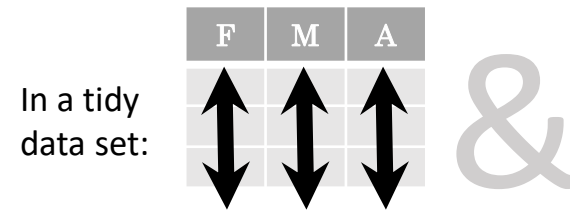


# Data Wrangling

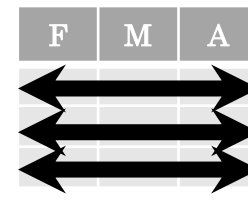
## with pandas Cheat Sheet

<http://pandas.pydata.org>

# Tidy Data – A foundation for wrangling in pandas

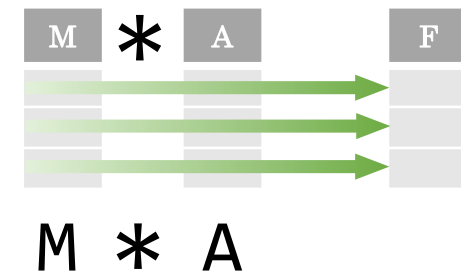


Each **variable** is saved in its own **column**



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.



## 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.

	n	v	a	b	c
d	1	4	7	10	
e	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

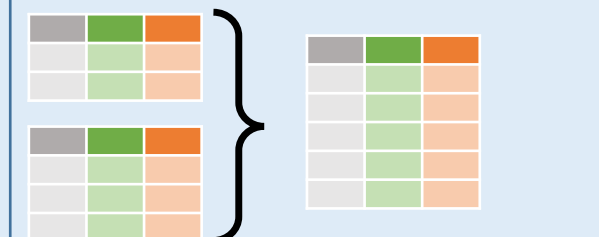
## Reshaping Data – Change the layout of a data set



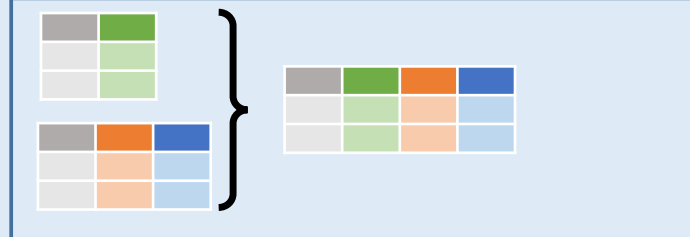
**pd.melt(df)**  
Gather columns into rows.



**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).

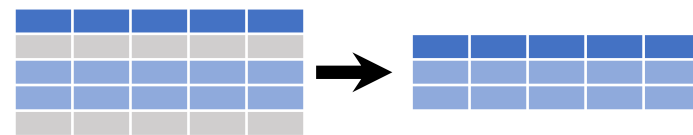
df=df.rename(columns = {'y': 'year'})
    Rename the columns of a DataFrame

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

'\.'	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.
```

## 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')
     )
```

### 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

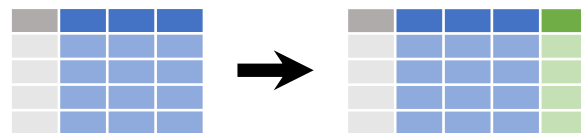
**df=df.dropna()**

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) abs()**

Trim values at input thresholds 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.

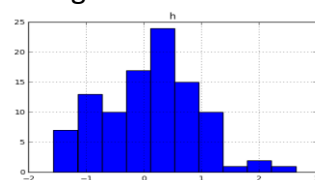
**cumprod()**

Cumulative product.

## Plotting

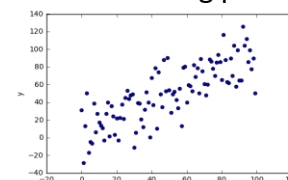
**df.plot.hist()**

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).