```
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]
```

Air quality data

```
In [4]: air_quality = pd.read_csv(
   ...:     "data/air_quality_long.csv", index_col="date.utc", parse_dates=True
   ...: )
   ...:

In [5]: air_quality.head()
Out[5]:
                           city country location parameter  value   unit
date.utc
2019-06-18 06:00:00+00:00  Antwerpen      BE  BETR801      pm25   18.0  µg/m³
2019-06-17 08:00:00+00:00  Antwerpen      BE  BETR801      pm25    6.5  µg/m³
2019-06-17 07:00:00+00:00  Antwerpen      BE  BETR801      pm25   18.5  µg/m³
2019-06-17 06:00:00+00:00  Antwerpen      BE  BETR801      pm25   16.0  µg/m³
2019-06-17 05:00:00+00:00  Antwerpen      BE  BETR801      pm25    7.5  µg/m³
```

How to reshape the layout of tables

Sort table rows

I want to sort the Titanic data according to the age of the passengers.

```
In [6]: titanic.sort_values(by="Age").head()
Out[6]:
     PassengerId  Survived  Pclass  ...     Fare Cabin  Embarked
803          804         1       3  ...   8.5167   NaN         C
755          756         1       2  ...  14.5000   NaN         S
644          645         1       3  ...  19.2583   NaN         C
469          470         1       3  ...  19.2583   NaN         C
78            79         1       2  ...  29.0000   NaN         S

[5 rows x 12 columns]
```

I want to sort the Titanic data according to the cabin class and age in descending order.

```
In [7]: titanic.sort_values(by=['Pclass', 'Age'], ascending=False).head()
Out[7]:
     PassengerId  Survived  Pclass  ...     Fare Cabin  Embarked
851          852         0       3  ...   7.7750   NaN         S
116          117         0       3  ...   7.7500   NaN         Q
280          281         0       3  ...   7.7500   NaN         Q
483          484         1       3  ...   9.5875   NaN         S
326          327         0       3  ...   6.2375   NaN         S

[5 rows x 12 columns]
```

With `DataFrame.sort_values()`, the rows in the table are sorted according to the defined column(s). The index will follow the row order.

To user guide More details about sorting of tables is provided in the user guide section on sorting data.

Long to wide table format

Let's use a small subset of the air quality data set. We focus on NO_2 data and only use the first two measurements of each location (i.e. the head of each group). The subset of data will be called `no2_subset`.

```
# filter for no2 data only
In [8]: no2 = air_quality[air_quality["parameter"] == "no2"]
```

```
# use 2 measurements (head) for each location (groupby)
In [9]: no2_subset = no2.sort_index().groupby(["location"]).head(2)

In [10]: no2_subset
Out[10]:
                            city country  ... value   unit
date.utc                                  ...
2019-04-09 01:00:00+00:00  Antwerpen      BE  ...  22.5  µg/m³
2019-04-09 01:00:00+00:00      Paris      FR  ...  24.4  µg/m³
2019-04-09 02:00:00+00:00     London      GB  ...  67.0  µg/m³
2019-04-09 02:00:00+00:00  Antwerpen      BE  ...  53.5  µg/m³
2019-04-09 02:00:00+00:00      Paris      FR  ...  27.4  µg/m³
2019-04-09 03:00:00+00:00     London      GB  ...  67.0  µg/m³

[6 rows x 6 columns]
```

I want the values for the three stations as separate columns next to each other.

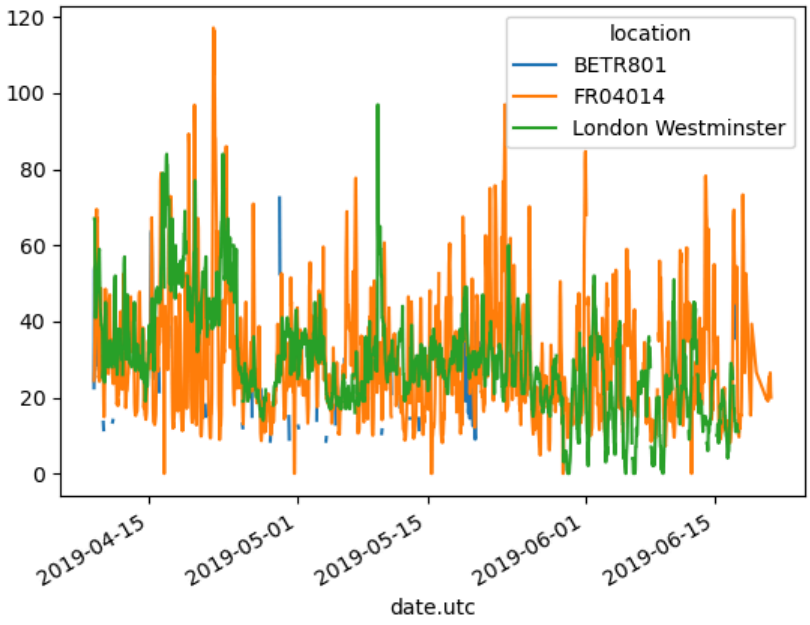
```
In [11]: no2_subset.pivot(columns="location", values="value")
Out[11]:
location                   BETR801  FR04014  London Westminster
date.utc
2019-04-09 01:00:00+00:00     22.5     24.4                 NaN
2019-04-09 02:00:00+00:00     53.5     27.4                67.0
2019-04-09 03:00:00+00:00      NaN      NaN                67.0
```

