THE UNIVERSITY OF WESTERN AUSTRALIA

Lecture 13
File Processing Part I

Objectives

- To understand how to format strings
- To understand the basic text file processing concepts in Python.
- To learn how to read and write text files in Python and string formatting

Revision

```
intlist = []
for i in range(6) :
    if i % 2 == 0 :
        intlist.append(i)
    else:
        intlist[-1] += 1
print(intlist)
```

- What is printed when the code is executed ?

String Formatting

```
>>> amount = 1.50
>>> print(amount)
1.5
```

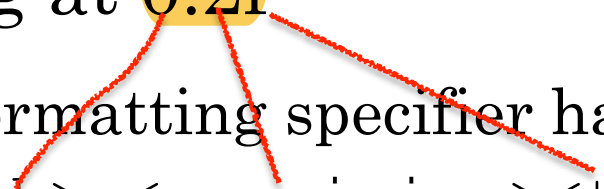
- If the value is meant to represent an amount in dollars and cents, we conventionally use dollars with 2 digits for cents such as $1.5
- **f-string method**

```
>>> print(f"${amount:0.2f} change")
$1.50 change
```

The syntax for an f-string is to prefix the string with the letter 'f' You can include variable names in between braces { } in the f-string to insert the data stored in those variables: The part after ':' is format specifier (how the value should look).

String Formatting

Looking at 0.2f



- The formatting specifier has the form:
  `<width>.<precision><type>`
- `f` means "floating point" number.
  - *Other specifiers are: `s` for string, `d` for integers*
- <width> tells us how many spaces to use to display the value. `0` means to use as much space as necessary.
- <precision> is the number of decimal places.

```
>>> f"Compare {amount} and {amount:0.20f} "
'Compare 3.14 and 3.14000000000000001243'
```

F string formatting

```
>>name = "Muhammad"
>>age = 62
>>years = 21
>>per = 21/(62-21)
```

Formatting using f-string

```
>>print(f"{name} spent {years} years or
{per*100:2.2f}% of his life for the cause.")
```

Output:

```
Muhammad spent 21 years or 51.22% of his life
for the cause.
```

String Formatting Example

```
# Print out a child's multiplication table 0..10
def multiplication_table() :
  for i in range(11) :
     for j in range(11) :
        print(f"{i:0d} x {j:0d} = {i*j:0d} ")
     print()
```

```
>>> %Run multiplication_table.py

  0 x 0 = 0
  0 x 1 = 0
  0 x 2 = 0
  0 x 3 = 0
  0 x 4 = 0
  0 x 5 = 0
  0 x 6 = 0
  0 x 7 = 0
  0 x 8 = 0
  0 x 9 = 0
  0 x 10 = 0

  1 x 0 = 0
  1 x 1 = 1
  1 x 2 = 2
  1 x 3 = 3
```

A basic child's multiplication table to illustrate string formatting.

Needs modification to properly resemble table, e.g., numbers along top and down left-hand side

Multiline Strings

- You sometimes need strings that span more than one line. Two ways to do this:
- Embedded `'\n'` in single string
  - `"Twas brillig, and the slithy toves\nDid gyre and gimble in the wabe\nAll mimsy were the borogoves\nAnd the mome raths outgrabe."`
- Multiline string:

```
"""Beware the Jabberwock, my son!
The jaws that bite, the claws that catch!
Beware the Jubjub bird, and shun
The frumious Bandersnatch!"""
```

- `'''` single quotes are also available
- `"hello\tworld"`
- `'\t'` is the tab character

Files: Multi-line Strings

- A file is a sequence of data that is stored in secondary memory (disk drive).
  - *Files don't disappear when program ends*
- Files can contain any data type, but the easiest to work with are text.
- A file usually contains more than one line of text.
- Python uses the standard newline character (`\n`) to mark line breaks.

File Processing

- The process of *opening* a file involves associating a file on disk with variable in memory.
- We can manipulate the file by manipulating this variable.
  - *Read from the file*
  - *Write to the file*

File Processing

- When you've finished working with the file, it needs to be closed.
  - *Closing the file causes any outstanding operations and other bookkeeping for the file to be completed.*
- In some cases, not properly closing a file could result in data loss.
  - *Think of safely ejecting your memory stick*

File Processing - Reading

- Reading a file into a program, e.g., word processor
  - *File opened*
  - *Contents read into RAM*
  - *File closed*
  - *Changes to the file are made to the copy stored in memory, not on the disk.*

File Processing - Writing

- Saving a file, i.e., data in RAM onto file
  - *The original file on the disk is reopened in a mode that will allow writing (this actually erases the old contents unless specifically appending)*
  - *File writing operations copy the version of the document in memory to the disk*
  - *The file is closed*

File Processing in Python

- Working with text files in Python
  - *Associate a disk file with a file object using the open function*

    <filevar> = `open(`<name>, <mode>`)`

  - <name> *is a string with the actual file name on the disk. The* <mode> *can be* `'r'`, `'w'` *or* `'a'` *depending on whether we are reading, writing or appending the file. You can also add* `'+'` *in mode to mention both read and write operations.*

  - `infile = open("numbers.dat", "r")`

File Methods

- <file>.`read()` – returns the entire remaining contents of the file as a single (possibly large, multi-line) string. Watch out for final `\n`

- <file>.`readline()` – returns the next line of the file. This is all text up to *and including* the next newline character

- <file>.`readlines()` – returns a list of the remaining lines in the file. Each list item is a single line including the newline characters.

File Processing

```
# printfile.py
#     Prints a file to the screen.

def main():
    fname = input("Enter filename: ")
    infile = open(fname,'r')
    data = infile.read()
    infile.close()
    print(data)
```

- First, prompt the user for a file name
- Open the file for reading
- The file is read as one string and stored in the variable data

File Processing

- `readline` can be used to read the next line from a file, including the trailing newline character

```
infile = open(someFile, "r")
for i in range(5):
    line = infile.readline()
    print(line[:-1])
```

- This reads the first 5 lines of a file
- Slicing is used to strip out the newline characters at the ends of the lines

File Processing Loop

- Python treats the file itself as a sequence of lines!

```
infile = open(someFile, "r")
for line in infile:
   # process the line here
infile.close()
```

- Most efficient way to read through (and process) file
  - *Multiple calls to readline() is inefficient*

File Processing

- Opening a file for writing prepares the file to receive data
- If you open an existing file for writing, you 抹去 wipe out the file's contents. If the named file does not exist, a new one is created.

```
outfile = open("mydata.out", "w")
outfile.write(<string>)
```

May use `writelines()` for writing sequence (list) of strings

Summary

- We learned how to format a string for output that is more readable and looks nice
- We learned how to read files
  - *All at once*
  - *Single lines*
  - *All the lines, line-by-line*
- We learned how to write into files