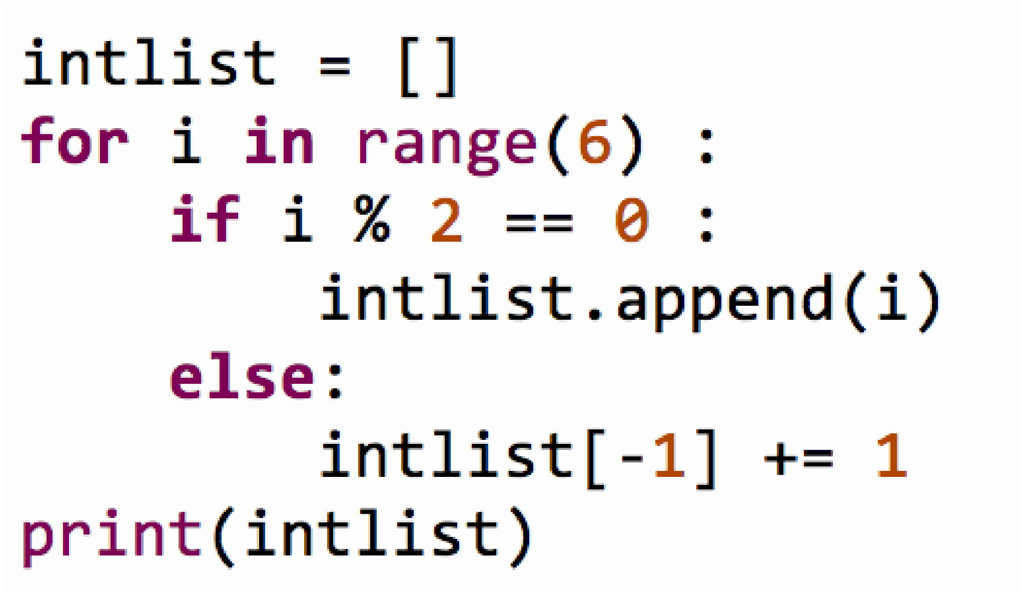
THE UNIVERSITY OF WESTERN AUSTRALIA

Lecture 10
File Processing

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



```python
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 code about is meant to represent an amount in dollars and cents, we conventionally do not use fractional dollars but rather dollars with 2 digits for cents
- Use the format method

```
>>> print("${0:0.2f} change".format(amount))
$1.50 change
```

- The first part is the string to be printed, called the template string. The part between `{}` is the format specifier (where the value is to be inserted and how it should look).

String Formatting

```
"${0:0.2f} change".format(amount)
```

- The template contains a single specifier slot with the description: `0:0.2f`
- Form of description:
  <index>:<format-specifier>
- Index tells which parameter to insert into the slot (there can be more than one). In this case, `amount` (numbered from 0!)

String Formatting

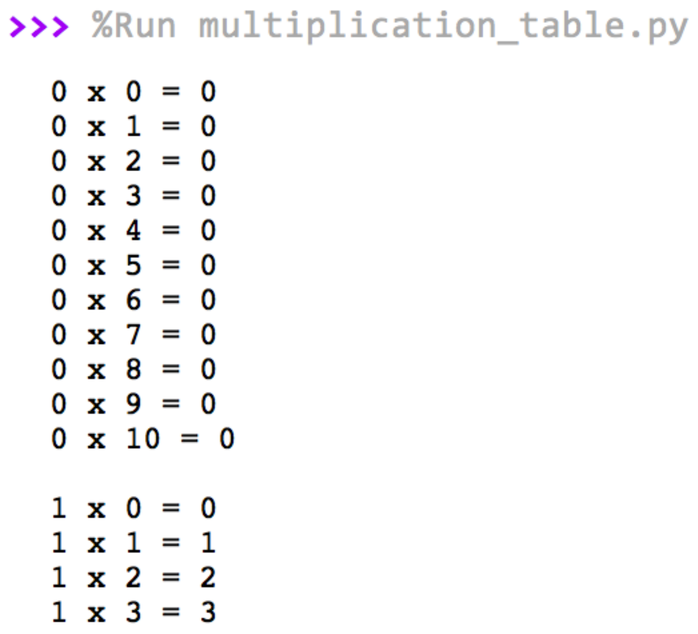
Looking at 0.2f

- The formatting specifier has the form: `<width>.<precision><type>`
- `f` means "fixed point" number
- <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.

```
>>> "Compare {0} and {0:0.20f}".format(3.14)
'Compare 3.14 and 3.14000000000000001243'
```

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("{0:0d} x {1:0d} = {2:0d}".format(i, j, i*j))
     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!"""
```

- `'''` 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> *is either* `'r'` *or* `'w'` *depending on whether we are reading or writing the file.*
  - `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 wipe out the file's contents. If the named file does not exist, a new one is created.

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

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

Example Program: Batch Usernames

- Batch mode processing is where program input and output are done through files (the program is not designed to be interactive)
  - *Real strength of Python of many applications. GUI is fine for small number of cases, but need automation for larger number.*
- Let's create usernames for a computer system where the first and last names come from an input file.

Example Program: Batch Usernames

```
# userfile.py
#    Program to create a file of usernames in batch mode.

def main():
    print ("This program creates a file of usernames from")
    print ("a file of names.")

    # get the file names
    infileName = input("Which file are the names in? ")
    outfileName = input("Where should the usernames go? ")

    # open the files
    infile = open(infileName, 'r')
    outfile = open(outfileName, 'w')
```

Example Program: Batch Usernames

```
# process each line of the input file
 for line in infile:
     # get the first and last names from line
     first, last = line.split()
     # create a username
     uname = (first[0]+last[:7]).lower()
     # write it to the output file
     outfile.write(uname)

 # close both files
 infile.close()
 outfile.close()

 print("Usernames written to”, outfileName)
```

Example Program: Batch Usernames

- Things to note:
  - *It's not unusual for programs to have multiple files open for reading and writing at the same time. However, if a file is no longer needed, close it as there is a limit to number of open files.*
  - *The* `lower` *method is used to convert the names into all lower case, in the event the names are mixed upper and lower case, e.g de Witt.*

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