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IT FDN 110 A
Assignment 06

Creating Python Scripts – Functions

Introduction

This Assignment 06 consists in creating a Python program that uses constants, variables, and print statements to display a message about a student's registration for a Python course. Building on the knowledge from Assignment 05, this assignment introduces new concepts, such as use of use of functions, classes, and using the separation of concerns pattern.

Preparation for this assignment

To prepare for this assignment, I reviewed the "Module 06 Notes" (Reference 1), completed the three lab examples, and watched both the Module 06 videos available on Washington University's Canvas platform (Figure 1) and the recommended external videos in References 2 through 3. Through these materials, I learnt how to work with functions, including their parameters and arguments, overloaded functions, and return values. I also gained an understanding of how to work with classes and apply the Separation of Concerns (SoC) pattern. I learned that functions and classes are fundamental building blocks of the SoC principle in Python programming.

I also learned the common practice of including a header at the beginning of a class or function, known as a "docstring" in Python. Including additional notes within the docstring can be helpful for developers, providing clear explanations and context for the code.

Mod06 Videos











Module	Name	Link
6	Demo01 - Using Functions	https://www.youtube.com/watch?v=8tZdqlArsbc  
6	Demo02 - Using Arguments	https://www.youtube.com/watch?v=a6dmUlaNB0Q  
6	Demo02 - Using Returns	https://www.youtube.com/watch?v=tTPdCTUsDb8  
6	Demo03 - Using Classes	https://www.youtube.com/watch?v=TAD_BczzOIQ  
6	Demo04- Separation Of Concerns	https://www.youtube.com/watch?v=fapZdUP-vdw  

Figure 1 – Mod06-Videos

Python Scripting

I began by reviewing the provided Assignment06-Starter.py file and use it as the starting point for my script. The objective was to implement the use of function classes and organize the script according to the SoC pattern. The script should allow the user to register multiple students, display their inputs, and save the data back into a '.json' file containing all registered students. Additionally, structured error handling should be implemented when reading the file into dictionary rows, when the user enters first and last names, and when writing the dictionary rows back into the file.

The functions should be grouped into two classes: FileProcessor and IO The FileProcessor class contains functions responsible for reading data from and writing data to a .json file. The IO class includes functions that manage user interactions, such as collecting menu options, gathering input data, displaying messages, and printing error notifications.

Two global variables are defined: menu_choice (a string) to store the user's selected option, and students (a list) to hold the information of all registered students. These variables are initialized with an empty string and an empty list, respectively.

I began by organizing the script into major sections: the header, imports, variable and constant definitions, class and function definitions, and the main body. The functions were grouped into classes based on their roles, aligning with the data processing and presentation layers of concern.

```
# Header
# Import
# Global Data
# Data Layer
    Definition of data constants
    Definition of variable

# Class Definition

    Processing data layer
        Class FileProcessor created
            Function read_data_from_file created
            Function write_data_to_file created

    Presentation data layer
        Class IO created
            Function output_error_messages created
            Function input_menu_choice
            Function output_student_courses
            input_student_data

# Main body of the script
```

The script is displayed in separated figures, split across Figure 2 to Figure 5 according its correspondent sections.

Header, import, constants and variables script parts are presented in the Figure 2.

```

1  # ----- #
2  # Title: Assignment06
3  # Desc: This assignment demonstrates using classes and functions
4  # with structured error handling and SoC
5  # Change Log: (Who, When, What)
6  #   Renato Felício,11/16/2024,Created Script
7  #   <Your Name Here>,<Date>,<Activity>
8  # ----- #
9
10 # Import section
11 import json
12 from typing import TextIO
13
14 # Global Data Layer
15
16 # Define the Data Constants
17 MENU: str = '''
18 ---- Course Registration Program ----
19 Select from the following menu:
20 1. Register a Student for a Course.
21 2. Show current data.
22 3. Save data to a file.
23 4. Exit the program.
24 -----
25 '''
26
27 # Define the Data Constants
28 FILE_NAME: str = "Enrollments.json" # Constant holds the name of the file with students data
29
30 # Define the Data Variables and constants
31 students: list=[] # This variable holds the information of all registered students.
32 menu_choice: str='' # It holds the user choice.
33

