COMS BC1016
Introduction to Computational Thinking and Data Science

Lecture 7: Functions, Groups, Pivots, and Joins

Sept 3, 2025

February 16, 2026

Logistics

- HW 2 is due Wednesday at 11:59pm
  - Please remember to submit it as a **.ipynb** file
  - If you are having trouble, please come to one of the office hours (mine, TA, or computing fellow)

Last time: Charts

Charts Summary

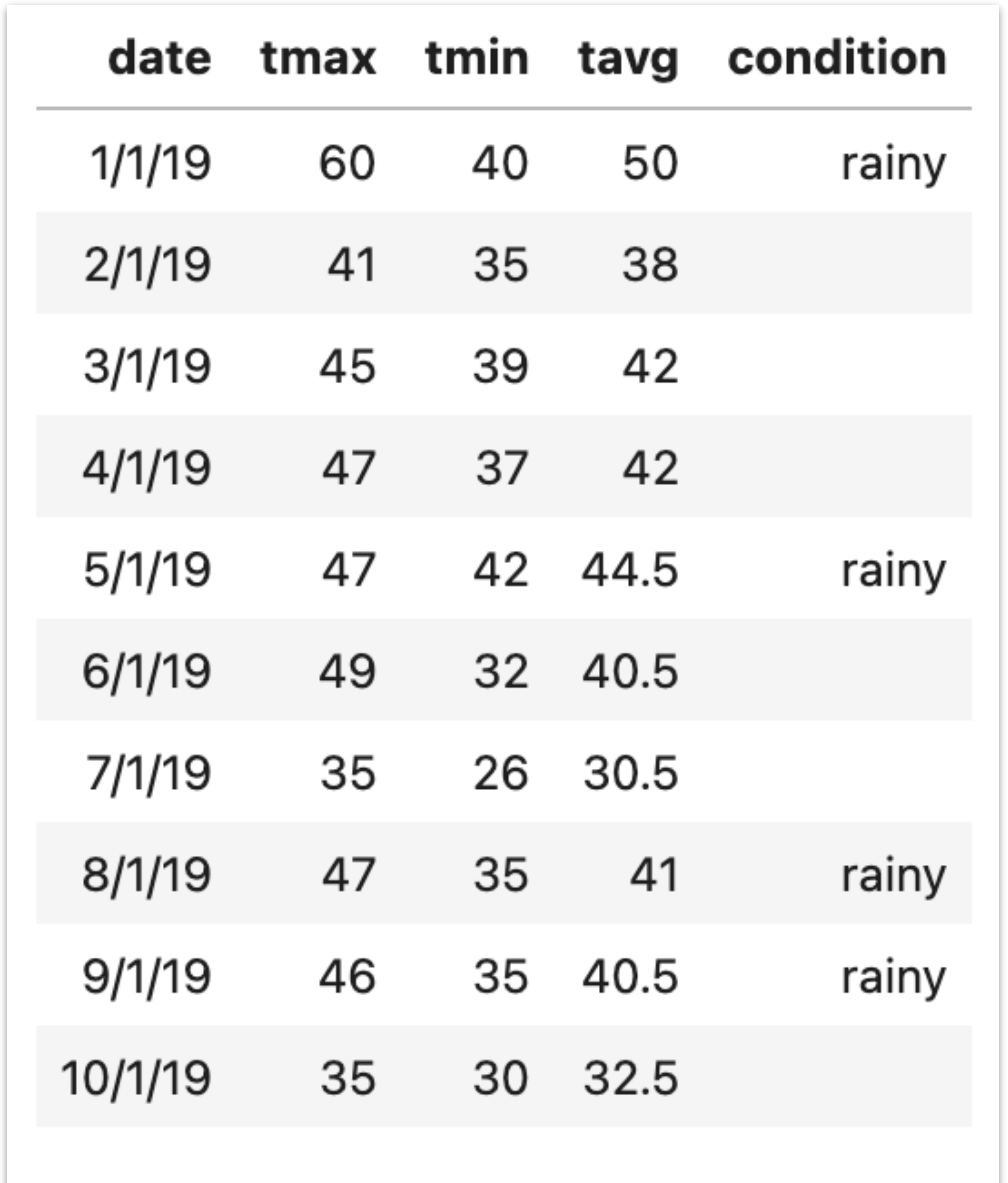
Type	Syntax	Description
Line graph	`.plot(x_axis, y_axis)`	Sequential numerical data
Scatter Plot	`.scatter(x_axis, y_axis)`	Relation between two numerical values
Bar Chart	`.barh(column_label)`	Distribution of one categorical variable (already grouped)
Histogram	`.hist(column_label, unit, bins)`	Distribution of one numerical variable

Chart Selection Exercise

We have NYC weather data from 2019 as shown below (from Kaggle)

Which type of chart (line, scatter, bar, histogram) would best help you answer to each question?

- Do days with hotter highs also tend to have hotter lows?
- How do the number of rainy days compare with the number of snowy days?
- What percent of days have a high of at least 75 degrees?



date	tmax	tmin	tavg	condition
1/1/19	60	40	50	rainy
2/1/19	41	35	38	
3/1/19	45	39	42	
4/1/19	47	37	42	
5/1/19	47	42	44.5	rainy
6/1/19	49	32	40.5	
7/1/19	35	26	30.5	
8/1/19	47	35	41	rainy
9/1/19	46	35	40.5	rainy
10/1/19	35	30	32.5	

Functions

Recall: Anatomy of a Function

Name, Parameters, Body, Return Statement

Example:

```
def convert_to_figs(weight):
  new_weight = (weight/7).round(1)
  return new_weight
```

Functions with Multiple Arguments/Parameters

Functions can take in multiple inputs

- Each argument is given a unique name and separated by commas

```
def convert_to_figs(weight, decimal_places):
   '''Divides the input by 7 (Figs weight) and then rounds to
   the given number of decimal places'''
   new_weight = (weight/7).round(decimal_places)
   return new_weight
```

