Introducing DataFrames

DATA MANIPULATION WITH PANDAS

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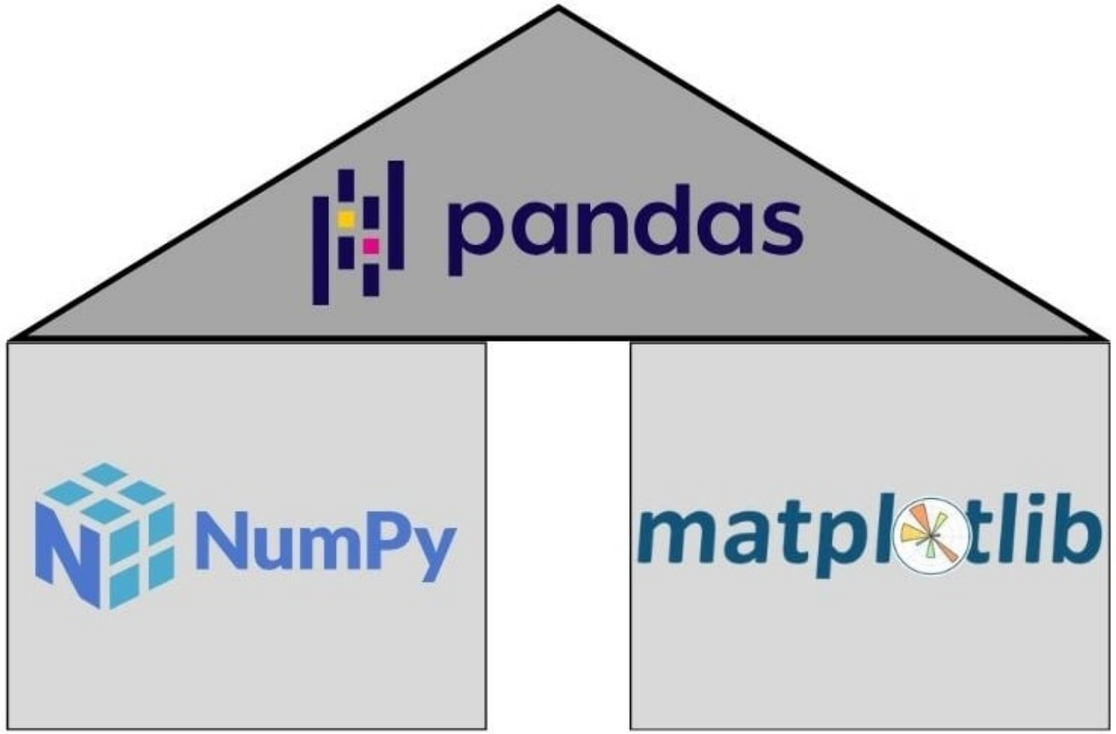
What's the point of pandas?

