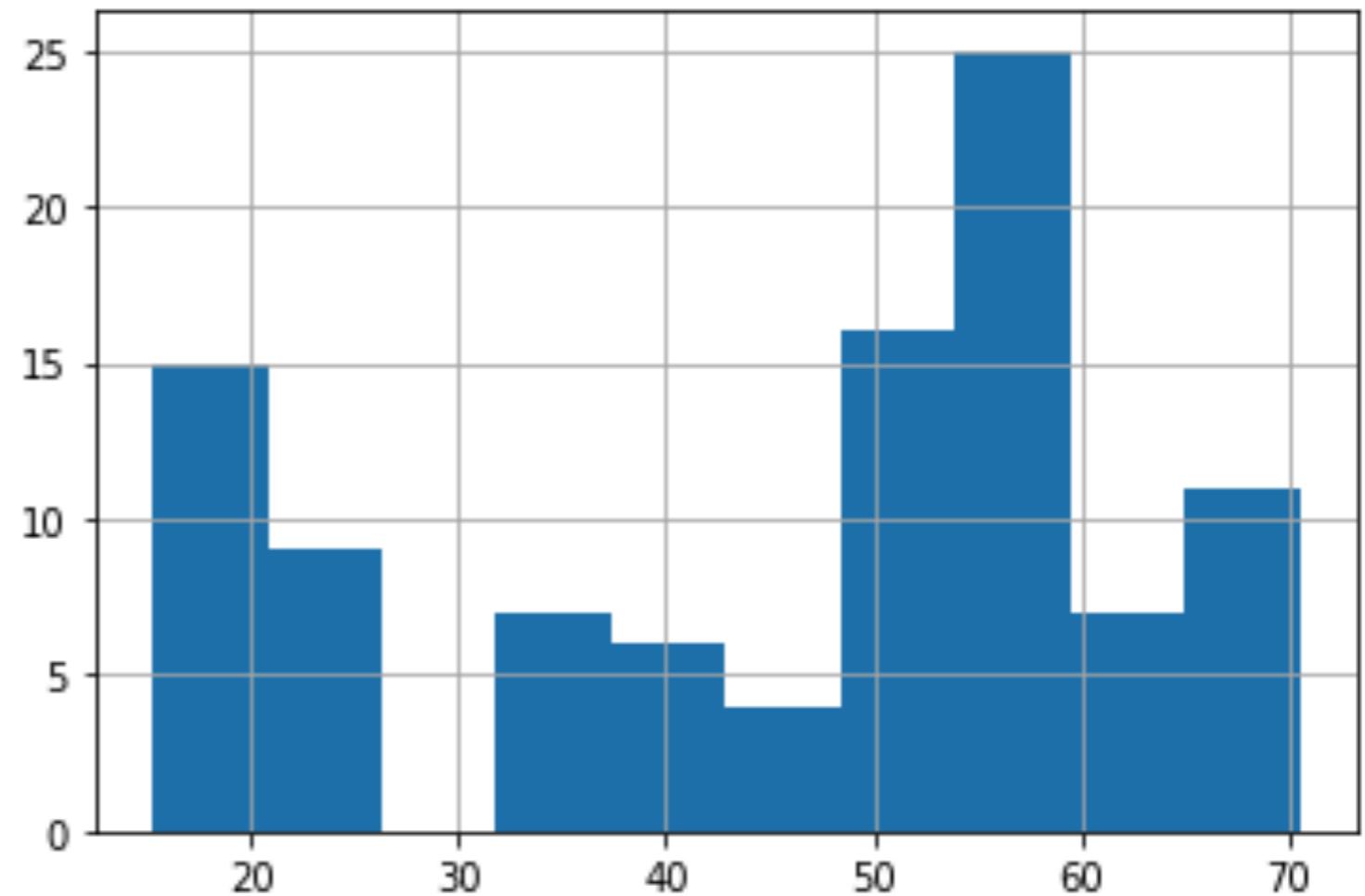


Histograms

```
import matplotlib.pyplot as plt
```

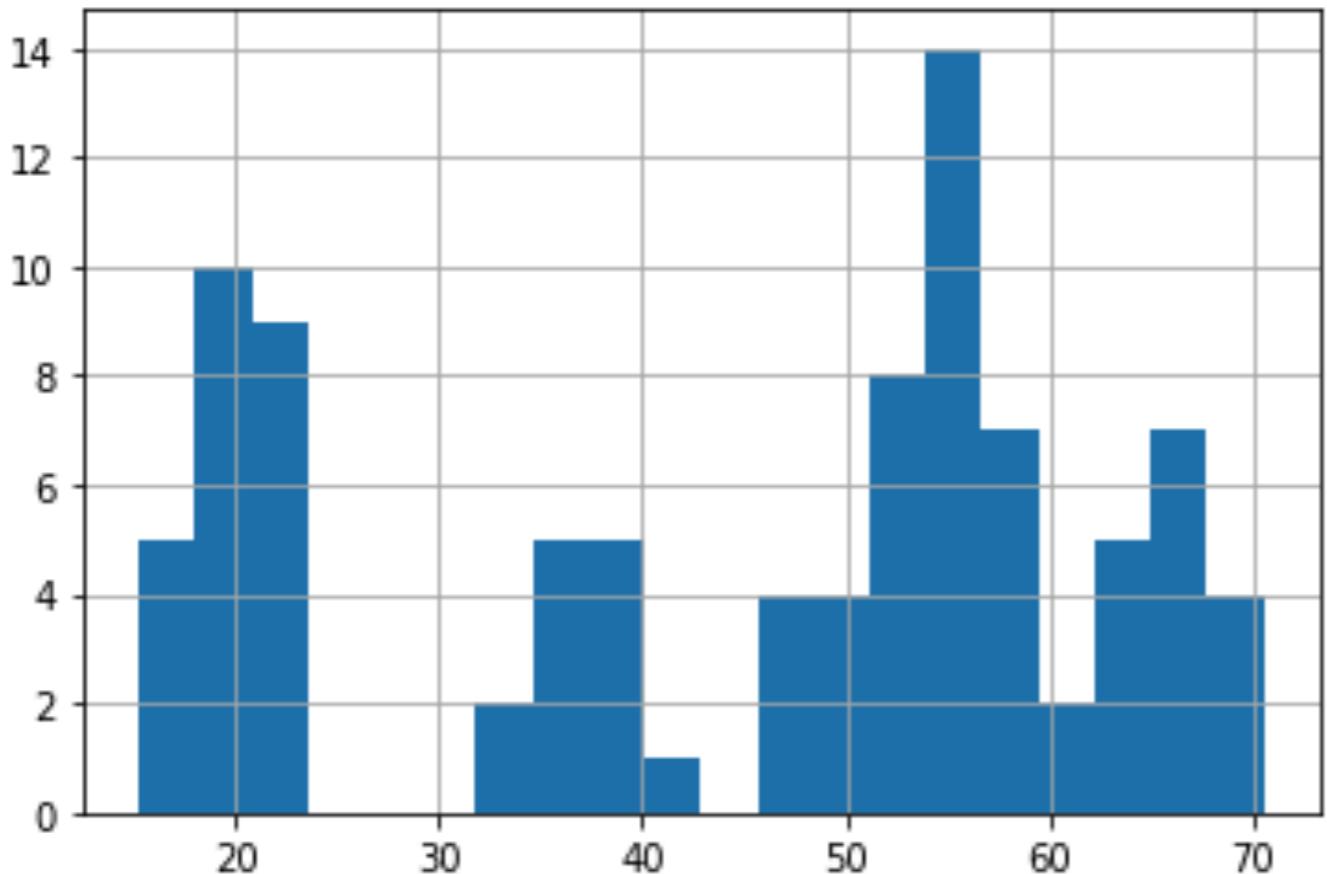
```
dog_pack["height_cm"].hist()
```

```
plt.show()
```