Functions with Multiple Arguments/Parameters

Functions can take in multiple inputs

- Each argument is given a unique name and separated by commas
- Specifying default values for particular inputs to makes them optional

```
def convert_to_figs(weight, decimal_places=1):
   '''Divides the input by 7 (Figs weight) and then rounds to
   the given number of decimal places'''
   new_weight = (weight/7).round(decimal_places)
   return new_weight
```

Function Demo

Recall: `apply`

Use `apply` to call a function on each element in a column

```
def convert_to_figs(weight):
   new_weight = (weight/7).round(1)
   return new_weight
```

```
cat_tbl.apply(convert_to_figs, 'Weight')
```

Returns an array with convert_to_figs called on each element in the 'Weight' column

apply with Multiple Inputs

For functions with multiple inputs, apply can take multiple columns

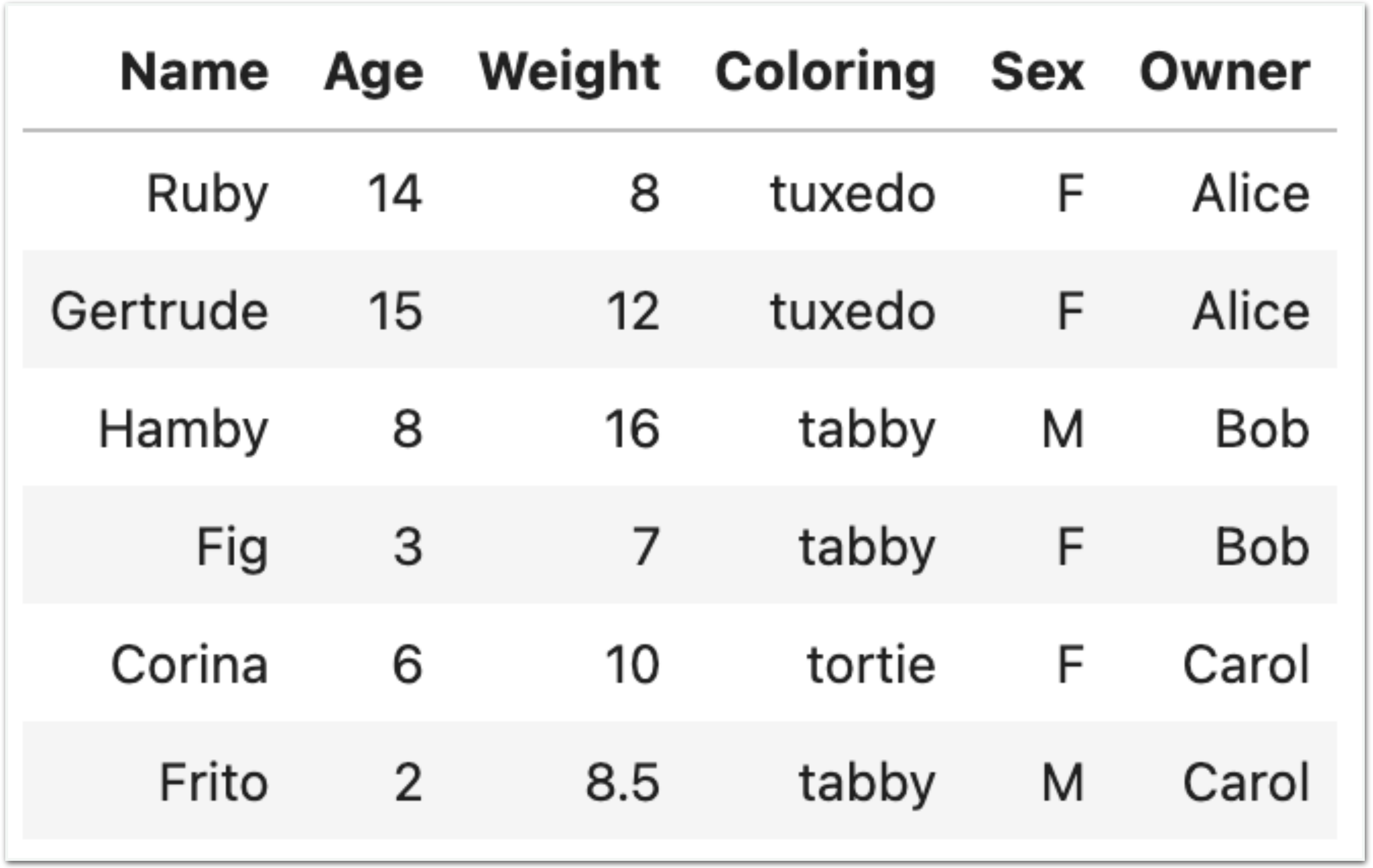
```
def convert_to_figs(weight, decimal_places=1):
    new_weight = (weight/7).round(decimal_places)
    return new_weight


cat_tbl.apply(convert_to_figs, 'Weight', 'Precision')
```

Apply Demo

Groups and Pivot Tables

Groups and Pivots

Two ways of **summarizing** table data by categorical variables



Name	Age	Weight	Coloring	Sex	Owner
Ruby	14	8	tuxedo	F	Alice
Gertrude	15	12	tuxedo	F	Alice
Hamby	8	16	tabby	M	Bob
Fig	3	7	tabby	F	Bob
Corina	6	10	tortie	F	Carol
Frito	2	8.5	tabby	M	Carol

