Final Exam – Part 1
No documents

DysAsso is an association that helps students with learning disabilities such as dyslexia. A member of this association wants to develop a game for smartphone (or tablet) to train students to solve mathematics problems in a ludic way. The game will propose a set of exercises that have to be solved with method cards.
For instance, let's consider the problem "solve the equation $3x^2 - 4x + 5$". Several method cards are proposed to the player: "I want to use the *factoring by inspection* method", "I recognize a *remarkable identity*", "I want to compute *the discriminant*". Once a card chosen, the player is more or less guided to apply it.

DigitalX Company is in charge of the development of the game. The game designer is neither a software engineer nor a mathematics teacher, but he is very available. He has some problem examples that he uses with his children.

1.1 Choose a requirement elicitation method. (1,5)
1.2 Explain the principles of this method and its limits in this context.

DysAssociation and the game designer want to propose a first limited version of the game as soon as possible (to evaluate it with their student members). A single category of problem will first be considered (solving an equation) and three method cards. Additional problems, categories and methods cards will be progressively be added.

2.1 Choose a development process appropriate to the situation. (1,5)
2.2 Explain the principles of this process and justify your choice.

The game designer would like the game to be executable on all type of systems and easy to use.

3.1 What is the problem with the formulation of these requirements? (1,5)
3.2 Suggest a reformulation for each requirement.

The design of exercises will follow a life-cycle. First, an exercise has to be written. During this phase, we say that the exercise is "under construction". As soon as the construction is over, the exercise enters in a testing phase. We say that the exercise is "under test". An exercise goes from "under test" to "available" after approval. Some student can report a problem with an exercise when it is available. If it is the case, the exercise returns in testing phase. If an error is identified during the testing phase, the exercise goes back in "under construction" phase.
The construction of an exercise consists of two parallel processes. One of them is dedicated to the problem statement edition. The second is dedicated to the selection of method cards. At least 3 method cards have to be selected before the selection can be declared "over".

An exercise has an identifier and a statement description. It has a single type. A type of exercises can be solved with different method cards. A method card has a name. It is associated with a unique form which represent the steps to be followed to apply a method. Reciprocally, a form[1] is associated to a single card. To be able adapt the game to the level of the student (beginner, medium, advanced), we want present the same form with different levels of details. An exercise is also associated to a solution. A solution corresponds to a specific form (it indicates the expected values of the fields).

4.1 Express the first part of the previous description with an appropriate UML diagram. (4,5)
It should include following elements: "addCard", "approval", "available", "choosing card", "editionOver", "errorFound", "problemSuspected", "removeCard", "selection over", "statementEdition" "under construction", "under test"

4.2 Express the second part of the previous description with an appropriate UML diagram.

[1] A form is a document with fields to fill (*formulaire* en français).