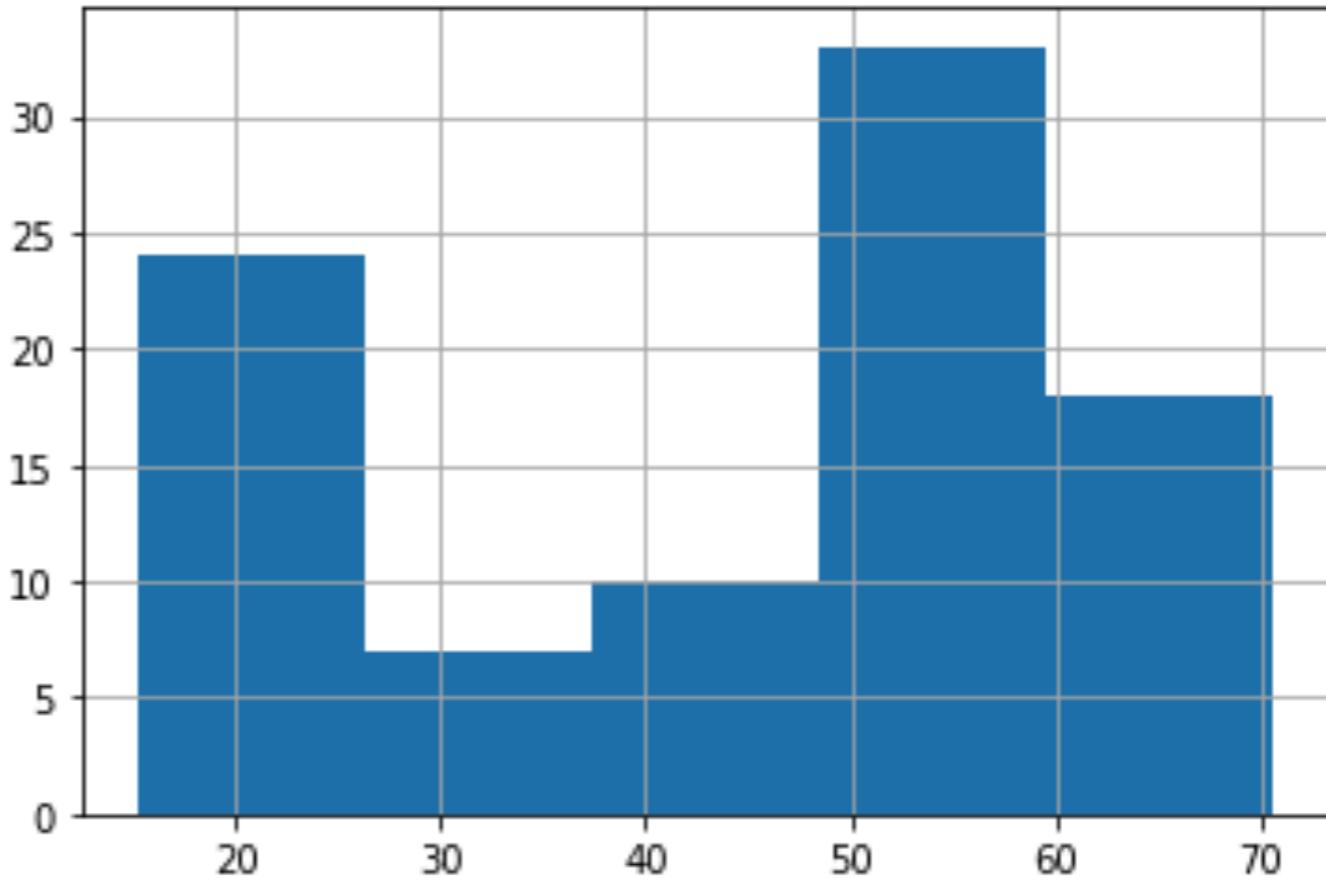


Histograms

```
dog_pack["height_cm"].hist(bins=20)  
plt.show()
```



```
dog_pack["height_cm"].hist(bins=5)  
plt.show()
```



