

Welcome to the course!

INTRODUCTION TO IMPORTING DATA IN PYTHON



Hugo Bowne-Anderson
Data Scientist at DataCamp

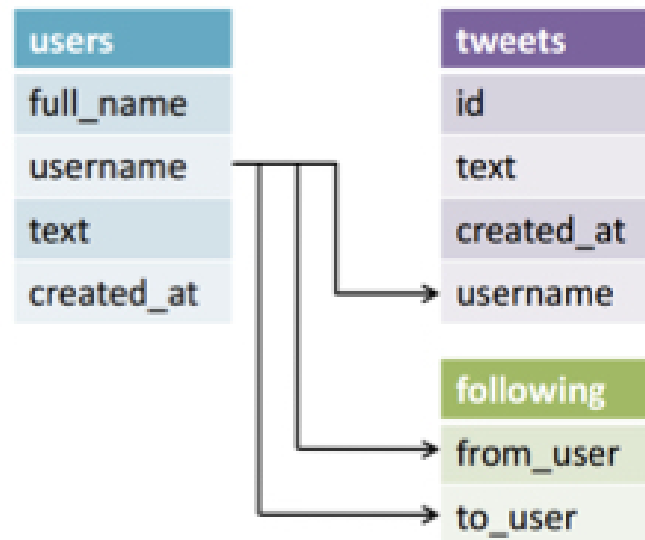
Import data

- Flat files, e.g. .txts, .csvs
- Files from other software

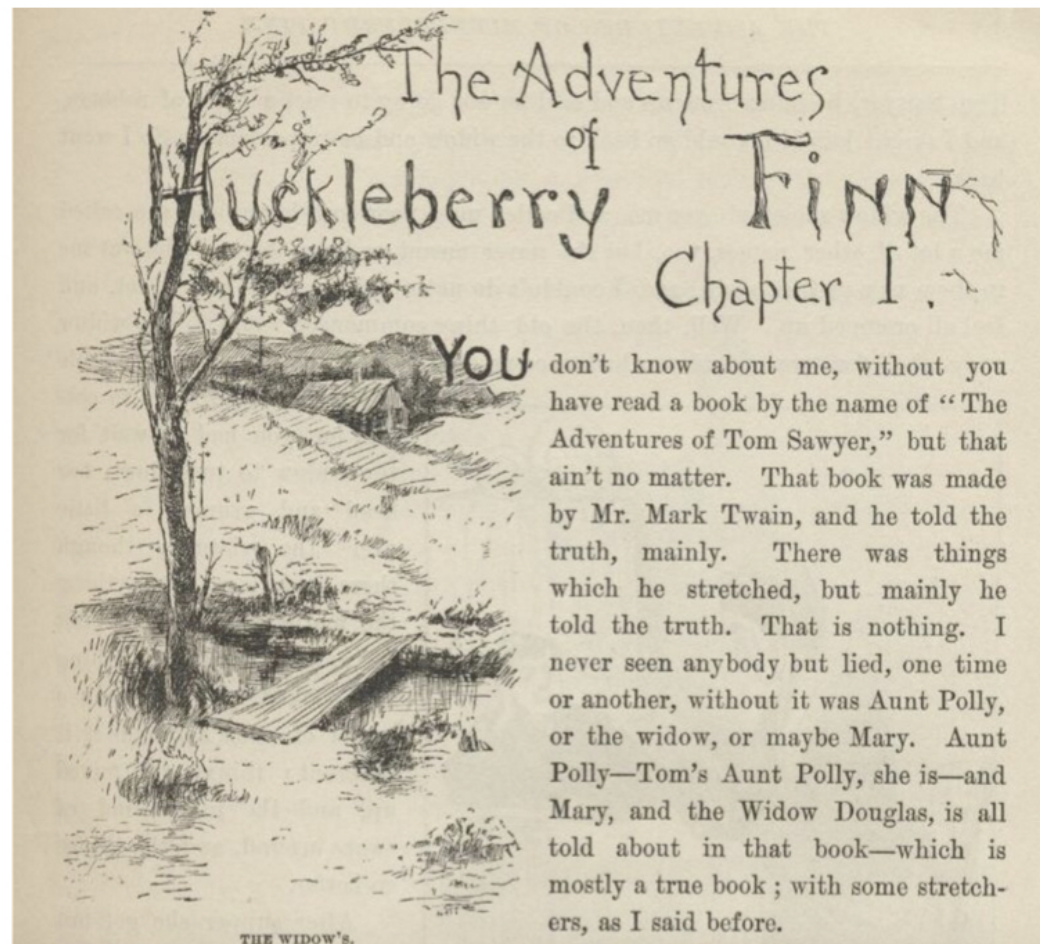


Import data

- Flat files, e.g. .txts, .csvs
- Files from other software
- Relational databases



Plain text files



Source: Project Gutenberg

Table data

titanic.csv

Name	Sex	Cabin	Survived
Braund, Mr. Owen Harris	male	NaN	0
Cumings, Mrs. John Bradley	female	C85	1
Heikkinen, Miss. Laina	female	NaN	1
Futrelle, Mrs. Jacques Heath	female	C123	1
Allen, Mr. William Henry	male	NaN	0

¹ Source: Kaggle

Table data

titanic.csv

Name	Sex	Cabin	Survived
Braund, Mr. Owen Harris	male	NaN	0
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Futrelle, Mrs. Jacques Heath	female	C123	1
Allen, Mr. William Henry	male	NaN	0

^column

- Flat file

Reading a text file

```
filename = 'huck_finn.txt'  
file = open(filename, mode='r') # 'r' is to read  
text = file.read()  
file.close()
```


Printing a text file

```
print(text)
```

```
YOU don't know about me without you have read a book by  
the name of The Adventures of Tom Sawyer; but that  
ain't no matter. That book was made by Mr. Mark Twain,  
and he told the truth, mainly. There was things which  
