

File I/O

October 27, 2021

Administrative Notes

- HW5: no further extensions. If you've got an extension, submit whatever you have before midnight tonight.
- Project 1 is due Friday, November 5 - 9 days from now.
 - We'll talk about it at the end of class today
 - You should be making good progress on it before next Monday
 - A reminder: project 1 is the same as the majors' sections are doing. It will be the only one of the three projects for which that's true. Projects 2 and 3 will be unique to our section

And now to File I/O

Input and Output in Python

Up until now, all input has been from the keyboard and all output has been to the screen

```
X = input("kindly hand over the data I need.")
```

- Everything comes in as a string; you have to cast it to another type if you need integers, floats, etc.

```
print ("the output is", output)
```

That has limited usefulness

It's a pain in the neck to ask the user to type in data, over and over and over...

You can't easily preserve your program results for later use, unless you do a whole bunch of screenshots

It would be far better if you could have all the data stored in a file that was saved on a computer, so it didn't have to be typed in

And it would help if you could save your output in a file that you could reference later on, or even use for further processing

Fortunately, you can!!!

File Input in Python

You can read from any file that can be found on the computer - that is in the “Python path”

- Exactly how this works varies by operating system, but there is an environment variable that can be set that tells the Python interpreter where to look for any files you reference

The easiest thing to do is just make sure that your data files are in the directory in which you're working

- Or you can specify the full path in the **open** statement

Opening a file

Before you can read from or write to a file in Python, you have to open it

There are several different open statements; we'll use

with open("filename", "mode") as f:

#rest of your code indented one tab

“

“Mode” is one of:

- “r” if you just want to read from the file
- “r+” if you want to both read from and write to the file - modify existing contents
- “w” if you want to write to the file - ERASE EXISTING CONTENTS!!
- “a” if you just want to append to the file - add new content without modifying existing content

Modes

- If you leave off the mode value, it defaults to “r” - you can read from the file but you can’t modify it
- Using “w” gives you a new, empty file!! If the file previously existed, any content that was there before will be erased.
- Using “a” does not erase existing content; it just moves the “stream pointer” to the end of the existing file and adds from there

Text mode

For our purposes, all files are just text. They consist of one or more strings and lines of characters. All read commands return strings.

There are “binary” files in Python that are different, but we’re not going to talk about them right now.

Reading from a file

with open("test_data.txt", "r") as f: File name in the current directory or in the path

data = f.read() #reads in all data from the file as a single string

data_lines = f.readlines() # reads in all data from the file

Use one of
these three

returns a list of strings - each element in the

#list is one line from the file

next_line = f.readline() #reads in one line from the file; returns it as a string

If you want to give a path name for the file:

On a Mac:

with open

("Users/alfredarsenault/PycharmProjects/Fall_2021/
next_test.py", "r") as f:

This will work fine because MacOS uses the forward slash / which is not a reserved character in Python.

On Windows:

```
with open("C:\Users\Dad\PycharmProjects\next_test.py", "r") as f:  
    s = f.read()
```

Results in:

```
C:\Users\Dad\PycharmProjects\exam_qs\venv\Scripts\python.exe C:/Users/Dad/PycharmProjects/exam_qs/new_den.py  
File "C:/Users/Dad/PycharmProjects/exam_qs/new_den.py", line 1  
    with open("C:\Users\Dad\PycharmProjects\next_test.py", "r") as f:  
        ^  
SyntaxError: (unicode error) 'unicodeescape' codec can't decode bytes in position 2-3: truncated \UXXXXXXX escape  
  
Process finished with exit code 1
```

You have to escape the backslash character

```
with open("C:\\Users\\Dad\\PycharmProjects\\next_test.py",  
"r") as f:  
    s = f.read()
```

Linux is like Mac; it uses / which doesn't have to be escaped. But make sure your code runs on glll

How it works

There is a ***file pointer*** for any open file, that points to the next character to be read or the place where the next item will be written.

When you open a file for reading, the file pointer starts at the beginning of the file.

Each time you read a line, the file pointer is advanced to the start of the next line.

When you open a file for writing, the file pointer starts at the beginning of a new file.

When you open a file for appending, the file pointer starts at the end of the current content

Reading a file - an example

```
# read in a file of integers, and print the largest integer
```

```
with open("integers.txt", "r") as f:
```

```
    #read the whole file in as a single string
```

```
    data = f.read()
```

```
    #split the string into components at
```

```
    whitespace
```

```
    numbers = data.split()
```

```
    #we have a list of strings, each of which  
    must be converted to integers
```

```
    for i in range(len(numbers)):
```

```
        numbers[i] = int(numbers[i])
```

```
#now find the largest integer. Start by
```

```
#setting the "largest" to the first value
```

```
largest = numbers[0]
```

```
#now see what's bigger
```

```
for i in range(len(numbers)):
```

```
    if numbers[i] > largest:
```

```
        largest = numbers[i]
```

```
# now print out the largest value
```

```
print("The largest integer in the file was",  
largest)
```

What if we wanted to write the result to a file?

“print” puts the output on the screen. What if we wanted it to go to a file?

The `file.write()` method will work

with `open(“results.txt”, “w”) as out:`

```
out.write(“The largest integer in the file is” + largest)
```

Next example: read from & write to the same file

Read data from a file

Manipulate the data - replace every occurrence of the word “dog” with the word “cat”

Write the modified data back out to the same file we started with

Be careful how you do this! You don't want to erase all the data in the file before you've finished reading it!!!

If we have time..

Using .csv (comma-separated value) files

Using .json (JavaScript Object Notation) files

(if no time today, we'll briefly cover these next week)