



Class:

S6 ICT

Date:

Tuesday, May the 4th, 2021

Teacher:

Mr Barsamian

B Test — Without computer

Family name: _____

First name: _____

Grade: ___ / 10

Duration: 45 minutes.

The usage of any electronic device is prohibited.

The subject consists of two independent parts. Some questions are bonuses, and it is highly advised to do them only at the end, when everything else has been done.

Unless clearly stated otherwise, the candidate must answer on a separate sheet of paper that has to be handled inside this subject.

Please keep track of the clock, and avoid spending too much time on a question. Stay focused, and May the 4th... be with you !



Short description of this work:

At Bertrand's local store, there is a special offer: each time he goes and buy something, they give him a figurine. The figurine earned is given at random each time, among 10 different ones (it is thus possible that Bertrand earns a figurine he already has). Each figurine represents a different animal, and he would like to collect them all.

We will simulate how Bertrand's collection grows, and how he can keep track of it.

We start by giving an identifier to each of the 10 different figurines. These identifiers are the numbers between 0 and 9: {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}.

Each part of this work shows a different way to manage this collection. The two parts are independent, and you may work on them in any order.

1 Algorithms

6 points

Bertrand's collection is stored in an array `collection`. This array is an array of 10 integers. The cell `collection[i]` holds the number of figurines with identifier i he has in his collection.

For instance, if `collection` is the array `[2, 4, 0, 0, 1, 3, 2, 0, 1, 1]`, it means that Bertrand has 2 figurines with identifier 0, 4 figurines with identifier 1, 0 figurine with identifier 2, etc.

At the beginning, Bertrand's collection is empty, hence we initialize this array with:

$$\text{collection} \leftarrow [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]$$

Then, as Bertrand earns new figurines, the array will change.

- Write a function `is_not_complete` that takes as input an array of length 10, and returns the boolean `True` when at least a cell is equal to 0, and returns `False` otherwise. For example:
 - the call `is_not_complete([2, 4, 0, 0, 1, 3, 2, 0, 1, 1])` must return `True`
 - the call `is_not_complete([2, 4, 2, 1, 1, 3, 2, 5, 1, 1])` must return `False`
- In this question, you can use the function `randint(a, b)` that outputs an integer chosen uniformly at random between a (inclusive) and b (inclusive).

The purpose of the algorithm given in Figure 1 is to simulate the creation of Bertrand's collection and the addition of 15 random figurines in it. You must write the missing parts (you can write on this subject), according to the following description: the algorithm starts by creating an empty array of 10 integers, then 15 times it chooses a number at random between 0 and 9 (inclusive), incrementing (adding 1 to) the corresponding cell of the array. Here is an example of what can happen during the execution of this algorithm:

- `collection` starts at `[0, 0, 0, 0, 0, 0, 0, 0, 0, 0]`
- it is then updated to `[0, 0, 0, 1, 0, 0, 0, 0, 0, 0]` (if the random integer chosen was 3)
- it is then updated to `[0, 0, 0, 1, 0, 0, 0, 0, 0, 1]` (if the random integer chosen was 9)
- it is then updated to `[0, 0, 0, 2, 0, 0, 0, 0, 0, 1]` (if the random integer chosen was 3)
- it is then updated to `[1, 0, 0, 2, 0, 0, 0, 0, 0, 1]` (if the random integer chosen was 0)
- etc.

Of course many other possibilities can happen, depending on the random values.

- The purpose of the function given in Figure 2 is unknown. What value is returned by this function if we call it with the input `[2, 4, 0, 0, 1, 3, 2, 0, 1, 1]`? Can you explain what it does?

BONUS How can you modify the algorithm given in Figure 1 to update the collection not with 15 figurines, but as many times is needed to finish Bertrand's collection?

BONUS The function given in Figure 2 may lead to a crash if not used as intended. Can you explain why and give an example?

```
Variables:  
collection is an array of integers.  
identifier and i are two integers.  
  
Instructions of the algorithm:  
1  collection ← [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]  
2  For i .....  
3      identifier ← randint(..., ...)  
4      collection[.....] ← .....  
5  End For  
6  Return collection
```

Figure 1: Algorithm “starting a collection”.

```
Input:  
collection is an array of integers.  
  
Variables:  
i and result are two integers.  
  
Instructions of the function:  
1  result ← 0  
2  For i From 0 to 9  
3      result ← result + collection[i]  
5  End For  
6  Return result
```

Figure 2: Function “mystery”.

2 SQL

4 points

The collection is now managed thanks to a database. Each figurine represents a fictional animal with a name, a color and a number of legs, e.g. one of the figurines is a red bird with 2 legs. The primary key for a figurine is its identifier (id, a number between 0 and 9).

Bertrand stores his collection in different drawers. Each week, he changes the drawer in which he puts his new figurines, to avoid losing all of them if something bad happens. Each drawer has a color and is located in a room (no room have two drawers of the same color).

The big picture of the database is the following:

- figurines: `id`, `name`, `color`, `nb_legs`
- collection: `#figurine_id`, `drawer_color`, `drawer_room`

1. There is a problem with the definition of the table collection: nothing prevents Bertrand from receiving twice the same figurine on a given week, so two figurines in the same drawer could have the same id, preventing this organization to work. Can you explain why this is a problem? How would you solve this problem?

In the following, we make the supposition that during any given week, it's impossible for Bertrand to receive twice the same figurine. Hence, for the remainder of this work, this database is perfectly valid. We give in Table 1 the full table of the different figurines, and in Table 2 an excerpt from Bertrand's collection (this is not the full table).

id	name	color	nb_legs
0	bird	red	2
1	bird	green	3
2	bird	green	2
3	cat	black	4
4	cat	white	3
5	cat	red	4
6	snake	green	0
7	fox	red	4
8	fox	black	4
9	centipede	white	10

Table 1: The 10 figurines.

figurine_id	drawer_color	drawer_room
7	red	living_room
0	red	living_room
2	black	kitchen
3	black	kitchen
0	black	kitchen
4	red	bedroom
5	red	bedroom
4	black	bedroom
5	black	bedroom

Table 2: An excerpt from Bertrand's collection.

For each of the next questions, you must write a SQL request that answers the question.

2. Which of the 10 figurines are red?
3. Which of the 10 figurines have (strictly) more than 3 legs?
4. Which of Bertrand's figurines are in the bedroom?
5. What are Bertrand's figurines that are of the same color than the drawer they are in?

BONUS How many figurines does Bertrand own? How many different ones?