- Data Manipulation skill track
- Data Visualization skill track

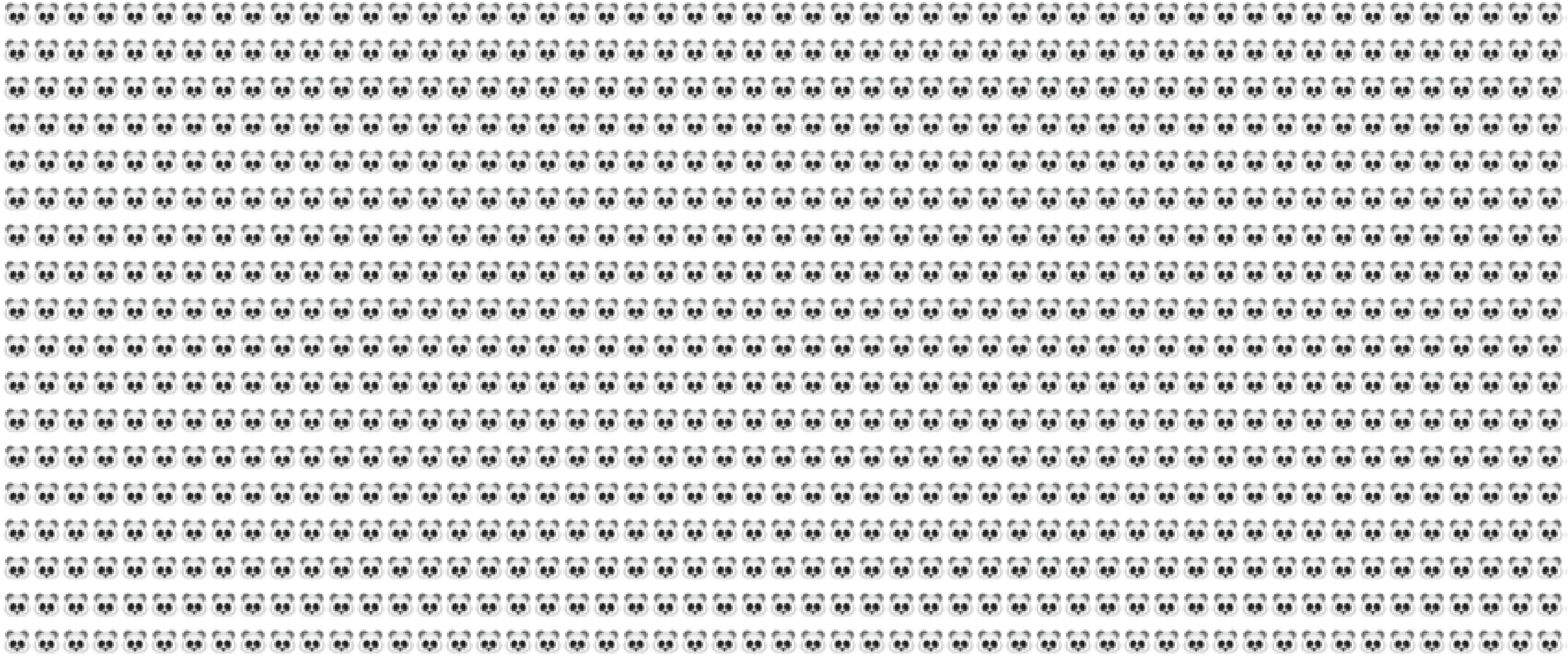
Course outline

- **Chapter 1: DataFrames**
  - Sorting and subsetting
  - Creating new columns
- **Chapter 2: Aggregating Data**
  - Summary statistics
  - Counting
  - Grouped summary statistics
- **Chapter 3: Slicing and Indexing Data**
  - Subsetting using slicing
  - Indexes and subsetting using indexes
- **Chapter 4: Creating and Visualizing Data**
  - Plotting
  - Handling missing data
  - Reading data into a DataFrame

pandas is built on NumPy and Matplotlib



pandas is popular



[1] https://pypistats.org/packages/pandas

Rectangular data

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

pandas DataFrames

```
print(dogs)
```

```
      name         breed  color  height_cm  weight_kg date_of_birth
0    Bella      Labrador  Brown         56         24    2013-07-01
1  Charlie        Poodle  Black         43         24    2016-09-16
2     Lucy     Chow Chow  Brown         46         24    2014-08-25
3   Cooper     Schnauzer   Gray         49         17    2011-12-11
4      Max      Labrador  Black         59         29    2017-01-20
5   Stella     Chihuahua    Tan         18          2    2015-04-20
6   Bernie  St. Bernard  White         77         74    2018-02-27
```

Exploring a DataFrame: .head()

```
print(dogs.head())
```

```
     name          breed  color  height_cm  weight_kg date_of_birth
0    Bella       Labrador  Brown         56         24    2013-07-01
1  Charlie         Poodle  Black         43         24    2016-09-16
2     Lucy      Chow Chow  Brown         46         24    2014-08-25
3   Cooper      Schnauzer   Gray         49         17    2011-12-11
4      Max       Labrador  Black         59         29    2017-01-20
```

Exploring a DataFrame: .info()

```
print(dogs.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7 entries, 0 to 6
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
 --  ------         --------------  -----
 0   name           7 non-null      object
 1   breed          7 non-null      object
 2   color          7 non-null      object
 3   height_cm      7 non-null      int64
 4   weight_kg      7 non-null      int64
 5   date_of_birth  7 non-null      object
dtypes: int64(2), object(4)
memory usage: 464.0+ bytes
```

