Workshop 7 Files and Exception Handling

Exercise 1 – Concept Revision in the Python Shell

Let's revise the concepts from this module by typing some simple statements into the **Python Shell**. Feel free to deviate from the workshop and experiment!

> *Before typing each of these statements, try to work out which exception they will raise. If you are wrong, take a few moments to read the error message and understand why.*

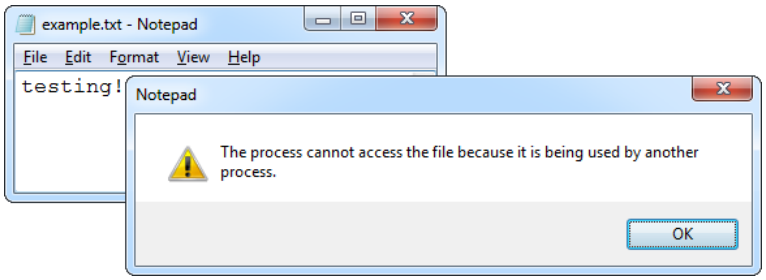
1. `potato`
2. `5/0`
3. `int('0.999')`
4. `round(3.14159, '2')`
5. `open('exam_answers.txt', 'r')`

Exercise 2 – Unclosed Files

This task simply demonstrates the importance of closing a file once you have finished using it. Create a new file in the **Python Editor** and copy-paste the following code into it:

```
f = open('example.txt', 'w')
```
Python

Save and run the program, then go to the folder you saved the program into and open "example.txt" in Notepad. Write something into the file and try to save it. You should see an error:



Since the program didn't close the file, it is still "locked" and can't be written to by other programs. Cancel the saving and close "example.txt". Add the following line to the program and run it again:

```
f = open('example.txt', 'w')
f.write('Write this to the file.')
```
Python

Open "example.txt" again. Is the file still empty? If so, it's because the data that the program wrote was written into a "buffer" in memory (which is faster), rather than writing it to the file on the disk itself. The data in the buffer is only written to the file on the disk when you *close* the file. Add a line to close the file, and now the program should work as intended:

```
f = open('example.txt', 'w')
f.write('Write this to the file.')
f.close()
```
Python

Exercise 3 – "To Do List" Case Study

We're going to put together a slightly bigger than usual program in the next few tasks – don't worry, we'll break it down into separate functions and tackle them one at a time. Create a new file in the **Python Editor** and copy-paste the following code into it (*or download the file from Blackboard*):

Python

```
# --- getList(filename), returns a list of strings ---
# (open/create file and return lines of text as a list of strings)
def getList(filename):
    data = [] # this line is a placeholder
    return data



# --- showList(data), returns nothing ---
# (receive list of strings and display them, or "nothing in list" message)
def showList(data):
    return



# --- addToList(filename, data), returns a list of strings ---
# (prompt for an item to add to the list of strings and append to the file)
def addToList(filename, data):
    return data



# --- deleteFromList(filename, data), returns a list of strings ---
# (prompt for item number to delete from the list of strings and write list to the file)
def deleteFromList(filename, data):
    return data



# --- main part of program ---
FILENAME = 'list.txt' # define the filename used to store the list
lineList = getList(FILENAME) # call the getList function to read the file into a list

while True: # this endless loop displays the list and prompts the user for a command

    showList(lineList) # call showList to show the current content of the list

    # show the instructions for the possible commands - [a]dd, [d]elete, e[x]it
    print('\nType "a" to add an item.')

    if len(lineList) > 0: # only show the delete instruction if the list has items
        print('Type "d" to delete an item.')

    print('Type "x" to exit.')

    command = input('> ') # prompt for a command

    # if "a", calladdToList to prompt for item and add to list
    if command == 'a':
        lineList = addToList(FILENAME, lineList)

    # if "d", call deleteFromList to prompt for item number and delete from list
    elif command == 'd' and len(lineList) > 0:
        lineList = deleteFromList(FILENAME, lineList)

    elif command == 'x': # if "x", break out of the loop to end the program
        print('Goodbye!')
        break

    else: # if anything else, show an error message
        print('Invalid command.\n')
```

Save the file and run it. At the moment, it runs but does nothing useful. Look through the code and read the following notes about what the program will do once it is complete:

- The program will become a **"To Do List" application** which uses a **text file to store its data**. It will allow the user to **see** the items on the list, add **items** to it and **delete** items from it.

