Visualizing your data

DATA MANIPULATION WITH PANDAS

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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!

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Missing values

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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
```

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Creating DataFrames

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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 (cm)	weight (kg)	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
```

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Reading and writing CSVs

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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!

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Wrap-up

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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!

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