```

Figure 2 – Python Script Header Import and Variables

Processing data layer is presented in Figure 3.

```

33 |
34 # Class definition
35
36 # Processing Data Layer
37 class FileProcessor: 2usages
38     """
39     A collection of processing layer functions that work with json files
40
41     ChangeLog: (Who, When, What)
42     Renato Felício,11/16/2024,Created Class
43     """
44     @staticmethod 1usage
45     def read_data_from_file(file_name: str, student_data: list):
46         """ This function reads data from a json file into a list of dictionary rows
47
48         Notes:
49         - Data sent to the student_data parameter will be overwritten.
50
51         ChangeLog: (Who, When, What)
52         Renato Felício,11/16/2024,Created function
53
54         :param file_name: string with the name of the file we are reading
55         :param student_data: list of dictionary rows we are adding data to
56         :return: list of dictionary rows filled with data
57         """
58         try:
59             file: TextIO = open(file_name, "r") # Open the JSON file for reading
60             student_data: list = json.load(file) # File data is loaded into a table
61             # Now 'student_data' contains the parsed JSON data as a Python list of dictionaries
62             file.close()
63         except FileNotFoundError as e: # Handles error in case there is no initial file
64             IO.output_error_messages("Data file must exist before running this script!")
65             file = open(FILE_NAME, "w") # Creates an empty initial file, in case of file not found
66             IO.output_error_messages("Empty file was created!\n")
67         except Exception as e:
68             IO.output_error_messages("Error: There was a problem with reading the file.", e)
69         finally:
70             if file.closed == False:
71                 file.close()
72         return student_data
73
74
75 @staticmethod 1usage
76 def write_data_to_file(file_name: str, student_data: list):
77     """ This function writes data to a json file from a list of dictionary rows
78
79     ChangeLog: (Who, When, What)
80     Renato Felício,11/16/2024,Created function
81
82     :param file_name: string with the name of the file we are writing to
83     :param student_data: list of dictionary rows containing our data
84     :return: None
85     """
86     try:
87         file: TextIO = open(file_name, "w")
88         json.dump(student_data, file) # It writes the list of dictionaries into a json file
89         file.close()
90     except Exception as e: # It handles any exception that could happen when writing the file
91         if file.closed == False:
92             file.close()
93         IO.output_error_messages("There was a problem with writing to the file.", e)
94         IO.output_error_messages("Please check that the file is not open by another program.", e)
95         print()
96     # End of Processing Data Layer
97