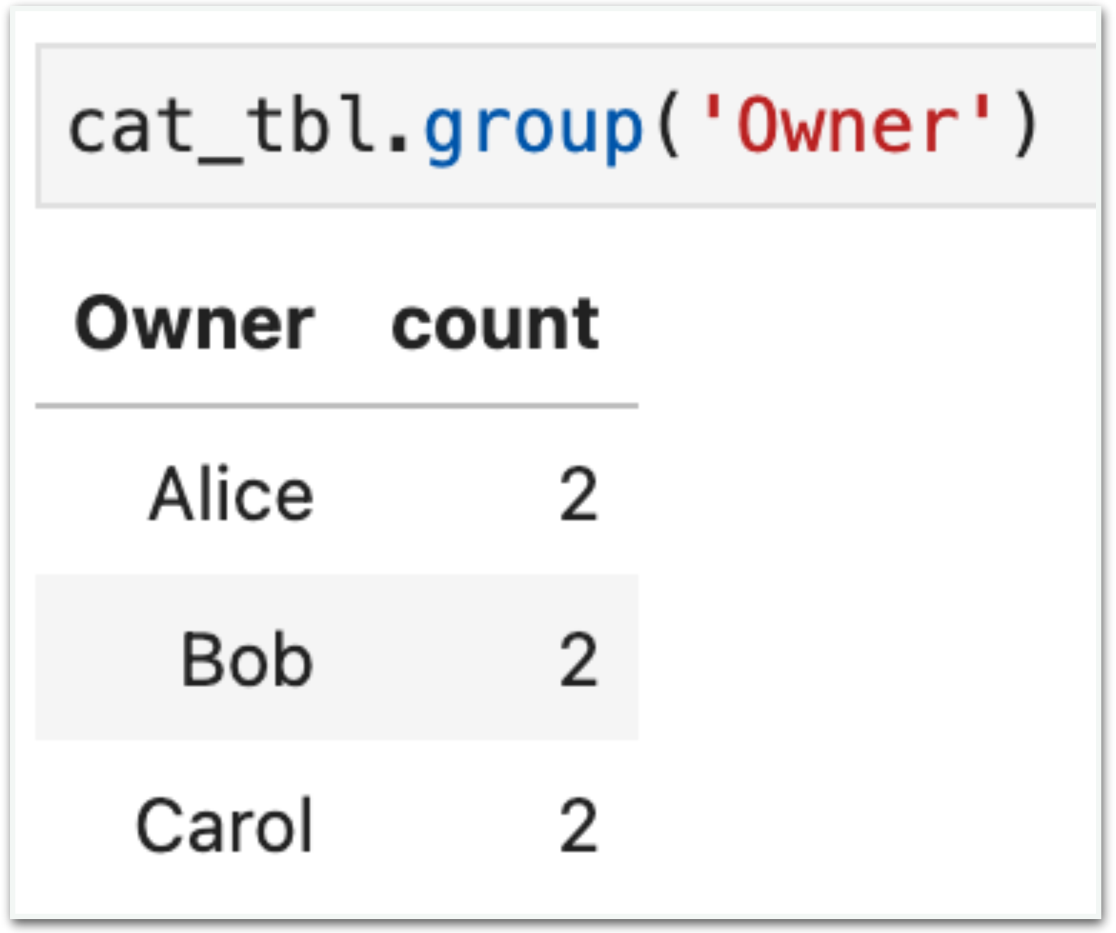
Grouping by a Single Column

The `group` method aggregates all rows with the same value in column `c`

- `tbl.group(c)`
- `tbl.group(c, func)`

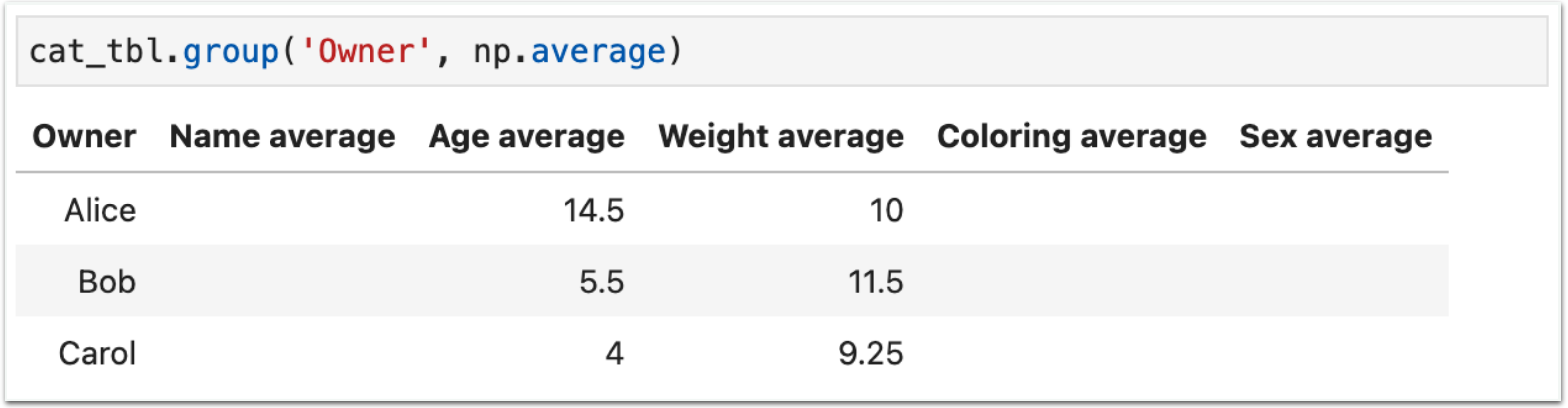
`group` can optionally apply `func` to grouped values, for example:

- `len`: count of grouped values (default)
- `list`: list of all grouped values
- `sum`: total of all grouped values



```
cat_tbl.group('Owner')
```

