```
In [1]: import pandas as pd
```

Data used for this tutorial:

Titanic data

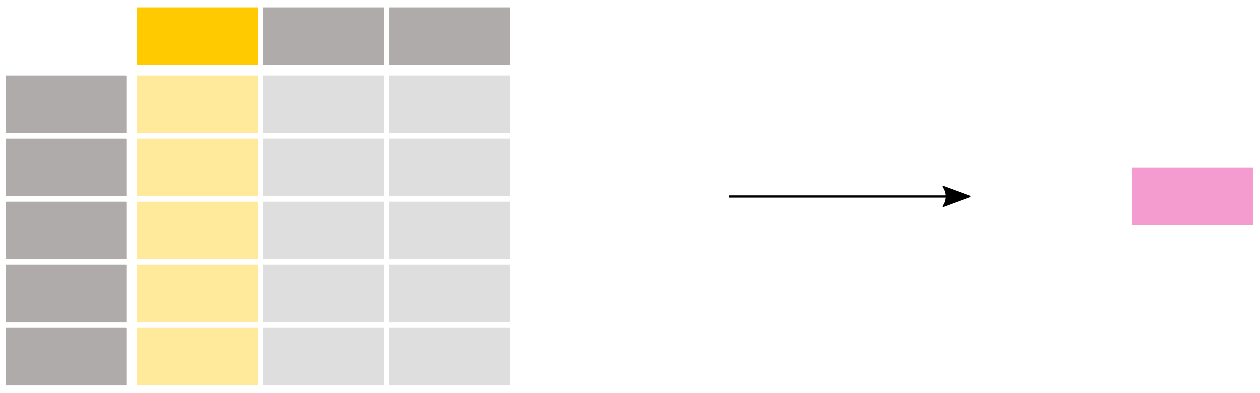
```
In [2]: titanic = pd.read_csv("data/titanic.csv")

In [3]: titanic.head()
Out[3]: 
   PassengerId  Survived  Pclass  ...     Fare Cabin  Embarked
0            1         0       3  ...   7.2500   NaN         S
1            2         1       1  ...  71.2833   C85         C
2            3         1       3  ...   7.9250   NaN         S
3            4         1       1  ...  53.1000  C123         S
4            5         0       3  ...   8.0500   NaN         S

[5 rows x 12 columns]
```

How to calculate summary statistics

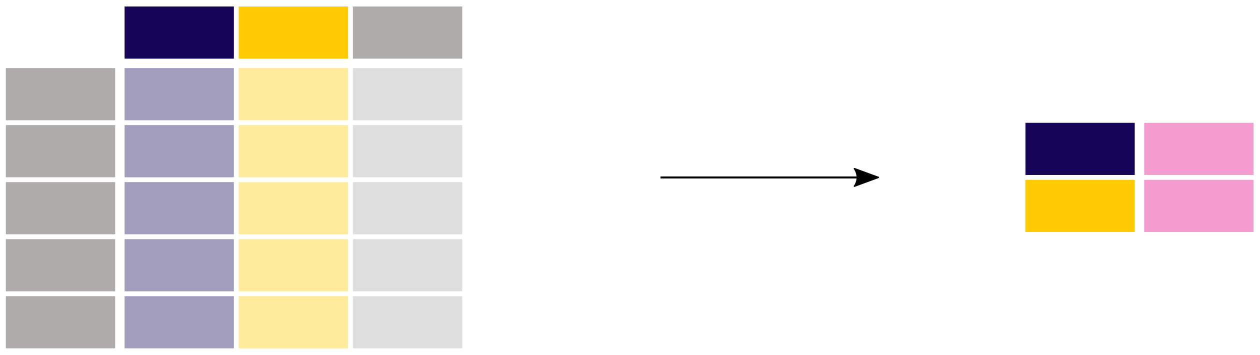
Aggregating statistics



What is the average age of the Titanic passengers?

```
In [4]: titanic["Age"].mean()
Out[4]: 29.69911764705882
```

Different statistics are available and can be applied to columns with numerical data. Operations in general exclude missing data and operate across rows by default.



What is the median age and ticket fare price of the Titanic passengers?

```
In [5]: titanic[["Age", "Fare"]].median()
Out[5]: 
Age     28.0000
Fare    14.4542
dtype: float64
```

The statistic applied to multiple columns of a `DataFrame` (the selection of two columns returns a `DataFrame`, see the subset data tutorial) is calculated for each numeric column.