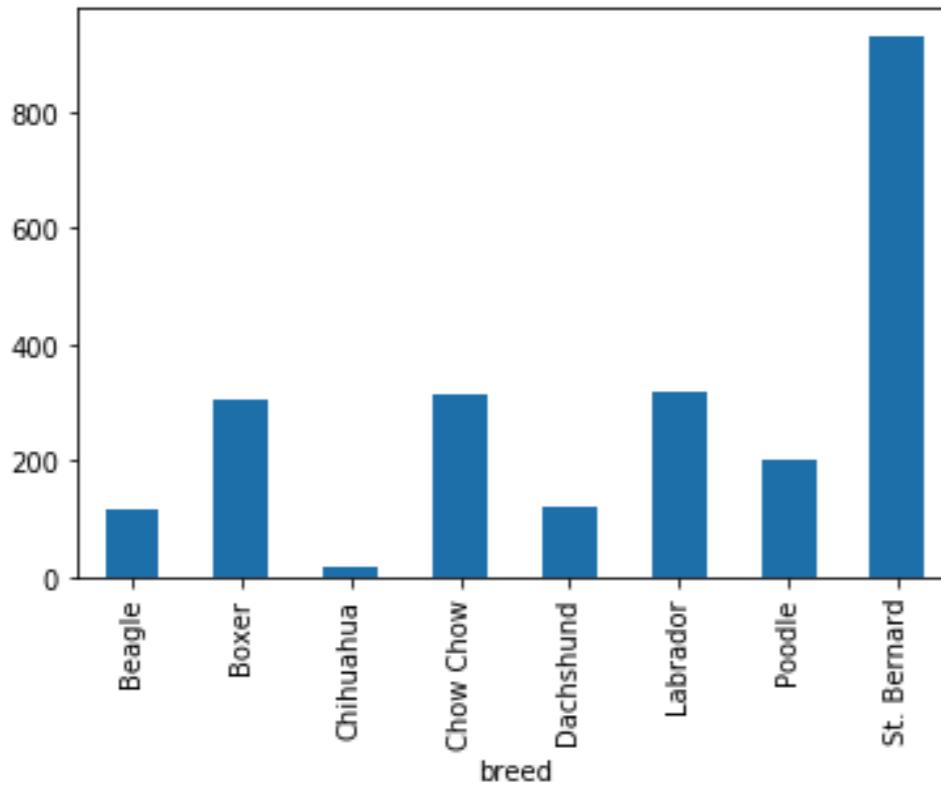
Bar plots

```
avg_weight_by_breed = dog_pack.groupby("breed")["weight_kg"].mean()  
print(avg_weight_by_breed)
```

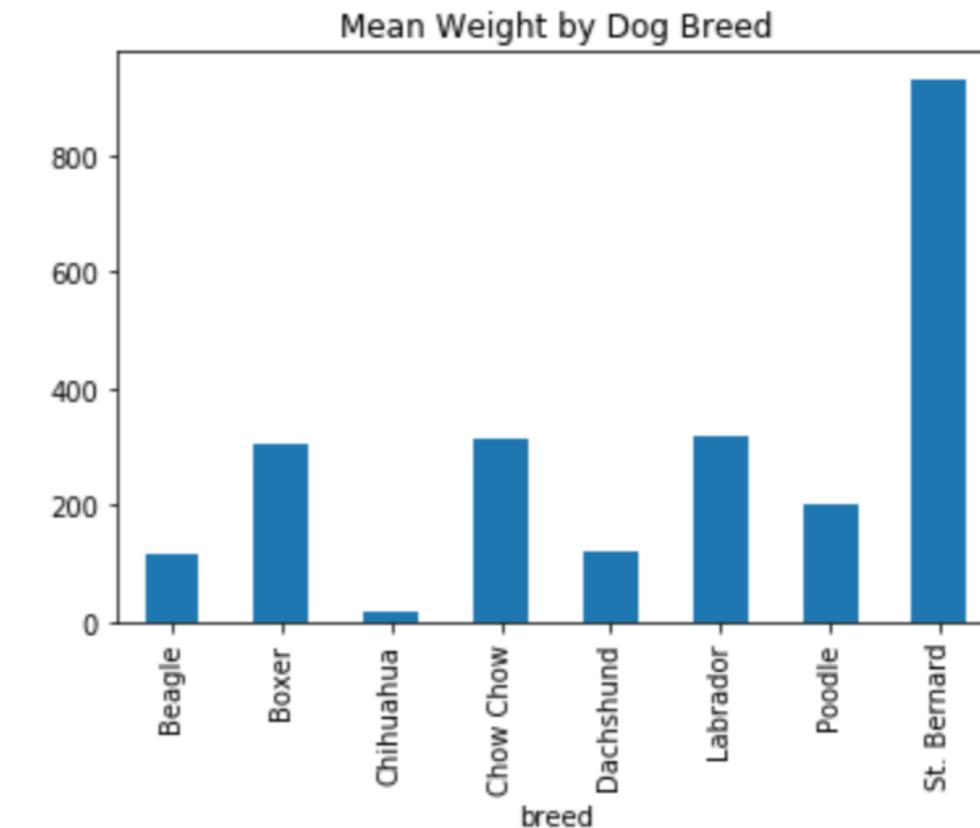
```
breed  
Beagle      10.636364  
Boxer       30.620000  
Chihuahua   1.491667  
Chow Chow    22.535714  
Dachshund   9.975000  
Labrador     31.850000  
Poodle       20.400000  
St. Bernard  71.576923  
Name: weight_kg, dtype: float64
```

Bar plots

```
avg_weight_by_breed.plot(kind="bar")  
plt.show()
```



```
avg_weight_by_breed.plot(kind="bar",  
                         title="Mean Weight by Dog Breed")  
plt.show()
```

