Welcome to the course!

1. Importing entire text files

In this exercise, you'll be working with the file `moby_dick.txt` . It is a text file that contains the opening sentences of Moby Dick, one of the great American novels! Here you'll get experience opening a text file, printing its contents to the shell and, finally, closing it.

Instructions

- Open the file `moby_dick.txt` as read-only and store it in the variable file. Make sure to pass the filename enclosed in quotation marks `''` .
- Print the contents of the file to the shell using the `print()` function. As Hugo showed in the video, you'll need to apply the method `read()` to the object `file` .
- Check whether the file is closed by executing `print(file.closed)` .
- Close the file using the `close()` method.
- Check again that the file is closed as you did above.

In [1]:

```python
# Open a file: file
file = open('moby_dick.txt','r')

# Print it
print(file.read())
print()
# Check whether file is closed
print(file.closed)

# Close file
file.close()

# Check whether file is closed

print(file.closed)
```

```
CHAPTER 1. Loomings.

Call me Ishmael. Some years ago--never mind how long precisely--having
little or no money in my purse, and nothing particular to interest me on
shore, I thought I would sail about a little and see the watery part of
the world. It is a way I have of driving off the spleen and regulating
the circulation. Whenever I find myself growing grim about the mouth;
whenever it is a damp, drizzly November in my soul; whenever I find
myself involuntarily pausing before coffin warehouses, and bringing up
the rear of every funeral I meet; and especially whenever my hypos get
such an upper hand of me, that it requires a strong moral principle to
prevent me from deliberately stepping into the street, and methodically
knocking people's hats off--then, I account it high time to get to sea
as soon as I can. This is my substitute for pistol and ball. With a
philosophical flourish Cato throws himself upon his sword; I quietly
take to the ship. There is nothing surprising in this. If they but knew
it, almost all men in their degree, some time or other, cherish very
nearly the same feelings towards the ocean with me.

False
True
```

1.1 Importing text files line by line

For large files, we may not want to print all of their content to the shell: you may wish to print only the first few lines. Enter the `readline()` method, which allows you to do this. When a file called `file` is open, you can print out the first line by executing `file.readline()` . If you execute the same command again, the second line will print, and so on.

Instructions

- Open `moby_dick.txt` using the `with` context manager and the variable `file` .
- Print the first three lines of the file to the shell by using `readline()` three times within the context manager

In [2]:

```python
# Read & print the first 3 lines
with open('moby_dick.txt') as file:
    print(file.readline())
    print(file.readline())
    print(file.readline())
```

```
CHAPTER 1. Loomings.



Call me Ishmael. Some years ago--never mind how long precisely--having


```

Type *Markdown* and LaTeX: α^2

2. The importance of flat files in data science

2.1 Pop quiz: examples of flat files

You're now well-versed in importing text files and you're about to become a wiz at importing flat files. But can you remember exactly what a flat file is? Test your knowledge by answering the following question: which of these file types below is NOT an example of a flat file?

Answer the question

1. A .csv file.
2. A tab-delimited .txt.
3. A relational database (e.g. PostgreSQL).

Answer: 3

2.2 Pop quiz: what exactly are flat files?

Which of the following statements about flat files is incorrect?

Answer the question

1. Flat files consist of rows and each row is called a record.
2. Flat files consist of multiple tables with structured relationships between the tables.
3. A record in a flat file is composed of fields or attributes, each of which contains at most one item of information.
4. Flat files are pervasive in data science.

Answer: 2

2.3 Why we like flat files and the Zen of Python

In PythonLand, there are currently hundreds of Python Enhancement Proposals, commonly referred to as PEPs. PEP8 (https://www.python.org/dev/peps/pep-0008/), for example, is a standard style guide for Python, written by our sensei Guido van Rossum himself. It is the basis for how we here at DataCamp ask our instructors to style their code (https://www.datacamp.com/teach/documentation#tab_style_guide_python). Another one of my favorites is PEP20 (https://www.python.org/dev/peps/pep-0020/), commonly called the Zen of Python. Its abstract is as follows:

> Long time Pythoneer Tim Peters succinctly channels the BDFL's guiding principles for Python's design into 20 aphorisms, only 19 of which have been written down.

