

Written examination – 16/05/2022

Is it your first try?	Yes	No
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- Section 1: basic questions [max. score: 16]. It contains four simple questions about the topics of the whole course. Each question requires a short answer. Each question answered correctly will give you 4 points (or less for partial answers).
- Section 2: understanding [max. score 8]. It contains an algorithm in Python, and you have to report the particular results of some of its executions according to specific input values.
- Section 3: development [max. score 8] It describes a particular computational problem to solve, and you are asked to write an algorithm in Python for addressing it.

You have 1 hour and 30 minutes for completing the examination. By the final deadline, you should deliver only the original text (i.e. this document) with the definitive answers to the various exercises that must to be written with a pen – pencils are not permitted. You can keep all the draft papers that you may use during the examination for your convenience – blank sheets will be provided to you on request.

Section 1: basic questions

1 – Which of the following sentences are true?

- A list is a mutable object
- A stack is an immutable object
- A dictionary is an immutable object
- An integer is an immutable object
- A set is an immutable object
- A tuple is a mutable object

2 – Consider the following snippet of Python code:

```
def g(s):  
    result = dict()  
    for c in s:  
        if c not in result:  
            result[c] = 0  
        result[c] = result[c] + 1  
    return result.get("o")
```

Which value is returned by calling the function above as follows: `g("Bologna")`?

3 – Write down a small function in Python that takes in input two strings *s1* and *s2* and returns True if *s1* is the reverse of *s2*, otherwise it returns False.

4 – Describe, at a general level, the main characteristics of the data structure introduced by Euler for solving the problem of the seven bridges of Königsberg.

Section 2: understanding

Consider the following functions written in Python:

```
def rin(g_name, f_name, idx):
    result = []

    if len(g_name) > 0:
        if g_name[0] in f_name:
            result.append(idx)

        idx = idx + 1
        result.extend(rin(g_name[1:], f_name, idx))

    return result
```

Consider the variable `my_g_name` containing the string with your given name in lower case and the variable `my_f_name` containing the string with your family name in lower case. What is the value returned by calling the function `rin` as shown as follows:

```
rin(my_g_name, my_f_name, 0)
```

Section 3: development

The **Fisher–Yates shuffle** is an algorithm for generating a random permutation of a string (i.e. a finite sequence of characters). The algorithm effectively puts all the elements into a hat; it continually determines the next element by randomly drawing an element from the hat until no elements remain. In particular, it works as follows:

1. Iterate over each character c of the input string, from the first one to the penultimate, and repeat the following steps:
 - select a random integer j included between the position i of c and the position of the last character in the input list – i.e. $i \leq j < \text{len}(\text{input string})$;
 - swap the character in position i with the character in position j ;
 - repeat the steps above until all the characters from the first one to the penultimate of the input list have been considered.
2. Return the final permuted string.

Write an algorithm in Python – `def fy(s)` – which takes in input a string **s** and returns a new string defined as a permutation of the input string. For retrieving a random number given an interval, you can use the function `randint` of the package `random` (i.e. `from random import randint`). This function takes in input two integers s and t (e.g. `randint(4, 9)`) and returns a random values included in the interval s - t (e.g. 7).