he stretched, but mainly he told the truth. That is  
nothing. never seen anybody but lied one time or  
another, without it was Aunt Polly, or the widow, or  
maybe Mary. Aunt Polly--Tom's Aunt Polly, she is--and  
Mary, and the Widow Douglas is all told about in that  
book, which is mostly a true book, with some  
stretchers, as I said before.
```

Writing to a file

```
filename = 'huck_finn.txt'  
file = open(filename, mode='w') # 'w' is to write  
file.close()
```

Context manager with

```
with open('huck_finn.txt', 'r') as file:  
    print(file.read())
```

YOU don't know about me without you have read a book by the name of The Adventures of Tom Sawyer; but that ain't no matter. That book was made by Mr. Mark Twain, and he told the truth, mainly. There was things which he stretched, but mainly he told the truth. That is nothing. never seen anybody but lied one time or another, without it was Aunt Polly, or the widow, or maybe Mary. Aunt Polly--Tom's Aunt Polly, she is--and Mary, and the Widow Douglas is all told about in that book, which is mostly a true book, with some stretchers, as I said before.

In the exercises, you'll:

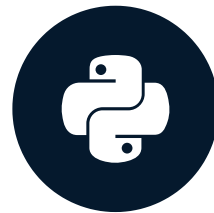
- Print files to the console
- Print specific lines
- Discuss flat files

Let's practice!

