PYTHON PANDAS DATAFRAME RESHAPING

Reshape pandas dataframe with pivot_table in Python — tutorial and visualization

Convert long to wide with pd.pivot_table

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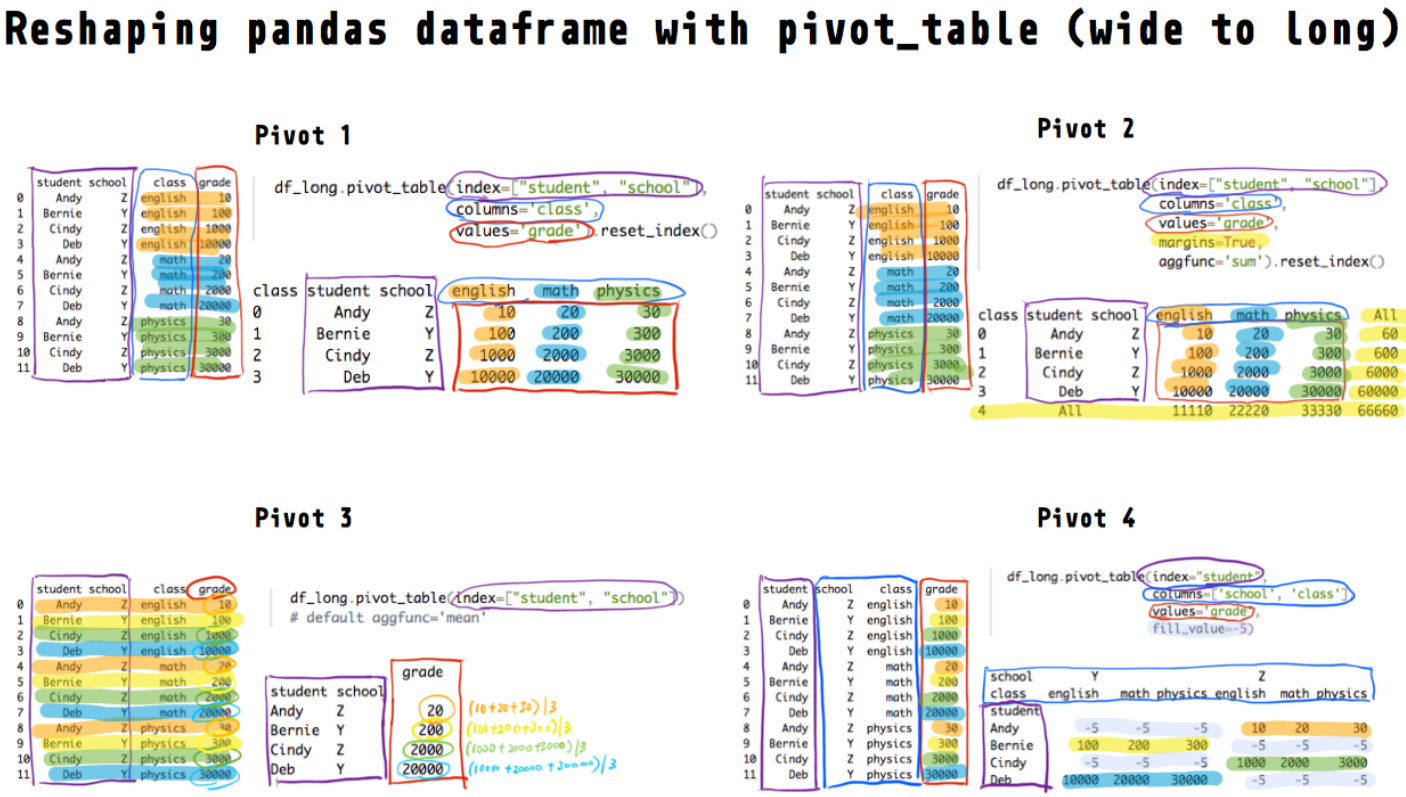

How to use pd.pivot_table() to reshape pandas dataframes from long to wide in Python (run code here)

There are many different ways to reshape a pandas dataframe from **long to wide** form. But the `pivot_table()` method is the most flexible and probably the only one you need

to use once you learn it well, just like how you only need to learn one method `melt` to reshape from **wide to long** (see my other post below).

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This tutorial will walk you through reshaping dataframes using `pd.pivot_table` or the `pivot_table` method associated with pandas dataframes. In other languages like R, pivot is also known as spread or dcast.

I highly recommend you try the code in Python while you read this article. Try running this tutorial on my shared **DeepNote notebook** (you can only run but not edit this notebook).

