Course outline

Diagnose dirty data

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Side effects of dirty data

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Clean data

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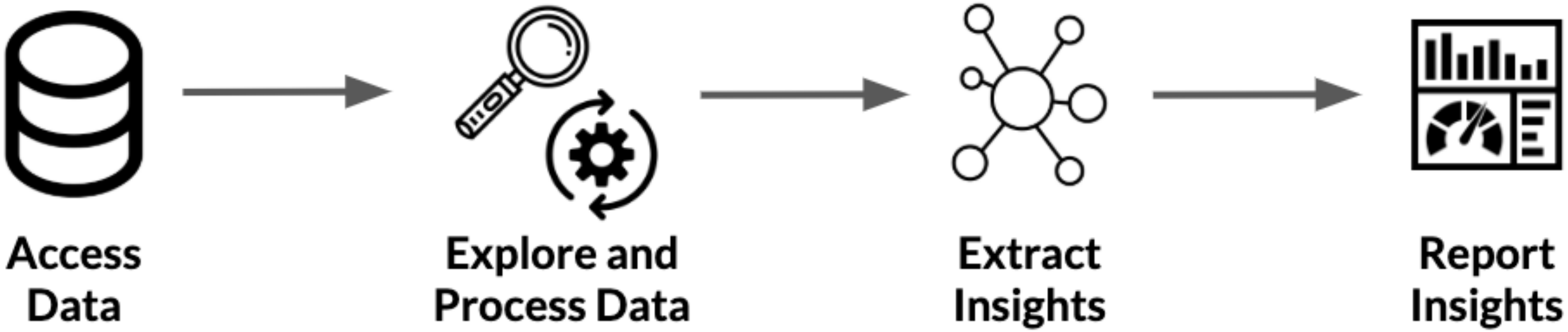
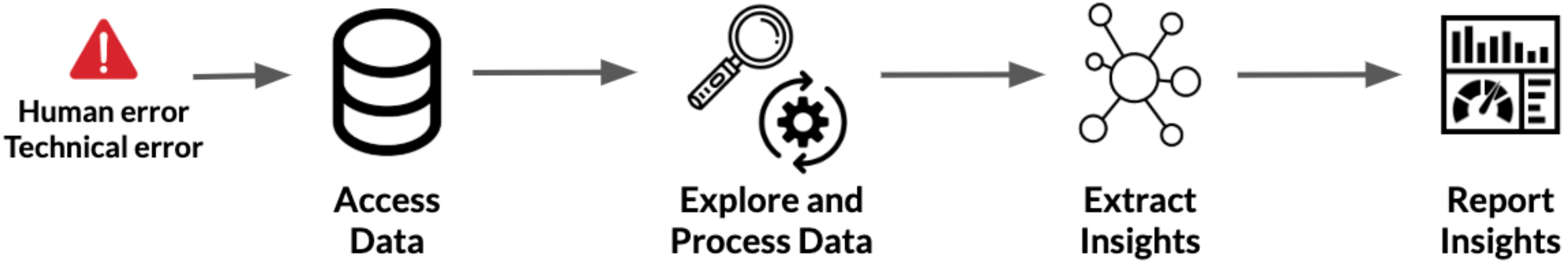
Clean data

Chapter 1 - Common data problems

Why do we need to clean data?



Why do we need to clean data?



