

# Data Wrangling

with pandas

Cheat Sheet

<http://pandas.pydata.org>

## Syntax – 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

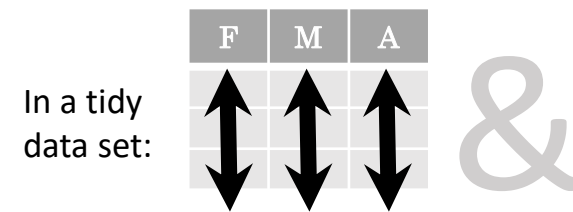
```
df = pd.DataFrame(  
    {"a" : [4 ,5, 6],  
     "b" : [7, 8, 9],  
     "c" : [10, 11, 12]},  
    index = pd.MultiIndex.from_tuples(  
        [('d',1),('d',2),('e',2)],  
        names=['n','v']))  
Create DataFrame with a MultiIndex
```

## Method Chaining

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

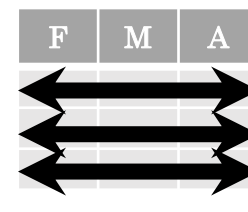
```
df = (pd.melt(df)  
      .rename(columns={  
          'variable' : 'var',  
          'value' : 'val'})  
      .query('val >= 200'))
```

## Tidy Data – A foundation for wrangling in pandas



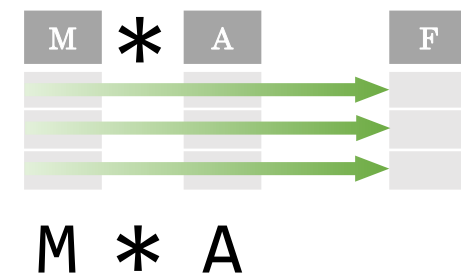
In a tidy data set:

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

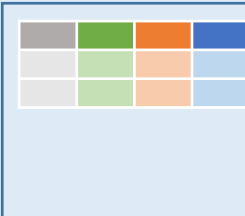


Each **observation** is saved in its own **row**

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



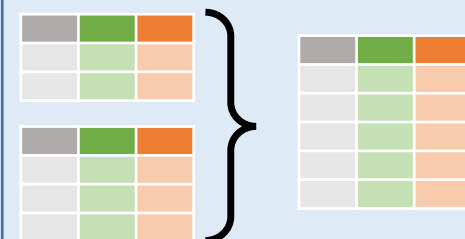
## Reshaping Data – Change the layout of a data set



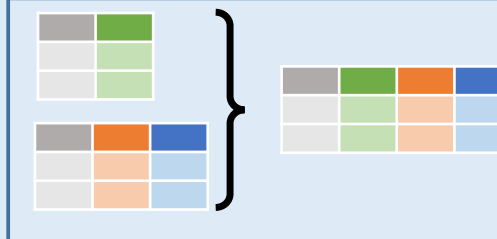
**pd.melt(df)**  
Gather columns into rows.



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



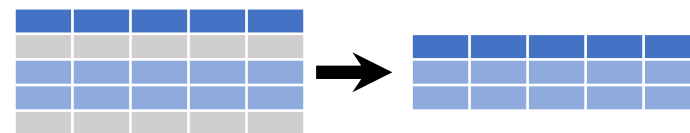
**pd.concat([df1,df2])**  
Append rows of DataFrames



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

```
df=df.sort_values('mpg')  
Order rows by values of a column (low to high).  
  
df=df.sort_values('mpg',ascending=False)  
Order rows by values of a column (high to low).  
  
df=df.rename(columns = {'y':'year'})  
Rename the columns of a DataFrame  
  
df=df.sort_index()  
Sort the index of a DataFrame  
  
df=df.reset_index()  
Reset index of DataFrame to row numbers, moving  
index to columns.  
  
df=df.drop(['Length','Height'], axis=1)  
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.head(n)  
Select first n rows.  
  
df.tail(n)  
Select last n rows.
```

```
df.sample(frac=0.5)  
Randomly select fraction of rows.  
  
df.sample(n=10)  
Randomly select n rows.  
  
df.iloc[10:20]  
Select rows by position.  
  
df.nlargest(n, 'value')  
Select and order top n entries.  
  
df.nsmallest(n, 'value')  
Select and order bottom n entries.
```

## 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.
```

### regex (Regular Expressions) Examples

regex	Matches
'\.'	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'

```
df.loc[:, 'x2': 'x4']  
Select all columns between x2 and x4 (inclusive).  
  
df.iloc[:, [1,2,5]]  
Select columns in positions 1, 2 and 5 (first column is 0).  
  
df.loc[df['a'] > 10, ['a','c']]  
Select rows meeting logical condition, and only the specific columns.
```

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

## Summarize Data

**df['Length'].value\_counts()**

Count number of rows with each unique value of variable

**len(df)**

# of rows in DataFrame.

**len(df['w'].unique())**

# of distinct values in a column.

**df.describe()**

Basic descriptive 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.

## 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.

## 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.

## Handling Missing Data

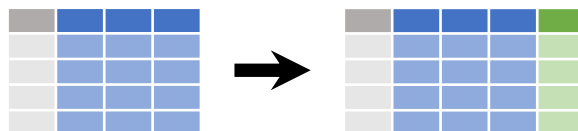
**df=df.dropna()**

Drop rows with any column having NA/null data.

**df=df.fillna(value)**

Replace all NA/null data with value.

## Make New Variables



**df=df.assign(Area=lambda df: df.Length\*df.Height)**

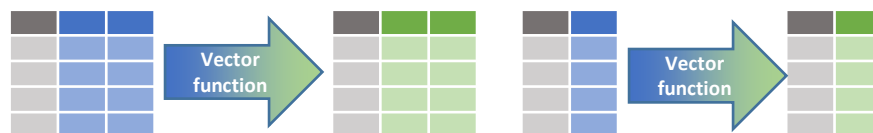
Compute and append one or more new columns.

**df['Volume'] = df.Length\*df.Height\*df.Depth**

Add single column.

**pd.qcut(df.col, n, labels=False)**

Bin column into n buckets.



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.

**min(axis=1)**

Element-wise min.

**clip(lower=-10,upper=10)**

Trim values at input thresholds

**abs()**

Absolute value.

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.

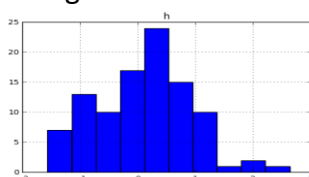
**cumprod()**

Cumulative product.

## Plotting

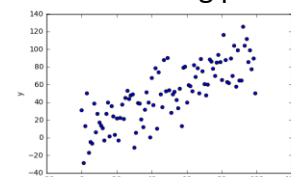
**df.plot.hist()**

Histogram for each column



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

Scatter chart using pairs of points



## 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(['\_merge'],axis=1)**  
Rows that appear in ydf but not zdf (Setdiff).