Also, you might be interested a similar tutorial that describes the reverse (reshape from wide to long) with `pd.melt` and my numpy reshape tutorial.

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. . .

Long versus wide dataframe

It's easiest to understand what a **long** dataframe is or looks like if we look at one and compare it with a wide dataframe.

	student	school	cLaSs	gRaDe
0	Andy	Z	english	10

1	Bernie	Y	english	100
2	Cindy	Z	english	1000
3	Deb	Y	english	10000
4	Andy	Z	math	20
5	Bernie	Y	math	200
6	Cindy	Z	math	2000
7	Deb	Y	math	20000
8	Andy	Z	physics	30
9	Bernie	Y	physics	300
10	Cindy	Z	physics	3000
11	Deb	Y	physics	30000

Long pandas dataframe can be pivoted or "unmelted" using pd.pivot_table() (run code here)

And below is the corresponding dataframe (with the same information) but in the **wide** form:

	student	school	english	math	physics
0	Andy	Z	10	20	30
1	Bernie	Y	100	200	300
2	Cindy	Z	1000	2000	3000
3	Deb	Y	10000	20000	30000

Wide pandas dataframe can be melted/stacked using pd.melt()

Before we begin our `pd.pivot_table` tutorial, let's recreate the wide dataframe above in Python with `pd.DataFrame`. Remember, you can also follow along with my shared notebook.

```
df_long = pd.DataFrame({
        "student":
            ["Andy", "Bernie", "Cindy", "Deb",
             "Andy", "Bernie", "Cindy", "Deb",
```

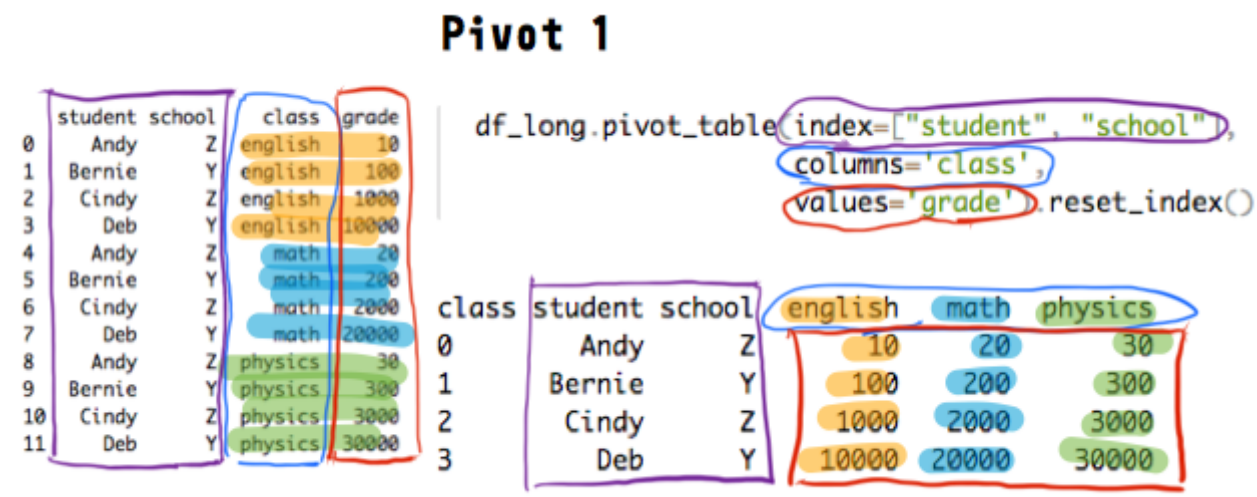
```
            "Andy", "Bernie", "Cindy", "Deb"],
        "school":
            ["Z", "Y", "Z", "Y",
             "Z", "Y", "Z", "Y",
             "Z", "Y", "Z", "Y"],
        "class":
            ["english", "english", "english", "english",
             "math", "math", "math", "math",
             "physics", "physics", "physics", "physics"],
        "grade":
            [10, 100, 1000, 10000,
             20, 200, 2000, 20000,
             30, 300, 3000, 30000]
})
```

. . .

Example 1

We often want to keep the identifier columns as they are (`index=["student", "school"]`), but pivot or "split" a column's values (`values="grade"`) based on another column (`columns="class"`). Compare the original and pivoted dataframes below and you'll understand what that means.

```
df_long.pivot_table(index=["student", "school"],
                    columns='class',
                    values='grade')
```



Long to wide: values in grade are split/pivoted into three separate columns (run code here)

Each unique value in the class column will be a new column (english, math, physics) in the pivoted/wide dataframe. We can also provide a **list** to the `columns` parameter.