Human error
Technical error

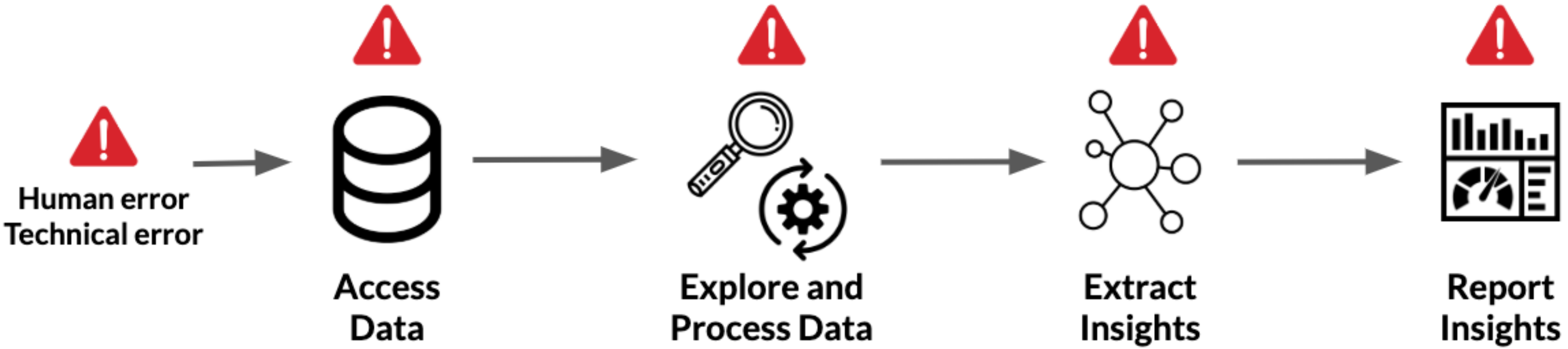
Access Data

Explore and Process Data

Extract Insights

Report Insights

Why do we need to clean data?



Garbage in Garbage out

Data type constraints

Datatype	Example
Text data	First name, last name, address ...
Integers	# Subscribers, # products sold ...
Decimals	Temperature, $ exchange rates ...
Binary	Is married, new customer, yes/no, ...
Dates	Order dates, ship dates ...
Categories	Marriage status, gender ...

Python data type
`str`
`int`
`float`
`bool`
`datetime`
`category`

Strings to integers

```
# Import CSV file and output header
sales = pd.read_csv('sales.csv')
sales.head(2)
```

```
   SalesOrderID    Revenue    Quantity
0         43659     23153$          12
1         43660      1457$           2
```

```
# Get data types of columns
sales.dtypes
```

```
SalesOrderID    int64
Revenue         object
Quantity        int64
dtype: object
```

String to integers

```
# Get DataFrame information
sales.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 31465 entries, 0 to 31464
Data columns (total 3 columns):
SalesOrderID     31465 non-null int64
Revenue          31465 non-null object
Quantity         31465 non-null int64
dtypes: int64(2), object(1)
memory usage: 737.5+ KB
```

String to integers

```
# Print sum of all Revenue column
sales['Revenue'].sum()
```

```
'23153$1457$36865$32474$472$27510$16158$5694$6876$40487$807$6893$9153$6895$4216..
```

```
# Remove $ from Revenue column
sales['Revenue'] = sales['Revenue'].str.strip('$')
sales['Revenue'] = sales['Revenue'].astype('int')
```

```
# Verify that Revenue is now an integer
assert sales['Revenue'].dtype == 'int'
```

The assert statement

```python
# This will pass
assert 1+1 == 2
```

```python
# This will not pass
assert 1+1 == 3
```

```
AssertionError                            Traceback (most recent call last)
         assert 1+1 == 3
AssertionError:
```

Numeric or categorical?

```
...   marriage_status    ...
...                 3    ...
...                 1    ...
...                 2    ...
```

`0` = Never married   `1` = Married   `2` = Separated   `3` = Divorced

```python
df['marriage_status'].describe()
```

```
       marriage_status
...
mean                1.4
std                 0.20
min                 0.00
50%                 1.8 ...
```

Numeric or categorical?

```
# Convert to categorical
df["marriage_status"] = df["marriage_status"].astype('category')
df.describe()
```

```
        marriage_status
count                241
unique                 4
top                    1
freq                 120
```

Let's practice!