INTRODUCTION TO IMPORTING DATA IN PYTHON

The importance of flat files in data science

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Flat files

titanic.csv

```
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```

Flat files

titanic.csv

```
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked  
  
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S  
  
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C  
  
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```



	Name	Sex	Cabin	Survived
	Braund, Mr. Owen Harris	male	NaN	0
	Cumings, Mrs. John Bradley	female	C85	1
	Heikkinen, Miss. Laina	female	NaN	1
	Futrelle, Mrs. Jacques Heath	female	C123	1
	Allson, Mrs. William Henry	female	NaN	0

Flat files

titanic.csv

```
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
-----
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S      <-- row
-----
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```



Name	Sex	Cabin	Survived
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Heikkinen, Miss. Laina	female	NaN	1
Futrelle, Mrs. Jacques Heath	female	C123	1
Allen, Mr. William Henry	male	NaN	0

Flat files

titanic.csv

```
column
PassengerId,Survived,Pclass, | Name | ,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```



Name	Sex	Cabin	Survived
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Cumings, Mrs. John Bradley	female	C85	1
Heikkinen, Miss. Laina	female	NaN	1
Futrelle, Mrs. Jacques Heath	female	C123	1
Allen, Mr. William Henry	male	NaN	0

Flat files

- Text files containing records
- That is, table data
- Record: row of fields or attributes

titanic.csv

```
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```

Flat files

- Text files containing records
- That is, table data
- Record: row of fields or attributes
- Column: feature or attribute

`titanic.csv`

```
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
-----
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S      <-- row
-----
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```

Flat files

- Text files containing records
- That is, table data
- Record: row of fields or attributes
- Column: feature or attribute

`titanic.csv`

```
column
PassengerId,Survived,Pclass, | Name | ,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```

Header

titanic.csv

```
-----  
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked  
-----  
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S  
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C  
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```

Header

titanic.csv

```
-----  
PassengerId,Survived,Pclass,Name,Gender,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked  
-----  
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S  
2,1,1,"Cumings, Mrs. John Bradley",female,38,1,0,PC 17599,71.2833,C85,C  
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2.3101282,7.925,,S
```

File extension

- .csv - Comma separated values
- .txt - Text file
- commas, tabs - Delimiters

Tab-delimited file

MNIST.txt

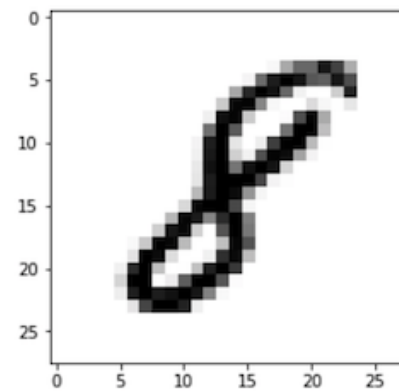
pixel149	pixel150	pixel151	pixel152	pixel153
0	0	0	0	0
86	250	254	254	254
0	0	0	9	254
0	0	0	0	0
103	253	253	253	253
0	0	0	0	0
0	0	0	0	0
0	0	0	0	41
253	253	253	253	253

Tab-delimited file

MNIST.txt

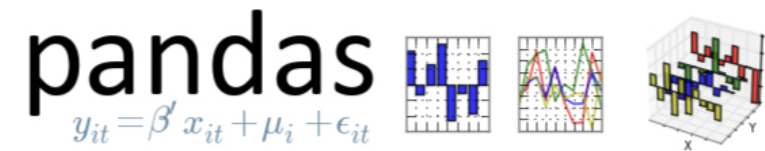
```
pixel149    pixel150    pixel151    pixel152    pixel153
0           0           0           0           0
86          250          254          254          254
0           0           0           9           254
0           0           0           0           0
103         253         253         253         253
0           0           0           0           0
0           0           0           0           0
0           0           0           0           41
253         253         253         253         253
```

MNIST image:



How do you import flat files?

- Two main packages: NumPy, pandas



- Here, you'll learn to import:
 - Flat files with numerical data (MNIST)
 - Flat files with numerical data and strings (titanic.csv)

Let's practice!

INTRODUCTION TO IMPORTING DATA IN PYTHON

Importing flat files using NumPy

INTRODUCTION TO IMPORTING DATA IN PYTHON



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Data Scientist at DataCamp

Why NumPy?

- NumPy arrays: standard for storing numerical data



Why NumPy?