- When the program starts, it will call a function to **read the text file** and store the lines of the file into a "**list**" variable, which we covered in Module 3. If the text file does not exist, it will be created (and since it has no text in it yet, the list will be empty).
    - This is the only time the text file needs to be read – after that, the program will be interacting with the list variable, writing data to the text file when needed.

- The program then enters an **endless loop** which calls a function that **displays the list items** and shows instructions regarding how to **add** and **delete** list items, or **exit** the program.

- The program then waits for the user's **input**. If they choose to add or delete, functions are used to do this – **modifying the list variable** and **writing the data to the text file**. The loop allows the user to continue adding and deleting items until they choose to exit the program.

Below is a usage example of the program (red lines indicate iterations of the program's main loop).

The user begins with an empty list. They enter "**a**" to add an item and then enter "**Sleep all day**".

```
Your To Do List is empty.

Type "a" to add an item.
Type "x" to exit.
> a
Add: Sleep all day
Item added to list.
```

When the list is shown on the next loop, it now has an item to show. The user enters "**a**" again then enters "**Work on my assignments**".

```
To Do List:
 1) Sleep all day

Type "a" to add an item.
Type "d" to delete an item.
Type "x" to exit.
> a
Add: Work on my assignments
Item added to list.
```

When the list is shown on the next loop, it now has two items to show. The user enters "**d**" then enters "**1**" to delete item number 1 from the list.

```
To Do List:
 1) Sleep all day
 2) Work on my assignments

Type "a" to add an item.
Type "d" to delete an item.
Type "x" to exit.
> d
Item number to delete: 1
Item deleted from list.
```

When the list is shown on the next loop, it now has only one item show. The user enters "**x**" to exit the program, breaking out of the endless loop.

```
To Do List:
 1) Work on my assignments

Type "a" to add an item.
Type "d" to delete an item.
Type "x" to exit.
> x
Goodbye!
```

The "main" part of the program is already complete – all that is left to do is write the code for the four functions: **getList**, **showList**, **addToList** and **deleteFromList**. The following tasks describe exactly what those functions need to do, and it is up to you to write the pseudocode and actual code.

Remember to spend some time looking over the code provided and reading the details on the previous page. Having a good understanding of a situation and what is required is extremely helpful.

Exercise 4 – Writing the getList function ("To Do List" Case Study)

The first function we are going to write is called getList. Here is the placeholder code we have so far:

Python

```
# --- getList(filename), returns a list of strings ---
# (open/create file and return lines of text as a list of strings)
def getList(filename):
    data = [] # this line is a placeholder
    return data
```

The getList function requires one **parameter**: The **filename** of the text file used to store the list data. The getList function must **return** a **list of strings** (the lines of text from the file).

The **purpose** of the getList function is to open the text file use to store the list data, read all of the lines from the file into a list, and return that list. If the text file does not exist, the function must create it. This will result in it returning an empty list, since there will be no lines of data to read.

Currently, the function assigns an empty list to the data variable – this is simply a placeholder to make sure that the code you start out with does not crash. You will need to edit this line.

Write **pseudocode** to plan your code, and then write the **code** of the getList function. Hints:

- First try to open the file in read ("r") mode, and if a FileNotFoundError exception is raised, open the file in Write/Read ("w+") mode (which will create an empty file and allow reading).
- Use the "`readlines()`" method on the file variable to read all lines of the file into a list.
- Remember to close the file once you have read it.

Be sure to **test** your code thoroughly:

- Add "`print(lineList)`" after the "`lineList = getList(FILENAME)`" line in the main part of the program so that you can see exactly what your function returned.
    - Remember to remove this once you've written the code for the showList function!
- Since we haven't written the function to add items to the list, the file will be empty and your function will return an empty list. Feel free to type a few lines into the file using Notepad.

Exercise 5 – Writing the showList function ("To Do List" Case Study)

Now that we can read the data, let's write the showList. Here is the placeholder code so far:

Python

```
# --- showList(data), returns nothing ---
# (receive list of strings and display them, or "nothing in list"...
def showList(data):
    return
```

The showList function requires one **parameter**: A **list of strings** containing the To Do List items.
The showList function **does not return anything**.

The **purpose** of the showList function is to display the items on the To Do List in a user-friendly way. If the list is empty, it should show a message saying that there are no items in the list. If there is at least one item in the list, it should show the items with a number before each one. See the usage example on Page 3 for examples of how the output of the showList function should look.

Currently, the function contains a return statement – this is simply a placeholder to make sure that the code you start out with does not crash. You can remove this line once the code is written.