If you don't know what the acronym `BDFL` stands for, I suggest that you look here (https://docs.python.org/3.3/glossary.html#term-bdfl). You can print the Zen of Python in your shell by typing `import this` into it! You're going to do this now and the 5th aphorism (line) will say something of particular interest.

The question you need to answer is: **what is the 5th aphorism of the Zen of Python?**

Possible Answers

1. Flat is better than nested.
2. Flat files are essential for data science.
3. The world is representable as a flat file.
4. Flatness is in the eye of the beholder.

Answer: 1

3 Importing flat files using NumPy

3.1 Using NumPy to import flat files

In this exercise, you're now going to load the MNIST digit recognition dataset using the numpy function `loadtxt()` and see just how easy it can be:

```
- The first argument will be the filename.
- The second will be the delimiter which, in this case, is a comma.
```

You can find more information about the MNIST dataset here (http://yann.lecun.com/exdb/mnist/) on the webpage of Yann LeCun, who is currently Director of AI Research at Facebook and Founding Director of the NYU Center for Data Science, among many other things.

Instructions

- Fill in the arguments of `np.loadtxt()` by passing file and a comma `','` for the delimiter.
- Fill in the argument of `print()` to print the type of the object `digits`. Use the function `type()`.
- Execute the rest of the code to visualize one of the rows of the data.

In [3]:

```python
# Import package
import numpy as np
import matplotlib.pyplot as plt

# Assign filename to variable: file
file = 'digits.csv'
# Load file as array: digits
digits = np.loadtxt(file, delimiter=',')

# Print datatype of digits
print(type(digits))

# Select and reshape a row
im = digits[21, 1:]
im_sq = np.reshape(im, (28, 28))

# Plot reshaped data (matplotlib.pyplot already loaded as plt)
plt.imshow(im_sq, cmap='Greys', interpolation='nearest')
plt.show()
```

```
<class 'numpy.ndarray'>

<Figure size 640x480 with 1 Axes>
```

3.2 Customizing your NumPy import

What if there are rows, such as a header, that you don't want to import? What if your file has a delimiter other than a comma? What if you only wish to import particular columns?

There are a number of arguments that `np.loadtxt()` takes that you'll find useful: delimiter changes the delimiter that `loadtxt()` is expecting, for example, you can use `','` and `'\t'` for comma-delimited and tab-delimited respectively; `skiprows` allows you to specify how many rows (not indices) you wish to skip; `usecols` takes a list of the indices of the columns you wish to keep.

The file that you'll be importing, `digits_header.txt` ,

- has a header
- is tab-delimited.

Instructions

- Complete the arguments of `np.loadtxt()` : the file you're importing is tab-delimited, you want to skip the first row and you only want to import the first and third columns.
- Complete the argument of the `print()` call in order to print the entire array that you just imported.

In [4]:

```
# Import numpy
import numpy as np

# Assign the filename: file
file = 'digits_header.txt'

# Load the data: data
data = np.loadtxt(file, delimiter="\t",skiprows=1,usecols=[0,2])

# Print data
print(data)
```

```
[[0. 0.]
 [1. 0.]
 [4. 0.]
 [0. 0.]
 [0. 0.]
 [7. 0.]
 [3. 0.]
 [5. 0.]
 [3. 0.]
 [8. 0.]
 [9. 0.]
 [1. 0.]
 [3. 0.]
 [3. 0.]
 [1. 0.]
 [2. 0.]
 [0. 0.]
 [7. 0.]
 [5. 0.]
 [8. 0.]
 [6. 0.]
 [2. 0.]
 [0. 0.]
 [2. 0.]
 [3. 0.]
 [6. 0.]
 [9. 0.]
 [9. 0.]
 [7. 0.]
 [8. 0.]
 [9. 0.]
 [4. 0.]
 [9. 0.]
 [2. 0.]
 [1. 0.]
 [3. 0.]
 [1. 0.]
 [1. 0.]
 [4. 0.]
 [9. 0.]
 [1. 0.]
 [4. 0.]
 [4. 0.]
 [2. 0.]
 [6. 0.]
 [3. 0.]
 [7. 0.]
 [7. 0.]
 [4. 0.]
 [7. 0.]
 [5. 0.]
 [1. 0.]
 [9. 0.]
 [0. 0.]
 [2. 0.]
 [2. 0.]
 [3. 0.]
 [9. 0.]
 [1. 0.]
 [1. 0.]
 [1. 0.]
 [5. 0.]
 [0. 0.]
 [6. 0.]
 [3. 0.]
 [4. 0.]
 [8. 0.]
 [1. 0.]
 [0. 0.]
 [3. 0.]
 [9. 0.]
 [6. 0.]
 [2. 0.]
 [6. 0.]
 [4. 0.]
 [7. 0.]
 [1. 0.]
 [4. 0.]
 [1. 0.]
 [5. 0.]
 [4. 0.]
 [8. 0.]
 [9. 0.]
 [2. 0.]
 [9. 0.]
 [9. 0.]
 [8. 0.]
 [9. 0.]
 [6. 0.]
 [3. 0.]
 [6. 0.]
 [4. 0.]
 [6. 0.]
 [2. 0.]
 [9. 0.]
 [1. 0.]
 [2. 0.]
 [0. 0.]
 [5. 0.]]
```