CLEANING DATA IN PYTHON

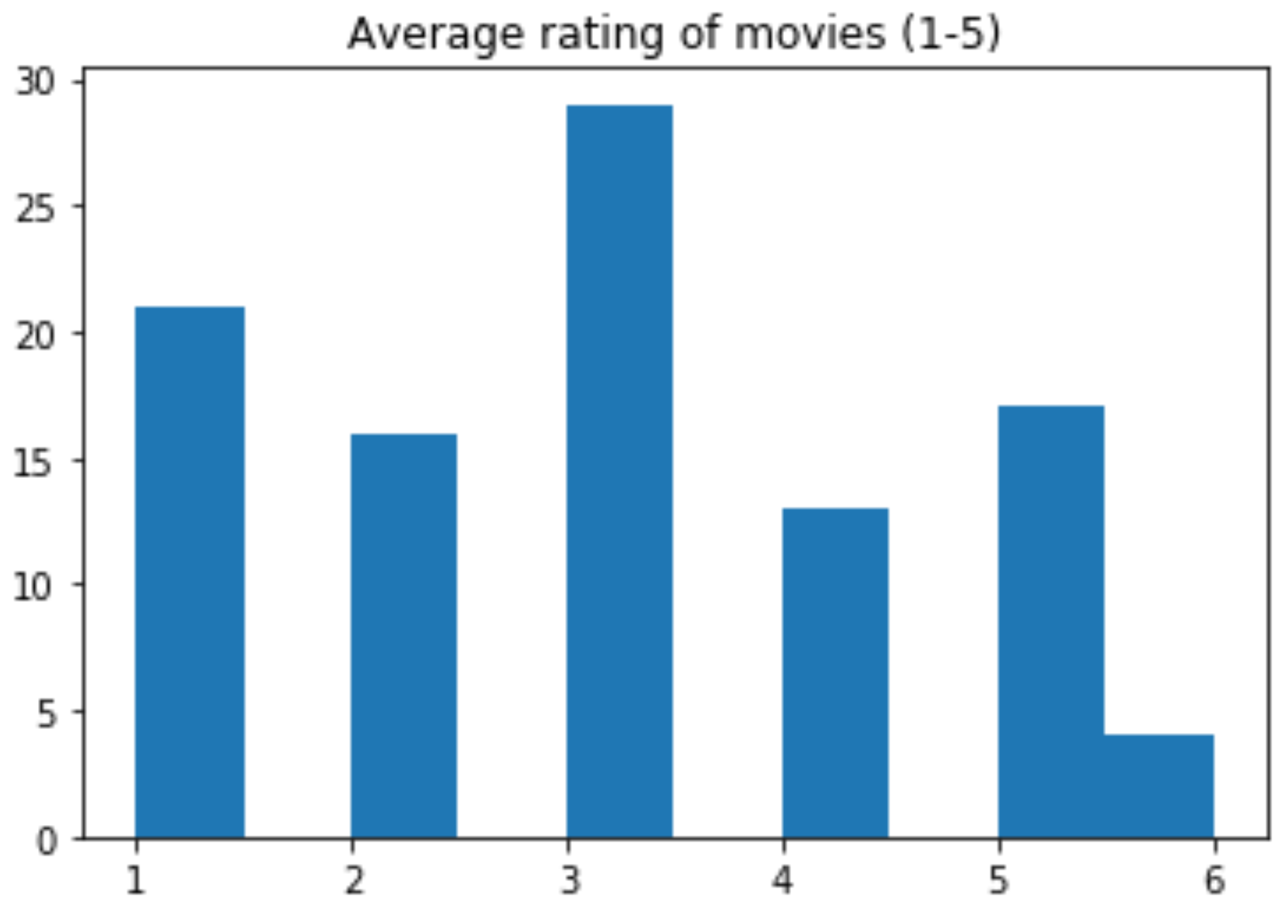
Motivation

```
movies.head()
```

```
     movie_name     avg_rating
0    The Godfather           5
1    Frozen 2                3
2    Shrek                   4
...
```

Motivation

```python
import matplotlib.pyplot as plt
plt.hist(movies['avg_rating'])
plt.title('Average rating of movies (1-5)')
```



Motivation

Can future sign-ups exist?

```
# Import date time
import datetime as dt
today_date = dt.date.today()
user_signups[user_signups['subscription_date'] > dt.date.today()]
```

```
   subscription_date  user_name         ...            Country
0         01/05/2021      Marah         ...            Nauru
1         09/08/2020     Joshua         ...            Austria
2         04/01/2020      Heidi         ...            Guinea
3         11/10/2020       Rina         ...            Turkmenistan
4         11/07/2020  Christine         ...            Marshall Islands
5         07/07/2020     Ayanna         ...            Gabon
```

How to deal with out of range data?