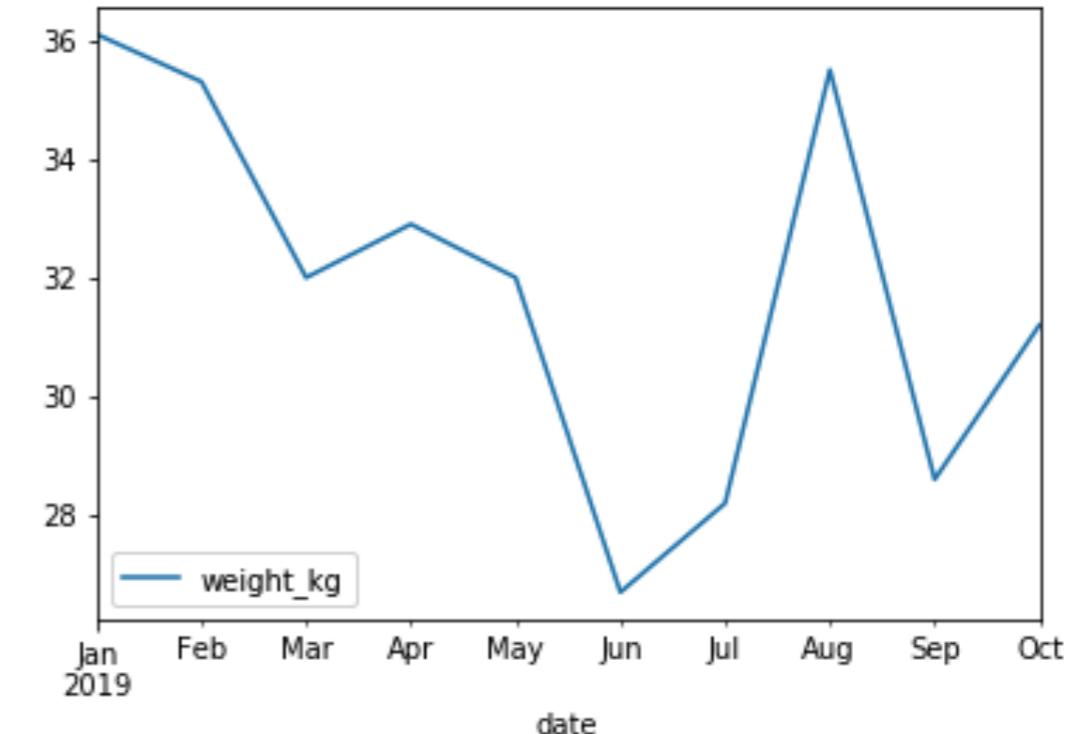


Line plots

```
sully.head()
```

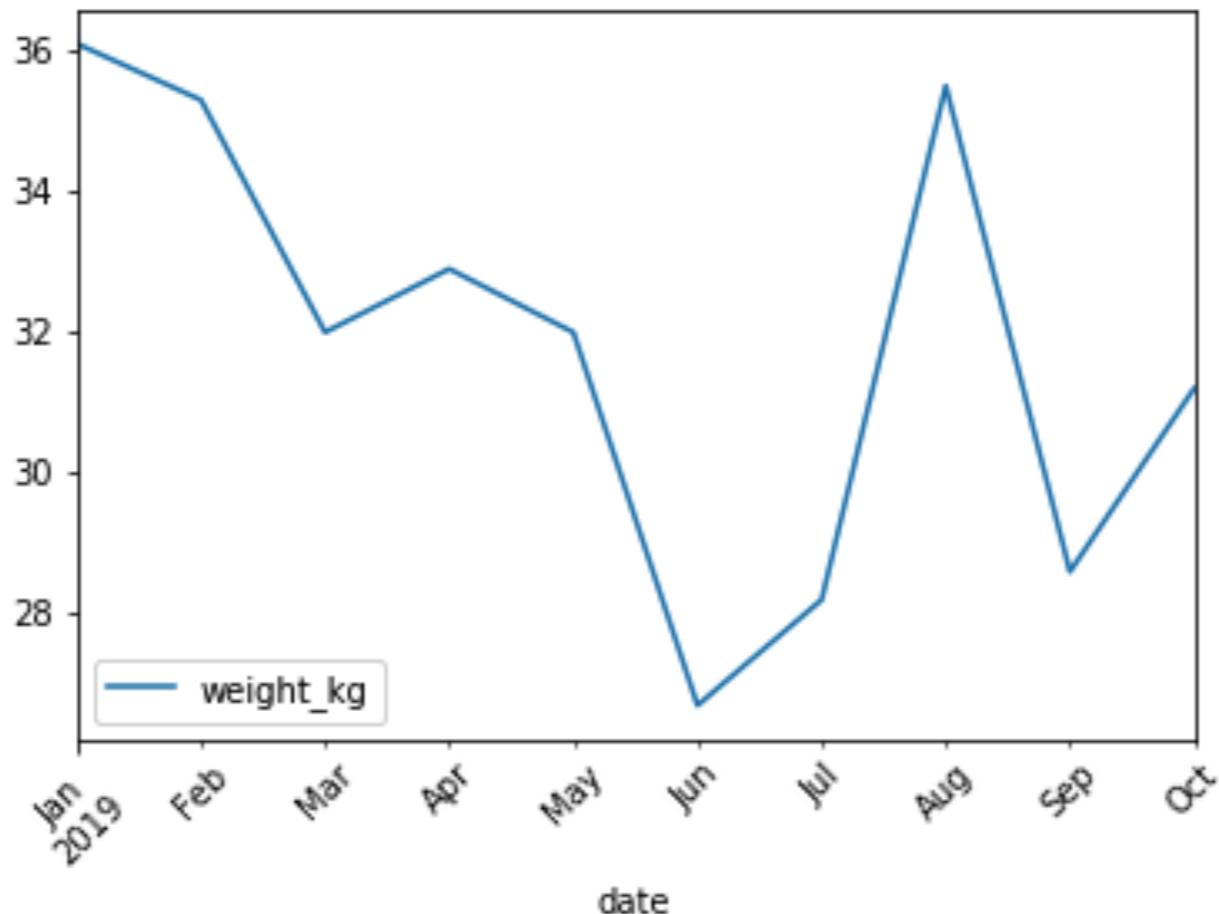
```
      date    weight_kg
0 2019-01-31        36.1
1 2019-02-28        35.3
2 2019-03-31        32.0
3 2019-04-30        32.9
4 2019-05-31        32.0
```

```
sully.plot(x="date",
            y="weight_kg",
            kind="line")
plt.show()
```