3.3 Importing different datatypes

The file `seaslug.txt`

- has a text header, consisting of strings

- is tab-delimited.

These data consists of percentage of sea slug larvae that had metamorphosed in a given time period. Read more here.

Due to the header, if you tried to import it as-is using `np.loadtxt()` , Python would throw you a `ValueError` and tell you that it could not convert string to float. There are two ways to deal with this: firstly, you can set the data type argument `dtype` equal to `str` (for string).

Alternatively, you can skip the first row as we have seen before, using the `skiprows` argument.

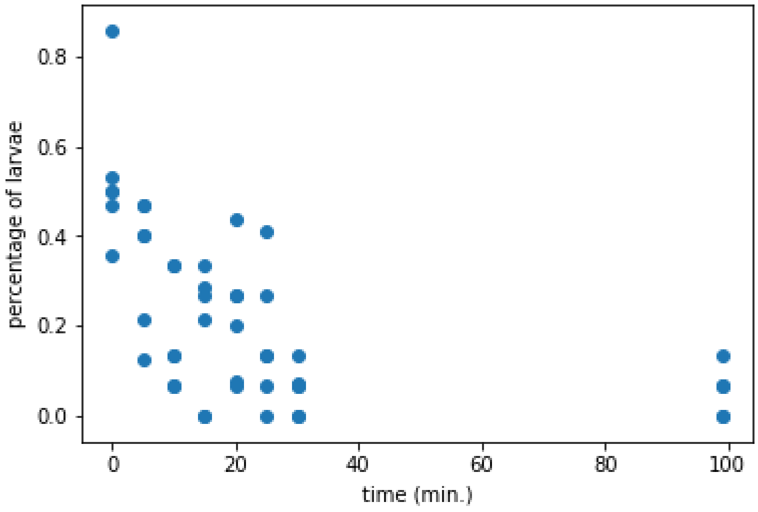
Instructions

- Complete the first call to `np.loadtxt()` by passing file as the first argument.
- Execute `print(data[0])` to print the first element of data.
- Complete the second call to `np.loadtxt()` . The file you're importing is tab-delimited, the datatype is `float` , and you want to skip the first row.
- Print the 10th element of `data_float` by completing the `print()` command. Be guided by the previous `print()` call.
- Execute the rest of the code to visualize the data.

In [5]:

```
# Assign filename: file
file = 'seaslug.txt'

# Import file: data
data = np.loadtxt(file, delimiter='\t', dtype=str)

# Print the first element of data
print(data[0])

# Import data as floats and skip the first row: data_float
data_float = np.loadtxt(file, delimiter='\t', dtype=float, skiprows=1)

# Print the 10th element of data_float
print(data_float[9])

# Plot a scatterplot of the data
plt.scatter(data_float[:, 0], data_float[:, 1])
plt.xlabel('time (min.)')
plt.ylabel('percentage of larvae')
plt.show()
```

```
['Time' 'Percent']
[0.    0.357]
```



3.4 Working with mixed datatypes (1)

Much of the time you will need to import datasets which have different datatypes in different columns; one column may contain strings and another floats, for example. The function `np.loadtxt()` will freak at this. There is another function, `np.genfromtxt()` , which can handle such structures. If we pass `dtype=None` to it, it will figure out what types each column should be.

