

The dog dataset, revisited

```
print(dogs)
```

	name	breed	color	height_cm	weight_kg
0	Bella	Labrador	Brown	56	25
1	Charlie	Poodle	Black	43	23
2	Lucy	Chow Chow	Brown	46	22
3	Cooper	Schnauzer	Gray	49	17
4	Max	Labrador	Black	59	29
5	Stella	Chihuahua	Tan	18	2
6	Bernie	St. Bernard	White	77	74

.columns and .index

```
dogs.columns
```

```
Index(['name', 'breed', 'color', 'height_cm', 'weight_kg'], dtype='object')
```

```
dogs.index
```

```
RangeIndex(start=0, stop=7, step=1)
```

Setting a column as the index

```
dogs_ind = dogs.set_index("name")  
print(dogs_ind)
```

	breed	color	height_cm	weight_kg
name				
Bella	Labrador	Brown	56	25
Charlie	Poodle	Black	43	23
Lucy	Chow Chow	Brown	46	22
Cooper	Schnauzer	Grey	49	17
Max	Labrador	Black	59	29
Stella	Chihuahua	Tan	18	2
Bernie	St. Bernard	White	77	74

Removing an index

```
dogs_ind.reset_index()
```

	name	breed	color	height_cm	weight_kg
0	Bella	Labrador	Brown	56	25
1	Charlie	Poodle	Black	43	23
2	Lucy	Chow Chow	Brown	46	22
3	Cooper	Schnauzer	Grey	49	17
4	Max	Labrador	Black	59	29
5	Stella	Chihuahua	Tan	18	2
6	Bernie	St. Bernard	White	77	74

Dropping an index

```
dogs_ind.reset_index(drop=True)
```

	breed	color	height_cm	weight_kg
0	Labrador	Brown	56	25
1	Poodle	Black	43	23
2	Chow Chow	Brown	46	22
3	Schnauzer	Grey	49	17
4	Labrador	Black	59	29
5	Chihuahua	Tan	18	2
6	St. Bernard	White	77	74

Indexes make subsetting simpler

```
dogs[dogs["name"].isin(["Bella", "Stella"])]
```

	name	breed	color	height_cm	weight_kg
0	Bella	Labrador	Brown	56	25
5	Stella	Chihuahua	Tan	18	2

```
dogs_ind.loc[["Bella", "Stella"]]
```

	breed	color	height_cm	weight_kg
name				
Bella	Labrador	Brown	56	25
Stella	Chihuahua	Tan	18	2

Index values don't need to be unique

```
dogs_ind2 = dogs.set_index("breed")  
print(dogs_ind2)
```

	name	color	height_cm	weight_kg
breed				
Labrador	Bella	Brown	56	25
Poodle	Charlie	Black	43	23
Chow Chow	Lucy	Brown	46	22
Schnauzer	Cooper	Grey	49	17
Labrador	Max	Black	59	29
Chihuahua	Stella	Tan	18	2
St. Bernard	Bernie	White	77	74

Subsetting on duplicated index values

```
dogs_ind2.loc["Labrador"]
```

	name	color	height_cm	weight_kg
breed				
Labrador	Bella	Brown	56	25
Labrador	Max	Black	59	29

Multi-level indexes a.k.a. hierarchical indexes

```
dogs_ind3 = dogs.set_index(["breed", "color"])
print(dogs_ind3)
```

		name	height_cm	weight_kg
breed	color			
Labrador	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Chow Chow	Brown	Lucy	46	22
Schnauzer	Grey	Cooper	49	17
Labrador	Black	Max	59	29
Chihuahua	Tan	Stella	18	2
St. Bernard	White	Bernie	77	74

Subset the outer level with a list

```
dogs_ind3.loc[["Labrador", "Chihuahua"]]
```

		name	height_cm	weight_kg
breed	color			
Labrador	Brown	Bella	56	25
	Black	Max	59	29
Chihuahua	Tan	Stella	18	2

Subset inner levels with a list of tuples

```
dogs_ind3.loc[ [("Labrador", "Brown"), ("Chihuahua", "Tan") ]]
```

		name	height_cm	weight_kg
breed	color			
Labrador	Brown	Bella	56	25
Chihuahua	Tan	Stella	18	2