- Dropping data
- Setting custom minimums and maximums
- Treat as missing and impute
- Setting custom value depending on business assumptions

Movie example

```
import pandas as pd
# Output Movies with rating > 5
movies[movies['avg_rating'] > 5]
```

```
         movie_name  avg_rating
23  A Beautiful Mind           6
65   La Vita e Bella           6
77            Amelie           6
```

```
# Drop values using filtering
movies = movies[movies['avg_rating'] <= 5]
# Drop values using .drop()
movies.drop(movies[movies['avg_rating'] > 5].index, inplace = True)
# Assert results
assert movies['avg_rating'].max() <= 5
```

Movie example

```
# Convert avg_rating > 5 to 5
movies.loc[movies['avg_rating'] > 5, 'avg_rating'] = 5
```

```
# Assert statement
assert movies['avg_rating'].max() <= 5
```

Remember, no output means it passed

Date range example

```
import datetime as dt
import pandas as pd
# Output data types
user_signups.dtypes
```

```
subscription_date    object
user_name            object
Country              object
dtype: object
```

```
# Convert to DateTime
user_signups['subscription_date'] = pd.to_datetime(user_signups['subscription_date'])
```

```
# Assert that conversion happened
assert user_signups['subscription_date'].dtype == 'datetime64[ns]'
```

Date range example

```
today_date = dt.date.today()
```

Drop the data

```
# Drop values using filtering
user_signups = user_signups[user_signups['subscription_date'] < today_date]
# Drop values using .drop()
user_signups.drop(user_signups[user_signups['subscription_date'] > today_date].index, inplace = True)
```

Hardcode dates with upper limit

```
# Drop values using filtering
user_signups.loc[user_signups['subscription_date'] > today_date, 'subscription_date'] = today_date
# Assert is true
assert user_signups.subscription_date.max().date() <= today_date
```

Let's practice!

CLEANING DATA IN PYTHON

What are duplicate values?

All columns have the same values

first_name	last_name	address	height	weight
Justin	Saddlemyer	Boulevard du Jardin Botanique 3, Bruxelles	193 cm	87 kg
Justin	Saddlemyer	Boulevard du Jardin Botanique 3, Bruxelles	193 cm	87 kg

What are duplicate values?

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first_name	last_name	address	height	weight
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Justin	Saddlemyer	Boulevard du Jardin Botanique 3, Bruxelles	***194 cm***	87 kg

Why do they happen?

Data Entry &
Human Error

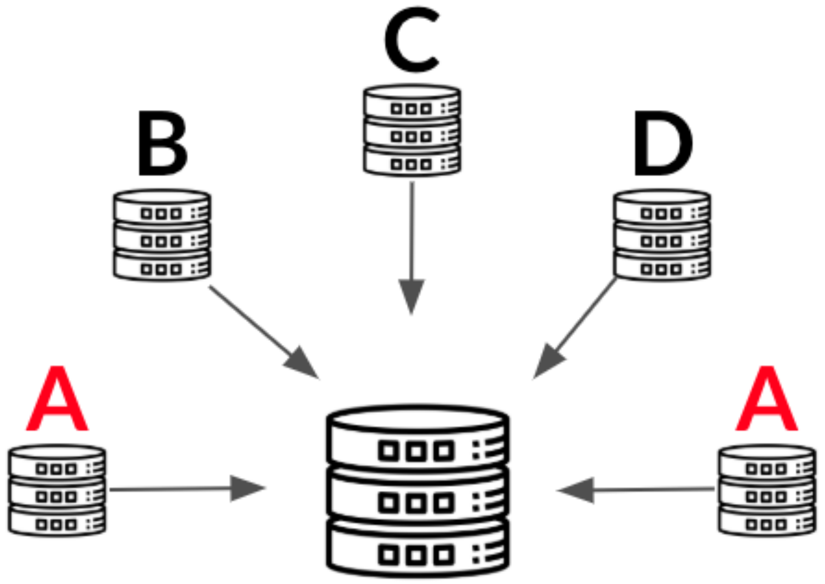
Why do they happen?