```

Figure 3 – Python Script Processing Data Layer

Presentation data layer and main body are presented in Figure 4 and Figure 5, respectively.

```

140 # Presentation Data Layer
141
142 class IO: 13 usages
143     """A collection of presentation layer functions that manage user input and output
144
145     Changelog: (Who, When, What)
146     Renato Felicio,11/16/2024,Created Class
147
148     """
149
150     @staticmethod 8 usages
151     def output_error_messages(message: str, error: Exception = None):
152         """ This function displays a custom error messages to the user
153
154         Changelog: (Who, When, What)
155         Renato Felicio,11/16/2024,Created function
156
157         """
158         _return: None
159
160         print(message, end="\n\n")
161         if error is not None:
162             print("--- Technical Error Message -- ")
163             print(error, error.__doc__, type(error), sep='\n')
164
165     @staticmethod 1 usage
166     def output_menu(menu: str):
167         """ This function displays the menu of choices to the user
168
169         Changelog: (Who, When, What)
170         Renato Felicio,11/16/2024,Created function
171
172         """
173         _return: None
174
175         print(menu)
176
177     @staticmethod 1 usage
178     def input_menu_choice():
179         """ This function gets a menu choice from the user
180
181         Changelog: (Who, When, What)
182         Renato Felicio,11/16/2024,Created function
183
184         """
185         _return: string with the users choice
186
187         choice="0"
188
189         try:
190             choice: str = input("What would you like to do: ")
191             if choice not in ("1", "2", "3", "4"): # Note these are strings
192                 raise Exception("Please, choose only 1, 2, 3, or 4")
193         except Exception as e:
194             IO.output_error_messages(e.__str__()) # Not passing e to avoid the technical message
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196         return choice
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Figure 4 – Python Script Presentation Data Layer

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196
197 # Start of the main body of the script
198
199 # Read data from a file
200 students:list = FileProcessor.read_data_from_file(file_name=FILE_NAME, student_data=students)
201
202 while (True): # Loops through the menu of options
203     # Present the menu of choices
204     IO.output_menu(MENU)
205     menu_choice=IO.input_menu_choice()
206
207     # Input user data
208     if menu_choice == "1": # This will not work if it is an integer!
209         students=IO.input_student_data(students)
210         continue
211
212     # Present the current data
213     elif menu_choice == "2":
214
215         # Process the data to create and display a custom message
216         IO.output_student_courses(students)
217         continue
218
219     # Save the data to a file and present to user
220     elif menu_choice == "3":
221         FileProcessor.write_data_to_file(FILE_NAME,students)
222         IO.output_student_courses(students)
223         continue
224
225     # Stop the loop
226     elif menu_choice == "4":
227         break # out of the loop
228     else:
229         print("Please only choose option 1, 2, or 3")
230
231 print("Program Ended")
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Figure 5 – Python Script Main Body

Python Script Testing

I executed the Python script using PyCharm (see Figure 7) and also tested it in the Windows Command Prompt (see Figure 8), verifying that the script performed as expected in both environments. Additionally, I confirmed that the Enrollments.json file was updated correctly and contained the expected output (see Figure 9). Following the assignment instructions, I used the initial Enrollments.json file provided in the module_06.zip file. The original content of this file is shown in Figure 6.

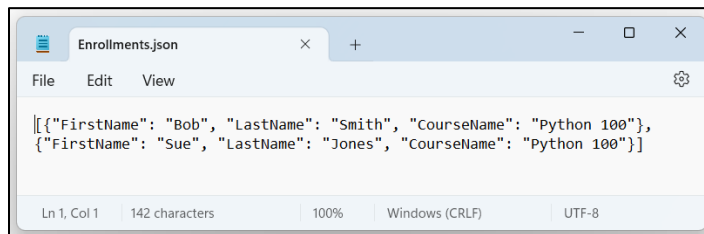


Figure 6 – Initial Enrollment File Python

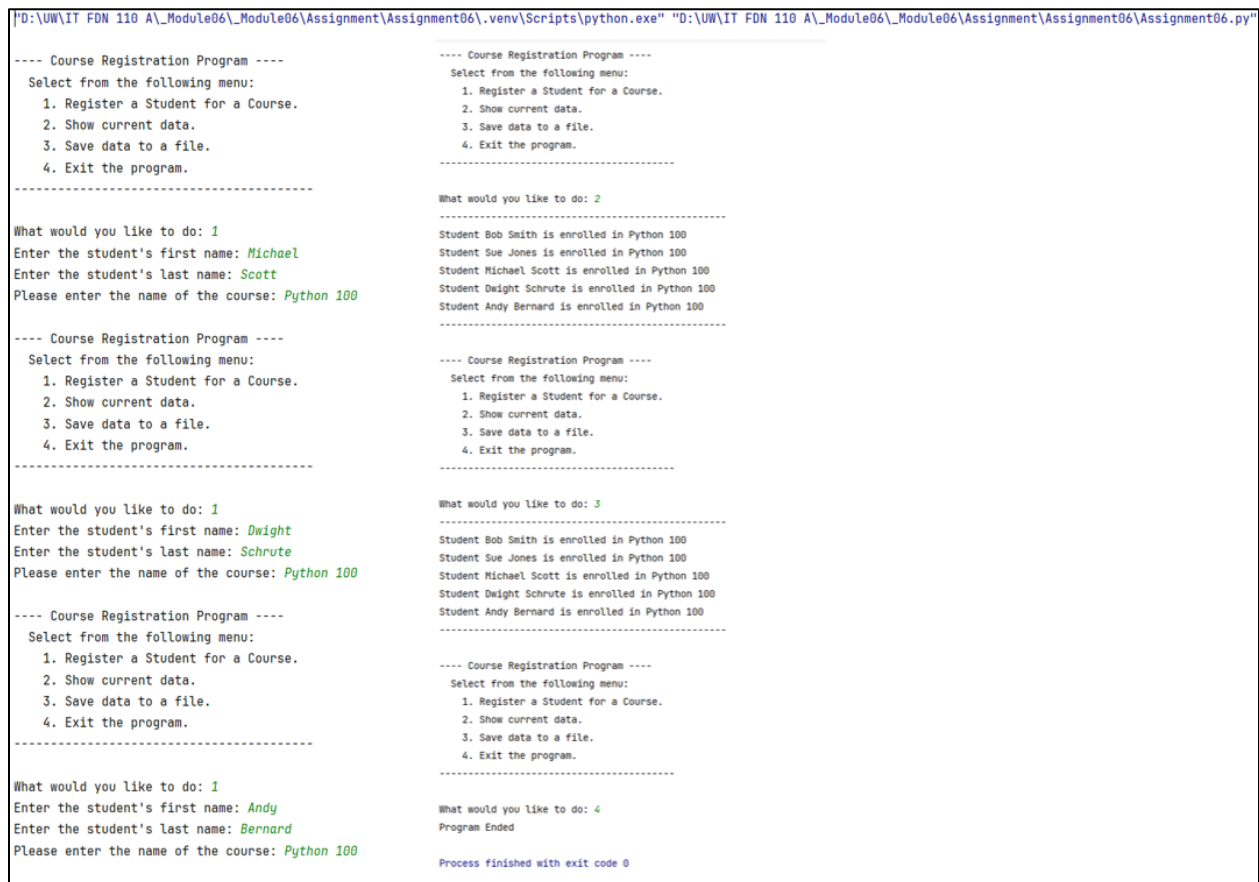


Figure 7 – Python Script PyCharm Run