Import 'titanic.csv' using the function `np.genfromtxt()` as follows:

> data = np.genfromtxt('titanic.csv', delimiter=',', names=True, dtype=None)

Here, the first argument is the filename, the second specifies the delimiter `,` and the third argument `names` tells us there is a header. Because the data are of different types, `data` is an object called a structured array (http://docs.scipy.org/doc/numpy/user/basics.rec.html). Because numpy arrays have to contain elements that (http://docs.scipy.org/doc/numpy/user/basics.rec.html). Because numpy arrays have to contain elements that are all the same type, the structured array solves this by being a 1D array, where each element of the array is a row of the flat file imported. You can test this by checking out the array's shape in the shell by executing `np.shape(data)` .

Accessing rows and columns of structured arrays is super-intuitive: to get the ith row, merely execute `data[i]` and to get the column with name `'Fare'` , execute `data['Fare']` .

Print the entire column with name `Survived` to the shell. What are the last 4 values of this column?

Possible Answers

1. 1,0,0,1.
2. 1,2,0,0.
3. 1,0,1,0.
4. 0,1,1,1.

Answer 3

In [6]:

```
# above question proof

data = np.genfromtxt('titanic.csv', delimiter=',', names=True, dtype=None)
data['Survived'][-4:]

```

```
C:\Users\Jesus\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: VisibleD
eprecationWarning: Reading unicode strings without specifying the encoding a
rgument is deprecated. Set the encoding, use None for the system default.
  This is separate from the ipykernel package so we can avoid doing imports
until
```

Out[6]:

```
array([1, 0, 1, 0])
```

3.5 Working with mixed datatypes (2)

You have just used `np.genfromtxt()` to import data containing mixed datatypes. There is also another function `np.recfromcsv()` that behaves similarly to `np.genfromtxt()` , except that its default `dtype` is `None` . In this exercise, you'll practice using this to achieve the same result.

Instructions

- Import `titanic.csv` using the function `np.recfromcsv()` and assign it to the variable, `d` . You'll only need to pass `file` to it because it has the defaults `delimiter=','` and names=True in addition to `dtype=None` !
- Run the remaining code to print the first three entries of the resulting array `d` .

In [7]:

```python
# Assign the filename: file
file = 'titanic.csv'

# Import file using : d
d = np.recfromcsv(file)

# Print out first three entries of d
print(d[:3])

```

```
[(1, 0, 3, b'male', 22., 1, 0, b'A/5 21171',  7.25  , b'', b'S')
 (2, 1, 1, b'female', 38., 1, 0, b'PC 17599', 71.2833, b'C85', b'C')
 (3, 1, 3, b'female', 26., 0, 0, b'STON/O2. 3101282',  7.925 , b'', b'S')]

C:\Users\Jesus\Anaconda3\lib\site-packages\numpy\lib\npyio.py:2315: VisibleD
eprecationWarning: Reading unicode strings without specifying the encoding a
rgument is deprecated. Set the encoding, use None for the system default.
  output = genfromtxt(fname, **kwargs)
```

4. Importing flat files using pandas

4.1 Using pandas to import flat files as DataFrames (1)

In the last exercise, you were able to import flat files containing columns with different datatypes as `numpy` arrays. However, the `DataFrame` object in pandas is a more appropriate structure in which to store such data and, thankfully, we can easily import files of mixed data types as DataFrames using the pandas functions `read_csv()` and `read_table()`.

Instructions

- Import the `pandas` package using the alias `pd`.
- Read `titanic.csv` into a DataFrame called `df`. The file name is already stored in the file object.
- In a `print()` call, view the head of the DataFrame.

In [8]:

```python
# Import pandas as pd

import pandas as pd
# Assign the filename: file
file = 'titanic.csv'

# Read the file into a DataFrame: df
df = pd.read_csv(file)

# View the head of the DataFrame
print(df.head())
```

```
   PassengerId  Survived  Pclass     Sex   Age  SibSp  Parch  \
0            1         0       3    male  22.0      1      0
1            2         1       1  female  38.0      1      0
2            3         1       3  female  26.0      0      0
3            4         1       1  female  35.0      1      0
4            5         0       3    male  35.0      0      0

             Ticket     Fare Cabin Embarked
0         A/5 21171   7.2500   NaN        S
1          PC 17599  71.2833   C85        C
2  STON/O2. 3101282   7.9250   NaN        S
3            113803  53.1000  C123        S
4            373450   8.0500   NaN        S
```

4.2 Using pandas to import flat files as DataFrames (2)

In the last exercise, you were able to import flat files into a `pandas` DataFrame. As a bonus, it is then straightforward to retrieve the corresponding `numpy` array using the attribute `values` . You'll now have a chance to do this using the MNIST dataset, which is available as `digits.csv` .