Owner	count
Alice	2
Bob	2
Carol	2

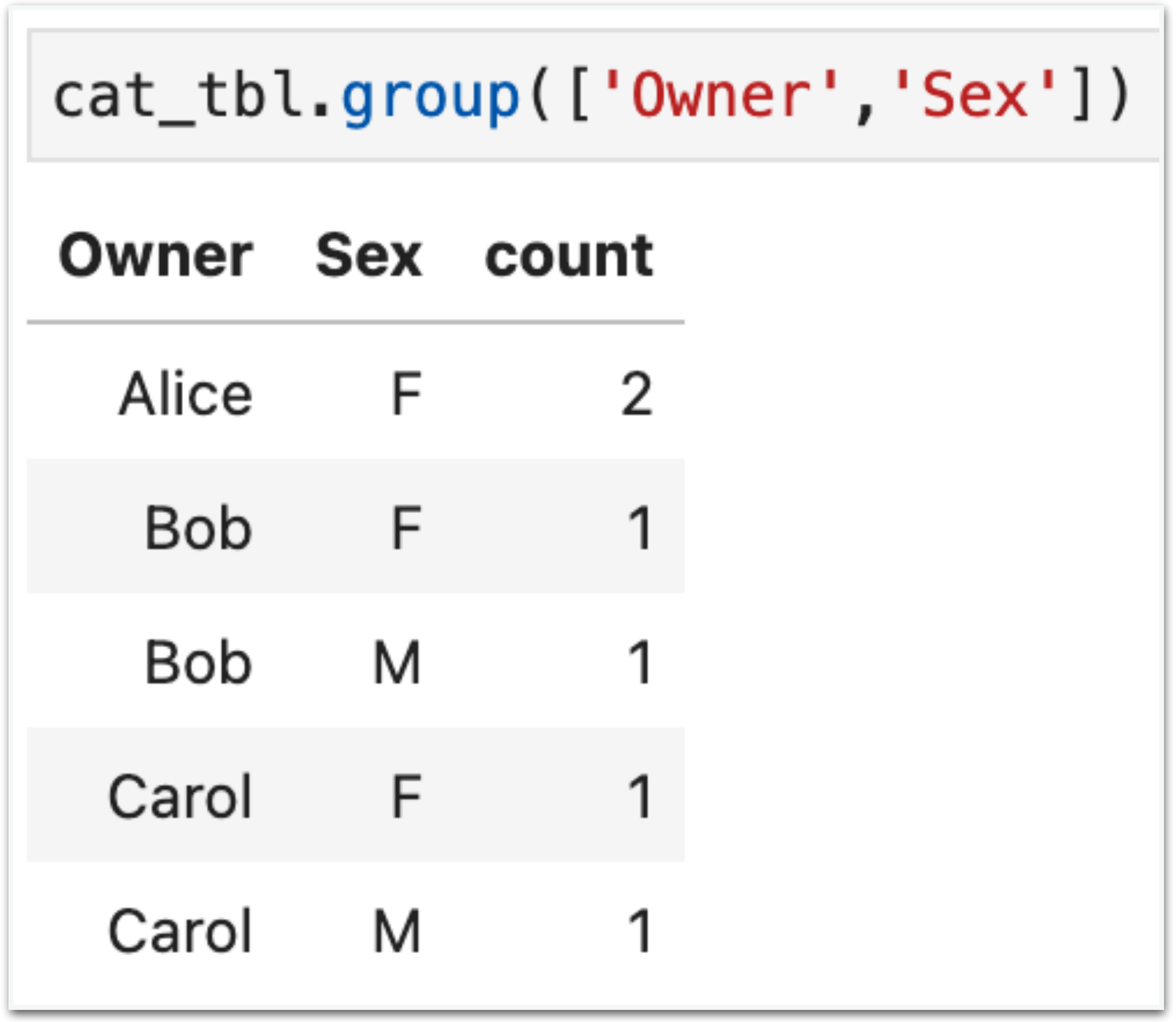


```
cat_tbl.group('Owner', np.average)
```

Owner	Name average	Age average	Weight average	Coloring average	Sex average
Alice		14.5	10		
Bob		5.5	11.5		
Carol		4	9.25		

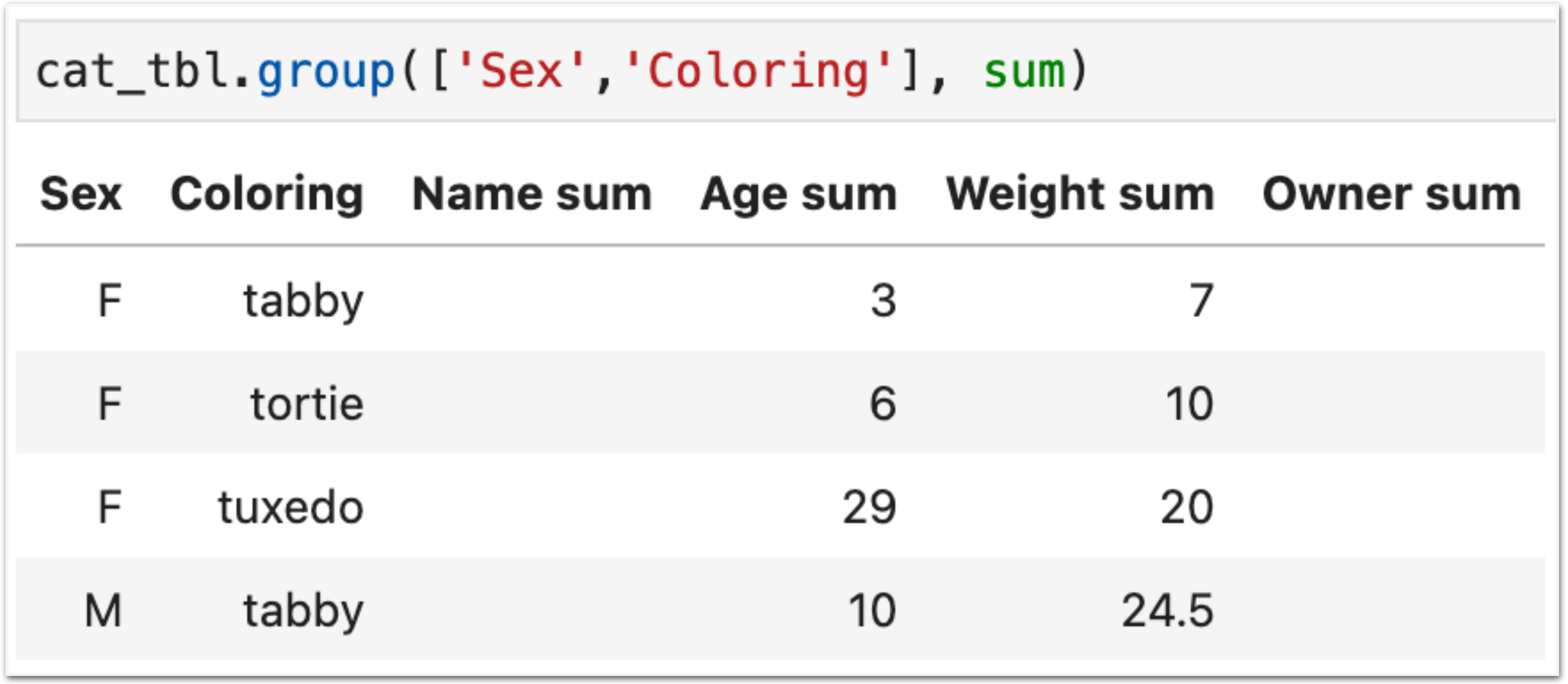
Grouping by Multiple Columns

The `group` method can also aggregate all rows that *share the combination of values* from multiple columns



```
cat_tbl.group(['Owner','Sex'])
```