The aggregating statistic can be calculated for multiple columns at the same time. Remember the `describe` function from the first tutorial?

```
In [6]: titanic[["Age", "Fare"]].describe()
Out[6]: 
              Age        Fare
count  714.000000  891.000000
mean    29.699118   32.204208
std     14.526497   49.693429
min      0.420000    0.000000
25%     20.125000    7.910400
50%     28.000000   14.454200
75%     38.000000   31.000000
max     80.000000  512.329200
```

Instead of the predefined statistics, specific combinations of aggregating statistics for given columns can be defined using the `DataFrame.agg()` method:

```
In [7]: titanic.agg(
   ...:     {
   ...:         "Age": ["min", "max", "median", "skew"],
   ...:         "Fare": ["min", "max", "median", "mean"],
   ...:     }
   ...: )
   ...: 
Out[7]: 
              Age        Fare
min      0.420000    0.000000
max     80.000000  512.329200
median  28.000000   14.454200
skew     0.389108         NaN
mean          NaN   32.204208
```

To user guide Details about descriptive statistics are provided in the user guide section on descriptive statistics.

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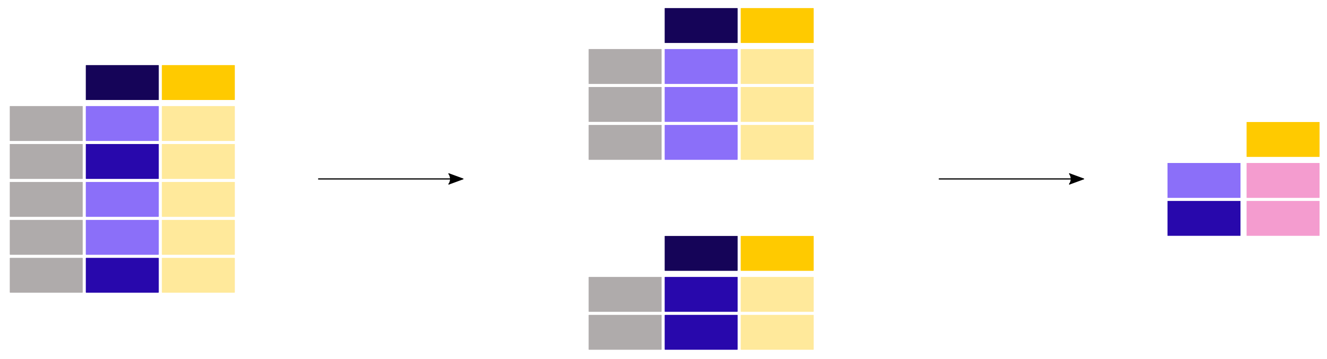
Aggregating statistics grouped by category



What is the average age for male versus female Titanic passengers?

```
In [8]: titanic[["Sex", "Age"]].groupby("Sex").mean()
Out[8]: 
              Age
Sex              
female  27.915709
male    30.726645
```

As our interest is the average age for each gender, a subselection on these two columns is made first: `titanic[["Sex", "Age"]]`. Next, the `groupby()` method is applied on the `Sex` column to make a group per category. The average age *for each gender* is calculated and returned.

Calculating a given statistic (e.g. `mean` age) *for each category in a column* (e.g. male/female in the `Sex` column) is a common pattern. The `groupby` method is used to support this type of operations. This fits in the more general `split-apply-combine` pattern:

- **Split** the data into groups
- **Apply** a function to each group independently
- **Combine** the results into a data structure

The apply and combine steps are typically done together in pandas.

In the previous example, we explicitly selected the 2 columns first. If not, the `mean` method is applied to each column containing numerical columns by passing `numeric_only=True`:

```
In [9]: titanic.groupby("Sex").mean(numeric_only=True)
Out[9]: 
        PassengerId  Survived    Pclass  ...     SibSp     Parch       Fare
Sex                                      ...                               
female   431.028662  0.742038  2.159236  ...  0.694268  0.649682  44.479818
male     454.147314  0.188908  2.389948  ...  0.429809  0.235702  25.523893

[2 rows x 7 columns]
```

It does not make much sense to get the average value of the `Pclass`. If we are only interested in the average age for each gender, the selection of columns (rectangular brackets `[]` as usual) is supported on the grouped data as well:

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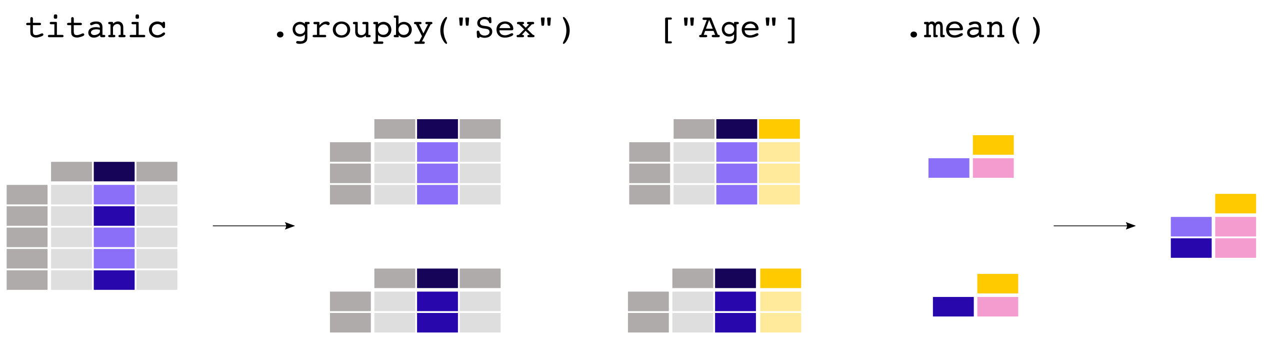
```
In [10]: titanic.groupby("Sex")["Age"].mean()
Out[10]:
Sex
female    27.915709
male      30.726645
Name: Age, dtype: float64
```



Note

The `Pclass` column contains numerical data but actually represents 3 categories (or factors) with respectively the labels ‘1’, ‘2’ and ‘3’. Calculating statistics on these does not make much sense. Therefore, pandas provides a `Categorical` data type to handle this type of data. More information is provided in the user guide Categorical data section.

What is the mean ticket fare price for each of the sex and cabin class combinations?

```
In [11]: titanic.groupby(["Sex", "Pclass"])["Fare"].mean()
Out[11]:
Sex     Pclass
female  1         106.125798
        2          21.970121
        3          16.118810
male    1          67.226127
        2          19.741782
        3          12.661633
Name: Fare, dtype: float64
```

Grouping can be done by multiple columns at the same time. Provide the column names as a list to the `groupby()` method.

To user guide A full description on the split-apply-combine approach is provided in the user guide section on groupby operations.

Count number of records by category

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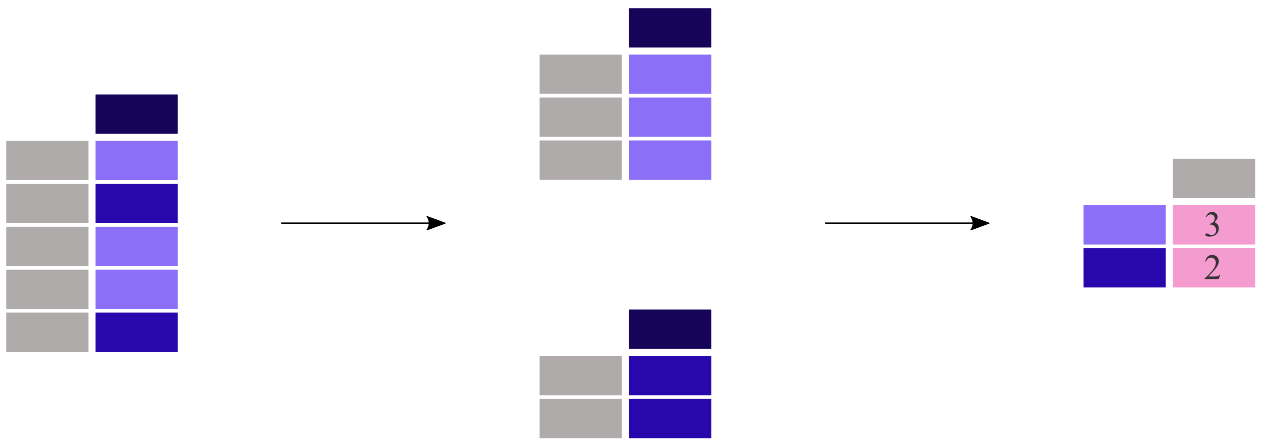

What is the number of passengers in each of the cabin classes?

```
In [12]: titanic["Pclass"].value_counts()
Out[12]:
Pclass
3    491
1    216
2    184
Name: count, dtype: int64
```

The `value_counts()` method counts the number of records for each category in a column.

The function is a shortcut, as it is actually a groupby operation in combination with counting of the number of records within each group:

```
In [13]: titanic.groupby("Pclass")["Pclass"].count()
Out[13]:
Pclass
1    216
2    184
3    491
Name: Pclass, dtype: int64
```

Note

Both `size` and `count` can be used in combination with `groupby`. Whereas `size` includes `NaN` values and just provides the number of rows (size of the table), `count` excludes the missing values. In the `value_counts` method, use the `dropna` argument to include or exclude the `NaN` values.

To user guide The user guide has a dedicated section on `value_counts`, see the page on discretization.

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How to reshape the layout of tables

REMEMBER

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