Instructions

- Import the first 5 rows of the file into a DataFrame using the function `pd.read_csv()` and assign the result to `data` . - You'll need to use the arguments `nrows` and `header` (there is no header in this file).
- Build a numpy array from the resulting DataFrame in data and assign to `data_array` .
- Execute `print(type(data_array))` to print the datatype of `data_array` .

In [9]:

```
# Assign the filename: file
file = 'digits.csv'

# Read the first 5 rows of the file into a DataFrame: data

data=pd.read_csv(file,nrows=5,header=None)
# Build a numpy array from the DataFrame: data_array
data_array=data.values

# Print the datatype of data_array to the shell
print(type(data_array))
```

```
<class 'numpy.ndarray'>
```

4.3 Customizing your pandas import

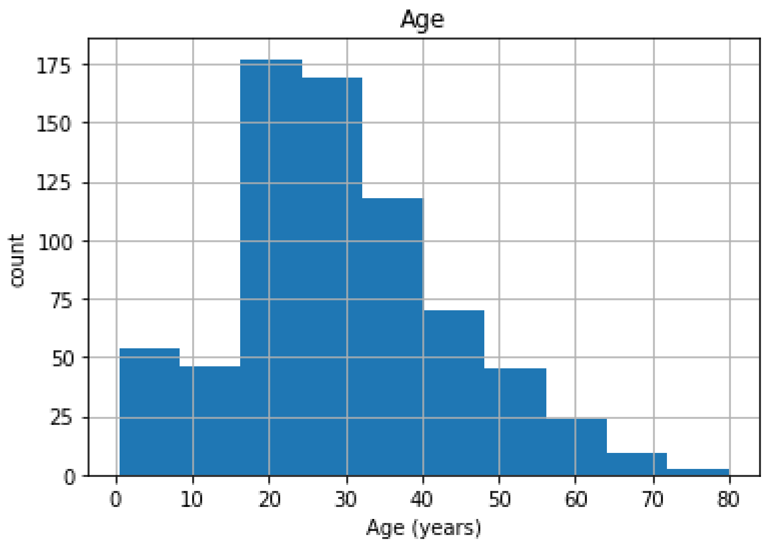
The `pandas` package is also great at dealing with many of the issues you will encounter when importing data as a data scientist, such as comments occurring in flat files, empty lines and missing values. Note that missing values are also commonly referred to as `NA` or `NaN` . To wrap up this chapter, you're now going to import a slightly corrupted copy of the Titanic dataset `titanic_corrupt.txt` , which

- contains comments after the character `'#'`
- is tab-delimited.

In [10]:

```python
# Import matplotlib.pyplot as plt
import matplotlib.pyplot as plt

# Assign filename: file
file = 'titanic_corrupt.txt'

# Import file: data
data = pd.read_csv(file, sep='\t', comment='#', na_values=['Nothing'])

# Print the head of the DataFrame
print(data.head())

# Plot 'Age' variable in a histogram
pd.DataFrame.hist(data[['Age']])
plt.xlabel('Age (years)')
plt.ylabel('count')
plt.show()
```

```
   PassengerId  Survived  Pclass     Sex   Age  SibSp  Parch             Ticke
t  \
0            1       0.0     3.0    male  22.0    1.0    0.0         A/5 2117
1
1            2       1.0     1.0  female  38.0    1.0    0.0          PC 1759
9
2            3       1.0     3.0  female  26.0    0.0    0.0  STON/O2. 310128
2
3            4       1.0     1.0  female  35.0    1.0    0.0            11380
3
4            5       0.0     3.0    male  35.0    0.0    0.0            37345
0

     Fare Cabin Embarked
0   7.250   NaN        S
1     NaN   NaN      NaN
2   7.925   NaN        S
3  53.100  C123        S
4   8.050   NaN        S
```


Age
count
Age (years)