The `pivot()` function is purely reshaping of the data: a single value for each index/column combination is required.

As pandas supports plotting of multiple columns (see plotting tutorial) out of the box, the conversion from *long* to *wide* table format enables the plotting of the different time series at the same time:

```
In [12]: no2.head()
Out[12]:
                           city country location parameter  value   unit
date.utc
2019-06-21 00:00:00+00:00  Paris      FR  FR04014       no2   20.0  µg/m³
2019-06-20 23:00:00+00:00  Paris      FR  FR04014       no2   21.8  µg/m³
2019-06-20 22:00:00+00:00  Paris      FR  FR04014       no2   26.5  µg/m³
2019-06-20 21:00:00+00:00  Paris      FR  FR04014       no2   24.9  µg/m³
2019-06-20 20:00:00+00:00  Paris      FR  FR04014       no2   21.4  µg/m³
```

```
In [13]: no2.pivot(columns="location", values="value").plot()
Out[13]: <Axes: xlabel='date.utc'>
```



Note

When the `index` parameter is not defined, the existing index (row labels) is used.

To user guide For more information about `pivot()`, see the user guide section on pivoting DataFrame objects.

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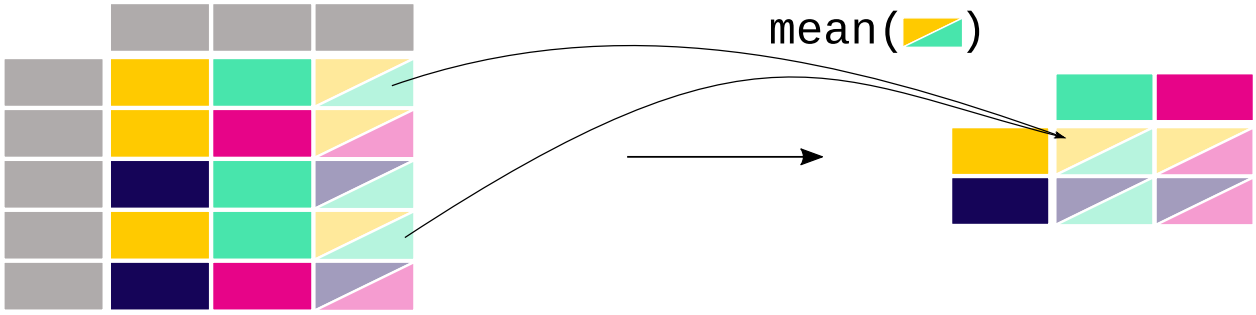
Pivot table



I want the mean concentrations for NO_2 and $PM_{2.5}$ in each of the stations in table form.

```
In [14]: air_quality.pivot_table(
   ....:     values="value", index="location", columns="parameter", aggfunc="mean"
   ....: )
   ....:
Out[14]:
parameter                 no2       pm25
location
BETR801             26.950920  23.169492
FR04014             29.374284        NaN
London Westminster  29.740050  13.443568
```

In the case of `pivot()`, the data is only rearranged. When multiple values need to be aggregated (in this specific case, the values on different time steps), `pivot_table()` can be used, providing an aggregation function (e.g. mean) on how to combine these values.

Pivot table is a well known concept in spreadsheet software. When interested in the row/column margins (subtotals) for each variable, set the `margins` parameter to `True`:

```
In [15]: air_quality.pivot_table(
   ....:     values="value",
   ....:     index="location",
   ....:     columns="parameter",
   ....:     aggfunc="mean",
   ....:     margins=True,
   ....: )
   ....:
Out[15]:
parameter                 no2       pm25        All
location
BETR801             26.950920  23.169492  24.982353
FR04014             29.374284        NaN  29.374284
London Westminster  29.740050  13.443568  21.491708
All                 29.430316  14.386849  24.222743
```

To user guide For more information about `pivot_table()`, see the user guide section on pivot tables.