Data Entry & Human Error

Bugs and design errors

Why do they happen?

Data Entry & Human Error



Join or merge Errors

Bugs and design errors

How to find duplicate values?

```python
# Print the header
height_weight.head()
```

```
  first_name last_name                         address  height  weight
0       Lane     Reese              534-1559 Nam St.     181      64
1       Ivor    Pierce             102-3364 Non Road     168      66
2      Roary    Gibson   P.O. Box 344, 7785 Nisi Ave     191      99
3    Shannon    Little  691-2550 Consectetuer Street     185      65
4      Abdul       Fry                4565 Risus St.     169      65
```

How to find duplicate values?

```
# Get duplicates across all columns
duplicates = height_weight.duplicated()
print(duplicates)
```

```
1       False
...     ....
22      True
23      False
...     ...
```

How to find duplicate values?

```python
# Get duplicate rows
duplicates = height_weight.duplicated()
height_weight[duplicates]
```

```
    first_name last_name                               address  height  weight
100       Mary     Colon                           4674 Ut Rd.     179      75
101       Ivor    Pierce                     102-3364 Non Road     168      88
102       Cole    Palmer                       8366 At, Street     178      91
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
```

How to find duplicate rows?

The `.duplicated()` method

`subset` : List of column names to check for duplication.

`keep` : Whether to keep **first** (`'first'`), **last** (`'last'`) or **all** (`False`) duplicate values.

```python
# Column names to check for duplication
column_names = ['first_name','last_name','address']
duplicates = height_weight.duplicated(subset = column_names, keep = False)
```

How to find duplicate rows?

```
# Output duplicate values
height_weight[duplicates]
```

```
    first_name last_name                               address  height  weight
1         Ivor    Pierce                     102-3364 Non Road     168      66
22        Cole    Palmer                       8366 At, Street     178      91
28     Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     195      83
37        Mary     Colon                           4674 Ut Rd.     179      75
100       Mary     Colon                           4674 Ut Rd.     179      75
101       Ivor    Pierce                     102-3364 Non Road     168      88
102       Cole    Palmer                       8366 At, Street     178      91
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
```

How to find duplicate rows?

```python
# Output duplicate values
height_weight[duplicates].sort_values(by = 'first_name')
```

```
    first_name last_name                               address  height  weight
22        Cole    Palmer                       8366 At, Street     178      91
102       Cole    Palmer                       8366 At, Street     178      91
28     Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     195      83
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
1         Ivor    Pierce                     102-3364 Non Road     168      66
101       Ivor    Pierce                     102-3364 Non Road     168      88
37        Mary     Colon                           4674 Ut Rd.     179      75
100       Mary     Colon                           4674 Ut Rd.     179      75
```

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# Output duplicate values
height_weight[duplicates].sort_values(by = 'first_name')
```

```
    first_name last_name                                 address  height  weight
22        Cole    Palmer                         8366 At, Street     178      91
102       Cole    Palmer                         8366 At, Street     178      91
28     Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     195      83
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
1         Ivor    Pierce                      102-3364 Non Road     168      66
101       Ivor    Pierce                      102-3364 Non Road     168      88
37        Mary     Colon                            4674 Ut Rd.     179      75
100       Mary     Colon                            4674 Ut Rd.     179      75
```

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```python
# Output duplicate values
height_weight[duplicates].sort_values(by = 'first_name')
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```
    first_name last_name                               address  height  weight
22        Cole    Palmer                       8366 At, Street     178      91
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101       Ivor    Pierce                    102-3364 Non Road     168      88
37        Mary     Colon                         4674 Ut Rd.     179      75
100       Mary     Colon                         4674 Ut Rd.     179      75
```

