

Software Engineering

Books or notes are **not** allowed.

Write only on these sheets. **Concise** and **readable** answers please.

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Survey and questionnaire management

In many cases surveys are done to get feedback on products or services. For instance in universities at the end of a course students are asked to fill in a questionnaire about the quality of the course. At Polito the questionnaire contains about a dozen questions (such as: “Was the teacher competent?”, “Was the teacher on time”, “Was the supporting material effective”, etc), each question having an answer on 3 ordinal values (bad, average, good).

In the past, questionnaires were paper based. Now they are web based.

In the following you should analyze and model the application that supports web based questionnaires in a university. A questionnaire based survey is done at the end of each course in the university. All students enrolled in the course receive an email inviting them to fill in the questionnaire. They fill in the questionnaire on a web site in the last week of the course.

Key functions to be considered are:

- Definition of questionnaire by a university person, like the dean (text of questions, types of answers)
- Presentation of questionnaire to students, collection of answers, storage. A student should fill in only one questionnaire per course.
- Closing of collection phase, analysis of results
- Presentation of results in aggregated form (averages of answers for a given course) to dean, students and teachers

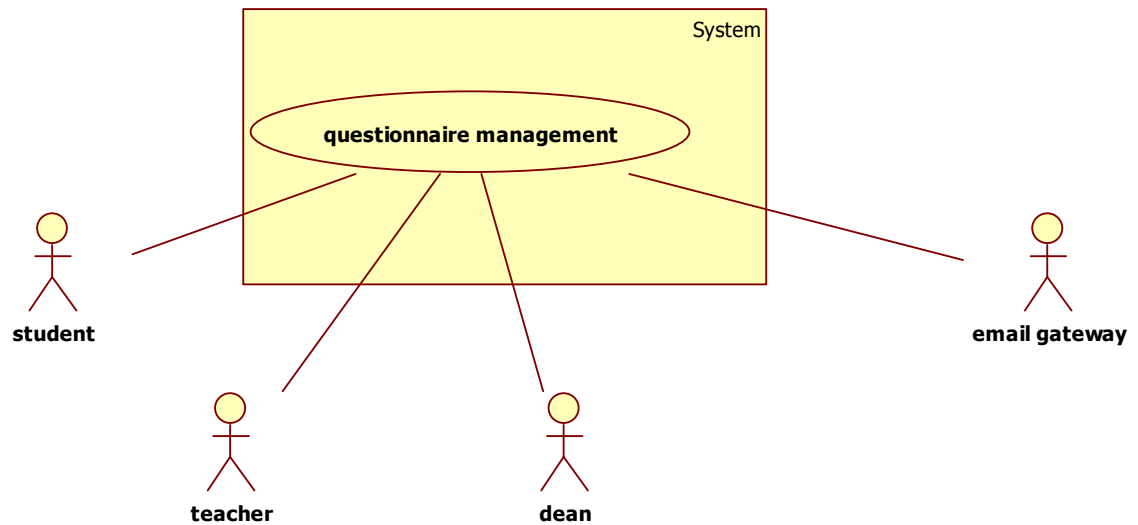
Key requirements are about privacy (nobody, and especially the teacher should be able to read the answers of a student about a course)

1 (14 points) – a. Define the context diagram (including relevant interfaces)

Interfaces

GUI to teacher, student, dean

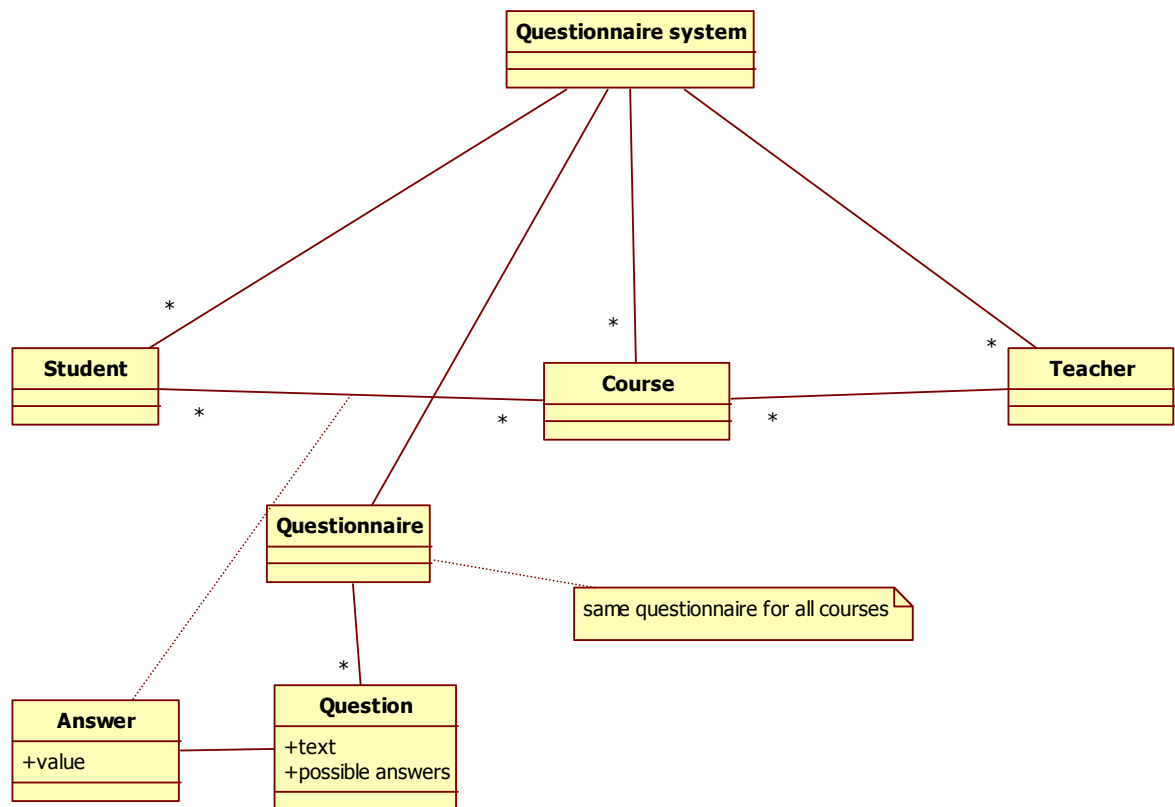
Specific interface (ex POP) to email gateway