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Note

In case you are wondering, `pivot_table()` is indeed directly linked to `groupby()`. The same result can be derived by grouping on both `parameter` and `location`:

```
air_quality.groupby(["parameter", "location"])[["value"]].mean()
```

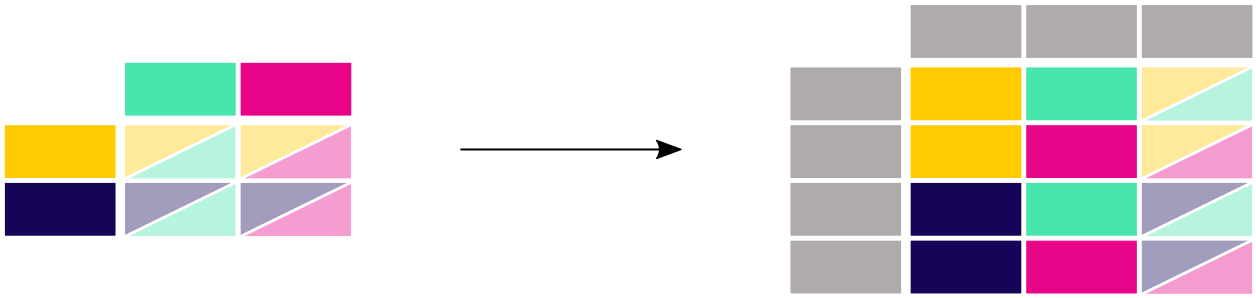
To user guide

Wide to long format

Starting again from the wide format table created in the previous section, we add a new index to the `DataFrame` with `reset_index()`.

```
In [16]: no2_pivoted = no2.pivot(columns="location", values="value").reset_index()

In [17]: no2_pivoted.head()
Out[17]:
location                 date.utc  BETR801  FR04014  London Westminster
0        2019-04-09 01:00:00+00:00     22.5     24.4                 NaN
1        2019-04-09 02:00:00+00:00     53.5     27.4                67.0
2        2019-04-09 03:00:00+00:00     54.5     34.2                67.0
3        2019-04-09 04:00:00+00:00     34.5     48.5                41.0
4        2019-04-09 05:00:00+00:00     46.5     59.5                41.0
```



I want to collect all air quality NO_2 measurements in a single column (long format).

```
In [18]: no_2 = no2_pivoted.melt(id_vars="date.utc")

In [19]: no_2.head()
Out[19]:
                  date.utc location  value
0 2019-04-09 01:00:00+00:00  BETR801   22.5
1 2019-04-09 02:00:00+00:00  BETR801   53.5
2 2019-04-09 03:00:00+00:00  BETR801   54.5
3 2019-04-09 04:00:00+00:00  BETR801   34.5
4 2019-04-09 05:00:00+00:00  BETR801   46.5
```

The `pandas.melt()` method on a `DataFrame` converts the data table from wide format to long format. The column headers become the variable names in a newly created column.

The solution is the short version on how to apply `pandas.melt()`. The method will *melt* all columns NOT mentioned in `id_vars`

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default the name `value`.

The parameters passed to `pandas.melt()` can be defined in more detail:

```
In [20]: no_2 = no2_pivoted.melt(
   ....:     id_vars="date.utc",
   ....:     value_vars=["BETR801", "FR04014", "London Westminster"],
   ....:     value_name="NO_2",
   ....:     var_name="id_location",
   ....: )
   ....:

In [21]: no_2.head()
Out[21]:
                  date.utc id_location  NO_2
0 2019-04-09 01:00:00+00:00     BETR801  22.5
1 2019-04-09 02:00:00+00:00     BETR801  53.5
2 2019-04-09 03:00:00+00:00     BETR801  54.5
3 2019-04-09 04:00:00+00:00     BETR801  34.5
4 2019-04-09 05:00:00+00:00     BETR801  46.5
```

The additional parameters have the following effects:

- `value_vars` defines which columns to *melt* together
- `value_name` provides a custom column name for the values column instead of the default column name `value`
- `var_name` provides a custom column name for the column collecting the column header names. Otherwise it takes the index name or a default `variable`

Hence, the arguments `value_name` and `var_name` are just user-defined names for the two generated columns. The columns to melt are defined by `id_vars` and `value_vars`.

To user guide Conversion from wide to long format with `pandas.melt()` is explained in the user guide section on reshaping by melt.

REMEMBER

- Sorting by one or more columns is supported by `sort_values`.
- The `pivot` function is purely restructuring of the data, `pivot_table` supports aggregations.