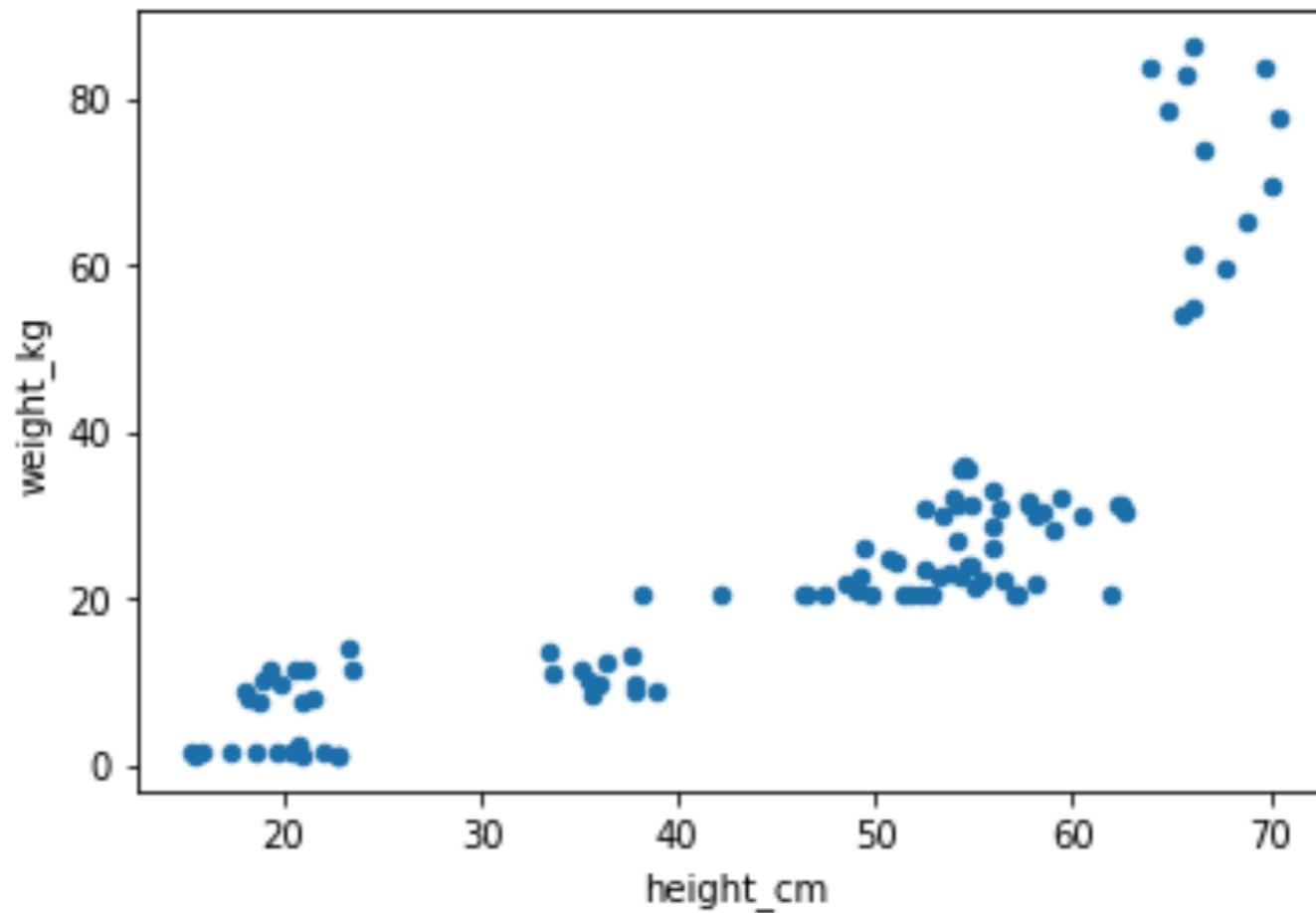
Rotating axis labels

```
sully.plot(x="date", y="weight_kg", kind="line", rot=45)  
plt.show()
```



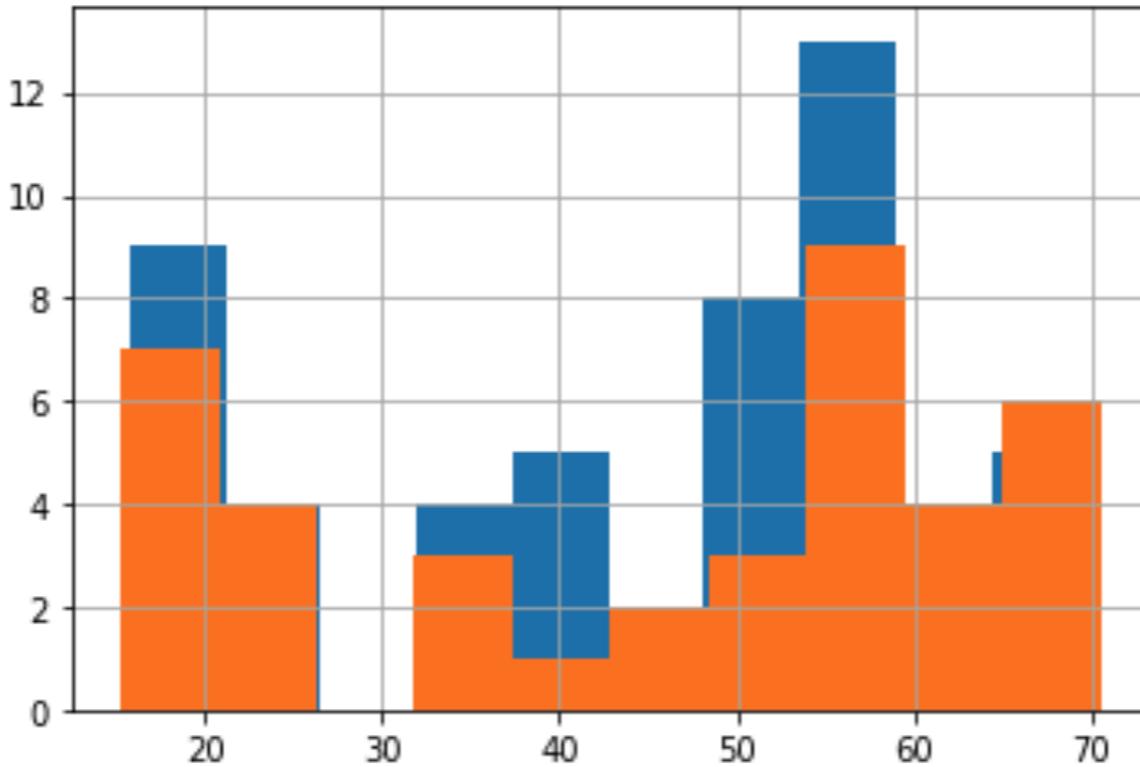
Scatter plots

```
dog_pack.plot(x="height_cm", y="weight_kg", kind="scatter")  
plt.show()
```