Owner	Sex	count
Alice	F	2
Bob	F	1
Bob	M	1
Carol	F	1
Carol	M	1



```
cat_tbl.group(['Sex','Coloring'], sum)
```

Sex	Coloring	Name sum	Age sum	Weight sum	Owner sum
F	tabby		3	7	
F	tortie		6	10	
F	tuxedo		29	20	
M	tabby		10	24.5	

Pivot Tables

Cross-classifies according to *two* categorical variables

- Produces a grid of all possible combinations of the two categorical variables
- Grid entries are either counts or aggregated values

Create a pivot table where entries are counts:

```
tbl.pivot(col_var, row_var)
```

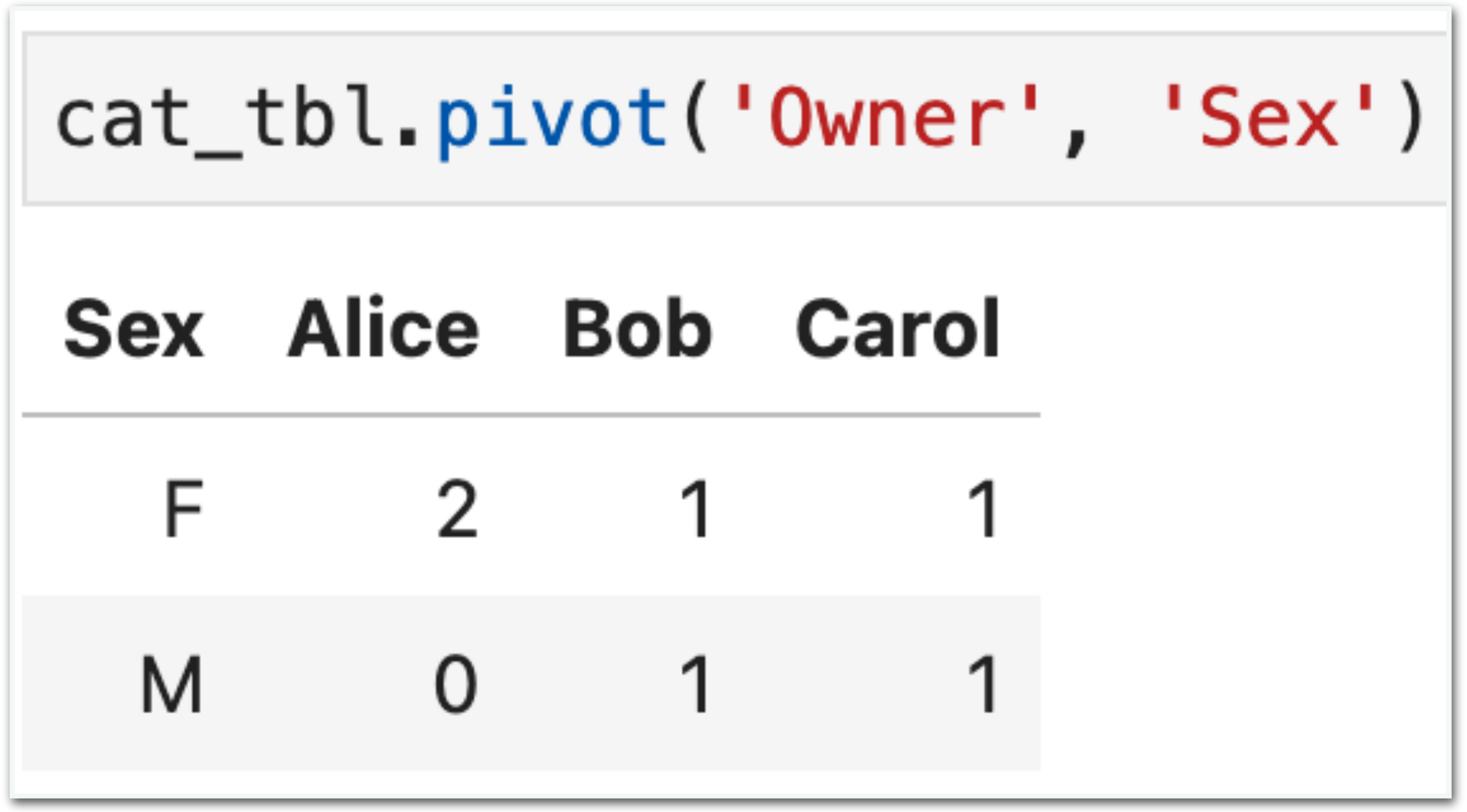
Create a pivot table where entries are aggregated according function `collect` on values in column `values`

```
tbl.pivot(col_var, row_var, values, collect)
```

Pivot Tables

```
tbl.pivot(col_var, row_var)
```

- `col_var`: Variable that forms column labels of grid
- `row_var`: Variable that forms row labels of grid



```
cat_tbl.pivot('Owner', 'Sex')
```

