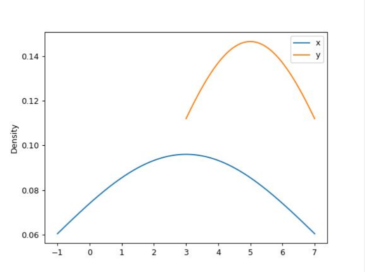
For Dataframes:

```
> df = pd.DataFrame({'x': [1, 2, 2.5, 3, 3.5, 4,
5],'y': [4, 4, 4.5, 5, 5.5, 6, 6],})
```

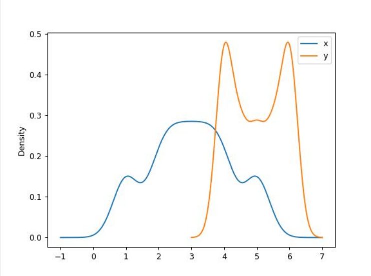
`> ax = df.plot.kde()`



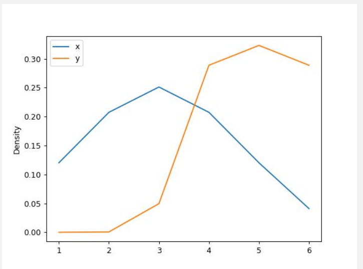
`df.plot.kde(bw_method=3)`



`df.plot.kde(bw_method=0.3)`

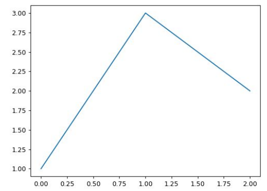


`df.plot.kde(ind=[1, 2, 3, 4, 5, 6])`

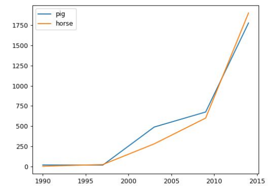


Line Charts

`s.plot.line()`



`df.plot.line()`



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I/O with Pandas

Format type	Data Format	Reader Function	Writer Function
text	CSV	`read_csv(filepath)`	`to_csv(filepath)`
text	JSON	`read_json(filepath)`	`to_json(filepath)`
text	HTML	`read_html(io)`	`to_html(io)`
text	XML	`read_xml(path)`	`to_xml(path)`
text	Local Clipboard	`read_clipboard()`	`to_clipboard()`
binary	MS Excel	`read_excel(filepath, sheet_name)`	`to_excel(filepath)`
binary	HDF5	`read_hdf(path)`	`to_hdf(path)`
binary	Feather	`read_feather(path)`	`to_feather(path)`
binary	Parquet	`read_parquet(path)`	`to_parquet(path)`
binary	Stata	`read_stata(filepath)`	`to_stata(filepath)`
binary	Python Pickle	`read_pickle(filepath)`	`to_pickle(filepath)`
SQL	SQL	`read_sql(sql_query, con)` where con = SQLAlchemy connectable, str or sqlite3 connection	`to_sql(table_name, con)`
SQL	Google BigQuery	`read_gbq(query)`	`to_gbq(destination_table)`

All file paths are strings with relevant extensions.

pd.NA

Missing values indicator that can be used consistently across data types (nullable integer, boolean and dedicated string data types)

Function	Default data type
np.nan	Float
None	Object
pd.NaT	Float
pd.NA	Integer, float, string

Frequently Used Options

Option	Function	Value type
`display.chop_threshold`	If set to a float value, all float values smaller than the given threshold will be displayed as 0	Float
`display.colheader_justify`	Controls the justification of the headers	Left/Right
`display.expand_frame_repr`	Whether to print out the full DataFrame representation for wide DataFrames across multiple lines	True/False
`display.large_repr`	Whether to display DataFrames that exceed max_columns/max_rows as a truncated frame, or as a summary.	Truncate/info
`display.max_cols`	Sets the maximum number of columns displayed	Integer
`display.max_colwidth`	Sets the maximum width of columns	Integer
`display.max_info_columns`	Sets a threshold for when by-column info will be given.	Integer
`display.max_info_rows: df.info()`	Will show null-counts for each column (for large frames this can be quite slow)	Integer
`display.max_rows`	Sets the maximum number of rows displayed	Integer
`display.precision`	Sets the output display precision in terms of decimal places	Integer

The above functions can be called using the below getting/setting options, available directly from the pandas namespace:

```
pd.get_option(option)
pd.set_option(option, value)
pd.reset_option(option)
```

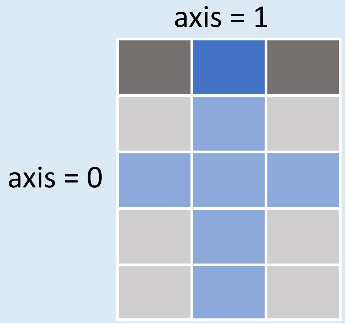
Apply Functions

`df.apply(func, axis)`

Apply a function along an axis of the DataFrame.

`df.applymap(func, na_action)`

Apply a function to a Dataframe elementwise. Set na_action to 'ignore' if NaN values are to be ignored.



Cheatsheet for pandas (http://pandas.pydata.org/) originally written by Irv Lustig, Princeton Consultants, inspired by Rstudio Data Wrangling Cheatsheet