Explicit indexes

DATA MANIPULATION WITH PANDAS

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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

```python
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

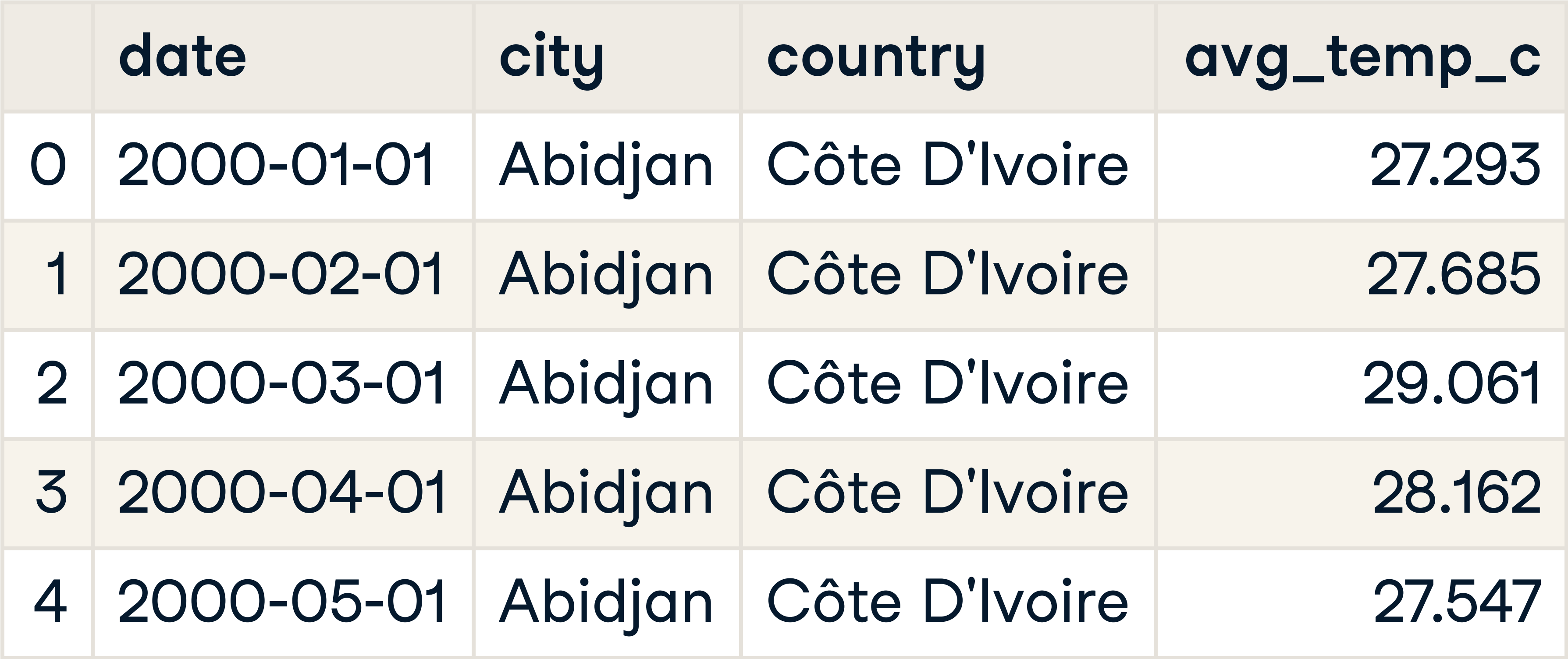
```
dogs_ind3.sort_index(level=["color", "breed"], ascending=[True, False])
```

```
                        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!

Slicing and subsetting with .loc and .iloc

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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

```python
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"]
```

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

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
```

Dog days

```python
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

```python
# 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

```python
# 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

Working with pivot tables

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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
breed
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!

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