

Data Structures

Solve the following exercises and upload your solutions to [Moodle](#) until the specified due date. Make sure to use the *exact filenames* that are specified for each individual exercise. Unless explicitly stated otherwise, you can assume correct user input and correct arguments.

Exercise 1 – Submission: ex1.py

10 Points

Write a program that reads a string as input. This string is the processed character by character. Every lowercase character is added to a list, every uppercase letter is added to another list and all remaining/other characters are also added to yet another list. In addition, collect all unique characters in a set. Print all data structures afterwards-

Example input:

Enter string: This 12 IS an ExamPLE SENTENCE.

Example output (order of **unique** might differ):

```
lowercase: ['h', 'l', 's', 'a', 'n', 'x', 'a', 'm', 'n', 'c', 'e']  
uppercase: ['T', 'I', 'S', 'E', 'P', 'L', 'E', 'S', 'E', 'N', 'T', 'E']  
other: [' ', '1', '2', ' ', ' ', ' ', ' ', ' ', ' ', ' ']  
unique: {'e', 'n', 'l', 'N', '2', 'c', 'E', 'h', 'a', 'I', 'x', '.', 'S',  
         's', 'm', 'L', 'T', ' ', '1', 'P'}
```

Exercise 2 – Submission: ex2.py

10 Points

You are given the following list of filenames:

```
fnames = ["file7.txt", "file1.png", "file3.txt", "file2.txt",  
          "file7.txt", "file1.txt", "file3.txt", "file4.png",  
          "file4.png", "file5.txt", "file0.txt", "file7.dat"]
```

Write a program that drops all duplicate entries and only collects files ending with ".txt" into a sorted list. Print this list afterwards.

Output:

```
['file0.txt', 'file1.txt', 'file2.txt', 'file3.txt', 'file5.txt', 'file7.txt']
```

Exercise 3 – Submission: ex3.py

10 Points

Write a program that counts characters in a user specified string using a dictionary. Before counting, all characters must be transformed to lowercase. Print the dictionary afterwards.

Example input:

Enter string: This 12 IS an ExamPLE SENTENCE.

Example output (order might differ):

```
{ 't': 2, 'h': 1, 'i': 2, 's': 3, ' ': 5, '1': 1, '2': 1, 'a': 2, 'n': 3,
  'e': 5, 'x': 1, 'm': 1, 'p': 1, 'l': 1, 'c': 1, '.': 1}
```

Exercise 4 – Submission: ex4.py**35 Points**

Write a program that calculates the row sums, the column sums and the total sum of a 2D matrix that was entered by the user. The program should work as follows:

- The 2D matrix should be implemented as a nested list of integer numbers.
- To extract the matrix from the console input, the following actions must be performed:
 - Until "x" is entered, the user can enter entire rows.
 - Such an entire row input must follow the format "`int_1 int_2 ... int_n`", where `int_i` are integer numbers separated by a single space character (you can assume correct user input w.r.t. the data types).
 - The individual integers must then be extracted and stored in a (row) list.
 - If the user enters rows with different sizes, extend all shorter rows with 0, so that all rows are equally sized afterwards, i.e., apply 0-padding to the end of shorter rows.
 - All row lists must then be collected inside another list, which will then be the matrix/nested list.
- Using the matrix, calculate the row sum, i.e., for each row, compute the sum and store the result in a list (row sum list).
- Using the matrix, calculate the column sum, i.e., for each column, compute the sum and store the result in a list (column sum list).
- Using the matrix, calculate the total sum of all elements.
- Print a nicely formatted matrix of the form


```
[[r1c1 r1c2 ... r1cn]
 ...
 [rmc1 rmc2 ... rmcn]]
```

 where `ricj` indicates the element in the `i`-th row and `j`-th column.
- Print the row sums, the column sums and the total sum.