Sorting by index values

```
dogs_ind3.sort_index()
```

		name	height_cm	weight_kg
breed	color			
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Controlling sort_index

```
dogs_ind3.sort_index(level=["color", "breed"], ascending=[True, False])
```

		name	height_cm	weight_kg
breed	color			
Poodle	Black	Charlie	43	23
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Chow Chow	Brown	Lucy	46	22
Schanuzer	Grey	Cooper	49	17
Chihuahua	Tan	Stella	18	2
St. Bernard	White	Bernie	77	74

Now you have two problems

- Index values are just data
- Indexes violate "tidy data" principles
- You need to learn two syntaxes

Temperature dataset

	date	city	country	avg_temp_c
0	2000-01-01	Abidjan	Côte D'Ivoire	27.293
1	2000-02-01	Abidjan	Côte D'Ivoire	27.685
2	2000-03-01	Abidjan	Côte D'Ivoire	29.061
3	2000-04-01	Abidjan	Côte D'Ivoire	28.162
4	2000-05-01	Abidjan	Côte D'Ivoire	27.547

Let's practice!

DATA MANIPULATION WITH PANDAS

Slicing lists

```
breeds = ["Labrador", "Poodle",  
          "Chow Chow", "Schnauzer",  
          "Labrador", "Chihuahua",  
          "St. Bernard"]
```

```
['Labrador',  
 'Poodle',  
 'Chow Chow',  
 'Schnauzer',  
 'Labrador',  
 'Chihuahua',  
 'St. Bernard']
```

```
breeds[2:5]
```

```
['Chow Chow', 'Schnauzer', 'Labrador']
```

```
breeds[:3]
```

```
['Labrador', 'Poodle', 'Chow Chow']
```

```
breeds[:]
```

```
['Labrador', 'Poodle', 'Chow Chow', 'Schnauzer',  
 'Labrador', 'Chihuahua', 'St. Bernard']
```

Sort the index before you slice

```
dogs_srt = dogs.set_index(["breed", "color"]).sort_index()  
print(dogs_srt)
```

		name	height_cm	weight_kg
breed	color			
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Slicing the outer index level

```
dogs_srt.loc["Chow Chow":"Poodle"]
```

		name	height_cm	weight_kg
breed	color			
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23

The final value "Poodle" is included

Full dataset

		name	height_cm	weight_kg
breed	color			
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Slicing the inner index levels badly

```
dogs_srt.loc["Tan":"Grey"]
```

```
Empty DataFrame  
Columns: [name, height_cm, weight_kg]  
Index: []
```

Full dataset

		name	height_cm	weight_kg
breed	color			
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Slicing the inner index levels correctly

```
dogs_srt.loc[  
    ("Labrador", "Brown"):( "Schnauzer", "Grey")]
```

		name	height_cm	weight_kg
breed	color			
Labrador	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17

Full dataset

		name	height_cm	weight_kg
breed	color			
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Slicing columns

```
dogs_srt.loc[:, "name":"height_cm"]
```

		name	height_cm
breed	color		
Chihuahua	Tan	Stella	18
Chow Chow	Brown	Lucy	46
Labrador	Black	Max	59
	Brown	Bella	56
Poodle	Black	Charlie	43
Schnauzer	Grey	Cooper	49
St. Bernard	White	Bernie	77

Full dataset

		name	height_cm	weight_kg
breed	color			
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Slice twice

```
dogs_srt.loc[
    ("Labrador", "Brown"):( "Schnauzer", "Grey"),
    "name":"height_cm"]
```

breed	color	name	height_cm
Labrador	Brown	Bella	56
Poodle	Black	Charlie	43
Schnauzer	Grey	Cooper	49

Full dataset

breed	color	name	height_cm	weight_kg
Chihuahua	Tan	Stella	18	2
Chow Chow	Brown	Lucy	46	22
Labrador	Black	Max	59	29
	Brown	Bella	56	25
Poodle	Black	Charlie	43	23
Schnauzer	Grey	Cooper	49	17
St. Bernard	White	Bernie	77	74

Dog days

```
dogs = dogs.set_index("date_of_birth").sort_index()
print(dogs)
```

	name	breed	color	height_cm	weight_kg
date_of_birth					
2011-12-11	Cooper	Schanuzer	Grey	49	17
2013-07-01	Bella	Labrador	Brown	56	25
2014-08-25	Lucy	Chow Chow	Brown	46	22
2015-04-20	Stella	Chihuahua	Tan	18	2
2016-09-16	Charlie	Poodle	Black	43	23
2017-01-20	Max	Labrador	Black	59	29
2018-02-27	Bernie	St. Bernard	White	77	74