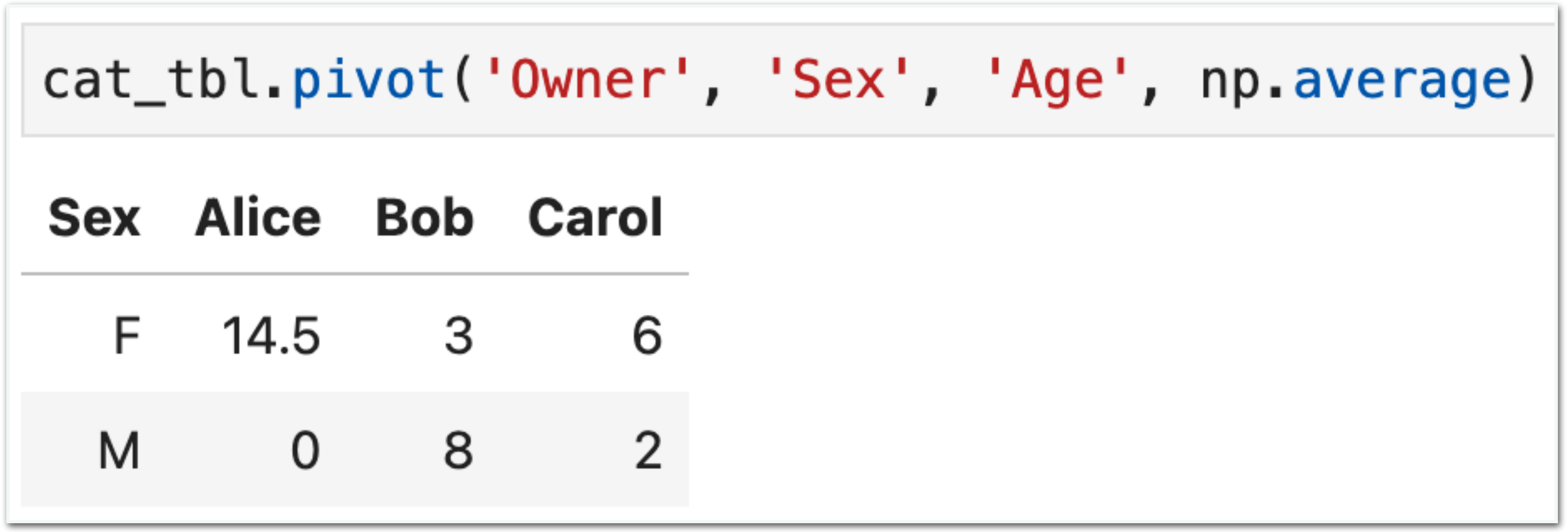
Sex	Alice	Bob	Carol
F	2	1	1
M	0	1	1

Pivot Tables

```
tbl.pivot(col_var, row_var, values, collect)
```

- `values`: Table column to aggregate
- `collect`: Function to aggregate with

Either include **both** `values` and `collect` or **neither**



```
cat_tbl.pivot('Owner', 'Sex', 'Age', np.average)
```

Sex	Alice	Bob	Carol
F	14.5	3	6
M	0	8	2

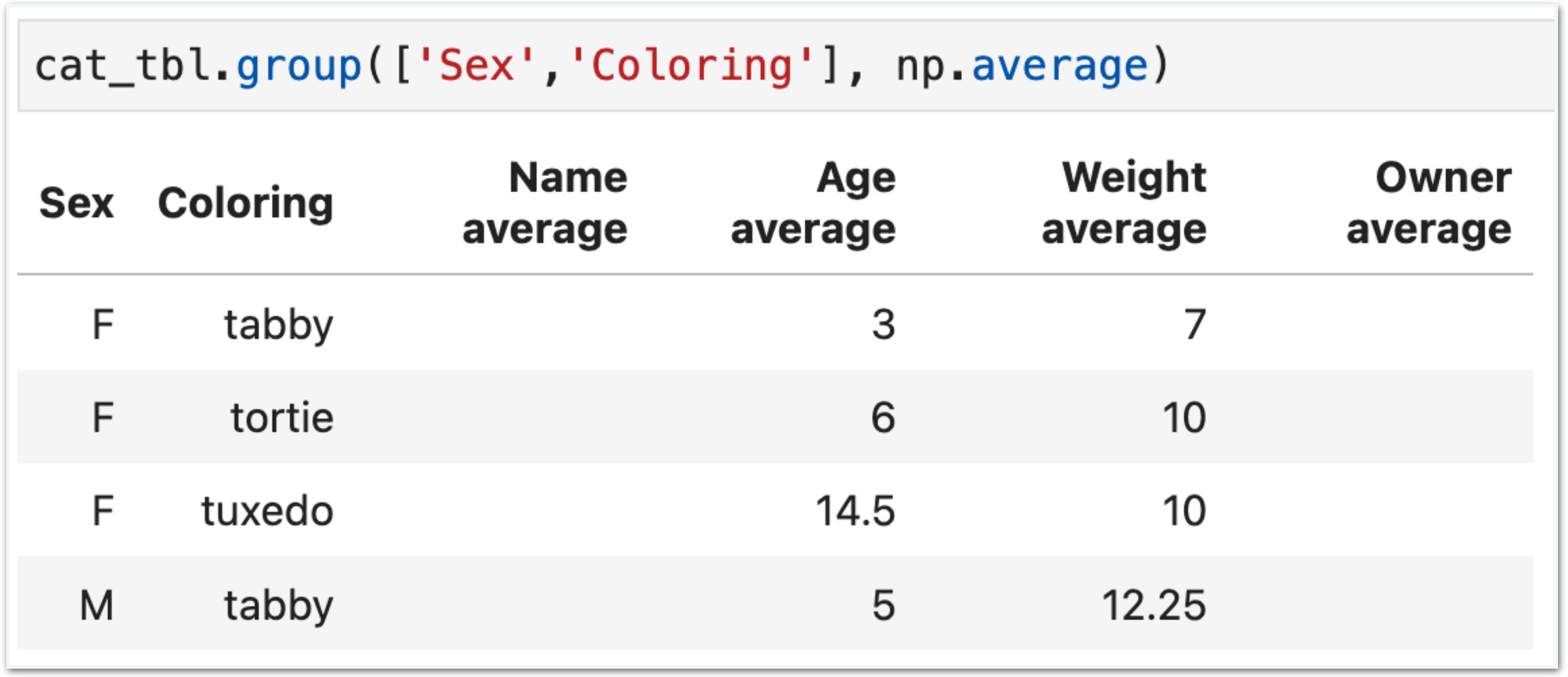
Group vs Pivot

Group

- One combo of grouping variables **per row**
- **Any number** of grouping variables
- Aggregate values of **all other columns** in the table
- Missing combos are **absent**