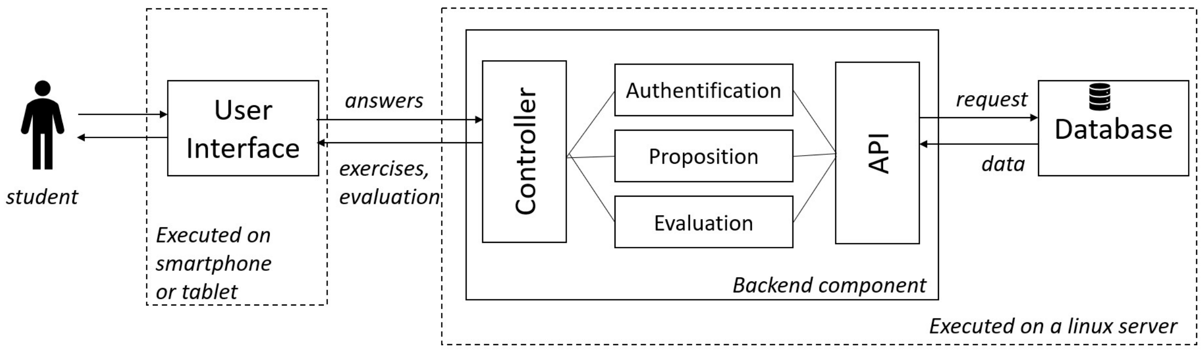


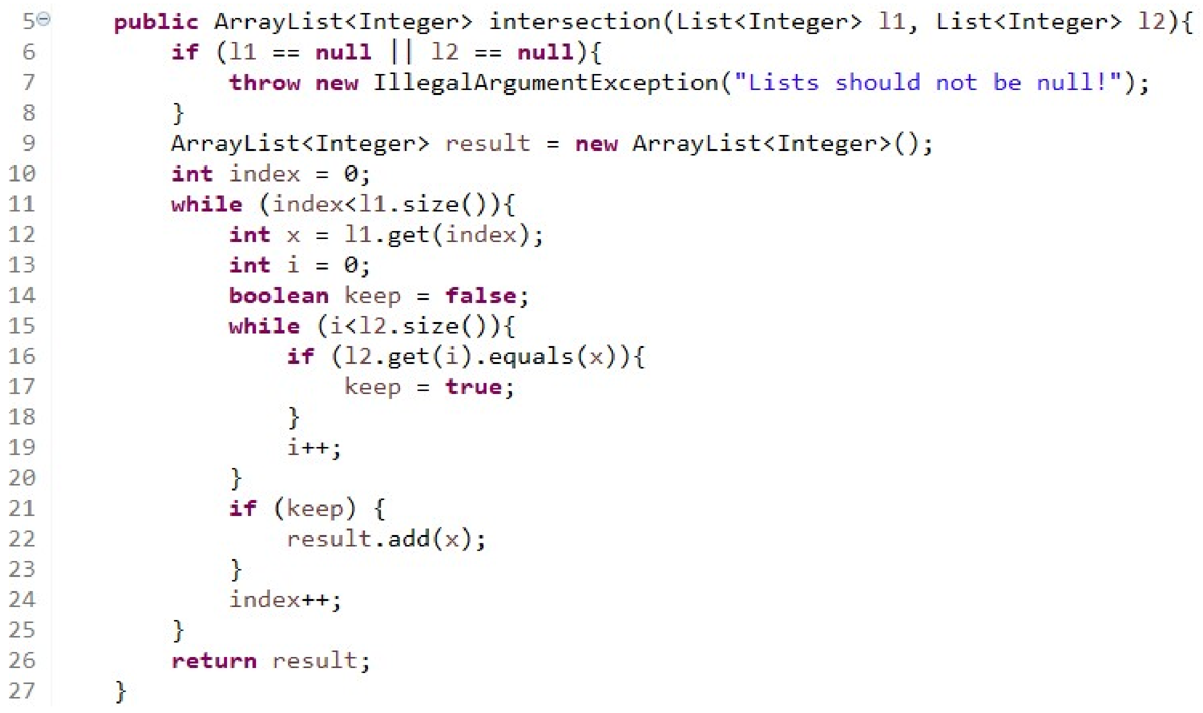
Fig. 1: an architecture

DigitalX Company proposes the architecture given Fig. 1 as a first design.

5. Reformulate the architecture proposed Fig. 1 using: (3)
   (a) two component diagrams to express two logical views,
   (b) one sequence diagram to express a dynamical view, and
   (c) one deployment diagram to express a physical view

During the development phase, the function "intersection" is implemented (see Fig. 2). This function returns the intersection of two sets: The result is thus the set of elements that belongs to the two input sets. In mathematics, sets are collections of elements, but here they have been implemented with lists.

6.1 Build the control-flow graph of the intersection function given Fig. 2. (3)
6.2 Give a test set that achieve the statement coverage of the program.



```java
    public ArrayList<Integer> intersection(List<Integer> l1, List<Integer> l2){
        if (l1 == null || l2 == null){
            throw new IllegalArgumentException("Lists should not be null!");
        }
        ArrayList<Integer> result = new ArrayList<Integer>();
        int index = 0;
        while (index<l1.size()){
            int x = l1.get(index);
            int i = 0;
            boolean keep = false;
            while (i<l2.size()){
                if (l2.get(i).equals(x)){
                    keep = true;
                }
                i++;
            }
            if (keep) {
                result.add(x);
            }
            index++;
        }
        return result;
    }
```

Fig. 2: Java code f or "intersection" function