```

D:\UW\IT FDN 110 A\_Module06\_Module06\Assignment\Assignment06>python Assignment06.py

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----

What would you like to do: 1
Enter the student's first name: Michael
Enter the student's last name: Scott
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----

What would you like to do: 1
Enter the student's first name: Dwight
Enter the student's last name: Schrute
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----

What would you like to do: 1
Enter the student's first name: Andy
Enter the student's last name: Bernard
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----

What would you like to do: 2
-----
Student Bob Smith is enrolled in Python 100
Student Sue Jones is enrolled in Python 100
Student Michael Scott is enrolled in Python 100
Student Dwight Schrute is enrolled in Python 100
Student Andy Bernard is enrolled in Python 100
-----

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----

What would you like to do: 3
-----
Student Bob Smith is enrolled in Python 100
Student Sue Jones is enrolled in Python 100
Student Michael Scott is enrolled in Python 100
Student Dwight Schrute is enrolled in Python 100
Student Andy Bernard is enrolled in Python 100
-----

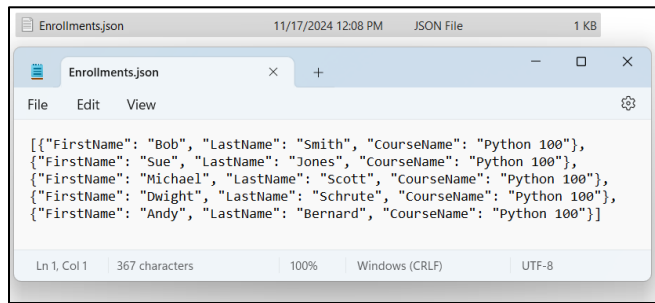
---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----

What would you like to do: 4
Program Ended

```

Figure 8 – Python Script Windows Command Prompt Run

Figure 9 shows that the Enrollments.json file was updated correctly with the three new student data.



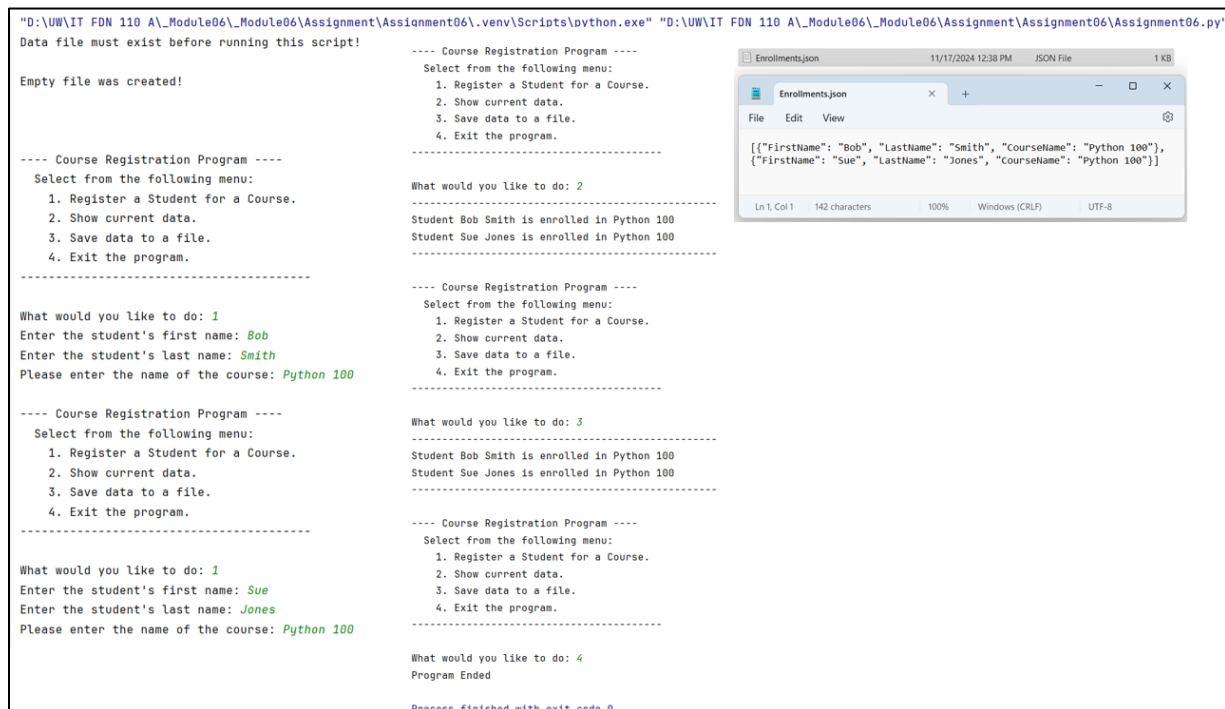
```
[{"FirstName": "Bob", "LastName": "Smith", "CourseName": "Python 100"}, {"FirstName": "Sue", "LastName": "Jones", "CourseName": "Python 100"}, {"FirstName": "Michael", "LastName": "Scott", "CourseName": "Python 100"}, {"FirstName": "Dwight", "LastName": "Schrute", "CourseName": "Python 100"}, {"FirstName": "Andy", "LastName": "Bernard", "CourseName": "Python 100"}]
```

Figure 9 – Output JSON File Content

Python Script Error Handling Test

After testing the script with valid user inputs using a pre-existing Enrollments.json file, I evaluated its error-handling capabilities for scenarios such as a "file not found" exception and invalid first and last name inputs. All tests were conducted using PyCharm.

The Figure 10 below shows the FileNotFoundError handling and the Enrolments.json being updated correctly after menu choice 3 is selected.