List the requirements in tabular form

ID	Type (Functional Non Functional)	Description
1	F	Define questions for questionnaire, define possible answers
2	F	Support filling questionnaire by student
3	F	Control answers are acceptable (zero or one values only, one one at most)
4	f	Invite students to fill in questionnaire via email
5	F	Control that a student fills a questionnaire only once per course
6	F	Open period to fill in questionnaire for a course
7	F	Close period to fill in questionnaire
8	F	Aggregate results of questionnaires for a course
9	F	Present aggregated results
10	F	Authenticate and authorize students/teachers/dean
11	NF	Privacy, answers to a questionnaire should not be traced to the student who filled them in

Define the model (UML class diagram) for the application



Define one scenario describing the filling in of a questionnaire by a student

Precondition: student S has not filled questionnaire for course C

Postcondition: student S can not fill in questionnaire for course C

Step	Description	Req ID
1	Student logs in, selects course C	10
2	Student is authorized to fill in questionnaire for course C	5
3	Student fills in questionnaire	2
4	System controls answers are acceptable	3
5	Student logs out	10

2 (8 points) -Define black box tests for the following function

The function checks one answer to a question in the questionnaire. The answer is either good, or average, or bad: the parameter has value one in correspondence of the answer selected, zero otherwise. No other values are allowed, no two values can be selected together. The student can also decide not to answer to the question, then all values are zero.

```
int verifyAnswer( int good, int average, int bad);
```

The function applies the following rules

- all parameters (good, average, bad) should be zero or one
- of all parameters at most one can have value 1

if all these rules are satisfied then the function returns 1
if one of these rules is not satisfied the function returns 0

ex. $\text{verifyAnswer}(0,0,0) \rightarrow 1$
 $\text{verifyAnswer}(0,0,1) \rightarrow 1$
 $\text{verifyAnswer}(0,1,1) \rightarrow 0$
 $\text{verifyAnswer}(0,18,0) \rightarrow 0$

there are few equivalence classes, feasible to compute all combinations

class			Valid / invalid	Test case
One of input values is not an integer	Is a float		invalid	$T(1.0, 0, 0) \rightarrow 0$
	Is a string		Invalid	$T(0.0, "1", 0) \rightarrow 0$
	Is a char		Invalid	$T(0, '1', 1) \rightarrow 0$
All input values are integers	One input value is outside range 0,1	Positive	Invalid	$T(0,22,1) \rightarrow 0$
		Negative	Invalid	$T(0,-1, 0) \rightarrow 0$
	All input values are in range 0,1	Sum is ≤ 1	valid	$T(0,1,0) \rightarrow 1$
		Sum is > 1	Invalid	$T(1,1,0) \rightarrow 0$

3 (6 points) – For the following function define the control flow graph, and define test cases to obtain the highest possible node coverage, edge coverage, multiple condition coverage, loop coverage.

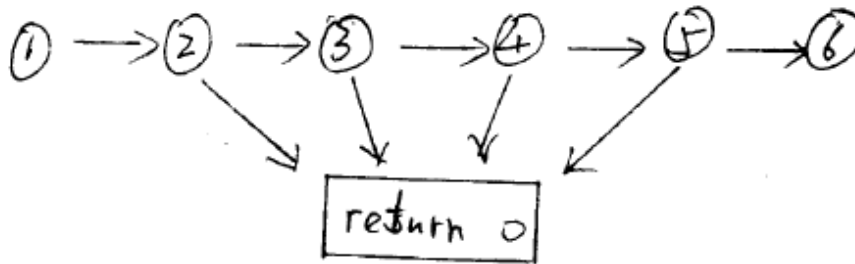
For the test cases, **write only the input value.**

```

1  int verifyAnswer (int good, int average, int bad){
2      if (good < 0 or > 1) return 0;
3      if (average < 0 or > 1) return 0;
4      if (bad < 0 or > 1) return 0;
5      if (good + average + bad) > 1 return 0;
6      return 1;
    }

```

Coverage type	Feasibility (Y/N)	Coverage obtained (%)	Test cases
Node	Y	100%	T1(0,0,0) T2(-1,0,0)
Edge	Y	100%	T1 T2 T3(1,-1,0) T4(0,0,-1) T5(1,1,0)
Multiple condition (line 3)	Partially (not possible to have True True)	75%	T1 T3 T6(0,2,0)
Loop	There are no loops		
Path	Y	100%	Same as edge



4 (1 points) – What can happen if no change control is applied in a project?
Concurrent changes by different developers can cause defects

5 (1 points) – Describe the lock modify unlock strategy for controlling changes
User U locks CI, extracts from repository, modifies, inserts in repository, unlocks. This means only one user at a time can do changes to CI. It is a strategy that avoids concurrent changes but causes bottlenecks

6 (1 points) – What is correctness? Can it be achieved?
Given a function, providing the expected output for each possible input. In other words the function has no failures. In most case it is unfeasible to demonstrate it because the number of inputs for a function is virtually infinite

7 (1 points) – What techniques can be used to find faults and failures in a software project?
Test, inspections, static analysis