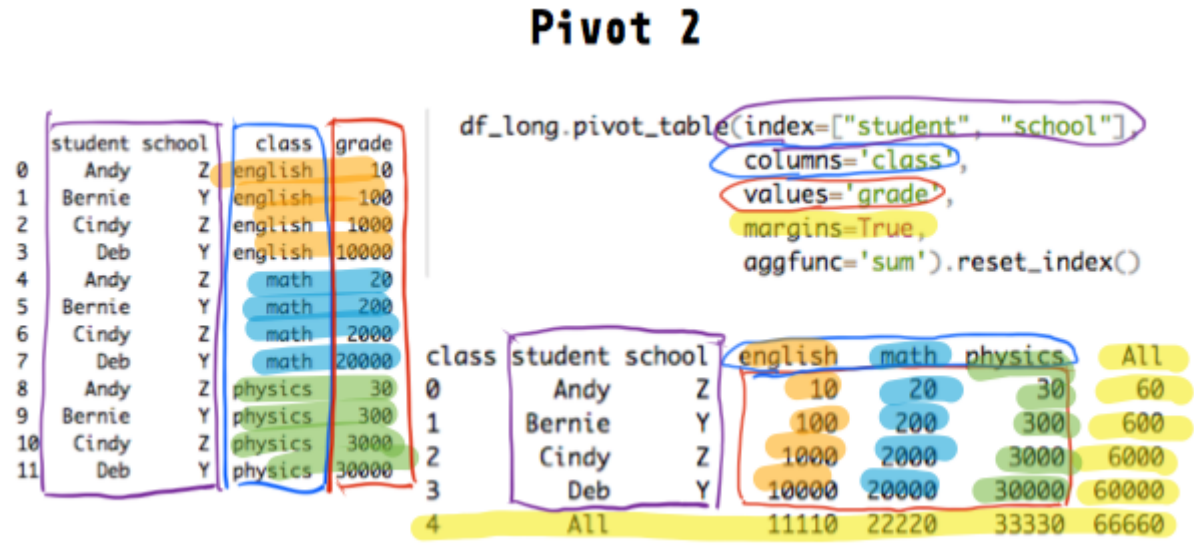
To get rid of the multi-index, use `reset_index()`.

Example 2

You can also aggregate each resulting row and column by specifying `margins=True` (default `False`).

```
df_long.pivot_table(index=["student", "school"],
                    columns='class',
                    values='grade',
                    margins=True,  # add margins
                    aggfunc='sum')  # sum margins (rows/columns)
```

Here we aggregate by computing the sum via `aggfunc='sum'` (default `'mean'`).



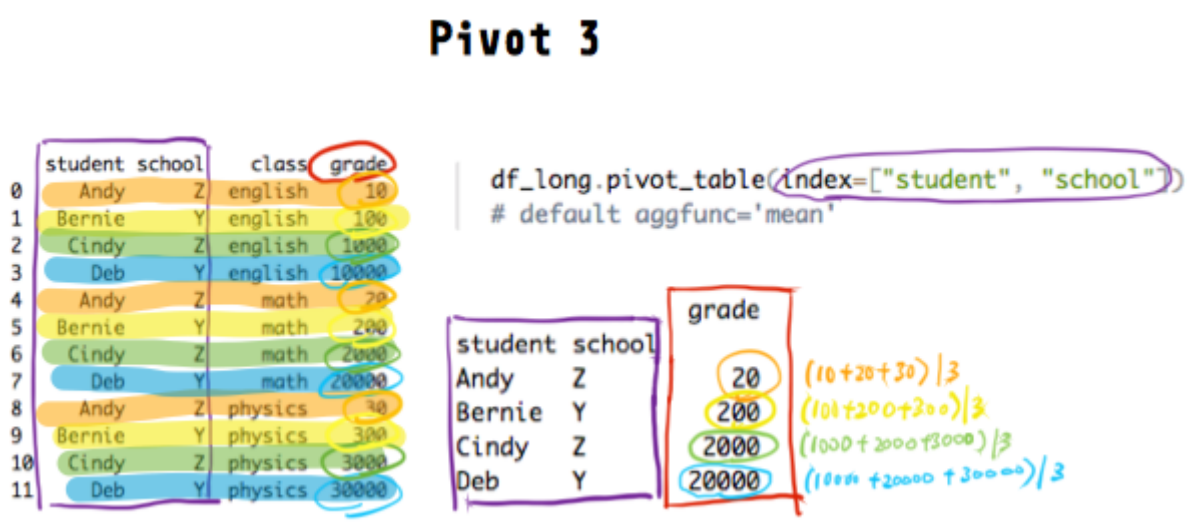
Long to wide: margins are included (run code here)

There are many other aggregation functions you can use (e.g., `'median' 'sum' 'max'`). You can also specify multiple functions as a list (e.g., `aggfunc=['mean', 'sum']`).