Example input:

```
Enter row: 1 2 3 4
Enter row: 5
Enter row: 0
Enter row: x
```

Example output:

```
[[1 2 3 4]
 [5 0 0 0]
 [0 0 0 0]]
row sums: [10, 5, 0]
column sums: [6, 2, 3, 4]
total sum: 15
```

Exercise 5 – Submission: ex5.py**35 Points**

In an earlier exercise, we already talked about **powerlifting** and the three weight lifts: squat, bench press and deadlift. Write a program that can manage lifters and their weights as follows (see the example below for more details):

- Create a console user interface as shown in the example program execution below. The available actions are "a" to add a new lifter, "r" to remove an existing lifter, "u" to update an existing lifter, "v" to view all lifters and "x" to exit the program. All other input is invalid and leads to an error message (see example).
- The add action "a" must do the following:
 - The user must enter a new lifter name.
 - A corresponding entry is created in the dictionary, which then maps to a further dictionary with three default entries that all contain empty lists: "squat", "bench press", "deadlift".
 - If the dictionary already contains the name, an error message is displayed and the action is aborted.
- The remove action "r" must do the following:
 - The user must enter an existing lifter name.
 - If the dictionary contains the name, the entry is removed. Otherwise, an error message is displayed and the action is aborted.
- The add action "u" must do the following:
 - The user must enter an existing lifter name.
 - If the name does not exist, an error message is displayed and the action is aborted.
 - The user must then enter which lift to update (must be one of "squat", "bench press", "deadlift"), followed by float numbers separated by single space characters indicating the lifted weights (you can assume correct user input in both cases).
 - The corresponding list must then be extended by this entered weight (e.g., if the user entered "squat" and then "120.5 130 140", this lifter's squat list must be extended with [120.5, 130, 140]).
- The view action "v" should display all lifters and all their weights for each of the three lifts.

Example program execution:

```
Welcome to Powerlifting Data Collector!
```

```
Available actions:
```

```
a - Add lifter
```

```
r - Remove lifter
```

```
u - Update lifter
```

```
v - View lifters
```

```
x - Exit the program
```

```
Enter action: y
```

```
Invalid action 'y'. Try again!
```

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
Enter action: v

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
Enter action: a
Enter new lifter name: Jake

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
Enter action: a
Enter new lifter name: Jake
Lifter 'Jake' already exists!

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
Enter action: a
Enter new lifter name: Tina

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
Enter action: v

Name: Jake
squat: []
bench press: []
deadlift: []

Name: Tina
squat: []
bench press: []
deadlift: []

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program

Enter action: u

Enter lifter name to update: TINA

Lifter 'TINA' does not exist!

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program

Enter action: u

Enter lifter name to update: Tina

Enter lift (one of 'squat', 'bench press', 'deadlift'): squat

Enter weight(s): 120.5 130 140

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program

Enter action: u

Enter lifter name to update: Tina

Enter lift (one of 'squat', 'bench press', 'deadlift'): deadlift

Enter weight(s): 195.5

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program

Enter action: v

Name: Jake

squat: []

bench press: []

deadlift: []

Name: Tina

squat: [120.5, 130.0, 140.0]

bench press: []

deadlift: [195.5]

Available actions:

a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters

```
x - Exit the program
Enter action: u
Enter lifter name to update: Tina
Enter lift (one of 'squat', 'bench press', 'deadlift'): deadlift
Enter weight(s): 200 201
```

Available actions:

```
a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
```

Enter action: v

Name: Jake

squat: []

bench press: []

deadlift: []

Name: Tina

squat: [120.5, 130.0, 140.0]

bench press: []

deadlift: [195.5, 200.0, 201.0]

Available actions:

```
a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
```

Enter action: r

Enter lifter name to remove: TEMP

Lifter 'TEMP' does not exist!

Available actions:

```
a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
```

Enter action: r

Enter lifter name to remove: Jake

Available actions:

```
a - Add lifter
r - Remove lifter
u - Update lifter
v - View lifters
x - Exit the program
```

Enter action: v

Name: Tina

squat: [120.5, 130.0, 140.0]

bench press: []

deadlift: [195.5, 200.0, 201.0]

Available actions:

a - Add lifter

r - Remove lifter

u - Update lifter

v - View lifters

x - Exit the program

Enter action: x

Bye!