Slicing by dates

```
# Get dogs with date_of_birth between 2014-08-25 and 2016-09-16
dogs.loc["2014-08-25":"2016-09-16"]
```

	name	breed	color	height_cm	weight_kg
date_of_birth					
2014-08-25	Lucy	Chow Chow	Brown	46	22
2015-04-20	Stella	Chihuahua	Tan	18	2
2016-09-16	Charlie	Poodle	Black	43	23

Slicing by partial dates

```
# Get dogs with date_of_birth between 2014-01-01 and 2016-12-31
dogs.loc["2014":"2016"]
```

	name	breed	color	height_cm	weight_kg
date_of_birth					
2014-08-25	Lucy	Chow Chow	Brown	46	22
2015-04-20	Stella	Chihuahua	Tan	18	2
2016-09-16	Charlie	Poodle	Black	43	23

Subsetting by row/column number

```
print(dogs.iloc[2:5, 1:4])
```

	breed	color	height_cm
2	Chow Chow	Brown	46
3	Schnauzer	Grey	49
4	Labrador	Black	59

Full dataset

	name	breed	color	height_cm	weight_kg
0	Bella	Labrador	Brown	56	25
1	Charlie	Poodle	Black	43	23
2	Lucy	Chow Chow	Brown	46	22
3	Cooper	Schnauzer	Grey	49	17
4	Max	Labrador	Black	59	29
5	Stella	Chihuahua	Tan	18	2
6	Bernie	St. Bernard	White	77	74

Let's practice!

DATA MANIPULATION WITH PANDAS

A bigger dog dataset

```
print(dog_pack)
```

```
   breed  color  height_cm  weight_kg
0   Boxer  Brown    62.64     30.4
1   Poodle  Black    46.41     20.4
2   Beagle  Brown    36.39     12.4
3  Chihuahua   Tan    19.70      1.6
4   Labrador   Tan    54.44     36.1
..     ...    ...         ...      ...
87   Boxer   Gray    58.13     29.9
88  St. Bernard  White    70.13     69.4
89   Poodle   Gray    51.30     20.4
90   Beagle  White    38.81      8.8
91   Beagle  Black    33.40     13.5
```

Pivoting the dog pack

```
dogs_height_by_breed_vs_color = dog_pack.pivot_table(  
    "height_cm", index="breed", columns="color")  
print(dogs_height_by_breed_vs_color)
```

color	Black	Brown	Gray	Tan	White
breed					
Beagle	34.500000	36.4500	36.313333	35.740000	38.810000
Boxer	57.203333	62.6400	58.280000	62.310000	56.360000
Chihuahua	18.555000	NaN	21.660000	20.096667	17.933333
Chow Chow	51.262500	50.4800	NaN	53.497500	54.413333
Dachshund	21.186667	19.7250	NaN	19.375000	20.660000
Labrador	57.125000	NaN	NaN	55.190000	55.310000
Poodle	48.036000	57.1300	56.645000	NaN	44.740000
St. Bernard	63.920000	65.8825	67.640000	68.334000	67.495000

.loc[] + slicing is a power combo

```
dogs_height_by_breed_vs_color.loc["Chow Chow":"Poodle"]
```

color	Black	Brown	Gray	Tan	White
Chow Chow	51.262500	50.480	NaN	53.4975	54.413333
Dachshund	21.186667	19.725	NaN	19.3750	20.660000
Labrador	57.125000	NaN	NaN	55.1900	55.310000
Poodle	48.036000	57.130	56.645	NaN	44.740000

The axis argument

```
dogs_height_by_breed_vs_color.mean(axis="index")
```

```
color
Black    43.973563
Brown    48.717917
Gray     48.107667
Tan       44.934738
White    44.465208
dtype: float64
```


Calculating summary stats across columns

```
dogs_height_by_breed_vs_color.mean(axis="columns")
```

```
breed
Beagle      36.362667
Boxer       59.358667
Chihuahua   19.561250
Chow Chow   52.413333
Dachshund   20.236667
Labrador    55.875000
Poodle      51.637750
St. Bernard 66.654300
dtype: float64
```

Let's practice!

DATA MANIPULATION WITH PANDAS