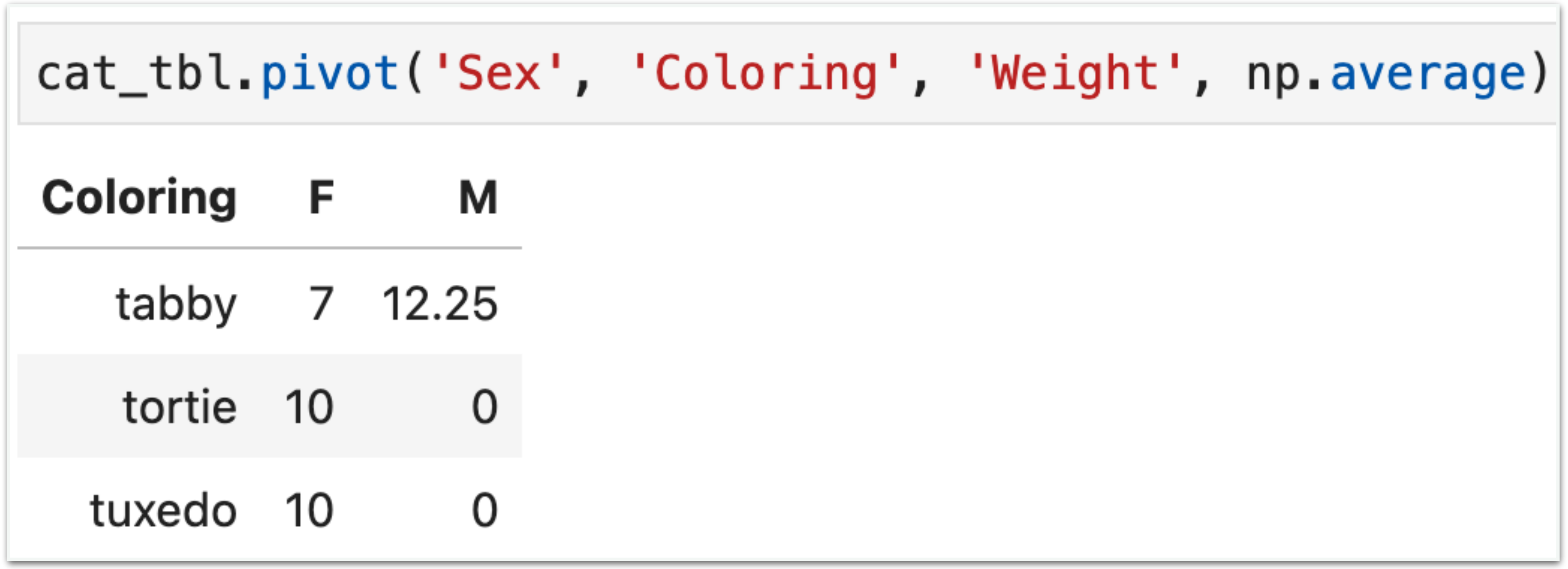
Pivot

- One combo of grouping variables **per entry**
- **Two** grouping variables: columns and rows
- Aggregate values of **values column**
- Missing combos **= 0 (or empty string)**



```
cat_tbl.group(['Sex','Coloring'], np.average)
```

Sex	Coloring	Name average	Age average	Weight average	Owner average
F	tabby		3	7	
F	tortie		6	10	
F	tuxedo		14.5	10	
M	tabby		5	12.25	



```
cat_tbl.pivot('Sex', 'Coloring', 'Weight', np.average)
```

Coloring	F	M
tabby	7	12.25
tortie	10	0
tuxedo	10	0

Joining Two Tables

Sometimes data about the same individuals are in different tables

- `join` combines the two datasets together
- Entries that do not appear in both tables are not included in the new table