How to treat duplicate values?

```python
# Output duplicate values
height_weight[duplicates].sort_values(by = 'first_name')
```

```
    first_name last_name                              address  height  weight
22        Cole    Palmer                      8366 At, Street     178      91
102       Cole    Palmer                      8366 At, Street     178      91
28     Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     195      83
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
1         Ivor    Pierce                     102-3364 Non Road     168      66
101       Ivor    Pierce                     102-3364 Non Road     168      88
37        Mary     Colon                         4674 Ut Rd.     179      75
100       Mary     Colon                         4674 Ut Rd.     179      75
```

How to treat duplicate values?

The `.drop_duplicates()` method

`subset` : List of column names to check for duplication.

`keep` : Whether to keep **first** (`'first'`), **last** (`'last'`) or **all** (`False`) duplicate values.

`inplace` : Drop duplicated rows directly inside DataFrame without creating new object (`True`).

```
# Drop duplicates
height_weight.drop_duplicates(inplace = True)
```

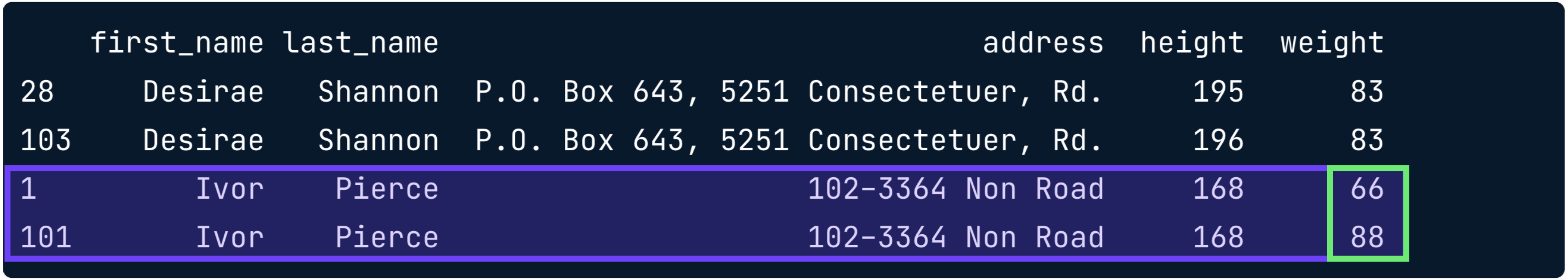
How to treat duplicate values?

```python
# Output duplicate values
column_names = ['first_name','last_name','address']
duplicates = height_weight.duplicated(subset = column_names, keep = False)
height_weight[duplicates].sort_values(by = 'first_name')
```

```
    first_name last_name                                 address  height  weight
28     Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     195      83
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
1         Ivor    Pierce                     102-3364 Non Road     168      66
101       Ivor    Pierce                     102-3364 Non Road     168      88
```

How to treat duplicate values?

```
# Output duplicate values
column_names = ['first_name','last_name','address']
duplicates = height_weight.duplicated(subset = column_names, keep = False)
height_weight[duplicates].sort_values(by = 'first_name')
```



```
    first_name last_name                                address  height  weight
28     Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     195      83
103    Desirae   Shannon  P.O. Box 643, 5251 Consectetuer, Rd.     196      83
1         Ivor    Pierce                     102-3364 Non Road     168      66
101       Ivor    Pierce                     102-3364 Non Road     168      88
```

How to treat duplicate values?

The `.groupby()` and `.agg()` methods

```python
# Group by column names and produce statistical summaries
column_names = ['first_name','last_name','address']
summaries = {'height': 'max', 'weight': 'mean'}
height_weight = height_weight.groupby(by = column_names).agg(summaries).reset_index()
# Make sure aggregation is done
duplicates = height_weight.duplicated(subset = column_names, keep = False)
height_weight[duplicates].sort_values(by = 'first_name')
```

```
first_name    last_name    address    height    weight
```

Let's practice!

CLEANING DATA IN PYTHON