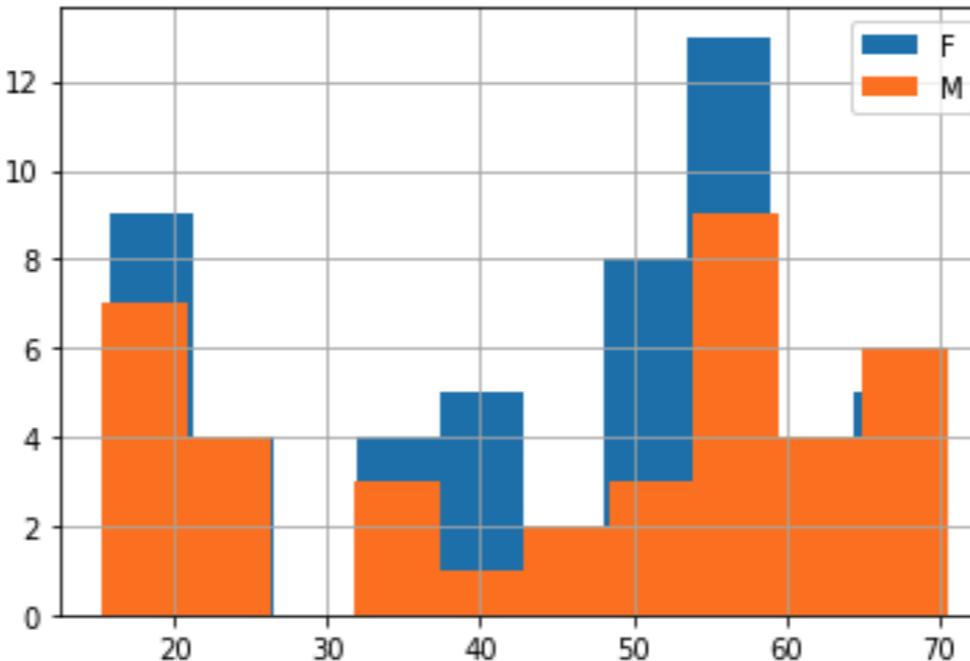
Layering plots

```
dog_pack[dog_pack["sex"]=="F"]["height_cm"].hist()  
dog_pack[dog_pack["sex"]=="M"]["height_cm"].hist()  
plt.show()
```



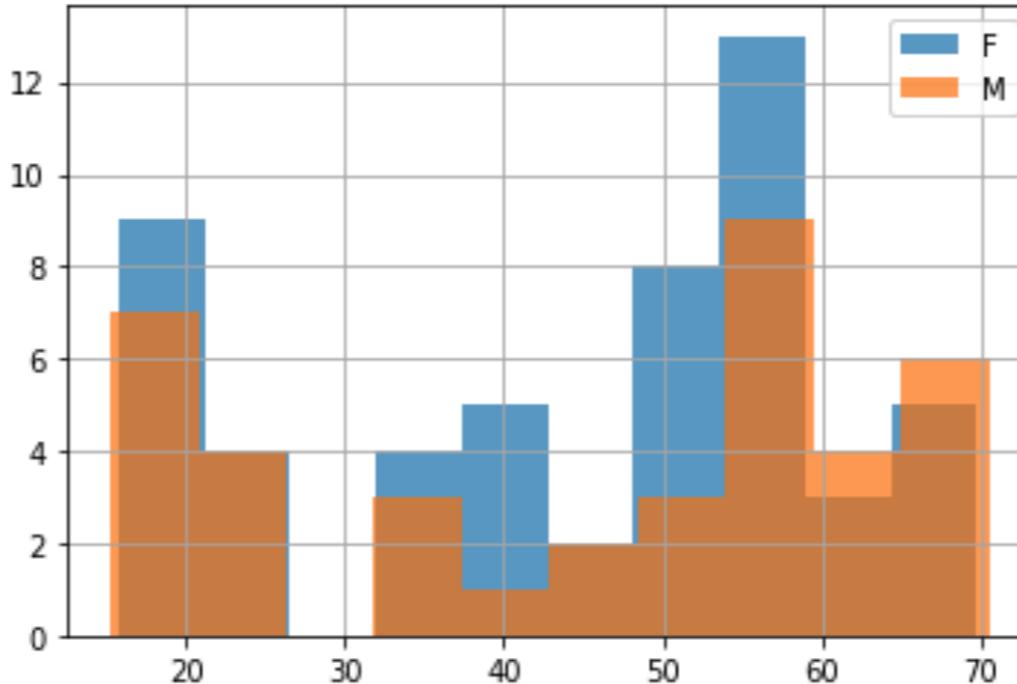
Add a legend

```
dog_pack[dog_pack["sex"]=="F"]["height_cm"].hist()  
dog_pack[dog_pack["sex"]=="M"]["height_cm"].hist()  
plt.legend(["F", "M"])  
plt.show()
```



Transparency

```
dog_pack[dog_pack["sex"]=="F"]["height_cm"].hist(alpha=0.7)
dog_pack[dog_pack["sex"]=="M"]["height_cm"].hist(alpha=0.7)
plt.legend(["F", "M"])
plt.show()
```



Avocados

```
print(avocados)
```

```
      date        type  year  avg_price     size  nb_sold
0  2015-12-27  conventional  2015       0.95  small  9626901.09
1  2015-12-20  conventional  2015       0.98  small  8710021.76
2  2015-12-13  conventional  2015       0.93  small  9855053.66
...
1011 2018-01-21        organic  2018       1.63  extra_large  1490.02
1012 2018-01-14        organic  2018       1.59  extra_large  1580.01
1013 2018-01-07        organic  2018       1.51  extra_large  1289.07
```

[1014 rows x 6 columns]

Let's practice!

DATA MANIPULATION WITH PANDAS

What's a missing value?

Name	Breed	Color	Height (cm)	Weight (kg)	Date of Birth
Bella	Labrador	Brown	56	25	2013-07-01
Charlie	Poodle	Black	43	23	2016-09-16
Lucy	Chow Chow	Brown	46	22	2014-08-25
Cooper	Schnauzer	Gray	49	17	2011-12-11
Max	Labrador	Black	59	29	2017-01-20
Stella	Chihuahua	Tan	18	2	2015-04-20
Bernie	St. Bernard	White	77	74	2018-02-27

What's a missing value?

Name	Breed	Color	Height (cm)	Weight (kg)	Date of Birth
Bella	Labrador	Brown	56	?	2013-07-01
Charlie	Poodle	Black	43	23	2016-09-16
Lucy	Chow Chow	Brown	46	22	2014-08-25
Cooper	Schnauzer	Gray	49	?	2011-12-11
Max	Labrador	Black	59	29	2017-01-20
Stella	Chihuahua	Tan	18	2	2015-04-20
Bernie	St. Bernard	White	77	74	2018-02-27

Missing values in pandas DataFrames

```
print(dogs)
```

	name	breed	color	height_cm	weight_kg	date_of_birth
0	Bella	Labrador	Brown	56	NaN	2013-07-01
1	Charlie	Poodle	Black	43	24.0	2016-09-16
2	Lucy	Chow Chow	Brown	46	24.0	2014-08-25
3	Cooper	Schnauzer	Gray	49	NaN	2011-12-11
4	Max	Labrador	Black	59	29.0	2017-01-20
5	Stella	Chihuahua	Tan	18	2.0	2015-04-20
6	Bernie	St. Bernard	White	77	74.0	2018-02-27