- NumPy arrays: standard for storing numerical data
- Essential for other packages: e.g. scikit-learn



- `loadtxt()`
- `genfromtxt()`

Importing flat files using NumPy

```
import numpy as np
filename = 'MNIST.txt'
data = np.loadtxt(filename, delimiter=',')
data
```

```
[[ 0.  0.  0.  0.  0.]
 [ 86. 250. 254. 254. 254.]
 [ 0.  0.  0.  9. 254.]
 ...,
 [ 0.  0.  0.  0.  0.]
 [ 0.  0.  0.  0.  0.]
 [ 0.  0.  0.  0.  0.]
```


Customizing your NumPy import

```
import numpy as np
filename = 'MNIST_header.txt'
data = np.loadtxt(filename, delimiter=',', skiprows=1)
print(data)
```

```
[[ 0.  0.  0.  0.  0.]
 [ 86. 250. 254. 254. 254.]
 [ 0.  0.  0.  9. 254.]
 ...,
 [ 0.  0.  0.  0.  0.]
 [ 0.  0.  0.  0.  0.]
 [ 0.  0.  0.  0.  0.]
```

Customizing your NumPy import

```
import numpy as np
filename = 'MNIST_header.txt'
data = np.loadtxt(filename, delimiter=',', skiprows=1, usecols=[0, 2])
print(data)
```

```
[[ 0.  0.]
 [86. 254.]
 [ 0.  0.]
 ...,
 [ 0.  0.]
 [ 0.  0.]
 [ 0.  0.]
```

Customizing your NumPy import

```
data = np.loadtxt(filename, delimiter=',', dtype=str)
```

Mixed datatypes

titanic.csv

Name	Sex	Cabin	Fare
Braund, Mr. Owen Harris	male	NaN	7.3
Cumings, Mrs. John Bradley	female	C85	71.3
Heikkinen, Miss. Laina	female	NaN	8.0
Futrelle, Mrs. Jacques Heath	female	C123	53.1
Allen, Mr. William Henry	male	NaN	8.05

¹ Source: Kaggle

Mixed datatypes

titanic.csv

Name	Sex	Cabin	Fare
Braund, Mr. Owen Harris	male	NaN	7.3
Cumings, Mrs. John Bradley	female	C85	71.3
Heikkinen, Miss. Laina	female	NaN	8.0
Futrelle, Mrs. Jacques Heath	female	C123	53.1
Allen, Mr. William Henry	male	NaN	8.05

^ ^

strings floats

¹ Source: Kaggle

Let's practice!

