

File I/O

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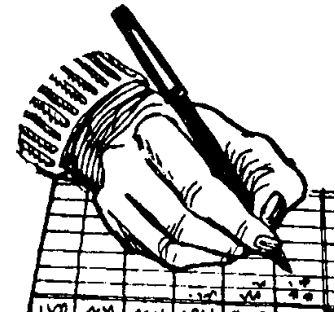
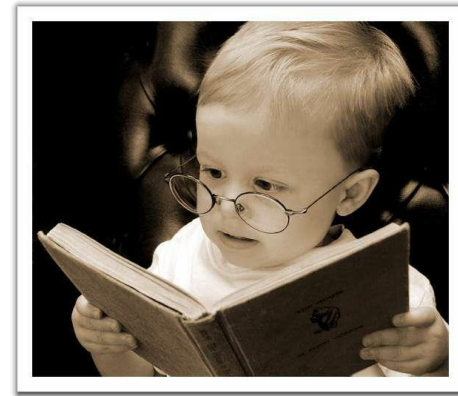
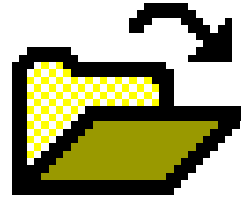
File Input and Output

- As a programmer, when would one use a file?
- As a programmer, what does one do with a file?

Files store information when a program is not running

Important operations:

- open a file
- close a file
- read data
- write data



Files and filenames

- A **file object** represents data on your disk drive
 - It is an object in your Python program that you create
 - Can read from it and write to it in your program
- A **filename** (usually a string) states where to find the data on your disk drive
 - Can be used to find/create a file
 - Examples of filenames:
 - Linux/Mac: `"/home/rea/class/160/lectures/file_io.pptx"`
 - Windows: `"C:\Users\rea\My Documents\cute_dog.jpg"`
 - Linux/Mac: `"homework3/images/Husky.png"`
 - `"Husky.png"`

Two types of filenames

An **Absolute** filename gives a specific location on disk:

- `"/home/rea/class/160/22au/lectures/file_io.pptx"`
- `"C:\Users\rea\My Documents\homework3\images\Husky.png"`
 - Starts with `"/` (Unix) or `"C:\"` (Windows)
 - Warning: code will fail to find the file if you move or rename files or run your program on a different computer

A **Relative** filename gives a location relative to the *current working directory*:

- `"lectures/file_io.pptx"`
- `"images\Husky.png"`
- `"data\test-small.fastq"`
 - Warning: code will fail to find the file unless you run your program from a directory that contains the given contents
- *A relative filename is usually a better choice*

Examples

Linux/Mac: These could all refer to the same file:

```
"/home/rea/class/160/homework3/images/Husky.png"
```

```
"homework3/images/Husky.png"
```

```
"images/Husky.png"
```

```
"Husky.png"
```

Windows: These could all refer to the same file:

```
"C:\Users\rea\My Documents\class\160\homework3\images\Husky.png"
```

```
"homework3\images\Husky.png"
```

```
"images\Husky.png"
```


```
"Husky.png"
```

Aside: “Current Working Directory” in Python

Current Working Directory - the directory from which you ran Python

To determine it from a Python program:

```
import os
print("The current working directory is", os.getcwd())
```



os stands for
“operating system”

Might print:

```
' /Users/johndoe/Documents '
```

Opening a file in python

To open a file for reading:

```
# Open takes a filename and returns a file object.  
# This fails if the file cannot be found & opened.
```

```
my_file = open("datafile.dat")
```

- Or equivalently:

```
my_file = open("datafile.dat", "r")
```

By default, file is opened for reading

To open a file for writing:

```
# Will create datafile.dat if it does not already  
# exist, if datafile.dat already exists, then it  
# will be OVERWRITTEN
```

```
my_file = open("datafile.dat", "w")
```

```
# If datafile.dat already exists, then we will  
# append what we write to the end of that file
```

```
my_file = open("datafile.dat", "a")
```


Reading a file in python

```
# Open takes a filename and returns a file object.  
# This fails if the file cannot be found & opened.  
my_file = open("datafile.dat")
```

```
# Approach 1: Process one line at a time  
for line_of_text in my_file:  
    ... process line_of_text
```

```
# Approach 2: Process entire file at once  
all_data_as_a_big_string = my_file.read()
```

```
my_file.close() # close the file when done reading
```

Assumption: file is a sequence of lines

Where does Python expect to find this file (note the relative pathname)?

Simple Reading a file Example

```
# Reads in file one line at a time and  
# prints the contents of the file.  
in_file = "student_info.txt"  
my_file = open(in_file)  
for line_of_text in my_file:  
    print(line_of_text)  
my_file.close()
```

Reading a file Example

```
# Count the number of words in a text file
in_file = "thesis.txt"
my_file = open(in_file)
num_words = 0
for line_of_text in my_file:
    word_list = line_of_text.split()
    num_words += len(word_list)
my_file.close()
print("Total words in file: ", num_words)
```

Equivalent to:
`num_words = num_words + len(word_list)`

In general, try to **avoid** reading a file more than once. Reading files is slow.

Reading a file multiple times

You can iterate over a **list** as many times as you like:

```
mylist = [ 3, 1, 4, 1, 5, 9 ]
for elt in mylist:
    ... process elt
for elt in mylist:
    ... process elt
```

Iterating over a **file** uses it up:

```
my_file = open("datafile.dat")
for line_of_text in my_file:
    ... process line_of_text
for line_of_text in my_file:
    ... process line_of_text
```

This loop body will never be executed!

How to read a **file** multiple times?

Solution 1: Read into a list, then iterate over it

```
my_file = open("datafile.dat")
my_lines = []
for line_of_text in my_file:
    my_lines.append(line_of_text)
for line_of_text in my_lines:
    ... process line_of_text
for line_of_text in my_lines:
    ... process line_of_text
```

Solution 2: Re-create the file object (slower, but a better choice if the file does not fit in memory)

```
my_file = open("datafile.dat")
for line_of_text in my_file:
    ... process line_of_text
my_file = open("datafile.dat")
for line_of_text in my_file:
    ... process line_of_text
```

Writing to a file in python

Replaces any existing file of this name

```
my_file = open("output.dat", "w")
```

open for **Writing**
(no argument, or
"r", for **Reading**)

Similar to printing output

```
my_file.write("a bunch of data")
```

Next thing written will
be on this same line.

except you must add newline if desired

```
my_file.write("a line of text\n")
```

"\n" means
end of line
(**Newline**)

and the argument must be a string

```
my_file.write(4)
```

Incorrect; results in:
**TypeError: expected a character
buffer object**

```
my_file.write(str(4))
```

Correct. Argument
must be a string

```
my_file.close()
```

close when done
with all writing

```
# Count the number of words in a text file and  
# make a list of all the words in the file
```

```
num_words = 0
```

```
file_word_list = []
```

```
silly_file = open("silly.txt", "r")
```

```
for line in silly_file:  
    print(line, end="")
```

```
# what should come next? (Hint: use split())
```

```
silly_file.close()
```

```
print("Total words in file: ", num_words)
```

```
num_words = 0
word_list = []
silly_file = open("silly.txt", "r")
for line in silly_file:
    new_words = line.split()
    word_list.extend(new_words)
    num_words = num_words + len(new_words)
silly_file.close()

print("Total word count:", num_words)
print(word_list)
```

This is a silly file.

Here is some more silly text.

And even another silly line.

The fourth silly line.