Exploring a DataFrame: .shape

```
print(dogs.shape)
```

```
(7, 6)
```

Exploring a DataFrame: .describe()

```
print(dogs.describe())
```

```
       height_cm  weight_kg
count   7.000000   7.000000
mean   49.714286  27.428571
std    17.960274  22.292429
min    18.000000   2.000000
25%    44.500000  19.500000
50%    49.000000  23.000000
75%    57.500000  27.000000
max    77.000000  74.000000
```

Components of a DataFrame: .values

```
print(dogs.values)
```

```
array([['Bella', 'Labrador', 'Brown', 56, 24, '2013-07-01'],
       ['Charlie', 'Poodle', 'Black', 43, 24, '2016-09-16'],
       ['Lucy', 'Chow Chow', 'Brown', 46, 24, '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']],
      dtype=object)
```

Components of a DataFrame: .columns and .index

```
print(dogs.columns)
```

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

```
dogs.index
```

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

pandas Philosophy

> There should be one -- and preferably only one -- obvious way to do it.

- *The Zen of Python* by Tim Peters, Item 13

[1] https://www.python.org/dev/peps/pep-0020/

Let's practice!

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Sorting and subsetting

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Sorting

```
dogs.sort_values("weight_kg")
```

	name	breed	color	height_cm	weight_kg	date_of_birth
5	Stella	Chihuahua	Tan	18	2	2015-04-20
3	Cooper	Schnauzer	Gray	49	17	2011-12-11
0	Bella	Labrador	Brown	56	24	2013-07-01
1	Charlie	Poodle	Black	43	24	2016-09-16
2	Lucy	Chow Chow	Brown	46	24	2014-08-25
4	Max	Labrador	Black	59	29	2017-01-20
6	Bernie	St. Bernard	White	77	74	2018-02-27

Sorting in descending order

```
dogs.sort_values("weight_kg", ascending=False)
```

	name	breed	color	height_cm	weight_kg	date_of_birth
6	Bernie	St. Bernard	White	77	74	2018-02-27
4	Max	Labrador	Black	59	29	2017-01-20
0	Bella	Labrador	Brown	56	24	2013-07-01
1	Charlie	Poodle	Black	43	24	2016-09-16
2	Lucy	Chow Chow	Brown	46	24	2014-08-25
3	Cooper	Schnauzer	Gray	49	17	2011-12-11
5	Stella	Chihuahua	Tan	18	2	2015-04-20

Sorting by multiple variables

```
dogs.sort_values(["weight_kg", "height_cm"])
```

	name	breed	color	height_cm	weight_kg	date_of_birth
5	Stella	Chihuahua	Tan	18	2	2015-04-20
3	Cooper	Schnauzer	Gray	49	17	2011-12-11
1	Charlie	Poodle	Black	43	24	2016-09-16
2	Lucy	Chow Chow	Brown	46	24	2014-08-25
0	Bella	Labrador	Brown	56	24	2013-07-01
4	Max	Labrador	Black	59	29	2017-01-20
6	Bernie	St. Bernard	White	77	74	2018-02-27

Sorting by multiple variables

```
dogs.sort_values(["weight_kg", "height_cm"], ascending=[True, False])
```

	name	breed	color	height_cm	weight_kg	date_of_birth
5	Stella	Chihuahua	Tan	18	2	2015-04-20
3	Cooper	Schnauzer	Gray	49	17	2011-12-11
0	Bella	Labrador	Brown	56	24	2013-07-01
2	Lucy	Chow Chow	Brown	46	24	2014-08-25
1	Charlie	Poodle	Black	43	24	2016-09-16
4	Max	Labrador	Black	59	29	2017-01-20
6	Bernie	St. Bernard	White	77	74	2018-02-27

pandas with relevant values highlighted: Bella, Lucy and Charlie in descending order by height

Subsetting columns

```
dogs["name"]
```

```
0      Bella
1    Charlie
2       Lucy
3     Cooper
4        Max
5     Stella
6     Bernie
Name: name, dtype: object
```

Subsetting multiple columns

```
dogs[["breed", "height_cm"]]
```

```
          breed  height_cm
0      Labrador         56
1        Poodle         43
2     Chow Chow         46
3     Schnauzer         49
4      Labrador         59
5     Chihuahua         18
6  St. Bernard         77
```

```
cols_to_subset = ["breed", "height_cm"]
dogs[cols_to_subset]
```

```
          breed  height_cm
0      Labrador         56
1        Poodle         43
2     Chow Chow         46
3     Schnauzer         49
4      Labrador         59
5     Chihuahua         18
6  St. Bernard         77
```