Write **pseudocode** to plan your code, and then write the **code** of the showList function. Hints:

- Determine whether the list is empty and show the appropriate output by using an "`if`" statement and built-in "`len()`" function.

- If the list is not empty, use a "`for`" loop to loop through the items in the list.
  - There is an example of this in Lecture 3, Slide 37.
  - Create a variable before the loop (and increment it inside the loop) for the item number. Print this number in front of each item as seen in the examples on page 3.
  - It is more user-friendly to start the item number at 1, but remember – the index of the items in the list starts at 0, so your item number will be 1 higher than its index!

- Use the "`rstrip()`" method to remove line breaks from the end of the items in the list as you loop through it and print the items.
  - There is an example of this in Lecture 6, Slide 27.

Be sure to **test** your code thoroughly:

- Make sure that if the file is empty, the "Your To Do List is empty." message is shown.

- Add some lines of text to the file and make sure that your program displays them correctly.
  - Spend some time making the output to look nice (see the usage example on Page 3).

Exercise 6 – Writing the addToList function ("To Do List" Case Study)

Now let's write the addToList function so that we can add items. Here is the placeholder code so far:

```
# --- addToList(filename, data), returns a list of strings --
# (prompt for an item to add to the list of strings and append to...
def addToList(filename, data):
    return data
```

Python

The addToList function requires two **parameters**: The **filename** and the **list of strings** containing the To Do List items. The addToList function must **return** the **list of strings** (with the new item added).

The **purpose** of the addToList function is to prompt the user for an item and append it to the list of items, as well as appending the item to the text file.

Currently, the function contains a return statement – this will remain at the end of the addToList function's code, since the function must return the modified list (with the new item appended).

Write **pseudocode** to plan your code, and then write the **code** of the addToList function. Hints:

- Once you have used the built-in "`input()`" function to prompt for the item to add, concatenate a "\n" to the end of the item to make sure it will have a line break in the file.
- Use the "`append()`" method to add the item to the list (see Lecture 3, Slide 11).
- Open the text file in Append ("a") mode and write the item to it, then close the file.
- Print a message confirming that the item has been added, and then return the list.

Be sure to **test** your code thoroughly:

- Add items to the list and ensure that they are shown correctly by the showList function.
  - Open the text file in Notepad to confirm the items are correctly saved in the file.
- Add an item consisting of spaces or an empty string (by just pressing enter at the prompt).
  - It is up to you whether you wish to add code to prevent this from being saved.

Exercise 7 – Writing the deleteFromList function ("To Do List" Case Study)

The final function we need to write is deleteFromList. Here is the placeholder code so far:

```python
# --- deleteFromList(filename, data), returns a list of strin
# (prompt for item number to delete from the list of strings and ...
def deleteFromList(filename, data):
    return data
```

The deleteFromList function requires two **parameters**: The **filename** and the **list of strings** containing the To Do List items. The deleteFromList function must **return** the **list of strings** (with the specified item deleted).

The **purpose** of the deleteFromList function is to prompt the user for an item number and delete it from the list of items, as well as deleting the item from the text file. Deleting the item from the list involves deleting the appropriate index from the list, and deleting the item from the text file involves erasing the content of the file and rewriting it using the list.

The function must first prompt the user for an item number to delete (the showList function shows these numbers at the start of each item). This must be converted to an integer, and then used to delete the appropriate index from the list.

Currently, the function contains a return statement – this will remain at the end of the function (to return the modified list) as well as being in the exception handlers (to return the unchanged list).

Write **pseudocode** to plan your code, and then write the **code** of the deleteFromList function. Hints:

- Converting the input to an integer can cause a ValueError, and trying to reference an index number in the list can cause an IndexError if there is no item with that index number.
    - Place these statements into a "try" block, and handle both of the exceptions. The exception handlers simply need to print an error message and return the list (bringing the user back to the main part of the program without changing anything).

- Remember that the item numbers start at 1 but the index of the list starts at 0.
    - Subtract 1 from the number the user enters to get the appropriate index number.
    - Use a "`del`" statement to remove an item from a list. See Lecture 3, Slide 11.

- Open the text file in Write ("w") mode (which will erase the current data) and use the "`writelines()`" method on the file variable to write the list to it, then close the file.

- Print a message confirming that the item has been deleted, and then return the list.

That's it – the application is complete. You can now view, add and delete items from the list, and a text file is used to store the list so that it is remembered. Be sure to **test** your code thoroughly.