Detecting missing values

```
dogs.isna()
```

```
    name  breed  color  height_cm  weight_kg  date_of_birth
0  False  False  False      False     True        False
1  False  False  False      False    False        False
2  False  False  False      False    False        False
3  False  False  False      False     True        False
4  False  False  False      False    False        False
5  False  False  False      False    False        False
6  False  False  False      False    False        False
```

Detecting any missing values

```
dogs.isna().any()
```

```
name      False
breed     False
color     False
height_cm False
weight_kg  True
date_of_birth False
dtype: bool
```

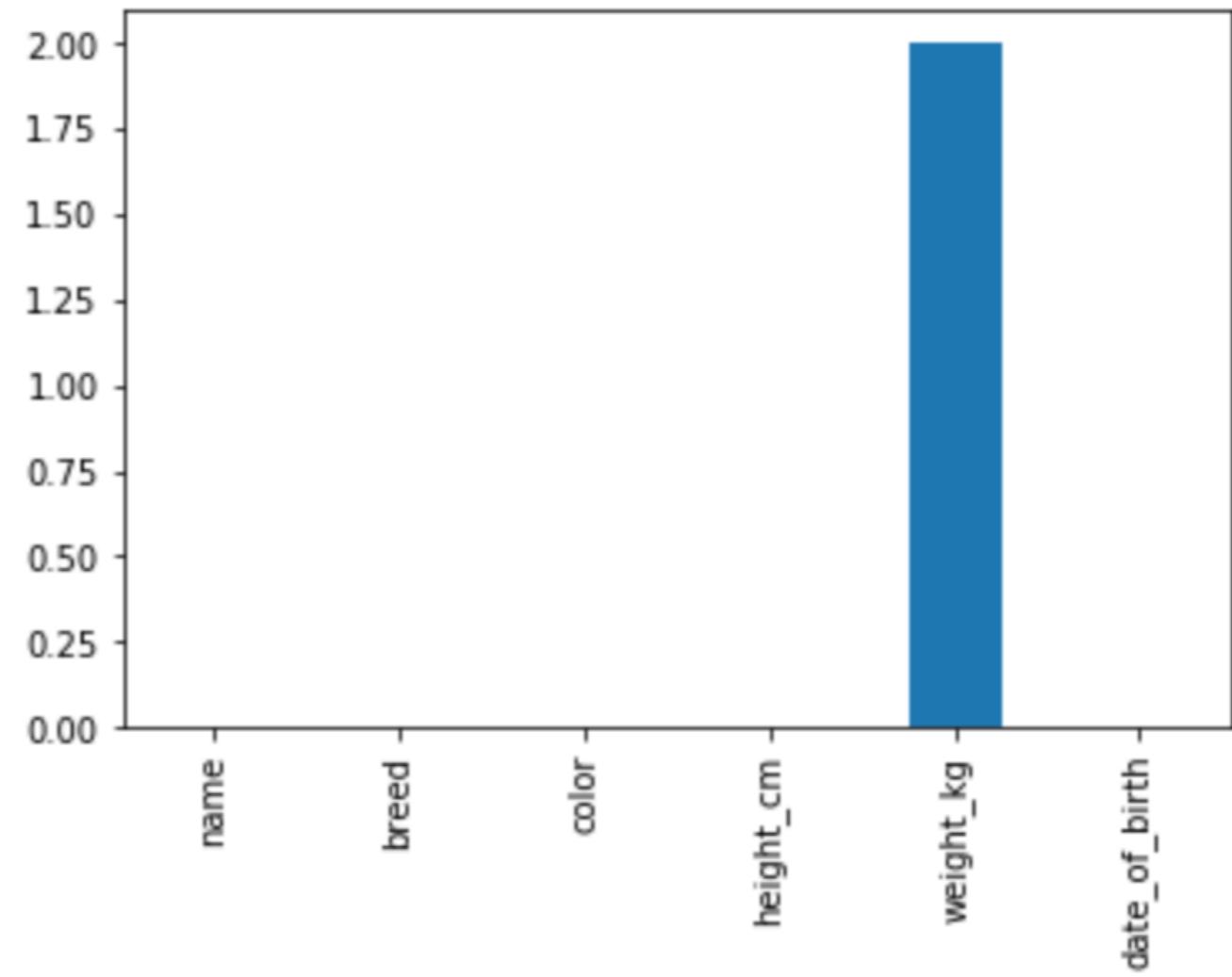
Counting missing values

```
dogs.isna().sum()
```

```
name      0  
breed     0  
color     0  
height_cm 0  
weight_kg 2  
date_of_birth 0  
dtype: int64
```

Plotting missing values

```
import matplotlib.pyplot as plt  
dogs.isna().sum().plot(kind="bar")  
plt.show()
```



Removing missing values

```
dogs.dropna()
```

	name	breed	color	height_cm	weight_kg	date_of_birth
1	Charlie	Poodle	Black	43	24.0	2016-09-16
2	Lucy	Chow Chow	Brown	46	24.0	2014-08-25
4	Max	Labrador	Black	59	29.0	2017-01-20
5	Stella	Chihuahua	Tan	18	2.0	2015-04-20
6	Bernie	St. Bernard	White	77	74.0	2018-02-27

Replacing missing values

```
dogs.fillna(0)
```

	name	breed	color	height_cm	weight_kg	date_of_birth
0	Bella	Labrador	Brown	56	0.0	2013-07-01
1	Charlie	Poodle	Black	43	24.0	2016-09-16
2	Lucy	Chow Chow	Brown	46	24.0	2014-08-25
3	Cooper	Schnauzer	Gray	49	0.0	2011-12-11
4	Max	Labrador	Black	59	29.0	2017-01-20
5	Stella	Chihuahua	Tan	18	2.0	2015-04-20
6	Bernie	St. Bernard	White	77	74.0	2018-02-27

Let's practice!