Subsetting rows

```
dogs["height_cm"] > 50
```

```
0     True
1    False
2    False
3    False
4     True
5    False
6     True
Name: height_cm, dtype: bool
```

Subsetting rows

```
dogs[dogs["height_cm"] > 50]
```

```
     name         breed  color  height_cm  weight_kg date_of_birth
0   Bella      Labrador  Brown         56         24    2013-07-01
4     Max      Labrador  Black         59         29    2017-01-20
6  Bernie  St. Bernard  White         77         74    2018-02-27
```

Subsetting based on text data

```
dogs[dogs["breed"] == "Labrador"]
```

```
    name        breed  color  height_cm  weight_kg date_of_birth
0   Bella     Labrador  Brown         56         24    2013-07-01
4     Max     Labrador  Black         59         29    2017-01-20
```

Subsetting based on dates

```
dogs[dogs["date_of_birth"] < "2015-01-01"]
```

```
     name       breed  color  height_cm  weight_kg date_of_birth
0   Bella    Labrador  Brown         56         24    2013-07-01
2    Lucy  Chow Chow  Brown         46         24    2014-08-25
3  Cooper  Schnauzer   Gray         49         17    2011-12-11
```

Subsetting based on multiple conditions

```
is_lab = dogs["breed"] == "Labrador"
is_brown = dogs["color"] == "Brown"
dogs[is_lab & is_brown]
```

```
     name         breed  color  height_cm  weight_kg date_of_birth
0   Bella      Labrador  Brown         56         24    2013-07-01
```

```
dogs[ (dogs["breed"] == "Labrador") & (dogs["color"] == "Brown") ]
```

Subsetting using .isin()

```
is_black_or_brown = dogs["color"].isin(["Black", "Brown"])
dogs[is_black_or_brown]
```

```
      name       breed  color  height_cm  weight_kg date_of_birth
0    Bella    Labrador  Brown         56         24    2013-07-01
1  Charlie      Poodle  Black         43         24    2016-09-16
2     Lucy  Chow Chow  Brown         46         24    2014-08-25
4      Max    Labrador  Black         59         29    2017-01-20
```

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New columns

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Adding a new column

```
dogs["height_m"] = dogs["height_cm"] / 100
print(dogs)
```

```
      name         breed  color  height_cm  weight_kg date_of_birth  height_m
0    Bella      Labrador  Brown         56         24    2013-07-01      0.56
1  Charlie        Poodle  Black         43         24    2016-09-16      0.43
2     Lucy     Chow Chow  Brown         46         24    2014-08-25      0.46
3   Cooper     Schnauzer   Gray         49         17    2011-12-11      0.49
4      Max      Labrador  Black         59         29    2017-01-20      0.59
5   Stella     Chihuahua    Tan         18          2    2015-04-20      0.18
6   Bernie  St. Bernard  White         77         74    2018-02-27      0.77
```

Doggy mass index

$$\text{BMI} = \text{weight in kg} / (\text{height in m})^2$$

```
dogs["bmi"] = dogs["weight_kg"] / dogs["height_m"] ** 2
print(dogs.head())
```

```
      name      breed  color  height_cm  weight_kg date_of_birth  height_m         bmi
0    Bella   Labrador  Brown         56         24    2013-07-01      0.56   76.530612
1  Charlie     Poodle  Black         43         24    2016-09-16      0.43  129.799892
2     Lucy  Chow Chow  Brown         46         24    2014-08-25      0.46  113.421550
3   Cooper  Schnauzer   Gray         49         17    2011-12-11      0.49   70.803832
4      Max   Labrador  Black         59         29    2017-01-20      0.59   83.309394
```

Multiple manipulations

```
bmi_lt_100 = dogs[dogs["bmi"] < 100]
bmi_lt_100_height  = bmi_lt_100.sort_values("height_cm", ascending=False)
bmi_lt_100_height[["name", "height_cm", "bmi"]]
```

```
     name  height_cm        bmi
4     Max         59  83.309394
0   Bella         56  76.530612
3  Cooper         49  70.803832
5  Stella         18  61.728395
```

Let's practice!

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