Example 3

If we don't specify any columns via `columns`, **all** remaining non-identifier **numeric** columns (only grade in this dataframe) will be pivoted (long to wide).

```
df_long.pivot_table(index=["student", "school"])
```



Long to wide: all non-identifier numeric columns are pivoted (run code here)

In the original long data, each student has **four** grades (english, math, physics), yet in the `pivot_table` example above, each student only has **one** grade after pivoting.

Why and how does it work? If you remember from the example above, the default is `aggfunc='mean'`. Thus, what the function did was it grouped the data by student and school (via `index=["student", "school"]`), and computed the mean value for each group.

If you use the `groupby` method associated with the pandas dataframe, you will get the same result as above.

```
df_long.groupby(['student', 'school']).mean().reset_index()
```

```
  student school  grade
0    Andy      Z     20
1  Bernie      Y    200
2   Cindy      Z   2000
3     Deb      Y  20000
```

If you change the default aggregation function (e.g., `aggfunc='max'`), you'll get different results. The examples below show you how to specify different aggregation functions and also show you how `groupby` can be used to perform the same pivot.

Note that you'll also see the class that is associated with each 'max' and 'first' value.

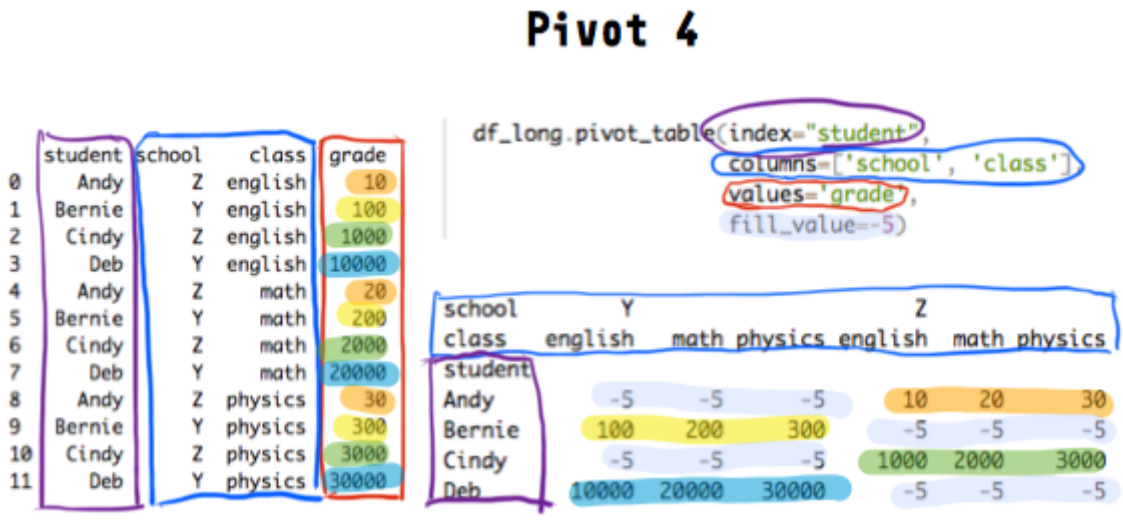
```
df_long.pivot_table(index=["student", "school"],
                    aggfunc=['max', 'first'])

# groupby equivalent
# df_long.groupby(["student", "school"]).agg(['max', 'first'])
```

		max		first	
		class	grade	class	grade
student	school				
Andy	Z	physics	30	english	10
Bernie	Y	physics	300	english	100
Cindy	Z	physics	3000	english	1000
Deb	Y	physics	30000	english	10000

Example 4

The final example shows you what happens when you pivot multiple columns (`columns=['school', 'class']`) and you can also deal with missing values after pivoting by replacing the `NaN` values with another value (-5 in the example below).

```
df_long.pivot_table(index="student",
                    columns=['school', 'class'],
                    values='grade',
                    fill_value=-5)  # replace NaN with -5
```



Long to wide: missing values replaced with -5 (default NaN) (run code here)

The `NaN` values are expected because each student belongs to only one school (Y or Z). For example, Andy is in school Z and therefore doesn't have grades in the Y columns.

Final remarks

I hope now you have a better understanding of how `pd.pivot_table` reshapes dataframes. I look forward to your thoughts and comments.

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