To combine entries from `table1` and `table2` based on columns `c1` and `c2`

- `table1.join(c1, table2, c2)`

`join` Example

`bubble_teas`

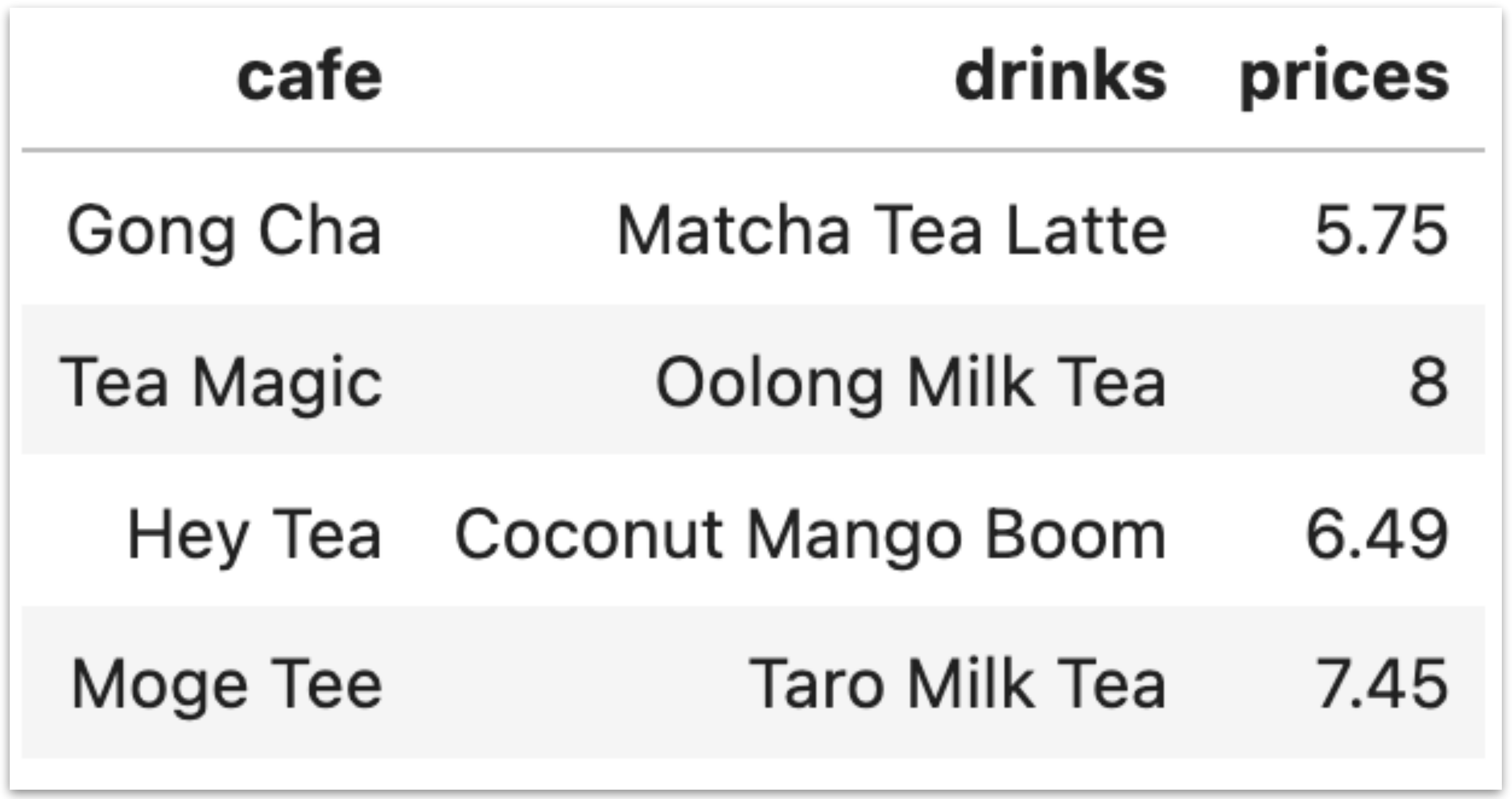
cafe	drinks	prices
Gong Cha	Matcha Tea Latte	5.75
Tea Magic	Oolong Milk Tea	8
Hey Tea	Coconut Mango Boom	6.49
Moge Tee	Taro Milk Tea	7.45

`discounts`

% off	location
10	Gong Cha
25	Hey Tea
5	Moge Tee

`join` Example

`bubble_teas`



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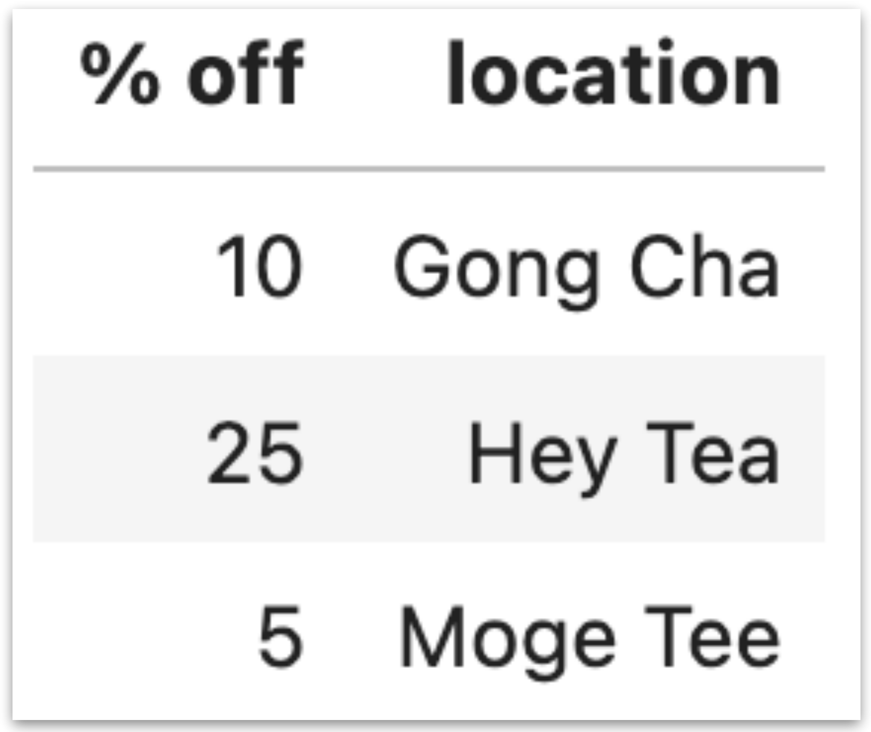
`discounts`



% off	location
10	Gong Cha
25	Hey Tea
5	Moge Tee

```
bubble_teas.join('cafe', discounts, 'location')
```

Match rows in this table…

…using values in this column …

…with rows in this second table…

…using values in this column.

`join` Example

`bubble_teas`

cafe	drinks	prices
Gong Cha	Matcha Tea Latte	5.75
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`discounts`

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```
bubble_teas.join('cafe', discounts, 'location')
```

Match rows in this table…

…using values in this column …

…with rows in this second table…

…using values in this column.

`output:`

cafe	drinks	prices	% off
Gong Cha	Matcha Tea Latte	5.75	10
Hey Tea	Coconut Mango Boom	6.49	25
Moge Tee	Taro Milk Tea	7.45	5

`join` Example

`bubble_teas`

cafe	drinks	prices
Gong Cha	Matcha Tea Latte	5.75
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Match rows in this table…

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output:

cafe	drinks	prices	% off
Gong Cha	Matcha Tea Latte	5.75	10
Hey Tea	Coconut Mango Boom	6.49	25
Moge Tee	Taro Milk Tea	7.45	5

Next Class

- Today
  - Functions and Apply
  - Group and Pivot
- Wednesday
  - Conditionals and iteration