DATA MANIPULATION WITH PANDAS

Dictionaries

```
my_dict = {  
    "key1": value1,  
    "key2": value2,  
    "key3": value3  
}
```

```
my_dict["key1"]
```

value1

```
my_dict = {  
    "title": "Charlotte's Web",  
    "author": "E.B. White",  
    "published": 1952  
}
```

```
my_dict["title"]
```

Charlotte's Web

Creating DataFrames

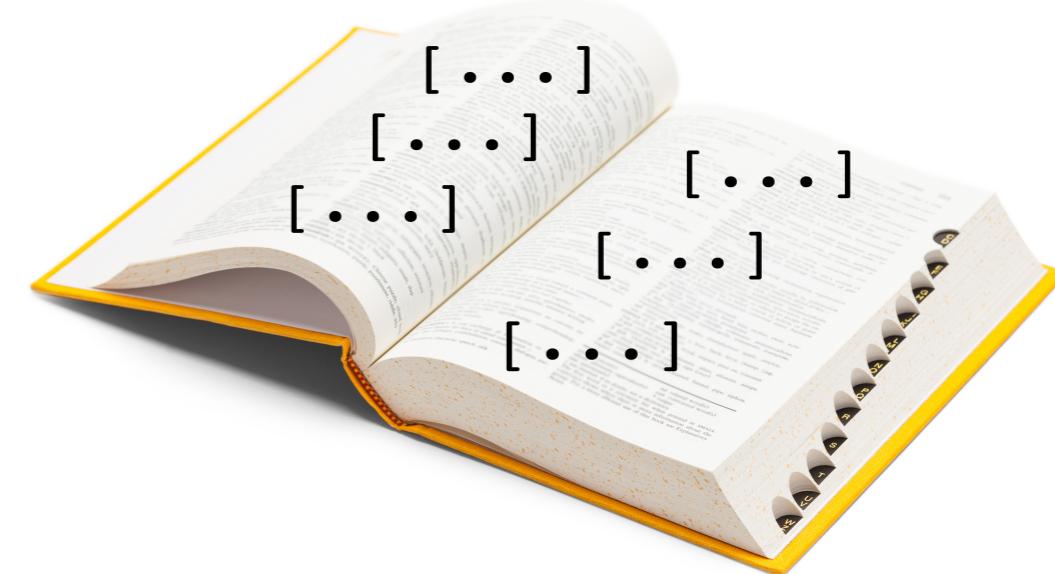
From a list of dictionaries

- Constructed row by row



From a dictionary of lists

- Constructed column by column



List of dictionaries - by row

name	breed	height (cm)	weight (kg)	date of birth
Ginger	Dachshund	22	10	2019-03-14
Scout	Dalmatian	59	25	2019-05-09

```
list_of_dicts = [  
    {"name": "Ginger", "breed": "Dachshund", "height_cm": 22,  
     "weight_kg": 10, "date_of_birth": "2019-03-14"},  
    {"name": "Scout", "breed": "Dalmatian", "height_cm": 59,  
     "weight_kg": 25, "date_of_birth": "2019-05-09"}  
]
```

List of dictionaries - by row

name	breed	height (cm)	weight (kg)	date of birth
Ginger	Dachshund	22	10	2019-03-14
Scout	Dalmatian	59	25	2019-05-09

```
new_dogs = pd.DataFrame(list_of_dicts)  
print(new_dogs)
```

```
      name      breed  height_cm  weight_kg  date_of_birth  
0  Ginger  Dachshund        22         10  2019-03-14  
1    Scout   Dalmatian        59         25  2019-05-09
```

Dictionary of lists - by column

name	breed	height	weight	date of birth
Ginger	Dachshund	22	10	2019-03-14
Scout	Dalmatian	59	25	2019-05-09

- **Key** = column name
- **Value** = list of column values

```
dict_of_lists = {  
    "name": ["Ginger", "Scout"],  
    "breed": ["Dachshund", "Dalmatian"],  
    "height_cm": [22, 59],  
    "weight_kg": [10, 25],  
    "date_of_birth": ["2019-03-14",  
                      "2019-05-09"]  
}
```

```
new_dogs = pd.DataFrame(dict_of_lists)
```

Dictionary of lists - by column

name	breed	height (cm)	weight (kg)	date of birth
Ginger	Dachshund	22	10	2019-03-14
Scout	Dalmatian	59	25	2019-05-09

```
print(new_dogs)
```

```
      name      breed  height_cm  weight_kg  date_of_birth
0  Ginger  Dachshund        22         10  2019-03-14
1    Scout   Dalmatian        59         25  2019-05-09
```

Let's practice!

DATA MANIPULATION WITH PANDAS

What's a CSV file?

- CSV = comma-separated values
- Designed for DataFrame-like data
- Most database and spreadsheet programs can use them or create them



Example CSV file

name	breed	height (cm)	weight (kg)	date of birth
Ginger	Dachshund	22	10	2019-03-14
Scout	Dalmatian	59	25	2019-05-09

new_dogs.csv

```
name,breed,height_cm,weight_kg,d_o_b  
Ginger,Dachshund,22,10,2019-03-14  
Scout,Dalmatian,59,25,2019-05-09
```

CSV to DataFrame

```
import pandas as pd  
  
new_dogs = pd.read_csv("new_dogs.csv")  
  
print(new_dogs)
```

```
   name      breed  height_cm  weight_kg  date_of_birth  
0  Ginger  Dachshund        22         10  2019-03-14  
1    Scout  Dalmatian        59         25  2019-05-09
```

DataFrame manipulation

```
new_dogs["bmi"] = new_dogs["weight_kg"] / (new_dogs["height_cm"] / 100) ** 2  
print(new_dogs)
```

```
   name      breed  height_cm  weight_kg  date_of_birth        bmi  
0  Ginger  Dachshund       22          10  2019-03-14  206.611570  
1   Scout  Dalmatian       59          25  2019-05-09  71.818443
```

DataFrame to CSV

```
new_dogs.to_csv("new_dogs_with_bmi.csv")
```

new_dogs_with_bmi.csv

```
name,breed,height_cm,weight_kg,d_o_b,bmi  
Ginger,Dachshund,22,10,2019-03-14,206.611570  
Scout,Dalmatian,59,25,2019-05-09,71.818443
```

Let's practice!

DATA MANIPULATION WITH PANDAS

Recap

- Chapter 1
 - Subsetting and sorting
 - Adding new columns
- Chapter 2
 - Aggregating and grouping
 - Summary statistics
- Chapter 3
 - Indexing
 - Slicing
- Chapter 4
 - Visualizations
 - Reading and writing CSVs

More to learn

- [Joining Data with pandas](#)
- [Streamlined Data Ingestion with pandas](#)
- [Analyzing Police Activity with pandas](#)
- [Analyzing Marketing Campaigns with pandas](#)

Congratulations!

DATA MANIPULATION WITH PANDAS