```
"D:\UW\IT FDN 110 A\Module06\Module06\Assignment\Assignment06\venv\Scripts\python.exe" "D:\UW\IT FDN 110 A\Module06\Module06\Assignment\Assignment06\Assignment06.py"
Data file must exist before running this script!

Empty file was created!

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.

What would you like to do: 1
Enter the student's first name: Bob
Enter the student's last name: Smith
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.

What would you like to do: 3
Student Bob Smith is enrolled in Python 100
Student Sue Jones is enrolled in Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.

What would you like to do: 1
Enter the student's first name: Sue
Enter the student's last name: Jones
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.

What would you like to do: 4
Program Ended

Process finished with exit code 0
```

Figure 10 – FileNotFoundError Handling

The second error handling test involved checking the condition where the user enters non-alphabetic characters for the first or last names (see Figure 11). The Enrollments.json file was also correctly updated

```
"D:\UW\IT FDN 110 A\Module06\Module06\Assignment\Assignment06\.env\Scripts\python.exe" "D:\UW\IT FDN 110 A\Module06\Module06\Assignment\Assignment06\Assignment06.py"
---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 1
Enter the student's first name: 1

-- Technical Error Message --
The last name should not contain numbers.
Inappropriate argument value (of correct type).
<class 'ValueError'>

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 1
Enter the student's first name: Michael
Enter the student's last name: Scott
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 1
Enter the student's first name: Dwight
Enter the student's last name: 2

-- Technical Error Message --
The last name should not contain numbers.
Inappropriate argument value (of correct type).
<class 'ValueError'>

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 1
Enter the student's first name: Dwight
Enter the student's last name: Schrute
Please enter the name of the course: Python 100

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 2
Student Bob Smith is enrolled in Python 100
Student Sue Jones is enrolled in Python 100
Student Michael Scott is enrolled in Python 100
Student Dwight Schrute is enrolled in Python 100
-----

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 3
Student Bob Smith is enrolled in Python 100
Student Sue Jones is enrolled in Python 100
Student Michael Scott is enrolled in Python 100
Student Dwight Schrute is enrolled in Python 100
-----

---- Course Registration Program ----
Select from the following menu:
1. Register a Student for a Course.
2. Show current data.
3. Save data to a file.
4. Exit the program.
-----
What would you like to do: 4
Program Ended

Process finished with exit code 0
```

Figure 11 – Non-Alphabetic Characters Error Handling

GitHub

Script and documentation for this assignment is available in my GitHub site:

<https://github.com/rfnaval/IntroToProg-Python-Mod06.git>

Summary

This assignment built upon the previous one, providing an opportunity to learn and practice key Python concepts such as functions, function parameters, return values, and classes. Functions and classes are essential building blocks of the Separation of Concerns (SoC) principle in Python programming. By applying the SoC design principle, I was able to create a more encapsulated and organized script, significantly reducing the complexity of the main body of the code while improving its readability.

References

1. Module 06 - Functions, Randal Root, January 02, 2024.
2. External site: [Let's Learn Python - Basics #6 of 8 - Functions](#), Anchor Rainbow.
3. External site: [Python Functions || Python Tutorial || Learn Python Programming](#), Socratica.