INTRODUCTION TO IMPORTING DATA IN PYTHON

Importing flat files using pandas

INTRODUCTION TO IMPORTING DATA IN PYTHON

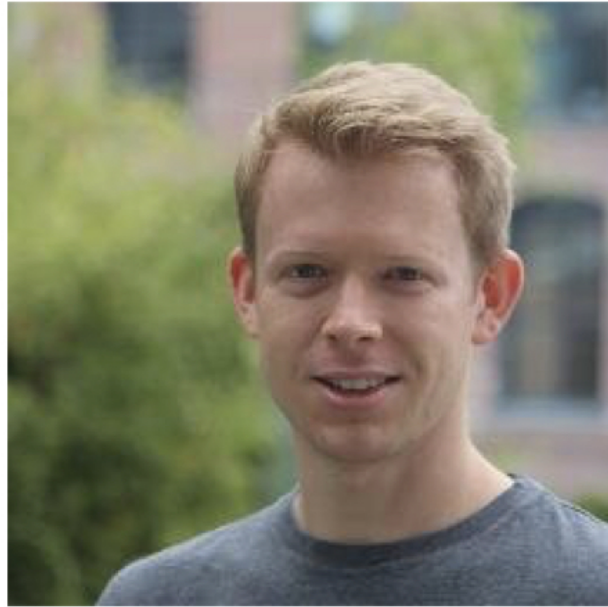


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What a data scientist needs

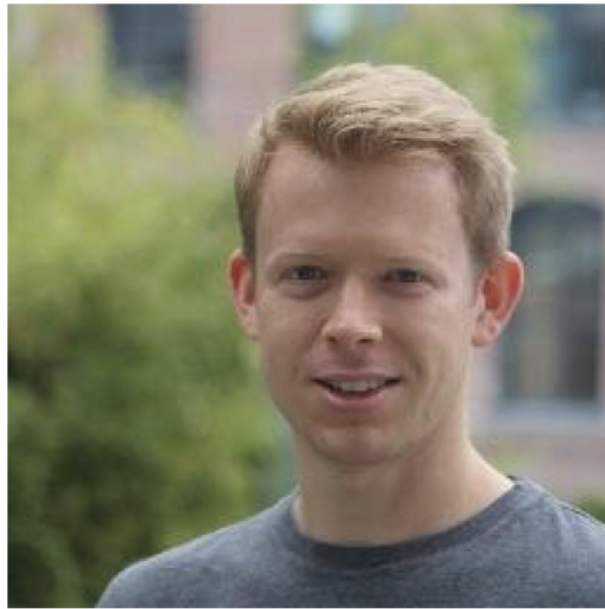
- Two-dimensional labeled data structure(s)
- Columns of potentially different types
- Manipulate, slice, reshape, groupby, join, merge
- Perform statistics
- Work with time series data

Pandas and the DataFrame



Wes McKinney

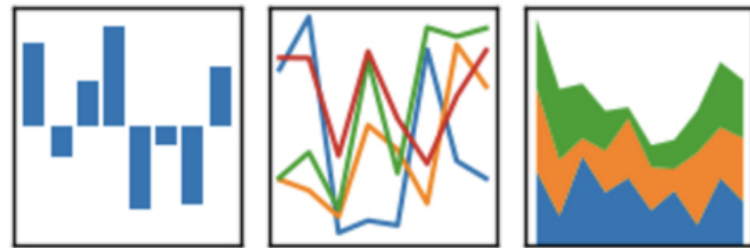
Pandas and the DataFrame



Wes McKinney

pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$




Pandas and the DataFrame

What problem does *pandas* solve?


Python has long been great for data munging and preparation, but less so for data analysis and modeling. *pandas* helps fill this gap, enabling you to carry out your entire data analysis workflow in Python without having to switch to a more domain specific language like R.

- DataFrame = pythonic analog of R's data frame

Pandas and the DataFrame




Hadley Wickham
@hadleywickham



Following

A matrix has rows and columns. A data frame has observations and variables. [#rstats](#) [#tidydata](#)

RETWEETS	LIKES	
128	233	

Manipulating pandas DataFrames

- Exploratory data analysis
- Data wrangling
- Data preprocessing
- Building models
- Visualization
- Standard and best practice to use pandas

Importing using pandas

```
import pandas as pd
filename = 'winequality-red.csv'
data = pd.read_csv(filename)
data.head()
```

	volatile acidity	citric acid	residual sugar
0	0.70	0.00	1.9
1	0.88	0.00	2.6
2	0.76	0.04	2.3
3	0.28	0.56	1.9
4	0.70	0.00	1.9

```
data_array = data.values
```

You'll experience:

- Importing flat files in a straightforward manner
- Importing flat files with issues such as comments and missing values

Let's practice!

INTRODUCTION TO IMPORTING DATA IN PYTHON

Final thoughts on data import

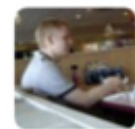
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Next chapters:

- Import other file types:
 - Excel, SAS, Stata
- Feather



Wes McKinney
@wesmckinn



Following

Announcing Feather: A fast, language-agnostic data frame file format, by [@hadleywickham](#) and [@wesmckinn](#)

- Interact with relational databases

Next course:

- Scrape data from the web
- Interact with APIs

Let's practice!

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